SC/58/O9

Cruise report of the second phase of the Japanese Whale Research Program under Special Permit in the Western North Pacific (JARPN II) in 2005 - Coastal component off Sanriku.

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ABSTRACT

The second survey of the revised JARPN II coastal component was conducted from 11 April to 21 May 2005, off Sanriku district, northeastern Japan (middle part of the sub-area 7), using four small-type whaling catcher boats, one echo sounder-trawl survey vessel, and one dedicated sighting survey vessel. Based on results from the two-year feasibility study conducted in 2002 and 2003, the coastal component of JARPN II was revised to be conducted twice a year and to sample 60 common minke whales in each of spring and autumn, and then the first revised survey was carried out in autumn of 2004. In the present survey, sampling of common minke whales was conducted in coastal waters within 30 nautical miles from Ayukawa port in the Sanriku district, and all animals collected were landed on the JARPN II research station established in the port for biological examination. During the survey, a total of 5245.8 nautical miles (466.9 hours) was surveyed for whale sampling, the 202 schools (205 individuals) of common minke whales were detected with sightings of 2 humpback whale schools (2 animals), and all the 60 animals were caught. Average body length of the animals was 6.29m (SD=0.82, *n*=23) for males and 6.55m (SD=1.15, *n*=37) for females. Dominant prey species found from forestomach of animals was Japanese sand lances (*Ammodytes personatus*). Krill (*Euphausia pacifica*) and Japanese anchovies (*Engraulis japonicus*) were also observed, but their occurrence frequency was much lower. This observation was different from the 2003 JARPN II coastal survey off Sanriku, in which krill were also dominant. These results indicate that feeding habit of common minke whales in coastal waters off Sanriku changes yearly.

KEYWORDS: COMMON MINKE WHALE; NORTH PACIFIC; COASTAL WATERS OF JAPAN; FOOD/PREY; ECOSYSTEM; SCIENTIFIC PERMITS.

INTRODUCTION

After the two-year feasibility study in 2000-2001, the full-scale survey of the second phase of the Japanese Whale Research Program under Special Permit in the Western North Pacific (JARPN II) was started in 2002. The purpose of the program is, i) feeding ecology and ecosystem studies, involving prey consumption by cetaceans, prey preferences of cetaceans and ecosystem modeling, ii) monitoring

environmental pollutants in cetaceans and the marine ecosystem, and iii) elucidation of stock structure of whales (Government of Japan, 2002a).

The JARPN (1994-1999) and the JARPN II feasibility study (2000-2001) revealed that common minke whales are widely distributed from offshore waters to coastal waters and feed on various prey species such as Japanese anchovy, Pacific saury, and walleye pollock (Government of Japan, 2002b; Tamura and Fujise, 2002). The coastal waters of Japan are also very important fishing ground. Thus, it was thought that the coastal waters are also very important research area for the full-scale JARPN II program. However, the *Nisshin Maru* research vessels can not be operated in the near shore areas, because of their movement restrictions from shallow water depth, and many fishing gears and boats. Furthermore, the vessels can not work from late autumn to early spring because of their practical availability. In order to cover the temporal and spatial gap of the vessels, sampling of common minke whales in the coastal waters using small-type whaling catcher boats was planned.

In the original JARPN II plan, the coastal component was presented as the two-year feasibility study to examine the logistic aspects of the methodology (Government of Japan, 2002a). First survey was carried out in the coastal waters off Kushiro, northeast Japan, from 10 September to 12 October 2002 (Kishiro, *et al*., 2003) and then the second survey was conducted in the coastal waters off Sanriku district, from 8 April to 2 May 2003 (Yoshida, *et al*., 2004). In each of the surveys, 50 common minke whales were caught. From detailed examination of logistic aspects in the surveys, it was concluded that no substantial problem occurred and that the coastal survey could be continued as a component of the JARPN II using same kind of vessels (small-type whaling catcher boats) and methodology (Government of Japan, 2004b, Kato, *et al*., 2004). However, re-calculation of required sample size from the survey data suggested that the size should be modified to be at least 60 individuals in each area/season (Tamura, *et al*., 2004), and from the possible geographical and/or temporal variations of prey consumption of the whales, the coastal surveys thought to be needed on a yearly bases in each local area (Government of Japan, 2004b).

The first survey of the revised JARPNII was carried out from 13 September to 31 October, 2004, off Kushiro and finished successfully (Kishiro *et al*. 2005). In the present paper, we show results of the second survey carried out in coastal waters off the Sanriku district, Japan, from 11 April to 21 May 2005. This survey was authorized by the Government of Japan in compliance with Article VIII of the International Convention for the Regulation of Whaling. The National Research Institute of Far Seas Fisheries (NRIFSF), Fisheries Research Agency, planned and conducted the survey, entrusted by the Institute of Cetacean Research (ICR).

MATERIALS AND METHODS

Response to the discussion at the IWC/SC meeting

The revised JARPN II research plan was presented at the 56th IWC/SC annual meeting (Government of Japan, 2004a). Then, the first revised survey was conducted in 2004, off Kushiro and results was reported

at the 57th IWC/SC annual meeting (Kishiro *et al*. 2005). Since serious comments and recommendations to the plan were not noted at the both meetings, the present survey was conducted under the original revised plan (Government of Japan, 2004a).

Research area

Research area was set in the same waters where the 2003 JARPN II coastal survey off the Sanriku district was conducted (Yoshida *et. al*, 2004). The district occupies northeastern part of the Japanese main island, Honshu (see, Fig. 1). In coastal waters off the Sanriku district, common minke whales were taken by the past land-based coastal whaling (Miyashita and Hatanaka, 1997). The waters are also very important fishing grounds. So, the waters were thought to be suitable for the research area of the JARPN II, and thus the 2003 coastal survey was conducted there. The present research area was also set in the same waters: within 50 nautical miles (mainly 30 n. miles) from the Ayukawa port in the Sanriku district (Fig. 1). The survey area is included in the middle part of the sub-area 7 established by the IWC.

Research vessels and station

Whale sampling survey

Four small-type whaling catcher boats were used as sampling vessels: *Taisho Maru* No. 28 (hereinafter referred as 28T; 47.3GT), *Koei Maru* No. 75 (75K; 46.0GT), *Katsu Maru* No.7 (7K; 32.0GT), and *Sumitomo Maru* No.31 (31S; 32.0GT). The whale sampling survey was conducted in a period from 11 April to 21 May, 2005. All the animals sampled were landed on the JARPN II research station established in the Ayukawa port for biological examination.

Prey species survey

The *Takuyo Maru* (TAK, 120.0GT), the trawler-type research vessel, conducted the prey species survey in research area set off northeast coast of Honshu, from 11 to 27 April. Detail of the prey species survey is shown in Appendix 1. The *Takuyo maru* also carried out oceanographic observation using CTD and EPCS. Oceanographic condition revealed from the observation is shown in Appendix 2.

Dedicated sighting survey

The *Shonan Maru* (SM1; 712.0GT) joined as the dedicated sighting vessel. The dedicated sighting survey was conducted from 19 April to 2 May, following zigzag track lines predetermined in coastal waters off northeast coast of Honshu. Detail of the survey is shown in Appendix 3.

Sighting and sampling methods

Sighting and sampling methods by whale sampling vessels were almost same in the first coastal survey conducted in Kushiro 2002 (Kishiro *et al*. 2003). The research head office was placed in the research station and controlled the sampling vessels during the survey. In order to avoid concentration of sampling vessels, research area was divided into 3 small areas (Fig. 1). The office determined searching area and routes of sampling vessels everyday, from weather conditions, whale distribution, and information on

coastal fisheries.

A researcher was on board each of four sampling vessels, and recorded sighting and sampling information, e.g., coordinates and time of common minke whales sighting and sampling made, weather conditions, and vessel activity. Sighting information was also recorded for other baleen whales and sperm whales. Searching activity was conducted from top barrel and upper bridge by crews and researchers. All common minke whales sighted were targeted for sampling, except cow-calf pair. When a school consisted of plural animals, an individual was selected randomly from the school and then caught. Once the vessel sampled a whale, she returned to the Ayukawa port as soon as possible, to transport the animal to the research station. During the return cruise, even if common minke whales were sighted, sampling was not conducted. At the port, animals taken were lift up from the vessels by a crane, using a wire net and then carried to the station by a 11-tons freight trailer. At that time, animal body weight was measured with the truck scale.

Biological research for common minke whales collected

All the animals collected were examined biologically by researchers at the research station. Research items of the biological examination are summarized in Table 4. These items are related to studies on feeding ecology, stock structure, life history and pollutions.

RESULTS

Searching effort made by sampling vessels

Cruise tracks made by sampling vessels (28T, 75K, 7K, and 31S) during the present survey are shown in Fig. 2a. The sampling vessels tried to cover widely research areas within 30 n. miles from Ayukawa port. In offshore waters, however, searching activity was very difficult from changeable weather condition and bigger waves for small sampling vessels, which resulted in more searching effort in Area 1. A sampling vessel went southward out of 30 n. miles once for scouting, but no sighting was recorded there (see, Fig. 2). Searching distance and time made by four sampling vessels are listed in Table 1. Here, searching distance and time are defined as distance and time recorded under searching activity conducted from top barrel of vessels. Total searching distance and time made by the four vessels were 5,245.8 n. miles and 466.9 hours, respectively.

