

2009-2010 International Whaling Commission-Southern Ocean Whale and Ecosystem Research (IWC-SOWER) Cruise

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ABSTRACT

The 32nd annual IWC-SOWER (formerly IDCR) Cruise in Antarctic Area IV aboard the Japanese research vessel *Kaiko Maru* was conducted in 2009-2010. The cruise departed Benoa, Bali, Indonesia on 23 December 2009 and returned to Benoa, Bali, Indonesia on 22 February 2010. The cruise had two main objectives: 1) undertake a sightings survey in collaboration with an Australian Antarctic Division aerial survey designed to investigate and compare minke whale densities from within the pack ice and from the ice-free water north of the pack ice; 2) continue research on the priority species southern right, blue, fin, and humpback whales (biopsy sampling and photo-identification as well as identification of sub-species for blue whales). After transiting to the research area (spanning longitudes 100°E - 115°E), we carried out a line transect survey eastward from 7 to 21 January, and then resurveyed the same area westward from 22 January to 03 February, collaborating with the Australian Antarctic Division aerial survey. Our research area extended from the pack ice edge and both eastward and westward surveys had a common northern boundary established 60 n.miles north of the ice edge. The position of the latter was estimated from daily ice information. A total of 1072.3 n.miles were covered during the two surveys, and in two survey modes: SS-II mode (501.7 n.miles) and BT-Option II mode (511.3 n.miles). After completing the western survey, we extended the trackline again to the east for maximum coverage of the research area. The total surveyed distance between 3 and 5 February was 91.6 n.miles, in which 45.8 n.miles were covered in SS-II and 40.6 n.miles in BT mode. The survey continued after changing mode to BB, east along the ice edge until we completed our survey period in the Antarctic research area at 18:00 on 7 February. The total number of minke whales sighted during the entire coverage of the research area was 83 groups comprising 152 animals. Humpback whales were the most frequently sighted species in the research area, with 174 groups including 322 animals. A total of 21 biopsy samples and 45 individual photo-id's were taken from humpback whales. No blue whales were observed but five fin whales in three groups were sighted, two groups near the ice edge. A notable number of southern right whales were sighted (38 animals in 28 groups). From these, a total of 22 biopsy samples and 26 individual photo-id's were taken. On 03 February, one group consisting of one southern right whale and one humpback whale that were closely associated were sighted at 63°30'S 100°16'E. Both animals were photographed and biopsy samples were taken. Sperm whales were the third most encountered cetacean species with 39 groups including 41 animals. In total, 9 groups of 78 killer whales were sighted, however, most groups did not show strong characteristics for any types, except one group of 20 animals were identified as Type A. One of 29 sighted groups of southern bottlenose whale contained a calf of which photographs were taken. SCANS experiments were planned for SOWER 2009-2010; however, due to missing equipment, the experiment was dropped. The Estimated Angle and Distance Training Exercise and Experiment were completed as in previous years.

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INTRODUCTION

The 2009-2010 International Whaling Commission - Southern Ocean Whale and Ecosystem Research Program (IWC-SOWER) Cruise was conducted from 23 December 2009 to 22 February 2010. The cruise was the 32nd in a consecutive series of Antarctic cruises conducted by the IWC. The first eighteen cruises were conducted under the auspices of the International Decade of Cetacean Research (IDCR) and known as the IWC/IDCR Southern Hemisphere Minke Whale Assessment Cruises. The subsequent and fourteen most recent cruises were part of the IWC-SOWER Circumpolar program. The first twenty-six IDCR/SOWER cruises focused on obtaining data to estimate the population size and distribution of minke whales south of latitude 60°S and comprised the first, second and third circumpolar series of surveys. A new phase of research was initiated during the 2004-2005 cruise.

The 2009-2010 cruise continued the research begun during the 2004-2005 cruise. The main objectives for the 2009-2010 cruise were to:

- 1) undertake a sightings survey in collaboration with an Australian Antarctic Division aerial survey designed to investigate and compare minke whale densities from within the pack ice and from the ice-free water north of the pack ice;
- 2) continue research on the priority species southern right, blue, fin, and humpback whales (biopsy sampling and photo-identification and additionally for blue whales identification of sub-species).

Initial planning for the cruise was undertaken at the 2009 Meeting of the IWC Scientific Committee (IWC in Press). Logistical aspects for the cruise and operations of the ships were finalized at a Planning Meeting held in Tokyo on 24-25 September 2009 (Anon. 2009a).

The IWC provided partial funding for the cruise. The Government of Japan provided the research ship, the *Kaiko Maru*. This ship replaced the *Shonan Maru No.2* which has been used in previous IWC-IDCR/SOWER cruises since the 1981-82 cruise. Specifications of the *Kaiko Maru* are given in Appendix A.

The research area for the cruise, 100° - 115°E (in Area IV) was almost the same as for last year's cruise which was designed to coincide with an Australian Antarctic Division (AAD) aerial survey.

Research in Area IV was previously carried out during the 1978-79, 1984-85, 1988-89 IWC/IDCR cruises and during the 1998-1999, 2007-2008 and 2008-2009 IWC-SOWER cruises.

For the 2009-2010 SOWER cruise Benoa, Bali, Indonesia was used as the home port.

Personnel

Four researchers were selected for the cruise; Keiko Sekiguchi (cruise leader, Japan), Kazuki Fukutome (Japan), Laura Morse (USA) and Cornelia Oedekoven (Germany).

Schedule

Listed below is the cruise itinerary.

Date	Event
23-Dec	<i>Kaiko Maru</i> arrived Benoa Harbour, Bali, Indonesia
23-Dec	Scientists and equipment board outside 12 n.miles via tug and departed Benoa
23-Dec	Pre-cruise Meeting on <i>Kaiko Maru</i>
24-Dec	<i>Kaiko Maru</i> departed the 200 n.miles EEZ of Indonesia; the first refuel just outside of EEZ.
7-Jan	Minke whale survey, (Eastern Survey, west to east) commenced at longitude 100°00'E
9-Jan	Larsen biopsy gun training
10-Jan	Estimated Angle and Distance Training
21-Jan	Eastern Survey completed at longitude 115°00'E
22-Jan	Western survey (east to west survey, 115°00'E to 100°00'E) commenced
25-Jan	<i>Kaiko Maru</i> conducted Estimated Angle and Distance Experiment
3-Feb	Eastern Survey completed at longitude 100°00'E. The extended short trackline to the east commenced.
4-Feb	<i>Kaiko Maru</i> was refueled at 63°46.7'S 101°44.8'E
5-Feb	<i>Kaiko Maru</i> completed the short trackline at 64°15.3'S 102°10.2'E, continued the BB survey along the ice edge to east
7-Feb	Antarctic research area survey completed and transit commenced to Benoa, Indonesia
18-Feb	Post-cruise Meeting held aboard the ship
20-Feb	<i>Kaiko Maru</i> entered the 200 n.miles EEZ of Indonesia
22-Feb	<i>Kaiko Maru</i> arrived off Benoa, Indonesia, scientists and equipment leave vessel outside 12 n.miles via Rescue Boat 202
22-Feb	<i>Kaiko Maru</i> departed Benoa, Indonesia

OBJECTIVES AND METHODS

There were two main objectives for the 2009-2010 IWC-SOWER cruise:

- (1) undertake a sightings survey in collaboration with an Australian Antarctic Division (AAD) aerial survey designed to investigate and compare minke whale densities from within the pack ice and from the ice-free water north of the pack ice;
- (2) continue research on the priority species southern right, blue, fin, and humpback whales (biopsy sampling and photo-identification and for blue whales including identification of sub-species).

30 days in the research area were allocated as follows:

- 24 days for the minke whale survey, collaborating with an AAD aerial survey designed to investigate and compare minke whale densities from within the pack ice and from the ice-free water north of the pack ice
- 4.5 days for biopsy and photo-identification of the priority species including southern right whales, blue whales, fin whales and humpback whales
- 0.5 days for Angle and Distance estimation training and experiment
- 1 day for refuelling and resupply

Minke Whale Research

As mentioned above, the main research objective for the 2009-2010 cruise was once again a sightings survey in collaboration with the AAD aerial survey designed to investigate and compare minke whale densities from within the pack ice and the ice-free waters north of the pack ice. During the collaborative research with the aerial survey, the SOWER vessel was to survey the research area (100-115°E) from west to east (referred to as the “collaborative survey” in this report). After reaching the east end of the research area, the SOWER vessel would re-survey from east to west using the same cruise track design although with an opposite orientation of the zigzag lines (see below for details). This was the third SOWER cruise to focus on monitoring changes in spatial distribution on systematically constructed tracklines within the survey season. The last two SOWER cruises (Ensor et al, 2008 and 2009) had a similar intention to pursue a collaborative study with an aerial survey conducted by the AAD.

Collaborative research with the aerial survey for whales (Research area)

Collaboration between the SOWER cruise and the AAD aerial survey was again the highest priority research item for this cruise. The research area, longitude 100°E-115°E, was selected for the 2009-2010 cruise to collaborate with the AAD aerial survey.

The aerial survey would provide important information on minke whales in the pack ice – which is relevant to interpretation of SOWER cruise data.

The SOWER research was to be synchronized temporally and within the same longitudinal area as the AAD aerial survey: from early January until early February operating from the Bunger Hill Camp and Casey Station, between longitudes 100°E and 113°E. The aircraft would survey from the Antarctic coast covering the pack ice zone and ice-free water in approximately the same extent from the ice edge. The SOWER vessel was to survey an area from the ice edge to approximately 60 n.miles north, thus providing some overlap with the aerial survey.

The SOWER research area was to be covered in a single southern strata. The southern stratum was to extend 60 n.miles north from the ice edge and a standard SOWER cruisetrack design and coverage intensity was planned.

The SOWER collaborative survey was to be synchronized as much as possible with the aerial survey.

A contingency plan in the event that the aerial component could not be undertaken for logistical reasons was that effort in the southern stratum between 120° and 135°E should focus on photo-identification and biopsy sampling, with priority being allocated to humpback, blue and southern right whales. This would provide valuable information to the ongoing Comprehensive Assessment of Humpback Whales Breeding Stock D and E and in particular their distribution and possible overlap on the feeding grounds.

Just before departing from Benoa, the SOWER cruise leader received the e-mail from Dr. Natalie Kelly (ADD) mentioning their aerial survey had started.

The line-transect survey component was to be conducted using BT-Option II mode and SS-II mode (closure when abeam) methodology.

Cruisetrack design and survey modes

The cruisetrack design for eastward and westward surveys was designed as a series of zigzags between waypoints constructed using a locus interstratum boundary survey design. As there was only a single southern stratum, the northern boundary of the research area (longitude 100°E-115°E) was designed as a line running parallel to the ice edge 60 n.miles to the north mapped by daily ice information.

Tracklines were covering the entire north-south extent of the research area. With the time available for this cruise, tracklines were designed to start at the ice edge at 100°E and zigzag back and forth between the boundary and the ice edge three times in legs of approximately less than 100 n.miles each.

The entire survey was to be conducted in alternating SS-II (closure when abeam) and BT-Option II modes. Each of the zigzag survey legs was to be divided equally by two survey modes. Waypoints for mode alternation were established on lines of longitude.

Due to the limited time available, coupled with the requirement to cover the entire area at least twice, it was likely that gaps in survey coverage would be necessary as the total length of the trackline will be too great to be entirely covered. Survey effort was to be distributed as evenly as possible by latitude and longitude.

As with last years survey, BT-Option II was to be used instead of IO mode in order to further evaluate BT mode survey methodology (Buckland and Turnock, 1992) as a protocol for future SOWER minke whale surveys. For BT-Option II the location of the Tracker Platform was the Top Barrel with the two observers searching the forward 60° on either side of the trackline using 7x50 binoculars. The Primary Platform was the IOP with two observers, one topman and one researcher searching 90° either side of the trackline with naked eye. Both the Tracker and the Primary Platforms tracked minke whale sightings until they were estimated abeam with all re-sightings recorded. BT-Option II was also trialled on the 2006-07 to 2008-09 cruises; full details of the methods used for BT-Option II mode trials are described in Anon (2009b).

Investigation of minke whale school size estimation was to be continued during this cruise and SS-II mode (abeam closure from Passing mode (NSP)) was to be used instead of normal closing mode (NSC). The aim was to continue the investigation into the difference between confirmed school sizes of minke whales (mainly obtained during NSC mode) and unconfirmed school sizes (mainly obtained during Passing mode). Abeam closure was attempted on all minke whale and 'like minke whale' sightings that fell within 1.5 n.miles perpendicular distance from the trackline. The methods to be used for the SS-II mode trials are provided in Anon (2009b).

Research was conducted for 12 hours between 06:00-18:00 hrs. During days when the survey was conducted in BT-Option II mode (effectively involving the same crew schedule as Passing mode with independent observer (IO mode)) research was scheduled for 12 hrs a day between 06:00-19:00 hrs to allow for potentially two 30-minute meal breaks. However, because of sufficient number of primary observers (eight, including the Captain), we did not need to break for meals. Thus we conducted the BT mode survey in the regular time schedule (i.e. 06:00-18:00). Research was scheduled for 12 hrs a day during the transits to and from the research area.

Video distance and angle measurement (SCANS II)

With respect to the continuing concerns related to SOWER distance and angle estimates, the IWC Scientific Committee recommended that more data related to distance and angle measurements should be obtained on the 2009-2010 cruise. The SCANS II system consisted of two sets of equipments; the SCANS II video equipment to estimate distance, and two digital still cameras to record angle estimation and observers search patterns.

Minke whale visual dive time experiment

Because collaboration with the aerial survey had the highest priority, continuation of the minke whale visual dive time experiment was given a low priority when planning this cruise.

Estimated angle and distance experiments

An Estimated Angle and Distance Training Exercise and Estimated Angle and Distance Experiment were planned using the same protocol as on recent cruises (Anon. 2009b).

Blue whale research

No specific time was allocated for blue whale research for SOWER 2009-2010, although blue whales had the highest priority for biopsy, video and photo-id (see the following section). No acoustic research was carried out due to equipment limitations.

Southern right, blue, fin and humpback whale biopsy sampling and photo-identification

For the SOWER 2009-2010 cruise, the priority species for biopsy and photo-identification studies remained unchanged from recent cruises; southern right, blue, fin and humpback whales. A total of 4.5 days of research time was allocated to biopsy and photo-id studies. Priority was to be given to blue and southern right whales during the early part of the cruise, with additional priority allocated to fin and humpback whales later in the cruise, depending on time available. This was because humpback whales were expected to be abundant throughout the area for the duration of the research. Opportunities were to be taken for collection of biopsy samples from killer whales as well as other 'incidental' species during the normal process of confirming species identification and numbers, or if animals approached the vessel while off-effort. Three types of biopsy equipment were available on board: Larsen guns, Paxarms guns, and compound crossbows. The Larsen gun was used as a primary biopsy equipment because of its wide target range and ease of use.

Biopsy tissue samples were split, with one half for Japan and the other half for IWC. All samples were frozen. When samples had a "significant" amount of blubber attached, the blubber was removed from the skin, and frozen.

During the SOWER 0910 cruise photographs were taken mainly by the four researchers on board, Sekiguchi (KS), Fukutome (KF), Morse (LJM) and Oedekoven (CSO), but contributions were also made by the crewmember Yamaguchi (YF) on a few occasions. Fukutome was using the camera and lenses provided by IWC (Canon EOS 20D with a 100-400 mm image-stabilized zoom lens) while Sekiguchi, Morse and Oedekoven used personal cameras (Nikon D300s and Canon 7D and equivalent lenses) since they were superior to IWC equipment. Platforms used for photographing included the top barrel in the case of right whales as well as the upper bridge and the forecastle deck. The latter was generally used by Morse and Oedekoven who were coordinating with the biopsy team, i.e. the crewmembers Hasebe and Yamaguchi on which whale to biopsy and matching photographs with biopsy samples.

Acoustics Research

No acoustic research was carried out since the *Kaiko Maru* was not properly equipped to receive sonobuoy signals.

Ice Edge Information

Ice edge information was critical for construction of the cruise-track for the SOWER vessel and ice information was received from two sources:

- 1) daily Advanced Microwave Scanning Radiometer (AMSR-E) passive microwave images (available at <http://iup.physik.uni-bremen.de:8084/amsr/amsre.html>); were sent to the SOWER vessel from the Australian Antarctic Division (after transformation at AAD). See Appendix B for details.
- 2) via the Internet originally from the US National Ice Center (NIC) during the cruise. (Available at <ftp://sidads.colorado.edu/pub/DATASETS/seaice/polar-stereo/nasateam/near-real-time/south/>; SSM/I satellite image data provided on a daily basis.) As with recent cruises the SSM/I data were transformed aboard the vessel (by programs developed at ICR), from polar stereographic to Mercator projection.

Oceanography

No oceanographic sampling was planned. As on the last three year's cruises, two ARGO floats were provided under the ARGO oceanographic programme to be deployed during the southward transit (at latitude of 53°S).

NARRATIVE, RESULTS AND DISCUSSION

The following section is a descriptive account of the major aspects of the cruise. Details of the survey area and cruise tracks are presented in Figures 1a to 1d.

Pre-cruise meeting and transit to the Antarctic research area

An informal pre-cruise meeting was held for all four researchers at the Sanur Beach Hotel, Bali on 21 December.

Because the *Kaiko Maru* does not possess a ship inspection certificate for international voyage, it is unable to enter international ports except for emergencies. Therefore, all four researchers and IWC equipment which was either bonded in Bali or sent directly to Bali, were transferred from Benoa using the tugboat Abasa No.2 (98 tons, 14.3m) to the *Kaiko Maru*. The latter was waiting outside of the 12 n.mile Indonesian territorial water, at 14:20 on 23 December, at 09°04.3'S 115°11.8'E. Under good weather conditions, all transfer was safely completed within one hour and the *Kaiko Maru* commenced sailing to the SSW to the Antarctic research area.

The R/V *Kaiko Maru* was out of the Indonesian EEZ at 09:29 on 24 December (12°07.6'S 113°56.6'E), and refueled just beyond in the same afternoon. The official pre-cruise meeting and emergency drills were held after refueling. No research was planned or conducted within the EEZ of Indonesia; however this was to our benefit, as it took more than one day to sort and arrange all equipment.

The transit survey started at 06:00 on 25 December. Given the time constraints in reaching the research area from Benoa, only Passing mode survey was planned during the remainder of the transit after departing the EEZ of Indonesia. On 30 December, the *Kaiko Maru* changed her course from 208° to 180° at 35°00'S 100°00'E. The *Kaiko Maru* did not enter the Australian EEZ.

