Cruise Report of the Second Phase of the Japanese Whale Research Program under Special Permit in the Western North Pacific (JARPN II) in 2009 - (Part II) - Coastal component off Sanriku

GENTA YASUNAGA[1)], HIDEHIRO KATO[2)], TOSHIYA KISHIRO[3)], HIDEYOSHI YOSHIDA[3)], HAJIME ISHIKAWA[1)], MUTSUO GOTO[1)], SHIGEO TABATA[1)], HIKARI MAEDA[2)], GEN NAKAMURA[2)], SATOKO INOUE[2)], NAOKO MIYAKAWA[2)], TSUTOMU TAMURA[1)], SAEKO KUMAGAI [1)], TOSHIHIDE IWASAKI[3)], YU KANAJI[3)], HIKARU WATANABE[3)], HISOKA HIRUTA[1)], KEI YAMAZAKI[2)], YUTA YONEHARA[2)], HIROYUKI OIKAWA[1)], KEIICHI ONODERA[4)]

1) The Institute of Cetacean Research, 4-5 Toyomi-cho, Chuo-ku, Tokyo 104-0055, Japan.

2) Tokyo University of Marine Science and Technology 4-5-7 Konan, Minato-ku, Tokyo 108-0075, Japan

3) National Research Institute of Far Seas Fisheries, 2-12-4 Fukuura, Kanazawa-ku, Yokohama, Kanagawa 236-8648, Japan

4) Miyagi Prefecture Fisheries Technology Institute, 97-6 Sodenohama, Watanoha, Ishinomaki, Miyagi 986-2135, Japan

Contact e-mail:yasunaga@cetacean.jp

ABSTRACT

The 2009 survey of the JARPN II coastal component off Sanriku (northeastern Japan, corresponding to a part of sub-area 7), was conducted from 22 April to 21 May, using four small-type whaling catcher boats and one echo sounder trawl survey vessel. Sampling of common minke whales was conducted in coastal waters within 50n. miles from Ayukawa port in the Sanriku district, and all animals collected were landed on the JARPN II research station established for biological examination. A total of 4,756.08n.miles (464.0 hours) was surveyed and 111 schools (112 individuals) of common minke whales were sighted. A total of 60 animals were sampled. Average body length of the animals was 5.14m (SD: 0.61, *n*=27) for males and 5.12m (SD: 0.80, *n*=33) for females. Dominant prey species found in the forestomach were adult of Japanese sand lance (*Ammodytes personatus*) throughout all survey period. Japanese anchovy (*Engraulis japonicus*) and krill (*Euphausia pacifica*) were observed less frequently. High density of Japanese anchovy was observed in the middle of Sendai Bay by the quantitative echosounder, but the main prey item of minke whale was the sand lance. This suggests possible preferences of minke whale for this prey species.

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 objectives of the program are to evaluate the feeding ecology and ecosystem studies, involving prey consumption by cetaceans, prey preferences of cetaceans and ecosystem studies, to monitor environmental pollutants in cetaceans and the marine ecosystem and to elucidate the stock structure of whales (Government of Japan, 2002a).

The JARPN (1994-1999) and the JARPN II feasibility studies (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 feasibility survey was carried out in the coastal waters off Kushiro in autumn 2002 (Kishiro *et al*., 2003) and then the second feasibility survey was conducted in the coastal waters off Sanriku district in spring 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, 2004a, 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 revised survey off Sanriku was carried out in spring 2005 (Yoshida *et al*., 2006), 2006 (Goto *et al*., 2007), 2007 (Bando *et al*., 2008) and 2008 (Yasunaga *et al*., 2009).

In the present paper, we show results of the sixth survey carried out in coastal waters off the Sanriku district, Japan, from 22 April to 21 May in 2009. This survey was authorized by the Government of Japan in compliance with Article VIII of the International Convention for the Regulation of Whaling. The Institute of Cetacean Research (ICR) planned and conducted the survey cooperated with National

Research Institute of Far Seas Fisheries, Tokyo University of Marine Science and Technology and Miyagi Prefecture Fisheries Technology Institute.

MATERIALS AND METHODS

Research area

Research area was set in the same waters where the previous JARPN II coastal surveys off the Sanriku district were conducted (Yoshida *et. al*, 2004; 2006; Goto *et al*., 2007; Bando *et al.*, 2008; Yasunaga *et al*., 2009). 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 have been also very important fishing grounds. So, the waters were considered to be suitable for the research area of the JARPN II, and thus the coastal surveys were conducted in this area. 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 (1994).

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 22 April to 21 May, 2009. All the animals sampled were landed on the JARPN II research station established by 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 20 April to 1 May. The distribution and abundance of the prey species were investigated with the quantitative echo sounder (EK 500 and ER 60) on board TAK. 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 trawling. Detail of the prey species surveys are shown in Appendix 1.

