Cruise Report of the second phase of the Japanese Whale Research Program under Special Permit in the Western North Pacific (JARPN II) in 2006 (part I) - Offshore component –

TAMURA, T.[1] , MATSUOKA, K. [1], BANDO, T. [1], MOGOE, T.[1], KONISHI, K.[1], MORI, M. [2], TSUNEKAWA, M. [2], OKAMOTO, K. [3], FUNASAKA, N.[4], SAKAJIRI, H.[1], YOSHIDA, Y.[5], KUMAGAI, S.[1], KIMURA, K.[6], TAKAMATSU, T.[2], KONAGAI, T.[2], SASAKI, S.[2], KUWAOKA, J.[2] AND OGAWA T.[2]

1) The Institute of Cetacean Research, 4-5, Toyomi-cho, Chuo-ku, Tokyo, 104-0055, Japan,
2) Kyodo Senpaku Co. Ltd., 4-5, Toyomi-cho, Chuo-ku, Tokyo, 104-0055, Japan,
3) Tokyo University of Marine Science and Technology, Faculty of Marine Science, 4-5-7, Konan, Minato-ku, Tokyo, 108-8477, Japan
4) Mie University, Graduate School of Bioresoureces, 1577, Kurimamatiya-cho, Tsu, Mie, 514-8507, Japan,
5) Hokkaido University, Faculty of Fisheries, 3-1-1, Minato-cho, Hakodate, 041-8611, Japan,
6) Tokai University, Marine Science and Technology, 104-0055, Japan,

Contact e-mail: tamura@cetacean.jp

ABSTRACT

The fifth cruise of the full-scale survey of the second phase of the Japanese Whale Research Program under Special Permit in the Western North Pacific (JARPN II) -offshore component- was conducted from 16 May to 29 August 2006 in sub-areas 7, 8 and 9 of the western North Pacific. The objectives of the full-scale research are (a) feeding ecology and ecosystem studies, (b) monitoring environmental pollutants in cetaceans and the marine ecosystem and (c) elucidation of stock structure. Target species are common minke whale *Balaenoptera acutorostrata*, Bryde's whale *B. edeni*, sei whale *B. borealis* and sperm whale *Physeter macrocephalus*. A total of five research vessels were used: one dedicated sighting vessel (SV), three sighting/sampling vessels (SSVs) and one research base vessel. A total of 5,541.7 n.miles was surveyed in a period of 106 days by SV. During that period 54 common minke, 15 Bryde's, 244 sei and 220 sperm whales were sighted by the SV. A total of 12,245.3 n.miles was surveyed in a period of 85 days by SSVs. During that period 134 common minke, 172 Bryde's, 326 sei and 330 sperm whales were sighted by the SSVs. A total of 100 common minke, 100 sei, 50 Bryde's and 6 sperm whales was sampled by the SSVs. All whales sampled were examined on board the research base vessel. One Bryde's whale was tracked by satellite tag in the western North Pacific during July. The satellite tracking data was received for two weeks. As in previous surveys common minke whales fed mainly on Pacific saury (*Cololabis saira*) and Japanese anchovy (*Engraulis japonicus*). Bryde's whales fed mainly on krill and Japanese anchovy. In addition, results of the present survey suggested that Bryde's whales also fed on oceanic lightfish (*Vinciguerria nimbaria*). Sei whales fed mainly on copepods, krill and Japanese anchovy. Dominant preys in the stomach of six sperm whales were various kinds of squids, which inhabit the mid- and deep-waters. These data will be used for ecosystem modelling in near future.

KEYWORDS: PACIFIC OCEAN, COMMON MINKE WHALE; BRYDE'S WHALE; SEI WHALE; SPERM WHALE; MONITORING, FOOD/PREY; ECOSYSTEM; SATELLITE TAGGING; SCIENTIFIC PERMITS

BACKGROUND

After the Japanese Whale Research Program under Special Permit in the Western North Pacific (JARPN) from 1994 to 1999, the meeting to review the survey results and data was held in February 2000. At that meeting, it was agreed that no sub-stock scenario exists within the O stock for common minke whale *Balaenoptera acutorostrata* in western North Pacific but the issue of whether or not the W-stock exists (western part of sub-area 9) was not resolved. Regarding the feasibility studies on feeding ecology, the workshop considered them successful. The results showed that the main prey species of common minke whale changed seasonally and geographically. As most of these prey species are also the target species of Japanese commercial fisheries, a possible competition between common minke whales and fisheries was postulated. The Workshop agreed that, if ecological studies are to be conducted in the area, the sampling regime must be designed to allow for a more quantitative estimation of temporal and geographical variation in diet. It was also recommended that acoustic and trawl surveys should be conducted concurrently with future whale surveys, if possible (IWC, 2001).

The second phase of Japanese Whale Research Program under Special Permit in the Western North Pacific (JARPNII) was started in the 2000 summer season as a two-year feasibility study. The first objective was to study feeding ecology of whales and the marine ecosystem. During the previous JARPN surveys, it was revealed the common minke whales consumed various commercial fish species such as Pacific saury *Cololabis saira*, Japanese anchovy *Engraulis japonicus*. Japanese common squids *Todarodes pacificus* and walleye pollock *Theragra chalcogramma*, and that they ate considerable amount of these prey species. The second objective of the feasibility survey of JARPNII was related to stock structure issues, and third to pollution studies. Sampling of minke whale, Bryde's whale *B. edeni* and sperm whale *Physeter macrocephalus* was conducted in the feasibility research program.

Based on the success of the feasibility study (Government of Japan, 2002a) and increasingly strong support from international fisheries organizations, including FAO, for research to improve multi-species approaches to management, JARPN II started as a full-scale research program in 2002.The full-scale study aimed mainly i) to evaluate the feeding ecology and ecosystem studies, ii) to monitor environmental pollutants in cetaceans and the marine ecosystem and iii) to elucidate the stock structure (Government of Japan, 2002b).

The full-scale JARPN II plan involved two survey components: the 'offshore' survey was covered by the *Nisshin Maru* research unit and the 'coastal' survey was covered by catcher boats of small type whaling. The coastal component was necessary to cover the temporal and spatial gaps, which could not be covered by the *Nisshin Maru* unit (Government of Japan, 2002b).

Sampling of 100 minke whales, 50 Bryde's whales and 10 sperm whales as in the JARPN II feasibility study was continued in the full research program with the addition of 50 sei whales *B. borealis* in each year and 50 common minke whales to be taken by small-type whaling catcher boats in 2002. Sei whale was selected as a target species as they feed on fisheries resources such as common squid and their estimated biomass is larger than that of Bryde's and common minke whales. The additional 50 common minke whales provide full coverage of the spring and autumn seasons in coastal waters where the competition between cetaceans and fisheries is likely to be substantial. In the full JARPN II plan the coastal survey component was presented as a two-year feasibility study to be conducted in 2002 and 2003. The plan also noted that in the case of the sei whale, 'the required sample size will be recalculated after the first two years making use of the data accumulated' (Government of Japan, 2002b).

In accordance with these provisions, a revised JARPN II research plan was presented for the period starting from 2004, which takes into consideration i) the results of the coastal survey component (feasibility surveys in 2002 and 2003) regarding logistic and sample size of the common minke whale and ii) the results of new calculations of required sample size for the sei whale based on the data accumulated in those two years. The research area was set in sub-areas 7, 8 and 9, and the target species and sample sizes in 2006 were set as follows: 220 common minke whales (100 were to be sampled by the offshore survey and 120 - by the each coastal survey); 100 sei whales (offshore survey), 50 Bryde's whales (offshore survey) and 10 sperm whales (offshore survey) (Government of Japan, 2004a, 2004b).

In this paper, we present an outline of the fifth full-scale survey of the JARPN II -offshore component-, which was conducted from 16 May to 29 August 2006.

MATERIALS AND METHODS

Research area

Sub-areas 7, 8 and 9, excluding the EEZ zones of foreign countries, were the research area (Fig. 1). These sub-areas were further divided as follows:

Sub-area 7: Five small blocks (7N, 7MI, 7MO, 7SI, 7SO) stratified for taking into account satellite information on water temperature.

Sub-areas 8 and 9: Four small blocks were divided at latitude of 40ºN in each sub area (8N and 8S, 9N and 9S).

Research vessels

Five research vessels were used.

The research base vessel *Nisshin Maru* (NM: 8,030GT) commanded the research and was the platform for biological examination of whale samples and processing of by-products. The *Yushin Maru* (YS1: 720GT), *Yushin Maru* No.2 (YS2: 747GT) and *Kyo Maru* No.1 (K01: 812.08GT) were used as the sighting/sampling vessels (SSVs), which conducted sighting activities, sampling of targeted whale species and various experiments and observations. The *Kyoshin Maru* No. 2 (KS2: 372GT) was used as dedicated sighting vessel (SV).

Survey components

The survey was composed of three main components: whale survey, sighting survey and the cooperative survey however, the cooperative survey could not be conducted due to logistical reasons. The prey survey was conducted by *Kyoshin Maru* No. 2 using echo sounder and plankton net. This vessel was also dedicated sighting of cetaceans.

Whale survey
Vessels: Four research vessels (NM, YS1, YS2 and K01)

Research area: Sub-areas 7, 8 and 9. In addition, a 'special monitoring survey' (SMS) was undertaken in some areas where the number of common minke, Bryde's and sei whales was expected to be abundant.

Research period (Table 1):

First period: Between 24 May and 19 July.

Second period: Between 22 July and 16 August.

Dedicated Sighting survey (Table 1)
Vessels: One research vessel (KS2)

Research area: Sub-areas 7, 8 and 9

Research period:

Entire period: Between 16 May and 29 August.

Prey survey (only Echo sounder and plankton net)
Vessels: One research vessel (KS2)

Research area: Sub-areas 7, 8 and 9

Research period:

Entire period: Between 16 May and 29 August.

Methods for setting cruise track line for the whale survey
Track lines and allocation of vessels were made as in previous JARPN and JARPN II surveys (Fujise *et al.*, 1995, 1996, 1997, 2000, 2001, 2002, 2003; Ishikawa *et al.*, 1997; Zenitani *et al.*, 1999; Tamura *et al.*, 2004, 2005, 2006). The zigzag-shaped track line was established on an arbitrary basis in each sub-area and month, taking into consideration previous sighting information of target whales and sea conditions.

Furthermore, some 'special monitoring surveys' (SMS) were conducted in areas where the abundance of common minke whales, Bryde's and sei whales was expected to be high. Track line in the SMS was designed separately from the original track line. Three SSVs were allocated to these tracks with the allocation being changed every day.

The research course for the SSVs consisted of one main track and two parallel tracks established in 7 n.miles apart from main course.

Apart from these sampling activities, an independent track line for dedicated sighting survey was designed in the research area. The track lines were determined randomly.

Sighting surveys
Sighting procedure both for the whale survey and dedicated sighting survey was similar to the previous surveys of JARPN and JARPN II (Fujise *et al.*, 1995, 1996, 1997, 2000, 2001, 2002, 2003; Ishikawa *et al.*, 1997; Zenitani *et al.*, 1999; Tamura *et al*., 2004, 2005, 2006). In the research area sighting was conducted mainly under closing mode. Furthermore two modalities of sighting in closing mode were adopted, *NSC* and *NSS modes*, by taking into consideration weather and sea conditions. The *NSC* and *NSS modes* were the same as *BC* and *BS modes* in the previous JARPN surveys, respectively. The conditions to conduct surveys under *NSC mode* were similar to those established in Japanese sighting surveys conducted by the National Research Institute of Far Seas Fisheries (*i.e*. visibility of 2 n.miles or more and wind force of 4 or below). The *NSS mode* was used under bad weather conditions such as heavy rain and fog when the collection of whale samples was still possible. This *NSS mode* was used only by SSV vessels. These two mode surveys were recorded separately for future analysis. Also an *ASP mode* was used (closing mode survey without sampling activities under normal sighting conditions).

