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Report of the 1995/96 Japanese Whale Research Programme Under Special Permit in the Antarctic (JARPA) in Area IV and eastern part of Area III

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ABSTRACT

The ninth survey of the Japanese Whale Research Programme Under Special Permit in the Antarctic (JARPA) was carried out in the Antarctic Area IV (south of 60° S between 70°E and 130°E) and eastern part of Area III (south of 60° S between 35°E and 70°E). The survey was conducted for 118 days, from 26 November 1995 to 22 March 1996. The research fleet was composed of a research base vessel, engaged in the biological survey of minke whale sampled, three sighting /sampling vessels (SSVs) engaged in sighting and sampling and one sighting vessel (SV) dedicated exclusively to sighting activities. Survey in the eastern part of Area III was conducted before and after the survey in the entire Area IV. The survey in Area IV was conducted during the period in which the peak migration of minke whales was expected. Survey in the eastern part of Area III was conducted as a feasibility study on stock identity, and samples were taken during an early and late period of the feeding season in order to study intra-seasonal changes. During the sampling, one animal was taken randomly from schools sighted as primary sighting. This was made in order to improve the representation of the population. Dwarf form minke whales were not sampled. The SV was exclusively engaged in whale sighting survey in all the research areas, along an independent sighting track line. Sighting and sampling activities were independently conducted by the three SSVs, in parallel track lines to each other. Searching distance for these four vessels was of 21,455.5 n.miles. During the research period, 893 schools (2,021 animals) of the ordinary minke whale were sighted as primary sighting and 244 schools (564 animals) as secondary sightings. Out of 693 schools (1,439 animals) primarily sighted by the SSVs, 440 ordinary form minke whales (273 males and 167 females) were randomly sampled. The distribution pattern of minke whales in Area IV was not considerably different from that observed during the 1993/94 JARPA. In the previous research, high density was observed in the Prydz Bay. However, such high density was not found in the present research. Distribution of cetacean species during the research period suggest the segregations between minke and humpback

whales, and between sperm and beaked whales including southern bottlenose whales. Those were related to the pattern of the ice edge in the research area. It is supposed that concentration of pregnant female in the Prydz bay lead to such difference, because no significant different is observed when the data of the Prydz bay is excluded from the western part of the Area IV. The eastern part of the Area III located closely to the Prydz bay and many large matured female were collected in eastern south of the Area III in the second survey. It seems that the most of female minke whale in the Prydz bay tend to migrate through in the eastern part of the Area III. During the survey, 3 schools (4 animals) of the blue, 25 schools (48 to 50 animals) of the humpback whale and 4 schools (4 animals) of the right whale were photographed for natural markings. Ten skin biopsy samples were taken from humpback whales and one sample was taken from the blue and right whales, respectively.

INTRODUCTION

Japan constructed a long-term research plan in compliance with Article VIII of the International Convention for the Regulation of Whaling, and the Japanese Whale Research Program under Special Permit in the Antarctic (JARPA) has been conducting every year since 1987/88 season. The research on the Southern Hemisphere minke whale and the research on the marine ecosystem in the Antarctic were planned by the Japanese government, and the Institute of Cetacean Research (ICR) has been conducting in the survey continuously every year. This research has been conducted once a year on alternately in the Antarctic Areas IV and V. The present 1995/96 JARPA was fifth for the Area IV.

The research plan in the 1995/96 JARPA was submitted to 47th International Whaling Commission and the Scientific Committee (IWC/SC) meetings by the Japanese Government (Government of Japan, 995). This research has the following principal three objectives:

(I)Estimation of biological parameters to contribute toward an rational Southern Hemisphere minke whales management stocks
(II)Elucidation of the role of whales in Antarctic marine ecosystem
(III) Elucidation of the effect of environmental changes on cetacean stocks

The First two objectives are essentially from JARPA was initially planned (Government of Japan, 1987). The third objective has been added in response to Commission resolutions regarding the environment and pollution (Resolution on research on the environmental and whale stocks in 1994a and Resolution on promotion of research related to conservation of large baleen whales in the Southern Oceans in 1994a).

Results and analysis of research in previous year were reported to the IWC/SC every year, and contributed to elucidation of knowledges, such as stock structure and age distribution with sexual segregation of minke whales which could not be obtained through data from the commercial whaling. Since the beginning of the program, practical modifications of research have been made in response to the comments from the Scientific Committee.

The study on stock identity using JARPA samples has been owed largely to mtDNA analysis. Such analyses supported the hypothesis of the occurrence of more than one stock in Area IV and V, and also suggested that these hypothesized stocks could be distributed under complex geographical and temporal patterns (Pastene *et al* .,1994). A recent analysis of mtDNA (Pastene and Goto, 1995) suggests the possibility of temporal and geographical interaction of stocks in the western part of Area IV.

In this research, the regular research in the Antarctic Area IVwas conducted peak migration season of minke whales. In addition, in eastern part of Area III, a feasibility study was conducted twice before and after the regular research in Area IV, to investigate the stock of minke whales in west of Area IV.

RESEARCH METHODS

The pre-cruise meeting was held in Tokyo on 27 October 1995 with the participation of scientists, researchers of the cruise and representatives of the ships' crews. Outline of cruise and research method employed are summarized below.

Research fleet

The research base vessel, *Nisshinmaru* (*NM*; 7,440GT) acted in general matters such as planning of the daily research strategy, setting cruise course and arrangements for SV and SSVs. The measurements, collection of biological samples and processing of the whale carcasses were took place on the deck of *NM*. A part of humane killing survey was also conducted on the deck.

Three SSVs, *Kyomaru No.1* (*K01*; 812.08GT), *Toshimaru No.18* (*T18*; 758.33GT) and *Toshimaru No.25* (*T25*; 739.92GT) engaged in the whale sightings and sampling of minke whales. During research periods, experiments of the distance and angle estimation and the whale reaction monitoring were conducted.

Kyoshinmaru No.2 (*KS2*; 372.00GT) engaged in varous experiments in addition to whale sightings. The distance and angle estimation experiment, the natural markings and collection of skin biopsy samples of blue, right and humpback whales, observations of the behavior of blue and beaked whales and oceanographical surveys were conducted during research periods.

Number of Samples

Present research was planned to collect 300 ordinary minke whales with 10% allowances in Area IV and 100 ordinary minke whales with 10% allowances in eastern part of Area III for samples.

Research area divisions

The research area for sampling of minke whales were Antarctic areas IV (from 70°E to 130°E) and eastern part of AreaTT (from 35°E to 70°E) in the area between south of 60°S and the ice edge line. During the course of transit cruises, sighting surveys were also conducted in the area between south of 30°S and north of 60° S to collect informations on the distribution of whales on the lower and middle latitudinal areas.

a) Area IV (The entire area research)

The research area divided into the east and west sectors by line of 100°E, and then further divided into north and south strata. The north and south strata were separated by a line of 45 n.miles northward from the ice edge line. In the area between 70°E and 80°E , the southern boundary of the south stratum was drawn at latitude of 66°S. The area south of this boundary was designated as the Prydz Bay area.

b) Eastern part of Area III (the feasibility research)

Eastern part of Area III was not divided to smaller strata. The research conducted twice before and after the research in Area IV.

Sighting and sampling methods

a) Cruise track

In principle, the cruise track in the south strata was set according to that used in the 1991/92 research (Fujise *et al.*, 1993). A zigzag line that is used in the IWC/IDCR survey was used both in eastern part of Area III and the north strata of the research in Area IV. In the south strata except the Prydz Bay, the track line was zigzagged from north to south at intervals of four degrees longitude. In the Prydz Bay, the pack ice line in the Bay was confirmed beforehand by the ice information of the Joint Ice Information Center (JIC). Then, the area from the mouth to the innermost part of the bay was further divided into the north and south zones, each of which had a latitudinal track line. Both ends of these track lines were diagonally connected and formed a hourglass-shaped track line.

b) Sighting method

The sighting method was basically in conformance with that is used in the IWC/IDCR research (Kato *et al.*, 1989,1990: Fujise *et al.*, 1990: Kasamatsu *et al.*, 1993). The limited-closing mode to approach the whale sighted was used, in which the ship should approach only minke whales primarily sighted. Additionally, the SV approached to targeted species for natural markings (blue, right and humpback whales) on the track line. The SV was deployed on whole research area. The SV always preceded SSVs in order to assure the independent sighting activity in the research area. Three SSVs had a main course and two subcurses of track lines. The main course was the same as the course for the SV, two subcourses were parallel to the main course 7 n.miles apart from it. Three SSVs exchanged their courses every day in principle.

c) Sampling method

The sampling method was the same as in the 1991/92 research (Fujise *et al.*, 1993). One ordinary form minke whale was sampled randomly from a primarily sighted school. When a Dwarf form minke whale was not target species.

Biological research of sampled whales

Sampled whales were towed by sampling vessels to the research base vessel (*NM*) as quickly as possible to obtain a wide range of biological data and materials, including genetics, morphology, reproductive status, age, food and environmental chemistry. The measurement and collection of specimen were conducted according to the manual of biological research for JARPA.

The survey to improve whale killing method

The whale killng method and time were recorded on SSVs in detail. The trajectory of harpoons fired into the sampled animals are studied, and visual autopsies were carried out on the deck of the *NM*. Blood sampling was carried out on the *T18* for the analysis of serum contents.

Experiments

a) Distance and angle estimation experiment

This experiment was conducted to help adjustment and correction of sighting data for the

abundance analysis by evaluating the accuracy of sighting distance and angle estimates. The method used was the same as that of the IWC/IDCR research . A buoy was set and then sighting staff on the moving vessel estimated the distance and angle from the vessel to the buoy. Radar is simultaneously used to detect the position of the buoy.

b) Reaction monitoring experiment
This experiment was planned in order to assess the effects on the behavior of whales by the sampling activity of the SSVs. It is designed to be conducted three times in two days in areas where the density of minke whales was high.

c) Experiment for the assessment of the effect on whales' behavior by the use of a sonic device
A sonic device is expected to be used for the abundance estimation of krill in future. This experiment was planned in order to assess the effects of the sonic device on the behavior of whales.

d) Natural marking
Blue, humpback and right whales within 3 n.miles from the track line were photographed by the SV for natural marking.

e) Skin biopsy sampling
Blue, humpback and right whales which were sighted and photographed by SV were subjected to biopsy skin sampling.

f) Observation of the behavior of blue whales
The SV engaged in observation of behavior of blue whales on feeding grounds. Attention was paid to the diving time.

g) Observation of the behavior of beaked whales
Beaked whales such as Southern bottlenose whale, Arnoux's beaked whale and *Mesoplodon* species were paid close attention in order to assess the possibility of research take of them in future. They had reactions to approaching vessels.

h) Satellite telemetry tagging for minke whales
Attachment of a satellite telemetry tag to the whale body was tried on swimming minke whales.

i) Marine debris
The SV was engaged in the survey of marine debris observation in the research area. When the stomach of minke whale was examined on *NM*, the presence of artificial materials were checked.

j)Oceanographical surveys
Oceanographical surveys with XBT were carried out on board of *KS2* once a day at a discretionary point of the research area. In addition, *KS2* engaged in taking samples of air and sea water during the cruise as part of the Fisheries Agency's (Department of Research, Fishing Ground Environment Conservation Division) Global Environment Monitoring Scheme that utilizes fishing boats. And the floating substance collection was conducted by the neuston

net.

RESULTS

Sighting surveys

a) Survey period and main activities

Sighting and sampling activities were carried out in the Antarctic Areas IV and III East for 118 days from 26 November 1995 to 22 March 1996. The following is the detailed description of the survey period in each stratum and allotment of duties of three SSVs and one SV.

		KS2	*K01*	*T25*	*T18*
The first survey in eastern part of Area III					
	26 Nov. -22 Dec. 1995	SV	SSV	SSV	SSV[*1]
The entire research in Area IV					
South-west stratum	22 Dec.1995-9 Jan.1996	SV	SSV	SSV	SSV
North-west stratum	10 Jan.-26 Jan. 1996	SV	SSV	SSV	SSV
Prydz Bay	27 Jan.- 6 Feb. 1996	SV	SSV	SSV	SSV
North-east stratum	10 Feb.-19Feb. 1996	SV	SSV	SSV	SSV
South-east stratum	19 Feb.- 1Mar. 1996	SV	SSV	SSV	SSV
The second survey in eastern part of Area III					
	5Mar.-12Mar. 1996	SV	SSV	SSV	SSV
	13Mar.-22Mar. 1996	SV[*2]	SV[*3]	SV[*3]	SV[*3]

[*1] : *T18* arrived at research area on 3 December 1995 because of nautical instrument repairs.

[*2] : *KS2* finished sighting survey on 19 March 1996.

[*3] : Sampling activity finished the second survey in eastern part of Area III where 440th samples was obtained at 12 March 1996.

b) Cruise track

Fig. 2 shows the main cruise tracks in research areas. A broken line in Fig. 2 displays distinction of main cruise tracks between SV and SSVs. One vessel of three SSVs delayed to arrive on research area. Therefore, the first survey in eastern part of Area III was changed to make two cruises for investigate tendency and efficiency in the research activity, and the cruise track in the first survey took the shape of cross. The cruise track of north-west stratum in the Area IV overlaps with that of south-west stratum. Such a overlaps took place because cruise track of north-west stratum was set up from JIC ice information but it differed more or less from actual ice status. This was conducted to evade a lost area between the south border of north-west stratum and 45 n.miles lines from the actual pack ice line gotten from JIC ice information. The survey in Prydz Bay was conducted when pack ice opened. The shape and extent in the Pryze Bay were grasped by JIC ice information, and cruise track was constructed like hourglass line from to avoid biased research effort in longitude. The pack ice line in Fig. 2 are drawn by its positions observe during the research period.

c) Searching effort

The searching distance (n.miles) of a SV and three SSVs in each stratum is shown in Table 1. The total searching distance during the 118-day research period was 21,455.5 n.miles. The searching distance in this cruise was 3,521.6 n.miles longer than that in the 1993/94

JARPA (Nishiwaki *et al.*, 1994). This is due to more 11 days longer in the research period and one more research vessel than the previous research. Comparing the entire Area IV research with the 1993/94 JARPA, searching effort of SSVs increased by additonal one vessel but that of SV was considerably lower than that in the 1993/94 JARPA. Following several causes were considered . *KS2* (former squid jigging boat) of modified sighting vessel was slower in ship speed than ordinary whale catcher boat, and much time was lost by sighting procedure and returning procedure to the track line.

d) Cetacean species sighted

Table 2 shows the number of schools and animals sighted by cetacean species during research period.

As for ordinary form minke whales , 1,137 schools (2,585 animals) were sighted, including the primary sightings of 893 schools (2,021 animals) and secondary sightings of 244 schools (564 animals). Minke whales were the most dominant species throughout research period. As for dwarf form minke whales, 2 schools (2 animals) were primarily sighted in the north-east stratum.

In the baleen whales except for minke whales, 324 schools (561 animals) of the humpback whale were primarily sighted and 74 schools (139 animals) were secondarily sighted. Humpback whales were the second dominant baleen whales. As for blue whale 13 schools (28 animals) were sighted (primary: 9 schools 16 animals, secondary: 4 schools 12 animals). Fin whales were 82 schools (334 animals) (primary: 60 schools 214 animals, secondary: 22 schools 120 animals) . Right whales were 11 schools 13 animals (primary: 8 schools 8 animals, secondary: 3 schools 5 animals).

In this survey, it was characteristic that sightings of humpback and fin whales were increased compared with the previous research. Sightings of baleen whales which were not identified amounted 166 schools 303 animals (primary: 135 schools 231 animals, secondary: 31 schools 72 animals). It was considered that baleen whales concentrated around humpback and fin whales sighting place. Sightings of humpback and fin whales were not much to choose between sightings of minke whales in the first survey in eastern part of Area III. Humpback whales was sighted more than in previous research, with the exception of the Prydz Bay. The humpback whales were remarkably sighted in north-west stratum this area while minke whales sighted was not considerably different from previous research. In the toothed whales, 338 schools (349 animals) of the sperm whales were primarily sighted and 76 schools (82 animals) were secondarily sighted. Sperm whales were the most dominant in the toothed whales and density was almost the same as humpback whales. This is followed by 337 schools (647 animals) of beaked whales (primary: 305 schools 575 animals, secondary: 32 schools 72 animals) , including 157 schools (315 animals) of the Southern bottlenose whales , 2 schools (16 animals) of the Arnoux's beaked whales. In addition, 126 schools (1,455 animals) of killer whales , 30 schools (1,495 animals) of long-finned pilot whales and 30 schools (208 animals) of hourglass dolphins were sighted.

e) Distribution of minke whales

The geographical locations of primary sightings of the minke whales are plotted in Fig. 3. In the eastern part of Area III, it is noted that many minke whales were widely distributed. In the second survey, distribution of minke whales changed remarkably between the east and the west side, and a longitudinal line (near 53°E) seemed to form the boundary of such defference. Sightings concentrated in the east side. These results indicated the difference of the pattern of distribution in research ground of AREA III.