Two ARGO buoys were successfully deployed on 04 January at 53°00.21'S 100°18.19'E.

The vessel intersected 60°00'S (at longitude 099°59.6'E) at 01:28 hrs on 06 January. During the transit survey, the weather conditions were poor. Between the boundary of the Indonesian EEZ and the intercept with latitude 60°00'S, a total of 63.69 hours (664.8 n.miles) of searching in NSP mode was conducted. Between the latitude of 60°00'S and the ice edge, a total of 1.29 hrs (14.9 n.miles) of research was conducted.

The ship arrived at the starting point for the minke whale research at 07:11 hour on 07 January. However, due to high winds, the survey was delayed. The survey commenced in the early afternoon of 09 January just after the 0.5 hr Larsen gun practice.

Minke whale survey - Collaboration with the Australian Antarctic Division Aerial Survey

The three zigzag tracklines were constructed according to direct observation of the ice edge and latest available ice information. The trackline was based on a locus interstratum boundary approximately 60 n.miles from the estimated ice edge. The interstratum boundary was readjusted by the latest information after reaching the ice edge each time. The aim of the adjustments, perpendicular to the ice edge, was to maintain the width of the southern stratum as close as possible to 60 n.miles and to avoid tracklines running parallel to the ice edge. Appendix C shows waypoints, survey modes, and distance for SOWER 2009-2010 in the Antarctic research area.

1. Eastern survey - West to East

Although the SOWER vessel reached the ice edge at 100°E on 07 January, the survey start was postponed until 09 January due to the bad weather. The eastern survey of the research area commenced from the western border of the research area (100°00'E) at an ice edge waypoint at position 63°36.93'S 100°00'E on 09 January (06:25hrs) and was completed at 115°E on 21 January (16:28hrs). Because of the bisector survey, the survey was finished at position 64°54.06'S 115°04.17'E.

As planned, the research area was constructed by a single southern stratum, which was approximately 60 n.miles in width from the ice edge. Survey was conducted in alternating SS-II and IO modes. Each survey leg was divided in half by survey mode. The cruise track was constructed in relation to an estimated ice edge based on satellite information.

The cruise track during the eastern survey totalled 517.7 n.miles (including a bisector 14.0 n.miles in length) and a total of 489.8 n.miles (94.6%) were covered on effort.

A total of 7.8 n.miles was steamed off effort through snow showers and fog.

Ice obstructed a total of 37.0 n.miles of the constructed trackline. At all ice edge waypoints the pack ice was of relatively high concentration ranging from 6/10 to 9/10 concentration.

During the eastern survey, from the SOWER vessel a total of 46.52 hours of searching was conducted and 489.8 n.miles were covered on primary effort: SS-II mode – 250.6 n.miles (23.88 hours) and BT mode – 239.2 n.miles (22.64 hours).

A summary of research effort by mode during the eastern survey is presented in Table 1. Sections of the trackline covered on primary effort during the eastern survey are shown in Figure 1b. The position details of waypoints is in Appendix C.

For almost all of the survey period very bad weather, rough seas and poor sighting conditions were experienced. Of the 177.31 hours available for research a total of 120.01 hours (67.7%) were lost to poor weather. The SOWER vessel took 14 days to complete the eastern survey. In addition very few aerial flights were made, thus no real time collaborative survey was conducted during the eastern survey period.

During the eastern survey, research on southern right, humpback and killer whales was conducted (see Table 2, Appendix D and Biopsy and Photo-id Sections below).

According to e-mails from Dr. Natalie Kelly, the aerial survey was conducted on 7 and 16 Jan from the Bunger Hills field camp. Due to problem with the airplane, they had to fly directly back to Casey Base on 16 Jan. They had good sightings of minke whales in the ice on that day. Because of the airplane problem, aerial surveys did not resume until the *Kaiko Maru* started the western survey. No overlap of the research area and no real time ‘collaborate survey’ occurred during the eastward survey.

Estimated Angle and Distance Training Exercise

The Estimated Angle and Distance Training Exercise was conducted on the first survey leg on the morning of 10 January and took 3 hours to complete. During the exercise the observers familiarized themselves with naked eye estimates from the IOP in preparation for BT–Option II mode.

2. Western survey - East to West

After completing the eastern transit survey on 21 January, the *Kaiko Maru* steamed due north during the night to the starting point for our western survey, 63°55'S 115°00'E (WP15). This waypoint was 60 n. miles north from the true ice edge at the longitude 115°E on 21 January. On 22 January 06:00, the *Kaiko Maru* started the western survey in the same Antarctic research area from this location, using a survey design of zigzag transect lines which were oriented opposite to the eastern design to maximize effort coverage in the research area. The weather during the western survey was better than the eastern survey; however, a total of 55.9% of research time (149.91 hours) was lost due to the poor survey conditions. The survey was completed at WP28 (63°30'S 100°00'E) on 3 February, 09:27.

Similar to the eastern survey, the tracklines for the western survey were constructed using the Locus Interstratum Boundary, direct observations of the true ice edge and satellite ice edge information. Tracklines were readjusted each time two legs were completed. As in the eastern survey, each leg was divided equally for the two survey modes (SS-II and BT modes). The survey was started in SS-II mode.

The originally planned distance of transect lines was 534.6 n.miles in total. Due to differences between estimated and true ice edge positions, the actual total available survey distance was 554.6 n.miles, including the bisectors to the ice edge at WP17 and WP22.

During the western survey, with a total of 554.6 n.miles of tracklines (including two bisectors totalling 23.0 n.miles in length), the SOWER vessel conducted a total of 50.1 hours of searching and 523.2 n.miles were covered on primary effort: SS-II mode – 251.1 n.miles (24.30 hours) and BT-Option II mode – 272.1 n.miles (25.80 hours). A summary of research effort by mode during the western survey is presented in Table 1. Sections of the trackline covered on primary effort during the western survey are shown in Figure 1c. The position details of waypoints is in Appendix C.

Ice obstructed a total of 26.0 n.miles of the constructed trackline during the re-survey.

During the western survey, research on southern right, humpback and killer whales was conducted (see Table 2, Appendix D and Biopsy and Photo-id Sections below).

During the western survey, the SOWER vessel could not enter the polynya located around 110°E due to higher concentrations of ice at the access point than anticipated.

According to e-mails from Dr. Natalie Kelly, the repairs on their survey airplane were finished by 21 Jan. They planned to fly on 25 Jan, however, the airplane was not in our vicinity. The aerial survey had originated from the

Casey Station on 31 Jan and 1 Feb. Unfortunately, their survey transects were more east than the *Kaiko Maru* position at that time; thus no direct co-ordinate survey took place. After the *Kaiko Maru* finished the western survey, we planned a survey along another short trackline to the ice edge. We proposed to Dr. Natalie Kelly to survey in BB mode along the ice edge for biopsy, standing-by for a possible survey coordinated with their aerial survey, however on 3 Feb, it became apparent that it would not be feasible to conduct further coordinated survey effort due to limitations of aircraft availability.

Estimated Angle and Distance Experiment

The Estimated Angle and Distance Experiment was conducted on 25 January during a total of 4.37 hours. The IOP observers made naked-eye estimates as is done for BT-Option II mode.

3. Extended survey - 100°E to 108°E

After completing the western survey (09:27 on 03 February), the *Kaiko Maru* immediately continued the short trackline survey from WP28 (63°30'S 100°00'E), which was the last waypoint for the western survey. The extended short trackline was constructed to maximize the survey effort in the research area, and compensate for the fact that the beginning of last leg was almost parallel to the ice edge for 18.5 n.miles (most of survey distance between WP26b and WP27) rather than at an angle similar to other tracklines as intended by the Locus Interstratum Boundary survey design.

The survey started in SS-II mode and changed to BT at WP29.

The trackline between WP29 and 30 was interrupted because of refueling during the morning of 4 Feb. Refueling took place west of the tracklines at 63°46.7'S 101°44.8'E.

The *Kaiko Maru* reached the ice edge 9 n.miles before WP30. WP30 was set up on the true ice edge on 31 January (WP26), but the ice edge moved further north in the following six days. After WP30a, we changed to BB mode, steaming east 2 n. miles north of the ice edge. Inside the small bay (around 102°30'E), a total of 21 minke whales in 13 groups were sighted on 5 Feb. On 6 Feb we encountered another small concentration of minke whales (9 animals in 9 groups) around 104°20'E.

Due to strong wind and low visibility, no BB effort was conducted on 7 Feb. The *Kaiko Maru* TD steamed east along the ice edge, hoping for incidental sightings of biopsy/photo-id target species, but none were encountered. The *Kaiko Maru* completed the survey in the Antarctic research area at 18:00 and commenced the transit north immediately after ED.

During the extended survey, a 100.6 n.mile short trackline between WP28 and WP30 was covered in SS-II (45.8 n.miles in 4.31 hours) and BT (40.6 n.miles in 3.84 hours) modes. Following this BB mode was conducted for 93.5 n.miles (9.62 hours).

Ice edge

For this survey, our best estimate of the position of the ice edge was based on our visual and radar observations of the ice edge as well as satellite predictions.

The general shape of the ice edge in the research area was approximately the same during the eastern and western surveys. However, for the extended survey, the ice edge had moved further north. According to the satellite image data, the ice edge was just north of the 1000m isobath line since 12 January. Only between 28 January and 31 January, was the ice edge around 100 to 102°E south of the 1000m isobath.

One extensive coastal polynya (in the Vincennes Bay) south of the main ice edge in the research area was indicated on the satellite image data for the entire research period. This polynya is an inter-annual feature of the ice pack in this region. Its size varied with dynamics of the pack ice; having a maximum size of 3300 n.miles² (21 January) down to the minimum of 875 n.miles² (07 February). This polynya, however, never opened to north during the research period. Another polynya off Cape Pointsett noted during the SOWER 2007-08 (Ensor *et al.* 2008) was not obvious during the SOWER 2009-2010 research period.

The AMSR-E satellite image was sent by Dr. M. Barvington (CSIRO, Australia) daily via e-mail. These images were very useful to understanding the ice edge condition and changes for the entire research area. However, to estimate the ice edge for the trackline construction, it was rather difficult to use these data, since the estimation was sometimes too north or too south. Therefore, for SOWER 2009-2010, the SSM/I data was primarily used to construct the survey trackline, because it was easier to pinpoint the exact location of expected ice edge from this data format.

The ship's officers, recorded the location of the ice edge routinely during the cruise usually using a combination of visual and radar observations. A best estimate of the position of the ice edge (as normally produced on SOWER cruises aimed at abundance estimation) was made for each of the three surveys (the eastward, westward and extended surveys). The spacing of the ice edge waypoints and the precision of the best estimate of the ice edge was approximately the same as for recent SOWER cruises.

BT-Option II

This was the fourth cruise to incorporate BT-Option II as part of standard survey protocol. During the entire survey of the research area, BT-Option II mode was used on alternate trackline segments instead of IO mode. BT-Option II mode was employed for a total of 551.9 n.miles covered during 52.28 hours of research. BT-Option II was conducted in conditions representative of normal SOWER survey strata and in a range of sighting conditions.

Sightings during BT-Option II mode from all platforms combined included a total of 22 groups of minke whales (comprising 34 animals, including two undetermined minke whales in one group) with 11 duplicate sightings. Minke whale was the second most frequently sighted cetacean species during BT mode. The 'Tracker' platform (Top) detected a total of 16 groups of minke whales. The 'Primary' platform (IOP) subsequently detected seven of those minke whale groups. In addition, the 'Primary' platform detected one other minke whale group that was not seen by the 'Tracker' platform. Three additional sightings of minke whales were sighted only by the Upper Bridge.

Sightings classified as 'minke whale, like Antarctic' from all platforms combined, included a total of two groups (comprising four animals). Both sightings were made from the 'Tracker' platform.

Sightings classified as 'like minke whale' from all platforms combined, included a total of three groups (comprising four animals). The 'Tracker' platform detected two groups classified as 'like minke whale'. These groups were not detected by the 'Primary' platform. The 'Primary' platform detected no group but the Upper Bridge detected one group classified as 'like minke whale' that was not detected by the 'Tracker' platform.

As with the trials conducted during the previous cruise the 'Tracker' and 'Primary' platforms tracked only those sightings believed to be minke whales. Tracking of all sightings and recording re-sightings data for minke whales was accomplished this year without the aid of neither the Miyashita voice recording system nor any kind of voice recording tools. All recording was done at the Upper Bridge via communication through the intercoms.

Humpback whales were the most frequently encountered species. Sightings during survey in BT-Option II mode included a total of 65 groups of humpback whales comprising 124 animals (from all platforms combined). In addition, a total of seven 'like humpback whales' in three groups were sighted.

The 'Primary' observers, searching with the naked eye, did not have the usual aids (a pointer attached to the binocular stick and reticle binoculars) to assist with angle and distance estimation. There were also no pointers available on the IOP angle boards to assist the 'Primary' observers with estimation of angles. During survey in BT-Option II research was usually not interrupted for the 30-minute meal breaks. (Although BT-Option II survey requires the same number of crew and same rotation schedule as IO mode).

BT-Option II mode was easily implemented on this cruise as one of the main survey methods. As with the experimental trials conducted last cruise, no major problems were encountered.

SS-II

In the research area on this cruise, SS-II mode survey was used as a standard survey mode instead of normal closing mode. SS-II mode survey was conducted for a total of 547.5 n.miles covered during 52.49 hours of research.

Sightings during SS-II mode included a total of 28 groups of minke whales and one group of five minke whale, 'like Antarctic' (there were no groups in SS-II mode that were classified as 'like minke whale'). Numbers for two groups were confirmed from Passing mode without deviation from the course. Abeam closures were attempted for a total of 29 groups. All of the groups selected for closure were identified from abeam as either minke or 'like minke' whales, except two which were determined to be 'like minke' or southern bottlenose whales. One 'unidentified small whale' sighting was also closed upon but it was a minke-sized humpback whale. Successful closures were completed for 27 groups. The remaining two sightings were lost during closure and deemed unsuccessful.

The abeam estimates of group size for groups for which closure was successfully completed and numbers confirmed, ranged 1–5 (14 solitary animals, seven pairs, two groups of three, one groups of four, and one group of five).

The confirmed group sizes after closure ranged 1-6 (nine solitary animals, four pairs, five groups of three, two groups of four, one group of five and one group of six animals). In 50.0% of those sightings, group sizes were increased after successful closure to minke whales.

The sightings of minke whales were not concentrated during SS-II mode survey, and SS-II mode was conducted in a range of sighting conditions and initial cue types. Also, since only one minke whale group was detected prior to each closure attempt, return to trackline procedures were easily carried out. There was only one case of a secondary sighting of minke whales during the closure attempt (sighting number 5 on 24 January). In this case, group sizes were confirmed for both the primary and secondary sightings. As on the previous two cruises, SS-II mode was easily implemented on this cruise as one of the main survey methods.

Minke whale visual dive time experiment

No minke whale visual dive time experiments were carried out since no suitable group was encountered.

Video distance measurement (SCANS-II)

Because of missing equipment for the SCANS II (the box contained digital camera equipment was not delivered to the *Kaiko Maru*), the SCANS II experiment was dropped from this cruise under consultation with Greg Donovan and the Steering Group.

Blue whale research

No blue whales were sighted during the entire Antarctic research area survey.

Biopsy and photo-identification study for priority and other species

During the cruise a total of 57 sightings including seven species and a total of 120 individuals were photographed (Table 8). The species included humpback, southern right, killer, fin, Antarctic minke, sperm and southern bottlenose whales. All sightings, with the exception of two groups of killer whales were photographed in the Antarctic research area. The total effort expended in approaching sightings for photo-ID and biopsy was 17hr 27min (Table 2), 16hr 35min of these lead at least to successful photographs.

The biopsy equipment used exclusively during this cruise was the Larsen system. We obtained a total of 43 biopsies from humpback and southern right whales (Tables 7, 8).

A total of 24 groups of humpback whales including 45 individuals were photographed. While 11 groups including 20 individuals were photographed while passing close to a sighting without altering course, a total of 5hr 00min 16sec was spent approaching humpback whales for biopsies and photographs. Biopsies were taken from 21 individuals. Only few humpback whales were fluking, hence we only obtained fluke images of twelve whales.

Photographs of 18 groups including 26 individuals were obtained for southern right whales. Only one whale that was photographed during the approach of another group was considered as a most likely match with a previous sighting from the same day. Biopsies were taken from 22 whales. The total amount of time spent approaching southern right whales was 7hr 49min 17sec.

A total of 3hr 05min 42sec was used for approaching killer whale sightings to obtain photographs and biopsies. Due to the generally evasive to very evasive behavior of the animals encountered during this cruise, no biopsies were obtained. Photographs were taken from eight sightings including 34 individuals. While three sightings, one within and two outside the Antarctic research area, were identified as type A killer whales (Pitman and Ensor 2003) the remaining five groups could not be attributed to a type as at least some whales within the same group showed characteristics of both types, A and B, i.e. lack of a distinct cape (as in all whales encountered) and large eye-patches, respectively. However, whether the large eye patches observed in some of the killer whales were large enough to fit Pitman and Ensors (2003) description for type B is questionable. No killer whales encountered during the cruise showed distinct characteristics of type C. Only one individual showed a slight slant in its eye patch, although the size of the eye patch was medium and the animal did not have any cape

(sighting 17, 6 Feb.). These observations are in line with reports from previous SOWER cruises in this area, possibly indicating less definitive characteristics for killer whales in this region of Antarctica.

One group of two fin whales was approached for 20min 17sec for photographs and biopsies. While we obtained photographs of both whales, biopsy could not be attempted as the whales were too evasive.

For Antarctic minke whales, opportunistic photographs of three groups including eight individuals were obtained. One group was photographed as we passed it cruising down the trackline. The other two groups were photographed during SS-II closures.

Two pairs of southern bottlenose whales were photographed as we passed them closely on the trackline.

We photographed one sperm whale which was resting at the surface and fluked up as we passed nearby during an approach to another sighting.

A detailed log on all approaches for photo-id and biopsy attempts is given in Appendix D.

SIGHTINGS

A list of all the sightings recorded in the minke whale research area, by species and by effort mode, is presented in Table 4. Table 3a-d summarizes the sightings recorded during the three surveys of the research area. Figures 2a - m illustrate the location of the sightings.

Tables 5 lists the sightings observed during transits to and from the research area, including those south of latitude 60°S.

Table 9 summarizes all sightings observed during the entire cruise.

