CRUISE REPORT OF THE SECOND PHASE OF THE JAPANESE WHALE RESEARCH PROGRAM UNDER SPECIAL PERMIT IN THE ANTARCTIC (JARPAⅡ) IN 2006/2007 -FEASIBILITY STUDY-

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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, conducted in the 2005/2006 and 2006/2007 austral summer seasons, were planned as feasibility studies with the following objectives: 1) examine the practicability and appropriateness of sighting methods in the enlarged research area, 2) examine the practicability and appropriateness of sampling procedures to the increased sample size for Antarctic minke whales, and 3) 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 second feasibility survey of the JARPA II was carried out from 15 December 2006 to 28 February 2007 (76 days) in Areas VIW, VE and part of Area VW. The research activity was interrupted for three days due to external interference by the Sea Shepherd and for 10 days due to a fire accident on the research base Nisshin-Maru, then the survey was discontinued. The total searching distance was 11,968.87 n.miles and 6,091.73 n.miles for the two dedicated Sighting Vessels (SVs) and 5,877.14 n.miles for the three Sighting and Sampling Vessels (SSVs). The following species managed by the IWC were sighted: Antarctic minke, blue, fin, humpback, sperm and southern bottlenose whales. Antarctic minke whales were the most dominant species and were widely distributed in the whole research areas except the northern part of the research area. Out of 443 schools (1,043 individuals) of the primary sightings of Antarctic minke whales by SSVs, 438 schools (1,027 individuals) were targeted for sampling. A total of 505 animals were sampled. Out of 19 schools (156 individuals) of the primary sightings of fin whales by SSVs, 3 schools (9 individuals) sighted in Area VNE were targeted for sampling. A total of 3 animals were sampled. The maximum body length of the collected fin whales was 21.15 m with body weight of 65.02 tons. Photo-id experiments were conducted on blue and humpback whales. A total of 27 animals were photographed. Photographs of natural markings were obtained on one mother/calf pair of blue and six pairs of humpback whales. A total of 17 skin biopsy samples were collected from blue, fin and humpback whales. Two sets of humpback whale biopsy samples were taken from the mother/calf pairs. CTD and XCTD castings were conducted at 79 and 88 locations, respectively. EPCS survey was conducted for 62 days by SV and 57 days by SSVs in total. One of the SVs conducted a quantitative echo sounder survey for 62 days in the whole research area. The other of SV conducted prey species sampling (krill) using IKMT at 38 locations in the whole research area. The main findings of this feasibility survey were as follows: 1) the distribution of the Antarctic minke whales in the research area was dependent of their sex and reproductive status, 2) the humpback and fin whales were segregated from the Antarctic minke whales in the research area. Regarding the objectives of the feasibility survey, we confirmed that 1) the sighting methods used in this survey were practical and appropriate for the enlarged research area, 2) the sampling procedures we used were appropriate for the increased sample size of the Antarctic minke whales, and 3) the methods of hunting, hauling, flensing and biological sampling we applied to the large-sized whales were practical.

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 (SC) conducted an interim review of JARPA results in 1997 (IWC, 1998). In January 2005, a JARPA review meeting called by the government of Japan was held (Anonymous, 2005) and, the final JARPA review meeting by the IWC/SC was held in December 2006 (IWC, 2006).

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 at least two stocks in the research area but their geographical boundaries were different from those used for the IWC Areas (Pastene, 2006). Further, JARPA found that pollutant concentration in whale's tissues, such as heavy metals and PCBs, was extremely low (Yasunaga *et al*, 2006). 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 whales populations competing for a dominant single food resource, the krill. The meeting also agreed that the results obtained provide clear support for the need to take species-interactions (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 (Anon., 2005).

Based on these considerations, the Government of Japan launched a new comprehensive study under the Second Phase of the Japanese Whale Research Program under Special Permit in the Antarctic (JARPA II), combining lethal and non-lethal methods, starting from the 2005/2006 austral summer season. The first two seasons (2005/2006 and 2006/2007) were 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) Monitor changes occurring in the Antarctic ecosystem, 2) Model competition among whale species to develop future management objectives, 3) Elucidate temporal and spatial changes in stock structure, and 4) Improve the management procedure for the Antarctic minke whale stocks. JARPA II will focus on species such as Antarctic minke, humpback, fin whales and possibly some other species, all of which are major predators of Antarctic krill in the Antarctic ecosystem. 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, the annual sample size was 850+-10% Antarctic minke and ten fin whales. Humpback whales are not sampled 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 paper reports the results of the second JARPA II feasibility survey in the 2006/07 austral summer season. 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 *Kaiko Maru* (KK1), three sighting and sampling vessels *Yushin Maru* (YS1), *Yushin Maru No.2* (YS2) and *Kyo Maru No.1* (K01), and one research base vessel *Nisshin Maru* (NM).

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

Research area

The area to be covered by JARPA II is basically same as in JARPA: the eastern part of Area III, Areas IV and V, and the western part of Area VI (35°E - 145°W). In this season, JARPA II surveyed the Eastern Indian Ocean Stock and the Western South Pacific Ocean Stock of Antarctic minke whales (Pastene, 2006) in a longitudinal span of 85° on the eastern side of the JARPA II research area (130°E - 145°W). Figure.1 shows geographic location of research area for the 2006/2007 JARPAII survey.

Survey track line design

The minimum longitudinal unit is 10 degrees width in principle. The number of units that were allocated depended on the longitudinal width of each stratum. However, width of the units was changed based on the number of planned research days within the stratum. Track lines were constructed for SVs and SSVs separately. Vessels conducted sighting surveys simultaneously in the north and south strata. In the case of SVs, track lines of the two vessels crossed each other. Three SSVs conducted sighting and samplings simultaneously at intervals of 7 n.miles. The principle design of survey track-lines are shown in Figure 2 for SVs and Figure 3 for SSVs, respectively.

The survey track-lines were systematically designed in the 10 degree longitudinal width intervals 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 in the item below titled “The longitudinal intervals and number of the survey track lines in the sub-research area”.

Sighting method

Sighting procedures were the same as in the previous JARPA surveys (Nishiwaki *et al*. 1999, Ishikawa *et al*. 2000). The sighting surveys by SSVs were conducted under limited closing mode (when a sighting of Antarctic minke and fin whales were made on the predetermined track line, the vessel approached the whales and confirmed species and school size). Three SSVs advanced along parallel track lines 7 n.miles apart, at a standard speed of 11.5 knots. The sighting surveys by SVs were 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) at a standard speed of 10.5 knots.

The survey was operated under optimal research conditions (i.e., the wind speed below 25 knot in the south strata and 20 knot in the north strata, and visibility further than 1.5 n.miles). In addition to the sighting of Antarctic minke and fin whales or whales suspected to be those species, the SVs approached blue (*B. musculus*), humpback (*Megaptera novaeangliae*), southern right (*Eubalaena australis*), pigmy right (*Caperea marginata*), sei (*B.borealis*), sperm (*Physeter macrocehpalus*) and southern bottlenose *(Hyperoodon planifrons*) whales for conducting some experiments. The SSVs also approached the same whale species for experiments while they engaged in sighting survey.

Sampling method

Three SSVs were engaged in sampling survey. Sampling of 850 Antarctic minke whales (with 10 % allowance) and ten fin whales was planned in the research area south of 62°S. One to two Antarctic minke whales were sampled randomly from each primary sighted school within 3 n.miles of the track line. The dwarf form minke whales were not a target for sampling. Sampling of fin whales was restricted to those animals with an estimated body length less than 20m (this was revised downward to less than 19m during the research period) due to the limitation of NM facility for pulling up the animal onboard. One fin whale was sampled randomly from each primary sighted school within 3 n.miles of the track line and animal smaller than 20m (or 19m) was selected in the school. If two or more animals smaller than 20m were found in the single school, then only one of them was randomly selected.

Low and middle latitudinal sighting survey

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

Biological research

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

Experiments

Sighting distance and angle experiment

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

Photo-identification experiment
The following species were targeted for photographic record of natural markings by SVs 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 SVs and SSVs using compound-crossbows. All collected sample were preserved at –80°C.

Satellite tagging
The YS1 and the YS2 attempted satellite tag attachment on Antarctic minke whales.

Preliminary prey species survey
Prey species (krill) samples were collected using the Isaacs-Kidd Mid water trawl (IKMT) on the KK1.

Oceanographic and acoustic survey
SVs and SSVs conducted the following oceanographic surveys.

1) Consecutive measurements of surface temperature, conductivity, surface chlorophyll, dissolved oxygen, surface particle using the Electric Particle Counting and Sizing System (EPCS) on KS2 and YS2.
2) XCTD and CTD casting by KK1 and KS2.
3) Record of marine debris in the research area by KK1 and KS2. In addition 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 study distribution and abundance of prey species of baleen whales. Hydro-acoustic survey was conducted by KS2 along sighting survey through the whole research area.

In addition to these surveys, KK1 deployed Argo profiling floats (profiling devices) to collect high quality oceanographic data of upper and middle layers of the world ocean simultaneously with very high space-time resolution. This was done in cooperation with Japan Marine Science and Technology Center (JAMSTEC) (See http://w3.jamstec.go.jp/ARGO/J_ARGOe.html).

RESULTS
Outline of the research activities
Table 1 shows an outline of the research activities. The research period of the 2006/2007 JARPAII was 76 days from 15 December 2006 to 28 February 2007. The research activity was interrupted for three days due to external interference by the Sea Shepherd for 10 days due to a fire accident at NM, then the survey was discontinued. It was decided to stop the research earlier than planned because equipment for the survey was damaged by the fire.

The longitudinal interval and number of the survey track line in the sub-research area
The design of track lines of the SVs and SSVs are shown in Figures 4 and 5. The longitudinal interval and number of teeth in the unit of survey track line in each sub research area were as following:

1) The western part of Area VI
The research area was south of 60°S and from 145°W to 170°W. The starting points of the SVs and SSVs were at 145°W. The survey track line was set zigzag in north and south to westward. The longitudinal interval of one tooth of survey track line was 3° 20’ for the SSVs in both north and south strata, and 10 ° in north stratum and 5°of south stratum for the SVs. Allocated survey track line in one minimum unit is one tooth in the north stratum and two teeth in the south stratum for the SSVs. SVs surveyed one tooth in the north stratum and two 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 griddled sea ice concentration data set available from the National Snow and Ice Data Center (NSIDC, Cavalieri *et al.*1999).