In the entire Area IV, it is noted that minke whales were also widely distributed. In the north strata, sightings dispersed with between 70°E and 110°E in the north of 63°S, but east side from 110°E, minke whales were widely distributed. It is noted that pack ice line was very stable and stayed between 64° S and 65°S from early January to early March. Sightings of humpback whales was well over that of minke whales in this area.

Table 3 shows the Density Indices (DI), which is the number of minke schools sighted as primary sightings per 100 n.miles searched and the mean school size (MSS). In the eastern part of Area III, DI and MSS in second survey were higher than the first survey.

In the entire Area IV, considerable difference was not observed in DI and MSS between the east and west sector in the research area. DI was higher than that of 1993/94 JARPA. MSS ranged from 1.59 to 2.78 and 2.27 in the average. It was noted that solitary schools were dominant in this area and schools of large number animals were few.
In the Prydz Bay, DI was 10.03 and MSS was 1.59, and they were similar to those observed in the 1993/94,. In the past surveys, high density was observed in the Prydz Bay. It was observed in the east section of the bay in the 1989/90 JARPA (DI: 31.88) and in the west section of bay in the 1991/92 JARPA (DI: 89.46). However, high density was not found in the Prydz Bay in the present research, although survey was conducted cover a wide range of the bay.

Distribution of other whales than minke whales

The distribution of baleen, sperm and beaked whales plotted from Fig. 4 to Fig. 7 respectively, which were the all sighted in the research period.

Humpback whales (Fig. 4):

Humpback whales were sighted in every strata except Prydz Bay and were widely distributed on the research area of the south of 60°S similar to distribution of minke whales. However, they overlapped rarely with minke whales.

In the first survey of the eastern part of Area III, humpback whales were widely distributed pattern of distribution in the second survey were remarkably different between east and west sides. They were widely distributed in western part of research area and restricted in the south part in east side.

In Area IV, they were widely distributed in the entire research area similar to 1993/94 JARPA. However, they were rarely found Prydz Bay. They were sighted more in the north strata than in the south strata. In the north strata, they were found in large numbers particularly between 83° E to 115°E. In this ground, humpback whales sometimes exceeded minke whales that were the dominant species in entire research area. In the south strata, a few sightings were obtained except for a part of the area .

Blue whales (Fig. 5):

In eastern part of Area III, 5 solitary animals were seen and 6 schools (school size of 2 to 4 animals) were sighted in the vicinity of 55°E between 63°30' S and 65°S in the first survey. However, they were not sighted in the second survey.

In the entire Area IV, 2 schools (3 animals) were sighted in the vicinity of 63°30'S between 113°E and 115°E.

Fin whales (Fig. 5):

Fin whales were widely dispersed in eastern part of Area III and Area IV during all research periods. Most of the schools were composed of 2 animals or more. In addition, it was

confirmed that these sightings concentrated two parts of research area , between 61°S and 63°S of 35°E to 44°E in eastern part of Area III in the first survey and in the vicinity of 65°S between 126°E and 130°E in Area IV. Sightings in these areas overlapped with humpback whales, and sightings of minke whales were rare in the areas.

Right whales (Fig. 5):
Right whales were only observed in eastern part of Area IV. Sightings were widely dispersed. Most of sightings were concentrated in the vicinity of 63°30'S between 113° and 115°E.

Sperm Whales (Fig. 6):
Sperm whales were widely sighted in eastern part of Area III in the first survey. However, these sightings concentrated in the area between the ice-edge and 100 n.miles off the edge and near the ice bergs. And non of them were found in the second survey.

In the entire research in Area IV, sperm whales concentrated more in the south strata than in the north strata. However, none of them were found in the Prydz Bay.

Beaked whales including southern bottlenose whales (Fig. 7):
Beaked whales including southern bottlenose whales were widely distributed in research area during research periods. Dense distribution of beaked whales were found in the vicinity of ice edge between 90°E to 100°E. The distribution pattern of them were more dense in the north strata than the south strata. However, sightings were few in the Prydz Bay, although some schools were found in the entrance of the bay. The distribution pattern of beaked whales was not similar to that of minke whales.

Sampling
a) Sampling activities and samples
In the present research, samples were taken randomly based on the rule of one animal from one school at primary sighting in order to improve the representation of the population. However, in order to avoid an excessive burden of the research base vessel and to biases that samplings concentration in a particular time of the day, there were some cases in which sample numbers were adjusted, especially in such areas that minke whales were densely distributed. A total of 440 ordinary form minke whales were sampled from 26 November 1995 to 12 March 1996. The number of samples in each stratum is as follows, and Fig. 8 shows the sampling positions based on their sighting position.

Stratum	Male	Female	Total
The eastern part of Area III			
First survey	46	24	70
Second survey	23	17	40
The entire research in Area IV			
South-East	18	22	40
North-East	26	8	34
South-West	101	29	130
Prydz Bay	22	54	76
North-West	37	13	50

b) Sampling efficiency

The efficiency of sampling of minke whales in each stratum is shown in table 4. A and B show the total number of schools and individual minke whales which were primarily sighted by the sighting/sampling vessels, and C and D show the number of target animals for sampling and of samples actually taken. The sampling efficiency I (D/B) shows the ratio of samples actually taken to total primary sightings. The value decreases in the area where the mean school size is large and samplings is small. The sampling efficiency I was 0.31 in average, which was almost the same as the previous research. The sampling efficiency II (D/C) shows the ratio of samples actually taken to the number of target animals for sampling. This value is supposed to indicate technical efficiency or success rates of sampling. In the eastern part of Area III, these were 0.77 in the first survey and 0.87 in the second survey. As for the entire Area IV, the value ranged from 0.79 to 0.93 in the north stratum, while it was from 0.91 to 0.95 in the south stratum. It was 0.84 in the Prydz Bay area where water was muddy color and transparency were not clear enough to track whales successfully. The sampling efficiency II was 0.86 on average for the all research areas. This value was a high compared with previous research.

Out of target animals, 69 could not be taken. Sight was lost before confirmation of target whale in case of 8 animals. 34 animals were missed because they swam too fast or dived too long or too quick to take. 16 animals were abandoned to take because they crossed the border or escaped into the pack ice and 11 animals were missed by technical reasons.

Biological survey

a) Survey items and the number of samples

The number of samples in each items of the biological survey is shown in Table 5. All the samples, except one sample lost in the delivery from sampling vessel to research base vessel, were subjected to the biological survey on the research base vessel.

They were processed after the survey was finished. From the lost whale, information on estimated body length and sex, and a blood sample was collected aboard *T18*. Further more a part of blubber was collected aboard *NM*. There were 439 samples in total of which males were 272 and females were 167.

In addition, 95 fetuses were collected from 96 pregnant females, and one fetus was lost from harpooned wound. In eastern part of Area III, two large fetuses were collected, a male of body length of 281.5 cm at 2 December 1995 and a male of 222.2 cm at 7 March 1996. A fetus of 281.5 cm was the largest record through previous surveys of JARPA.

b) Optional biological survey and experiment

A detailed research was conducted to compare the biological data of ordinary form minke whales with those of dwarf form minke whales which were collected in the past. The skull of four whales were processed and measured in detail. Number of vertebra and rib were counted for 40 samples and all samples.

Blood samples were collected on the deck of the *NM* and *T18*. Those were immediately analyzed for serum contents chemically in the laboratory of the *NM*.

Live sperm from 61 and follicular oocytes from 157 minke whales were collected on board of *NM*. In vitro maturation and fertilization of immature follicular oocytes were performed by Dr. Yutaka Fukui, Professor of the Obihiro University of Agriculture and Veterinary Medicine. The result of the investigation will be published in detail in near future.

Experiments

a) Distance and angle estimation experiment

The four sighting and sampling vessels rehearsed the distance and angle estimation experiment after they entered the research area. *K01*, *T25* and *T18* conducted the experiment on 3 January 1996, and *KS2* did it on 26 January.

Six top men and seven persons on the upper bridge who were responsible for searching took part in the experiment. They estimated distances and angles to the buoy from the positions of eight different combinations of distances and angles. A total of 216 experiments were conducted by the four vessels with the participation of 400 persons in total.

b) Reaction monitoring experiment

This experiment was conducted on 4 and 5 February 1996 in the central part of the Prydz Bay. Two sets of trials were carried out. Deployment of sampling and observing vessels changed every trail. Fig. 5 shows activity of sampling vessel with positions of minke whales estimated by the observing vessel.

In the first trial, sampling vessel sighted 2 schools (3 animals) and sampled 2 animals. Two observing vessels observed 3 schools (5 animals). It seem that these schools did not respond to echo whale finder which was used two times during sampling activity. In addition, a sampling vessel during searching after taking 2 samples closed to one school (1 animal) near 0.2 n.miles. However, that school was not sighted sampling vessel and showed no response.

In the second trial, sampling vessel sighted 4 schools (10 animals) and sampled 3 animals. Two observing vessels observed 9 schools (12 animals). It was observed in the schools except for targeted.

As a result in two trails, effects of sampling activity were not observed through reactions of minke whales around the trial areas.

c) Photographing of natural markings

Natural markings of blue, humpback and right whales which were sighted during the research period were photographed by the SV.

Four blue whales from 3 schools (4 animals), 48 humpback whales from 25 schools (50 animals) and 4 right whales from 4 schools (4 animals) were photographed. (Table 6).

d) Biopsy sampling of blue, humpback and right whales

The collection of biopsy samples was tried from the whale species whose natural markings were the target of photographing.

Ten biopsy samples were collected from 24 schools (48 animals) of the humpback whale, 1 sample from 3 schools (4 animals) of the blue whale and 1 sample of right whale from 4 schools (4 animals) .

e) Observation of the behavior of blue whales

Observations of the behavior of blue whales were conducted on 2 schools (4 animals) in the first survey and on 1 school (1 animal) in the second survey during research periods in eastern part of Area III. All surfacing cues were counted in these cases.

In the first trial, two blue whales were observed for 37 minutes. Surfacing were confirmed 5 times within 29 minutes, cues were counted 39 times. Cues per one surfacing counted from 5 to 10 times and 8 times on the average. The diving time ranged from 6 to 9 minutes and 7.3 minutes in the average. The traveling distance between surfacing ranged

from 0.1 to 0.7 n.miles and 0.43 n.miles in the average. The total traveling distance during the observations was 1.7 n.miles.

In the second trial, four blue whales were observed for 38 minutes. Surfacing were confirmed 5 times within 34 minutes, cues were counted 97 times. Cues per one surfacing counted from 12 to 24 times and 19 times in the average. The diving time ranged from 7 to 10 minutes and 8.5 minutes in the average. The traveling distance between surfacing ranged from 0.7 to 1.4 n.miles and 1.0 n.miles in the average. The total traveling distance during the observations was 4.0 n.miles.

In the third trial, one blue whale was observed for 18 minutes. Surfacing were confirmed 3 times within 5 minutes, and cues were counted 10 times. Cues per one surfacing counted from 3 to 4 times and 3.3 times in the average. The diving time ranged from 2 to 3 minutes and 2.5 minutes in the average. The traveling distance between surfacing was 0.2 n.miles in the average. The total traveling distance during the observations was 0.4 n.miles.

f) Observation of the behavior of beaked whales

Eighteen schools (43 animals) of species which belongs to the beaked whales were sighted and approached for the observation of their behaviors. 15 schools (39 animals) of the southern bottlenose whale were identified. The remaining 3 schools (4 animals) were unidentified from the first sighting information and cues during observation (table 7).

Total observation time was 789 minutes. One observation ranged 34 to 62 minutes. The shortest approaching distances to these schools were 0.02 to 0.8 n. miles on the southern bottlenose whale except two cases of available shooting distance below 0.05 n.miles, and 0.4 to 1.5 n. miles on the unidentified beaked whales. A diving time ranged from 5 to 36 minutes and 20.9 minutes on average for 11 schools of the southern bottlenose whale. The traveling distances during diving were 0.1 to 1.5 n.miles, 0.79 n. miles on average.

g) Attachment of a satellite telemetry tag to minke whales

A modified biopsy firing system was used and attempted to attach a satellite telemetry tag to swimming minke whale by the *T25*. The trial was conducted on 7 schools (50 animals) of minke whales that were sighted along the ice edge on 23 February 1996. However, there was no chance to attach a satellite telemetry tag because these schools were not reached the firing range.

h) Assessment of the effect on whales' behavior by the use of a sonic device

KS2 engaged in two types of assessments of the effect on whales' behavior by the use of a sonic device (echo sounder and scanning sonar).

In the experiment by echo sounder, searching in the passing mode using echo sounder was conducted along the track line for a period of 30 minutes after the regular research time. The result of observation of whale reaction were recorded during experiment (Fig.10). The observations were conducted 56 times during research periods. Searching times were 804 minutes in total, and searching distance was 300.4 n.miles in total. Table 9 shows summary of whale reaction during the experiment. Reactions of minke whales were confirmed 1 case. In the case, when *KS2* approached a school of two minke whales within a distance of 0.3 n.miles, they began splash forward or swimming very fast. These results were not substantially different from normal searching without echo sounder. It was unknown if such reactions were due to the vessel itself or to the echo sounder.

The experiment by scanning sonar were conducted in the same procedure of echo sounder during transit along the pack ice. These were conducted 18 times during research

periods, searching time was 525 minutes, and searching distances were 94.8 n.miles in total. Table 10 shows summary of whale reaction during the experiment. Reactions of minke whales were observed in 9 schools (21 animals) of 12 schools (25 animals) sighted during the experiment. In tha case of minke whales, when *KS2* approached to minke whales within ranged 0.2 to 0.7 n.miles, they began splash or swimming very fast. However, it was unknown if such reactions were due to the vessel itself or to the scanning sonar. These results were not significantly different from the preliminary experiment in 1993/94 JARPA.

i) Marine debris and floating whale carcass

Marine debris recording was conducted during the present research (table 11). No debris was not found from the stomach contents of the whales sampled. A hook for tuna long-line fishery was stuck at the angle of the mouth of a minke whale , 7.49 meters in length and 4.74 tons in weight, which was sampled at 62°50' S and 68°49' E o n 22 December 1995.

Arnoux's beaked whale carcass was found floating at 63°01'S and 78°23'E on 29 December 1995.

j) Oceanographical surveys

The XBT observation was made at 98 locations from 11 November 1995 to 14 March 1996 by *KS2* (fig. 11). Meteorological data, such as weather conditions, wind direction, wind power, atmospheric pressure, surface water temperature was also recorded.

In addition, *KS2* was engaged in taking samples of microsubstances in air and sea water by the use of a filter at discretionary points in the research area (fig. 11). And the floating substances were collected by the neuston net (fig. 13).

Products

After the biological survey was completed, all whales were processed according to the provisions of Article VIII of the Convention. All of 440 except one lost sample were processed to produce 1,887.513 tons of frozen products and 55.5 tons of whale oil (table 12).

Results of preliminary analysis

a) Body length

Table 9 shows the average body length and the range of body lengths according to different subareas and different reproductive status. The average body length of the sampled whales were as follows: immature male 6.49 meters, immature female 6.70 meters, mature male 8.45 meters and mature females 8.95 meters. The present results were not substantially different from those observed in the 1993/94 JARPA.

I n the Prydz Bay of the average body length, mature was smaller and that of immature bigger than other strata. These results were indicated that many animals within 7 to 8 m in the body length were sampled in the Prydz Bay. .

Fig . 14 shows body length compositions of minke whales sampled in Area IV and eastern part of Area III.

b) Maturity rates

For females, the existence of corpus luteum or corpus albicans in the ovaries, the width of uterine horn and thickness of the mammary glands were examined in order to estimate their matuity status, and then samples were categorized as follows: 1) immature, 2) ovulating (not existent of corpus albicans but existence of corpus luteum), 3) resting (not exstent of corpus-luteum but existent of corpus albicans 4) pregnant, 5) lactation, 6) pregnant and lactation, 7)

unidentified mature. And for males, determination should be made by the histological observation of the testis and epididymis. However, such analysis was not completed and thus samples were categorized as the mature male when they have the testis weighing more than 400g (Ohsumi *et al.*, 1970: Kato, 1986).

Table 14 shows the maturity status of the sampled whales. The ratio of samples categorized by their maturity status is as follows: mature male 46.8%, immature male 15.0%, pregnant female 21.8% (including simultaneous lactation), mature female without pregnancy (resting and ovulating) 1.8% and immature female 14.1%.

In the Area IV, difference was observed between the east and the west. In the east, the ratio of immaturity whale is higher than in the west, and ratio of pregnancy of mature female was low. Except for the Prydz Bay, the ratios of mature males were dominant with range of 35.0 to 64.6%. In the Prydz Bay, pregnant females accounted for 59.2% and was consistent with the result of the previous surveys.

In eastern part of Area III, ratio of immature males was as high as 25.7% in the first survey. However, ratio of immature males decreased to 10.0% in the second survey and ratio of pregnant females increased from 22.8% to 30%.

c) Change in the average thickness of blubber

Figure 15 shows the moving average thickness of blubber of mature whale (the average thickness of blubber measured from the three locations of the body) in relation to the progress of the research (every ten research days). As sampling activities were conducted alternately between the north and south strata, it might have been the case that the difference of the strata affected the thickness of blubber. However, it was indicated that the average thickness increased as the research progressed. These results was almost the same as that in the 1993/94 JARPA (broken lines in the figure).