Minke Whale Research Area

A total of 83 groups, 152 minke whales (Antarctic, undetermined and minke, like Antarctic) were observed in the minke whale research area; 49 animals in 25 groups during the eastern survey, 31 groups (66 animals) during the western survey, 3 groups (5 animals) during the short survey and 24 groups (32 animals) during the BB survey (Figures 2a-c, Table 3a-d). Mean group size of minke whales during each of the four surveys was 1.96, 2.13, 1.67 and 1.35. Most minke whale sightings were recorded in the western half of the research area. Two very high concentrations of minke whale sightings were experienced during BB mode survey; inside of a small bay (about 5x15 n.miles) at the ice edge at approximately 102°30'E, and the western slope of the ice edge around 104°20'E (Fig. 2c). A total of 21 minke whales in 13 groups were sighted in the bay and nine solitary whales alongside of the slope. The excellent sighting conditions near the ice edge might have favored the relatively high number of sightings of solitary minke whales in these locations.

The largest group size of minke whales was eight. The group was sighted just after the survey hours at 18:17 on 01 February during the western survey at 63°44.50'S 100°23.06'E.

Humpback whales were the most frequently encountered species (174 groups, 322 animals). This species was sighted throughout the minke whale research area and on all three surveys. The sighting rate increased the season progressed, and whales were very abundant during the extended survey (Figs. 2g-i). Mean group size was 1.85.

No blue whales were sighted in the Antarctic research area during the SOWER 2009-2010.

Fin whales (3 groups, 5 animals) were observed in the minke whale research area and mostly near the pack ice.

Sperm whale sightings (39 groups, 41 animals) occurred throughout the study area (Figs. 2d, 2f, 2j). Most sightings were away from the ice edge during the eastern and western surveys, and only one sighting near the ice edge during BB mode.

Southern bottlenose whales (29 groups, 55 animals) were observed regularly within the research area (Figs. 2k and 2l). A total of three groups (seven animals) were sighted near ice edge during BB mode survey (Fig. 2m).

Killer whales were encountered less frequently during the SOWER 2009-2010, compared to the previous SOWER surveys. In total, 9 groups (78 animals) were sighted (Figs 2k, 2l, 2m). One of 9 groups was identified as 'Type A'; however, the remaining sightings did not show strong characteristics to identify any type. Biopsy and photo-id approaches were attempted for sightings near the trackline, however, all of them were difficult approach (See Appendix D).

More numbers of sightings were made during the western survey than the eastern survey (207 and 115 respectively; Tables 3a-b). During the eastern survey, the hourly weather records showed colder sea surface temperatures, and more whales were sighted in lower sea surface temperature (Fig. 3). This may be caused by seasonal movement of whales in general, especially abundant humpback whales during the western survey.

The collaboration survey with the Australian Antarctic Division aerial survey had the highest priority for SOWER 2009-2010. During the eastern and western surveys (7 January to 3 February), some flights were carried out from the Bunger Hill Camp (one flight) and the Casey Station (four flights). No airplane was available after 5 February. No 'real time' collaboration was made and the airplane was never seen in the vicinity of the SOWER vessel. The weather was rather poor most of the survey period. Hence, the SOWER vessel had 67.7% of off-effort time during the eastern survey and 55.9% for the western survey. The aerial survey was also limited by weather, including low ceilings and limited visibility, their results are presented independently from this report. Although no direct collaboration time had been made, both aerial and shipboard surveys were completed successfully in the same period and the data should be very useful for examining the distribution of minke whales around the ice edge. The SOWER vessel encountered two concentrations of minke whales along the ice edge during the BB mode survey. It might suggest that more animals were located south of the loose ice edge.

Transit sightings

During the 6851 n.mile transit (round trip) between Benoa, Indonesia and the Antarctic research area Passing mode research was conducted for a total of 113.72 hours and 1159.8 n.miles were covered (Table 1). There were 56 cetacean sightings of 526 animals of 8 different species (Table 5). The diversity of species was exemplary of the range of transited water masses, from polar to temperate and tropical. However due to poor survey conditions, the total number of sightings remained low.

Notable sightings

Right whales were sighted frequently (28 groups including 38 animals) in the research area (longitudes 100°-115°E) during the eastern, western and extended surveys. 26 individuals were photographed. Three sightings were of particular interest. On 29 January a single whale was encountered at 64°30.5'S 107°57.7'E lifting its fluke up vertically in a manner previously described as 'sailing'. On 3rd Feb a pair consisting of one humpback and one southern right whale was encountered at 63°30.71'S 100°16.01'E. The two whales were swimming synchronously and remained closely associated, within one body length, for the duration of the approach (38 minutes) and after. Also on 3rd Feb a pair of right whales was sighted at 63°32.6'S 100°59.4'E that were exhibiting social behavior including rolling and flipper waving, and on approach were found to be belly to belly.

A southern bottlenose whale cow and calf pair was recorded on 24 February at 64°35.34'S 111°54.80'E. Photographs were taken showing the light head coloration and the unscarred back of the younger animal (Appendix D).

A group of tropical killer whales (four animals, including one calf) was detected on 30 December at position 33°31.04'S 100°59.37'E during the transit from Benoa to the Antarctic. The whales were classified as 'Type A'.

KRILL – VISUAL OBSERVATIONS

Only one krill patch was recorded during the cruise at 63°58'S 103°55'E on 11 January.

MARINE DEBRIS

Three marine debris were recorded during the cruise south of latitude 60°S.

OCEANOGRAPHY

No oceanographic sampling was undertaken, as during the previous cruise. Two ARGO floats were deployed under the ARGO oceanographic programme. The deployments were made at 53°00.21'S 100°18.19'E during the transit from Benoa to the Antarctic.

TRANSIT TO BENOA

The *Kaiko Maru* commenced transit to Benoa, Bali, Indonesia from position 64°29'S 107°55'E on the evening of 07 February. During transit south of 60°00'S, no research was conducted due to the poor weather. Latitude 60°00'S was intersected on 08 February at 18:30hrs.

The transit course did not intersect the EEZ's of Australia.

During the transit between the research area and the intercept with the 200 n.mile EEZ of Indonesia, mainly very poor conditions were experienced in the south however conditions improved further north and a total of 480.1 n.miles was covered during 48.74 hours of research in NSP mode.

The Indonesian EEZ was intersected adjacent to the coast of Bali. The vessel entered the EEZ on 20 February at 12°08.53'S 113°49.48'E at 20:45 hours. No research was conducted in the EEZ of Indonesia.

The ship reached a location of 13 n.miles off Benoa Harbour, Bali, outside of the Indonesian territorial water, at 08:00 hours on 22 February. All four SOWER researchers and the IWC equipments from Bali were transferred to the rescue boat 202 (40m, 100t) which steamed to Benoa Harbor. The vessel departed for Shioyama, Japan from the rendezvous point of 9°04'S 115°10'E on the same day at 09:00 hours.

The report of the cruise was finalized aboard the vessel.

SUMMARY OF MODIFICATIONS AND PROBLEMS TO THE PROCEDURES, VESSELS AND EQUIPMENT

Data entry

Effort, weather and sightings data records were entered into computer files using the Moon Joyce DataForm00 program. The sightings data entry section of this program has no facility to record newly implemented survey modes such as SS-II, BT-Option II, and BB. Sightings recorded during these modes were entered into the computer files as NSC, IO, BI/NSC modes respectively. (The choice of these modes for the data entry process was only to facilitate data summary using the program).

The *Kaiko Maru* has a LAN system between the Upper Deck and Bridge and the data logging system which was developed by the ICR was available. The ICR kindly allowed us to try using this system for SOWER 2009-2010 cruise. Because this was the first use of the system for SOWER, only the Japanese researchers operated the system to minimize error since the screen displays only in Japanese, and the incoming primary information is spoken in Japanese. The researchers found this system to be very effective and simplified data collection procedures in real-time. Overall the system was much easier and more precise to obtain sighting data. Unfortunately, data entered in this logging system does not match with the IWC data format, and thus the IWC data had to be entered manually using the Moon Joyce Program after the end of the survey day.

Equipment

One of two boxes of SCANS equipment was not delivered to the *Kaiko Maru* from Bali.

One of four Larsen biopsy guns had a problem with the air-intake control dial and was not used.

Cruisetrack design

After completing the western survey, a short trackline was constructed to cover the research area with the maximum effort (Fig. 1d, Appendix C).

Vessel

A different vessel was used for SOWER 2009-2010. Unlike the *Shonan Maru* No.2, the *Kaiko Maru* was an ex-training vessel and does not have the catcher-boat characteristics. The forecastle deck (bowdeck) which was used for biopsy and photo-id is lower and smaller and the vessel sides were higher than the *Shonan Maru* No.2. However, we did not find any difficulty for either biopsy or photo-id operations. The *Kaiko Maru* is equipped with bow thrusters which were extremely useful for maneuvering to retrieve biopsy darts.

Slightly different seating arrangements were found on the Upper Bridge. On the *Shonan Maru* No.2, the seating arrangement from left to right was: Captain, two researchers, a wheelman, a researcher, and an engineer. On the *Kaiko Maru* the seating from left to right was: Captain, an engineer, one researcher, a wheelman, and then two researchers. Therefore, communication between three researchers was sometimes difficult and data handling often concentrated on the translating researcher.

Because the *Kaiko Maru* does not possess a ship inspection certificate for international voyage, it is unable to enter international ports (except for emergencies). Therefore, all four researchers and IWC equipment (bonded in Bali and sent directly to Bali) had to be transferred from Benoa, Bali using the tugboat Abasa No.2 (98 tons, 14.3m) to the *Kaiko Maru*, which had been waiting outside of the 12 n.mile Indonesian territorial water. At least one full day was necessary to open/unpack all equipment after boarding the vessel and prior to conducting research.

RECOMMENDATIONS

The researchers and captain make the following recommendations based on their experience of this cruise (note that recommendations do not appear in any order of priority).

General

1. The cruise leader should receive a complete and detailed inventory before the start of the cruise including the number of boxes to expect to transfer onto and already present on the ship as well as their contents. This could prevent misunderstandings and missing equipment after embarking the vessel.

Data entry

1. Given this is the final SOWER year, and a new series of North Pacific cruises are a potential, it is HIGHLY recommended by the researchers that a new data entry system be developed, preferably one that is computerized. The current system is very old (developed for SOWER1999-2000) and does not account for the changing survey modes that have evolved.
2. Two systems have good adaptability to future SOWER cruises. A) The ICR data logging system is potentially very useful, but would require that the IWC adapt the ICR data-entry program for its own use. B) Dr. Palka's pingle system used on her research cruises may be very complimentary to our dual platform operations but also would need to be adapted to SOWER data collection needs.
3. A back-up disk for the computer software SOWER Data Records is needed. The program was not functioning on the data entry computer provided by IWC upon arrival on the *Kaiko Maru* and had to be installed using a personal copy of the software.

Biopsy

1. One of the guns was deemed unusable due to a problem with the dial mechanism controlling power. Given this is the end of SOWER we recommend, that all 4 guns be shipped to F. Larsen for inspection/maintenance/repair before being used on the proposed North Pacific cruises.
2. New tips both for large whales and delphinids are needed. If small cetaceans become a priority for biopsy on the North Pacific SOWER, more small dart tips and "bumpers" will be required.
3. The paxarms were not used this year given the unfamiliarity by the research team and crew with the guns. There was concern that improper handling and cleaning of the guns might lead to damage to the guns. Hence, the Larsen guns were used primarily as we had good experience with this system.
4. Adequate supplies of purified and/or distilled water are needed for biopsy sample processing. About one liter of distilled water is necessary to clean up biopsy equipment per time.

Photo-id

1. A newer licensed version of ACDSee Pro is needed to handle the ever increasing image sizes for the digital cameras. A current version of ACDSee Pro from one of the participating researchers was installed on the toughbook laptop and utilized for this cruise.
2. A new photo-id computer is recommended. Given the potential for intensive photo-id operations in the North Pacific.
3. External hard drives are recommended for back up (at least two 500GB HDDs for the IWC use; one primary, one back-up to last a few cruises) and we advise the IWC to move away from use of DVD's given the increasing amount of space required to handle the newer digital camera images.

Acoustics

The acoustic study was not carried on during SOWER 2009-2010 because of lack of set-up for the acoustic study on the *Kaiko Maru*. However, because of the potential importance of the acoustic study, it is highly

recommend to build a proper set-up for the future IWC cruise. It is highly recommended to seek external advisement for updating the IWC acoustic system. See Appendix E for further detail.

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ACKNOWLEDGEMENTS

We thank the captain and all crewmembers of the *Kaiko Maru* for their hard work and dedication, which led to the successful execution of this study. We acknowledge the Secretariat of the IWC and the staff of The Institute of Cetacean Research (Tokyo) and Kaikou Senpaku Kaisha Ltd and also Kyodo Senpaku Kaisha Ltd for their assistance in arrangements and support for the cruise. The National Research Institute of Far Seas Fisheries (Yokohama) loaned equipment for the cruise which included Larsen Gun sites, video camera, items for biopsy processing and storage. Dr. Mark Bravington of the AAD sent satellite ice images to the ship on a daily basis. Crew members K. Hasebe and F. Yamaguchi played substantial roles during the collection of biopsy samples. We finally thank our ship agent Mr. Ricky and the captain and crew of the Abasa 2 for providing able assistance and safe transport of gear and researches to and from the *Kaiko Maru* in Bali, Indonesia.

2009-2010 IWC-SOWER Cruise

Table 1. Summary of search effort (time and distance) conducted during the cruise in each effort mode.

Area	Start	End	NSP		SS-II Abeam closure from NSP		BT-Option II		BB	
	Date	Date	Time	Distance	Time	Distance	Time	Distance	Time	Distance
	Time	Time	(hours)	(n.miles)	(hours)	(n.miles)	(hours)	(n.miles)	(hours)	(n.miles)
Benoa to boundary of Indonesian EEZ	23-Dec 15:15	24-Dec 9:29	0	0	0	0	0	0	0	0
Transit from Indonesian EEZ to Latitude 60°S	24-Dec 9:29	6-Jan 1:28	63.69	664.8	0	0	0	0	0	0
Transit from intercept of 60°S to start of Minke Whale survey	6-Jan 1:28	7-Jan 7:11	1.29	14.9	0	0	0	0	0	0
Eastward survey (100°E to 115°E)	7-Jan 7:11	21-Jan 16:28	0	0	23.88	250.6	22.64	239.2	0	0
Westerly survey (115°E to 100°E)	22-Jan 6:00	3-Feb 9:27	0	0	24.3	251.1	25.8	272.1	0	0
Short survey to east (100°E to 102.2°E)	3-Feb 9:27	5-Feb 8:48	0	0	4.31	45.8	3.84	40.6	0	0
BB survey to east (102.2°E to 108°E)	5-Feb 8:48	7-Feb 18:00	0	0	0	0	0	0	9.62	93.5
Transit from end of Minke Whale survey to intercept of 60°S	7-Feb 18:00	8-Feb 18:30	0	0	0	0	0	0	0	0
Transit from Latitude 60°S to intercept of Indonesian EEZ	8-Feb 18:30	20-Feb 20:45	48.74	480.1	0	0	0	0	0	0
Total			113.72	1159.8	52.49	547.5	52.28	551.9	9.62	93.5

Table 2. Summary of experimental time (hours) during SOWER 2009-2010.

Area	Start Date Time	End Date Time	Photo-ID, Biopsy Time (hours)	Estimated angle and distance training Time (hours)	Estimated angle and distance experiment Time (hours)
Benoa to boundary of Indonesian EEZ	23-Dec 15:15	24-Dec 9:29	0	0	0
Transit from Indonesian EEZ to Latitude 60°S	24-Dec 9:29	6-Jan 1:28	0	0	0
Transit from intercept of 60°S to start of Minke Whale survey	6-Jan 1:28	7-Jan 7:11	0	0	0
Eastward survey (100°E to 115°E)	7-Jan 7:11	21-Jan 16:28	3.55	2.78	0
Western survey (115°E to 100°E)	22-Jan 6:00	3-Feb 9:27	6.65	0	4.37
Short survey to east (100°E to 102.2°E)	3-Feb 9:27	5-Feb 8:48	2.76	0	0
BB survey to east (102.2°E to 105°E)	5-Feb 8:48	7-Feb 18:00	4.5	0	0
Transit from end of Minke Whale survey to intercept of 60°S	7-Feb 18:00	8-Feb 18:30	0	0	0
Transit from Latitude 60°S to intercept of Indonesian EEZ	8-Feb 18:30	20-Feb 20:45	0	0	0
Total	-	-	17.46	2.78	4.37

Table 3a. Number of sightings for all species (Groups/Animals) observed during the Eastern Survey (100°E - 115°E) of the Minke Whale Research Area in each effort mode. (Excludes sightings observed south of 60°S during transit from Benoa to the start of minke whale research).

Species	SS-II		BT- Option II		OE		Total	
	G	A	G	A	G	A	G	A
Minke (Antarctic)	12	28	9	11	1	1	22	40
Minke (undetermined)	0	0	1	2	0	0	1	2
Minke, like Antarctic	1	5	1	2	0	0	2	7
Like minke	1	1	1	1	1	1	3	3
Fin	1	2	0	0	0	0	1	2
Sperm	13	14	3	3	0	0	16	17
Humpback	11	16	6	16	7	11	24	43
Like humpback	0	0	1	3	0	0	1	3
Southern right whale	1	1	1	2	0	0	2	3
Killer whale	2	11	0	0	2	13	4	24
S. bottlenose whale	8	15	7	17	1	2	16	34
Ziphiidae	0	0	5	7	0	0	5	7
Unid. large baleen whale	4	11	3	4	1	1	8	16
Unid. large whale	2	2	0	0	0	0	2	2
Unid. small whale	3	5	2	4	0	0	5	9
Unid. whale	0	0	3	5	0	0	3	5
Total	59	111	43	77	13	29	115	217

Table 3b. Number of sightings for all species (Groups/Animals) observed during the Western survey (115°E - 100°E) of the Minke Whale Research Area in each effort mode.

Species	SS-II		BT- Option II		OE		Total	
	G	A	G	A	G	A	G	A
Minke (Antarctic)	14	32	12	21	4	11	30	64
Minke, like Antarctic	0	0	1	2	0	0	1	2
Like minke	0	0	2	3	0	0	2	3
Humpback	31	62	45	82	6	7	82	151
Like humpback	1	1	2	4	1	2	4	7
S. right whale	4	6	14	19	0	0	18	25
Like s. right whale	0	0	2	2	0	0	2	2
Sperm	10	10	11	12	0	0	21	22
Killer whale	0	0	1	3	0	0	1	3
Southern bottlenose whale	5	7	2	3	1	1	8	11
Like s. bottlenose whale	0	0	2	2	0	0	2	2
Ziphiidae	1	2	2	2	0	0	3	4
Unid. large baleen	4	4	25	35	1	1	30	40
Unid. large whale	1	1	0	0	0	0	1	1
Unid. small whale	0	0	2	5	0	0	2	5
Total	71	125	123	195	13	22	207	342

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Table 3c. Number of sightings for all species (Groups/Animals) observed during the short survey to east (100°E to 102.2°E) of the Minke Whale Research Area in each effort mode.