Common minke whale sightings made by sampling vessels

Sighting positions of common minke whale schools made by the sampling vessels are shown in Fig. 2b. At the margin of searching area, no sightings were obtained: all of common minke whale sightings were recorded in middle part of Sendai Bay, except a sighting obtained in Area 2. A total of 202 schools (205 individuals) of common minke whales were sighted. These were 168 primary sightings (171 animals/168 schools) and 34 secondary sightings (34 animals/34 schools, Table 2). These figures probably include some duplicated sightings made by plural vessels, because the sampling vessels searched same areas. Of 202 schools sighted, only 3 schools consisted of 2 individuals and others were solitary animals. No cow-calf pairs were sighted. Sightings of 2 humpback whale schools (2 animals) were also obtained in the present

survey, although, in the 2003 coastal survey off Sanriku, only minke whale sightings were made (Yoshida, *et al.* 2004).

Table 3 shows density index (SPUE: number of primary school sightings per one hour searching; DI: number of primary school sightings per 100 n. miles searching) of common minke whales recorded by the sampling vessels. Both SPUE and DI increased from the first to second period of the survey, and then decreased in the last period. This tendency was same as recorded in the 2003 coastal survey off Sanriku. However, density index in the present survey (0.37 for SPUE and 3.26 for DI) was lower than that in the 2003 survey (0.47 for SPUE and 4.20 for DI)(Yoshida, *et al*. 2004). This result was thought to be mainly from bad weather condition in the present survey.

Sampling of common minke whales

A total of 60 common minke whales were taken for biological examination. In the sampling process, there were no harpooned-missed animals (i.e., no struck-lost animals). Sampling positions of individuals are shown in Fig. 2c. Animals were taken evenly from whales sighted.

Prey species survey and dedicated sighting survey

The prey species survey was conducted using the trawler-type research vessel (TAK). Distribution and abundance of prey species were investigated using mid-water trawl net and quantitative echosounder (EK500). Oceanographic observation was also conducted using CTD and EPCS. Sand lances were mainly found in 4 shallower strata of all the 7 ones set in the research area (see, Appendix 2). Especially, juvenile sand lances were distributed in sallower waters of Sendai Bay. Krill were frequently detected at deeper waters than 60m. The dedicated sighting survey was carried out using the sighting survey vessel (SM1). All the 49 common minke whale schools (49 animals) were sighted. Most of the sightings were obtained in middle part of Sendai Bay, as recorded by the sampling vessels. The sighting number in the present survey was much larger than in the 2003 survey off Sanriku, in which only four common minke whale sightings were obtained by the dedicated sighting survey vessel (Yoshida, *et al*. 2004). Results from the prey species survey and the dedicated sighting survey are noted in Appendix 1 (the prey species survey), Appendix 2 (the oceanographic observations), and Appendix 3 (the dedicated sighting survey).

Sex ratio, body length and weight of animals caught

Research items of biological examination are summarized in Table 4, with number of data and samples obtained. The 60 animals taken consisted of 23 males and 37 females. Sex ratio of males to all animals was 0.38. The ratio was almost same as recorded in the 2003 coastal survey off Sanriku (0.42). Average body length was 6.29m (max=7.41, min=4.49, SD=0.82) for males and 6.55m (max=8.40, min=4.66, SD=1.15) for females (Table 5). Average body weight was 2.92 tons (max=4.39, min=1.32, SD=1.71) for males and 3.47 tons (max=7.26, min=1.32, SD=1.71) for females (Table 6). In both sexes, average body length and weight were largest at the second period of the survey. In comparisons with females collected during the 2003 coastal survey off Sanriku, the present survey females showed larger values in body length and body

weight (6.30 m and 3.12 tons for the 2003 survey females). The values were almost same between males collected in the present survey and the 2003 survey (6.28 m and 2.92 tons). Composition of sexual maturity of animals collected is listed in Table 7. In males, eight of 23 animals were sexually mature (34.8%), and 14 of 37 females attained sexual maturity (37.8%). All the mature females except an individual were pregnant. Lactating females were not observed. Frequency of sexually mature males was higher in the 2003 survey (38.1%), but lower in the 2003 females (31.0%).

Prey species of common minke whale found from forestomach

Following the same methods used in the JARPN II feasibility survey conducted in 2001 (Fujise, *et al*., 2002), stomach contents were weighted to the nearest 0.1 Kg, by each of four chamber, in both cases of including and excluding liquid contents. Then, small sample of forestomach contents was collected and frozen for laboratory analysis. Weight of forestomach contents including liquid ranged from 1.86kg to 99.84kg. The maximum weight, which consisted of unidentified fish, was recorded from a female with body weight of 5.68 tons. The maximum contents weight was 1.8% of her body weight.

Forestomach contents found from minke whales during the present survey are listed in Table 8. Dominant prey species was Japanese sand lance (*Ammodytes personatus*)(45.0%, from 27 of 60 animals). Sand lances were detected throughout the survey. Most of unidentified fishes (48.3%) were also thought to be sand lances from remains. All the sand lances found from whales were adult, except some juveniles detected from a whale. Krill (*Euphausia pacifica*) and Japanese anchovies (*Engraulis japonicus*) were also found (Table 8), but their frequency was much lower (6.7%). Krill were recorded in the first 2 period and anchovies were found only in the last one. In the 2003 coastal survey off Sanriku, dominant species changed with time (Yoshida, *et al*. 2004): krill were dominant in the first period (74.8%), then the occurrence frequency reduced with time, and in the third period sand lances were found most frequently (92.2%). However, in the present survey, such tendency was not observed.

By-products of the whales

After biological examination, all the animals were processed according to the International Convention for Regulation of Whaling, Article VIII. Total weight of productions including meat and blubber was 99.6 tons.

DISCUSSION

The present survey was the second coastal survey conducted under the revised JARPNII research plan and was also the second one carried out in coastal waters off Sanriku district. During the survey period, low atmospheric pressure and thick fog often disturbed the research activities. Furthermore, changeable weather condition and bigger waves obstructed searching activities of sampling vessels in offshore waters. From these, density index of minke whales recorded in the present survey was lower than that in the 2003 survey off Sanriku. However, sampling vessels could collect planned sample size during the survey period from 11 April to 21 May. The present survey was finished according to the plan.

When a comparison was made between composition of sex and sexual maturity recorded in the present survey and the 2003 survey off Sanriku, no obvious difference was observed. However, occurrence frequency of prey species found from animal forestomach was different between the surveys. In the 2003 coastal survey off Sanriku, dominant prey species changed with time: krill was dominant first, then the occurrence frequency reduced with time, and lastly sand lances were found most frequently. However, in the present survey, such tendency was not observed: the sand lance was only one dominant species and was detected throughout the survey. Krill were found only from four whales. These results indicate that feeding habit of minke whales changes yearly, probably from environmental factors, e.g., oceanographic conditions or prey species distribution. The yearly change in feeding habit of minke whales is also reported in coastal waters off Kushiro (Kishiro *et a*l. 2006).

In the present research area, krill and sand lance are one of the most important target species of coastal fisheries and the fisheries were operated during the survey. Main fishing ground of each of krill, juvenile sand lances, and adult sand lances were separated (H. Nagashima, Miyagi Prefecture Fisheries Research and Development Center). Krill fisheries were mainly operated at northern part of the research area. Juvenile sand lances were caught along shore line of Sendai Bay. Adult sand lances were taken at middle part of the bay. Fishing ground of adult sand lances overlapped with main sighting area of minke whales recorded in the present survey. Furthermore, prey species observation for minke whales collected in the present survey revealed that the sand lance was only one dominant species and that all the sand lances found were adult, except some juveniles detected from a whale. These results indicate that common minke whales and coastal fisheries caught adult sand lances at the same time and area, which indicate existence of interaction between them.

From the present survey, we could obtain valuable information including feeding ecology of minke whales. To evaluate more precise values on food consumption of minke whales and to obtain more information on interaction between the whales and coastal fisheries, further studies are needed.