Fig.16 shows relationship between the mean blubber thickness and fetal body length. These results indicated that the mean blubber tickness increased as fetal body length become larger.

d) Stomach contents of sampled whales

Observation of stomach contents of the first stomach and weigh of them were conducted on 380 samples, excluding 59 whose first stomach had been destroyed by the harpoon. Stomach contents of the first stomach were collected out of 186 samples. Prey species from stomach contents were identified. And, sex and maturity status of main prey species were observed.

Fig.17 shows food composition of minke whales sampled in each stratum. Antarctic krill (*Euphausia superba*) was found from 158 samples and it accounted for 84.9% of stomach contents. *E. crystallorophias* was found from 8 samples in the Prydz Bay. In the north of 64°S, *Thysanoessa macrura* was found from 13 samples. And *Parathemisto gaudichaudi* was found 7 samples with krill species, and it was observed a small quantity around the north-east stratum in Area IV.

DISCUSSION

Segregation between whales species

In 1993/94 JARPA, Humpback, sperm and beaked whales (including southern bottlenose whales) were widely distributed within entire research area. These were similar to pattern

of distribution of the minke whales except for the Prydz Bay. As for the distributions of the minke and the humpback whales, it was noted that minke whales were mainly sighted in the south strata. On the other hand , humpback whales were frequent in the north strata but they were scattered in the south strata. In case of the sperm and beaked whales, there was a distinctive separation of their distributions in the north strata. In the south stratum where the sightings of the two species were concentrated, when either of the two species was dominant, the other was infrequent or none. This is indicative that the two species may segregate their habitats (Nishiwaki *et al.*, 1994) .

In the present research, simillar pattern of distribution were observed between minke and humpback, sperm and beaked whales. As for the distribution of humpback whales, high density area compared with other area were found between 83° E and 115E°, 64°S to 65°S where ice edge line was fixed through the research periods. Density of humpback whales in northern part of this area exceeded that of minke whales that was dominant species in entire research. However, there was scattered in the south strata and was never sighted in the Prydz Bay. As for the distribution of minke whales, it was noted that sightings were widely distributed in the research area. In the north strata, sighting dispersed with small density between 70°E and 110°E in northern part of this area. In a part of east side from 110°E, minke whales were widely distributed. And in south strata and Prydz Bay, therewere high density compared with north strata. These results indicated that humpback whales were mainly distributed in northern part of the research area, and minke whales were mainly distributed southern part of research area especially near the pack ice and the Prydz Bay. It was known that the distribution of minke whales also observed in areas within the ice edge (Leatherwood *et al.*, 1981: Naito, 1982). It was presumable that minke whales go beyond the ice edge to avoid competition with the humpback whales. It is likely that the distribution and density of minke whales in the south stratum may be underestimated, when the ice edge was located further north than usual. In the future, it may be necessary that the location of the ice edge is taken into consideration when abundance estimate is calculated.

In order to clarify the ecosystem of the Antarctic Ocean, it is also necessary to research the distribution and migration not only minke whale but other species such as the humpback whale, sperm whale and beaked whales, in addition to research on the abundance and distribution of food sources.

Preliminary comparison of biological data between eastern part of Area III and IV

It was suggested that different stock of minke whales migrated into the western part of the Area IV early in the feeding season from the analysis of mt DNA variation in the Southern minke minke whales (Pastene *et al.*, 1995). The primary objective of the research in the eastern part of the Area III is a feasibility study on stock identity (the Government of Japan., 1995). Although genetic analysis for stock identification from the sample taken in this year, will be done at the laboratory, we preliminary compared some biological data in the eastern part of the Area III with the Area IV on board.

a) Average body length

Fig. 14 shows frequency distribution of body length and average body length in three longitudinally divided areas, eastern part of the Area III (35°E-70°E), western part of the Area IV (70°E-100°E) and eastern part of the Area IV (100°E-130°E). Comparison of average body length shows significant difference in two combination in female, one is eastern part of the Area III and eastern part of the Area IV, another is western and eastern part of the Area IV (t-test, $p<0.05$), but on the other hand, no significant difference is observed between eastern

part of the Area III and western part of Area IV in female and all combination in male.

It is supposed that concentration of pregnant female in the Prydz bay lead to such difference, because no significant different is observed when the data of the Prydz bay is excluded from the western part of the Area IV. The eastern part of the Area III located closely to the Prydz bay and many large matured female were collected in eastern south of the Area III in the second period (fig. 8). It seems that the most of female minke whale in the Prydz bay tend to migrate through in the eastern part of the Area III.

b) Fetal length

Fetus which length is under 10cm was dominant in eastern part of the Area III in the first period (44%). On the other hand, a fetus with length of 281.5cm was collected in the same period (2 December). A fetus with length of 222cm was also collected in the same area but in the second period (7 March). According to the formula in Kato and Miyashita (1991), fetal length under 10cm is considered within one month from the conception and length of 281.5cm is nearly 11 months which is parturition time with length of 290cm (Kato and Miyashita., 1991). The mean blubber thickness (the mean of three points of left side) of the pregnant female with the fetus of 281.5cm suggests that this whale had been stayed for long period in the Antarctic Sea as well as whales which sampled in the late season of the research (Figs. 15,16). It supports the consideration that arrival and leaving time of minke whale in the Antarctic Sea is not restricted (Kato and Miyashita,1991.,: Nishiwaki *et al.*, 1994).

In past JARPAs, there is no record of fetus with length over 180cm in the Area IV. Such record in the Area V was dated after the end of February. From the existence of pregnant female near the parturition time in the Area III, with the possibility that matured female in the Prydz Bay migrate through the Area III, we can speculate that the Area III is geographically located near the breeding area of minke whale than the Area IV.

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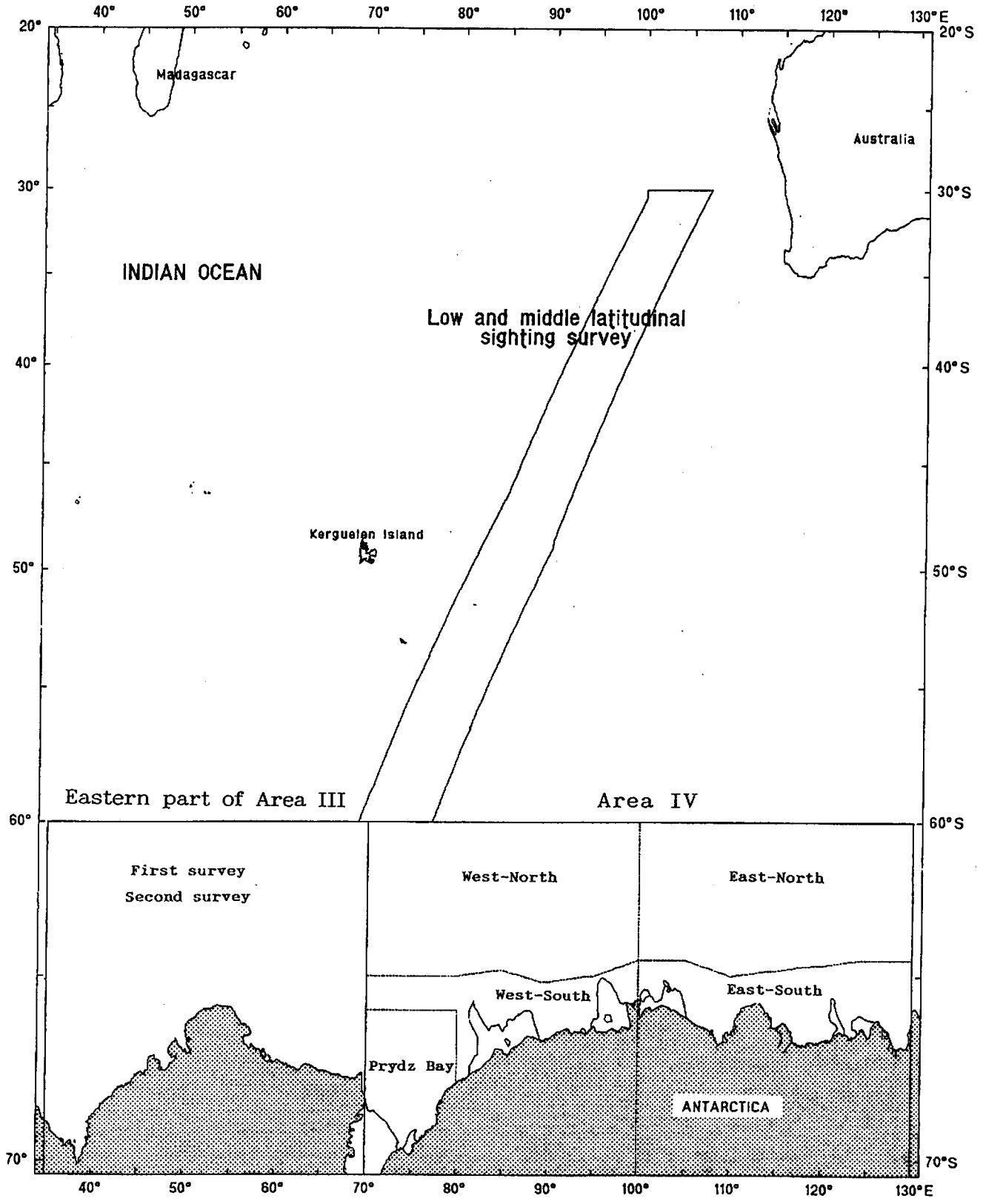

Fig. 1. Geographical location and the stratification of the research area in JARPA in 1995/96.

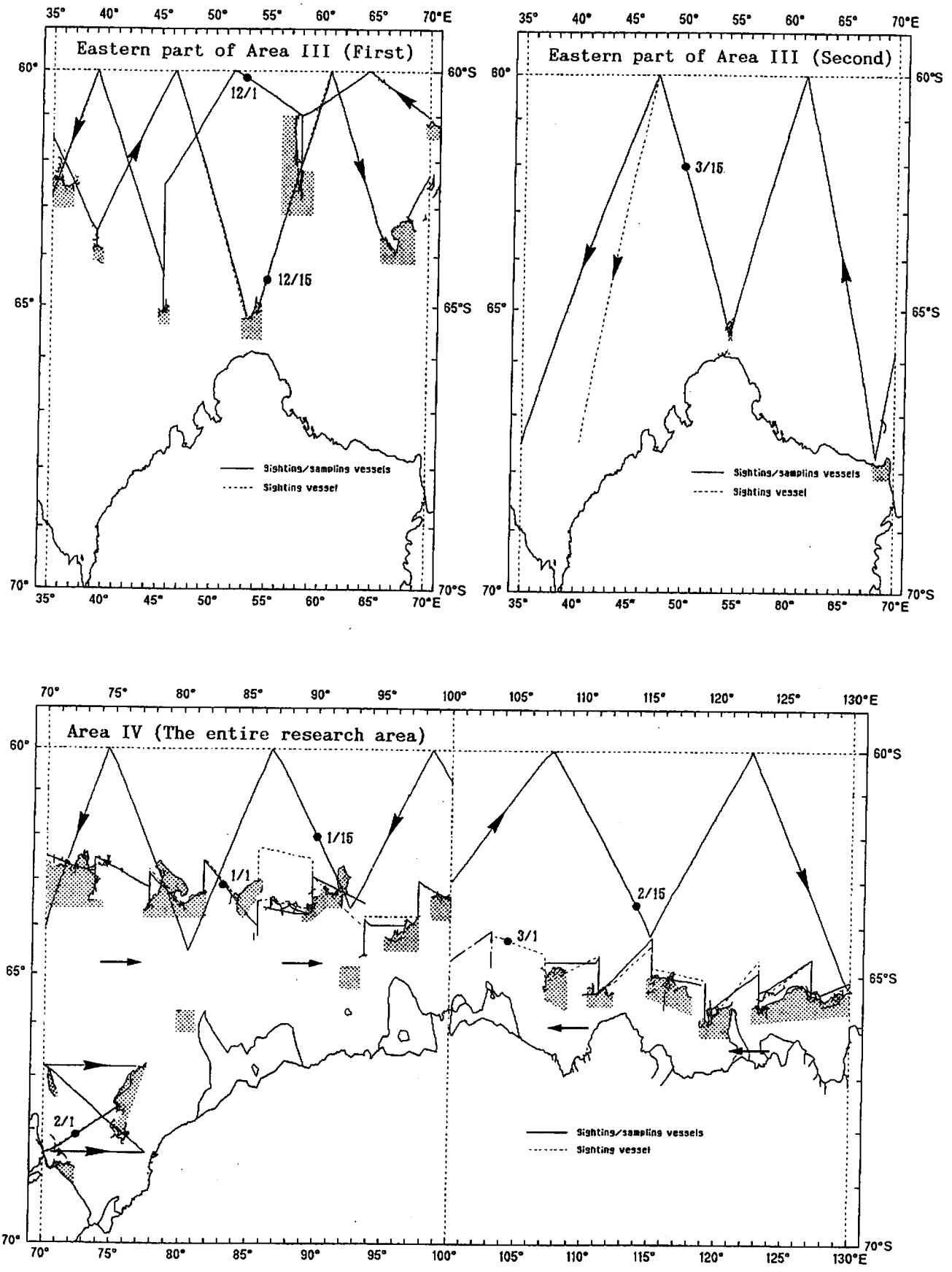

Fig. 2. Cruise tracks and noon positions of *Nisshinmaru* in JARPA in 1995/96. Upper; eastern part of Area III (first and second survey), lower; Area IV (the entire research area).

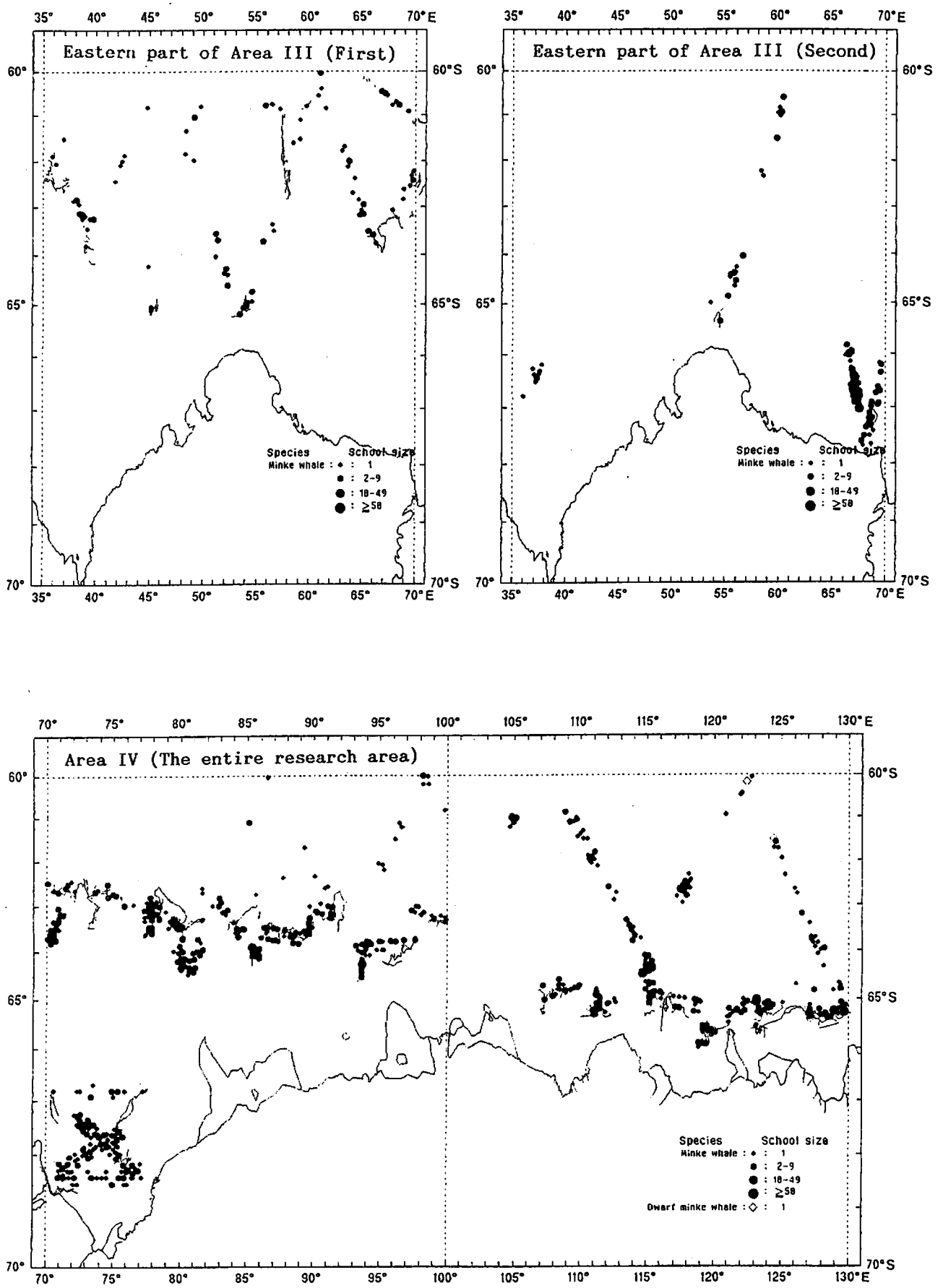

Fig. 3. Distribution of the primary minke whale sightings by a sighting vessel and three sighting/sampling vessels.
Upper; eastern part of Area III (first and second survey),
lower; Area IV (the entire research area).