Species	SS-II (Abeam closure from NSP)		BT-Option II		OE		Total	
	G	A	G	A	G	A	G	A
Minke (Antarctic)	2	3	0	0	1	2	3	5
Humpback	14	22	14	26	3	6	31	54
S. right whale	5	7	1	1	1	1	7	9
Like s. right whale	0	0	1	1	0	0	1	1
Sperm whale	0	0	1	1	0	0	1	1
Southern bottlenose whale	0	0	2	3	0	0	2	3
Ziphiidae	0	0	2	2	0	0	2	2
Killer whale (type A)	1	20	0	0	0	0	1	20
Unid. large baleen	2	2	3	3	0	0	5	5
Total	24	54	24	37	5	9	53	100

Table 3d. Number of sightings for all species (Groups/Animals) observed during the BB mode survey (102.2°E - 108°E) of the Minke Whale Research Area in each effort mode.

Species	BB		OE		Total	
	G	A	G	A	G	A
Minke (Antarctic)	22	30	1	1	23	31
Minke, like Antarctic	1	1	0	0	1	1
Fin	1	2	0	0	1	2
Humpback	31	65	5	7	36	72
Like humpback	1	1	0	0	1	1
Sperm	1	1	0	0	1	1
Southern right whale	1	1	0	0	1	1
Killer whale	3	31	0	0	3	31
Southern bottlenose whale	3	7	0	0	3	7
Ziphiidae	1	2	0	0	1	2
Unid. small whale	0	0	1	1	1	1
Unid. large baleen	1	1	0	0	1	1
Unid. whale	0	0	1	1	1	1
Total	66	142	8	10	74	152

Table 4. Number of sightings for all species (Groups/Animals) observed within the entire Minke Whale Research Area (eastern, western, transit between and extended surveys combined) in each effort mode. (Excludes sightings observed south of 60°S during transits between Benoa and the minke whale research).

Species	SS-II (Abeam closure from NSP)		BT- Option II		BB		OE		Total	
	G	A	G	A	G	A	G	A	G	A
Minke (Antarctic)	28	63	21	32	22	30	7	15	78	140
Minke (undetermined)	0	0	1	2	0	0	0	0	1	2
Minke, like Antarctic	1	5	2	4	1	1	0	0	4	10
Like minke	1	1	3	4	0	0	1	1	5	6
Fin	1	2	0	0	1	2	1	1	3	5
Southern right whale	10	14	16	22	1	1	1	1	28	38
Like s. right whale	0	0	3	3	0	0	0	0	3	3
Humpback	56	100	65	124	31	65	22	33	174	322
Like humpback	1	1	3	7	1	1	1	2	6	11
Sperm	23	24	15	16	1	1	0	0	39	41
Killer (type unclassified)	2	11	1	3	3	31	2	13	8	58
Killer (type A)	1	20	0	0	0	0	0	0	1	20
S. bottlenose whale	13	22	11	23	3	7	2	3	29	55
Like s. bottlenose whale	0	0	2	2	0	0	0	0	2	2
Ziphiidae	1	2	9	11	1	2	0	0	11	15
Unid. large baleen whale	10	17	31	42	1	1	2	2	44	62
Unid. large whale	3	3	0	0	0	0	0	0	3	3
Unid. small whale	3	5	4	9	0	0	1	1	8	15
Unid. whale	0	0	3	5	0	0	1	1	4	6
Total	154	290	190	309	66	142	41	73	451	814

Table 5. Number of sightings for all species (Groups/Animals) observed during the transits between the boundary of the Indonesia EEZ and the Minke Whale Research, in each effort mode. (Includes sightings observed south of 60°S during transit).

Species	NSP		OE		Total	
	G	A	G	A	G	A
Fin whale	1	4	0	0	1	4
Sei whale	0	0	1	1	1	1
Like sei whale	0	0	1	1	1	1
Humpback whale	9	19	8	16	17	35
Like humpback whale	1	3	1	2	2	5
Southern bottlenose whale	0	0	1	2	1	2
Ziphiidae	2	4	0	0	2	4
long-finned pilot whale	1	60	0	0	1	60
Pilot whale	1	35	0	0	1	35
like pilot whale	1	20	0	0	1	20
Type A killer whale	2	13	0	0	2	13
Striped dolphin	1	160	0	0	1	160
Long snouted dolphin	1	70	0	0	1	70
Unid. large baleen whale	10	22	2	6	12	28
Unid. large whale	1	1	0	0	1	1
Unid. small whale	1	1	1	1	2	2
Unid. whale	1	1	0	0	1	1
Unid. dolphin	8	84	0	0	8	84
Total	41	497	15	29	56	526

Table 6. Summary of all sightings (Groups/Animals) observed during the entire cruise.

Species	Total	
	G	A
Minke (Antarctic)	78	140
Minke (undetermined)	1	2
Minke, like Antarctic	4	10
Like minke	5	6
Fin	4	9
Southern right whale	28	38
Like s. right whale	3	3
Humpback	191	357
Like humpback	8	16
Sei whale	1	1
Like sei whale	1	1
Sperm	39	41
Killer (type unclassified)	8	58
Killer (type A)	3	33
Southern bottlenose whale	30	57
Like so. bottlenose whale	2	2
Ziphiid	13	19
Long-finned pilot whale	1	60
Pilot whale	1	35
Like pilot whale	1	20
Striped dolphin	1	160
Long snouted dolphin	1	70
Unid. large baleen whale	56	90
Unid. large whale	4	4
Unid. small whale	10	17
Unid. whale	5	7
Unid. dolphin	8	84
Total	507	1340

Table 7. Results of biopsy sampling during SOWER 2009-2010. All samples were collected with the Larsen system.

Species & date	Sight no.	Group size	Individual whale number	Sample number	Blubber	Comments
Southern right whale	Total no. of whales sampled = 22					
18-Jan	13	1	1	10080002	Yes	
21-Jan	8	2	1	10080003	Yes	3 miss, 1 skin samples, 1 blubber sample
23-Jan	1	1	1	10080007	Yes	double hit, 2 skin samples, 2 blubber samples
24-Jan	11	3	1	10080008	Yes	1 hit no sample, 1 skin sample, 1 blubber sample
24-Jan	11	3	2	10080009	Yes	1 miss, 1 skin sample, 1 blubber sample
29-Jan	21	1	1	10080011	Yes	double hit, 2 skin samples, 1 blubber sample
30-Jan	3	2	1	10080012	Yes	1 miss, 1 skin sample, 1 blubber sample
30-Jan	3	2	2	10080013	Yes	double hit, 2 skin samples, 1 blubber sample
30-Jan	19	1	1	10080014	No	
30-Jan	23	2	1	10080015	Yes	
30-Jan	23	2	2	10080016	No	2 miss
3-Feb	1	2	1	10080020	Yes	
3-Feb	5	1	1	10080021	No	
3-Feb	9	1	1	10080022	No	2 miss
3-Feb	21	2	1	10080023	No	
3-Feb	21	2	2	10080024	Yes	
3-Feb	24	1	1	10080026	No	
3-Feb	34	2	1	10080027	Yes	
3-Feb	34	2	2	10080028	Yes	1 miss, 1 hit no sample
3-Feb	36	1	1	10080029	Yes	double hit, 2 skin samples, 1 blubber sample
4-Feb	7	1	1	10080030	No	1 miss, 1 hit no sample
5-Feb	32	1	1	10080034	No	1 miss
Humpback	Total no. of whales sampled = 21					
18-Jan	9	1	1	10070001	Yes	
22-Jan	3	1	1	10070004	No	
22-Jan	6	3	1	10070005	Yes	
22-Jan	6	3	2	10070006	Yes	
29-Jan	6	2	1	10070010	Yes	2nd animal a calf, no biopsy attempt made
31-Jan	29	3	1	10070017	Yes	
31-Jan	29	3	2	10070018	Yes	
31-Jan	29	3	3	10070019	No	
3-Feb	24	1	1	10070025	Yes	
5-Feb	2	3	1	10070031	No	2 hits no sample
5-Feb	14	2	1	10070032	No	
5-Feb	14	2	2	10070033	Yes	
5-Feb	40	5	A1	10070035	Yes	
5-Feb	40	5	A2	10070036	No	

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Species & date	Sight no.	Group size	Individual whale number	Sample number	Blubber	Comments
5-Feb	40	5	B1	10070037	Yes	3 miss 1 miss 1 miss
5-Feb	40	5	B2	10070038	No	
6-Feb	1	1	1	10070039	Yes	
6-Feb	7	2	1	10070040	Yes	
6-Feb	8	1	1	10070041	Yes	
6-Feb	11	2	1	10070042	Yes	
6-Feb	11	2	2	10070043	Yes	

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Table 8. Summary of the photo-ID images of individual whales collected in 2009-2010. For humpback whales, fluke photographs of fair to excellent quality are noted in the Comments column.

Species	Date	Sight no.	Group size	No. of whales photographed	Biopsy sample no.'s	Comments
Southern right whale	18-Jan	13	1	1	1008002	2 biopsies from same animal <

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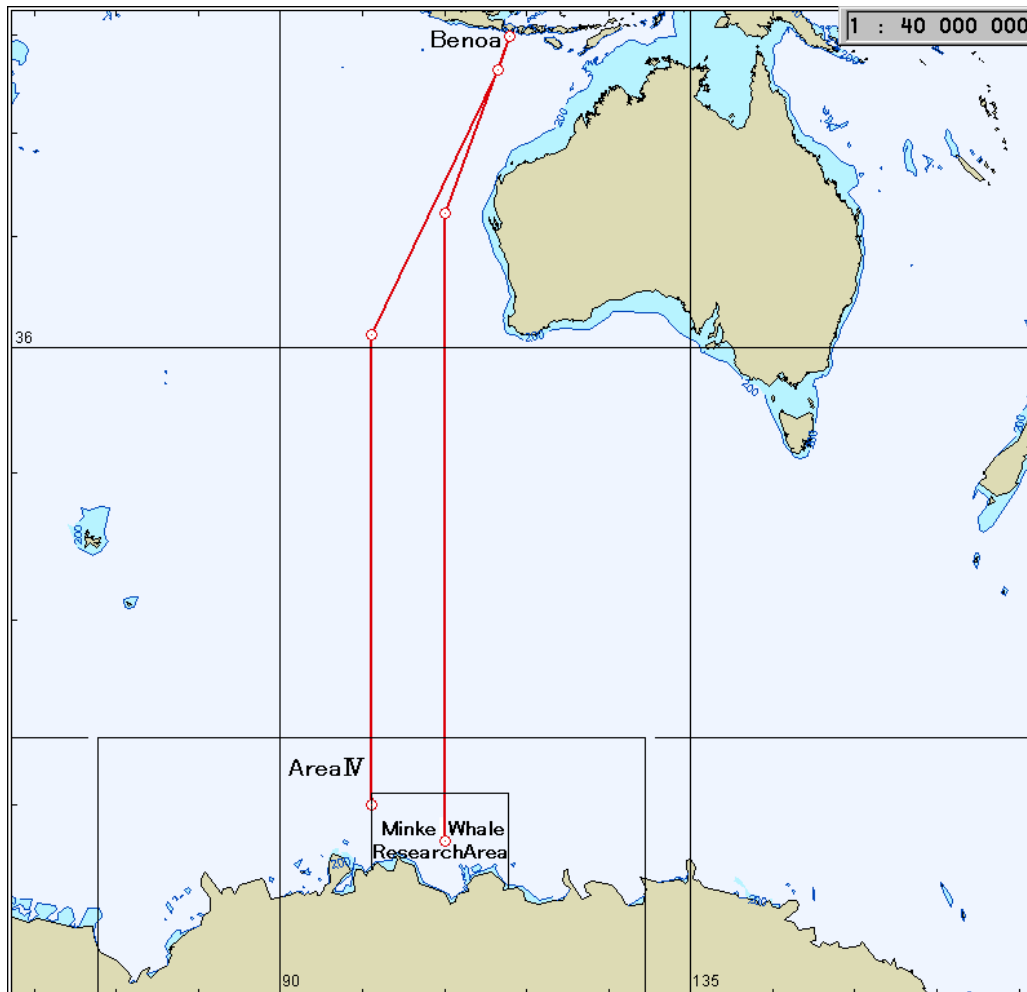
Species	Date	Sight no.	Group size	No. of whales photographed	Biopsy sample no.'s	Comments
Humpback	16-Jan	1	2	1		
	18-Jan	9	1	1	10070001	
	22-Jan	3	1	1	10070004	
	22-Jan	6	3	2	10070005, 10070006	
	29-Jan	6	2	2	10070010	cow/calf pair, cow biopsied
	30-Jan	1	2	2		
	31-Jan	29	3	3	10070017 (MN1), 10070018 (MN2), 10070019 (MN3)	1 fluke and 1 partial fluke
	3-Feb	24	1	1	10070025	associating closely with a s. right whale
	3-Feb	37	3	2		
	3-Feb	47	2	2		
	4-Feb	1	3	2		flukes from 2 whales
	4-Feb	3	2	2		
	4-Feb	4	1	1		
	5-Feb	2	3	3	10070031	2 flukes
	5-Feb	14	2	2	10070032 (MN1), 10070033 (MN2)	1 fluke
	5-Feb	29	1	1		1 fluke
	5-Feb	40	5	5	10070035 (MN-A1), 10070036 (MN-A2), 10070037 (MN-B1), 10070038 (MN-B2)	1 fluke
	6-Feb	1	1	1	10070039	1 fluke
	6-Feb	7	2	1	10070040	
	6-Feb	8	1	1	10070041	
	6-Feb	11	2	2	10070042 (MN1), 10070043 (MN2)	
	6-Feb	15	5	3		2 flukes, 1 partial fluke
	Total			45		

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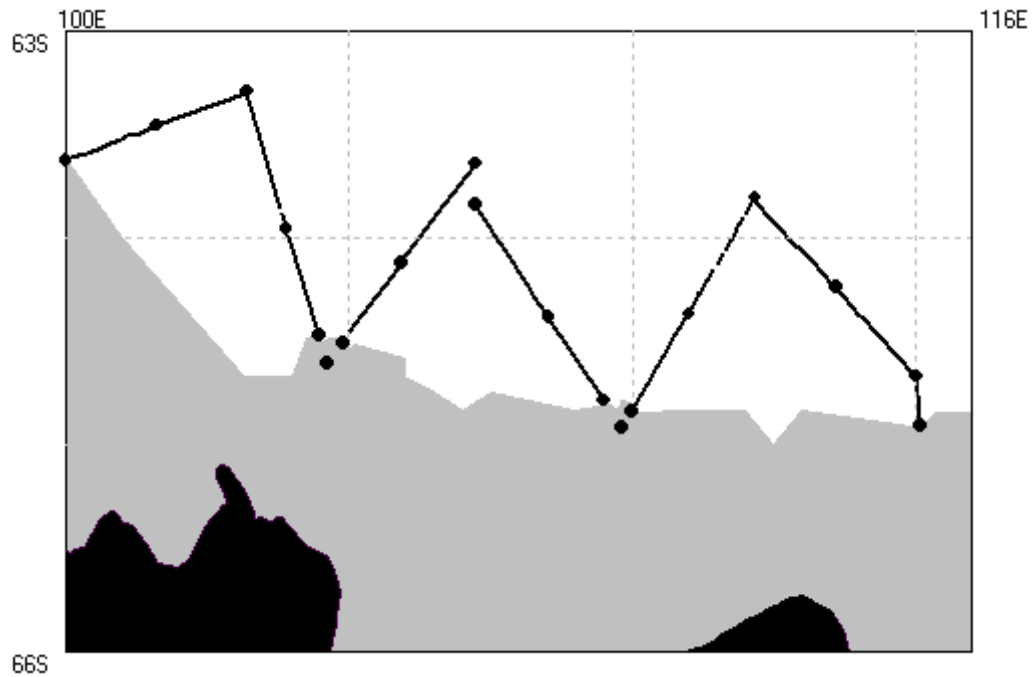
Species	Date	Sight no.	Group size	No. of whales photographed	Biopsy sample no.'s	Comments
Killer whale	30-Dec	1	4	3		Type A, in tropical waters during transit
	5-Jan	14	9	9		Type A
	11-Jan	14	3	2		
	11-Jan	15	2	2		
	3-Feb	10	3	3		
	3-Feb	20	20	2		
	6-Feb	14	14	8		
	6-Feb	17	5	5		
	Total			34		
Antarctic Minke	24-Jan	4	3	3		
	31-Jan	39	5	3		
	31-Jan	75	3	2		
	Total			8		
S. bottlenose whale	24-Jan	7	2	2		1 juvenile with light head and no scratches
	31-Jan	32	2	2		
	Total			4		
Sperm whale	5-Jan	42	1	1		1 fluke
	Total			1		
Fin whale	21-Jan	18	2	2		
	Total			2		

Figures 1a-d. Details of the cruisetracks.