During the transit from homeport (HP) to research area (RA) and from RA to HP, the *NSP mode* was adopted (passing mode without sampling activities under normal sighting conditions).

Closing was performed mainly on sightings of common minke, Bryde's, sei and sperm whales. Furthermore closing was made on sightings of large whales, such as blue, humpback, right and fin whales. In these cases, closing was done in order to confirm species and school size and in order to conduct some experiments.

Sampling of common minke, Bryde's, Sei and sperm whales
Most of the target whales sighted on the trackline were approached for sampling. Furthermore sampling effort was applied outside the established research hours (Main time: SSV: 07:00-19:00, SV: 07:00-19:00 (12 hrs)), if collection of whale samples was considered possible.

For schools consisting of two or more animals, numbering was made for all the whales in the school; to set sampling order randomly in accordance with the table of random numbers (Kato *et al.*, 1989). Cow and calf pairs were not targeted for sampling.

Sampled whales were immediately transported to a research base vessel, where biological measurements and sampling were carried out.

Experiments
The following experiments and observations were conducted on board the sighting/sampling vessels:

1. Sighting distance and angle experiments to examine the precision of sighting data (YS1, YS2 and K01).
2. Biopsy sampling on gray, blue, fin, humpback and right whales.
3. Photographic records of natural marks on blue, humpback and right whales.
4. Preliminary experiments on attachment of satellite tagging to sei and Bryde's whales.
5. Feeding behaviour patterns of large whale species (blue, fin, sei, Bryde's, common minke, humpback, right and sperm whales).

On board the SV, the following experiments and observations were conducted:

1. Sighting distance and angle experiment to examine the precision of sighting data.
2. Biopsy sampling on gray, blue, fin, sei, Bryde's, minke, humpback, right and sperm whales.
3. Photographic records of natural marks on blue, humpback and right whales.
4. Feeding behaviour patterns of large whales.
5. Prey survey using echo sounder and plankton net.
6. Oceanographic experiments using EPCS and CTD.

Observations of marine debris in the research area were conducted from the wheelhouse of the research base vessel (*NM*) (mainly during transit cruises). Marine debris was also investigated in the stomach contents of common minke, Bryde's, sei and sperm whales sampled. Experiments on killing method were conducted onboard of both the research base vessel and the SSVs.

RESULTS

Searching distance
Track line covered by the three sighting/sampling vessels (SSVs) is shown in Figs. 2 and 3. The total searching distance for SSVs was 12,245.3 n.miles (Table 2).

Track line covered by the dedicated sighting vessel (SV) is shown in Fig. 4. The total searching distance was 5,413.2 n.miles (Table 2).

Sightings of common minke, Bryde's, sei and sperm whales
Sighting and sampling vessels (SSVs)

A total of 131 schools (134 individuals) of common minke whales were sighted, consisting of 81 schools (83 individuals) of primary and 50 schools (51 individuals) of secondary sightings. For sei whale, 209 schools (326 individuals) were sighted, consisting of 147 schools (232 individuals) of primary sightings and 62 schools (94 individuals) of secondary sightings. For Bryde's whale, 133 schools (172 individuals) were sighted, consisting of 102 schools (129 individuals) of primary sightings and 31 schools (43 individuals) of secondary sightings. For sperm whale, 181 schools (330 individuals) were observed, consisting of 145 schools (270 individuals) of primary sightings and 36 schools (60 individuals) of secondary sightings (Table 3).

Fig 5. shows the distribution of common minke whales sighted by the SSVs in the sub-areas 7, 8 and 9. Figs.6 and 7 show the distribution of Bryde's and sei whales. Common minke whales were sighted in northern part of sub area 7, entire part of sub-areas 8 and 9. But, Bryde's whales were sighted mainly in southern part of sub-areas 7, 8 and 9. Sei whales were sighted mainly in offshore of sub-areas 8 and 9. In sub-areas 8 and 9, some segregation was observed

between sei and Bryde's whales. Fig. 8 shows the distribution of sperm whale sightings in sub-areas 8 and 9. Sperm whales were widely distributed in sub-areas 7, 8 and 9.

Dedicated sighting vessel (SV)
During the research cruise, 46 schools (54 individuals) of common minke whales were sighted, consisting of 45 schools (53 individuals) of primary sightings and 1 school (1 individuals) of secondary sightings. For sei whale, 137 schools (244 individuals) were sighted, consisting of 133 schools (238 individuals) of primary sightings and 4 schools (6 individuals) of secondary sightings. For Bryde's whale, 10 schools (15 individuals) were sighted, consisting of 10 schools (15 individuals) of primary sightings. For sperm whale, 118 schools (220 individuals) were sighted, consisting of 94 schools (183 individuals) of primary sightings and 24 schools (37 individuals) of secondary sightings (Fig. 13, Table 4).

Sightings of other large cetacean species
Sighting and sampling vessels (SSVs)

Table 3 also shows the number of sightings for other large whale species made by the SSVs, including large baleen whales such as blue (32 schs./42 inds.), fin (80 schs./103 inds.), humpback whales (58 schs./72 inds.) and right whale (9 sch./13 inds.) (Figs. 9, 10, 11 and 12).

Dedicated sighting vessel (SV)
Large baleen whales such as blue (22 schs. /33 inds.), fin (26 schs. /36 inds.), humpback whales (16 schs. /20 inds.) and right whale (1 sch./1 ind.) were found in the sub-areas 7, 8 and 9 (Figs. 14 and 15, Table 4).

Sampling of common minke, Bryde's, sei and sperm whales
This survey covered almost the entire research area for studies on feeding ecology and stock structure. Table 5 shows the number of whales sampled in each sub-area or special block for each research component and period. A total of 100 common minke whales (Male: 93 individuals, Female: 7 individuals) were sampled. A total of 100 sei whales (Male: 48 individuals, Female: 52 individuals) were sampled. A total of 50 Bryde's whales (Male: 21 individuals, Female: 29 individuals) were sampled. A total of two male and four female sperm whales were sampled during the whale survey component.

Geographical distribution of common minke, Bryde's and sei whale samples are also shown in Figs. 5 - 7 based on the sighting positions. Fig. 8 shows the distribution of sperm whale samples based on the sighting positions. One sei whale and one Bryde's whale were struck but lost due to technical failure.

Biological research for common minke, Bryde's and sei whales
Table 6 summarizes the biological data and samples collected from whales. A total of 46 research items were covered. These items are related to the studies conducted under the three main objectives of the JARPN II: study on feeding ecology of whales and marine ecosystem, pollution studies and elucidation of stock structure.

Composition of sex and sexual maturity of common minke, Bryde's, and sei whales is shown in Tables 7, 8 and 9. The rate of mature males in common minke was higher than in Bryde's and sei whales.

Preliminary analyses of biological data and experiments

Body length of sampled whales
The statistics of body length of common minke whales are shown in Table 10. Mean body length of common minke whales is 7.13 m and 7.03 m for males and females, respectively. For Bryde's whales, the statistics of body length are shown in Table 11. Mean body length of Bryde's whales is 11.79 m and 11.99 m for males and females, respectively. For sei whales, the statistics of body length are shown in Table 12. Mean body length of sei whales is 12.90 m and 13.93 m for males and females, respectively. For sperm whale, the statistics of body length are shown in Table 13. Mean body length of sperm whales is 12.03 m and 10.65 m for males and females, respectively.

Distribution and food habit
During the research season (from May to August) in the offshore area, common minke whales fed mainly on Japanese anchovy, and they also fed on Pacific saury and krill (Table 14). Bryde's whales were distributed in the southern part of the research area. They fed mainly on krill (Table 14). However, they fed on oceaniclight fish (*Vinciguerria nimbaria*) in sub areas 8 and 9. Sei whales were distributed widely in the research area. From May to August, they fed mainly on Japanese anchovy, copepods and krill (Table 14). Sperm whales were also distributed widely in the research area. They fed mainly on deep sea squids in offshore area (sub area 8 and 9).

Experiments

Biopsy sampling trial
Table 15 shows the results of biopsy skin sampling. A total of ten blue whales, one fin whale, four humpback whales and eight right whales were targeted for biopsy sampling by the SSVs. As a result, three blue whales, one humpback whale and one right whale biopsy skin samples were collected.

Natural marks (photo ID) for blue, humpback and right whales
Table 16 shows the results of the photo-ID experiments for blue whales, humpback whales and right whales. A total of eleven blue whales, three humpback whales and fourteen right whales were targeted by the SSVs.

Feeding behaviour for large baleen whales
The SSVs had planned to conduct recording of the feeding behaviour of large baleen whales using a video recorder. However, we did not have a chance to record the feeding behaviour of large baleen whales this year.

Preliminary examination of attachment of satellite tag to sei and Bryde's whale
The SSVs had planned to try attaching satellite tags to sei and Bryde's whales. A total of one sei and two Bryde's whales were targeted by the SSVs. As a result, one satellite tag was attached to a Bryde's whale. The satellite tracking data was received for a period of two weeks (See Appendix 1.).

By-products of whales
After biological measurements and sampling were completed, all the whales were processed in accordance with Article VIII of the International Convention for the Regulation of Whaling. Total production including red meat and blubber from 100 sampled common minke, 100 sei, 50 Bryde's and 6 sperm whales was 261 tons, 1,228 tons, 386 tons and 22 tons, respectively.

DISCUSSIONS

The fifth JARPN II was completed satisfactorily. New samples and data ware collected from almost the entire research area to advance in the main objectives of JARPN II.

The distributions and food habits of whales targeted
Minke whale

Common minke whales were sighted in sub areas 7, 8 and 9. In resent years, during early seasons (May - June), Japanese anchovy was the dominant prey species. During late season (July – August), Pacific saury was the dominant prey species (Tamura and Fujise, 2002a). Results from this cruise confirmed these findings.

Bryde's whale

Bryde's whales were sighted mainly in southern part of sub-areas 7, 8 and 9. It was confirmed that they were distributed in lower latitude waters of the research area during the summer season. Regarding seasonal movement, some studies have reported on the migration pattern of Bryde's whales in the western North Pacific. Omura and Nemoto (1959) reported that Bryde's whales were distributed in waters south of 40 ^{o}N with higher surface water temperatures (over 20 ^{o}C). Nemoto (1959) stated that they migrated to the areas of the higher surface water temperature of 18 ^{o}C or more degrees, and that surface water temperature of 20 ^{o}C was their distribution boundary in offshore. This research confirmed their distribution in the area south of 40 ^{o}N, and our research seems to confirm the northern limit of their distribution. In previous years, during early seasons (May - June), krill was the dominant prey species. During late season (July – August), Japanese anchovy was the dominant prey species (Tamura and Fujise, 2002b). Results from this cruise confirmed that krill and Japanese anchovy were most important prey species for Bryde's whales in the research area. However, some of them fed on the oceaniclight fish in sub areas 8 and 9 during July and August. This prey species was previously reported as the main prey species of Bryde's whale (Kawamura, 1980). The oceaniclight fish is distributed widely in the world oceans. It seems that this fish is an important fish as prey species of Bryde's whale in the southern part of western North Pacific during summer.