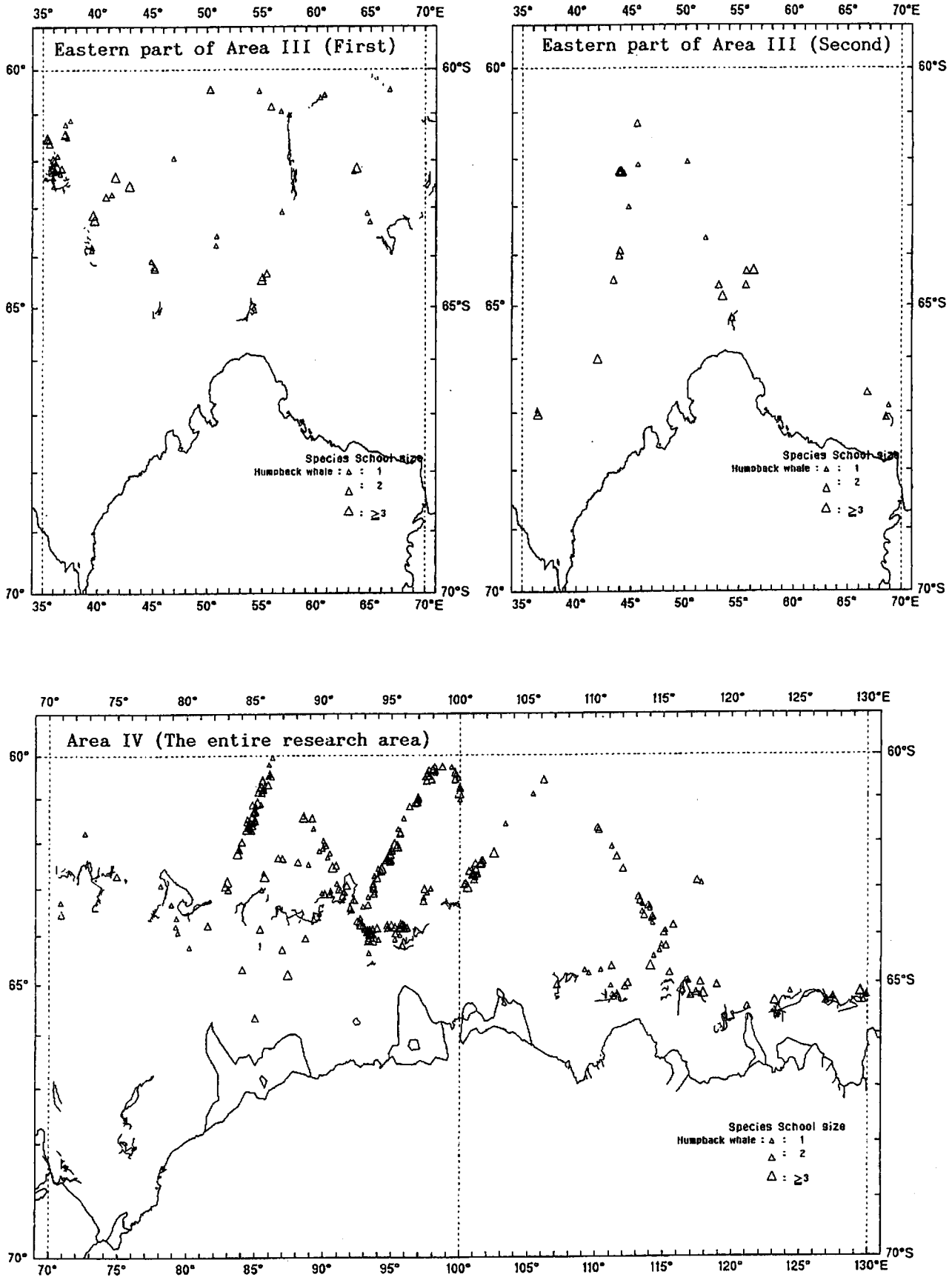

Fig. 4. Distribution of humpback whale sightings by a sighting vessel and three sighting/sampling vessels.
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lower; Area IV (the entire research area).

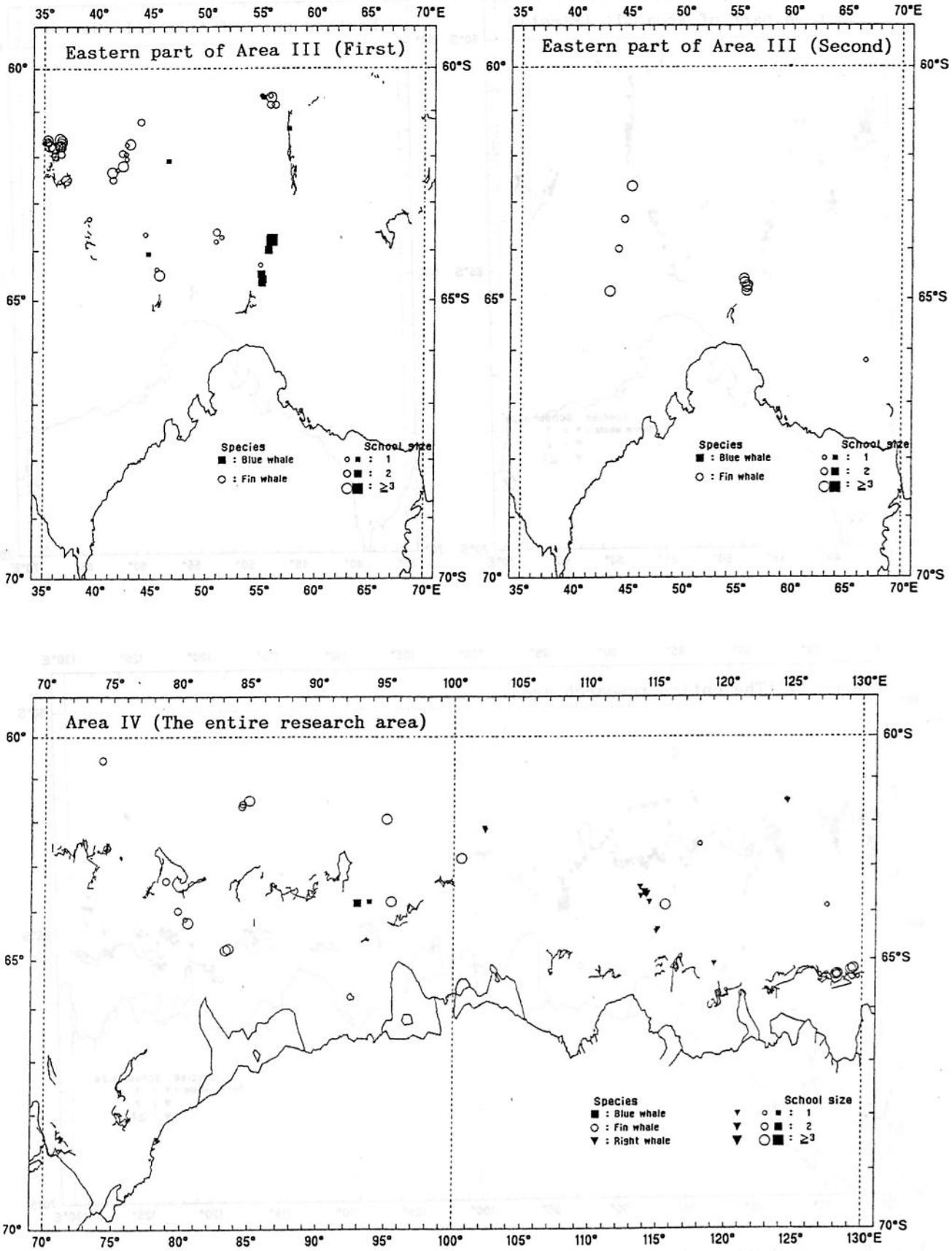

Fig. 5. Distribution of sightings of blue, fin, right whales by a sighting vessel and three sighting/sampling vessels.
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lower; Area IV (the entire research area).

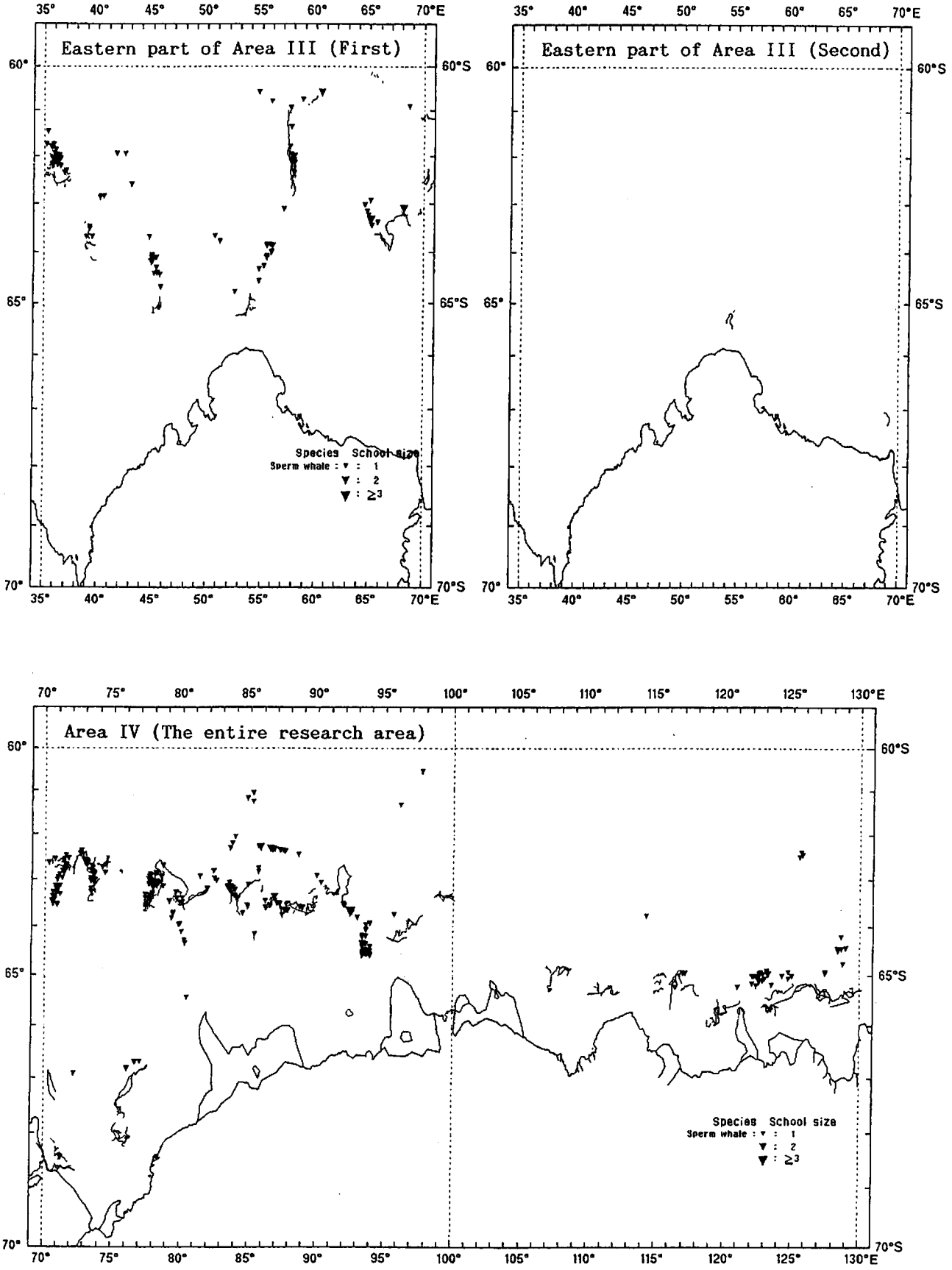

Fig. 6. Distribution of sperm whale sighting by a sighting vessel and three sighting/sampling vessels.
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lower; Area IV (the entire research area).

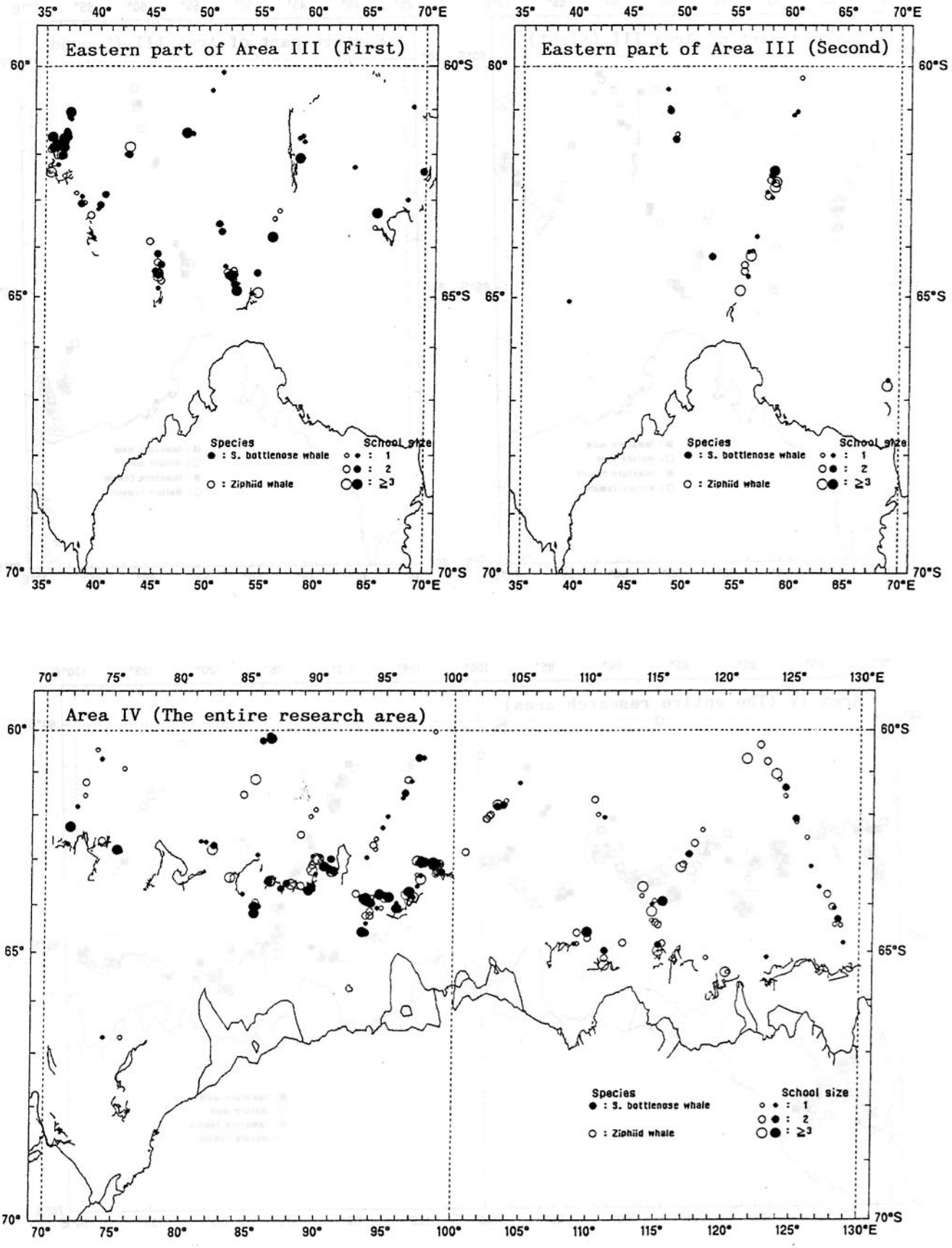

Fig. 7. Distribution of southern bottlenose whale and other ziphiid whales sightings by a sighting vessel and three sighting/sampling vessels.
Upper; eastern part of Area III (first and second survey),
lower; Area IV (the entire research area).