2) The Eastern part of Area V
East-North stratum
The research area ranged from 60°S to 69°S and from 170°W to 165°E (a latitudinal range was divided into two parts, from 60°S to 66°S and from 66°S to 69°S). The starting points of the SVs and SSVs were at 170°W. The survey track line was set zigzag in north and south to westward between 170°W to 170°E. The longitudinal interval of each tooth of the survey track line was 12°30’ for SSVs and 10°00’ for SVs for each planned research day. In the range between 170°E and

165°E, the same design of survey track line was continued from that of the western part of Area V. The SSVs surveyed each one and a half tooth in the northern part and in the southern part from the fluctuation of the ice edge line. The SVs surveyed four teeth in the northern part and two teeth in the southern part.

East-South stratum (Ross Sea)

The research area was south of 69°S between 165°E to 170°W (including east of 170°W in the inner part of the Ross Sea). The latitudinal range was divided from 69°S to 74°S and from 74°S to the ice edge. The starting and ending points of SVs and SSVs were at 69°S. The survey track line was set zigzag in north and south to westward or eastward in the Ross Sea. The longitudinal interval of the survey track line for SSVs and SVs was 5°00'. The start point of the longitudinal line in the survey track line was set by the random selection. This longitudinal interval of survey track line was adjusted corresponding to the ice edge line which was remarkably changed through the research period.

3) The western part of Area V (including west of 170°E in the eastern part of Area V)

The research area was south of 60°S and from 165°E to 130°E. The starting points of SVs were at 170°E. The survey track line was set zigzag in north and south to westward. The longitudinal interval of one tooth of survey track line was 3° 20' for SSVs in both north and south strata, and 10 ° in north stratum and 5°in south stratum for SVs. Allocated survey track line of the research area is one tooth in the north stratum and two teeth in the south stratum for SSVs. SVs surveyed one tooth in the north stratum and two teeth in the south stratum. The SVs surveyed two teeth in the north stratum and three teeth in the south stratum. The actual range surveyed in this area was from 170°E to 159°E, and SSVs could not survey in this sub research area due to the fire accident of NM on 15 February. The entire research activities were interrupted on 15 February due to fire accident on the NM.

Searching distance

The searching distances of the SVs and the SSVs are shown in Table 2. The total searching distances were 11,968.87 n.miles consisting of 6,091.73 n.miles for the two SVs and 5,877.14 n.miles for the three SSVs.

Whale species sighted

Eight species including dwarf form minke whales were identified during the research period. Table 3 shows the number of sightings by the SV and SSVs for seven species managed by the IWC. The following five species of baleen whales were confirmed; Antarctic minke, dwarf form minke, blue, fin and humpback whales, and two toothed whale species were confirmed; sperm and southern bottlenose whales.

Antarctic minke whales were the most abundant species in the whole research area. The number of total sightings of Antarctic minke whales by five research vessels was 1,023 schools (2,340 individuals). In addition 171 schools (308 individuals) of humpback whales, 41 schools (267 individuals) of fin whales, 63 schools (63 individuals) of sperm whales and 52 schools (81 individuals) of southern bottlenose whales were observed.

Geographical distribution

1) Antarctic minke whales

The distribution of sightings of the Antarctic minke whales by SVs and SSVs is shown in Figures 6 and 7, respectively. The Antarctic minke whales were widely distributed in the entire research area. A high concentration area was confirmed in the East-South stratum (Ross Sea). Few Antarctic minke whales distributed in the northern part of the research area compared to the southern part of the research area (Ross Sea).

2) Humpback whales

The distribution of sightings of humpback whales by SVs and SSVs is shown in Figures 8 and 9, respectively. Humpback whales were distributed in the northern part of the research area. These sightings overlapped with those of Antarctic minke whales in the northern part of the research area but humpback whales were not observed in the East-South stratum (Ross Sea) where Antarctic minke whales were highly concentrated.

3) Fin whales

The distribution of sightings of the fin whales by SVs and SSVs is shown in Figures 10 and 11, respectively. The fin whale had a similar distribution pattern with the humpback whale. These were widely distributed through the research areas except in the southern part. These sightings overlapped with those of Antarctic minke whales in the northern part of the research area but fin whales were not observed in the East-South stratum (Ross Sea) where Antarctic minke whales were highly concentrated.

4) Blue whales

The distribution of sightings of blue whales by SVs and SSVs is shown in Figures 12 and 13, respectively. The total sightings of blue whales in the research area were only eight schools.

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 vessel type and stratum. In the whole research area DI and MSS for SVs were 8.6 and 2.1, respectively. In the case of the SSVs, DI and MSS were 7.5 and 2.4, respectively. No remarkable differences were observed between vessels type. The MSS was similar throughout the whole research areas. The DI of Antarctic minke whales in the northern part of the research area was lower compared with that in the southern part of the research area (Ross Sea). The DI was remarkably high in the eastern part of Area V. This result indicated that the Ross Sea is an important feeding area for Antarctic minke whales.

2) Humpback whales

Table 5 shows DI and MSS of primary sightings of humpback whales by vessel type and stratum. In the whole research area, DI and MSS for SVs were1.5 and 1.9, respectively. For the SSVs these were 1.2 and 1.6, respectively. The MSS was similar through the whole research areas. The DI was remarkably high in the north strata.

3) Fin whales

Table 6 shows density indices DI and MSS of primary sightings of fin whales by kind of vessels and stratum. In the For SVs the DI and MMS were 0.3 and 5.4, respectively. For SSVs these were 0.3 and 8.2, respectively. The MSS was similar throughout the whole research area. The DI was remarkably high in the north strata.

Sampling of Antarctic minke whales and fin whales

1) Antarctic minke whales

Out of 443 schools (1,043 individuals) primarily sighted by SSVs, 438 schools (1,027 individuals) were targeted for sampling. A total of 505 animals were sampled (101 in Area VIW, 70 in Area VNE, 334 in Area VSE (Ross Sea)). Sampling efficiency was 93.8 %. This value was the highest in comparison with those obtained in previous JARPA surveys. Struck and lost occurred in only three cases.

2) Fin whales

Out of 19 schools (156 individuals) primarily sighted by SSVs, 3 schools (9 individuals) in Area VNE were targeted for sampling. A total of 3 individuals were sampled. Sampling efficiency was 100.0 %. No struck and lost occurred.

Biological research

Biological research was conducted on the research base ship for all whales sampled. Table 7 summarizes biological data and samples collected from the Antarctic minke whales. Table 8 summarizes biological data and samples collected from the fin whales. The head and part of the body of one fin whale was torn off and sank into the sea during the pulling onboard the NM. Therefore only partial information was obtained for this animal. The gender was determined by molecular genetic analysis.

Preliminary analyses of biological information

1) Antarctic minke whales

Table 9 shows the reproductive status of samples, by stratum. Figure 14 shows the sighted position of sampled whales, by sex and reproductive status. The collected samples were 171 individuals in the western part of Area VI and the East-North stratum in Area V and 334 individuals in the East-South stratum (Ross Sea) in Area V. Theratio of males, in the East-South stratum (Ross Sea) in Area V was 12.0 % and 66.7 % in the East-North stratum in Area V. The mature males were widely distributed throughout the whole research areas. Mature males were dominant in the entire research areas other than the East-South stratum (Ross Sea) in Area V. Immature males were not sampled in the East-South stratum (Ross Sea) in Area V. Females were widely distributed throughout the whole research area. Mature females were dominant in the East-South stratum (Ross Sea) in Area V. Females constituted 69.4 % of the collected samples and the pregnancy rate of mature females was 75.1 % in the whole research areas. 92.3% of the pregnant females were concentrated in the East-South stratum (Ross Sea) in Area V. Table 11 shows the mean body length of Antarctic minke whales collected in each stratum. Maximum length was 9.45 m for males and 9.86 m for females; minimum length was 4.74m and 4.97m, respectively.

2) Fin whales

Biological data collected for fin whales is shown in Table 10. The maximum body length of the collected fin whales was 21.15 m with body weight of 65.02 tons. This animal was a pregnant female.

Experiments

1) Sighting distance and angle experiment

A sighting distance and angle experiment was preformed on 31 December 2006 by SSVs. The results of this experiment will be used in estimating abundance. KS2 conducted a similar experiment on 31 December 2006 but it was interrupted due to unsuitable sea conditions. KK1 could not conduct a similar experiment during the survey period.

2) The results of photo-ID

Table 12 summarizes the results of the photo-ID experiment. It was conducted throughout the entire research areas. A total of 27 targeted individuals were photographed (2 blue whales and 25 humpback whales), from one school of blue whales and 12 schools of humpback whales. Photographs of natural markings were successfully taken from one mother/calf pair of blue and six pairs of humpback whales.

3) The results of biopsy sampling

Table 13 summarizes the results of biopsy sampling. A total of 17 skin biopsy samples were collected from blue whales (n=1), fin whales (n=3) and humpback whales (n=13). Two sets of biopsy samples were taken from mother and calf pairs of humpback whales.

4) Satellite tags

YS2 attempted the attachment of a satellite tag on one school of Antarctic minke whales (8 animals) on 23 January 2007. A satellite tag was attached to one animal around its dorsal fin. The body length of this animal was estimated at 8.4 m. However, technical problems were found with the transmission antenna. YS1 attempted unsuccessfully to attacha satellite tag to one school of Antarctic minke whales (5 animals) on 23 January 2007.

5) The oceanographic and acoustic surveys

Table 14 shows a summary of oceanographic and acoustic surveys. CTD and XCTD castings conducted at 79 and 88 locations, respectively (Figure 15). EPCS survey was conducted for 62 days by KS2 and 57 days by YS2 in total. KS2 conducted a quantitative echo sounder survey which ranges over 62 days in the whole research area. KK1 conducted sampling of prey species (Krill) by the IKMT at 38 locations in the whole research area (Figure 16).

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 seven fishing buoys were found. All of these buoys were observed in the East-North stratum of Area V. In this Area, more than one Antarctic toothfish long-line fishing vessels were observed. The same kind of fishing buoys were onboard these fishing vessels as the fishing gear.

DISCUSSION

The present paper reported the results of the second feasibility survey of the JARPA II. The main results of the second feasibility survey can be summarized as follows:

1) The Antarctic minke whales were widely distributed in the entire research area although segregation by sex and reproductive status was observed. The DI shows that Antarctic minke whales were concentrated in larger numbers in the East-South stratum (Ross Sea) compared to the East-North stratum in Area V and the western part of Area VI (Table4). Females were dominant in the East-South stratum (Ross Sea) of Area V and males in the East-North stratum of Area V and the western part of Area VI. Mature males were dominant in all the research areas other than the East-South stratum (Ross Sea) of Area V. No immature males were sampled in the East-South stratum (Ross Sea) of Area V. The females were widely distributed through the whole research areas. The concentration of pregnant females was high in the East-South stratum (Ross Sea) in Area V.

2) Humpback and fin whales were segregated from the Antarctic minke whales in the research area.