Sei whale

Sei whales were sighted mainly in southern part of sub-areas 8 and 9. It was confirmed that they were distributed in middle and higher latitude waters in the research area during the summer season. Our research seems to indicate the southern limit of their distribution. Sighting north of 45 ^{o}N were few because we could not conduct the research activity due to bad weather such as high density fog. In resent years, during all seasons (May – September), copepods and Japanese anchovy were the dominant prey species. During late season (July – August), Japanese anchovy was the dominant prey species (Government of Japan. 2004b). Results from this cruise confirmed that copepods and Japanese anchovy were most important prey species for sei whales in the research area.

The importance of the research for ecosystem modelling

Results from this research have shown a difference of prey species among three baleen whale species. Data on prey consumption together with data from prey surveys, oceanographic data and information on past successive replacement of the most abundant species (Yatsu *et al.* 2001) will be used to construct ecosystem models which will contribute to improved fisheries management. Reliable quantitative diet composition data obtained from this research will make model simulations of species interactions more robust**.**

ACKNOWLEDGMENTS

The authors are greatly indebted to Mr. Joji Morishita and Hideki Moronuki of the Fisheries Agency of Japan, Dr. Hidehiro Kato, Tokyo University of Marine Science and Technology, and Dr. Hiroshi Hatanaka, Dr. Seiji Ohsumi, Dr. Yoshihiro Fujise, Dr. L.A. Pasutene, and Mr. Shigetoshi Nishiwaki of The Institute of Cetacean Research (ICR) for their guidance in the design and implementation of the research. We thank all crew of the research vessels (NM, YS1, YS2, K01and KS2) and the staff of the ICR and Kyodo-Senpaku Co. Ltd. The present research project (JARPN II) was funded by a subsidy from the Ministry of Agriculture, Forestry and Fisheries, Government of Japan.

REFERENCES

Fujise, Y., Kishiro, T., Zenitani, R., Matsuoka, K., Kawasaki, M. and Shimamoto, K. 1995. Cruise report of the Japanese whale research program under a special permit for North Pacific minke whales in 1994. Paper SC/47/NP3 presented to the IWC Scientific Committee, May 1995 (unpublished). 29pp.

Fujise, Y., Iwasaki, T., Zenitani, R., Araki, J., Matsuoka, K., Tamura, T., Aono, S., Yoshida, T., Hidaka, H., Nibe, T. and Tohyama, D. 1996. Cruise report of the Japanese whale research program under a special permit for North Pacific minke whales in 1995 with the results of a preliminary analysis of data collected. Paper SC/48/Np13 presented to the IWC Scientific Committee, June 1996 (unpublished). 39pp.

Fujise, Y., Shimada, H., Zenitani, R., Goto, M., Tamura, T., Lindstrøm, U., Uchida, A., Yoshida, H., Shimamoto, K., Yuzu, S., Kasai, H., Kinoshita, T., Iwata, T. and Tohyama, D. 1997. Cruise report of the Japanese Whale Research Program under a Special Permit in the North Pacific (JARPN) in 1996 with some preliminary analysis of data collected during the 1994-1996 JARPN surveys. Paper SC/49/NP8 presented to the IWC Scientific Committee, September 1997 (unpublished). 38pp.

Fujise, Y., Zenitani, R., Tamura, T., Bando, T., Ohtani, S., Takeda, S., Kitajima, A., Kimura, T., Masaki, T. and Tohyama, D. 2000. Cruise report of the Japanese whale research program under special permit in the North Pacific (JARPN) in 1999. Paper SC/F2K/J9 presented to the JARPN review meeting, February 2000 (unpublished). 32pp.

Fujise, Y., Pastene, L.A, Tamura, T., Bando, T., Murase, H., Kawahara, S., Watanabe, H., Ohizumi, H., Mogoe, T., Kiwada, H., Nemoto, K. and Narita, H. 2001. Progress Report of the Feasibility study of the Japanese whale research program under special permit in the western North Pacific-Phase II (JARPN II) in 2000. Paper SC/53/O10 presented to the IWC Scientific Committee, July 2001 (unpublished). 77pp.

Fujise, Y., Tamura, T., Bando, T., Hikaru Watanabe, Hiroshi Kiwada, Otani, S., Kanda, N., Yasunaga, G., Mogoe, T., Konishi, K., Inamori, M., Shigemune, H. and Tohyama, D. 2002. Cruise report of the feasibility study of the Japanese whale research program under special permit in the western North Pacific – Phase II (JARPNII) in 2001. Paper SC/54/O16 presented to the IWC Scientific Committee, May 2002 (unpublished). 51pp.

Fujise, Y., Tamura, T., Bando, T., Yasunaga, G., Konishi, K., Murase, H., Yoshida, T., Itoh, S. Ogawa, R., Oka, T., Sasaki, T., Fukutome, K., Isoda, T., Birukawa, N., Horii, N., Zharikov, K.A., Park, K.J., Tohyama, D. and Kawahara, S. 2003. Cruise report of the Japanese whale research program under special permit in the western North Pacific – Phase II (JARPNII) in 2002 (Part I). Paper SC/55/O7 presented to the IWC Scientific Committee, May 2003 (unpublished). 41pp.

Government of Japan. 2000. Research Plan for Cetacean Studies in the Western North Pacific under Special Permit (JARPN II) (Feasibility Study Plan for 2000 and 2001). Paper SC/52/01 presented to the IWC Scientific meeting, 68pp.

Government of Japan. 2002a. Report of the 2000 and 2001 feasibility study of the Japanese whale research program under special permit in the western North Pacific-phase II (JARPN II). Paper SC/54/O17 presented to the IWC Scientific Committee, May 2002 (unpublished). 202pp.

Government of Japan. 2002b. Research Plan for Cetacean Studies in the Western North Pacific under Special Permit (JARPN II) Paper SC/54/O2 presented to the IWC Scientific Committee, May 2002 (unpublished). 115pp.

Government of Japan. 2004a. Revised research plan for cetacean studies in the western North Pacific under special permit (JARPN II). Paper SC/56/O1 presented to the IWC Scientific Committee, May 2004 (unpublished). 14pp.

Government of Japan. 2004b. Some considerations of the feasibility components of the JARPN II research plan. Paper SC/56/O2 presented to the IWC Scientific Committee, May 2004 (unpublished). 36pp

International Whaling Commission. 2001. Report of the workshop to review the Japanese Whale Research Programme under Special Permit for North Pacific minke whales (JARPN), Tokyo, 7-10 February 2000. J. Cetacean Res. Manage. (*Suppl.*) 3: 377-413.

Ishikawa, H., Yuzu, S., Shimamoto, K., Bando, T., Ohshima, K., Kasai, H., Kinoshita, T., Mizushima, Y., Iwakami, H., Nibe, T., Hosoyama, T., Kuramochi, T., Numano, K. and Miyamoto, M. 1997. Cruise report of the Japanese Whale Research Program under a Special Permit in the North Pacific (JARPN) in 1997. Paper SC/49/NP9 presented to the IWC Scientific Committee, September 1997 (unpublished). 28pp.

Kato, H., Hiroyama, H., Fujise, Y. and Ono, K. 1989. Preliminary report of the 1987/88 Japanese feasibility study of the special permit proposal for Southern Hemisphere minke whales. Report of the International Whaling Commission, 39: 235-248.

Kawamura, A. 1980. A review of food of Balaenopterid whales. Sci. Rep. Whales Res. Inst., Tokyo, 32: 155-197.

Omura, H. and Nemoto, T. 1955. Sei whales in the adjacent waters of Japan III. Relation between movement and water temperature of the Sea. Sci. Rep. Whales Res. Inst. 10: 79-87.

Nemoto, T. 1959. Food of baleen whales with reference to whale movements. Sci. Rep. Whales Res. Inst., Tokyo, 14: 149-291.

Tamura, T. and Fujise, Y. 2002. Appendix 1. Food habit of common minke whales based on JARPN II., pp 47-63. In: Government of Japan (Fujise, Y., Kawahara, S., Pastene, L.A. and Hatanaka, H. eds.), Report of 2000 and 2001 feasibility study of the Japanese Whale Research Program under Special Permit in the western North Pacific-Phase II (JARPN II). Paper SC/54/O17 submitted to the 54th IWC Scientific Committee Meeting.

Tamura, T. and Fujise, Y. 2002. Appendix 2. Food habit of Bryde's whales based on JARPN II., pp 64-74. In: Government of Japan (Fujise, Y., Kawahara, S., Pastene, L.A. and Hatanaka, H. eds.), Report of 2000 and 2001 feasibility study of the Japanese Whale Research Program under Special Permit in the western North Pacific-Phase II (JARPN II). Paper SC/54/O17 submitted to the 54th IWC Scientific Committee Meeting.

Tamura, T., Fujise, Y., Bando, T., Yasunaga, G., Konishi, K., Kiwada, H., Isoda, T., Itoh, S. Machida, S., Tsunekawa, M., Konagai, T., Takamatsu, T., Ohshima, T., Honjo, K., Matsuoka, T., Zharikov, K.A., Yong, Rock AN, Tohyama, D. and Kawahara, S. 2004. Cruise Report of the Japanese Whale Research Program under Special Permit in the western North Pacific -Phase II (JARPN II) in 2003 (part I) – Offshore component –. Paper SC/56/O13 presented to the IWC Scientific Committee, June 2004 (unpublished). 46pp.

Tamura, T., Fujise, Y., Mogoe, T., Kanda, N., Yasunaga, G., Konishi, K., Kiwada, H., Ogihara, M., Hasegawa, A., Kitajima, M, Sugiyama, T., Sasaki, T., Mori, M., Teraoka, T., Tsunekawa, M., Fukutome, K., Zharikov, K.A, NA, Jong-Hun., Tohyama, D, Inagake, D. and Kawahara, S. 2005. Cruise Report of the Japanese Whale Research Program under Special Permit in the western North Pacific -Phase II (JARPN II) in 2004 (part I) – Offshore component –. Paper SC/57/O3 presented to the IWC Scientific Committee, June 2005 (unpublished). 33pp

Tamura, T., Otani, S., Kiwada, H., Mori, M., Konishi, K., Isoda, T., Wada, A., Ogihara, M., Hasegawa, A., Kumagai, S., Komatsu, W., Hayasaka, K., Fukutome, M., Siozaki, M., Zharikov, K.A, NA, Jong-Hun., Ogawa, T, Watanabe, H., Yonezaki, S, Inagake, D. and Kawahara, S. 2006. Cruise report of the second phase of the Japanese Whale Research Program under Special Permit in the Western North Pacific (JARPN II) in 2005 – Offshore component –. Paper SC/58/O8 presented to the IWC Scientific Committee, June 2006 (unpublished). 52pp

Yatsu, A., Nishida, H., Tomosada, A., Kinoshita, T. and Wada, T. 2001. Trajectories of catch and stock abundance of dominant small pelagic fishes and common squid with some related environmental indices around Japan. PICES Sci. Rep. 18: 175-8.