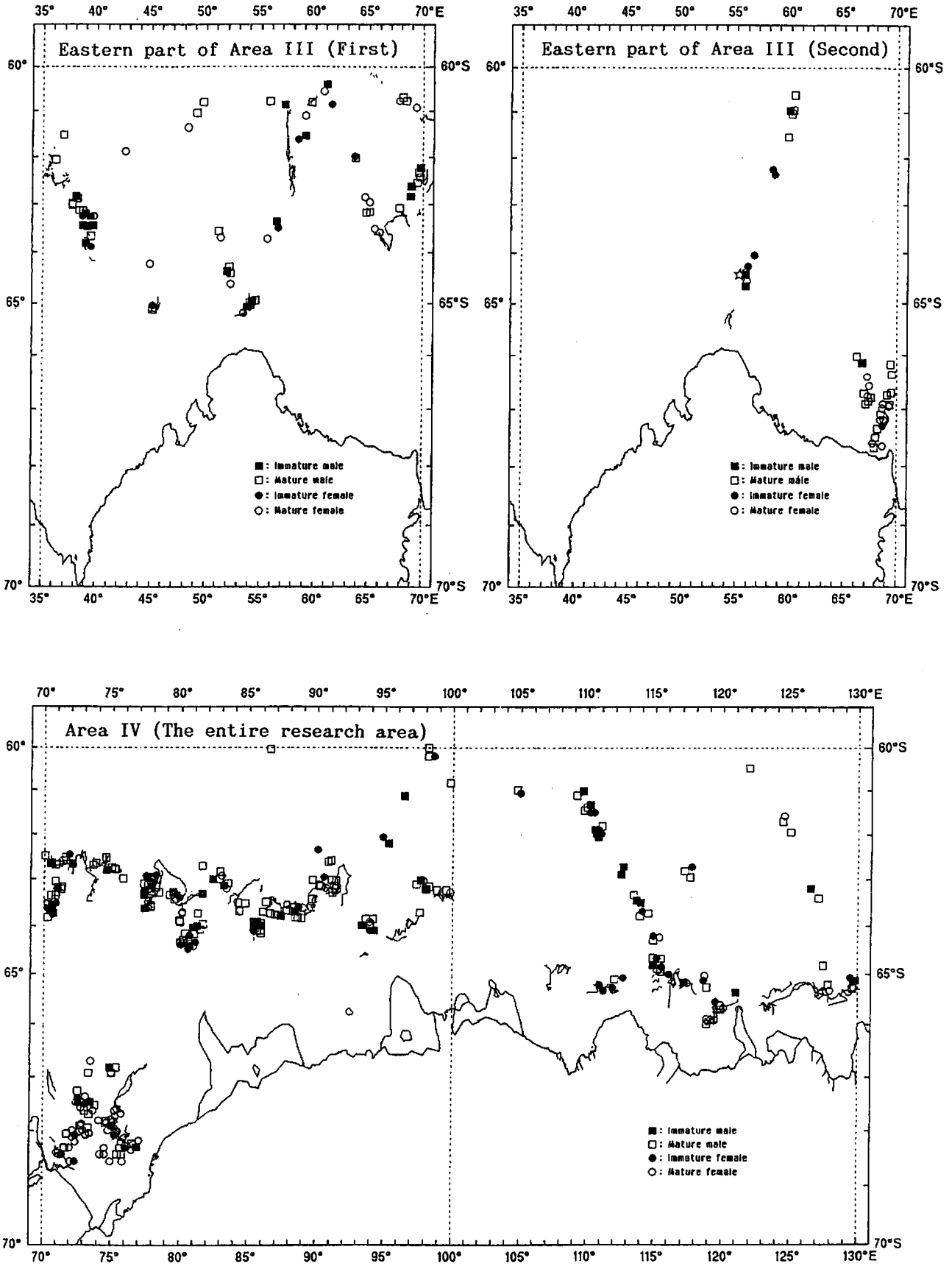

Fig. 8. Distribution of minke whales which were sampled based on their sighted position. One male sample was lost and couldn't be identified its reproductive status (asterisk).
Upper; eastern part of Area III (first and second survey),
lower; Area IV (the entire research area).

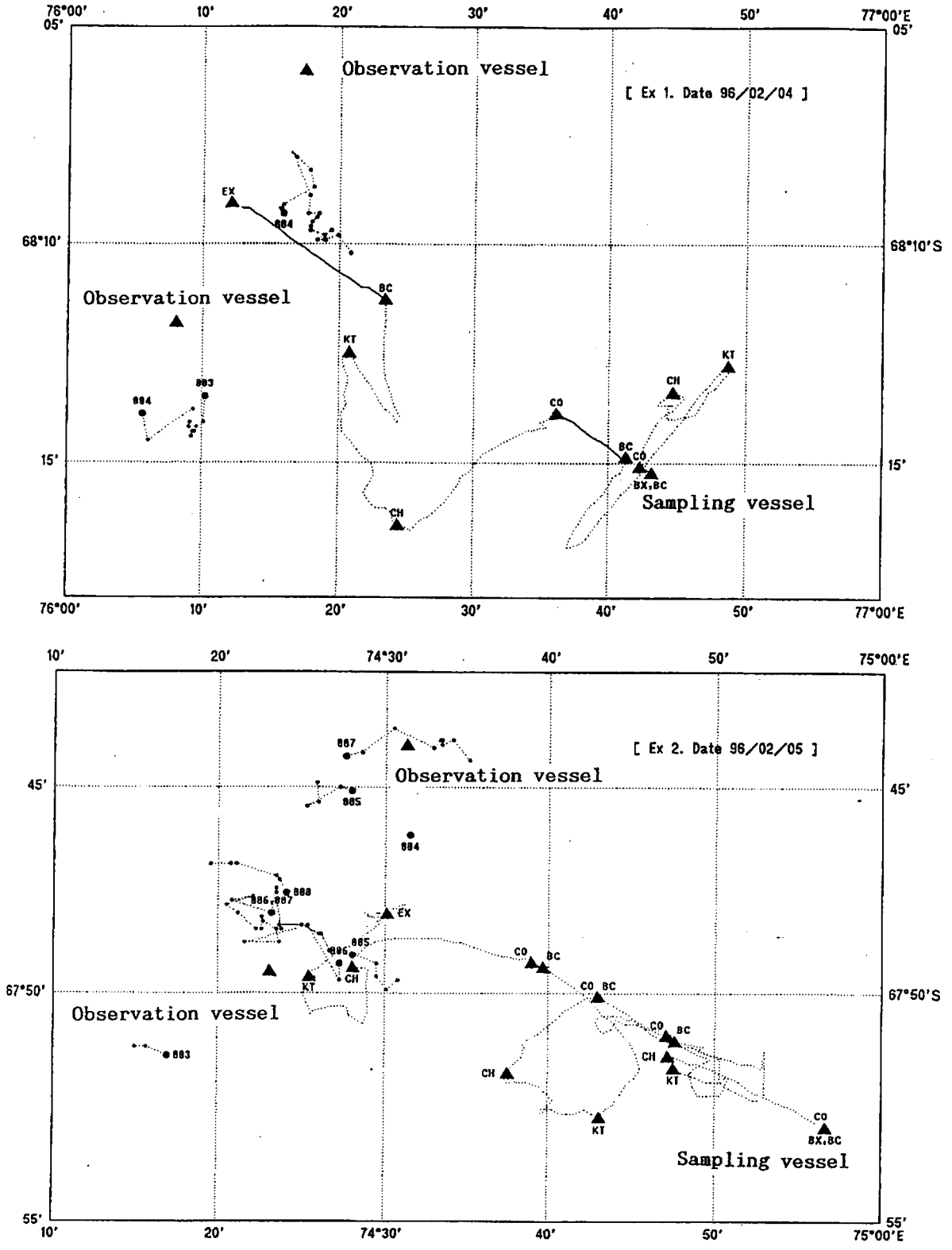

Fig. 9. The track of one sampling vessel and position of minke whales which were observed by two observation vessels during reaction monitoring experiment. Numbers represent schools of minke whale. Each action code of sampling vessel is as follows: BX; start of experiment, BC; start of sighting activity, CO; start of confirming minke whale school, CH; start of chasing, KT; finish of sampling, EX; end of experiment. Upper; first experiment, lower; second experiment.

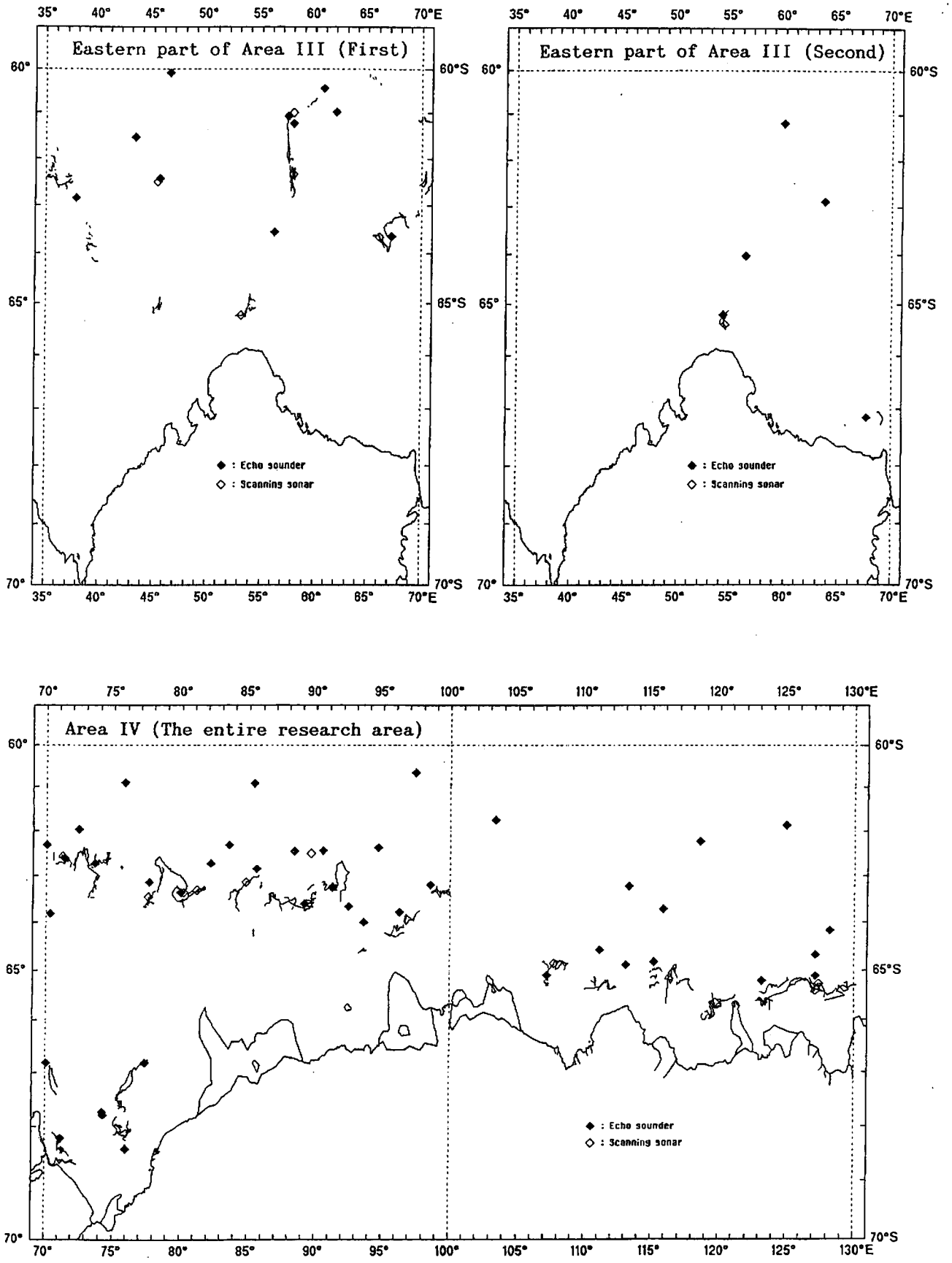

Fig.10. Positions of the echo sounder and the scanning sonar experiment.
Upper; eastern part of Area III (first and second survey),
lower; Area IV (the entire research area).

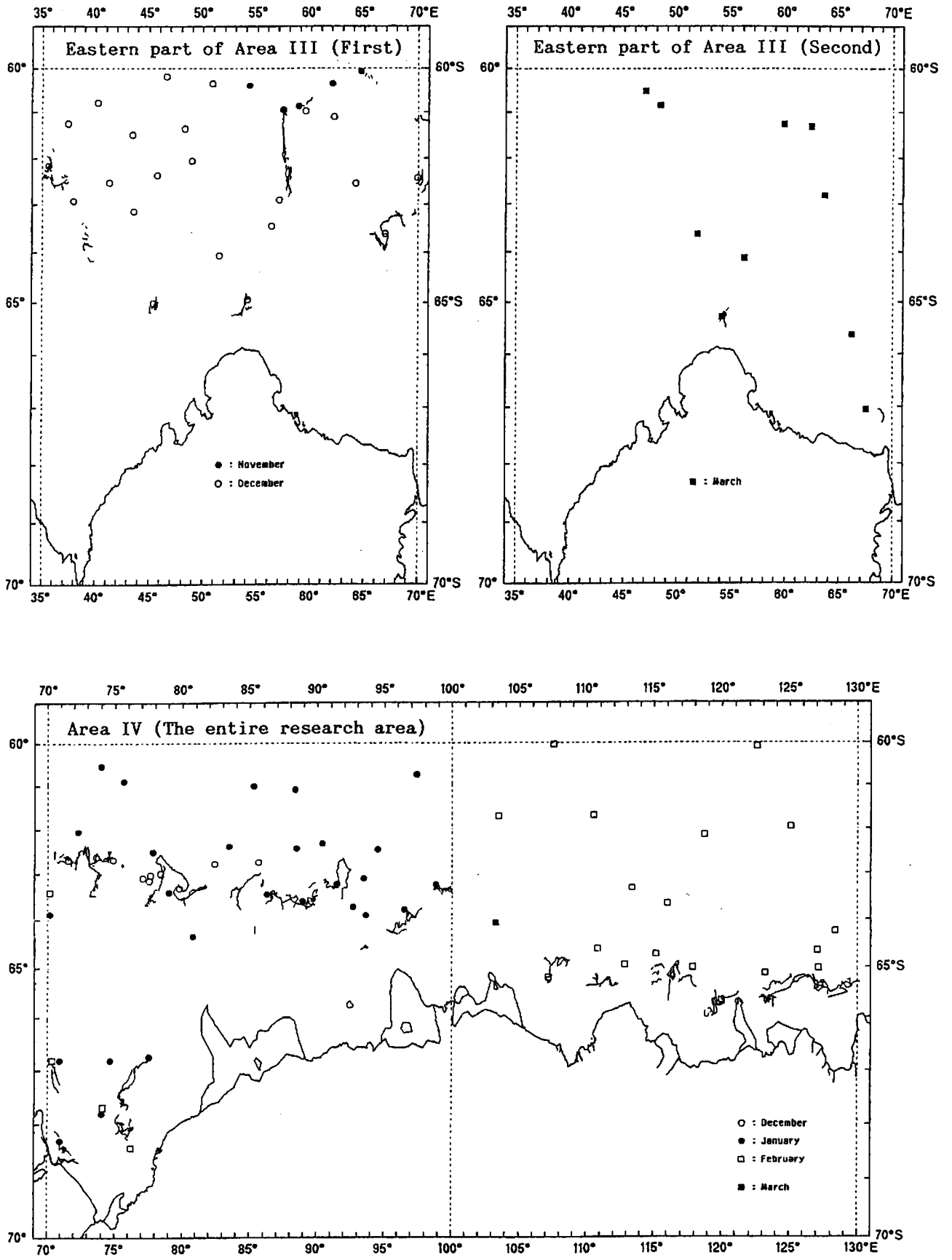

Fig.11. Position of the XBT survey.
Upper; eastern part of Area III (first and second survey),
lower; Area IV (the entire research area).