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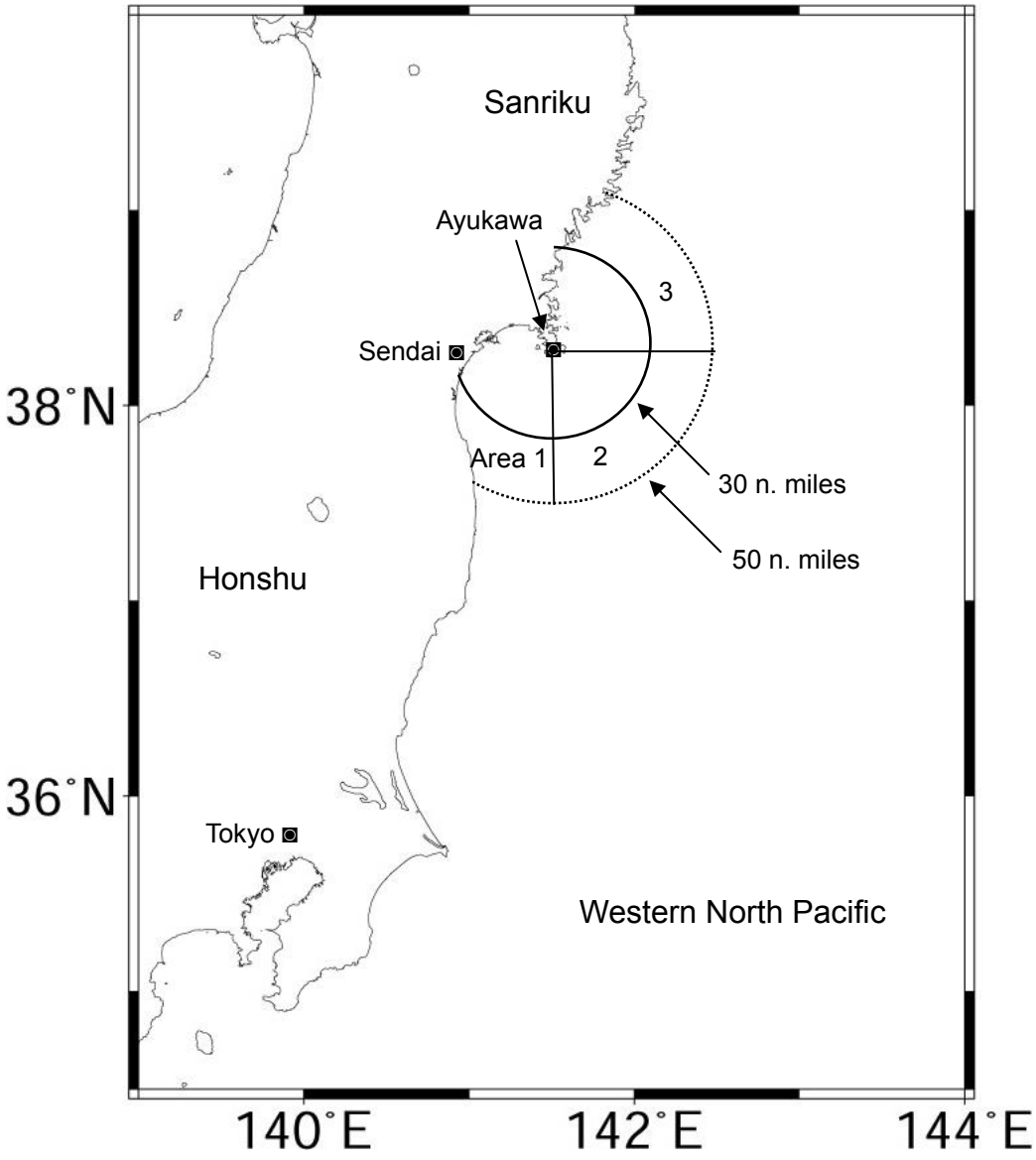

Figure 1. Research area of the 2005 JARPN II coastal survey off Sanriku.

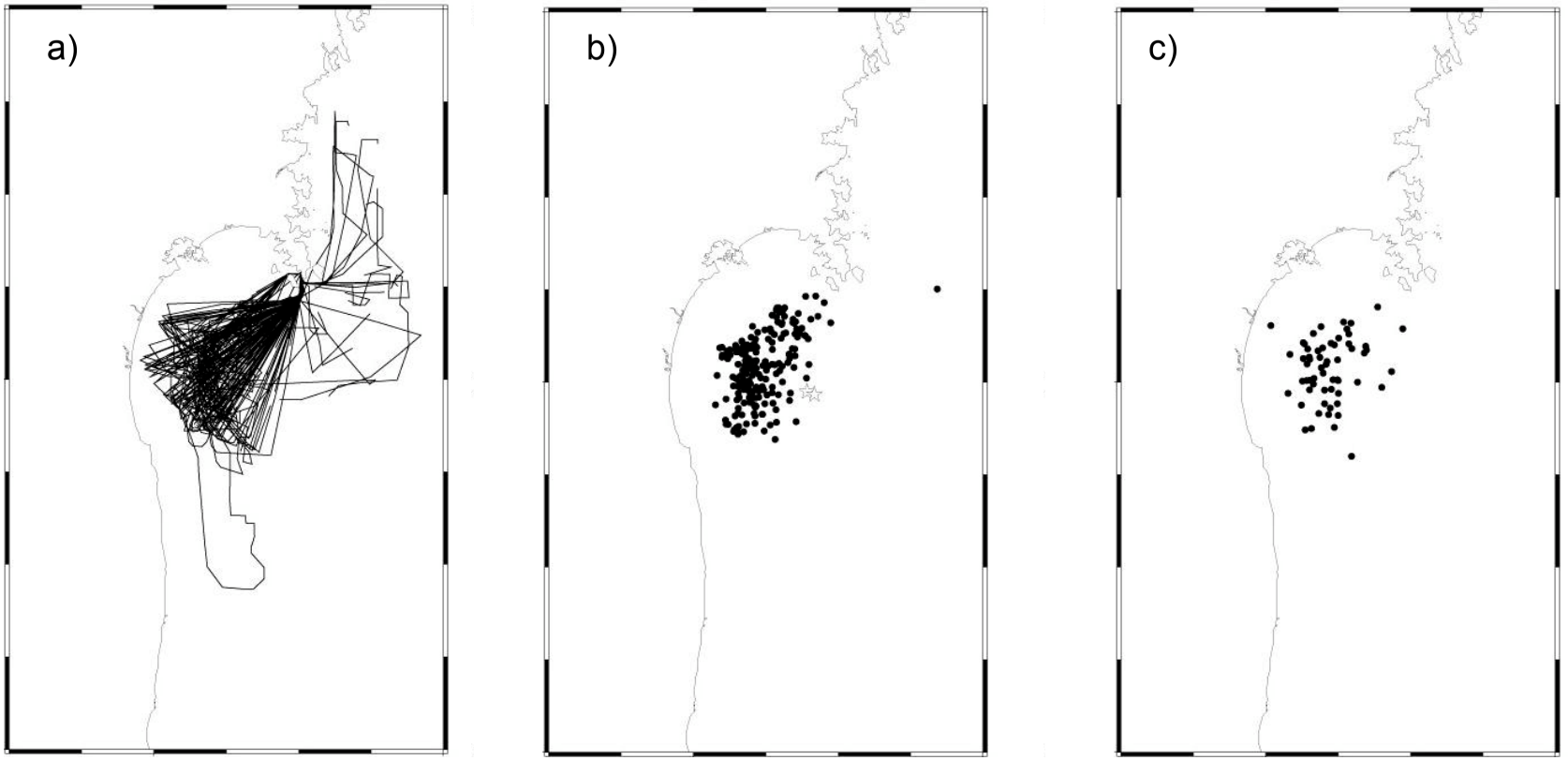

Figure 2. Cruise tracks (a), and sighting positions (b) and catch positions (c) of common minke whales made by sampling vessels in the 2005 JARPN II coastal survey off Sanriku. Sighting positions of humpback whales are also shown (star).

Table 1. Searching days, hours, distances made by four sampling vessels in the 2005 JARPN II coastal survey off Sanriku.

Period		Sampling vessels*[1]				
		28T	75K	7K	31S	Total
First period	Days	10	10	10	10	40
(11 - 23 April)	Hours	44.3	51.2	51.8	50.2	197.5
	Distances (n. miles)	517.2	578.1	567.0	513.9	2176.2
Second period	Days	9	9	9	9	36
(24 April – 7 May)	Hours	41.6	38.3	44.8	39.9	164.6
	Distances (n. miles)	496.1	434.7	500.9	434.2	1865.9
Third period	Days	8	8	8	8	32
(8 - 21 May)	Hours	28.1	25.4	26.9	24.4	104.8
	Distances (n. miles)	339.2	298.1	305.4	261.0	1203.7
Total	Days	27	27	27	27	108
	Hours	114.0	114.9	123.5	114.5	466.9
	Distances (n. miles)	1352.5	1310.9	1373.3	1209.1	5245.8

*[1]: 28T; *Taisho Maru* No. 28; 75K: *Koei maru* No. 75; 7K: *Katsu Maru* No. 7; 31S: *Sumitomo maru* No. 31.

Table 2. List of cetacean species and number of sightings (no. schools/no. individuals) made by four sampling vessels in the 2005 JARPN II coastal survey off Sanriku.