Zenitani, R., Fujise, Y., Matsuoka, K., Tamura, T., Bando, T., Ichihashi, H., Shimokawa, T., Krasnenko, A.S., Taguchi F., Kinoshita, T., Mori, M., Watanabe, M., Ichinomiya, D., Nakamura, M., Sakai, K., Matsuzaka, K., Kamei, H. and Tohyama, D. 1999. Cruise report of the Japanese Whale Research Program under a Special Permit in the North Pacific in 1998. Paper SC/51/RMP7 presented to the IWC Scientific Committee, May 1999 (unpublished). 20pp

Table 1. Outline of 2006 JARPN II

・Whale sampling survey

Research	Sub-area	Research periods	Days	Research ships and remark
Sighting survey	**7**	**May 24-26**	**(3)**	**YS1**
Whale survey (First period)	**7, 8, 9**	**May 27-July 19**	**54**	**NM, YS1, YS2 and K01**
	7	May 27- June 4	9	
	8	June 5- 15	11	
	9	June 16-July 2	17	
	8	July 3- 15	13	
	7	July 16-19	4	
Sighting survey	**7**	**July 20-21**	**2**	**YS1, YS2, K01**
Whale survey (Second period)	**7, 8, 9**	**July 22-August 16**	**26**	**NM, YS1, YS2 and K01**
	7	July 22-24	3	
	8	July 25-27	3	
	9	July 28-August 16	20	
Total	**7, 8, 9**	**May 24-August 16**	**85**	**NM, YS1, YS2 and K01**

・Sighting survey by Kyoshin Maru No.2

Research	Sub-area	Research periods	Days	Remarks
Dedicated sighting survey	**7, 8, 9**	**May 16 - August 29**	**106**	

Research base ship: *Nisshin Maru (NM)*
Sighting and Sampling vessels (SSVs) : *Yushin Maru (YS1), Yushin Maru No.2 (YS2) and Kyo Maru No.1 (K01)*
Sighting vessel (SV) : *Kyoshin Maru No.2 (KS2)*

Table 2. Searching distances made by the three sighting/sampling vessels (YS2, YS1 and K01) and sighting vessels (KS2) in the 2006 JARPN II

SSVs

	Sub-area	Period	Searching distance (n.miles)			
			NSC	ASP	NSS	Combined
Sighting survey	**7**	**May 24-26**	**255.7**	**0.0**	**0.0**	**255.7**
Whale survey (First period)	**7, 8, 9**	**May 27-July 19**	**4,933.5**	**45.6**	**3,037.6**	**8,016.7**
	7	May 27- June 4	1,134.1	0.0	497.4	1,631.5
	8	June 5- 15	843.0	0.0	389.2	1,232.2
	9	June 16-July 2	1,130.9	6.2	1,205.0	2,342.1
	8	July 3- 15	1,310.6	39.4	371.1	1,721.1
	7	July 16-19	514.8	0.0	575.0	1,089.8
Sighting survey	**7**	**July 20-21**	**0.0**	**257.3**	**0.0**	**257.3**
Whale survey (Second period)	**7, 8, 9**	**July 22-August 16**	**2,030.7**	**146.3**	**1,538.6**	**3,715.6**
	7	July 22-24	140.5	0.0	450.3	590.8
	8	July 25-27	285.6	0.0	199.3	484.9
	9	July 28-August 16	1,604.6	146.3	889.0	2,639.9
Total	**7, 8, 9**		**7,219.9**	**449.2**	**4,576.2**	**12,245.3**

SV (KS2)

	Sub-area	Period	Searching distance (n.miles)
			ASP
Dedicated sighting survey	7,8,9	**May 16 - Aug. 24**	**5,413.2**
Transit	7	**July 6 - July 11**	**128.5**
	Combined	**May 16 - Aug. 29**	**5,541.7**

Table 3. List of cetacean species and number of sightings (no. schools/no. individuals) made by three sighting/sampling vessels and research base in the 2006 JARPN II.

Cetacean species	NSC				NSS				ASP				OE	
	Primary		Secondary		Primary		Secondary		Primary		Secondary		Secondary	
	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.
Common minke whale	62	64	37	38	14	14	7	7	5	5	4	4	2	2
Like minke whale	2	2	3	3	4	4	0	0	1	1	0	0	0	0
Sei whale	101	147	41	62	36	51	20	29	10	34	1	3	0	0
Bryde's whale	60	78	23	32	41	50	8	11	1	1	0	0	0	0
Sperm whale	112	175	27	46	27	64	4	4	6	31	1	6	2	2
Blue whale	14	19	7	10	9	11	2	2	0	0	0	0	0	0
Fin whale	39	54	8	8	22	28	6	7	2	2	0	0	3	4
Humpback whale	28	36	5	5	13	18	4	4	6	7	2	2	0	0
Right whale	7	11	0	0	1	1	0	0	1	1	0	0	0	0

Cetacean species	Total					
	Primary		Secondary		Total	
	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.
Common minke whale	81	83	50	51	131	134
Like minke whale	7	7	3	3	10	10
Sei whale	147	232	62	94	209	326
Bryde's whale	102	129	31	43	133	172
Sperm whale	145	270	36	60	181	330
Blue whale	23	30	9	12	32	42
Fin whale	63	84	17	19	80	103
Humpback whale	47	61	11	11	58	72
Right whale	9	13	0	0	9	13

Table 4. List of cetacean species and number of sightings (no. schools/no. individuals) made by dedicated sighting vessel (KS2) in the 2006 JARPN II.

Cetacean species	ASP				OE		Total					
	Primary		Secondary		Secondary		Primary		Secondary		Total	
	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.
Common minke whale	45	53	0	0	1	1	45	53	1	1	46	54
Like Common minke whale	2	2	0	0	0	0	2	2	0	0	2	2
Blue whale	18	29	1	1	3	3	18	29	4	4	22	33
Fin whale	22	32	1	1	3	3	22	32	4	4	26	36
Sei whale	133	238	0	0	4	6	133	238	4	6	137	244
Bryde's whale	10	15	0	0	0	0	10	15	0	0	10	15
Humpback whale	14	18	1	1	1	1	14	18	2	2	16	20
Northern right whale	1	1	0	0	0	0	1	1	0	0	1	1
Sperm whale	94	183	5	8	19	29	94	183	24	37	118	220
Unidentified large cetacean	6	6	8	10	12	16	6	6	20	26	26	32
Unidentified cetacean	28	29	0	0	2	2	28	29	2	2	30	31

Table 5. Summary of whale sampling in the 2006 JARPN II

Research type	Sub-area	Research periods	Whale samples			
			Common minke	Sei	Bryde's	Sperm
Whale survey (First period)	**7, 8, 9**	**May 27-July 19**	**75**	**67**	**37**	**5**
	7	May 27- June 4	27	1	0	0
	8	June 5- 15	26	19	0	0
	9	June 16-July 2	10	20	21	3
	8	July 3- 15	11	24	11	2
	7	July 16-19	1	3	5	0
Whale survey (Second period)	**7, 8, 9**	**July 22-August 16**	**25**	**33**	**13**	**1**
	7	July 22-24	10	1	0	0
	8	July 25-27	1	5	0	0
	9	July 28-August 16	14	27	13	1
Total	**7, 8, 9**	**May 27-August 16**	**100**	**100**	**50**	**6**

Table 6. Summary of biological data obtained in the 2006 JARPN II

Samples and data	Common minke			Sei whale			Bryde's whale			Sperm whale		
	M	F	T	M	F	T	M	F	T	M	F	T
Body length and sex	93	7	100	48	52	100	21	29	50	2	4	6
External body proportion	93	7	100	48	52	100	21	29	50	2	4	6
Photographic record and external character	93	7	100	48	52	100	21	29	50	2	4	6
Diatom film record	93	7	100	48	52	100	21	29	50	2	4	6
Standard measurements of blubber thickness (five points)	93	7	100	48	52	100	21	29	50	2	4	6
Detailed measurements of blubber thickness (eleven points)	16	2	18	9	11	20	7	5	12	2	4	6
Body weight	93	7	100	48	52	100	21	29	50	2	4	6
Body weight by parts	16	2	18	9	11	20	7	5	12	2	2	4
Blubber tissues for DNA study	93	7	100	48	52	100	21	29	50	2	4	6
Blubber, muscle, liver and kidney tissues for heavy metal analysis	93	7	100	48	52	100	21	29	50	2	4	6
Blubber, muscle, liver and kidney tissues for organochlorines analy	93	7	100	48	52	100	21	29	50	2	4	6
Tissues for lipid analysis	16	2	18	9	11	20	7	5	12	2	2	4
Tissues for various analysis	93	7	100	48	52	100	21	29	50	2	4	6
Intestine contents for prey species identification	0	0	0	0	0	0	0	0	0	0	0	0
Tissues for virus test	93	7	100	48	52	100	21	29	50	2	4	6
Mammary grand; lactation status, measurement and histological sa	0	7	7	0	52	52	0	29	29	0	4	4
Collection of maternal milk sample	0	0	0	0	6	6	0	3	3	0	2	2
Uterine horn; measurement and endometrium sample	0	7	7	0	52	52	0	29	29	0	4	4
Collection of ovary	0	7	7	0	52	52	0	29	29	0	4	4
Photographic record of foetus	0	4	4	0	26	26	0	13	13	0	0	0
Foetal sex (identified by visual observation)	0	4	4	0	26	26	0	12	12	0	0	0
Foetal length and weight	0	4	4	0	26	26	0	13	13	0	0	0
External measurements of foetus	0	4	4	0	26	26	0	12	12	0	0	0
Foetal tissues for various analysis	0	4	4	0	26	26	0	12	12	0	0	0
Testis and epididymis; weight and histological sample	93	0	93	48	0	48	21	0	21	2	0	2
Collection of plasma sample	93	7	100	47	52	99	21	29	50	2	4	6
Collection of whole blood sample	83	7	90	47	52	99	21	29	50	2	3	5
Whole blood samples from umbilical cord	0	0	0	0	21	21	0	4	4	0	0	0
Stomach content, conventional record	93	7	100	48	52	100	21	29	50	2	4	6
Volume and weight of stomach content in each compartment	93	7	100	48	52	100	21	29	50	2	4	6
Stomach contents for feeding study	93	7	100	48	52	100	21	29	50	2	4	6
Record of external parasites	93	7	100	48	52	100	21	29	50	2	4	6
Collection of external parasites	0	1	1	3	2	5	4	1	5	0	2	2
Record of internal parasites	93	7	100	48	52	100	21	29	50	2	4	6
Collection of internal parasites	0	0	0	0	1	1	0	1	1	2	4	6
Earplug for age determination	93	7	100	48	52	100	21	29	50	0	0	0
Tympanic bulla for age determination	93	7	100	48	52	100	21	29	50	2	4	6
Maxillally teeth for age determination	0	0	0	0	0	0	0	0	0	2	4	6
Largest baleen plate for morphologic study and age determination	93	7	100	48	52	100	21	29	50	0	0	0
Baleen plate measurements (length and breadth)	92	7	99	48	52	100	21	29	50	0	0	0
Length of each baleen plate series	91	7	98	48	52	100	20	29	49	0	0	0
Vertebral epiphyses sample	93	7	100	48	52	100	21	29	50	2	4	6
Number of vertebrae	16	2	18	9	11	20	7	5	12	2	4	6
Number of ribs	93	7	100	48	52	100	21	29	50	2	4	6
Brain weight	16	2	18	9	11	20	7	5	12	2	2	4
Skull measurement (length and breadth)	93	7	100	48	52	100	21	29	50	2	4	6

Table 7. Compositon of sex and sexual maturity of common minke whales collected by the 2006 JARPN II