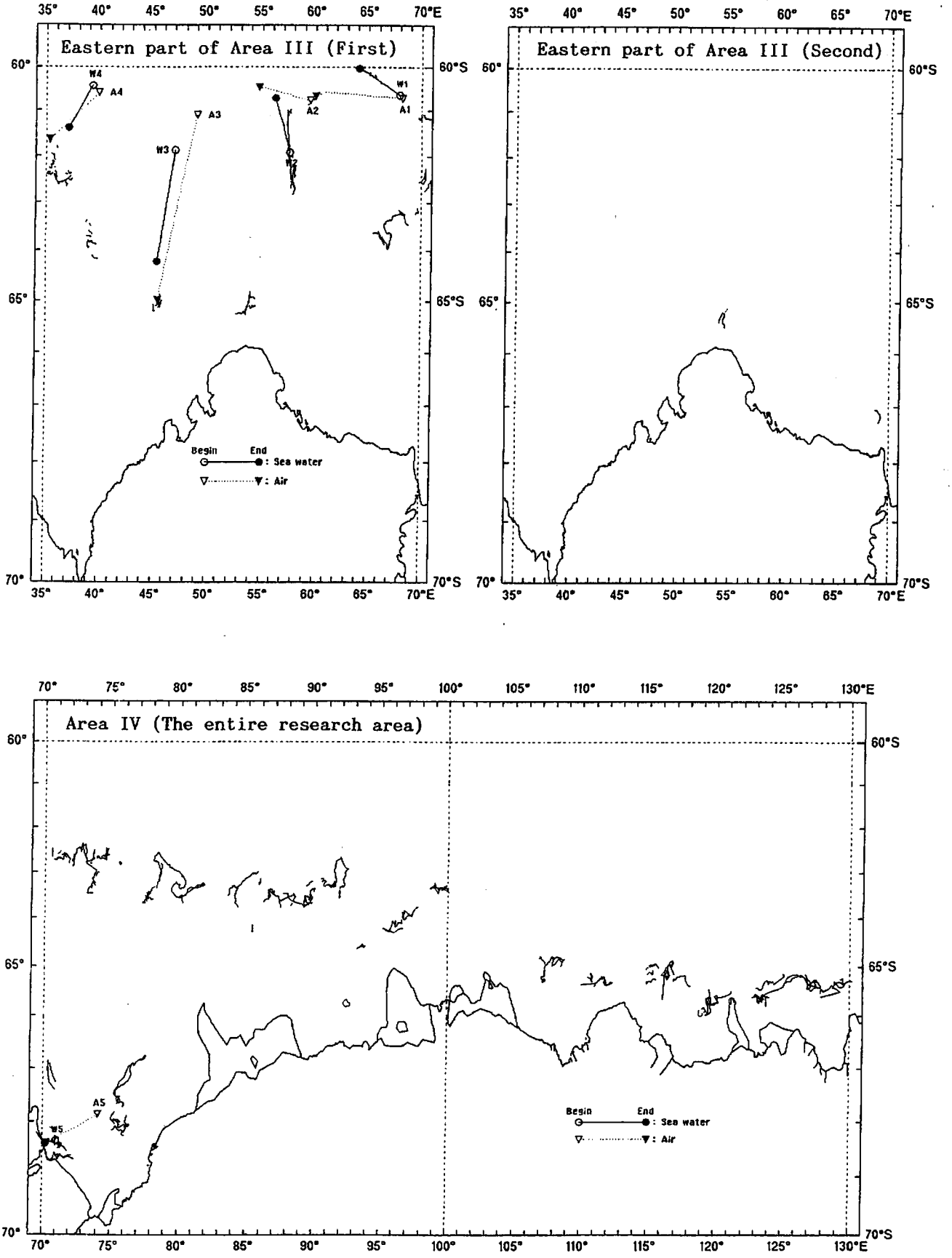

Fig.12. Position of the air and sea water collection for oceanographical surveys.
Upper; eastern part of Area III (first and second survey),
lower; Area IV (the entire research area).

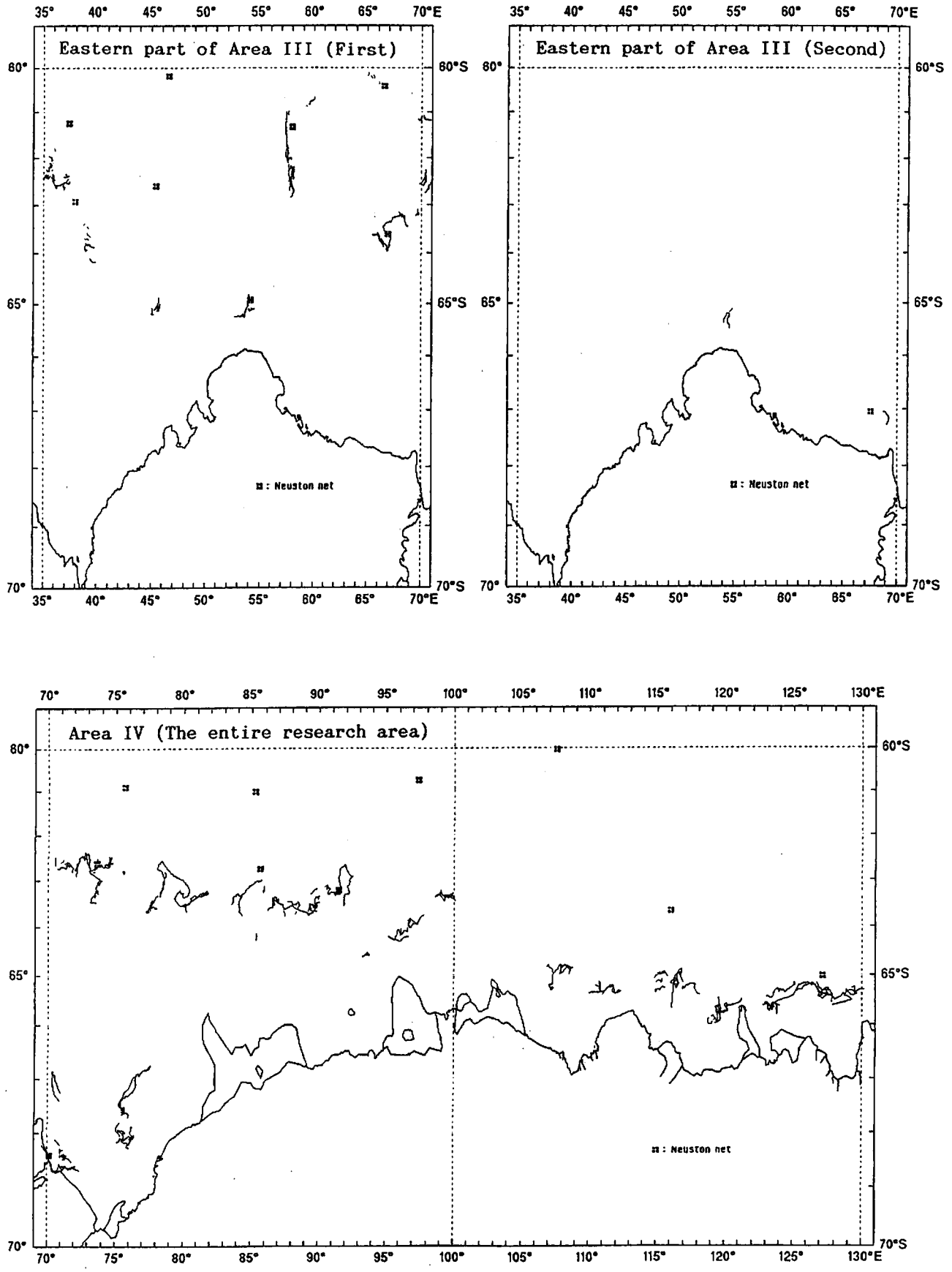

Fig.13. Position of the floating substance collection by the neuston net.
Upper; eastern part of Area III (first and second survey),
lower; Area IV (the entire research area).

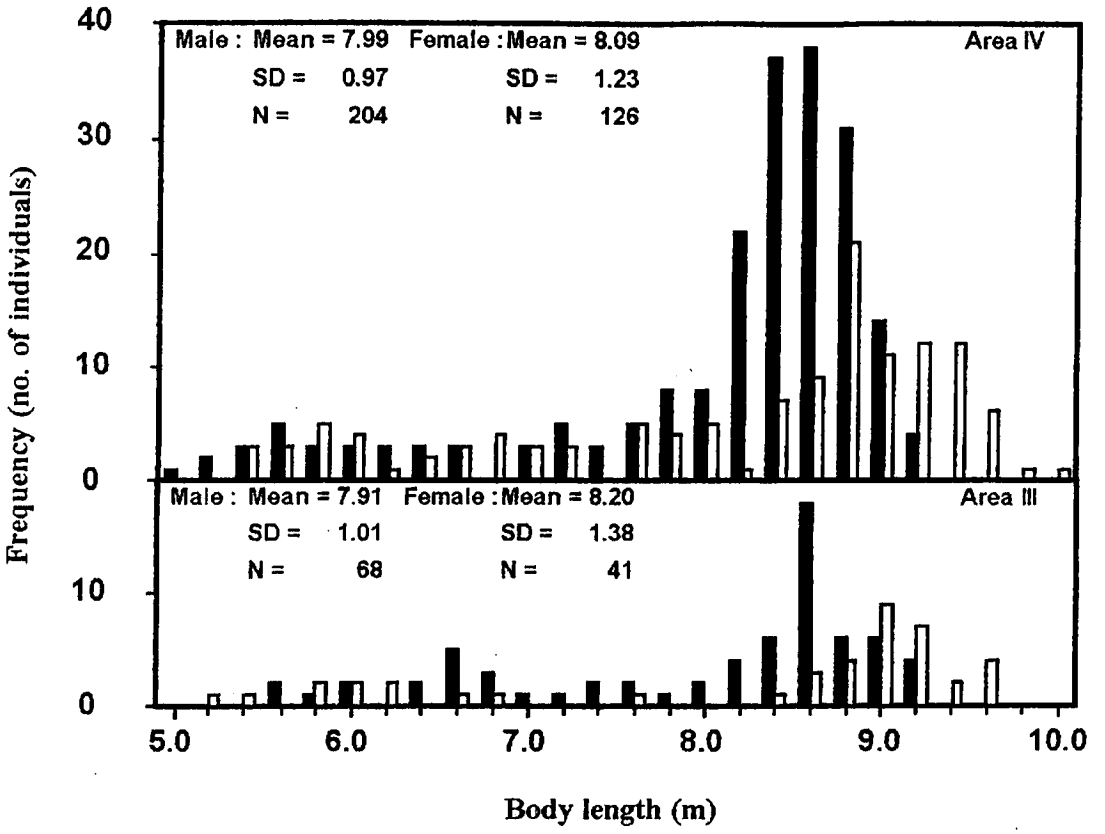

Fig.14a. Body length compositions (20cm intervals) of minke whales sampled in Area IV (upper) and eastern part of Area III (lower). Solid and striped lines represent males and females, respectively.

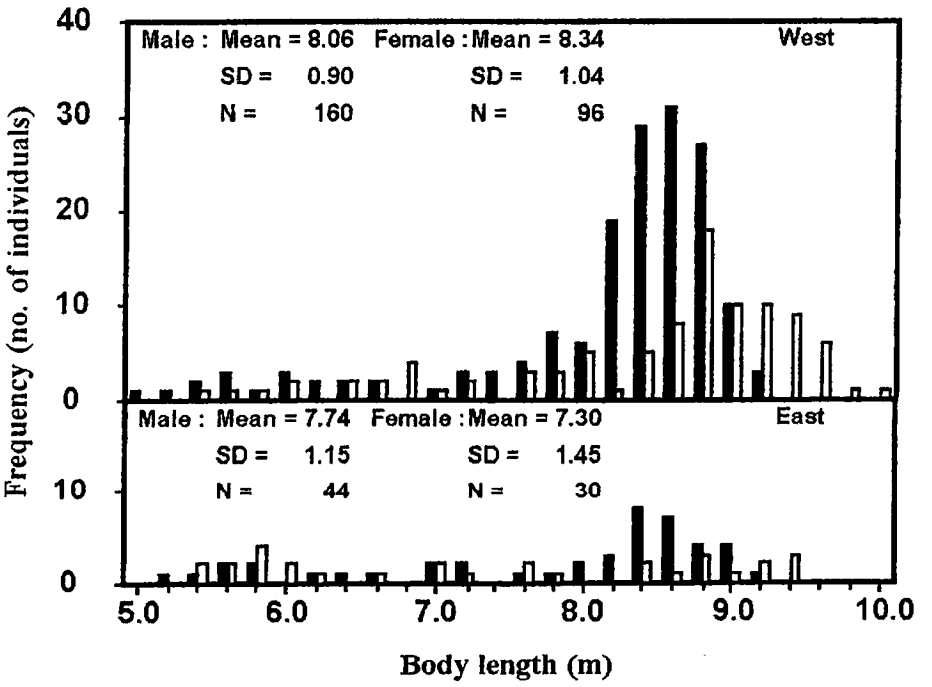

Fig.14b. Body length compositions (20cm intervals) of minke whales sampled in the western strata (upper) and the eastern strata (lower) of Area IV. Solid and striped lines represent males and females, respectively.

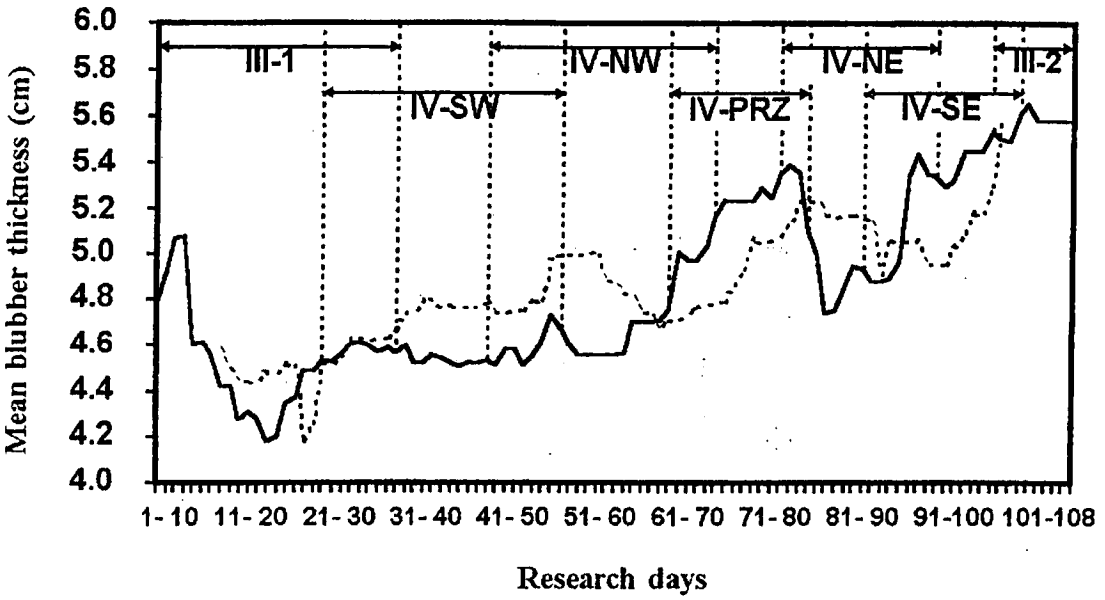

Fig.15. The moving average of mean blubber thickness (three left side points of the body at ear, navel and dorsal fin positions) of matured animals with every 10 research days. Solid and broken line represent 95/96 and 94/95 research, respectively. III-1; eastern part of Area III (first survey), IV-SW; Area IV South-West, IV-NW; Area IV North-West, IV-PRZ; Prydz Bay, IV-NE; Area IV North-East, IV-SE; Area IV South-East and III-2; eastern part of Area III (second survey).

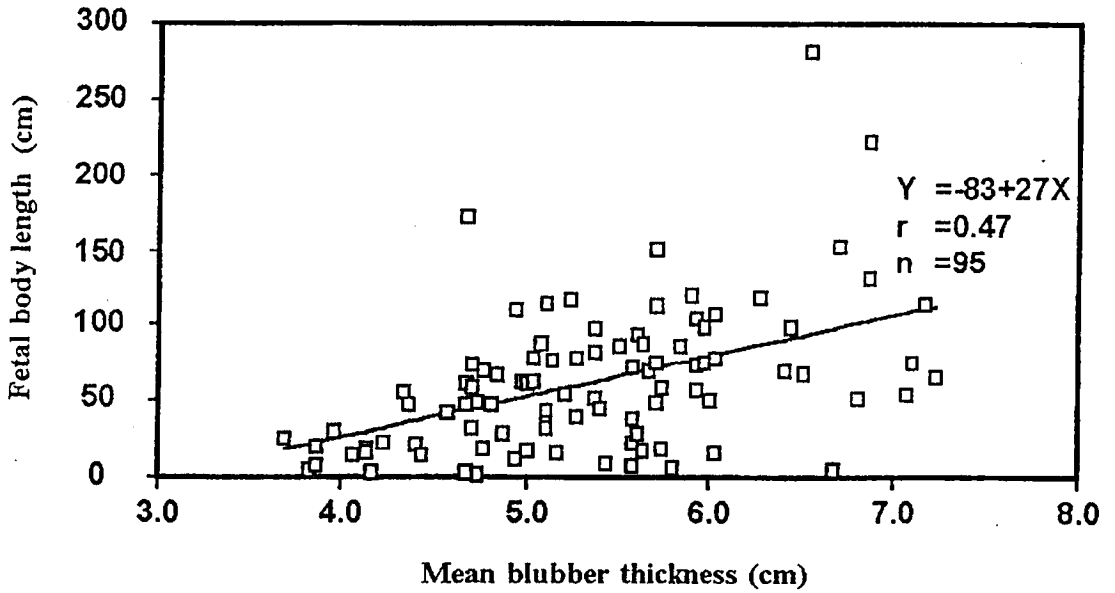

Fig.16. Relationship between the mean blubber thickness (three left side points of the body at ear, navel and dorsal fin positions) and fetal body length.