Period	Species	Primary*		Secondary*		Total*	
		Sch.	Ind.	Sch.	Ind.	Sch.	Ind.
First period	Common minke whale	63	64	13	13	76	77
(11 - 23 April)	Like minke whale	9	10	1	1	10	11
	Unidentified baleen whale	1	1	0	0	1	1
	Unidentified large whale	6	6	0	0	6	6
Second Period	Common minke whale	67	69	17	17	84	86
(24 April - 7 May)	Like minke whale	6	6	0	0	6	6
	Unidentified baleen whale	1	1	0	0	1	1
Third period	Common minke whale	38	38	4	4	42	42
(8 - 21 May)	Like minke whale	5	5	1	1	6	6
	Humpback whale	2	2	0	0	2	2
Total	Common minke whale	168	171	34	34	202	205
	Like minke whale	20	21	2	2	22	23
	Humpback whale	2	2	0	0	2	2
	Unidentified baleen whale	2	2	0	0	2	2
	Unidentified large whale	6	6	0	0	6	6

*: These figures probably include some duplicated sightings made by plural vessels.

Table 3. Density index of common minke whales made by sampling vessels in the 2005 JARPN II coastal survey off Sanriku.

Period	SPUE*[1]	DI*[2]
First period (11 - 23 April)	0.32	2.94
Second period (24 April - 7 May)	0.42	3.70
Third period (8 - 21 May)	0.36	3.16
Total	0.37	3.26

*[1]: No. of primary school sightings per 1 hour searching.

*[2]; No. of primary school sightings sighted per 100 n. miles searching.

Table 4. Summary of whale sampling in the 2005 JARPN II coastal survey off Sanriku.

Samples and data	Number of whales		
	Male	Female	Total
Body length and sex	23	37	60
External body proportion	23	37	60
Photographic record and external character	23	37	60
Diatom film record and sampling	23	37	60
Body scar record	23	37	60
Measurements of blubber thickness (eleven points)	23	37	60
Body weight	23	37	60
Body weight by parts	1	2	3
Skin tissues for DNA study	23	37	60
Muscle, liver, and heart tissues for isozyme analysis	23	37	60
Muscle, liver, kidney, and blubber tissues for chemical analysis	23	37	60
Muscle, liver, blubber, vertebrae, and stomach contents for lipid analysis	1	2	3
Mammary grand; lactation status, measurement and histological sample	-	37	37
Uterine horn; measurements and endometrium sample	-	37	37
Collection of Ovary	-	37	37
Photographic record of foetus	6	4	13
Foetal length and weight	6	4	12
External measurement of foetus	1	0	1
Collection of foetus	5	4	12
Testis and epididymis; weight and histological sample	23	-	23
Stomach contents, convenient record	23	37	60
Volume and weight of stomach content in each compartment	23	37	60
Observation of marine debris in stomach	23	37	60
Stomach contents for feeding study	23	37	60
Record of external parasites	23	37	60
Earplug for age determination	23	37	60
Tympanic bulla for age determination	23	37	60
Largest baleen plate for morphologic study and age determination	23	37	60
Baleen plate measurements (length and breadth)	23	37	60
Photographic record of baleen plate series	23	37	60
Length of each baleen series	23	37	60
Vertebral epiphyses sample	23	37	60
Number of vertebrae	23	37	60
Number of ribs	23	37	60
Skull measurement (length and breadth)	22	35	57

Table 5. Statistics of body length (m) of common minke whales collected by the 2005 JARPN II coastal survey off Sanriku.

Period	Male					Female				
	Mean	S.D.	Min.	Max.	*n*	Mean	S.D.	Min.	Max.	*n*
First period (11 - 23 April)	5.65	0.79	4.49	6.53	7	6.63	1.20	5.06	8.25	8
Second period (24 April - 7 May)	6.92	0.42	6.09	7.41	8	6.68	1.18	4.66	8.40	20
Third period (8 - 21 May)	6.23	0.74	5.17	7.28	8	6.17	1.09	5.08	7.81	9
Total	6.29	0.82	4.49	7.41	23	6.55	1.15	4.66	8.40	37

Table 6. Statistics of body weight (tons) of common minke whales collected by the 2005 JARPN II coastal survey off Sanriku.

Period	Male					Female				
	Mean	S.D.	Min.	Max.	*n*	Mean	S.D.	Min.	Max.	*n*
First period (11 - 23 April)	2.14	0.74	1.07	2.95	7	3.59	1.53	1.65	5.69	8
Second period (24 April - 7 May)	3.57	0.40	2.69	4.06	8	3.64	1.82	1.32	7.26	20
Third period (8 - 21 May)	2.96	0.91	1.80	4.39	8	2.98	1.69	1.49	5.92	9
Total	2.92	0.90	1.07	4.39	23	3.47	1.71	1.32	7.26	37

Table 7. Composition of sex and sexual maturity of common minke whales collected by the 2005 JARPN II coastal survey off Sanriku.

Period	Male				Female					
	Im	M	Total	Maturity(%)	Im	R	P	Total	Pregnancy(%)*	Maturity(%)
First period (11 - 23 April)	7	0	7	0.0	3	0	5	8	100.0	62.5
Second period (24 April - 7 May)	3	5	8	62.5	13	1	6	20	85.7	35.0
Third period (8 - 21 May)	5	3	8	37.5	7	0	2	9	100.0	22.2
Total	15	8	23	34.8	23	1	13	37	92.9	37.8

Im: Immature; M: Mature; R: Resting; P: Pregnant.

*: Apparent pregnancy rate.

Table 8. Prey species found in forestomach of common minke whales collected by the 2005 JARPN II coastal survey off Sanriku.

Period	Sample Size	Prey species (%)			
		Sand lance	Krill	Japanese anchovy	Unidentified fish
First period (11 - 23 April)	15	7(46.7)	3(20.0)	0(0.0)	7(46.7)
Second period (24 April - 7 May)	28	15(53.6)	1(3.6)	0(0.0)	13(46.4)
Third period (8 - 21 May)	17	5(29.4)	0(0.0)	4(23.5)	9(52.9)
Total	60	27(45.0)	4(6.7)	4(6.7)	29(48.3)

Appendix 1

2005 coastal prey species survey of JARPN II off Sanriku

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ABSTRACT

A prey species survey was conducted in the coastal region off Sanriku, northeastern Japan, concurrently with the coastal sampling survey for minke whale during spring 2005 as a part of JARPN II study. The objective of concurrent surveys was to estimate the prey preference (selection) of minke whale. While the sampling survey for minke whale was conducted within 30 nautical miles (max 50 nautical miles) from Ayukawa, Miyagi prefecture, the prey species survey was conducted in wider area at depths between 20m and 200m from 37o40'N to 38 o40'N off Sanriku, northeastern Japan, The survey area was divided into 7 blocks with depth and latitude The distribution and abundance of the prey species were investigated with the quantitative echosounder (EK500) on board Takuyo maru (120 GT) steaming at 9 knots along the track lines during daytime. Acoustic data were acquired with operating frequency at 38, 120 and 200 kHz. Species/size compositions of echo signs were identified by targeting mid-water trawlings. As the water temperature was low, a few schools of anchovy were detected. Echo signs identified as adult sand lance (>10cm in standard length) occurred at depths between 20m and 60m, especially off Fukushima prefecture. The echo signs were in the shape of patches on the bottom or sticks rising from the bottom. Many echo signs identified as juvenile sand lance occurred as smaller patches in the mid-layer in the shallower area. Krill was frequently found at depths deeper than 60m as large patches and in the shape of belts in the mid/bottom layers or sticks rising from the bottom.

INTRODUCTION

The goal of JARPN II is to contribute to the conservation and sustainable use of marine living resources including whales in the western North Pacific, especially within Japan's EEZ (Government of Japan, 2002). The priority is put on feeding ecology and ecosystem studies, involving studies of prey consumption by cetaceans, prey preference (selection) of cetaceans and ecosystem modeling. As it is difficult to cover the coastal area, especially in spring and autumn, by the Nisshin Maru, the full-scale JARPN II has a new coastal component, that is, the sampling survey for minke whale by small-type whaling catcher boats. As in

2003 surveys (Kawahara et al., 2004), a prey species survey was conducted in the coastal region off Sanriku, northeastern Japan, concurrently with the coastal sampling survey for minke whale during spring 2005. In this document, the results of the 2005 prey species survey off Sanriku are presented.

MATERIALS AND METHOD

While the sampling survey of minke whale was conducted in the coastal waters within the 30 nautical miles (max 50 nautical miles) from Ayukawa, Miyagi prefecture, the prey species survey was conducted in wider area at depths between 20m and 200m from 37º40'N to 38º40'N off Sanriku, northeastern Japan, to elucidate the distribution and abundance of main prey species (Fig. 1). To avoid the conflict with set nets in the coastal waters, the waters 10 miles from the coastal lines were excluded in principle. The survey area was divided into 7 blocks (A, B, C, D, E, F and G) at depths of 40m/100m and 37º54'N/38º15'N. Blocks E, F and G south of 37º54'N are located off Fukushima prefecture. A zigzag track line was set to cover each block. The waypoints of planned track lines in each block are shown in Table 1.