Sub-area	Male				Female					Combined	Sex ratio	Maturity		Pregnancy
	Imm.	Mat.	Unknown	Total	Imm	Ovu.	Rest.	Preg.	Total		(% males)	Male	Female	rate*)
7	14	19	1	34	2	0	0	2	4	38	89.5	55.9	50.0	100.0
	(36.8)	(50.0)	(2.6)	(89.5)	(5.3)	(0.0)	(0.0)	(5.3)	(10.5)	(100.0)				
8	6	26	4	36	0	0	0	2	2	38	94.7	72.2	100.0	100.0
	(15.8)	(68.4)	(10.5)	(94.7)	(0.0)	(0.0)	(0.0)	(5.3)	(5.3)	(100.0)				
9	1	19	3	23	1	0	0	0	1	24	95.8	82.6	0.0	-
	(4.2)	(79.2)	(12.5)	(95.8)	(4.2)	(0.0)	(0.0)	(0.0)	(4.2)	(100.0)				
Combined	21	64	8	93	3	0	0	4	7	100	93.0	68.8	57.1	100.0
	(21.0)	(64.0)	(8.0)	(93.0)	(3.0)	(0.0)	(0.0)	(4.0)	(7.0)	(100.0)				

*) Apparent pregnancy rate

Table 8. Compositon of sex and sexual maturity of Bryde's whales collected by the 2006 JARPN II

Sub-area	Male			Female							Combined	Sex ratio	Maturity		Pregnancy
	Imm.	Mat.	Total	Imm	Ovu	Rest.	Preg.	Lact.	Preg&Lact	Total		(% males)	Male	Female	rate*)
7	1	2	3	1	0	1	0	0	0	2	5	60.0	66.7	50.0	0.0
	(20.0)	(40.0)	(60.0)	(20.0)	(0.0)	(20.0)	(0.0)	(0.0)	(0.0)	(40.0)	(100.0)				
8	3	5	8	1	0	0	1	0	1	3	11	72.7	62.5	66.7	100.0
	(27.3)	(45.5)	(72.7)	(9.1)	(0.0)	(0.0)	(9.1)	(0.0)	(9.1)	(27.3)	(100.0)				
9	4	6	10	6	2	5	10	0	1	24	34	29.4	-	75.0	61.1
	(11.8)	(17.6)	(29.4)	(17.6)	(5.9)	(14.7)	(29.4)	(0.0)	(2.9)	(70.6)	(100.0)				
Combined	8	13	21	8	2	6	11	0	2	29	50	42.0	61.9	72.4	61.9
	(16.0)	(26.0)	(42.0)	(16.0)	(4.0)	(12.0)	(22.0)	(0.0)	(4.0)	(58.0)	(100.0)				

*) Apparent pregnancy rate

Table 9. Compositon of sex and sexual maturity of sei whales collected by the 2006 JARPN II

Sub-area	Male			Female							Combined	Sex ratio	Maturity		Pregnancy
	Imm.	Mat.	Total	Imm	Ovu	Rest.	Preg.	Lact.	Preg&Lact	Total		(% males)	Male	Female	rate*)
7	1	1	2	1	0	2	0	0	0	3	5	40.0	50.0	66.7	0.0
	(20.0)	(20.0)	(40.0)	(20.0)	(0.0)	(40.0)	(0.0)	(0.0)	(0.0)	(60.0)	(100.0)				
8	9	15	24	6	0	2	11	4	1	24	48	50.0	62.5	75.0	88.9
	(18.8)	(31.3)	(50.0)	(12.5)	(0.0)	(4.2)	(22.9)	(8.3)	(2.1)	(50.0)	(100.0)				
9	9	13	22	6	0	3	14	2	0	25	47	46.8	59.1	76.0	84.2
	(19.1)	(27.7)	(46.8)	(12.8)	(0.0)	(6.4)	(29.8)	(4.3)	(0.0)	(53.2)	(100.0)				
Combined	19	29	48	13	0	7	25	6	1	52	100	48.0	60.4	75.0	82.1
	(19.0)	(29.0)	(48.0)	(13.0)	(0.0)	(7.0)	(25.0)	(6.0)	(1.0)	(52.0)	(100.0)				

*) Apparent pregnancy rate

Table 10. Statistics of body length (m) of minke whales collected by the 2006 JARPN II

Sub area	Male					Female				
	Mean	S.D.	Min	Max	n	Mean	S.D.	Min	Max	n
7	6.69	1.13	4.04	8.11	34	6.95	0.85	5.88	7.64	4
8	7.28	0.63	5.46	8.06	36	8.02	0.20	7.88	8.16	2
9	7.53	0.38	6.29	8.07	23	5.39	NA	5.39	5.39	1
Combined	7.13	0.87	4.04	8.11	93	7.03	1.07	5.39	8.16	7

Table 11. Statistics of body length (m) of Bryde's whales collected by the 2006 JARPN II

Sub area	Male					Female				
	Mean	S.D.	Min	Max	n	Mean	S.D.	Min	Max	n
7	12.05	1.05	10.85	12.79	3	11.51	0.83	10.92	12.10	2
8	11.86	0.86	10.54	12.88	8	11.86	2.56	8.91	13.35	3
9	11.66	0.99	9.39	13.08	10	12.06	1.26	8.86	13.57	24
Combined	11.79	0.91	9.39	13.08	21	11.99	1.35	8.86	13.57	29

Table 12. Statistics of body length (m) of sei whales collected by the 2006 JARPN II

Sub area	Male					Female				
	Mean	S.D.	Min	Max	n	Mean	S.D.	Min	Max	n
7	13.50	0.83	12.91	14.09	2	13.23	0.63	12.53	13.75	3
8	13.02	1.42	8.06	14.53	24	14.00	1.26	11.46	16.32	24
9	12.71	1.42	9.72	14.50	22	13.94	1.19	11.44	15.93	25
Combined	12.90	1.39	8.06	14.53	48	13.93	1.20	11.44	16.32	52

Table 13. Statistics of body length (m) of sperm whales collected by the 2006 JARPN II

Sub area	Male					Female				
	Mean	S.D.	Min	Max	n	Mean	S.D.	Min	Max	n
7	NA	NA	NA	NA	0	NA	NA	NA	NA	0
8	12.41	NA	12.41	12.41	1	12.65	NA	12.65	12.65	1
9	11.65	NA	11.65	11.65	1	9.98	0.81	9.07	10.63	3
Combined	12.03	0.54	11.65	12.41	2	10.65	1.49	9.07	12.65	4

Table 14. Prey species and stomach contents weight (1st. + 2nd. stomachs) found in stomach of common minke, Bryde's, sei and sperm whales sampled by the 2006 JARPN II

Common minke whale (Broken 6; Empty 17)

	Prey species	N (Dominant)	Range of weight (kg) in the stomachs
Krill		4	1.6 - 16.7
Fish	Pacific saury	31	0.02 - 121.2
	Japanese anchovy	38	1.0 - 123.3
	Walleye pollock	2	3.8 - 5.2
	Chub mackerel	1	88.5
	Japanese pomfret	1	38.5
	Salmonidae*		
	Japanese sardine*		

*: Minor prey species

Bryde's whale (Broken 1; Empty 20)

	Prey species	N (Dominant)	Range of weight (kg) in the stomachs
Krill	Krill	15	2.3 - 172.3
Fish	Japanese anchovy	4	30.1 - 413.3
	Oceanic lightfish	10	0.8 - 74.2
	Chub mackerel*		
	Japanese sardine*		

*: Minor prey species

Sei whale (Broken 6; Empty 34)

	Prey species	N (Dominant)	Range of weight (kg) in the stomachs
Copepods	Neocalanus spp.	14	1.0 - 46.8
Krill		10	1.6 - 201.3
Fish	Pacific saury	7	0.5 - 240.1
	Japanese anchovy	29	0.6 - 903.2
	Oceanic lightfish*		-
	Japanese sardine*		-

*: Minor prey species

Table 15. Summary of biopsy skin sampling for baleen whales in the 2006 JARPN II

Whale species	Ship	Number of experiments (A)	Targeted individuals (B)	Number of shoots (C)	Number of hits (D)	Number of samples (E)	Effort (hr) (F)	sample per trial (E)/(C)	sample per hit (E)/(D)
Blue whale	SSVs	9	10	20	8	3	0	0.15	0.38
Fin whale	SSVs	1	1	1	0	0	0	0.00	-
Humpback whale	SSVs	4	4	4	1	1	0	0.25	1.00
Right whale	SSVs	7	8	6	1	1	0	0.17	1.00

Table 16. Summary of photo ID for baleen whales in the 2006 JARPN II

Whale species	Ship	Number of experiments (A)	Targeted individuals (B)	Number of photos (C)
Blue whale	SSVs	10	11	48
Humpback whale	SSVs	3	3	12
Right whale	SSVs	10	14	58

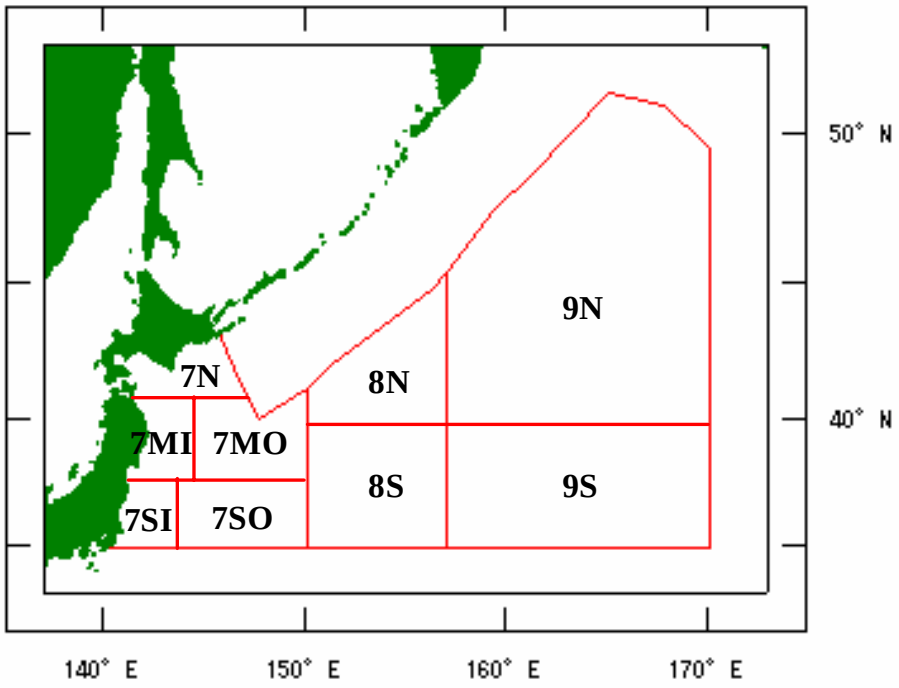

Fig 1. Map showing the research area and strata of the JARPN II full-scale program.