Humpback and fin whales were dominant in the northern part of the research area but not in the southern part (such as the Ross Sea) where Antarctic minke whales were highly concentrated. It is suggested that biomass of humpback and fin whales is similar to that of Antarctic minke whales.

The objectives of this feasibility survey were 1) to examine the practicability and appropriateness of sighting methods in the enlarged research area, 2) to examine the practicability and appropriateness of sampling procedures for the increased sample size of Antarctic minke whales, and 3) to examine the practicability of methods of hunting, hauling, flensing and biological sampling applied to the large-sized whales. For the feasibility surveys a total of 850+/-10% Antarctic minke whales and 10 fin whales were planned for sampling. In relation to these objectives of the second 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 85° from 130°E to 145°W through early December to late March and to provide search effort mainly in Area VE during the peak feeding season of baleen whales. We successfully covered all of the areas except those from 130 °E to 159°E in the case of the SVs and from 130°E to 170°E in the case of the SSVs. This was due to external interference and a fire accident on the NM. If this accident had not occurred, all of the research area could have been covered sufficiently. The practicability and appropriateness of the sighting methods was therefore confirmed.

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

Out of 443 schools of primarily sighted Antarctic minke whales by SSVs, 438 schools were targeted for sampling. A total of 505 individuals were sampled with sampling efficiency of 93.8 %. Out of 20 schools (157 individuals) primarily sighted fin whales by SSVs, 3 schools (9 individuals) were targeted for sampling. A total of 3 individuals were sampled with sampling efficiency of 100.0 %. Considering this high sampling efficiency and high concentration of the targeted whale species in the research area, we concluded that the sampling procedures used were practical and appropriate for the increased number of samples.

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

Although it took longer to catch, transport, measure and dissect fin whales than in the case of the Antarctic minke whales, the entire process was conducted smoothly and successfully. It appeared, however, thatimprovement of the methods would be required in future for sampling fin whales larger than 21 m in body length or heavier than 65 tons in body weight.

We conclude that the current survey proved the feasibility of the JARPAII.

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REFERENCES

Anon. 2005. Report of the Review Meeting of the Japanese Whale Research Program under Special Permit in the Antarctic (JARPA) called by the Government of Japan, Tokyo, 18-20 January 2005. 24pp.

Cavalieri, D., P. Gloerson and J. Zwally. 1999, updated regularly. Near real-time DMSP SSM/I daily polar griddled 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.

IWC. 1998. Report of the Intersessional Working Group to Review Data and Results from Special Permit Research on Minke Whales in the Antarctic, Tokyo, 12-16 may 1997. SC/49/Rep.1. 377-390. *REP. INT. COMMN* 48, 1998.

IWC. 2006. Report of the Internsessional Workshop to Review Data and Results from Special Permit Research on Minke Whales in the Antarctic, Tokyo 4-8 December 2006. SC/59/REP 1. 48pp.

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. 2006. What do we know about the stock structure of the Antarctic minke whale ? A summary of studies and hypotheses. Paper SC/D06/J12 presented to the JARPA Review meeting, December 2006. 24pp.

Yasunaga, G., Fujise, Y., Zenitani, R., Honda, K. and Kato, H. 2006. Yearly trend of trace element accumulation in liver of Antarctic minke whales, *Balaenoptera bonaerensis*. Paper SC/D06/J28 presented to the JARPA Review meeting, December 2006. 23pp.

Table 1. Outline of the 2006/2007 JARPAII research activities.

Event	Date	RBV	SSVs	SVs	
				KK1	KS2
Depature from Shimonoseki-city in Yamaguchi prefecture Japan	15/ Nov./ 2006	#	#		
Depature from Sendai-city in Miyagi prefecture Japan	17/ Nov./ 2006			#	#
Low and middle latitudinal sighting survey in transit area	6/ Dec./ 2006 ～ 14/ Dec./ 2006		#	#	
	7/ Dec./ 2006 ～ 14/ Dec./ 2006				#
Sighting and sampling survey in the western part of Area VI from 145W to 170W	16/ Dec./ 2006 ～ 30/ Dec./ 2006			#	#
	15/ Dec./ 2006 ～ 2/ Jan./ 2007	#	#		
Refueling and experiments	31/ Dec./ 2006 ～ 1/ Jan./ 2007	#	#	#	#
Sighting and sampling survey in the East-North stratum in Area V from 60S to 66S	2/ Jan./ 2007 ～ 10/ Jan./ 2007			#	#
	3/ Jan./ 2007 ～ 11/ Jan./ 2007	#	#		
Sighting and sampling survey in East-South stratum in Area V (Ross Sea)	13/ Jan./ 2007 ～ 26/ Jan./ 2007			#	
	13/ Jan./ 2007 ～ 31/ Jan./ 2007				#
	13/ Jan./ 2007 ～ 1/ Feb./ 2007	#	#		
Sighting and sampling survey in the East-North stratum in Area V from 66S to 69S	31/ Jan./ 2007 ～ 9/ Feb./ 2007				#
	2/ Feb./ 2007 ～ 8/ Feb./ 2007	#	#		
The terrorism attack by Seashepherd	9/ Feb./ 2007	#			
The avoidance from the terrorism attack by Seashepherd	9/ Feb./ 2007 ～ 11/ Feb./ 2007	#	#		
Sighting survey in the Western strata and East-North stratum in Area V from 170E to 130E	10/ Feb./ 2007 ～ 15/ Feb./ 2007			#	#
The terrorism attack from Seashepherd, and restoration works.	12/ Feb./ 2007 ～ 13/ Feb./ 2007			#	
Sighting and sampling survey in the East-South stratum in Area V (Ross Sea)	12/ Feb./ 2007 ～ 14/ Feb./ 2007	#	#		
The fire accident generation by the RBV	15/ Feb./ 2007	#			
The restoration from the fire accident on RBV and the rescue	15/ Feb./ 2007 ～ 24/ Feb./ 2007	#	#		
	18/ Feb./ 2007 ～ 20/ Feb./ 2007				#
	18/ Feb./ 2007 ～ 24/ Feb./ 2007			#	
Starting of the unaided navigation by Nissin-Maru and escort transit by SVs and SSVs	20/ Feb./ 2007				#
	24/ Feb./ 2007	#	#	#	
Ending of the sighting and sampling survey in the Antarctic Ocean	28/ Feb./ 2007	#	#	#	#
Arrive on Shinagawa-ku in Tokyo, Japan	21/ Mar./ 2007				#
Arrive on Shinagawa-ku in Tokyo, Japan	23/ Mar./ 2007	#			
Arrive on Shimonoseki-city in Yamaguchi Prefecture Japan	24/ Mar./ 2007		#		
Arrive on Shinagawa-ku in Tokyo, Japan	25/ Mar./ 2007			#	

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

Table 2. Searching distances (n.miles) of two sighting vessel (SVs) and three sighting / sampling vessels (SSVs) in each stratum.

Area	E/W	Stratum	SVs			SSVs			Grand total
			NSP	ASP	Sub total	NSC	ASP	Sub total	
VI	West	North	561.95	194.42	756.37	1,009.29	0.00	1,009.29	1,765.66
		South	531.68	189.57	721.25	1,534.85	0.00	1,534.85	2,256.10
		Sub-total	1,093.63	383.99	1,477.62	2,544.14	0.00	2,544.14	4,021.76
V	East	North	1,547.47	560.26	2,107.73	1,661.31	29.55	1,690.86	3,798.59
		South	1,665.00	607.88	2,272.88	1,642.14	0.00	1,642.14	3,915.02
		Sub-total	3,212.47	1,168.14	4,380.61	3,303.45	29.55	3,333.00	7,713.61
	West	North	74.36	22.89	97.25	0.00	0.00	0.00	97.25
		South	123.89	12.36	136.25	0.00	0.00	0.00	136.25
		Sub-total	198.25	35.25	233.50	0.00	0.00	0.00	233.50
Grand total			4,504.35	1,587.38	6,091.73	5,847.59	29.55	5,877.14	11,968.87

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

Type of the vessls	SVs						SSVs						Grand total					
Type of the sightings	Primary		Secondly		Sub total		Primary		Secondly		Sub total		Primary		Secondly		Combined	
Whale species	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.
Antarctic minke whale	526	1,126	41	105	567	1,231	443	1,043	13	66	456	1,109	969	2,169	54	171	1,023	2,340
Dwarf-formed minke whale	1	1	0	0	1	1	0	0	0	0	0	0	1	1	0	0	1	1
Like minke whale	20	32	2	4	22	36	8	8	2	4	10	12	28	40	4	8	32	48
Blue whale	5	8	0	0	5	8	2	4	1	3	3	7	7	12	1	3	8	15
Fin whale	18	97	0	0	18	97	19	156	4	14	23	170	37	253	4	14	41	267
Humpback whale	91	171	8	16	99	187	69	112	3	9	72	121	160	283	11	25	171	308
Baleen whales	33	50	2	4	35	54	0	0	3	7	3	7	33	50	5	11	38	61
Sperm whale	33	33	0	0	33	33	30	30	0	0	30	30	63	63	0	0	63	63
Southen bottlenose whale	25	41	0	0	25	41	26	39	1	1	27	40	51	80	1	1	52	81

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	E/W	Stratum	SVs					SSVs				
			Searching distance	Antarctic minke whales (Primary sighting)				Searching distance	Antarctic minke whales (Primary sighting)			
			(n.miles)	Sch.	Ind.	DI	MSS	(n.miles)	Sch.	Ind.	DI	MSS
VI	West	North	756.37	15	21	2.0	1.4	1,009.29	35	186	3.5	5.3
		South	721.25	30	111	4.2	3.7	1,534.85	49	112	3.2	2.3
		Sub total	1,477.62	45	132	3.0	2.9	2,544.14	84	298	3.3	3.5
V	East	North	2,107.73	40	96	1.9	2.4	1,690.86	66	142	3.9	2.2
		South	2,272.88	409	837	18.0	2.0	1,642.14	293	603	17.8	2.1
		Sub total	4,380.61	449	933	10.2	2.1	3,333.00	359	745	10.8	2.1
	West	North	97.25	12	18	12.3	1.5	-	-	-	-	-
		South	136.25	20	43	14.7	2.2	-	-	-	-	-
		Sub total	233.50	32	61	13.7	1.9	-	-	-	-	-
Grand total			6,091.73	526	1,126	8.6	2.1	5,877.14	443	1,043	7.5	2.4

Table 5. Density indices (DI, number of schools per 100 n.miles) and mean school size (MSS) of humpback whale primary sightings by SVs and SSVs.