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. 2. The sampling vessels tried to cover research areas widely within 30 n. miles from Ayukawa port. In offshore waters, however, searching activity was low because of changeable weather condition and bigger waves for small sampling vessels. Consequently, searching effort was concentrated in Sendai Bay. 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 4756.08n. miles and 464.0 hours, respectively (Table 1).

Common minke whale sightings made by sampling vessels

Sighting positions of common minke whale schools made by the sampling vessels are shown in Fig. 3. All of common minke whale sightings were extensively recorded in Sendai Bay during all research period. As shown in Table 2, a total of 111 schools (112 individuals) of common minke whales were sighted. These were 99 primary sightings (100 animals) and 12 secondary sightings (12 animals). Of 111 schools sighted, only 1 school consisted of 2 individuals and others were solitary animals. Cow-calf pairs were not sighted.

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 are higher during the early research period than the late period.

Sampling of common minke whales

A total of 60 common minke whales were taken for biological examination. In the sampling process, three common minke whale were struck and lost. Sighting positions of sampled individuals are shown in Fig. 3.

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 collected 60 animals consisted of 27 males and 33 females. Sex ratio of males to all animals was 0.45.

Average body length was 5.14m (max=6.85, min=4.03, SD: 0.61) for males and 5.12m (max=7.72, min=3.78, SD=0.80) for females, respectively (Table 5). Frequency of body length of common minke whale by sex was shown in Fig. 4. Average body lengths of both male and female in the early period were higher than those in the late period.

Composition of sexual maturity of animals collected is listed in Table 6. In males, 1 of 27 animals were sexually mature (0.04%), and 1 of 33 females attained sexual maturity (0.03%). One mature female was pregnant.

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.

Forestomach contents found from common minke whales during the present survey are listed in Table 7. Dominant prey species were adult Japanese sand lance (*Ammodytes personatus*) (83.3%, 45 from 54 animals). Japanese anchovy (*Engraulis japonicus*) were observed in two animals and krill (*Euphausia pacifica)* were observed 7 animals in the research period.

The maximum net weight of forestomach contents was 32.7 kg, of which consisted adult of Japanese sand lance (Table 8).

DISCUSSION

The present survey was the sixth coastal survey carried out in coastal waters off Sanriku district. During the survey period, low atmospheric pressure often disturbed the research activities. Furthermore, changeable weather condition and bigger waves obstructed searching activities of sampling vessels in offshore waters. Consequently, almost all of planned sample size was collected in Sendai Bay, where water depth is less than 100m.

The minke whales collected in the research period were extensively distributed in the Sendai Bay during all research period (Fig. 3). And, mature male and female of whales were only one individuals, respectively (Table 6). The results indicate the Sendai Bay was important for feeding area of immature minke whales during the research period.

Dominant prey species found from forestomach of animals were adult of Japanese sand lance throughout survey period (Table 7). Japanese anchovy and krill were observed during the early period.

In the coastal survey off Sanriku, adult of Japanese sand lance had mainly been observed in the stomach contents of minke whales, whereas Japanese anchovies and krill had slightly been observed since 2007 years (Yoshida, *et al*. 2004; Yoshida *et al*., 2006; Goto *et al.*, 2007; Bando *et al.*, 2008; Yasunaga *et al.*, 2009).

Likewise, the rank order of the stomach content of minke whales was Japanese sand lance (83.3%) > krill (13.0%) > Japanese anchovy (3.7%) in the present survey (Table 7). However, high density of Japanese anchovy was observed in the middle of Sendai Bay by the quantitative echosounder (Appendix 1), this indicates that common minke whales could have food preferences to sand lance in the Sendai Bay.

From the present survey, we could obtain valuable information for 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, continuation of studies are needed.

ACKNOWLEDGMENTS

We acknowledge crewmen of research vessels, staffs of the research station in Ayukawa, and the Japan small-type whaling association helped us. We also thank all the members of the municipal office of Ishinomaki, the Ojika fisheries cooperative association, and Miyagi prefectures office, for their kind assistance.

REFERENCES

Bando, T., Kato, H., Kishiro, T., Goto, M., Saito, T., Tabata, S., Morita, Y., Okamoto, R., Maeda, H., Inagaki, M., Nagatsuka, S., Ebisui, T., Nakai, K., Matsumoto, A., Gokita, A. and Kawahara, S. 2008. Cruise report of the second phase of the Japanese Whale Research Program under Special Permit in the Western North Pacific (JARPN II) in 2007- Coastal component off Sanriku. Paper SC/60/O6 submitted to the 60th IWC scientific Committee, 27pp.

Fujise, Y., Tamura, T., Bando, T., Watanabe, H., Kiwada, H., 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 (JARPN II) in 2001. Paper SC/54/O16 submitted to the 54th IWC Scientific Committee, 51pp.

Goto, M., Kato, H., Zenitani, R., Yoshida, H., Saito, T., Tabata, S., Morita, Y., Sato, H., Okamoto, R., Maeda, H., Odagawa, A., Ebisui, T., Nakai, K., Matsumoto, A., Fujimori, S., Nishiwaki, S. and Kawahara, S. 2007. Cruise report of the second phase of the Japanese Whale Research Program under Special Permit in the Western North Pacific (JARPN II) in 2006- Coastal component off Sanriku. Paper SC/59/O6 submitted to the 59th IWC scientific Committee, 34pp.