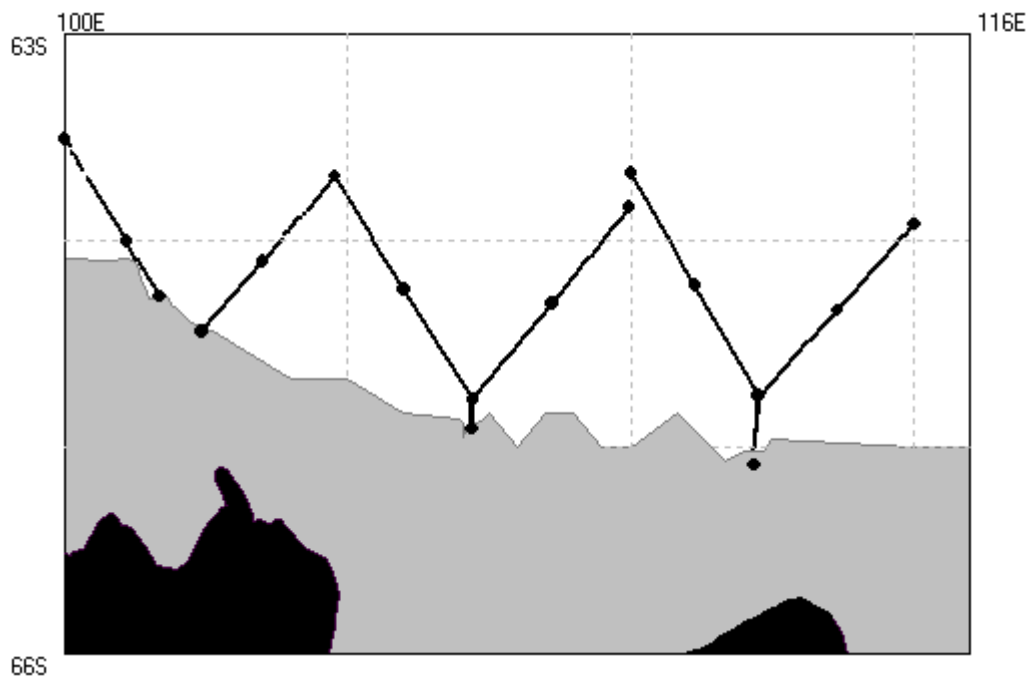
In Figures **1b-d** and **2a-m** the black area represents land and the light gray shaded area represents the ice extent. The gray dotted line represents the latitudinal and longitudinal lines of the research area. In Figures **1b-d** the filled circles are waypoints.



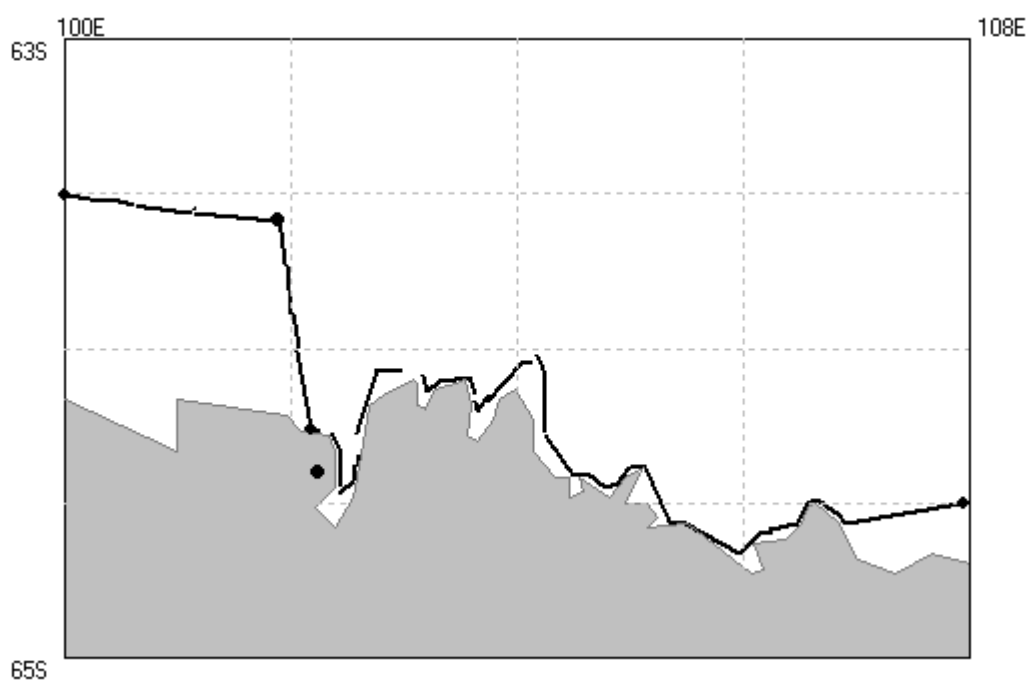
1a. The entire survey, including the transits to and from the Antarctic research area.



1b. The trackline for the eastern survey of the research area covered on search effort. The black circles indicate the waypoints at which the survey mode was changed. The survey started in SS-II mode.

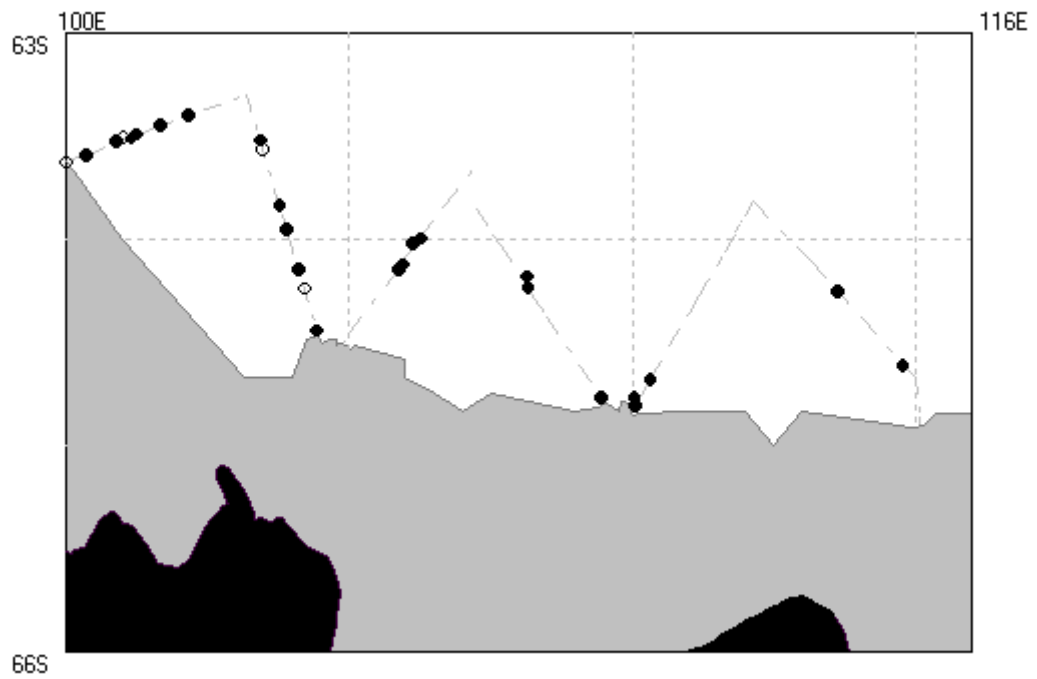


1c. Sections of the cruise track during the western survey of the research area covered on search effort. The grey line represents the best estimate of the ice edge observed during the western survey. The black circles indicate waypoints at which the survey mode was changed. The survey started in SS-II mode.

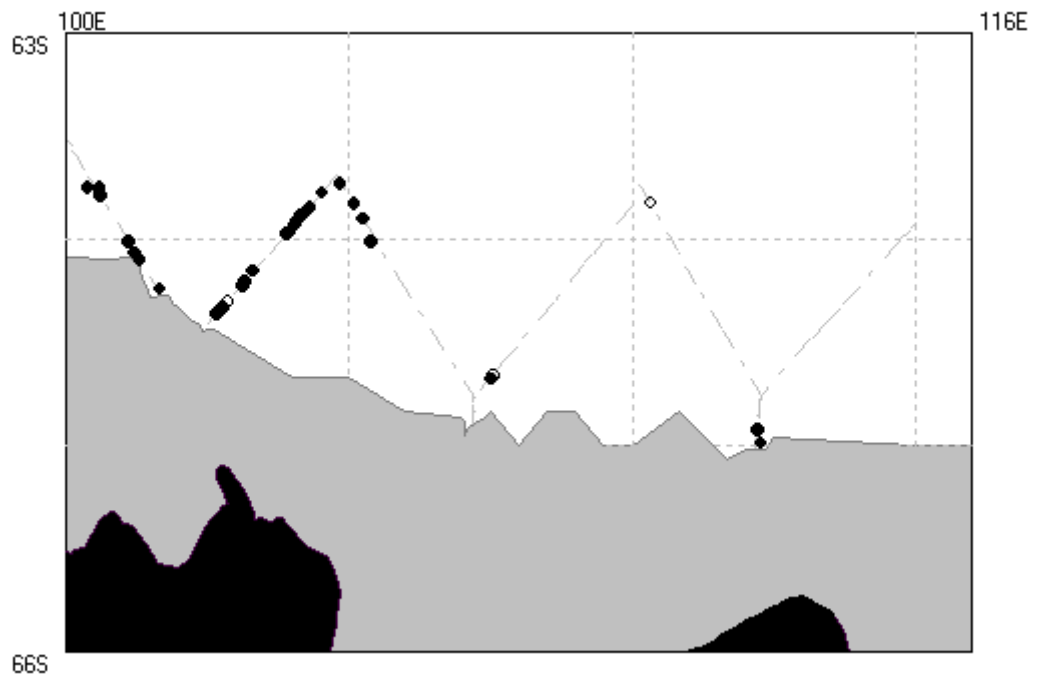


- 1d.** Sections of the cruise track during the extra survey of the research area covered on search effort, including TD during BB mode after WP30a (64°15.35S 102°10.27). The grey line represents the best estimate of the ice edge observed during the extended survey. The black circles indicate the waypoints at which the survey mode was changed. The survey started in SS-II mode, switched to BT first and then to BB mode.

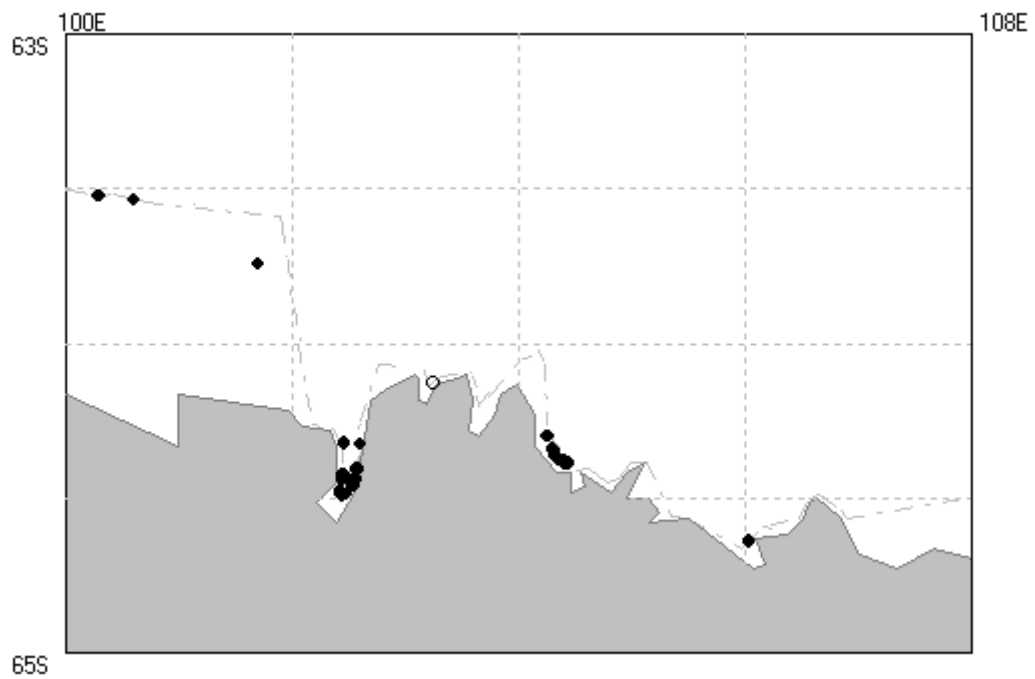
Figures 2a-m. Positions of whale sightings in the Antarctic research area.



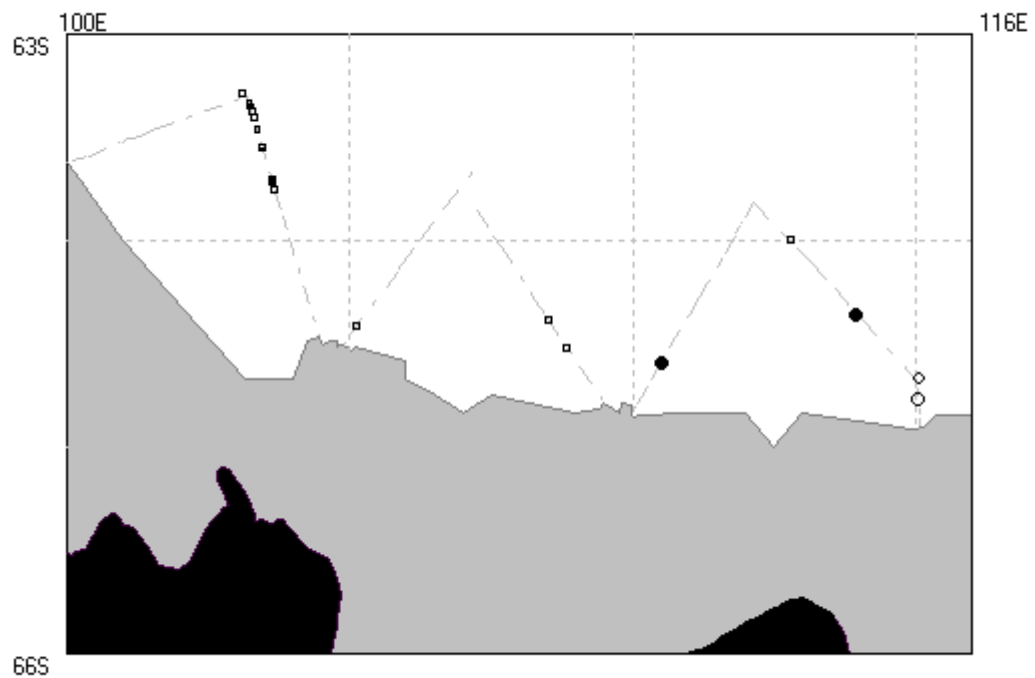
2a. Positions of minke whale (●) and 'like minke whale' (○) observed during the eastern survey of the research area.



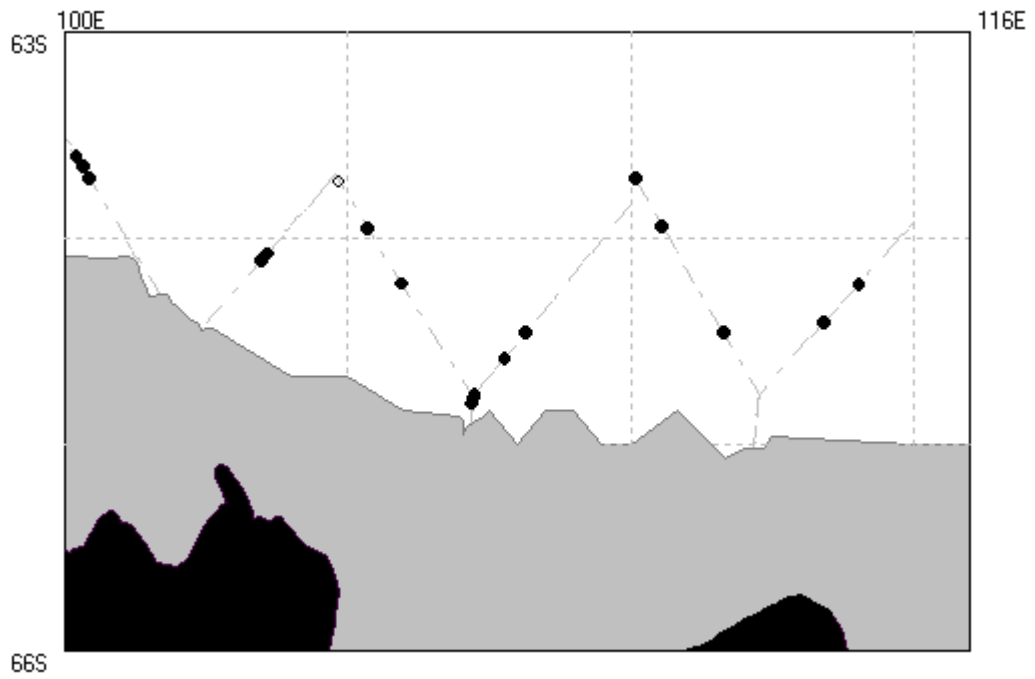
2b. Positions of minke whale (●) and 'like minke whale' (○) observed during the western survey of the research area.



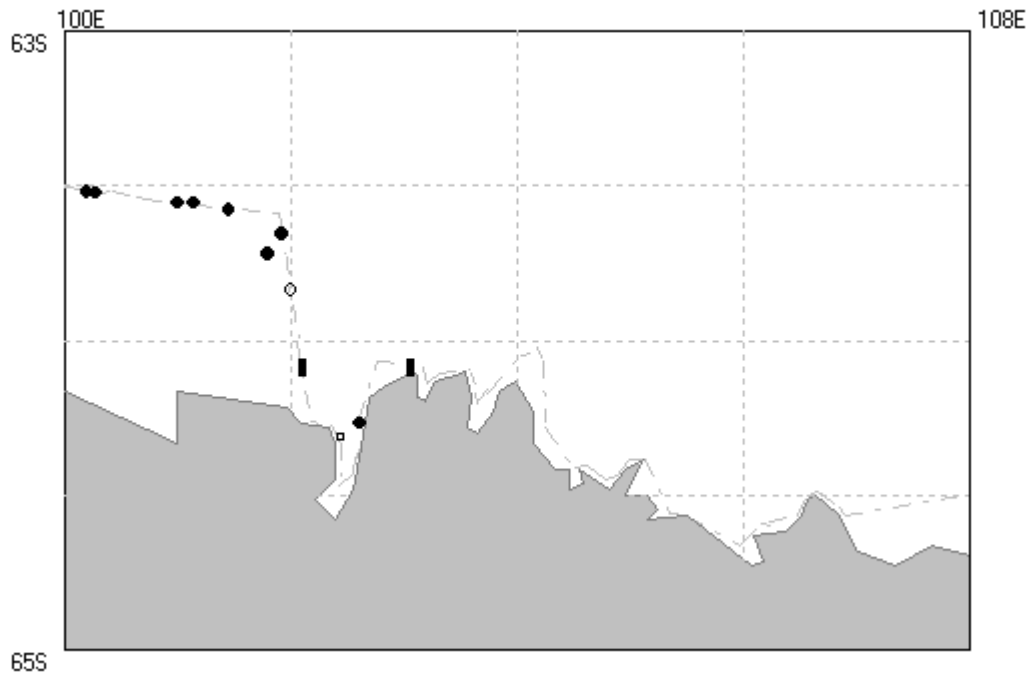
2c. Positions of minke whale (●) and 'like minke whale' (○) observed during the extended survey of the research area.