Area	E/W	Stratum	SVs					SSVs				
			Searching distance	Humpback whales (Primary sighting)				Searching distance	Humpback whales (Primary sighting)			
			(n.miles)	Sch.	Ind.	DI	MSS	(n.miles)	Sch.	Ind.	DI	MSS
VI	West	North	756.37	20	42	2.6	2.1	1,009.29	11	16	1.1	1.5
		South	721.25	7	13	1.0	1.9	1,534.85	1	1	0.1	1.0
		Sub total	1,477.62	27	55	1.8	2.0	2,544.14	12	17	0.5	1.4
V	East	North	2,107.73	49	89	2.3	1.8	1,690.86	52	88	3.1	1.7
		South	2,272.88	0	0	0.0	-	1,642.14	5	7	0.3	1.4
		Sub total	4,380.61	49	89	1.1	1.8	3,333.00	57	95	1.7	1.7
	West	North	97.25	6	10	6.2	1.7	-	-	-	-	-
		South	136.25	9	17	6.6	1.9	-	-	-	-	-
		Sub total	233.50	15	27	6.4	1.8	-	-	-	-	-
Grand total			6,091.73	91	171	1.5	1.9	5,877.14	69	112	1.2	1.6

Table 6. Density indices (DI, number of schools per 100 n.miles) and mean school size (MSS) of fin whale primary sightings by SVs and SSVs.

Area	E/W	Stratum	SVs					SSVs				
			Searching distance	Fin whales (Primary sighting)				Searching distance	Fin whales (Primary sighting)			
			(n.miles)	Sch.	Ind.	DI	MSS	(n.miles)	Sch.	Ind.	DI	MSS
VI	West	North	756.37	7	17	0.9	2.4	1,009.29	4	25	0.4	6.3
		South	721.25	0	0	0.0	-	1,534.85	1	1	0.1	1.0
		Sub total	1,477.62	7	17	0.5	2.4	2,544.14	5	26	0.2	5.2
V	East	North	2,107.73	11	80	0.5	7.3	1,690.86	14	130	0.8	9.3
		South	2,272.88	0	0	0.0	-	1,642.14	0	0	0.0	-
		Sub total	4,380.61	11	80	0.3	7.3	3,333.00	14	130	0.4	9.3
	West	North	97.25	0	0	0.0	-	-	-	-	-	-
		South	136.25	0	0	0.0	-	-	-	-	-	-
		Sub total	233.50	0	0	0.0	-	-	-	-	-	-
Grand total			6,091.73	18	97	0.3	5.4	5,877.14	19	156	0.3	8.2

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

Samples and data	Number of whales Antarctic minke whales		
	Male	Female	Total
Photographic record of external character	154	351	505
Body length and sex identification	153	350	503
Measurement of external body proportion	154	351	505
Body weight	65	54	119
Body weight by total weight of parts	13	15	28
Skull measurement (length and breadth)	151	346	497
Standard measurement of blubber thickness (two points)	154	351	505
Lactation status	-	351	351
Measurement of mammary gland	-	350	350
Testis weight	154	-	154
Weight of stomach content	142	327	469
Photographic record of fetus	139	113	258*
Fetal length and weight	137	111	255*
Diatom film observation	154	348	502
Blood plasma for physiological study	151	349	500
Earplug for age determination	154	351	505
Ocular lens for age determination	66	114	180
Tympanic bone for chemical analysis	18	28	46
Largest baleen plate for chemical analysis	154	351	505
Vertebral epiphyses sample	139	327	466
Ovary	-	351	351
Histological sample of endometrium	-	29	29
Histological sample of mammary gland	-	351	351
Milk sample for chemical analysis	-	0	0
Histological sample of testis	154	-	154
Skin and liver tissues for genetic study	154	351	505
Blubber, muscle and liver tissues for environmental monitoring	154	351	505
Lung and liver tissues for air monitoring	22	25	47
Macro pathological observation (thyroid, lung, stomach, gonad and liver)	154	351	505
Tissues for histopathological study	82	160	242
Tissues for various studies (muscle, blubber)	3	3	6
Tissues for food study (muscle, blubber, ventral groove)	0	0	0
Stomach contents for food and feeding study	24	66	90
Stomach contents for environmental monitoring	4	20	24
External parasites	0	1	1
Internal parasites	1	6	7
Fetus	1	1	7*
Fetus ocular lens for age determination	64	45	109
Fetal skin for genetic study	137	108	252*
Spermatogenic cell for round spermatid injection	1	-	1
Blood samples for genetic study	6	4	10
Placenta	0	0	0

* including a fetus of sex unidentified.

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

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

Table 9. Reproductive status of Antarctic minke whales sampled in 2006/2007 JARPAII. 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
					Mature					
	Immature	Mature	Total	Immature	No-pregnant		Pregnant		Total	
					Ovulating	Resting	Pregnant	Lactating		
AreaV West-North	0	0	0	0	0	0	0	0	0	0
	-	-	-	-	-	-	-	-	-	
AreaV East-North	17	34	51	11	0	0	8	0	19	70
	33.3%	66.7%	72.9%	57.9%	0.0%	0.0%	42.1%	0.0%	27.1%	
AreaVI West-North	5	23	28	9	0	2	5	0	16	44
	17.9%	82.1%	63.6%	56.3%	0.0%	12.5%	31.3%	0.0%	36.4%	
Northern Strata (Total)	22	57	79	20	0	2	13	0	35	114
	27.8%	72.2%	69.3%	57.1%	0.0%	5.7%	37.1%	0.0%	30.7%	
AreaV West-South	0	0	0	0	0	0	0	0	0	0
	-	-	-	-	-	-	-	-	-	-
AreaV East-South (Ross)*	0	40	40	30	4	16	242	0	292	332
	0.0%	100.0%	12.0%	10.3%	1.4%	5.5%	82.9%	0.0%	88.0%	
AreaVI West-South	7	28	35	13	0	2	7	0	22	57
	20.0%	80.0%	61.4%	59.1%	0.0%	9.1%	31.8%	0.0%	38.6%	
Southern Strata (Total)	7	68	75	43	4	18	249	0	314	389
	9.3%	90.7%	19.3%	13.7%	1.3%	5.7%	79.3%	0.0%	80.7%	
Combined	29	125	154	63	4	20	262	0	349	503
	18.8%	81.2%	30.6%	18.1%	1.1%	5.7%	75.1%	0.0%	69.4%	

* Two females with unknown maturity status.

Table 10. Some biological information on fin whales sampled in 2006/2007 JARPAII.

No.	Date of capture	Body length (m)	Body weight (ton)*	Sex	Testis weight (L/R, kg)	Reproductive information	Remarks
F001	Jan. 3, 2007	-	-	F	-	-	
F002	Jan. 5, 2007	20.67	51.62	M	8.10 / 9.80		
F003	Feb. 2, 2007	21.15	65.02	F	-	Pregnant	Fetal length 243.4cm

* 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 9.

Sex	Male						Female					
Maturity	Mature			Immature			Mature			Immature		
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 West-North	-	-	-	-	-	-	-	-	-	-	-	-
AreaV East-North	8.27 0.41	9.05 7.42	34	6.50 0.61	7.40 5.46	17	8.66 0.47	9.40 8.08	8	6.37 1.03	8.04 4.97	11
AreaVI West-North	8.21 0.42	9.45 7.51	23	6.34 1.24	7.55 4.74	5	8.83 0.55	9.28 7.67	7	7.35 0.70	8.12 6.15	9
AreaV West-South	-	-	-	-	-	-	-	-	-	-	-	-
AreaV East-South (Ross)	8.24 0.40	9.05 7.41	40	-	-	-	8.82 0.37	9.86 7.83	261	7.88 0.42	9.03 6.85	30
AreaVI West-South	8.24 0.37	8.83 7.47	27	7.57 0.69	8.51 6.33	7	8.77 0.26	9.27 8.48	9	6.80 0.65	8.26 5.86	13

Table 12. Summary of photo-ID.

Species	**Area VI**		**Area V**				**Total**
	West		**West**		**East**		
	North	**South**	**North**	**South**	**North**	**South**	
Blue whale	-	-	-	-	2	-	2
Humpback whale	6	-	-	-	19	-	25
Total	6	0	0	0	21	0	**27**

Table 13. Summary of biopsy sampling.

Species	**Area VI**		**Area V**				**Total**
	West		**West**		**East**		
	North	**South**	**North**	**South**	**North**	**South**	
Blue whale	-	-	-	-	1	-	1
Fin whale	-	-	-	-	3	-	3
Humpback whale	2	-	-	1	10	-	13
Total	2	0	0	1	14	0	**17**

Table14 . Summary of oceanographic and acoustic surveys.

Area	E/W	N/S	CTD (stations)		XCTD (stations)		IKMT (stations)	EPCS (days)		Echo sounder (days)
			KK1	KS2	KK1	KS2	KK1	KS2	YS2	KS2
VI	West	North	7	10	5	5	7	13	9	13
		South	6	5	1	2	6	6	10	6
V	East	North	7	18	15	17	7	19	15	19
		South	13	8	15	21	16	19	23	19
	West	North	1	1	2	0	1	2	0	2
		South	1	2	0	0	1	3	0	3
Other					5					
Total			**35**	**44**	**43**	**45**	**38**	**62**	**57**	**62**