The prey species survey was conducted from April 11 to 27 in blocks B, C, D, E, F, G and A in order of importance. The distribution and abundance of the prey species were investigated with the quantitative echosounder (EK500) and targeting mid-water trawling on board a stern trawler-type research vessel, Takuyo maru (Miyagi prefecture, 120 GT) steaming at about 9 knots along the track lines. The survey was conducted during the daytime from an hour after sunrise to an hour before sunset. Oceanographic observations were conducted with CTD and EPCS (Continuous Sea Surface Water Monitoring System). With EPCS, temperature, salinity and chlorophyll in the surface water were measured every minute. Preliminary sighting survey was made for marine mammals such as northern fur seals.

Acoustic data were acquired with Echoview Ver.3 (Sonar Data Co., Ltd.) with operating frequency at 38, 120 and 200 kHz. Calibrations were carried out at a depth around 30m in Ishinomaki Bay (April 11 2005) using the copper sphere technique described in EK 500 manual. Mid-water trawlings were made to identify the species and size compositions of targeting echo signs. The net had a mouth opening of 7m width/3.5m height and a 3mm liner cod end. The depth and height of mouth of net were monitored with a net recorder. Towing speed of the trawl net was 2-4 knots. Catches were identified to the species level and weighed at the vessel. For the major species, a sample of 100 animals was taken, and lengths and weights were measured. Scaled and standard lengths were used to anchovy and adult/juvenile sand lance, respectively. Total length from the tip of the rostrum to the end of the telson was used for krill. Some frozen samples were taken for further laboratory analysis.

RESULTS

The planned track lines were almost covered in the acoustic survey. A summary of the midwater trawl operations, temperature by depth and catches was shown on Table 2. Targeting trawlings were made 14 times and CTD observations were made at the trawling points and 28 waypoints. The oceanographic conditions are described in Appendix 2 in the report.

Acoustic data were analyzed with Echoview Ver.3 at the laboratory and the results are as follows. The surface water temperature in the survey area was between 5.8ºC and 12.5ºC based on EPCS. As the temperature was lower than 15ºC which was the indicator of the occurrence of northward migrating anchovy, a few schools of anchovy were detected during the prey species survey. Echo signs identified as adult sand lance (>10cm in standard length) occurred at depths between 20m and 60m in blocks B, C, E and F. Especially, many echo signs identified as adult sand lance were found in blocks E and F off Fukushima prefecture. The echo signs on the echograms were in the shape of patches on the bottom or sticks rising from the bottom. Juvenile sand lance could be identified from the difference in average Sv values between 38 and 120 kHz. Many echo signs identified as juvenile sand lance occurred in the shallower area of Sendai Bay (blocks B and C). Most of the echo signs were smaller patches, usually found in the mid-layer. Although the difference in average Sv values by frequency is similar to that of krill, Juvenile sand lance could be identified based on the distribution patterns and the size of the echo signs. Krill was frequently found at depths deeper than 60m. In most cases the echo signs were large patches and in the shape of belts in the mid/bottom layers or sticks rising from the bottom.

ACKNOWLEDGEMENT

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Table 1. Waypoints of planned track lines.

Block A

WP	Latitude				Longitude				Course	Distance
A1	38	-	40.0	N	141	-	36.6	E	100.1	11.39'
A2	38	-	38.0	N	141	-	50.9	E	260.5	12.09'
A3	38	-	36.0	N	141	-	35.7	E	99.5	12.10'
A4	38	-	34.0	N	141	-	50.9	E	260.7	12.41'
A5	38	-	32.0	N	141	-	35.3	E	99.5	12.11'
A6	38	-	30.0	N	141	-	50.5	E	260	11.49'
A7	38	-	28.0	N	141	-	36.1	E	99.9	11.65'
A8	38	-	26.0	N	141	-	50.7	E	258.9	10.34'
A9	38	-	24.0	N	141	-	37.8	E	101.3	10.19'
A10	38	-	22.0	N	141	-	50.5	E	260	11.51'
A11	38	-	20.0	N	141	-	36.1	E	100.3	11.21'
A12	38	-	18.0	N	141	-	50.1	E	259.7	11.14'
A13	38	-	16.0	N	141	-	36.2	E	100.7	5.38'
A14	38	-	15.0	N	141	-	42.9	E		
									TOTAL	143.02'

Block B

WP	Latitude				Longitude				Course	Distance
B1	38	-	21.2	N	141	-	20.7	E	248.2	5.94'
B2	38	-	19.0	N	141	-	13.7	E	110.7	7.08'
B3	38	-	16.5	N	141	-	22.1	E	260.7	15.50'
B4	38	-	14.0	N	141	-	2.7	E	104.1	10.25'
B5	38	-	11.5	N	141	-	15.3	E	258.7	12.80'
B6	38	-	9.0	N	140	-	59.4	E	100.7	13.43'
B7	38	-	6.5	N	141	-	16.1	E	260.2	14.68'
B8	38	-	4.0	N	140	-	57.8	E	100.4	13.83'
B9	38	-	1.5	N	141	-	15.0	E	259.8	14.15'
B10	37	-	59.0	N	140	-	57.4	E	101.8	12.21'
B11	37	-	56.5	N	141	-	12.5	E	255.3	9.83'
B12	37	-	54.0	N	141	-	0.5	E		
									TOTAL	129.69'

Block C

WP	Latitude				Longitude				Course	Distance
C1	38	-	16.0	N	141	-	25.6	E	248.4	5.43'
C2	38	-	14.0	N	141	-	19.2	E	101	10.53'
C3	38	-	12.0	N	141	-	32.3	E	260.3	11.85'
C4	38	-	10.0	N	141	-	17.5	E	103.2	8.76'
C5	38	-	8.0	N	141	-	28.3	E	258.4	9.92'
C6	38	-	6.0	N	141	-	16.0	E	103.3	8.69'
C7	38	-	4.0	N	141	-	26.7	E	257.7	9.39'
C8	38	-	2.0	N	141	-	15.1	E	103.5	8.54'
C9	38	-	0.0	N	141	-	25.6	E	258.1	9.71'
C10	37	-	58.0	N	141	-	13.6	E	102.9	8.94'
C11	37	-	56.0	N	141	-	24.6	E	258.3	9.87'
C12	37	-	54.0	N	141	-	12.4	E		
									TOTAL	101.62'

Block D

WP	Latitude				Longitude				Course	Distance
D1	38	-	15.0	N	141	-	49.8	E	259.4	13.64'
D2	38	-	12.5	N	141	-	32.8	E	101.1	12.95'
D3	38	-	10.0	N	141	-	48.9	E	261.3	16.62'
D4	38	-	7.5	N	141	-	28.1	E	98.1	17.64'
D5	38	-	5.0	N	141	-	50.2	E	262.5	19.14'
D6	38	-	2.5	N	141	-	26.2	E	98.8	16.41'
D7	38	-	0.0	N	141	-	46.7	E	261.9	17.67'
D8	37	-	57.5	N	141	-	24.6	E	100.8	13.30'
D9	37	-	55.0	N	141	-	41.1	E		
									TOTAL	127.37'

Block E

WP	Latitude				Longitude				Course	Distance
E1	37	-	54.0	N	141	-	4.3	E	98.7	6.57'
E2	37	-	53.0	N	141	-	12.5	E	260.2	8.85'
E3	37	-	51.5	N	141	-	1.5	E	99.3	9.32'
E4	37	-	50.0	N	141	-	13.1	E	259.7	8.38'
E5	37	-	48.5	N	141	-	2.7	E	103.5	6.45'
E6	37	-	47.0	N	141	-	10.6	E	256.9	6.60'
E7	37	-	45.5	N	141	-	2.5	E	106	5.45'
E8	37	-	44.0	N	141	-	9.1	E	253.1	5.15'
E9	37	-	42.5	N	141	-	2.9	E	102.8	6.76'
E10	37	-	41.0	N	141	-	11.2	E	256.1	4.18'
E11	37	-	40.0	N	141	-	6.1	E		
									TOTAL	67.71'

Block F

WP	Latitude				Longitude				Course	Distance
F1	37	-	54.0	N	141	-	12.4	E	99.4	9.16'
F2	37	-	52.5	N	141	-	23.8	E	260	8.61'
F3	37	-	51.0	N	141	-	13.1	E	100.7	8.07'
F4	37	-	49.5	N	141	-	23.1	E	261.7	10.42'
F5	37	-	48.0	N	141	-	10.1	E	98.5	10.11'
F6	37	-	46.5	N	141	-	22.7	E	262.2	11.06'
F7	37	-	45.0	N	141	-	8.9	E	98.7	9.96'
F8	37	-	43.5	N	141	-	21.3	E	260	8.63'
F9	37	-	42.0	N	141	-	10.6	E	100	8.63'
F10	37	-	40.5	N	141	-	21.3	E		
									TOTAL	84.66'

Block G

WP	Latitude				Longitude				Course	Distance
G1	37	-	54.0	N	141	-	24.4	E	96.9	12.45'
G2	37	-	52.5	N	141	-	40.0	E	263.6	13.48'
G3	37	-	51.0	N	141	-	23.1	E	96.9	12.54'
G4	37	-	49.5	N	141	-	38.8	E	263.1	12.55'
G5	37	-	48.0	N	141	-	23.1	E	97.2	11.92'
G6	37	-	46.5	N	141	-	38.0	E	263.1	12.55'
G7	37	-	45.0	N	141	-	22.3	E	97.3	11.77'
G8	37	-	43.5	N	141	-	37.0	E	263.1	12.48'
G9	37	-	42.0	N	141	-	21.4	E	97.4	11.62'
G10	37	-	40.5	N	141	-	35.9	E		
									TOTAL	111.37'

Table 2. A summary of the midwater trawl operations, temperature by depth and catches.