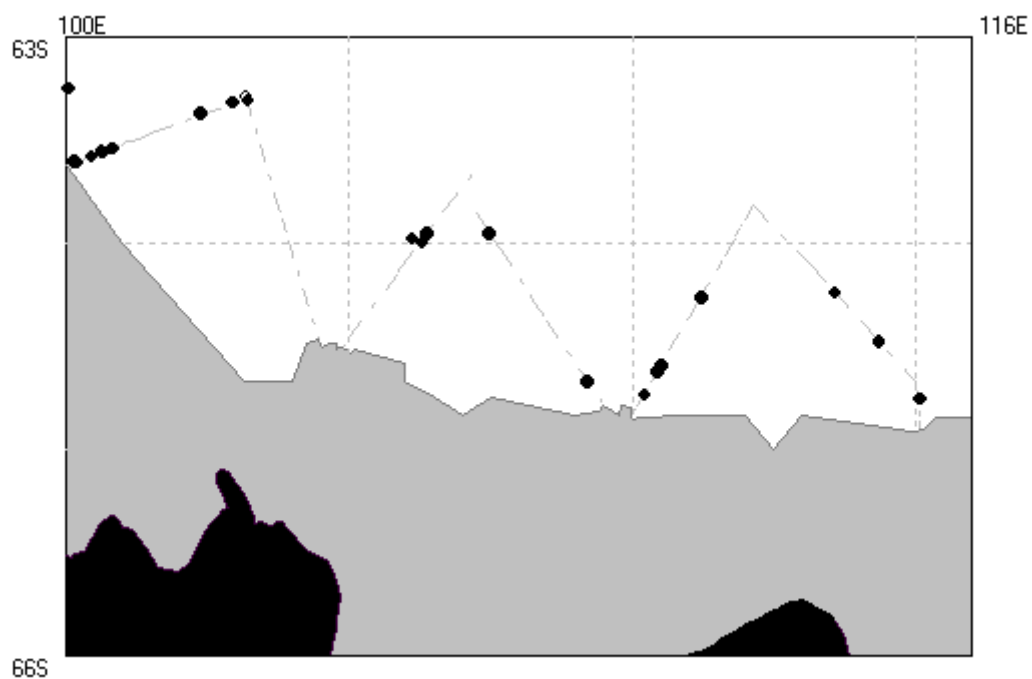
2d. Positions of fin whale (○), southern right whale (●), and sperm whale (□) observed during the eastern survey of the research area.



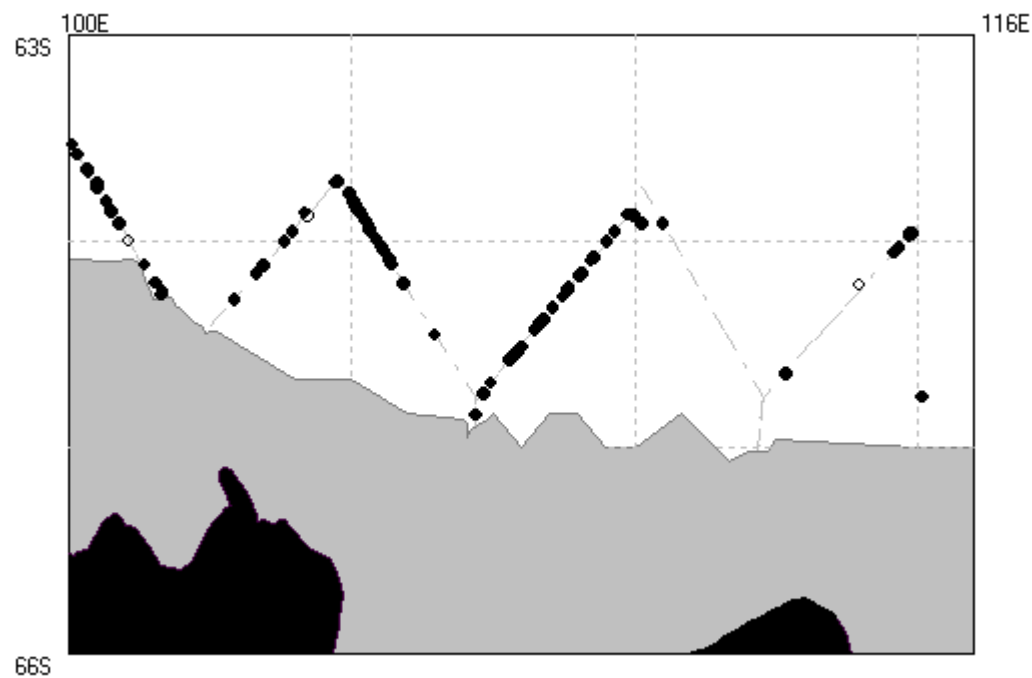
2e. Positions of southern right whale (●), and like right whale (○) observed during the western survey of the research area.



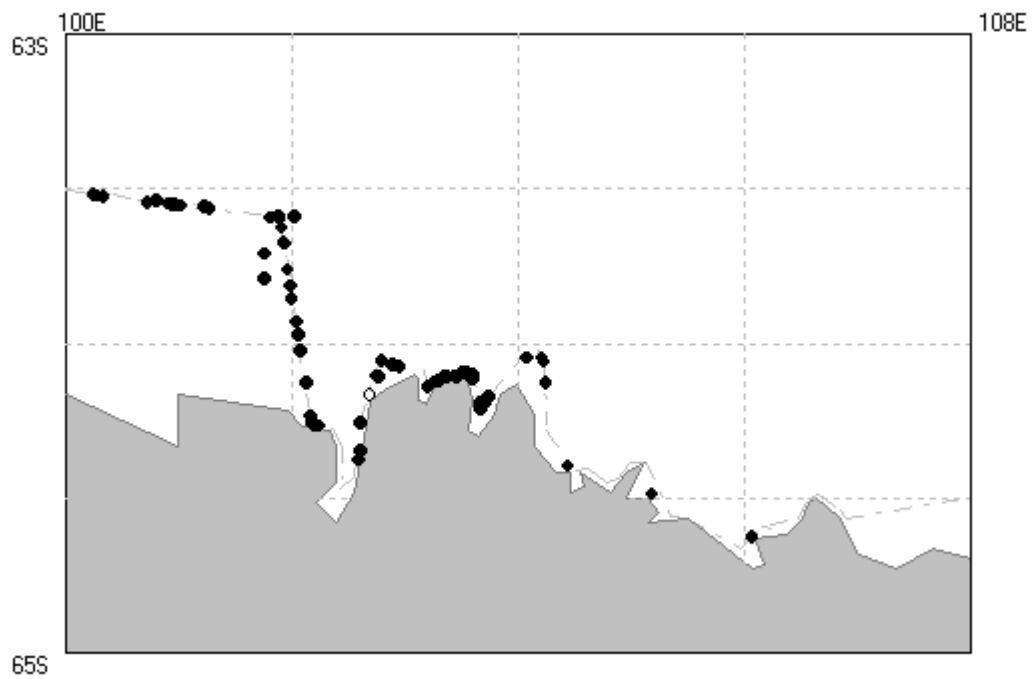
2f. Positions of fin whale (□), southern right whale (●), like southern right whale (○), and sperm whale (■) observed during the extended survey of the research area.



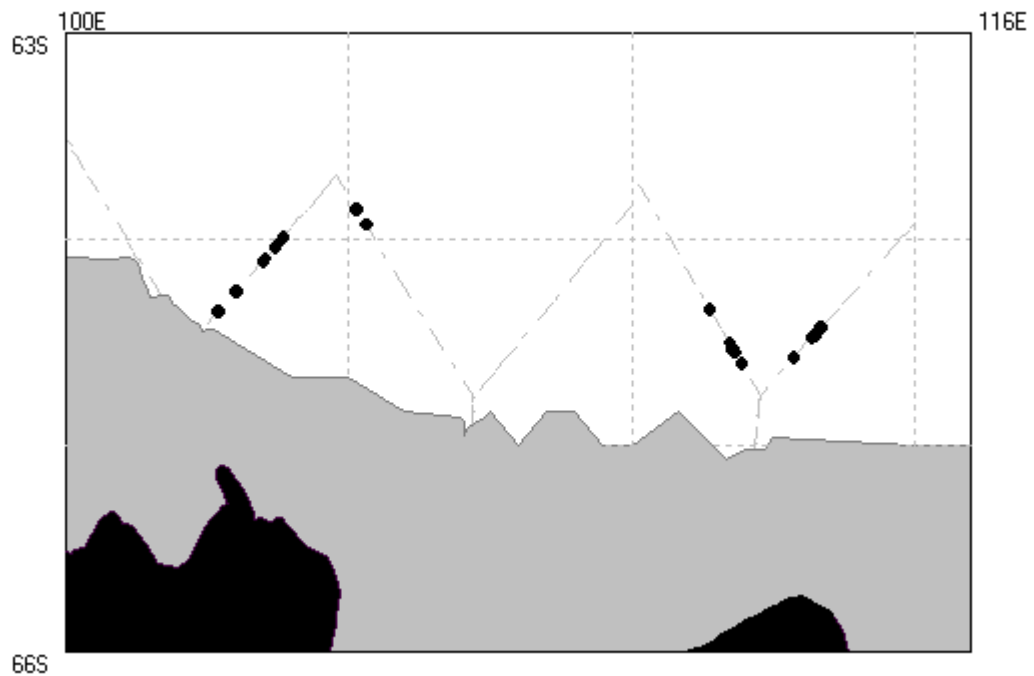
2g. Positions of humpback whale (●) and 'like humpback whale' (○) observed during the eastern survey of the research area.



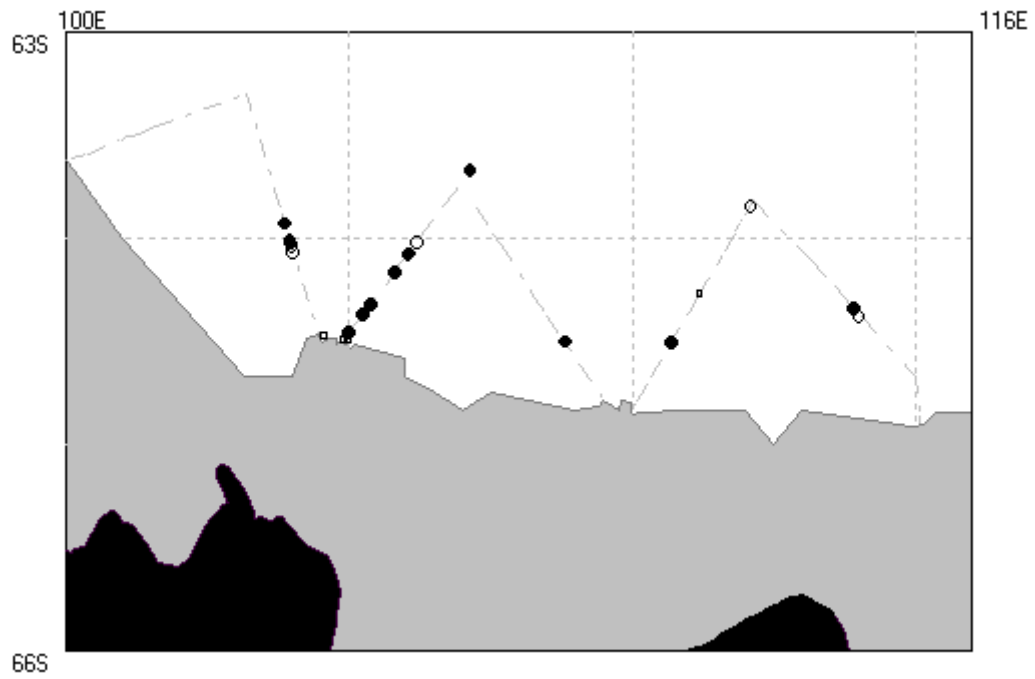
2h. Positions of humpback whale (●) and 'like humpback whale' (○) observed during the western survey of the research area.



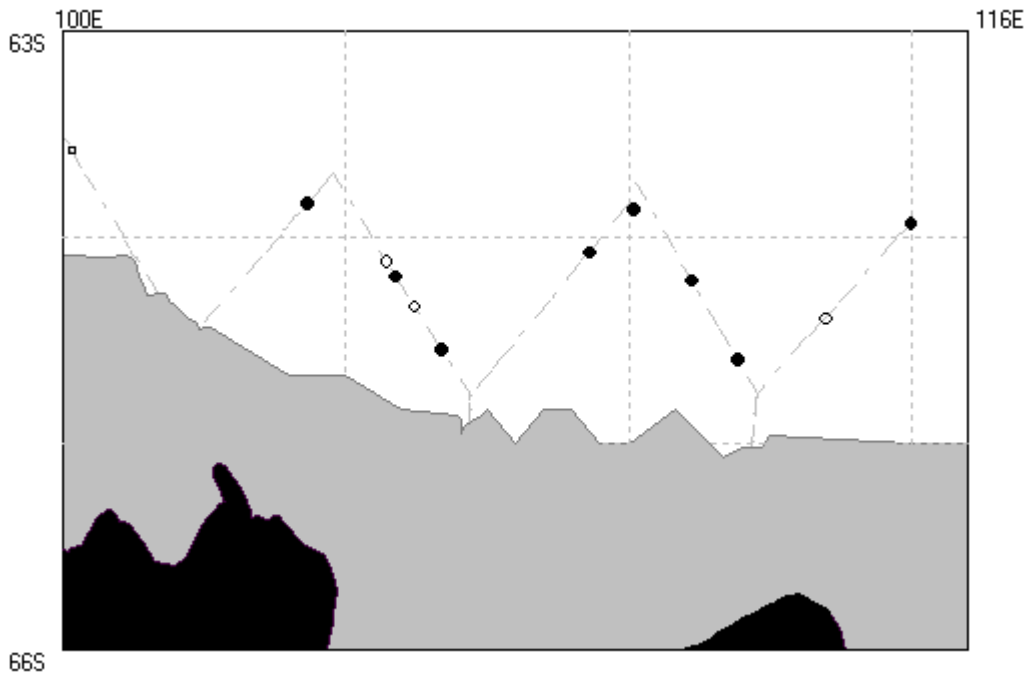
2i. Positions of humpback whale (●) and 'like humpback whale' (O) observed during the extended survey of the research area.



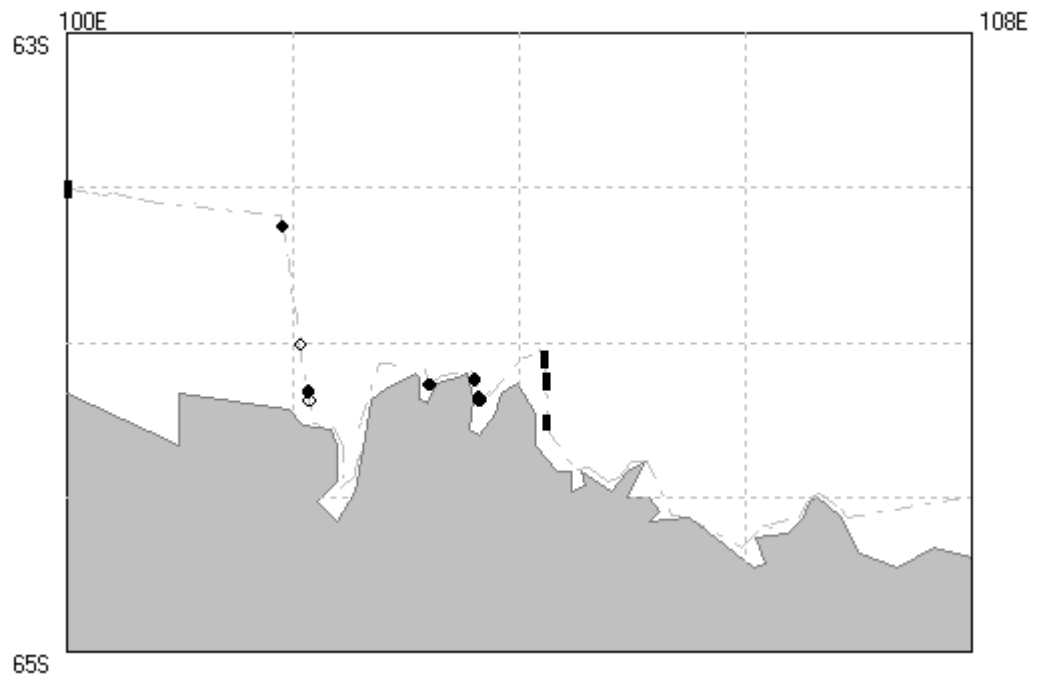
2j. Positions of sperm whale (●) observed during the western survey of the research area.



2k. Positions of Ziphiidae (O), southern bottlenose whale (●), and killer whale (□) observed during the eastern survey of the research area.

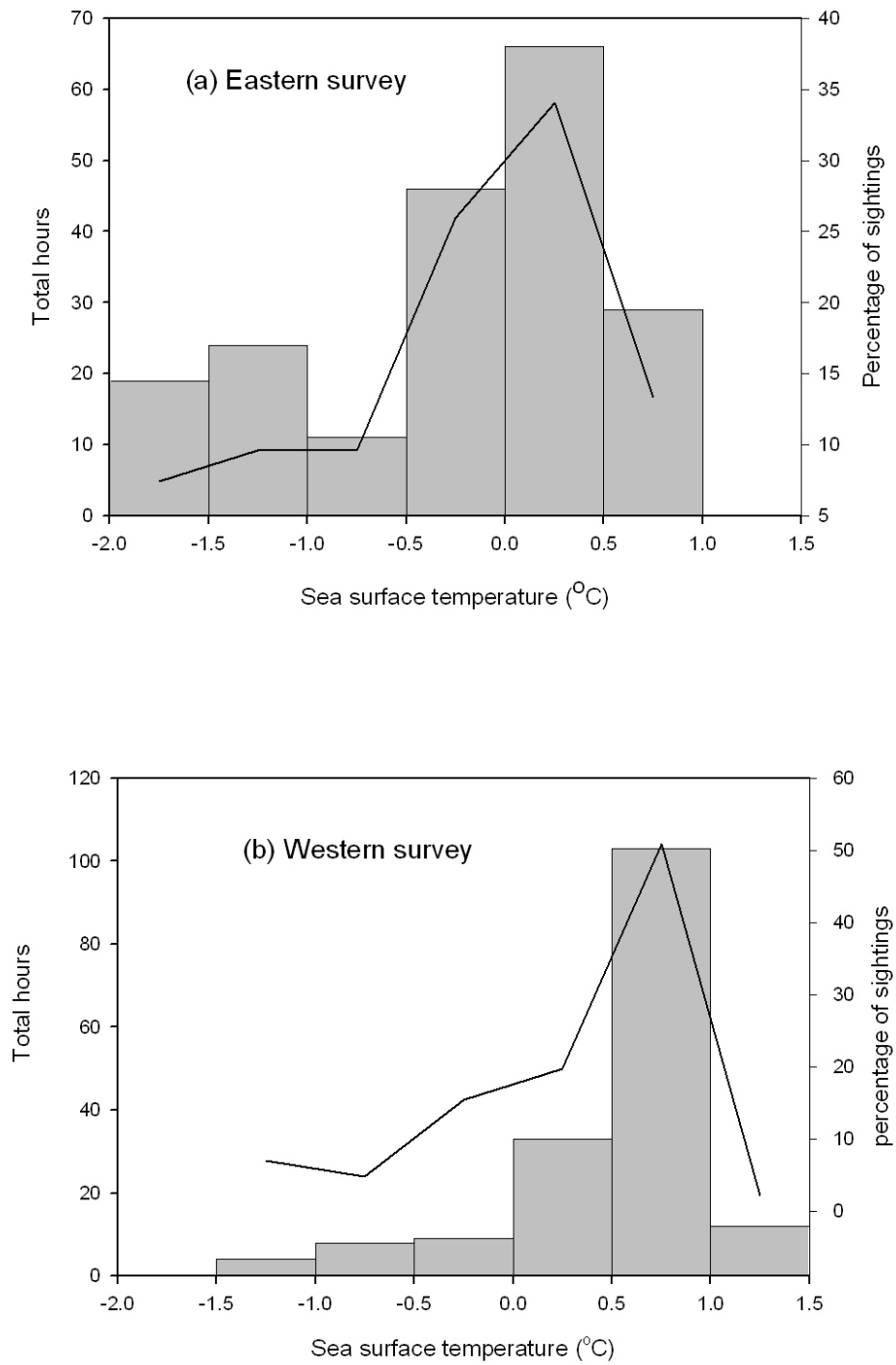


2l. Positions of Ziphiidae (O), southern bottlenose whale (●), and killer whale (□) observed during the western survey of the research area.