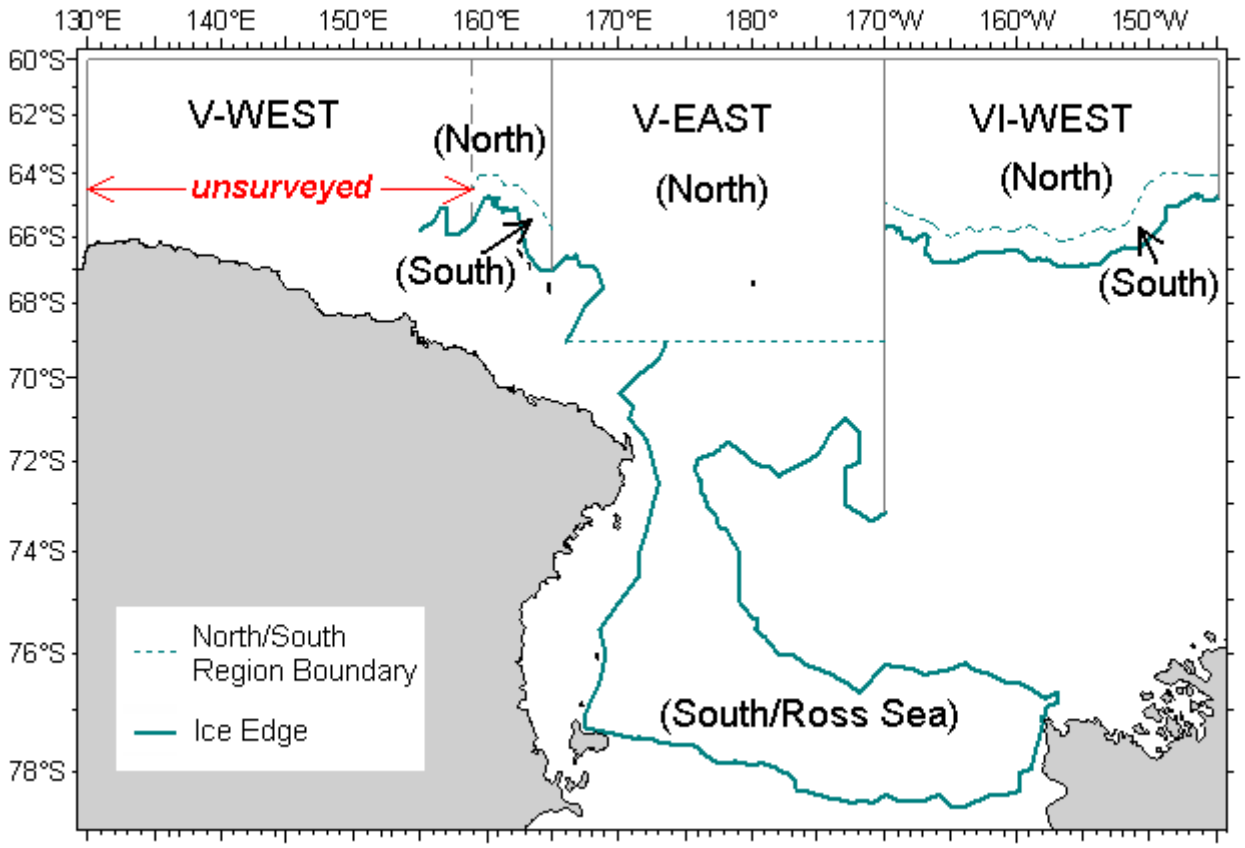

Figure 1. Geographic location of research area of the 2006/2007 JARPAII survey. Ice edge lines are estimated by observation from research vessels and the information from Near real time DMSP SSM / I daily polar griddled sea ice concentration data set available from the National Snow and Ice Data Center (NSIDC, Cavalieri *et al*. 1999).

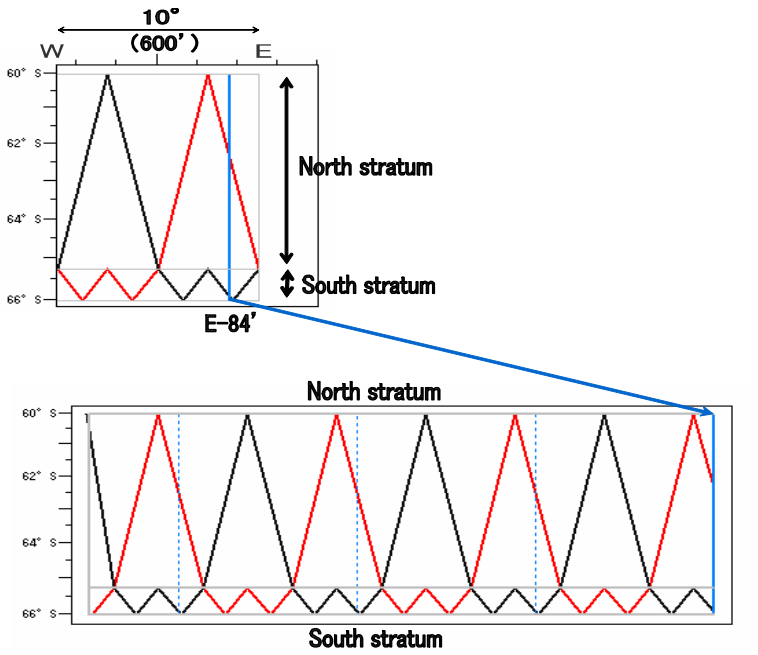

Figure 2. The principle design of survey track line of SVs based on the minimum unit.

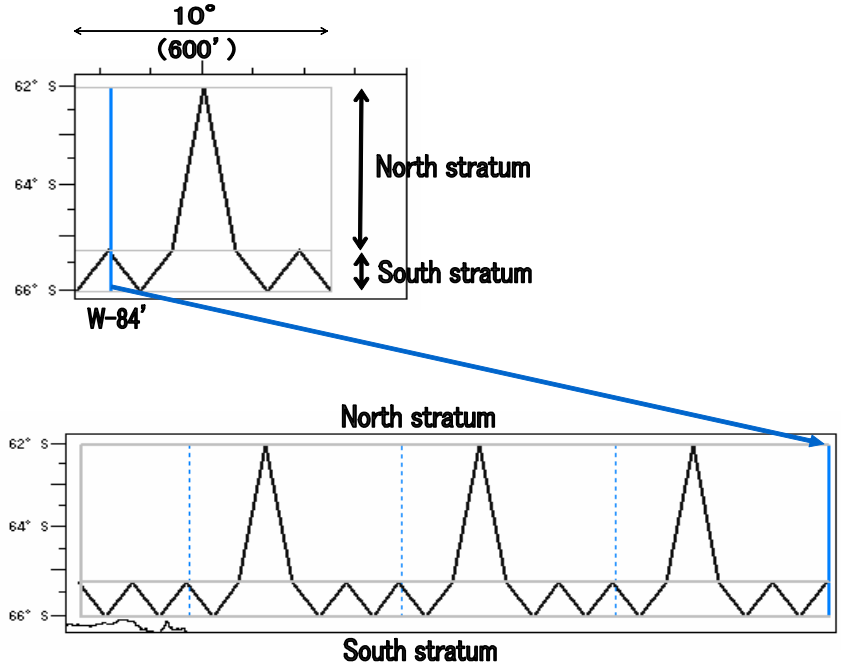

Figure 3. The principle design of survey track line of SSVs from the minimum unit.

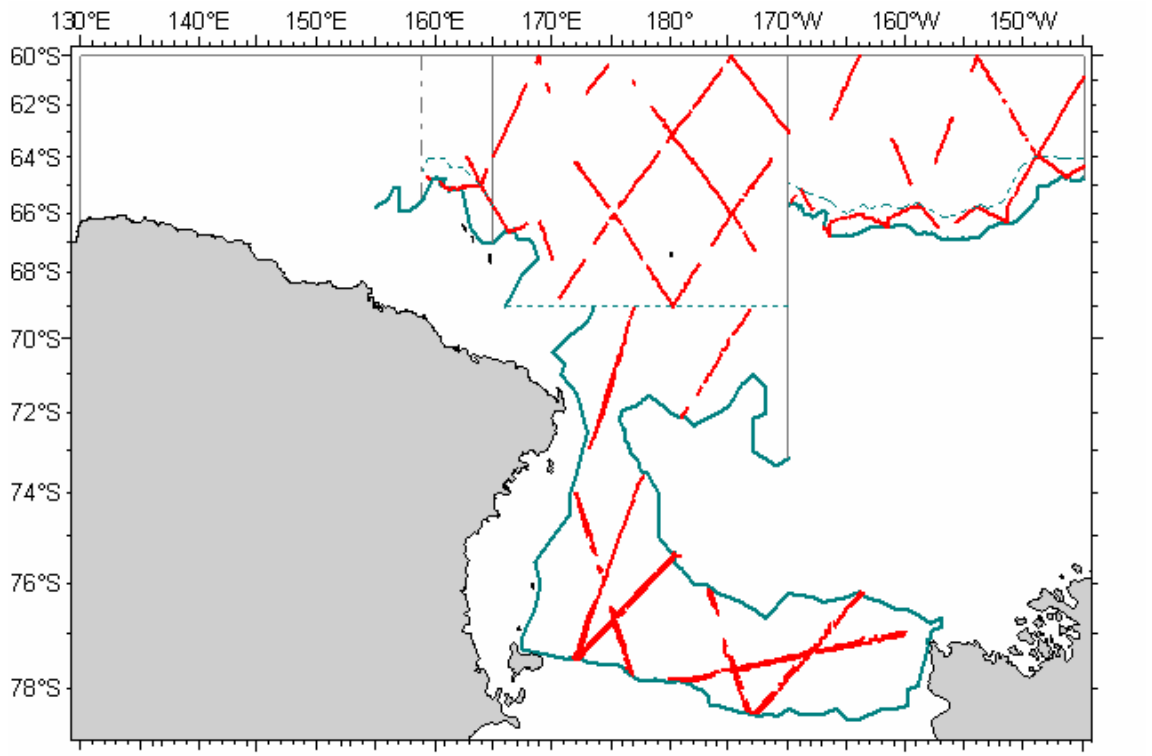

Figure 4. Survey track line Searching effort of SVs in 2006/2007 JARPAII.

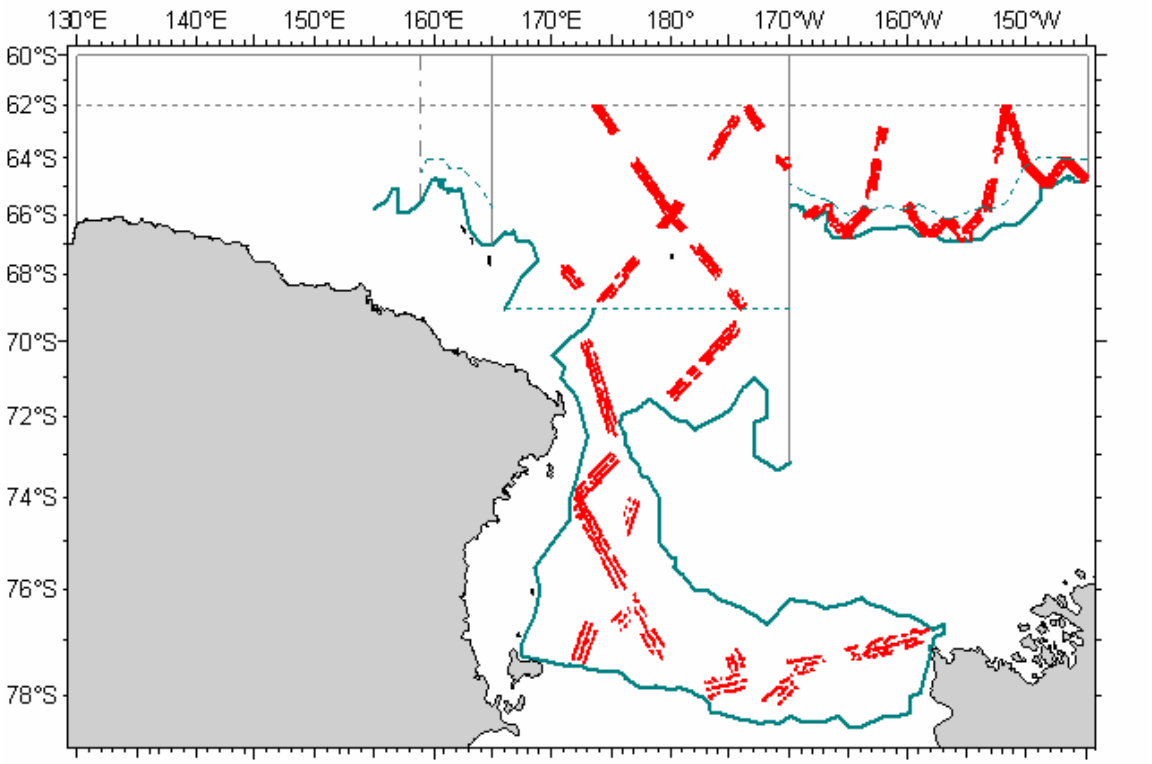

Figure 5. Survey track line of SSVs in 2006/2007 JARPAII.