Station	ST-1	ST-2	ST-3	ST-4	ST-5	ST-6	ST-7
Date	2005.04.12	2005.04.12	2005.04.13	2005.04.14	2005.04.14	2005.04.15	2005.04.15
Time	9:09	14:54	9:32	9:58	14:04	9:41	14:38
Latitude	38 ° 17.067'	38 ° 07.723'	38 ° 05.290'	37 ° 56.634'	38 ° 03.332'	38 ° 12.949'	38 ° 12.949'
Longitude	141 ° 20.099'	141 ° 07.437'	141 ° 07.708'	141 ° 20.404'	141 ° 22.056'	141 ° 25.733'	141 ° 25.733'
Surf.Temp.	7.92	8.65	8.05	7.03	8.44	8.82	8.82
Depth (m) 10m	7.99	8.13	8.06	7.59	7.68	8.15	7.89
Depth (m) 20m	7.73	8.05	8.39	7.62	7.46	7.89	7.79
Depth (m) 30m	7.00		7.20	7.44	7.36	7.28	7.41
Depth (m) 40m				6.99	7.20	7.01	7.12
Depth (m) 50m				6.81	6.22	6.58	6.90
Depth (m) 75m				6.22			
Depth(m)	35	29	33	83	62	53	57
Net depth(m)	20-30	10-20	16-30	14-30	40-50	15-25	45-55
Species caught, Length mode and range (mm)	juvenile sand lance, 34(26-49), krill, others	juvenile sand lance, 39(29-56)	adult sand lance, 120 (106-162),	juvenile sand lance, 33(29-43)	krill, 19(13-21.5)	juvenile sand lance, 34(29-42), jelly fish	adult sand lance, 170) (170-196), jelly fish
Catches(kg)	0.7	9.5	4.05	1.8	2	1.95	0.65

Station	ST-8	ST-9	ST-10	ST-11	ST-12	ST-13	ST-14
Date	2005.04.18	2005.04.19	2005.04.19	2005.04.24	2005.04.24	2005.04.25	2005.04.26
Time	13:28	8:12	10:05	7:36	9:33	11:58	13:07
Latitude	38 ° 06.673'	37 ° 58.3053'	37 ° 59.711'	37 ° 48.612'	37 ° 50.649'	37 ° 46.249'	38 ° 23.052'
Longitude	141 ° 33.758'	141 ° 31.887'	141 ° 44.814'	141 ° 14.170'	141 ° 15.9210'	141 ° 38.616'	141 ° 44.759'
Surf.Temp.	9.13	8.92	7.19	8.63	8.72	8.14	9.72
Depth (m) 10m	8.64	8.73	7.03	8.76	8.55	7.65	8.43
Depth (m) 20m	8.27	7.84	6.77	8.42	8.34	7.10	8.20
Depth (m) 30m	7.35	6.80	6.71	7.87	7.90	6.32	7.71
Depth (m) 40m	6.58	6.69	6.61		7.05	5.93	7.34
Depth (m) 50m	6.35	6.46	6.74		6.85	6.51	7.31
Depth (m) 75m	5.98	5.79	6.68			6.93	7.35
Depth (m) 100m	5.89	5.83	6.97			6.79	7.45
Depth (m) 125m		6.22	6.93			6.60	7.21
Depth (m) 150m			6.89				7.20
Depth(m)	123	132	158	41	58	147	160
Net depth(m)	75-85	100-120	80-90	25-35	30-50	175-190	145-155
Species caught, Length mode and range (mm)	krill, 19(15-29), amphipods	krill, 19(14-29)	krill, 20.5 (17-23)	krill, 20.5 (17-24), amphipods	adult sand lance, 150 (117-198)	pearlsides, 44(28-63), cods	pearlsides, 45(24-46), krill, 17.5 (12-22)
Catches(kg)	0.1	2.4	3.27	0.42	1.48	2.46	0.25

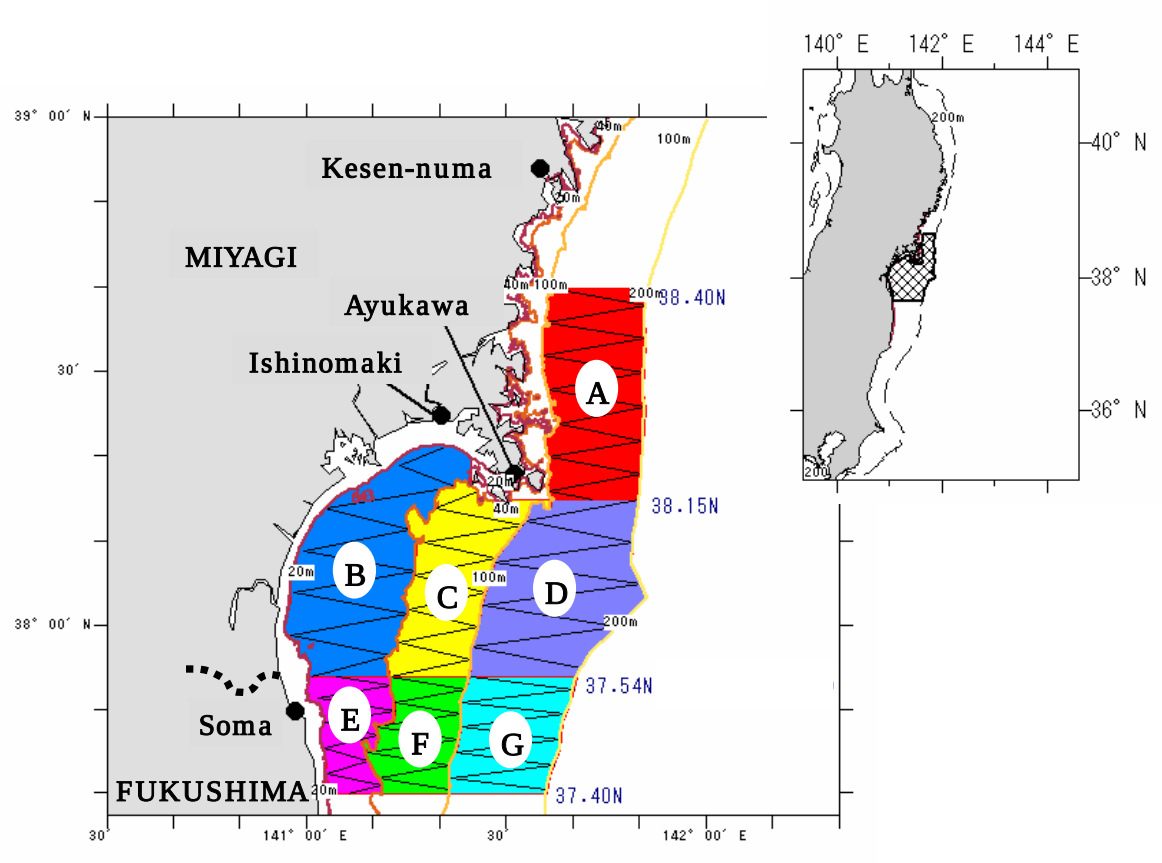

Fig. 1. Survey area, blocks and planned track lines of prey species survey in 2005 off Sanriku.

Appendix 2

Oceanographic conditions in the coastal survey of JARPN II off Sanriku, northeastern Japan, in April 2005

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ABSTRACT

A prey species survey was conducted in the coastal region off Sanriku, northeastern Japan, concurrently with the coastal sampling survey for minke whale during spring 2005 as a part of JARPN II study. Oceanographic observations were conducted with CTD and EPCS from 11 to 27 April 2005. According to the CTD data at 42 stations, water masses in the survey area have characteristics of the cold water (5ºC < temperature < 10ºC at 100m depth). The water on the shelf is occupied by the cold water mixed with low-salinity coastal water.

Introduction

The oceanographic condition at the Tohoku area northeast of Japan is the most complicated area in the world. In this area, there are a lot of fronts and water masses. The Kuroshio flows northward along the east coast of Japan to the southern part of the Tohoku area with warm high-salinity water. The Oyashio flows southward along the Kuril Islands to the northern part of the Tohoku area with cold low-salinity water. The Kuroshio and the Oyashio flows eastward from the Tohoku area, and the area between the Kuroshio and Oyashio was usually called the Kuroshio-Oyashio Inter-frontal Zone or perturbed area. The Tsugaru warm water enters into the Inter-frontal Zone through Tsugaru Strait, and also the warm-core ring is cut off from the Kuroshio extension into the Inter-frontal Zone. Each water mass is mixed with others, and make a new water mass. The coastal area off Sanriku is the most variable in the Tohoku area, because the Kuroshio, the warm-core ring, the Oyashio, the Tsugaru warm water and other water arrive here by turns.