2m. Positions of Ziphiidae (○), southern bottlenose whale (●), and killer whale (■) observed during the extended survey of the research area.

Figure 3. Total hours of encountered sea surface temperatures from hourly weather data (the bar graph) and percentage of sightings for each sea surface temperature range (the solid line) during the eastern survey (a) and the western survey (b).



Appendix A: Ship specifications and crew list**Ship specifications:**

	<i>Kaiko Maru</i>
Call sign	JGDW
Length	61.90 m
Breadth	11.0 m
International Gross tonnage	1010 t
Japan Gross tonnage	860.25t
Barrel height	19.5 m
IOP height	14.5 m
Upper Bridge height	9.0 m
Bow height	6.5 m
Engine power (main)	1471kW
Crew	19

Crew list:

	<i>Kaiko Maru</i>
Captain	Y. Shinyashiki
Chief Officer	Y. Yamauchi
Second Officer	T. Koyanagi
Chief Engineer	K. Nakamura
First Engineer	H. Yasunaga
Second Engineer	K. Satou
Chief Operator	K. Shigetomo
Boatswain	H. Ohmura
Jr. Boatswain	M. Kaseda
Quartermaster	K. Harima
Quartermaster	K. Hasebe
Quartermaster	F. Yamaguchi
Sailor	A. Tsuji
Sailor	K. Murakami
No. 1 Oiler	H. Yanagiuchi
Oiler	M. Abe
Oiler	Y. Kimura
Chief Steward	S. Murakami
Steward	I. Kaga

Appendix B. AMSR-E and SSM/I satellite ice.

Advanced Microwave Scanning Radiometer (AMSR-E) sea ice data were sent daily to the vessel from the Australian Antarctic Division (AAD). The sea ice data were downloaded daily at AAD from the website (<http://iup.physik.uni-bremen.de:8084/amsr/amsre.html>) and data for the SOWER research area were converted into an interpolated raster image using ArcMap. Sea ice maps were produced from the raster image constructed using sea ice concentration categories (0-3%, 3-20%, 20-30%, 30-90% and 90-100%).

For SOWER 2009-2010, SSM/I data was mainly used to construct tracklines. Data was downloaded, whenever necessary, through the internet (<ftp://sidads.colorado.edu/pub/DATASETS/seaice/polar-stereo/nasateam/near-real-time/south/>) and converted using an on board program.

See Figures A-B and E below for examples of AMSR-E satellite ice predictions and Figs. C-D for SSM/I ice image which used for trackline construction.

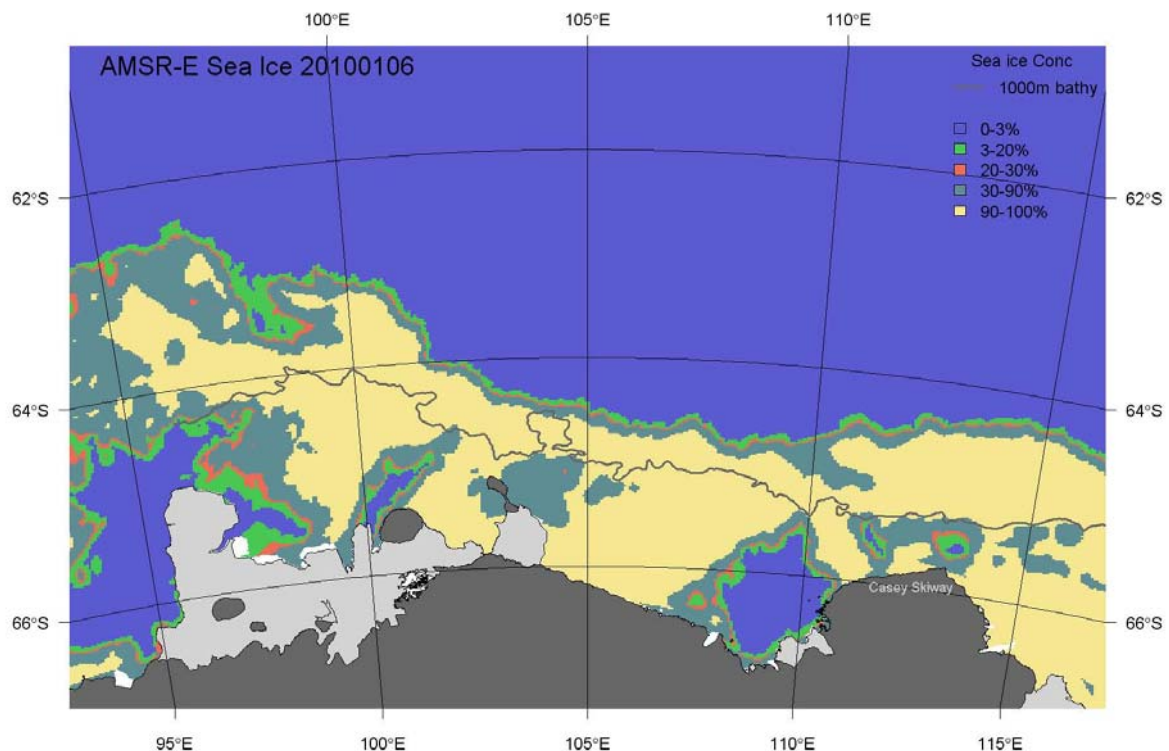


Figure A. Eastern survey of the Research Area commenced at longitude 100°E, on 07 January.

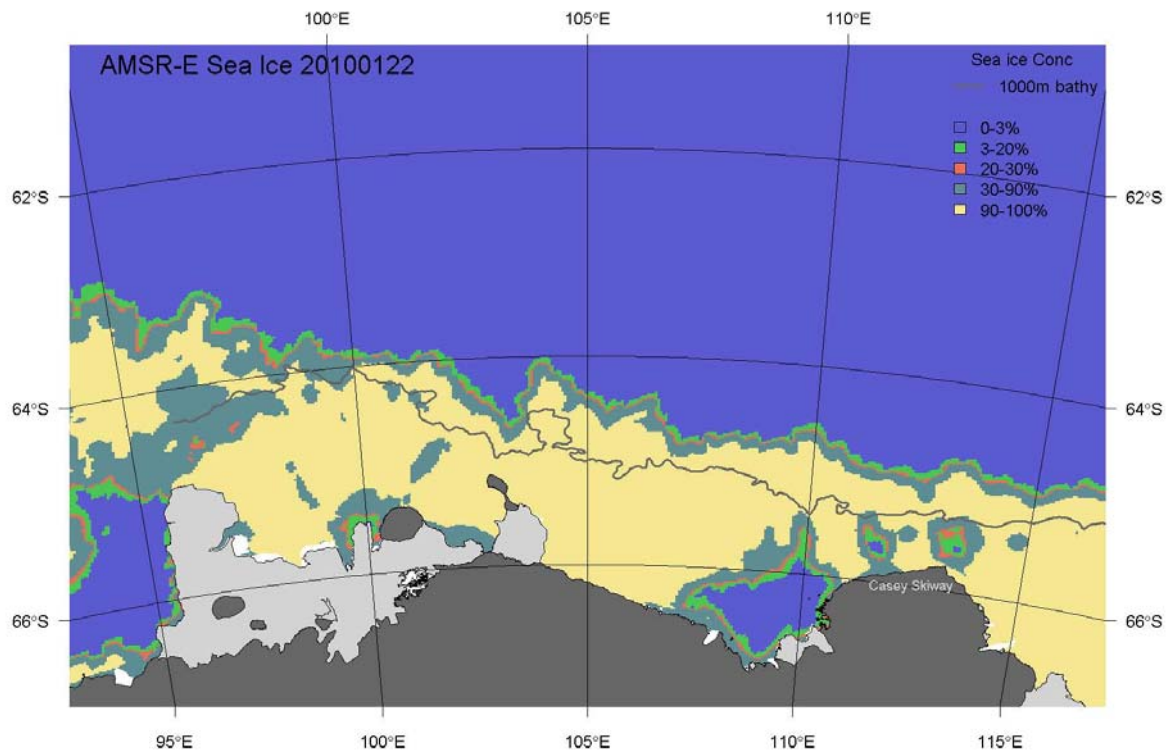


Figure B. Western survey of the Research Area commenced at longitude 115°E, on 22 January.

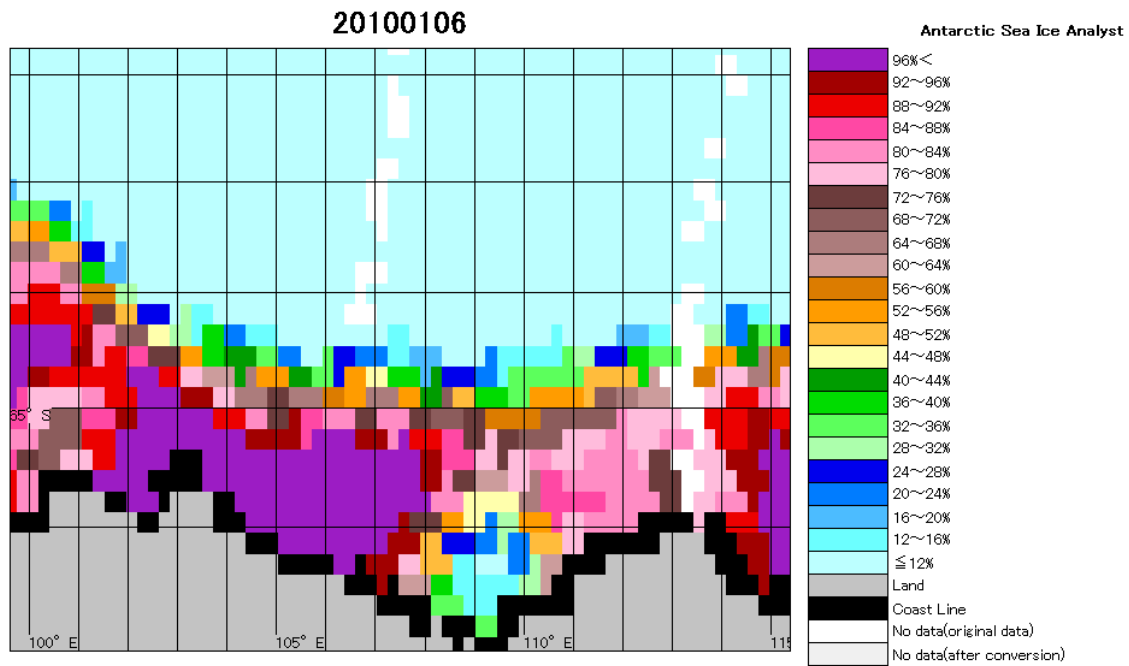


Figure C. SSM/I ice image data for 6 January 2010, which was used for eastern survey trackline construction.

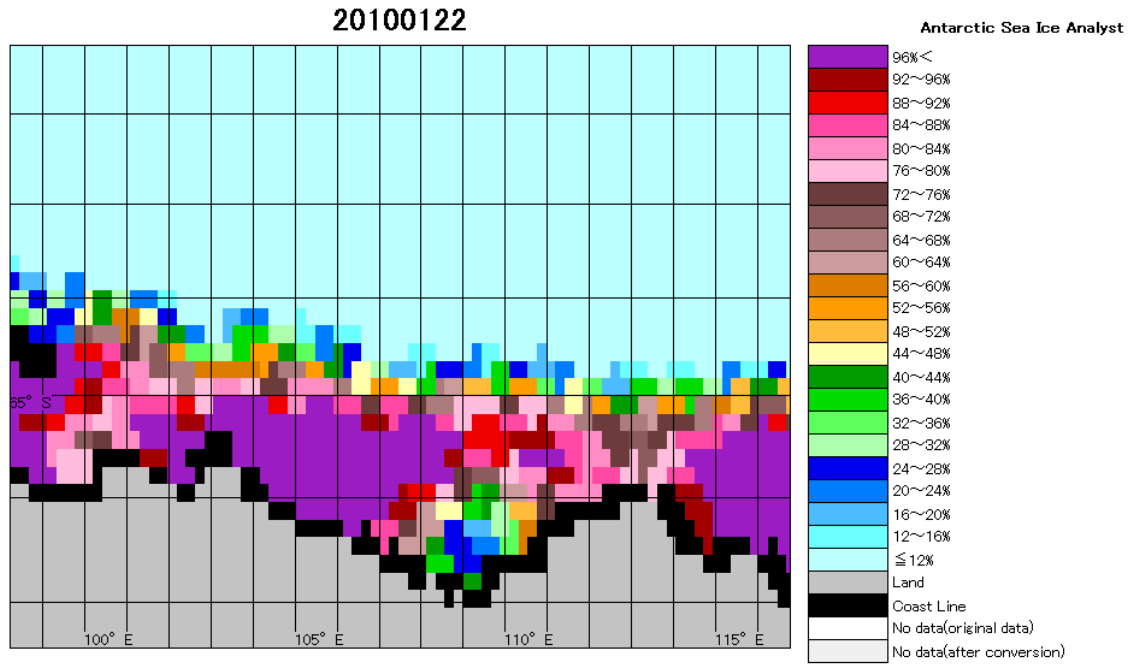


Figure D. SSM/I ice image data for 22 January 2010, which was used for western survey trackline construction.

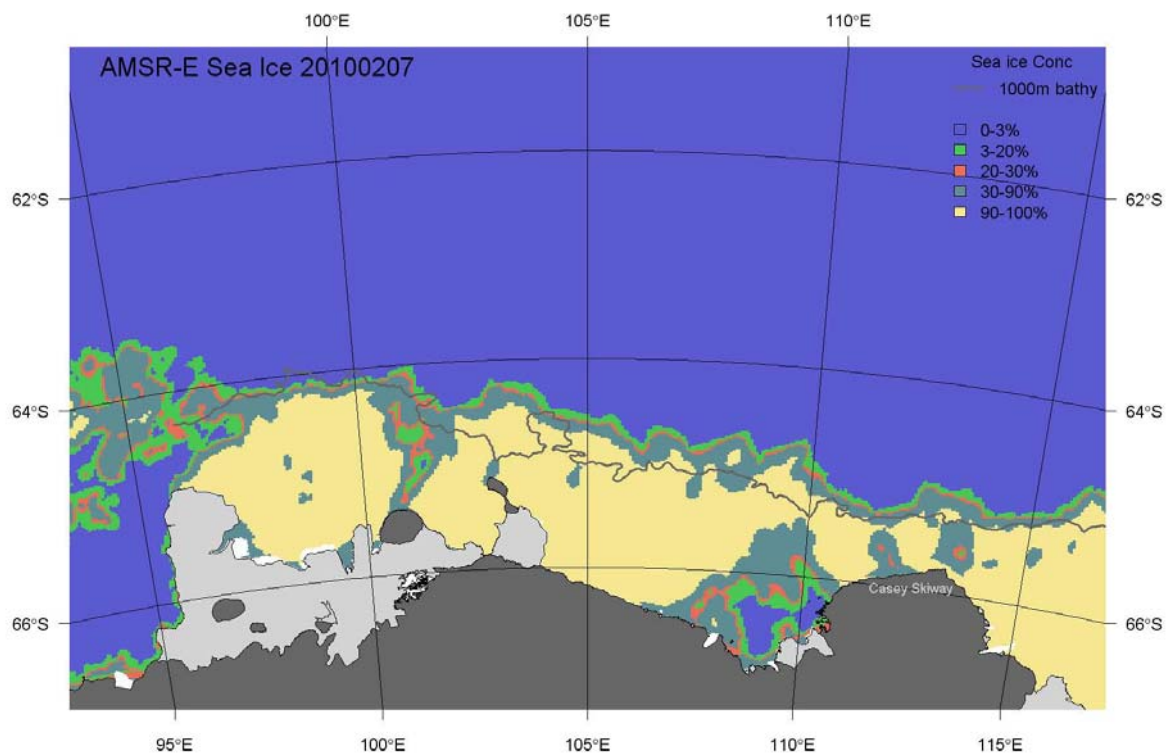


Figure E. End of scheduled research period, 07 February.

Appendix C. A list of waypoints, survey modes and distance constructed for SOWER 2009-2010 in the Antarctic research area.