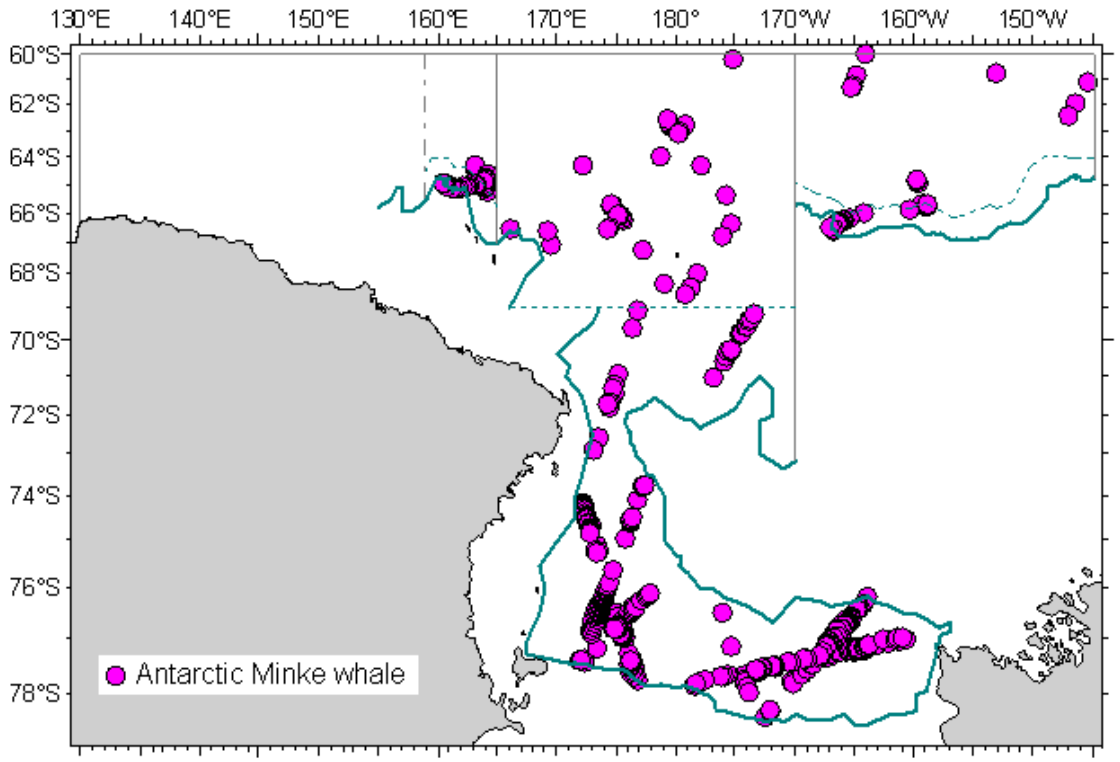

Figure 6. Distribution of primary sightings of Antarctic minke whales sighted by SVs in2006/007JARPAII.

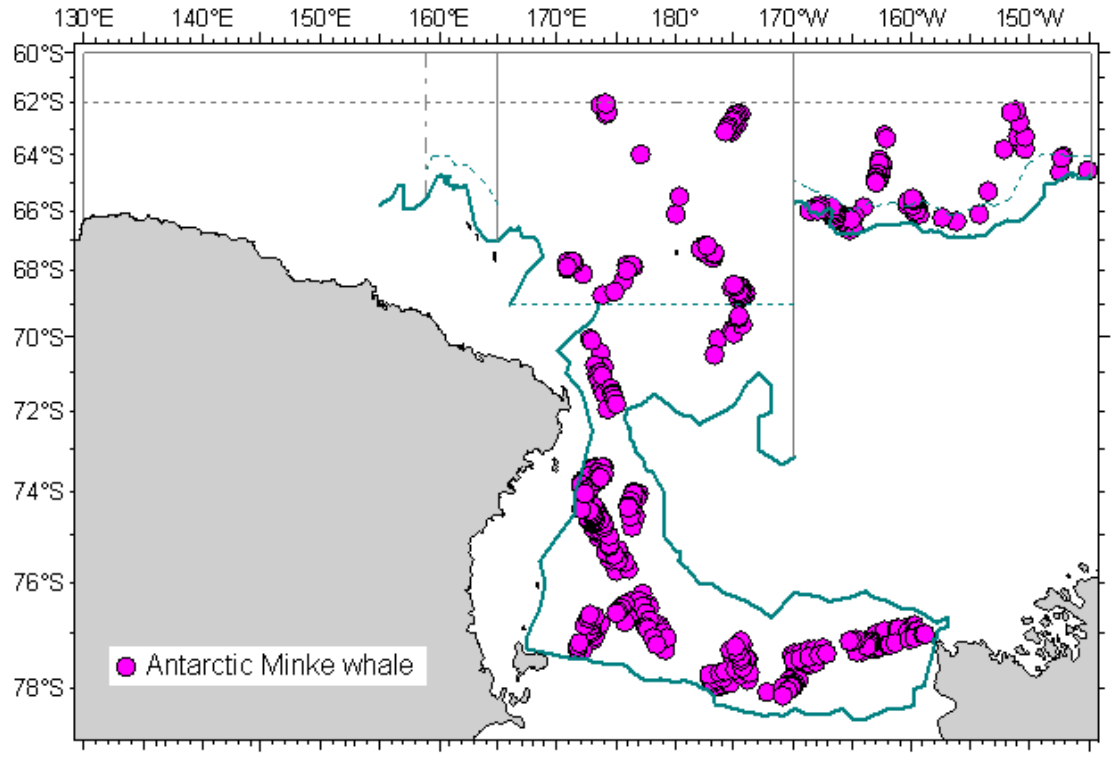

Figure 7. Distribution of primary sightings of Antarctic minke whales sighted by SSVs in 2006/2007 JARPAII.

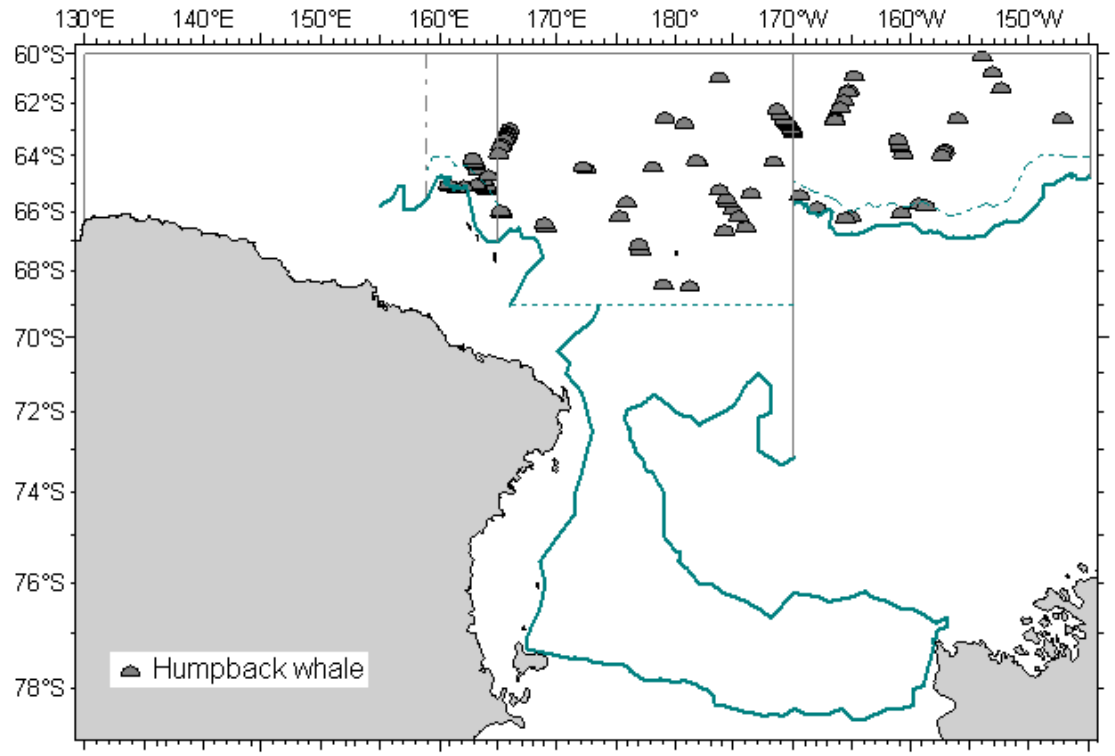

Figure 8. Distribution of primary sightings of humpback whales sighted by SVs in 2006/2007 JARPAII.