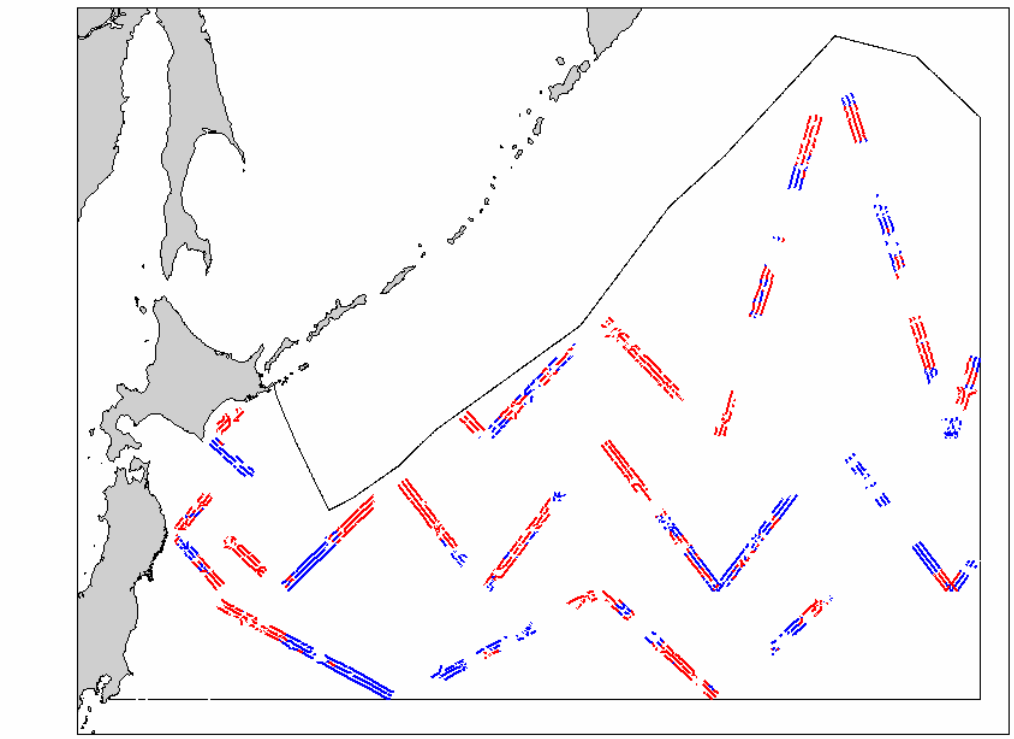

Fig. 2. Track-line covered by the three sighting/sampling vessels (SSVs) during the whale survey of the 2006 JARPN II (Red line: BC mode; Blue line: BS mode).

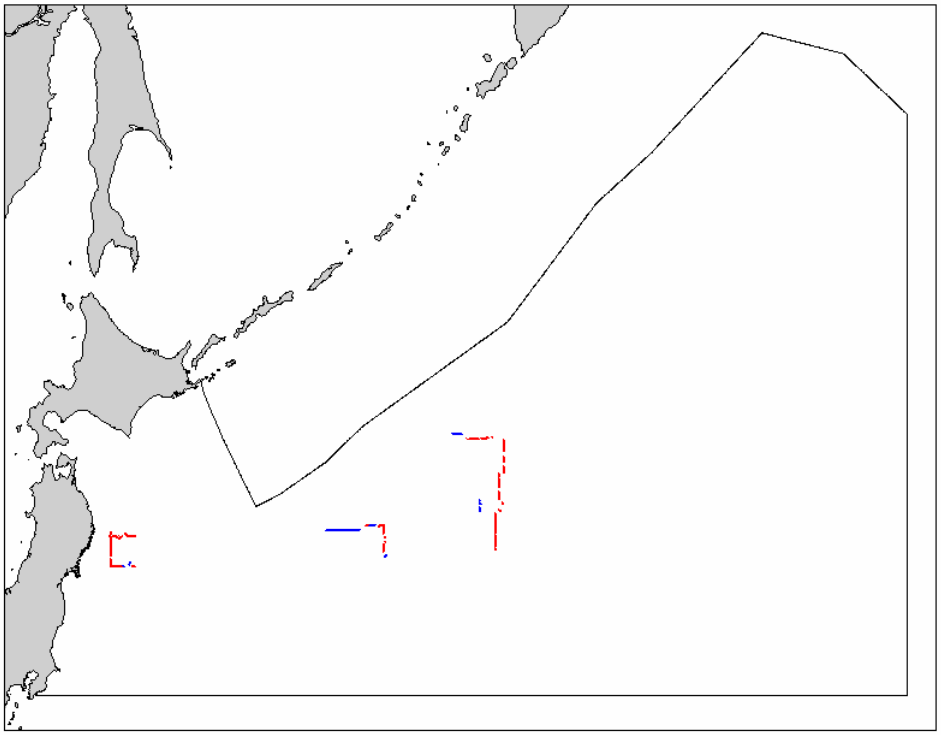

Fig. 3. Track-line covered by the three sighting/sampling vessels (SSVs) during the special survey (SMS) of the 2006 JARPN II (Red line: BC mode; Blue line: BS mode).

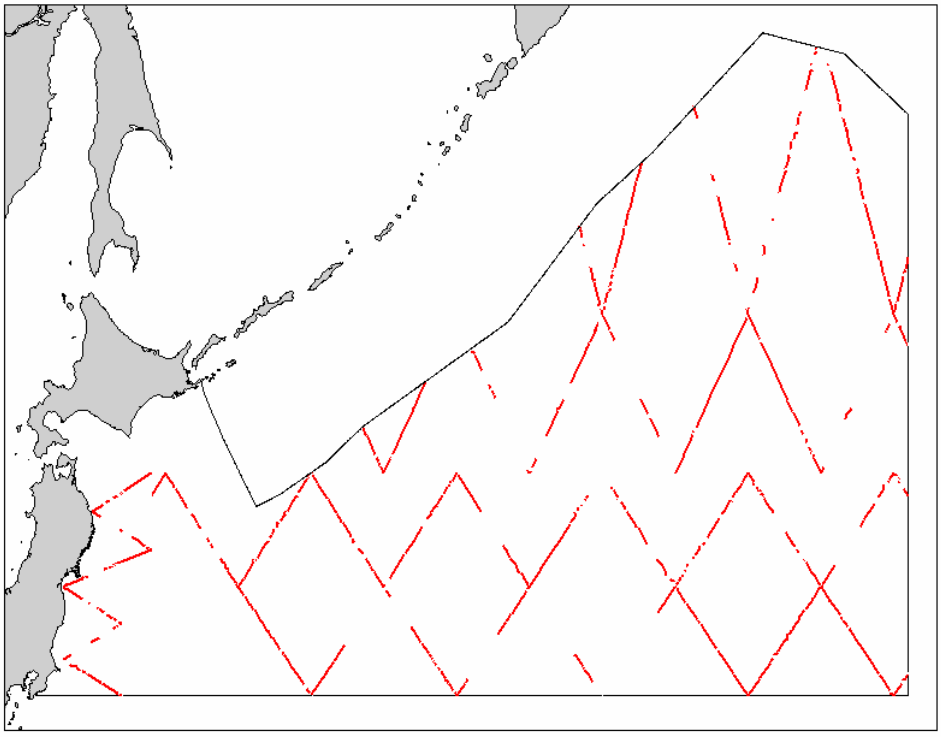

Fig. 4. Track-line covered by the sighting vessel (SV: KS2) in the 2006 JARPN II.

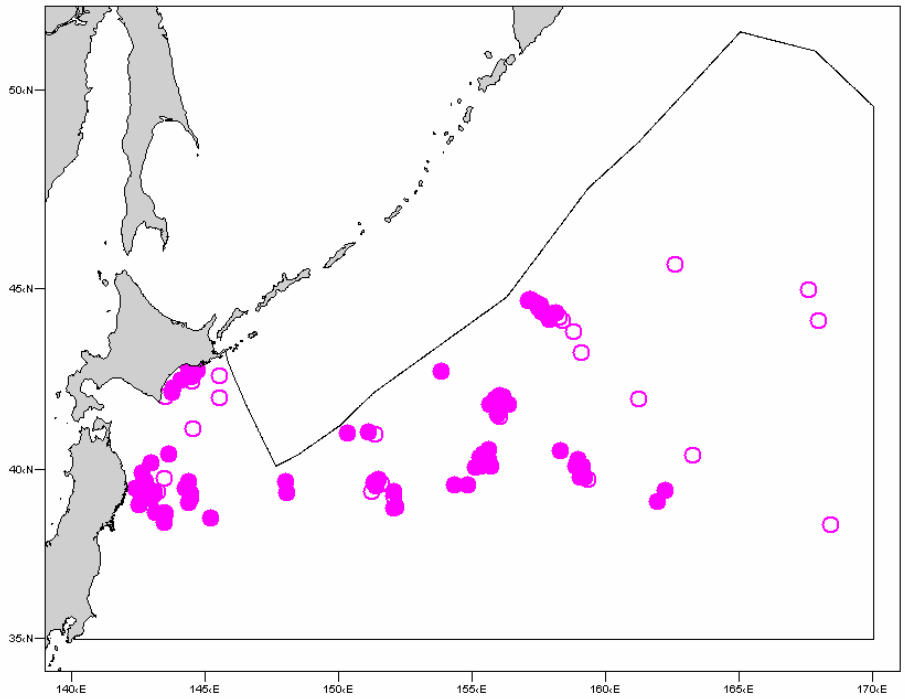

Fig. 5. Positions of the sightings and samplings of the common minke whales by SSVs (●: sighted and sampled, ○: sighted only).

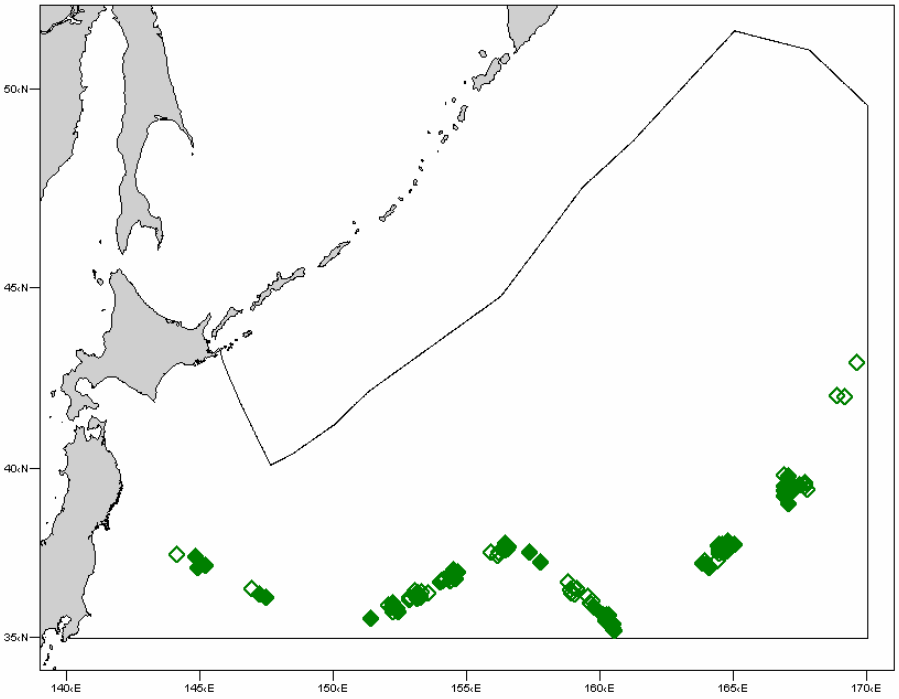

Fig. 6. Positions of the sightings and samplings of the Bryde's whales by SSVs (◆: sighted and sampled, ◇: sighted only).