A prey species survey was conducted on board *Takuyo maru* (Miyagi prefecture, 120 GT) in the coastal region off Sanriku, northeastern Japan, concurrently with the coastal sampling survey for minke whale during spring 2005 as a part of JARPN II study. Oceanographic observations were conducted with CTD (Conductivity Temperature Depth profiler) and EPCS (Continuous Sea Surface Water Monitoring System). In this paper, we analyzed the CTD data to make clear the oceanic environment in the survey area.

Data and Methods

Hydrographic observations with CTD (SBE 911plus) were carried out at 42 stations from 11 to 27 April 2005 in the coastal area off Sanriku, northeast of Japan (Fig. 1).

The oceanographic conditions in April 2005 were analyzed by Tohoku National Fisheries Research Institute (TNFRI), which used quasi-real-time data from several cooperative organs and prefectures, those were Fisheries Research Agency, Meteorological Agency, Hydrographic Department and Fisheries Experiment Stations, etc. TNFRI published temperature maps and schematic hydrographic maps using World Wide Web (http://www.myg.affrc.go.jp/kaiyo/temp/temp.
html). Oceanic fronts and water masses are usually detected by subsurface temperature map (sea Table 1), because they are obscure in sea surface temperature distributions from summer to fall seasons and the Oyashio water spreads into the subsurface layer.

Oceanographic conditions in the survey area

Figure 2 shows the Temperature-Salinity diagrams using CTD station data. Water masses in the survey area have characteristics of the cold water. Light blue dots show the data in cold waters defined by 100 m temperature which is over 5ºC and less than 10ºC. Black dots show the data on the shelf shallower than 100 m depth. Because black dots are similar with light blue dots in Fig. 2, the water on the shelf is occupied by the cold water mixed with low-salinity coastal water.

Figure 3 shows the schematic hydrographic map in April 2005, presented by TNFRI. The northern limit of the warm water spread from the Kuroshio Extension moves northward from March to November. The position of the warm water in April 2005 was at 39ºN on 145ºE line. Tsugaru warm water was obscure because it restricted near the coastal area called by coastal mode in April. The southern limit of the first Oyashio Intrusion located around 41ºN, 144ºE, which were more northern position from monthly mean location in April (38º30'N). Although cold water cut off from the first Oyashio Intrusion distributed around 40ºN, 143º30'E, the Oyashio Intrusion was restricted to the northern area in April 2005. All stations in the survey area were distributed in the cold water defined by 100 m temperature which is over 5ºC and less than 10ºC.

Figure 4 shows the 50 m and 100 m depth temperature map observed by *Takuyo maru*. 6ºC to 7ºC is dominant at the depth of 50 m and 100 m in Fig. 4. It means that the cold water occupied in this survey area.

All of these figure show that all stations are distributed in the cold area and shallow coastal area occupied by the cold water.

Acknowledgement

A special thank is given to Captain H. Kimura and crews of *Takuyo maru* for their dedication in collecting data.

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Table 1. Extraction method from temperature map to determine the position of each water mass.

Target characteristics	Extraction method
Kuroshio Extension Axis	14 ºC isotherm at 200m
Warm-core ring	Temperature front at 200m
Oyashio front	5ºC isotherm at 100m
Oyashio water	Area with T < 5ºC at 100m
Cold water	Area with 5ºC < T < 10ºC at 100m
Warm water	Area with T > 10ºC at 100m and T < 14ºC at 200m

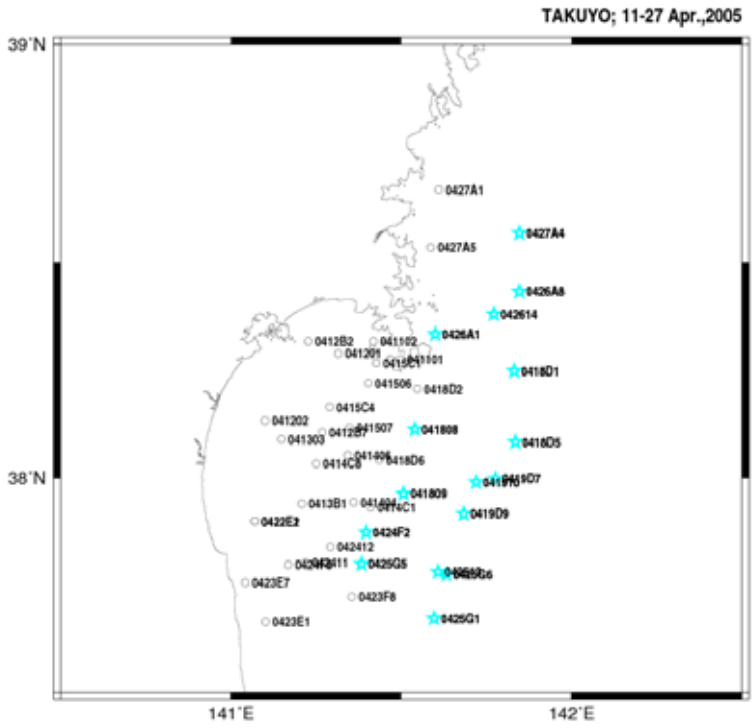

Fig. 1. Station map observed by *Takuyo maru* in 11 to 27 April 2005. Light blue stars and black circles denote CTD stations in the cold area (100 m temperature was over 5ºC and less than 10ºC) and the shallow coastal area, respectively.

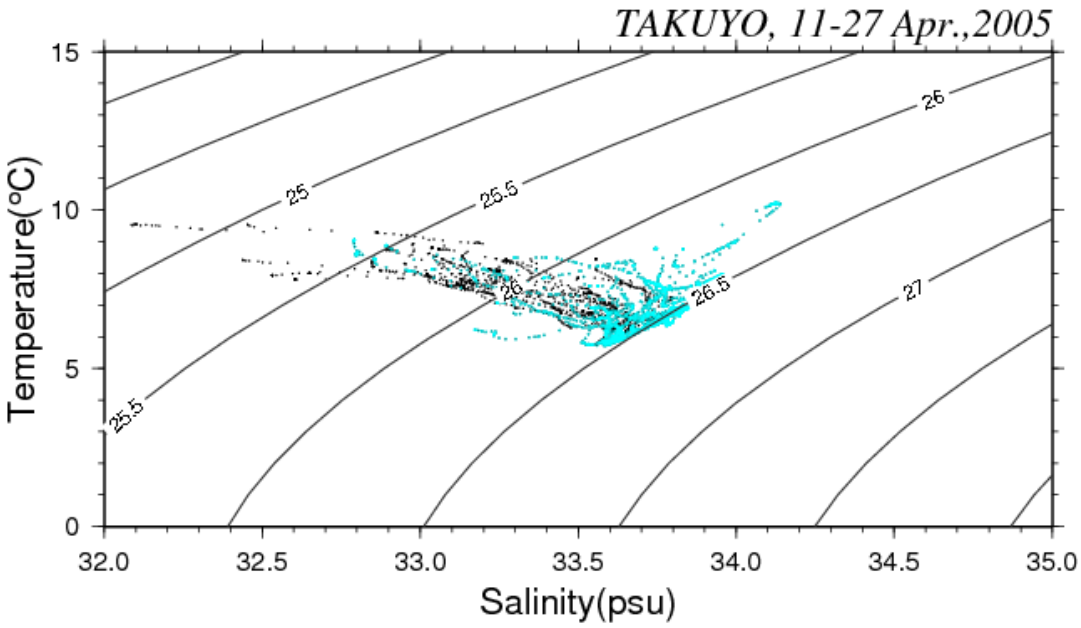

Fig. 2. Temperature-Salinity diagrams using CTD station data observe by *Takuyo maru* in 11 to 27 April 2005. Each thin line in this figure denotes a density line of sigma-t.