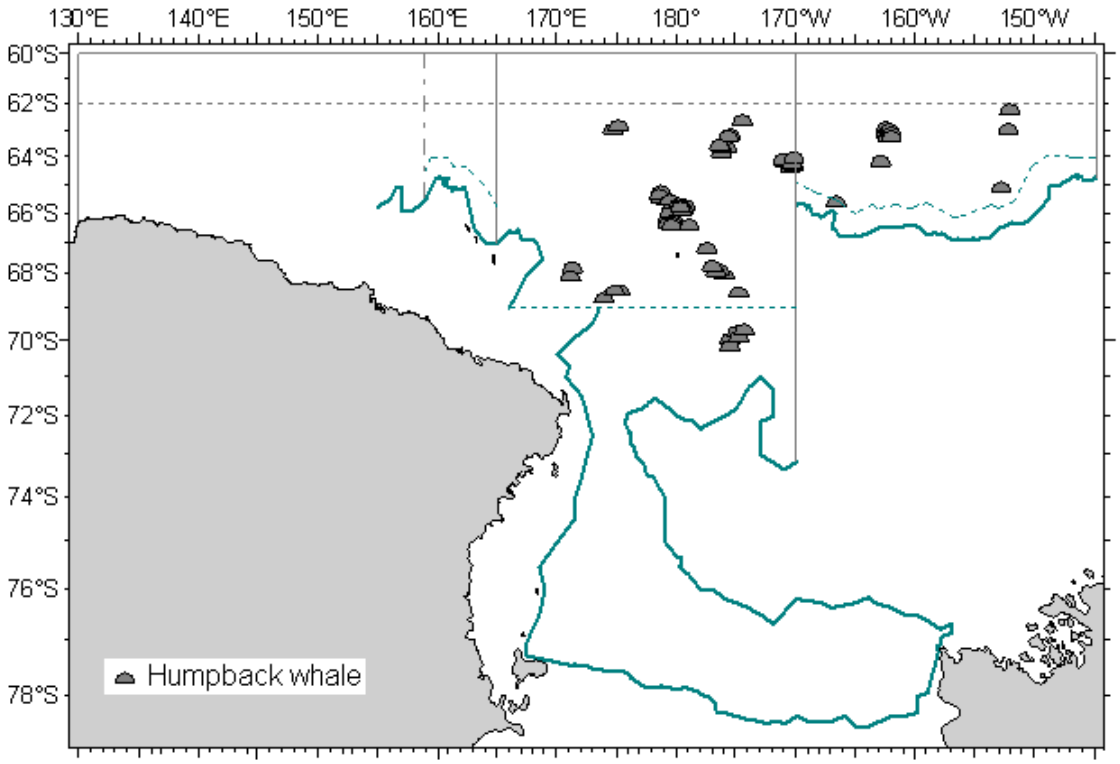

Figure 9. Distribution of primary sightings of humpback whales sighted by SSVs in 2006/2007 JARPAII.

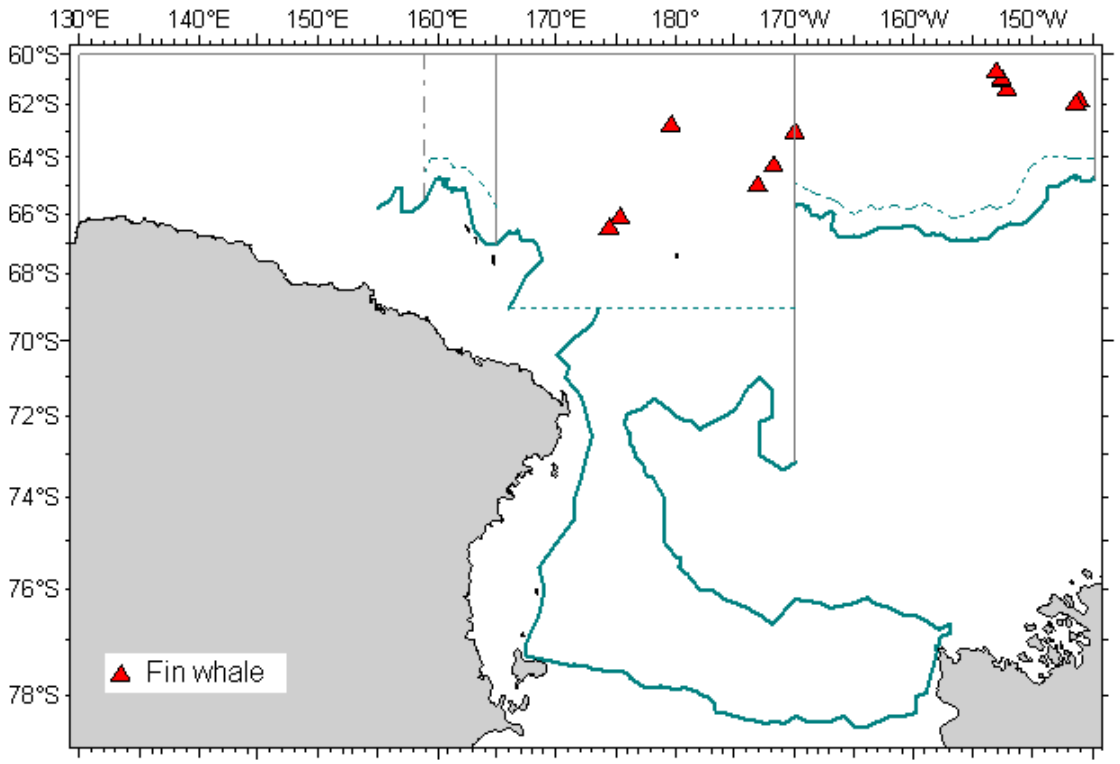

Figure 10. Distribution of primary sightings of fin whales sighted by SVs in 2006/2007 JARPAII.

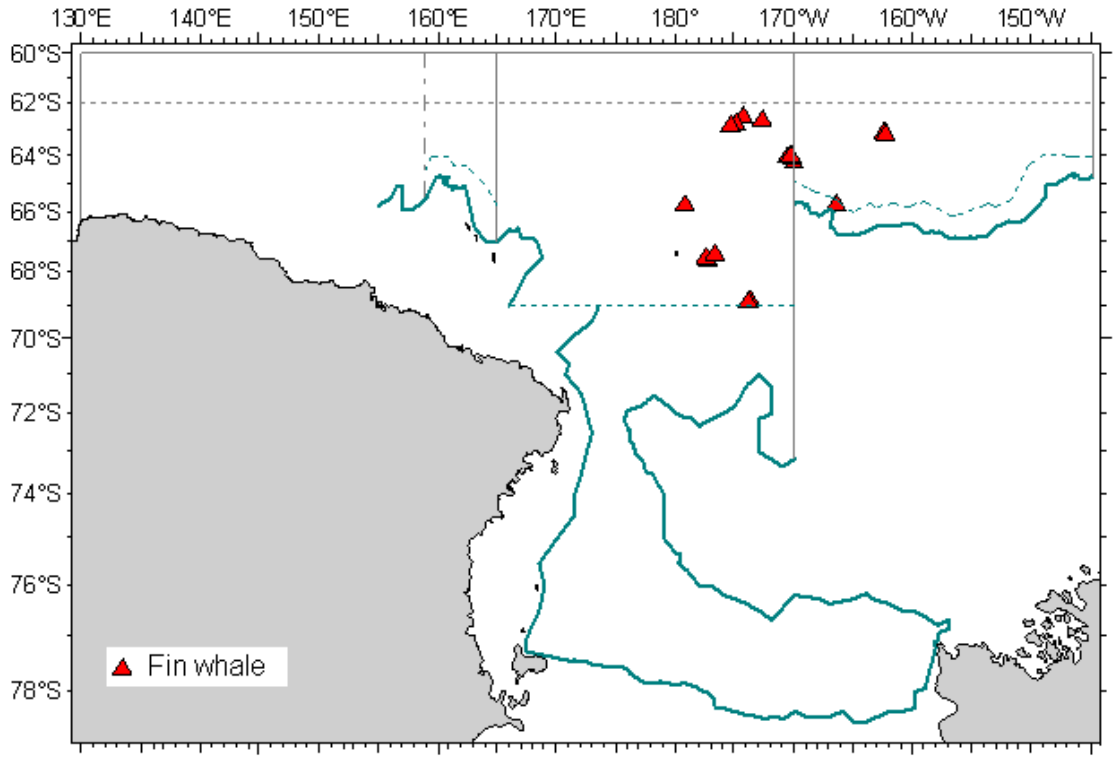

Figure 11. Distribution of primary sightings of fin whales sighted by SSVs in 2006/2007 JARPAII.

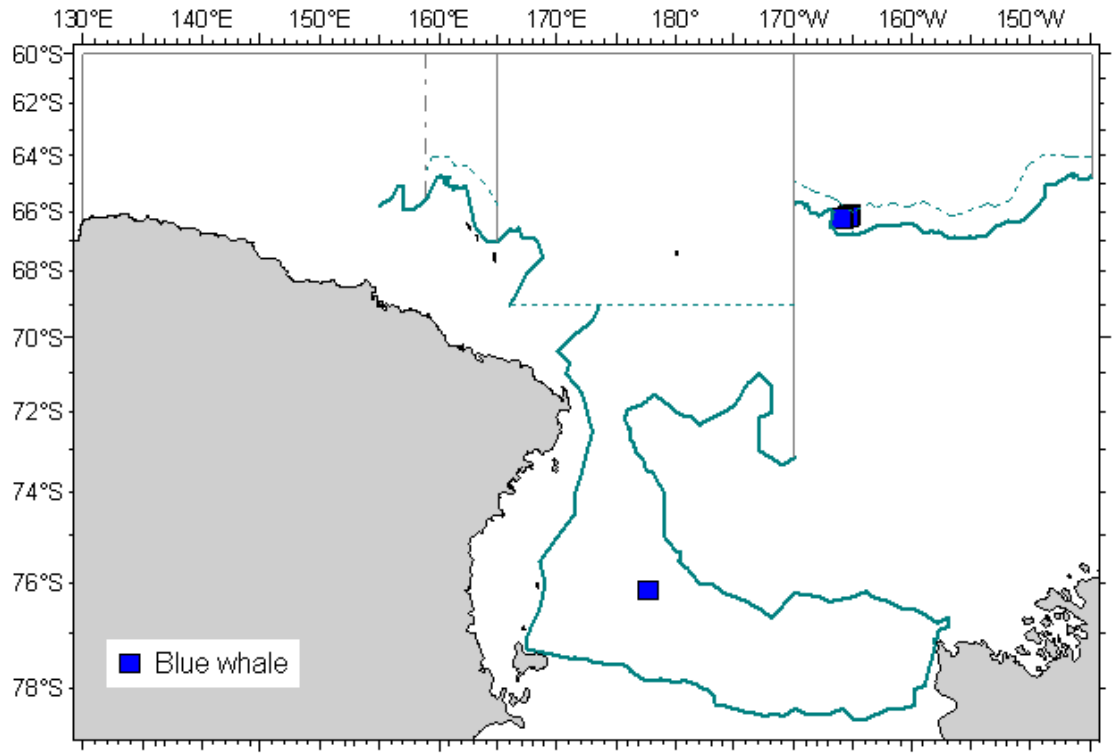

Figure 12. Distribution of primary sightings of blue whales sighted by SVs in 2006/2007 JARPAII.