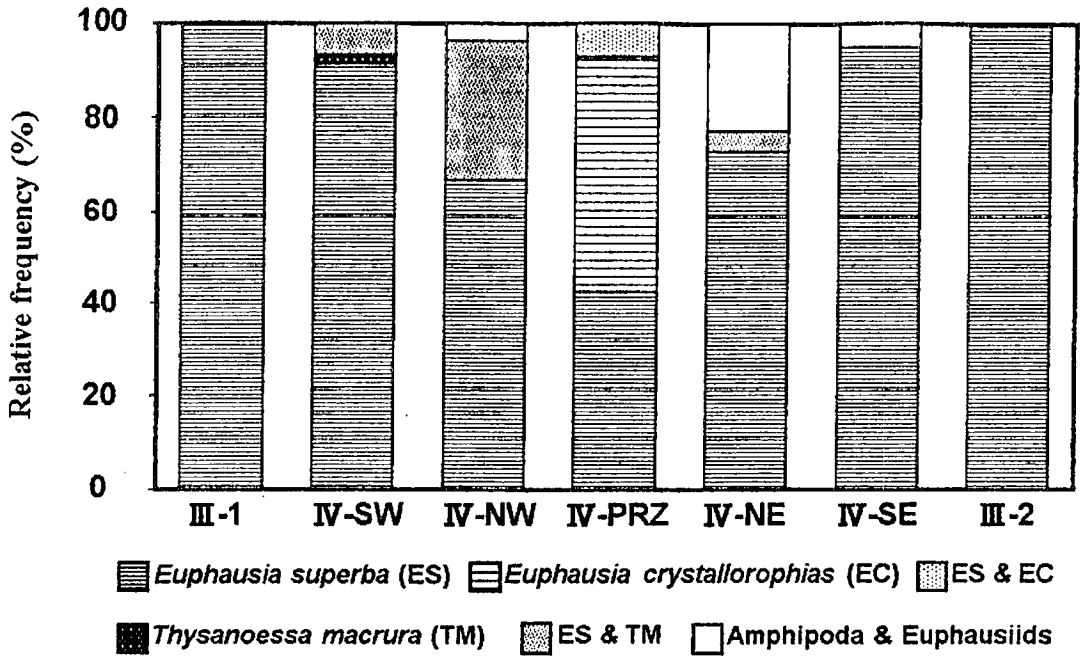

Fig.17. Food composition of minke whales sampled in each stratum expressed as relative frequency of occurrence of prey organisms. III-1; eastern part of Area III (first survey), IV-SW; Area IV South-West, IV-NW; Area IV North-West, IV-PRZ; Prydz Bay, IV-NE; Area IV North-East, IV-SE; Area IV South-East and III-2; eastern part of Area III (second survey).

Additional data
SC/48/SH12

Table 2a. Summary of sightings (no. schools /no. individuals) conducted by a 'sighting' vessel (SV) and three 'sighting/sampling' vessels (SSVs) in Area IV (the entire research area).

Species	SV				SSVs			
	West sector		East sector		West sector		East sector	
	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary
Northern stratum								
Minke whale	17/ 40	5/ 6	18/ 40	4/ 5	61/143	5/ 7	70/130	8/11
Dwarf minke whale			1/ 1				1/ 1	
Like minke whale	2/ 2	1/ 1	1/ 2		4/ 4	1/ 1	5/ 5	1/ 1
Fin whale	2/ 4		2/ 41		6/ 16	1/ 1	3/ 5	
Humpback whale	21/ 42	12/27	13/ 26	2/ 4	102/157	5/ 8	33/ 58	6/ 9
Right whale			3/ 3				2/ 2	3/ 5
Baleen whales		1/ 2			39/ 49	1/ 2	6/ 8	
Sperm whale	17/ 20	4/ 5	1/ 1		36/ 36	7/ 7	9/ 9	
S. bottlenose whale	2/ 2	1/ 1	8/ 17		10/ 17		23/ 38	
Ziphiid whales		1/ 2	4/ 7		15/ 22		11/ 16	
Killer whale	5/ 30	2/ 7	2/ 25		9/ 63		12/ 54	1/ 2
Long finned pilot whale	2/ 80	1/15	1/250		19/875		6/225	1/50
Pilot whales							4/220	
Hourglass dolphin			2/ 35		1/ 6		6/ 27	1/ 6
Unidentified dolphins							2/ 15	
Unidentified whales	3/ 3		8/ 10		19/ 19		17/ 18	
Southern stratum								
Minke whale	44/118	41/85	59/196	24/47	158/357	34/87	127/322	21/39
Like minke whale	8/ 8	1/ 3	1/ 1		8/ 9	1/ 2	3/ 3	6/ 9
Blue whale	1/ 1	1/ 2						
Fin whale	1/ 3	1/ 2	2/ 13				3/ 8	1/ 1
Humpback whale	21/ 49	12/23	7/ 18	2/ 2	37/ 61	6/12	21/ 35	5/ 9
Right whale			3/ 3					
Baleen whales	1/ 1	8/15	7/ 14		9/ 16		7/ 11	
Sperm whale	35/ 37	26/30	2/ 2		97/ 99	19/19	27/ 27	6/ 7
S. bottlenose whale	20/ 49	5/12	2/ 7	1/ 4	27/ 55	4/ 8	10/ 19	1/ 1
Arnoux's beaked whale					1/ 6			
Ziphiid whales	5/ 13	1/ 3	1/ 2		53/105	1/ 2	3/ 4	
Killer whale	4/ 36	1/26	5/ 62	1/40	17/153	1/ 3	16/313	4/62
Hourglass dolphin			1/ 30					
Unidentified whales	8/ 8	2/ 2	4/ 5	3/ 3	25/ 28		16/ 20	
Prydz bay								
Minke whale	26/51	7/14	107/161	22/28				
Like minke whale	3/ 3	3/ 4	5/ 5	6/ 7				
Baleen whales			1/ 1	1/ 1				
Sperm whale		3/ 3	5/ 5					
S. bottlenose whale			1/ 1					
Ziphiid whales			1/ 1					
Killer whale	3/44	1/10	9/118	1/10				
Hourglass dolphin	7/ 7		6/ 6					

Table 1. Searching distance (n.miles) by a 'sighting' vessel (SV) and three 'sighting/sampling' vessels (SSVs) in each stratum of the research area.

Stratum	SV	SSVs	Combined
Area III East			
First period	1,161.1	4,480.1	5,641.2
Area IV (the entire research area)			
East-North	851.9	2,123.5	2,975.4
East-South	577.2	1,461.4	2,038.6
West-North	792.8	2,736.2	3,529.0
West-South	713.9	2,134.7	2,848.6
Prydz Bay	472.3	854.3	1,326.6
Combined	3,408.1	9,310.1	12,718.2
Area III East			
Second period	829.3	2,266.8	3,096.1

Table 2b. Summary of sightings (no. schools /no. individuals) conducted by a 'sighting' vessel (SV) and three 'sighting/sampling' vessels (SSVs) in Area III East.

Species	SV		SSVs	
	Primary	Secondary	Primary	Secondary
First period				
Minke whale	13/ 16	4/ 5	90/128	11/13
Like minke whale		2/ 2	14/ 14	2/ 2
Blue whale	3/ 7	3/10	5/ 8	
Fin whale	12/ 36	2/ 6	26/ 68	6/11
Humpback whale	11/ 16	3/ 4	43/ 68	2/ 3
Baleen whales		7/17	57/113	5/14
Sperm whale	23/ 26	5/ 5	86/ 87	5/ 5
S. bottlenose whale	6/ 17	1/ 1	16/ 28	4/ 7
Ziphiid whales		1/ 3	56/100	6/ 9
Killer whale	1/ 1	1/ 2	7/ 54	3/ 7
Unidentified whales	9/ 9	4/ 5	40/ 42	1/ 6
Second period				
Minke whale	23/121	8/22	80/198	9/10
Like minke whale	1/ 1	1/ 2	2/ 3	2/ 2
Fin whale	3/ 20	2/ 3		7/77
Humpback whale	6/ 15	3/ 4	9/ 16	9/19
Baleen whale	5/ 14	3/ 8	3/ 4	4/10
S. bottlenose whale		1/ 3	13/ 26	1/ 2
Arnoux's beaked whale				1/10
Ziphiid whales	1/ 2		16/ 21	1/ 1
Killer whale	3/ 6		16/323	1/ 4
Hourglass dolphin	3/ 36	2/ 5	11/ 45	3/18
Unidentified whales	2/ 2	1/ 1	18/ 19	2/ 2

Table 2c. Summary of sightings (no. schools /no. individuals) conducted by a 'sighting' vessel (SV) and three 'sighting/sampling' vessels (SSVs) in all the research.

Species	SV		SSVs		Total	
	Primary	Secondary	Primary	Secondary	Primary	Secondary*
Minke whale	200/582	93/184	693/1439	110/195	893/2021	244/564
Dwarf minke whale	1/ 1		1/ 1		2/ 2	
Like minke whale	16/ 17	8/ 12	41/ 43	19/ 24	57/ 60	27/ 36
Blue whale	4/ 8	4/ 12	5/ 8		9/ 16	4/ 12
Fin whale	22/117	5/ 11	38/ 97	15/ 90	60/ 214	22/120
Humpback whale	79/166	34/ 64	245/ 395	33/ 60	324/ 561	74/139
Right whale	6/ 6		2/ 2	3/ 5	8/ 8	3/ 5
Baleen whales	13/ 29	19/ 42	122/ 202	11/ 27	135/ 231	31/ 72
Sperm whale	78/ 86	38/ 43	260/ 263	37/ 38	338/ 349	76/ 82
S. bottlenose whale	38/ 92	9/ 21	100/ 184	10/ 18	138/ 276	19/ 39
Arnoux's beaked whale			1/ 6	1/ 10	1/ 6	1/ 10
Ziphiid whales	11/ 24	3/ 8	155/ 269	9/ 15	166/ 293	12/ 23
Killer whale	23/204	6/ 85	86/1078	11/ 88	109/1282	17/173
Long finned pilot whale	3/330	1/ 15	25/1100	1/ 50	28/1430	2/ 65
Pilot whales			5/ 222		5/ 222	
Hourglass dolphin	6/101	2/ 5	18/ 78	4/ 24	24/ 179	6/ 29
Unidentified dolphins			2/ 15		2/ 15	
Unidentified whales	41/ 44	10/ 11	141/ 152	3/ 8	182/ 196	14/ 20

* :including secondary sightings during transit between strata and experiments.

Table 3. Density indices (DI) and mean school size (MSS) of minke whale sighted primarily by a 'sighting' vessel (SV) and three 'sighting/sampling' vessels (SSVs).

	SV				SSVs				Combined			
Stratum	Sch	Ind	DI	MSS	Sch	Ind	DI	MSS	Sch	Ind	DI	MSS
Area III East												
First period	13	16	1.12	1.23	90	128	2.01	1.42	103	144	1.83	1.40
Area IV (the entire research area)												
East-North	18	40	2.11	2.22	70	130	3.30	1.86	88	170	2.96	1.93
East-South	59	196	10.22	3.32	127	322	8.69	2.54	186	518	9.12	2.78
West-North	17	40	2.14	2.35	61	143	2.23	2.34	78	183	2.21	2.35
West-South	44	118	6.16	2.68	158	357	7.40	2.26	202	475	7.09	2.35
Prydz Bay	26	51	5.50	1.96	107	161	12.52	1.50	133	212	10.03	1.59
Combined	164	445	4.81	2.71	523	1113	5.62	2.13	687	1558	5.40	2.27
Area III East												
Second period	23	121	2.77	5.26	80	198	3.53	2.48	103	319	3.33	3.10

Sch : number of minke whale schools sighted
Ind : number of minke whales sighted
DI : density indices (the number of schools per 100 n.miles searching)
MSS : mean school size

Table 4. Number of minke whales sighted (schools/individuals, A/B), targeted (C), sampled (D), and efficiencies of sampling. Efficiency I shows the ratio of samples actually taken from the primary sightings and II shows the ratio of samples actually taken from the targeted animals.

Stratum	Sighted*	Targeted**	Sampled	Efficiency	
	A / B	C	D	I(D/B)	II(D/C)
Area III East					
First period	90 / 128	91	70	0.55	0.77
Area IV (the entire research area)					
East-North	70 / 130	43	34	0.26	0.79
East-South	127 / 322	42	40	0.12	0.95
West-North	61 / 143	54	50	0.35	0.93
West-South	158 / 357	143	130	0.36	0.91
Prydz Bay	107 / 161	90	76	0.47	0.84
Area III East					
Second period	80 / 198	46	40	0.20	0.87
Combined	693 /1439	509	440	0.31	0.86

* : primary sightings of three 'sighting/sampling' vessels.
** : including the second target in the same school.

Table 5. Summary of biological data and samples collected.

Data and samples	Number of whales		
	Male	Female	Total
Data			
Photographic record of external character[1)]	272	167	439
Body length	272	167	439
External measurement	272	167	439
Body weight	272	167	439
Body weight by total weight of parts	48	23	71
Skull measurement (length and breadth)	270	163	433
Craniometric study	2	2	4
Standard measurement of blubber thickness (three points)	272	167	439
Detailed measurement of blubber thickness (fourteen points)	48	23	71
Analysis of serum chemistry on board	17	8	25
Measurement of mammary grand and observation of lactation status	—	167	167
Breadth measurement of uterine horn	—	167	167
Testis and epididymis weight	272	—	272
Stomach contents weight	268	165	433
Photographic record of fetus	(45)	(41)	(95)[2)]
Fetal length and weight	(45)	(41)	(86)
External measurement of fetus	(45)	(40)	(85)
Vertebral formula	28	12	40
Number of ribs	272	167	439
Sample			
Diatom film	271	167	438
Serum sample for chemical analysis	272	166	438[3)]
Earplug for age determination	272	167	439
Earplug for chemical analysis (one of the pair)	9	10	19
Tympanic bulla for age determination	272	166	438
Largest baleen plate for age determination	80	58	138
Baleen plate for morphologic study	271	165	436
Whole baleen plates for chemical study	1	1	2
Section of vertebral epiphyseal plate	272	167	439
Ovary	—	166	166
Histological sample of endometrium	—	167	167
Histological sample of mammary grand	—	167	167
Milk sample for chemical analysis	—	4	4
Histological sample of testis	272	—	272
Histological sample of epididymis	272	—	272
Testis and epididymis smear for sperm detection	272	—	272
Urine sample for sperm detection	189	—	189
Blubber, muscle, liver, kidney and heart tissues for genetic study	273	167	440[3)4)]
Muscle, liver and kidney tissues for heavy metal analysis	272	167	439[4)5)]
Blubber and liver tissues for organochlorine analysis	272	167	439[4)6)]
Muscle, liver and blubber tissues for lipid analysis	48	23	71[4)7)]
Stomach contents for the food and feeding study	139	61	200
External parasites	90	54	144
Internal parasites	8	4	12
Live sperm for in-vitro fertilization (IVF)	20	—	20
Live oocyte for in-vitro fertilization (IVF)	—	95	95
Skeletal sample (parts) for anatomical study	32	13	45
Fetus	(2)	(2)	(13)[2)]
Blubber, muscle, liver, kidney and heart tissues for genetic study (fetus)	(43)	(39)	(82)
Jaws of fetus for embryological study	(10)	(11)	(21)

1) : photos including (1) color pattern of dorsal side, (2) dorsal fin, and (3) pectoral fin (left or right).
2) : including fetuses of sex unidentified.
3) : including sample from the lost whale.
4) : some organ samples are incomplete.
5) : including 21 samples of stomach contents.
6) : including 25 samples of stomach contents.
7) : including 39 samples of stomach contents.

Table 6. Summary of natural marking attempt during survey.