1. The eastern survey

Waypoint no.	Latitude			Longitude			start mode	distance (n.m.)	Note
WP1	63	37	S	100	0	E	SS-II		
WP2	63	27	S	101	35.9	E	BT	43.95	
WP3	63	17	S	103	11	E	SS-II	43.95	
WP4	63	56.5	S	103	53	E	BT	43.75	
WP5a	64	27.58	S	104	27.25	E	-	34.75	Ice obstructed 9nm
WP5	64	36	S	104	36	E	-		lost in ice
WP5b	64	29.86	S	104	52.6	E	SS-II		Ice obstructed 10nm
WP6	64	7	S	105	55.2	E	BT	35	
WP7	63	38	S	107	13	E	TF	45	
WP8	63	50	S	107	13	E	SS-II		TF 12nm transit
WP9	64	22.5	S	108	29.8	E	BT	46.8	
WP10a	64	46.55	S	109	29.3	E	-	35.8	Ice obstructed 11nm
WP10	64	55	S	109	48	E	-		lost in ice
WP10b	64	49.67	S	109	59.17	E	SS-II		Ice obstructed 7nm
WP11	64	21.5	S	110	59.2	E	BT	38.4	
WP12	63	48	S	112	9	E	SS-II	45.4	
WP13	64	14	S	113	33.9	E	BT	45.45	
WP14a	64	40	S	115	0	E	SS-II	45.45	bisector 14nm
WP14b	64	54.06	S	115	4.17	E		14	bisector 14nm
Total								517.7	

2. The western survey

Waypoint no.	Latitude			Longitude			start mode	distance (n.m.)	Note
WP15	63	55	S	115	0	E	SS-II		
WP16	64	20	S	113	38.1	E	BT	43.7	
WP17a	64	45	S	112	15	E	SS-II	43.7	bisector 15nm
WP17b	65	0.46	S	112	10.25	E	BT	15	ice edge
WP17c	64	45	S	112	15	E	SS-II	15	bisector 15nm
WP18	64	12.5	S	111	0.68	E	BT	43.9	
WP19	63	40	S	110	0	E	TF	43.9	
WP20	63	50	S	109	58	E	SS-II	10.1	TF10.1nm transit
WP21	64	18	S	108	35.7	E	BT	45.7	
WP22a	64	46	S	107	12	E	SS-II	45.7	bisector 8nm
WP22b	64	54.32	S	107	10.45	E	BT	8	ice edge
WP22c	64	46	S	107	12	E	SS-II	8	bisector 8nm
WP23	64	13.5	S	105	58.3	E	BT	45.5	
WP24	63	41	S	104	46	E	SS-II	45.5	
WP25	64	5.5	S	103	29.6	E	BT	41.7	
WP26a	64	25.79	S	102	24.71	E	-	34.7	Ice obstructed 7nm
WP26	64	30		102	12	E	-		lost in ice
WP26b	64	15.56	S	101	39.81	E	SS-II		Ice obstructed 19nm
WP27	64	0	S	101	5.3	E	BT	22.75	

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WP28	63	30	S	100	0	E		41.75	
Total								554.6	

3. The extended survey

Waypoint no.	Latitude			Longitude			start mode	distance (n.m.)	Note
WP28	63	30	S	100	0	E	SS-II		
WP29	63	35	S	101	53	E	BT	50.7	
WP30a	64	15.35	S	102	10.27	E		40.9	Ice obstructed 9nm lost in ice
WP30	64	24	S	102	14	E			
Total								91.6	
WP30	64	24	S	102	14	E	BB		along the ice edge
WP31	64	29.63		107	55.45	E			

Appendix D. Log for photo-identification and biopsy study:

Right Whales

10Jan18 (Sighting 013, Form ID 009): @64° 35.3S and 110° 30.0E a single southern right whale was approached and pursued for 44 minutes to obtain biopsies and photographs. Whale was not evasive before or after the successful biopsy attempt.

10Jan21 (Sighting 008, Form ID 010): @64° 20.8S and 113° 55.8E a pair of southern right whales was approached and pursued between 10:08 and 11:18 to obtain biopsies and photographs. Both animals were slightly evasive.

10Jan23 (Sighting 001, Form ID 014): @64° 28.4S and 113° 10.6E a single whale was slowly approached and followed for 44 minutes. The whale was evasive in that it changed direction frequently, more so after the successful biopsy attempt.

10Jan24 (Sighting 011, Form ID 017): @64° 27.3S and 111° 37.5E a group of three right whales were approached and pursued for 52 minutes. The whales were moderately evasive.

10Jan29 (Sighting 021, Form ID 019): @64° 30.5S and 107° 57.7E a single whale was pursued for 13 minutes during which we obtained photographs and biopsy samples. The whale became evasive after the biopsy samples were taken.

10Jan30 (Sighting 003, Form ID 021): @64° 34.6S and 107° 46.0E a pair of southern right whales was pursued for a total of 40 minutes including dart retrieval. No evasive behavior until the first successful biopsy after which they increased speed slightly.

10Jan30 (Sighting 019, Form ID 022): @64° 46.8S and 107° 11.8E a single whale was pursued for 5 minutes during which photographs and a biopsy sample were obtained. No reaction to the approach or the biopsy.

10Jan30 (Sighting 023, Form ID 023): @64° 47.7S and 107° 11.3E a pair of whales was pursued for 48 minutes including dart retrieval. No evasive behavior to the approach, however, after the first biopsy the animal picked up speed. The second animals we biopsied dove.

10Jan30 (Sighting 024, Form ID 024): @64° 45.4S and 107° 13.6E a single right whale was photographed without changing course while approaching the previous sighting. Photographs were obtained during less than 1 minute. No evasive behavior was observed.

10Feb03 (Sighting 001, Form ID 029): @ 63° 42.1S and 100° 26.3E a pair of right whales was approached for 48 minutes for biopsies and photos. Whales were slightly evasive after the biopsy.

10Feb03 (Sighting 005, Form ID 030): @ 63° 39.0S and 100° 19.5E a single right whale was approached for biopsy and photos for 21 minutes. The whale was almost curious about us at first headed towards us as we approached but became slightly evasive after the biopsy.

10Feb03 (Sighting 009, Form ID 031): @ 63° 35.5S and 100° 12.4E we approached a single right whale for 12 minutes. Biopsy sample and photos were obtained. The whale became slightly evasive after the biopsy.

10Feb03 (Sighting 021, Form ID 034): @ 63° 30.5S and 100° 10.9E we approached a pair of right whales for 24 minutes to obtain biopsy and photos. The whales became slightly evasive after the biopsy.

10Feb03 (Sighting 024, Form ID 036): @ 63° 30.7S and 100° 16.0E we approached a right whale that was closely associated with a humpback whale. We obtained biopsy and photos from both whales. Although the whales became slightly evasive after the biopsy they remained closely associated and coordinated in their movement and surfacing patterns. Our approach lasted for 21 minutes.

10Feb03 (Sighting 034, Form ID 037): @ 63° 32.6S and 100° 59.4E we approached a pair of right whales that were likely engaged in a social activity first as one whale was observed flipper slapping while laying on its

back. Also one whale (not sure if the same or the other) was spyhopping. As we came close, the two whales were likely engaged in a sexual activity as one whale was underneath the other, bellies touching each other. We obtained biopsy samples and photos of both. Our approach lasted 19 minutes. The whales became slightly evasive and swam away together.

10Feb03 (Sighting 036, Form ID 038): @ 63° 33.0S and 100° 08.0E we approached a single right whale within about 1 mile of previous sighting. Our approach lasted 19 minutes. The whale became slightly evasive after the biopsy.

10Feb04 (Sighting 007, Form ID 044): @ 63° 38.6S and 101° 54.5E we approached a single right whale for 33 minutes. After the first approach the whale became evasive.

10Feb05 (Sighting 032, Form ID 048): @ 64° 15.6S and 102° 35.2E a single whale was approached for 16 minutes. The whale was not evasive at close distance but became evasive after the biopsy.

Humpback whales

10Jan07 (Sighting 003, Form ID 003): @63° 10.2S and 99°43.9E, a group of 2 whales, without turning the ship to approach them we spent 3 minutes in close enough distance to obtain photographs. No evasive behavior.

10Jan14 (Sighting 001, Form ID 006): @63° 59.4S and 106° 17.1E a group of 2 humpback whales was encountered while off effort. Pictures were obtained without actively approaching the animals. No evasive behavior.

10Jan16 (Sighting 001, Form ID 007): @63°56.6S and 107° 28.3E a group of 2 humpback whales was encountered while drifting off effort. Pictures were obtained without actively approaching the animals. No evasive behavior.

10Jan18 (Sighting 009, Form ID 008): @64° 43.6S and 110° 12.2E a single humpback whale was approached and pursued for 30 minutes to obtain biopsy and photographs. Whale was not evasive before or after the successful biopsy attempt.

10Jan22 (Sighting 003, Form ID 012): @63° 57.0S and 114° 53.4E a single whale, length estimate: 8.5 m. Animal was approached and followed for 56 minutes. Evasive behavior after third biopsy attempt in changing directions and picking up speed slightly.

10Jan22 (Sighting 006, Form ID 013): @63° 58.2S and 114° 49.8E a group of three whales was approached and followed for approximately 10 minutes during which the smaller animal (larger than calf size) separated from the group and biopsies and photographs were obtained of the two larger animals. No evasive behavior of the two larger whales.

10Jan29 (Sighting 006, Form ID 018): @64° 07.3S and 109° 08.2E a cow/calf pair was approached for 7 minutes. These animals became very evasive after we biopsied the cow.

10Jan30 (Sighting 001, Form ID 020): @64° 34.3S and 107° 47.0E a pair of humpback whales was near to the trackline as we passed them. Without altering course we photographed both animals within less than 1 minute. No evasive behavior.

10Jan31 (Sighting 029, Form ID 025): @63° 41.9S and 104° 43.9E a trio of humpback whales was pursued for 26 minutes. Biopsy samples were obtained from all three individuals. Only after this did the whales become evasive but they continued their social behavior while still within .5 nm from us.

10Feb03 (Sighting 024, Form ID 035): @ 63° 30.7S and 100° 16.0E we approached a humpback whale that was closely associated with a right whale. We obtained biopsy and photos from both whales. Although the whales became slightly evasive after the biopsy they remained closely associated and coordinated in their movement and surfacing patterns. Our approach lasted for 21 minutes.

10Feb03 (Sighting 037, Form ID 039): @ 63° 33.2S and 100° 13.3E we photographed two humpback whales near the trackline. The whales were not evasive to us passing by in close vicinity.

10Feb03 (Sighting 047, Form ID 040): @ 63° 37.2S and 100° 53.8E we photographed two humpback whales that were near the ship without approaching them directly. The whales were not evasive.

10Feb04 (Sighting 001, Form ID 041): @ 63° 46.8S and 101° 44.8E a group of 3 whales was photographed that came close to the ship while we were off effort. The whales were not evasive.

10Feb04 (Sighting 003, Form ID 042): @ 63° 41.8S and 101° 44.7E a group of 2 humpback whales crossed in front of our bow as we were picking up ice pieces near an iceberg. The whales were not evasive.

10Feb04 (Sighting 004, Form ID 043): @ 63° 35.2S and 102° 01.2E we photographed a single humpback whale while cruising down the trackline. The whale was not evasive.

10Feb05 (Sighting 002, Form ID 045): @ 63° 55.4S and 102° 01.9E a group of three whales was approached for 30 minutes. A biopsy sample was obtained from one whale and photos from all three. The whales were evasive after the biopsy.

10Feb05 (Sighting 014, Form ID 046): @ 64° 15.5S and 102° 11.4E a pair of humpback whales was approached for 25 minutes. The whales were moderately evasive after approaching at close distance, i.e. less than 100m.

10Feb05 (Sighting 029, Form ID 047): @ 64° 22.3S and 102° 35.2E a single humpback that was near the trackline whale was photographed as we passed. The whale was not evasive.

10Feb05 (Sighting 040, subgroups A and B, Form ID 049): @ 64° 04.1S and 102° 53.5E two subgroups of humpback whales were approached, one subgroup consisting of 3, the other of 2 whales. The subgroup of three became very evasive particularly after obtaining the first biopsy. Only two animals were biopsied in this subgroup. The whales were swimming consistently away from us. The second subgroup of two whales was also evasive at close proximity and became very evasive after the biopsy. The larger of the two whales was 'trumpeting' during most exhalations at close proximity. Our approach for both subgroups and including retrieval of all darts lasted 100 minutes.

10Feb06 (Sighting 001, Form ID 051): @ 64° 06.4S and 103° 35.1E we approached a single humpback whale for 9 minutes during which we obtained a biopsy sample and photographs. The whale was not evasive, neither before or after the biopsy and showed no reaction to the hit.

10Feb06 (Sighting 007, Form ID 052): @ 64° 11.3S and 103° 39.7E we approached a single humpback whale for 5 minutes. The whale was not evasive.

10Feb06 (Sighting 008, Form ID 053): @ 64° 12.4S and 103° 39.4E we approached a single humpback whale for 27 minutes. The whale was not evasive to the approach, however, it reacted to the first missed biopsy attempt and became very evasive afterward.

10Feb06 (Sighting 011, Form ID 054): @ 64° 02.4S and 104° 03.9E we approached a pair of humpback whales that were moderately evasive. The approach lasted for 17 minutes.

10Feb06 (Sighting 014, Form ID 056): @ 64° 06.9S and 104° 14.2E during our approach to a killer whale sighting we passed within approximately 0.3 nm of a group of 5 humpback whales that were resting and socializing at the surface. The humpback whales were not evasive to our presence and continued their behavior.

Killer Whales

09Dec30 (Sighting 001, Form ID 001): @33deg 31.0S and 100deg 59.4 E, a group of 4 animals, 2 photographed with certainty. Type "A". Spent 9 minutes on chase. Group split, was moderately evasive.

10Jan05 (Sighting 014, Form ID 002): @58° 02.7S and 99° 59.7E, a group of 9 animals, possibly all 9 photographed. Type "A". Spent 32 minutes on the chase. Group did not split but was moderately evasive at close distance.

10Jan11 (Sighting 014, Form ID 004): @64° 28.1S and 104° 32.2E, a group of 2 whales, sighting 014, both photographed left and right sides. Undetermined type as larger male looked more like type A without cape and

normal sized eye patch and smaller had the large eye patch of type b. Biopsy attempted from the bow. Group was slightly evasive in particular after biopsy attempts: lead us in a full circle and then into the ice which slowed us down considerably. Spent a total of 60 minutes in approach and pursuit.

10Jan11 (Sighting 015, Form ID 005): @64° 29.2S and 104° 54.4E a group of 2 whales, sighting 015. Moderately evasive. We spent 35 minutes on approach and pursuit. Photos revealed it was the same two whales as sighting 014 from the same day.

10Feb03 (Sighting 010, Form ID 032): @ 63° 34.4S and 100° 10.6E a small group of killer whales were approached to obtain photos. However, the whales were very evasive in diving and changing direction under water whenever we came close and only distant pictures could be obtained. Due to the evasiveness we only spent 8 minutes in pursuit.

10Feb03 (Sighting 020, Form ID 033): @ 63° 30.1S and 100° 00.6E we approached a group of killer whales that consisted of several small subgroups. In particular those subgroups that had females and you were evasive. We were able to approach only single large males from this group within a few hundred meters. Our attempt lasted for 15 minutes.

10Feb06 (Sighting 014, Form ID 055): @ 64° 03.1S and 104° 13.1E we approached a group of killer whales (undetermined type). At least some of the whales had large eye patches, however, they were lacking the cape characteristic of type B killer whales. The group consisted of approximately 5 subgroups, all of them very evasive to the ship. The best photographs were obtained from one of the larger subgroups including at least one calf.

10Feb06 (Sighting 017, Form ID 057): @ 64° 14.1S and 104° 14.3E we approached a group of killer whales consisting of 5 whales swimming in line next to each other. At first it seemed like they were headed in the direction of a group of humpback whales, however, they passed these whales at approximately 0.5 nm without changing course or behavior. The group of humpback whales did not show any reaction to the presence of the killer whales. The killer whales were moderately evasive to the ship. Although they were traveling with what seemed to be a consistent course overall, they traveled submerged when we came within 0.2 nm.

Antarctic Minke Whales

10Jan24 (Sighting 004, Form ID 015): @64° 55.2S and 112° 12.5E three minke whales were approached into loose packice. This operation lasted for a total of 43 minutes. Whales were slightly evasive in that they swam away from us but they did not pick up any speed to do so.

10Jan31 (Sighting 039, Form ID 027): @63° 55.0S and 104° 01.9E we approached a group of 5 minke whales during SS-II closure during which photographs were obtained. The approach lasted 9 minutes, whales were slightly evasive at close distance.

10Jan31 (Sighting 075, Form ID 028): @64° 20.7S and 102° 41.6E a trio of minke whales were photographed during 2 minutes while we passed them cruising on the trackline. Whales were only evasive very shortly while within 0.1nm.

Fin Whales

10Jan21 (Sighting 018, Form ID 011): @64° 45.5S and 115° 01.4E a pair of fin whales was approached and pursued for obtaining biopsies and photos for 21 minutes. One animal was considerably smaller than the other, however, it was not small enough to be a calf. Both animals were very evasive to our approach and no biopsies were obtained as we did not get close enough.

Other:

09Dec30: Spent 12 minutes with pilot whales, species unconfirmed. Large group, easily approached. Very young calves seen.

10Jan24 (Sighting 007, Form ID 016): @64° 35.3S and 111° 54.8E we passed a group of two southern bottlenose whales, one of which was a juvenile with a light head and no scratches visible on body. We did not alter course to approach them. They were within visual/photographic range for six minutes.

10Jan31 (Sighting 032, Form ID 026): @63° 49.7S and 104° 19.1E we photographed a pair of southern bottlenose whales that were at the surface as we passed them cruising down the trackline. We did not alter course to approach them. The whales were not evasive

10Feb05 (Sighting 042, Form ID 050): @ 64° 04.8S and 102° 02.6E a single sperm whale that was resting at the surface was photographed as we passed by it approaching a sighting of humpback whales. We did not alter course to approach this whale and the whale was not evasive to us.

Appendix E: Recommendations for acoustic set-up revision.

- 1) A portable antennae, mount and pre-amp system, with at least 150ft of cable to go from the antennae thru pre-amp box and into the ship. A suggested location on the Kaiko Maru for the receiver and acoustic computer set up is in the aft chart/winch room area. It is recommended this system be purchased and retained with the IWC gear ,and can be utilized on any future ships used for IWC research.
- 2) Purchase of a Greenridge software license is needed to process the DIFAR signal and acquisition of post processing tools, which have proven to be very effective in realtime sonobuoy operations, be made. The set up of these programs are not simple, and therefore it is also recommended that the acoustic computer be set up well in advance of the start of a cruise.
- 3) An independent GPS system : a portable Garmin with its own antennae and cable long enough to reach a mount outside) is recommended. This is necessary to accurately determine cross bearing positions of vocalizing whales and linking them to visual sightings during daytime operations (such as for blue whales, and right whales)
- 4) Appropriate cables for dual receiver operations and synchronous recording on one computer.