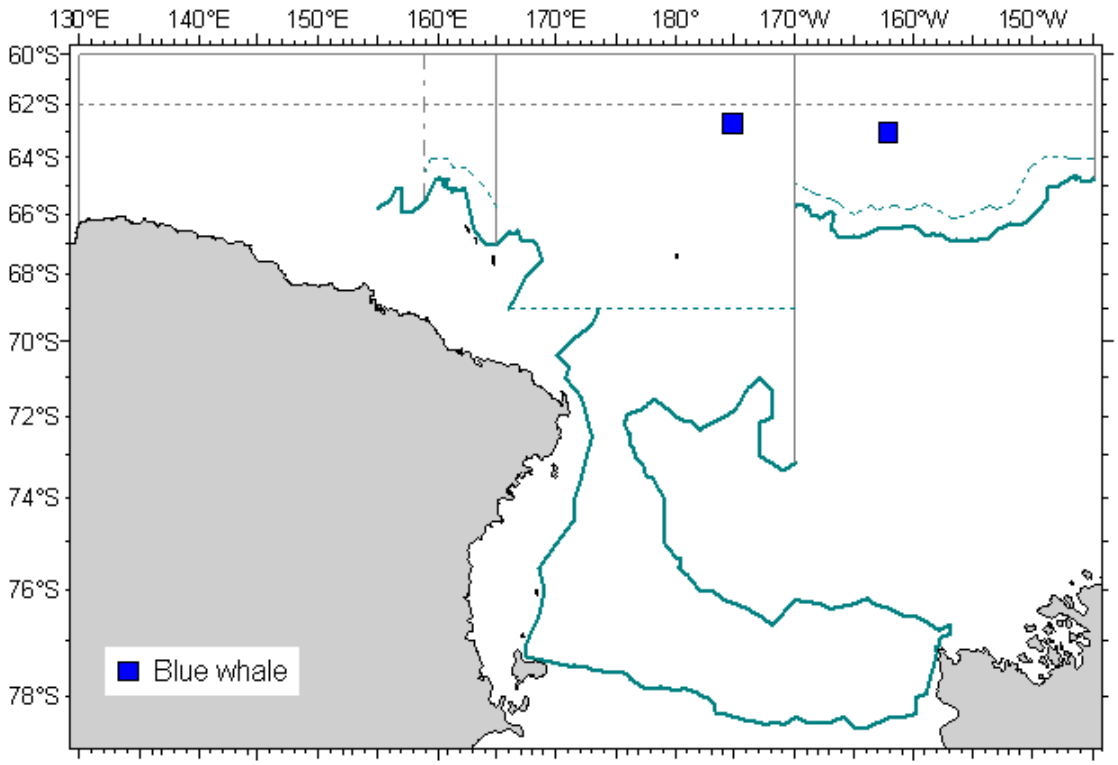

Figure 13. Distribution of primary sightings of blue whales sighted by SSVs in 2006/2007 JARPAII.

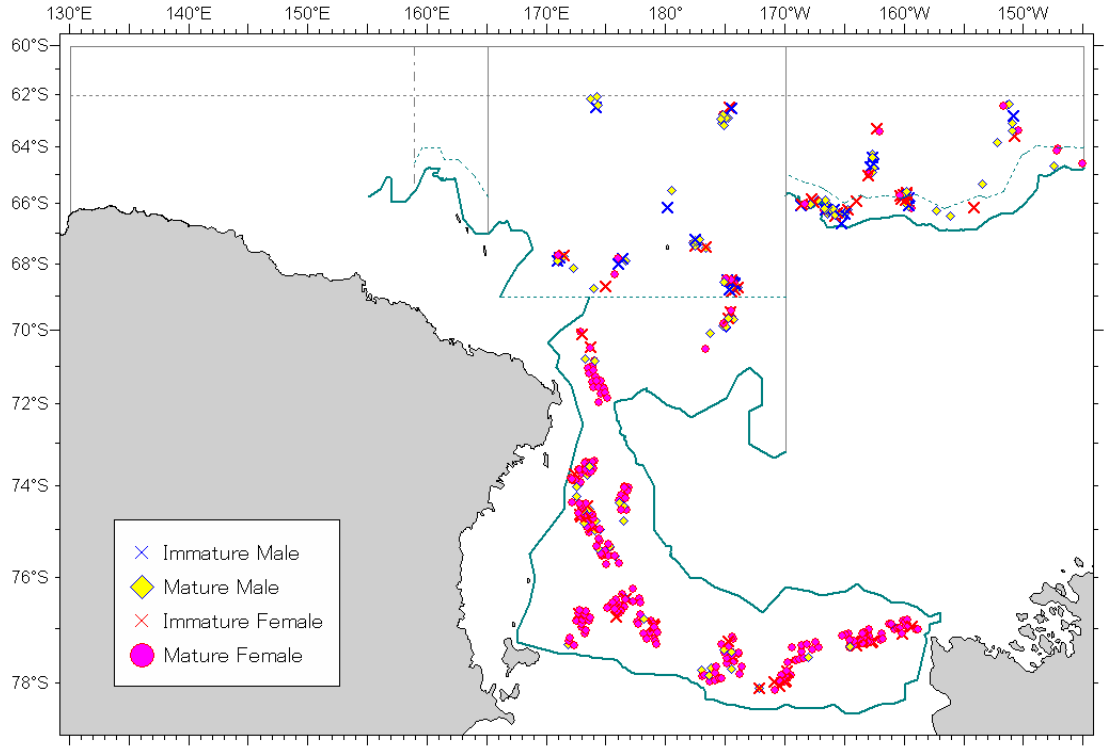

Figure 14. Sighted position of sampled Antarctic minke whales by sex and reproductive status in 2006/2007 JARPAII.

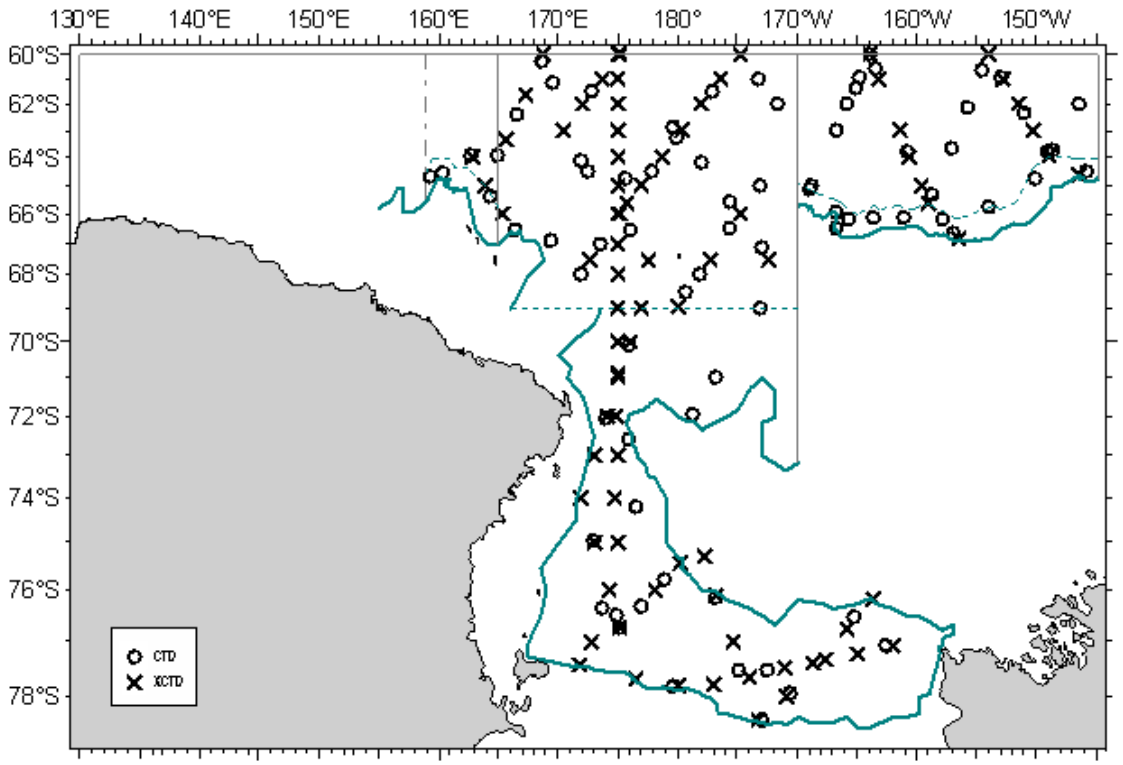

Figure 15. The CTD and XCTD observation stations in the research area in 2006/2007 JARPAII (circle: CTD stations, cross: XCTD stations).

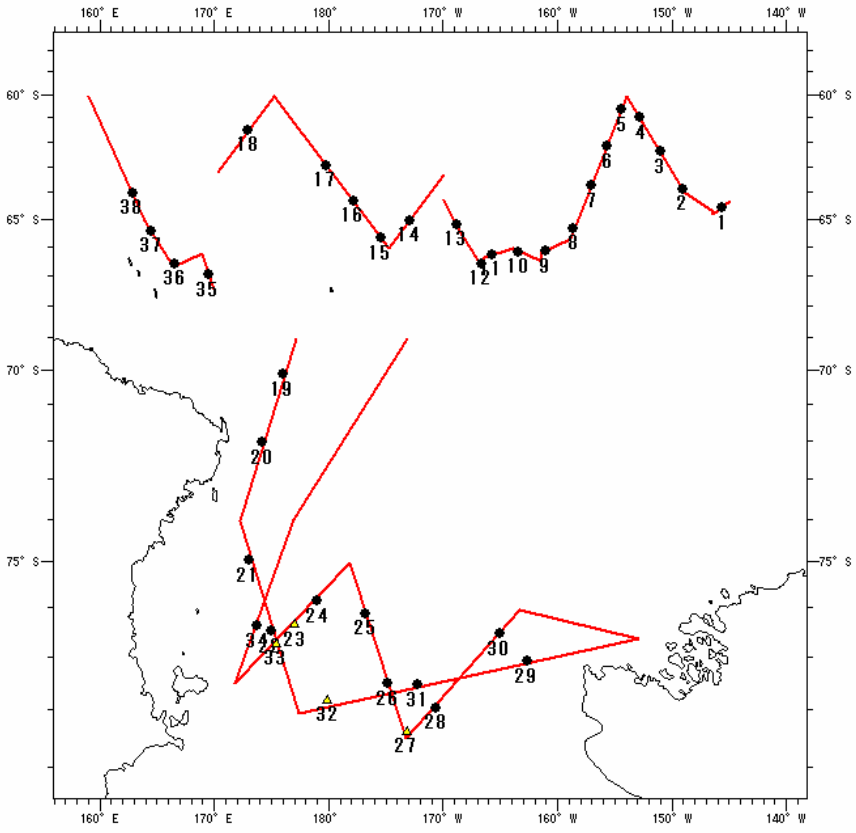

Figure 16. Pre-determined survey track line of KK1 and IKMT stations (filled circle: regular IKMT stations; open triangle: target IKMT stations) in 2006/2007 JARPAII.