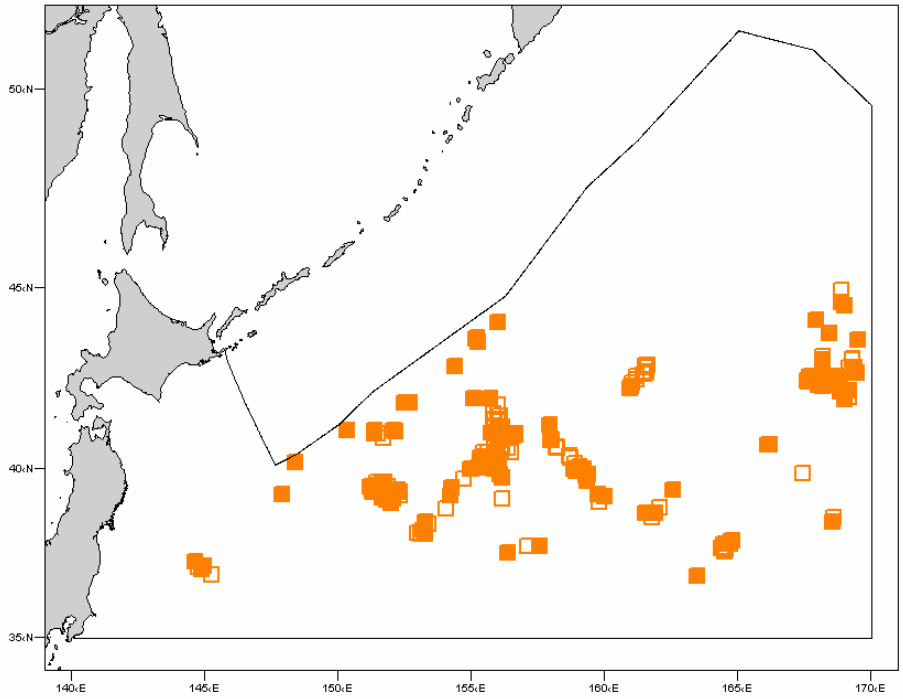

Fig. 7. Positions of the sightings and samplings of the sei whales by SSVs (■: sighted and sampled, □: sighted only).

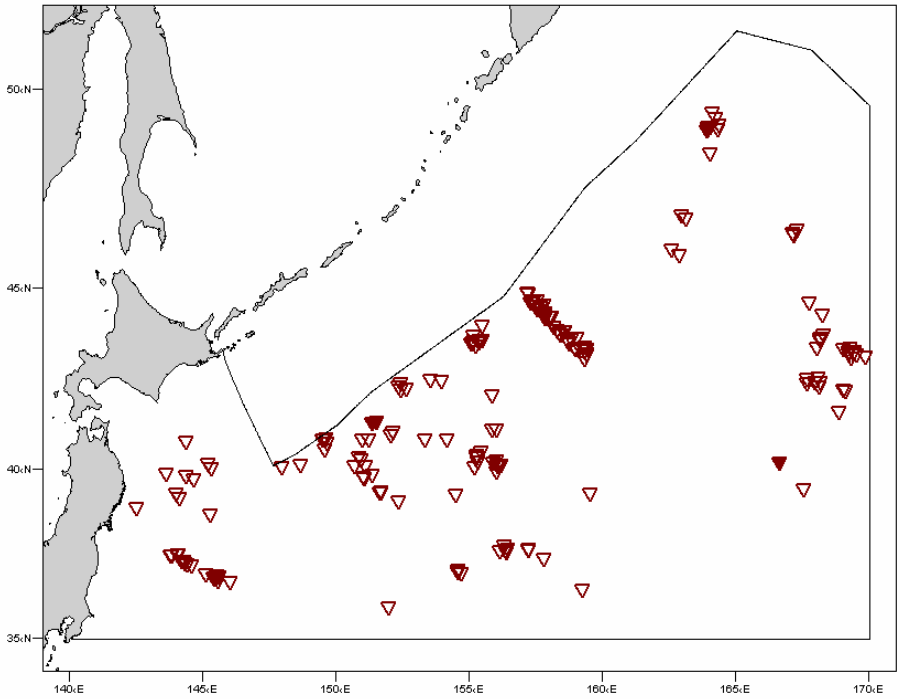

Fig. 8. Positions of the sightings and samplings of the sperm whales by SSVs (▼: sighted and sampled, ▽: sighted only).

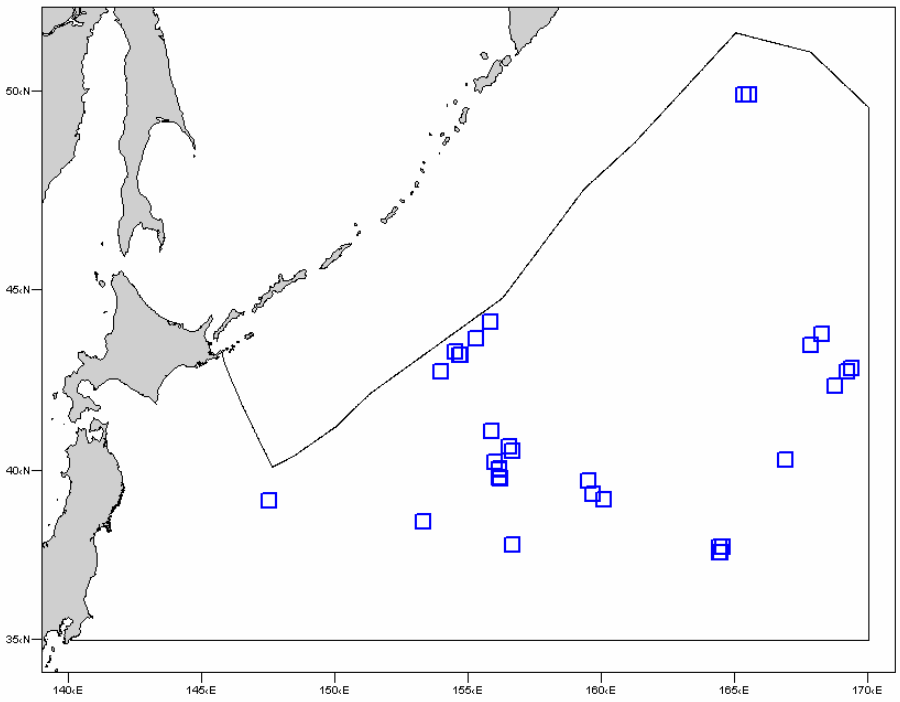

Fig. 9. Positions of the sightings of the Blue whales by SSVs (□)

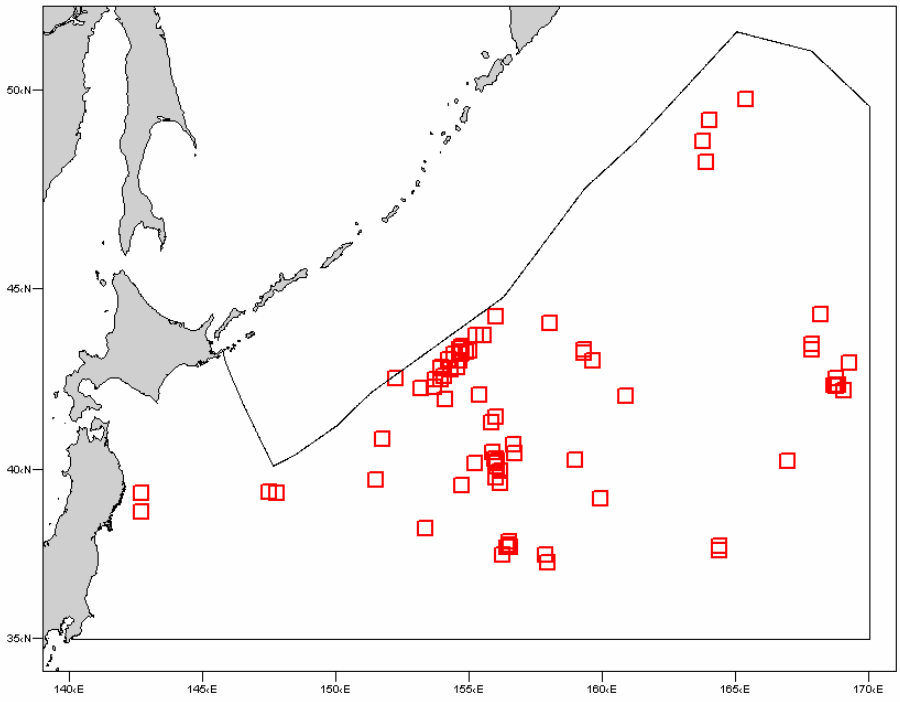

Fig. 10. Positions of the sightings of the fin whales by SSVs (□)

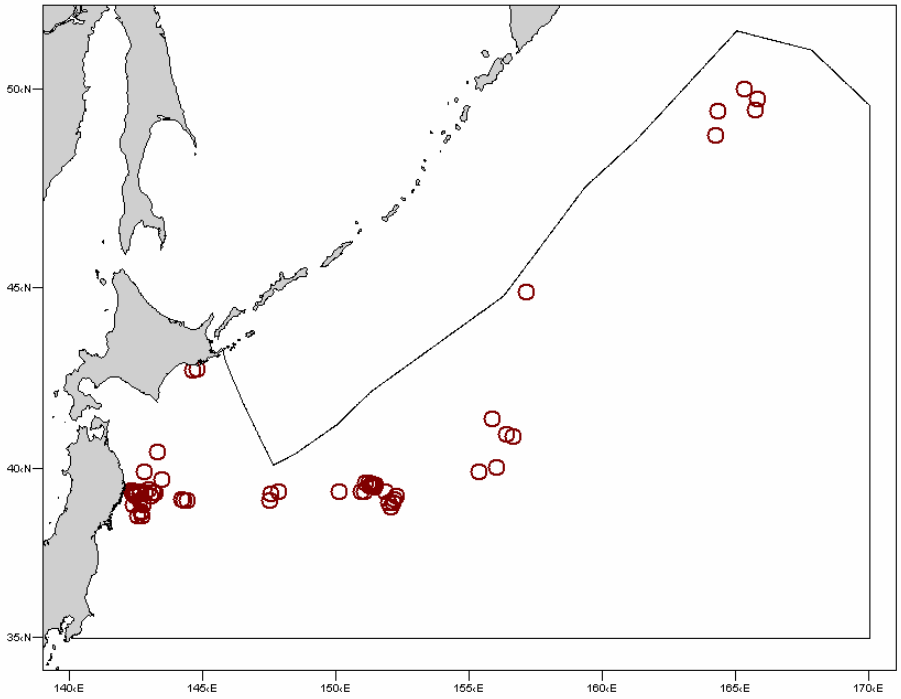

Fig. 11. Positions of the sightings of the humpback whales by SSVs (○).