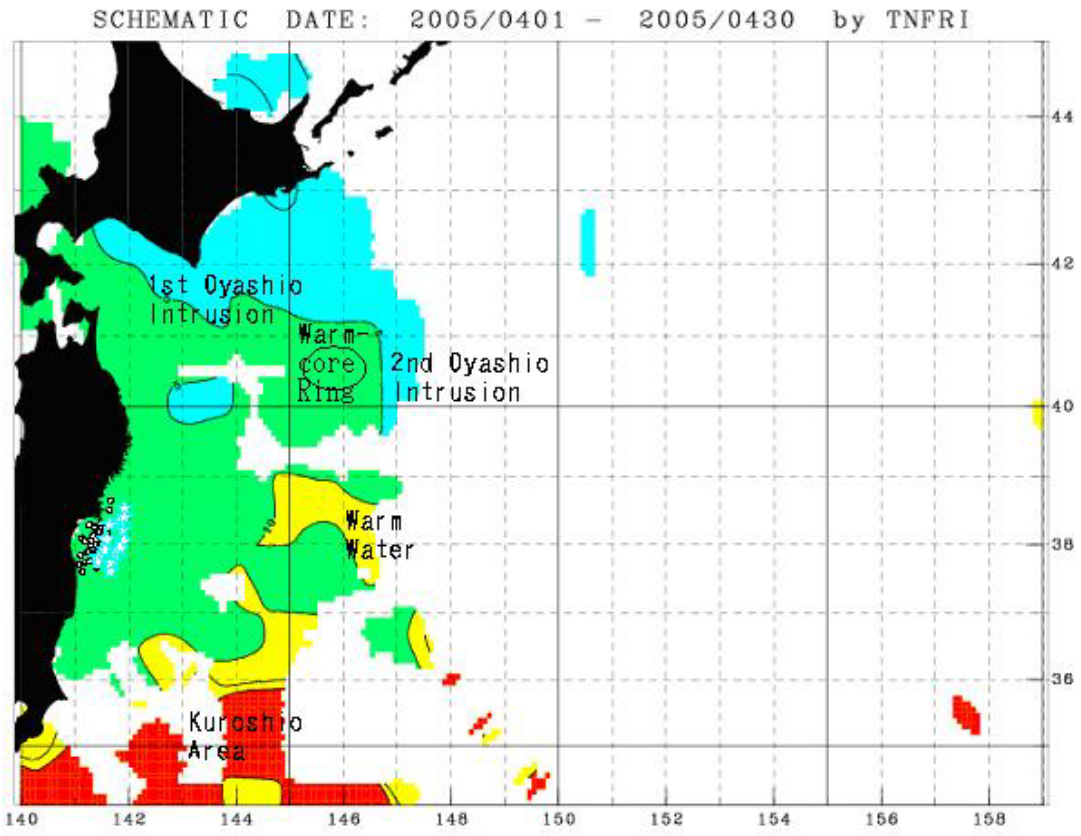

Fig. 3. Schematic hydrographic map in Tohoku area, northwestern Pacific, in April 2005 (presented by Tohoku National Fisheries Research Institute) with station map observed by *Takuyo maru*. Blue, green, yellow and red area show distributions of the Oyashio, the cold water, the warm water spread from the Kuroshio Extension and the Kuroshio Extension, respectively. Light blue star and black circles denote CTD stations observed by *Takuyo maru* in the cold area and the shallow coastal area, respectively.

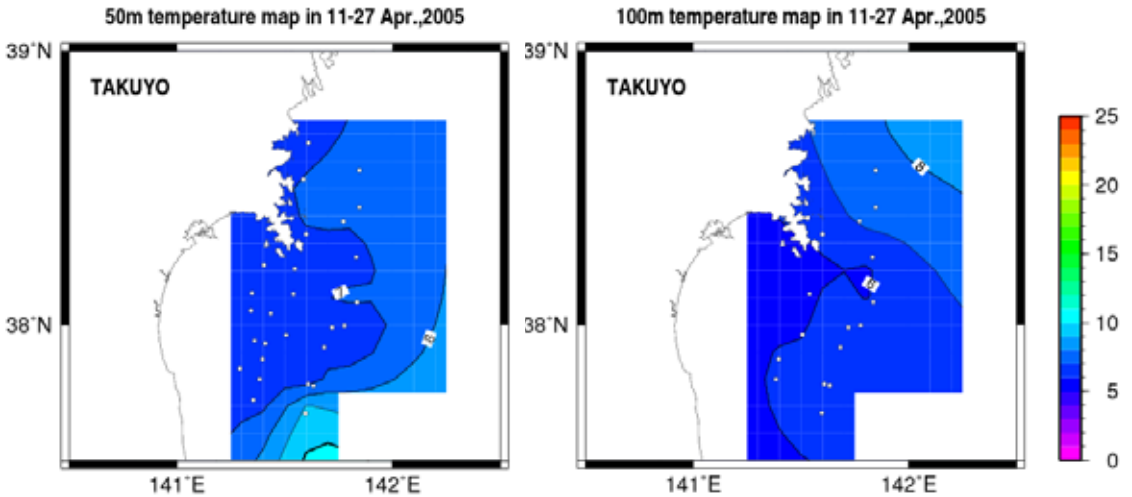

Fig.4. 50 m (left panel) and 100 m (right panel) temperature map observed by *Takuyo maru* in 11 to 27 April 2005.

Appendix 3

Cruise report of the dedicated sighting survey in 2005 JARPNII coastal survey off Sanriku, northeast Japan

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ABSTRACT

A cetacean sighting survey using the line transect method was conducted concurrently with the whale sampling survey and the whale prey survey off the Sanriku coast, Japan from 20 Apr. to 2 May, 2005. The primary objective of the sighting survey was the abundance estimation of baleen whales in the survey area. *Shonan-maru* was dedicated to the sighting survey. Total primary searching distance was 832.8 n. miles and the 50 schools (50 individuals) of primary sightings were made.

INTRODUCITON

A cetacean sighting survey using the line transect method was conducted concurrently with the whale sampling survey and the whale prey survey off the Sanriku coast, Japan from 20 April to 2 May, 2005, as a part of coastal component of 2005 JARPN II full scale study (Government of Japan, 2002). The primary objective of this survey was to obtain information on abundance of baleen whales in the survey area. Preliminary results of the cetacean sighting survey are presented in this paper.

MATERIALS AND METHODS

The cetacean sighting survey area was set within Sub-area 7 (Fig. 1). Though the sampling of whales was conducted within the 30 n. miles from Ayukawa port in the Sanriku, sighting survey area had larger are extent to see the overall baleen whale distribution pattern off the coast of the Sanriku. Near shore area of the survey block where the water depth is less than 50m was not surveyed because many fisheries gears were set in there. The survey block was further divided into the coastal and offshore area. Coastal area was divided into three at the two boundary lines, 37ºN and 39ºN. Offshore area was divided into two at the boundary lines on 38ºN. The survey was conducted from 20 Apr. to 2 May, 2005. *Shonan-maru* (SM1, 712GT) engaged in the cetacean sighting survey. Sighting survey procedures were same as offshore component of 2005 JARPN II. The right (*Eubalaena japonica*), blue (*Balaenoptera musculus*), and humpback (*Megaptera novaeangliae*) whales can be approached to obtain the Natural marking record experiments as the opportunistic basis. Large baleen

whale feeding behavior visual observation was attempted. If the behavior was observed, it was recorded on video tape.

RESULTS AND DISCUSSION

Tracklines surveyed are shown in Fig. 1. Total primary searching distance was 832.8 n.miles. The 50 schools (50 individuals) of primary sightings were obtained and one secondary sighting (one animal/one school) was also made. Details of sightings are listed in Table 1. Sightings of common minke whales were recorded. Sighting positions of these sightings are noted in the Fig. 1. Natural marking record and biopsy sampling experiments were not in opportunity, and no feeding behavior of large baleen whales was observed.

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Table 1. Summary of cetacean sightings made during the dedicated sighting survey in 2005 JARPNII coastal survey.

Species	Primary		Secondary	
	Sch.	Ind.	Sch.	Ind.
Common minke whale	48	48	1	1
Unidentified cetaceans	2	2		
Total	50	50	1	1

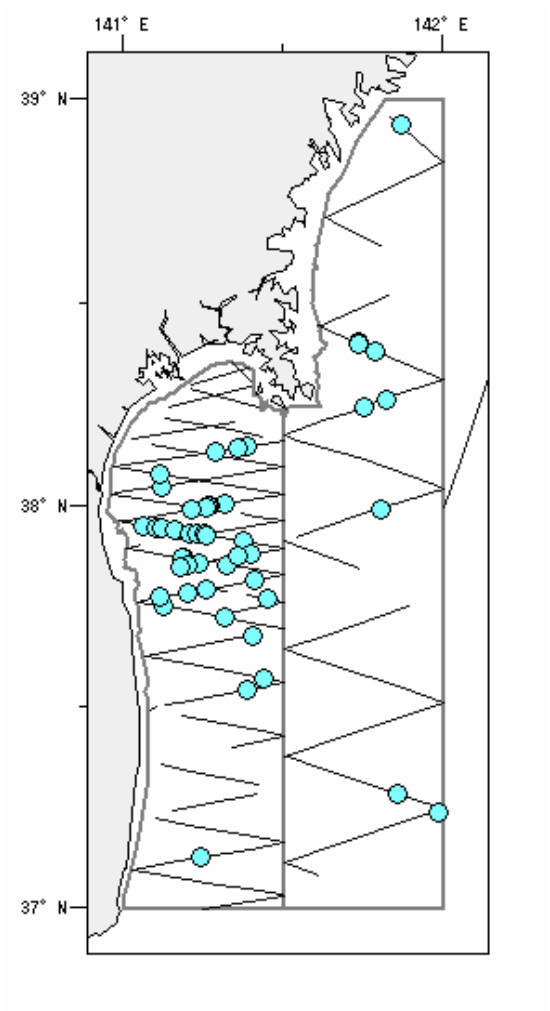

Fig. 1. Survey area and predetermined tracklines, and surveyed tracklines and sighting positions of common minke (open circle) during the dedicated sighting survey in 2005 JARPNII coastal survey.