Vessel	Date	Sight No.	Position	Species	School size	Whale No.	Target	Opportunity	Biopsy
KS2	26/Nov.	7	60.262 S 066.451 E	Humpback	1	1	Left side	Poor	
KS2	26/Nov.	7	60.262 S 066.451 E	Humpback	1	1	Right side	Poor	
KS2	2/Dec.	2	62.062 S 046.260 E	Blue	1	1	Left side	Poor	
KS2	2/Dec.	2	62.062 S 046.260 E	Blue	1	1	Right side	Poor	
KS2	4/Dec.	4	64.145 S 045.124 E	Humpback	2	1	Left side	Poor	
KS2	4/Dec.	4	64.145 S 045.124 E	Humpback	2	2	Left side	Poor	
KS2	7/Dec.	1	61.267 S 036.581 E	Humpback	2	1	Left side	Poor	Y
KS2	7/Dec.	1	61.267 S 036.581 E	Humpback	2	2	Right side	Poor	
KS2	8/Dec.	13	62.028 S 036.079 E	Humpback	1	1	Left side	Poor	
KS2	8/Dec.	16	62.075 S 036.162 E	Humpback	3	1	Right side	Poor	
KS2	8/Dec.	16	62.075 S 036.162 E	Humpback	3	2	Right side	Poor	
KS2	9/Dec.	3	62.458 S 040.454 E	Humpback	2	1	Left side	Poor	Y
KS2	9/Dec.	3	62.458 S 040.454 E	Humpback	2	1	Right side	Poor	
KS2	9/Dec.	3	62.458 S 040.454 E	Humpback	2	2	Left side	Poor	
KS2	9/Dec.	3	62.458 S 040.454 E	Humpback	2	2	Right side	Poor	
KS2	15/Dec.	9	63.590 S 055.377 E	Blue	2	1	Left side	Poor	Y
KS2	15/Dec.	9	63.590 S 055.377 E	Blue	2	1	Right side	Poor	
KS2	15/Dec.	9	63.590 S 055.377 E	Blue	2	2	Left side	Poor	
KS2	15/Dec.	9	63.590 S 055.377 E	Blue	2	2	Right side	Poor	
KS2	31/Dec.	2	62.571 S 082.465 E	Humpback	2	1	Right side	Poor	Y
KS2	31/Dec.	2	62.571 S 082.465 E	Humpback	2	2	Left side	Poor	
KS2	31/Dec.	3	63.005 S 082.580 E	Humpback	2	1	Right side	Poor	
KS2	31/Dec.	3	63.005 S 082.580 E	Humpback	2	1	Flukes	Poor	
KS2	31/Dec.	3	63.005 S 082.580 E	Humpback	2	2	Right side	Poor	
KS2	31/Dec.	3	63.005 S 082.580 E	Humpback	2	2	Flukes	Poor	
KS2	1/Jan.	5	62.403 S 085.363 E	Humpback	1	1	Right side	Good	
KS2	1/Jan.	5	62.403 S 085.363 E	Humpback	1	1	Flukes	Good	
KS2	1/Jan.	12	62.197 S 086.370 E	Humpback	2	1	Left side	Poor	
KS2	1/Jan.	12	62.197 S 086.370 E	Humpback	2	1	Right side	Poor	
KS2	1/Jan.	12	62.197 S 086.370 E	Humpback	2	2	Left side	Poor	
KS2	1/Jan.	12	62.197 S 086.370 E	Humpback	2	2	Right side	Poor	
KS2	1/Jan.	22	62.250 S 088.056 E	Humpback	2	1	Right side	Poor	Y
KS2	1/Jan.	22	62.250 S 088.056 E	Humpback	2	2	Right side	Poor	
KS2	1/Jan.	22	62.250 S 088.056 E	Humpback	2	2	Flukes	Poor	
KS2	4/Jan.	16	63.073 S 090.268 E	Humpback	2	1	Left side	Poor	
KS2	4/Jan.	16	63.073 S 090.268 E	Humpback	2	1	Right side	Poor	
KS2	4/Jan.	16	63.073 S 090.268 E	Humpback	2	2	Left side	Poor	
KS2	4/Jan.	16	63.073 S 090.268 E	Humpback	2	2	Right side	Poor	
KS2	4/Jan.	16	63.073 S 090.268 E	Humpback	2	2	Flukes	Poor	
KS2	6/Jan.	1	63.438 S 092.371 E	Humpback	2	1	Right side	Poor	
KS2	6/Jan.	1	63.438 S 092.371 E	Humpback	2	1	Flukes	Poor	
KS2	6/Jan.	4	63.456 S 092.446 E	Humpback	3	1	Left side	Good	
KS2	6/Jan.	4	63.456 S 092.446 E	Humpback	3	2	Left side	Good	Y
KS2	6/Jan.	4	63.456 S 092.446 E	Humpback	3	2	Flukes	Good	
KS2	6/Jan.	4	63.456 S 092.446 E	Humpback	3	3	Left side	Good	

Table 6. (continued)

Vessel	Date	Sight No.	Position	Species	School size	Whale No.	Target	Opportunity	Biopsy
KS2	6/Jan.	4	63.456 S 092.446 E	Humpback	3	3	Flukes	Good	
KS2	7/Jan.	5	63.471 S 093.471 E	Blue	1	1	Left side	Poor	
KS2	7/Jan.	5	63.471 S 093.471 E	Blue	1	1	Right side	Poor	
KS2	7/Jan.	11	63.468 S 094.412 E	Humpback	2	1	Left side	Poor	Y
KS2	7/Jan.	11	63.468 S 094.412 E	Humpback	2	1	Right side	Poor	
KS2	7/Jan.	11	63.468 S 094.412 E	Humpback	2	2	Left side	Poor	
KS2	7/Jan.	13	63.470 S 095.004 E	Humpback	2	1	Right side	Poor	
KS2	7/Jan.	13	63.470 S 095.004 E	Humpback	2	2	Left side	Poor	
KS2	7/Jan.	13	63.470 S 095.004 E	Humpback	2	2	Right side	Poor	
KS2	11/Jan.	1	61.013 S 096.527 E	Humpback	2	1	Left side	Good	
KS2	11/Jan.	1	61.013 S 096.527 E	Humpback	2	1	Right side	Good	
KS2	11/Jan.	1	61.013 S 096.527 E	Humpback	2	2	Left side	Good	
KS2	11/Jan.	1	61.013 S 096.527 E	Humpback	2	2	Right side	Good	
KS2	11/Jan.	1	61.013 S 096.527 E	Humpback	2	2	Flukes	Good	
KS2	17/Jan.	12	61.591 S 083.588 E	Humpback	2	1	Left side	Poor	
KS2	17/Jan.	12	61.591 S 083.588 E	Humpback	2	1	Right side	Poor	
KS2	17/Jan.	12	61.591 S 083.588 E	Humpback	2	2	Left side	Poor	
KS2	17/Jan.	14	62.089 S 083.456 E	Humpback	2	1	Left side	Good	Y
KS2	17/Jan.	14	62.089 S 083.456 E	Humpback	2	1	Right side	Good	
KS2	17/Jan.	14	62.089 S 083.456 E	Humpback	2	2	Left side	Good	
KS2	17/Jan.	14	62.089 S 083.456 E	Humpback	2	2	Right side	Good	
KS2	10/Feb.	8	62.104 S 102.157 E	Right	1	1	Head	Good	
KS2	10/Feb.	8	62.104 S 102.157 E	Right	1	1	Flukes	Good	
KS2	13/Feb.	3	62.187 S 111.330 E	Humpback	2	1	Left side	Good	Y
KS2	13/Feb.	3	62.187 S 111.330 E	Humpback	2	1	Right side	Good	
KS2	13/Feb.	3	62.187 S 111.330 E	Humpback	2	2	Left side	Good	
KS2	13/Feb.	3	62.187 S 111.330 E	Humpback	2	2	Right side	Good	
KS2	14/Feb.	12	63.492 S 114.195 E	Right	1	1	Head	Poor	
KS2	14/Feb.	12	63.492 S 114.195 E	Right	1	1	Right side	Poor	
KS2	15/Feb.	6	62.514 S 117.260 E	Humpback	2	1	Left side	Good	
KS2	15/Feb.	6	62.514 S 117.260 E	Humpback	2	1	Right side	Good	
KS2	15/Feb.	6	62.514 S 117.260 E	Humpback	2	1	Flukes	Good	
KS2	15/Feb.	6	62.514 S 117.260 E	Humpback	2	2	Left side	Good	
KS2	25/Feb.	2	64.579 S 117.423 E	Humpback	2	1	Left side	Poor	
KS2	25/Feb.	2	64.579 S 117.423 E	Humpback	2	1	Right side	Poor	
KS2	25/Feb.	2	64.579 S 117.423 E	Humpback	2	2	Right side	Poor	
KS2	26/Feb.	4	64.231 S 114.581 E	Right	1	1	Head	Excellent	Y
KS2	26/Feb.	6	64.255 S 114.543 E	Right	1	1	Head	Excellent	
KS2	26/Feb.	15	64.384 S 114.011 E	Humpback	3	1	Left side	Poor	Y
KS2	26/Feb.	15	64.384 S 114.011 E	Humpback	3	1	Flukes	Poor	
KS2	26/Feb.	15	64.384 S 114.011 E	Humpback	3	2	Left side	Poor	
KS2	26/Feb.	15	64.384 S 114.011 E	Humpback	3	2	Right side	Poor	
KS2	26/Feb.	15	64.384 S 114.011 E	Humpback	3	3	Right side	Poor	
KS2	27/Feb.	3	65.148 S 111.214 E	Humpback	2	1	Left side	Excellent	
KS2	27/Feb.	3	65.148 S 111.214 E	Humpback	2	1	Right side	Excellent	
KS2	27/Feb.	3	65.148 S 111.214 E	Humpback	2	1	Flukes	Excellent	
KS2	29/Feb.	1	65.007 S 107.090 E	Humpback	2	1	Right side	Poor	
KS2	29/Feb.	1	65.007 S 107.090 E	Humpback	2	2	Left side	Poor	Y
KS2	29/Feb.	1	65.007 S 107.090 E	Humpback	2	2	Right side	Poor	

Table 7. Result of the biopsy skin sampling. "Position struck" refers to the position where the biopsy dart struck the whale.

Vessel	Date	Speceis	Sight No.	School size	Whale No.	Position struck	Sample No.	Position
KS2	7/Dec.	Humpback	1	2	1	RC1	J95KS2H001	61.267 S 036.581 E
KS2	9/Dec.	Humpback	3	2	1	LC2	J95KS2H002	62.458 S 040.454 E
KS2	15/Dec.	Blue	9	2	1	LC3	J95KS2B003	63.590 S 055.377 E
KS2	31/Dec.	Humpback	2	2	1	RD3	J95KS2H004	62.571 S 082.465 E
KS2	1/Jan.	Humpback	22	2	1	LC3	J95KS2H005	62.250 S 088.056 E
KS2	6/Jan.	Humpback	4	3	1	LC2	J95KS2H006	63.456 S 092.446 E
KS2	7/Jan.	Humpback	11	2	1	RD3	J95KS2H007	63.468 S 094.412 E
KS2	17/Jan.	Humpback	14	2	1	RD2	J95KS2H008	62.089 S 083.456 E
KS2	13/Feb.	Humpback	3	2	1	RC1	J95KS2H009	62.187 S 111.330 E
KS2	26/Feb.	Right	4	1	1	LC3	J95KS2R010	64.231 S 114.581 E
KS2	26/Feb.	Humpback	15	3	1	LC1	J95KS2H011	64.384 S 114.011 E
KS2	29/Feb.	Humpback	1	2	1	RC3	J95KS2H012	65.007 S 107.090 E

Table 8. Number of sightings of the observation of the behavior of ziphiid whales.

Species	Schools	Individuals
S. bottlenose whale	15	39
Ziphiid whales	3	4
Combined	18	43

Table 9. Summary of whale reaction during the echo sounder experiment.

Species	Sightings	Reaction		
		Yes	No	Unknown
Minke whale	16 / 26	2 / 2	13 / 22	1 / 2
Like minke whale	4 / 4	1 / 1	-	3 / 3
Blue whale	1 / 5	1 / 5	-	-
Humpback whale	5 / 11	-	3 / 8	2 / 3
Baleen whales	1 / 1	-	-	1 / 1
Sperm whale	7 / 10	-	2 / 2	5 / 8
S. bottlenose whale	2 / 2	-	2 / 2	-
Ziphiid whales	1 / 2	-	-	1 / 2
Killer whale	3 / 44	-	1 / 2	2 / 42
Unidentified whales	2 / 2	-	-	2 / 2

Table 10. Summary of whale reaction during the scanning sonar experiment.

Species	Sightings	Reaction		
		Yes	No	Unknown
Minke whale	12 / 25	9 / 21	3 / 4	-
Like minke whale	1 / 2	-	-	1 / 2
Baleen whales	2 / 7	-	-	2 / 7
Sperm whale	2 / 2	-	1 / 1	1 / 1
Unidentified whales	4 / 4	-	-	4 / 4

Table 11. Observations of marine debris during the survey.

Vessel	Object	Date	Position	Size
KS2	Buoy	18/Dec.	60.19 S 60.18 E	50cm x2
KS2	Foaming styrofoam	16/Jan.	60.47 S 85.33 E	30-30cm
KS2	Foaming styrofoam	15/Feb.	62.33 S 118.03 E	30-30cm
KS2	Foaming styrofoam	17/Feb.	60.31 S 123.06 E	20-30cm
KS2	Foaming styrofoam	17/Feb.	60.51 S 123.32 E	20-20cm
KS2	Foaming styrofoam	17/Feb.	61.47 S 124.48 E	20-20cm
KS2	Foaming styrofoam	18/Feb.	62.33 S 125.50 E	20-30cm
KS2	Metal can	18/Feb.	63.41 S 127.29 E	150-250litres

Table 12. Products from samples.

Items of products	Weight (kg)	Items of products	Weight (kg)
Frozen products			
Ordinal meat	433,995.0	Maxillary cartilage	2,825.0
Premium meat (Oniku)	1,935.0	Mandibular ligaments	4,797.0
Breast meat	624,750.0	Nasal plug	4,875.0
Meat pieces	173,190.0	Tendon	35,294.0
Meat inside ventral grooves	20,679.0	Heart	5,530.0
Blubber of ventral grooves	10,138.5	Tongue	37,063.0
Meat/blubber of ventral grooves	119,569.5	Diaphragm	10,065.0
Meat/blubber of ventral part	93,425.0	Stomach	5,278.0
Ordinal blubber	198,913.0	Intestine	7,025.0
Underside part of blubber	22,262.5	Pancreas	1,026.0
Lining of meat	21,562.5	Kidney	4,718.0
Tail flukes	26,800.0	Testis	228.0
Meat/connective tissue		Esophagus	494.0
of lower jaw	5,475.0	Liver	5,600.0
		Boiled meat	10,000.0
		Total	1,887,513.0
Others			
Oil*	55,500.0		

* : Oil was consumed as fuel of Nisshin-maru.

Table 13. Mean body length(m) by sex and maturity in each stratum.

Male

Stratum	Immature					Mature				
	Mean	S.D.	Min.	Max.	n	Mean	S.D.	Min.	Max.	n
Area III East										
First period	6.76	0.72	5.59	8.43	18	8.44	0.37	7.31	9.01	28
Area IV (the entire research area)										
East-North	6.09	0.69	5.11	7.06	10	8.42	0.38	7.69	9.11	16
East-South	6.57	0.75	5.42	7.47	4	8.49	0.29	8.03	8.95	14
West-North	6.79	0.96	5.11	7.95	9	8.49	0.28	8.04	9.19	28
West-South	6.08	0.72	4.87	7.63	17	8.48	0.27	7.84	9.09	84
Prydz Bay	7.53	0.19	7.27	7.77	4	8.03	0.38	7.35	8.55	18
Area III East										
Second period	6.15	0.52	5.42	6.71	4	8.62	0.33	8.09	9.16	18
Total	6.49	0.84	4.87	8.43	66	8.45	0.34	7.31	9.19	206

Female

Stratum	Immature					Mature				
	Mean	S.D.	Min.	Max.	n	Mean	S.D.	Min.	Max.	n
Area III East										
First period	6.01	0.43	5.38	6.69	7	9.01	0.31	8.57	9.59	17
Area IV (the entire research area)										
East-North	6.24	0.86	5.24	7.53	7	9.29	——	9.29	9.29	1
East-South	6.43	0.92	5.46	8.21	12	8.89	0.32	8.40	9.36	10
West-North	6.47	0.55	5.63	7.47	10	9.38	0.28	9.03	9.71	3
West-South	7.14	0.91	5.35	8.21	12	8.92	0.31	8.37	9.49	17
Prydz Bay	7.75	0.66	6.58	8.49	9	8.90	0.36	8.11	9.87	45
Area III East										
Second period	6.48	1.17	5.08	8.21	5	9.03	0.23	8.60	9.47	12
Total	6.70	0.98	5.08	8.49	62	8.95	0.34	8.11	9.87	105

Table 14. Reproductive status of samples in each stratum.

Stratum	Male			Female							M%*
	Imm.	Mat.	Unk.	Imm.	Mat.						
					Preg.	Ovu.	Rest.	Lact.	P&L	Unk.	
Area III East											
First period	18	28	0	7	12	0	0	0	4	1	65.7
	(39.1)	(60.9)		(29.2)	(50.0)				(16.7)	(4.2)	
Area IV (the entire research area)											
East-North	10	16	0	7	0	1	0	0	0	0	76.5
	(38.5)	(61.5)		(87.5)		(12.5)					
East-South	4	14	0	12	5	1	4	0	0	0	45.0
	(22.2)	(77.8)		(54.5)	(22.7)	(4.5)	(18.2)				
West-North	9	28	0	10	3	0	0	0	0	0	74.0
	(24.3)	(75.7)		(76.9)	(23.1)						
West-South	17	84	0	12	16	1	0	0	0	0	77.7
	(16.8)	(83.2)		(41.4)	(55.2)	(3.4)					
Prydz Bay	4	18	0	9	44	0	1	0	0	0	28.9
	(18.2)	(81.8)		(16.7)	(81.5)		(1.9)				
Area III East											
Second period	4	18	1	5	12	0	0	0	0	0	57.5
	(17.4)	(78.3)	(4.3)	(29.4)	(70.6)						
Total	66	206	1	62	92	3	5	0	4	1	62.0
	(24.2)	(75.5)	(0.4)	(37.1)	(55.1)	(1.8)	(3.0)		(2.4)	(0.6)	

Explanation of abbreviations.
Imm.: immature, Mat.: mature, Preg.: pregnant, Ovu.: ovulating,
Rest.: resting, Lact.: lactating, P&L: pregnant and lactating,
Unk.: unknown.
* : percentage of males.