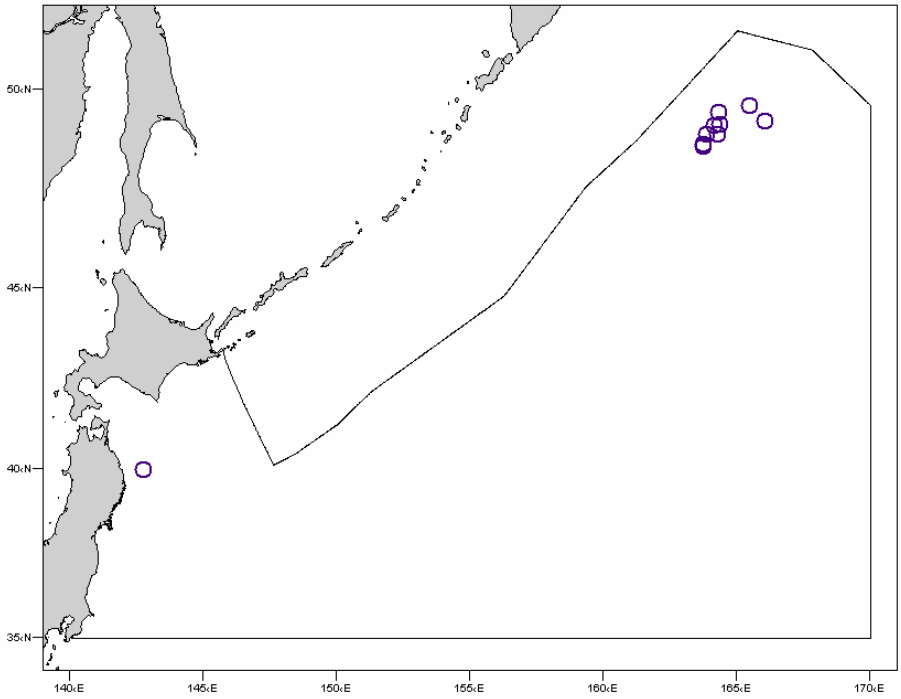

Fig. 12. Positions of the sightings of the right whales by SSVs (○).

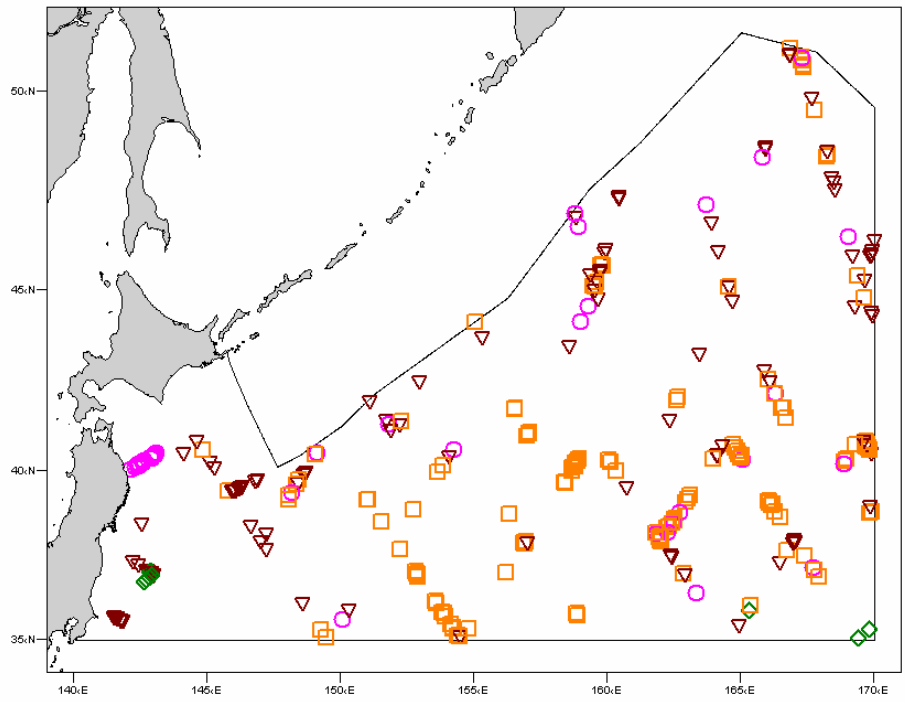

Fig. 13. Positions of the sightings of common minke, Bryde's, sei and sperm whales in dedicated sighting survey by KS2 (○: minke, ◇: Bryde's, □: sei, ▽: sperm)

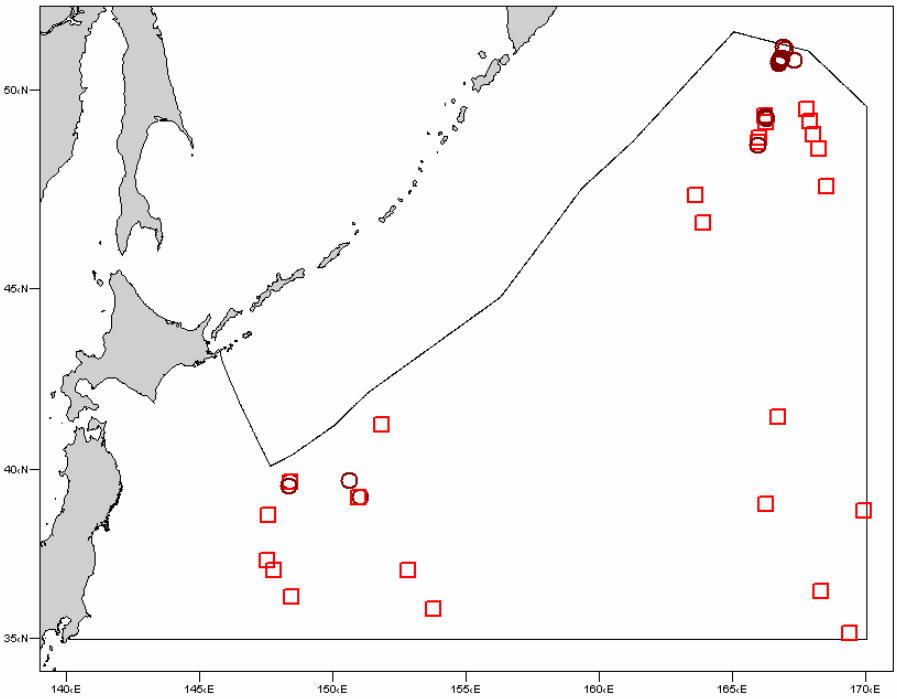

Fig. 14. Positions of the sightings of humpback and fin whales in dedicated sighting survey by KS2 (○: humpback, □: fin).

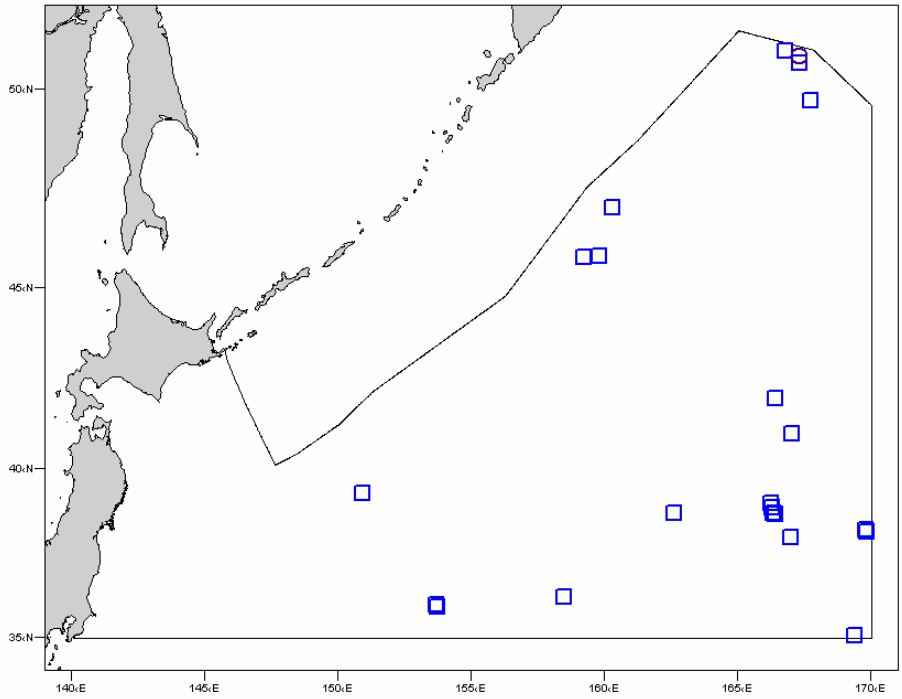

Fig. 15. Positions of the sightings of blue and right whales in dedicated sighting survey by KS2 (□: blue, ○: right).

Appendix.1. The satellite tagging of a Bryde's whale in the western North Pacific

(Tamura, T. and Nishiwaki, S)

Abstract

One Bryde's whale tagged with an argos transmitter (Telonics, INC. USA) was tracked in the western North Pacific from 13 to 27 July. The Bryde's whale with an estimated body length of 12.5m, was tagged on 13 July 2006, at 37-37N, 156-10E from the *Yushin Maru* No.2. The surface water temperature was 17.3 degree. This individuals was a mother swimming together with a calf (estimated body length was 8.7m). We received their position information from the satellite for a period of two weeks. After the satellite tag was attached, the animal moved southwest. The travelling distance was estimated to be approximately 650 naut. miles (1,170 km) in the two week period.

Fig. 1. The Bryde's whale with the satellite tag attached.

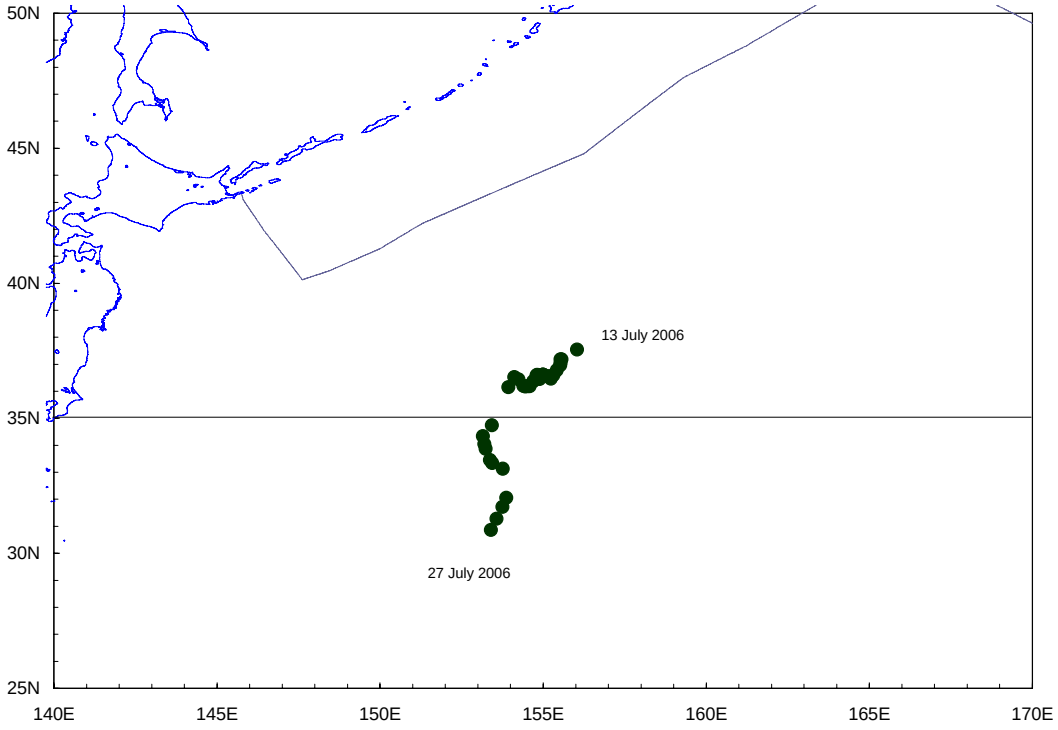

Fig. 2. Track of the Bryde's whale 13 to 27 July in the western North Pacific.