Government of Japan, 2002a. Research plan for cetacean studies in the western North Pacific under special permit (JARPN II). Paper SC/54/O2 submitted to the 54th IWC Scientific Committee.

Government of Japan (Fujise, Y., Kawahara, S., Pastene, L.A. and Hatanaka, H. eds.), 2002b. 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, 202pp.

Government of Japan (Fujise, Y., Tamura, T., Kato, H. and Kawahara, S. eds.), 2004a. Some considerations of the feasibility components of the JARPN II research plan. Paper SC/56/O2 submitted to the 56th IWC Scientific Committee, 36pp.

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

International Whaling Commission. 1994. Report of the Scientific Committee, Annex G. Report of the Working Group on North Pacific Minke Whale management trials. Rep. int. Whal. Commn 44:120-44.

Kato, H., Kishiro, T., Yoshida, H. and Kawahara, S. 2004. Feasibility of coastal surveys in the JARPN II, from the viewpoint of logistics. Appendix 1, pp4-12. In: Government of Japan (Fujise, Y., Tamura, T., Kato, H. and Kawahara, S. eds.), Some considerations of the feasibility components of the JARPN II research plan. Paper SC/56/O2 submitted to the 56th IWC Scientific Committee, 36pp.

Kishiro, T., Kato, H., Ohizumi, H., Yoshida, H., Saito, T., Isoda, T., Tabata, S., Sakakibara, M., Saino, S., Hara., T., Hayashi, T., Miyashita, T., Fukudome, K., Kiwada, H., and Kawahara, S. 2003. Report of the 2002 JARPN II survey in the western North Pacific. Part II: Coastal component - Coastal Survey off Kushiro, northeast Japan. Paper SC/55/O8 submitted to the 55th IWC Scientific Committee, 26pp.

Miyashita, T. and Hatanaka, H. 1997. A note on whaling grounds for the western North Pacific minke whale. Rep .int. Whal. Commn 47:539-542.

Tamura, T. and Fujise, Y. 2002. Geographical and seasonal changes of the prey species on minke whale in the Northwestern Pacific. ICES Journal of Marine Science, 59:516-528.

Tamura, T., Hakamada, T., Konishi, K., Fujise, Y., Kishiro, T., Yoshida, H., Ohizumi, H. and Kato, H. 2004. Recalculation of sample size of common minke whales in coastal areas required for estimating consumption of various prey items based on results of JARPN II. Appendix 2, pp13-17. In: Government of Japan (Fujise, Y., Tamura, T., Kato, H. and Kawahara, S. eds.), Some considerations of the feasibility components of the JARPN II research plan. Paper SC/56/O2 submitted to the 56th IWC Scientific Committee, 36pp. Paper SC/56/O16 submitted to the 56th IWC Scientific Committee, 36pp.

Yasunaga, G., Kato, H., Kishiro, T., Yoshida, H., Nishiwaki, S., Saito, T., Tabata, S., Okamoto, R., Maeda, H., Nakamura, G., Inoue, S., Otani, S., Iwasaki, T., Kanaji, Y., Mogoe, T., Murase, H., Wada, A., Nakai, K., Matsumoto, A., Gokita, A., Yamazaki, K., Oikawa, H., Onodera, K., Shiraishi, K. and Nagashima, H. 2009. Cruise report of the second phase of the Japanese Whale Research Program under Special Permit in the Western North Pacific (JARPN II) in 2008 - Coastal component off Sanriku. Paper SC/61/O6 submitted to the 61th IWC Scientific Committee, 20pp.

Yoshida, H., Kato, H., Kishiro, T., Iwasaki, T., Miyashita, T., Ryono, T., Tabata, S., Sakakibara, M., Saino, S., Hara, T., Hayashi, T., Tomizawa, Y., Tamai, K., Okamoto, R., Fukuoka, M., Watanabe, H., Tsunekawa, M. and Kawahara, S. 2004. Report of the coastal survey on common minke whales off Sanriku coast, northeast Japan: the Japanese whale research program under special permit in the western North Pacific – Phase II (JARPN II) in 2003 (Part II) – Coastal component. Paper SC/56/O14 submitted to the 56th IWC Scientific Committee, 31pp.

Yoshida, H., Kato, H., Kishiro, T., Iwasaki, T., Miyashita, T., Saito, T., Tabata, S., Morita, Y., Sato, H., Okada, A., Tomizawa, Y., Saino, S., Kuroishi, H., Ebisui, T., Nakai, K., Nishiwaki, S. 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- Coastal component off Sanriku. Paper SC/58/O9 submitted to the 58th IWC scientific Committee, 30pp.

Table 1. Searching days, hours, distances by four sampling vessels in the 2009 JARPN II coastal surveys off Sanriku.

Period		Sampling vessels*				Total
		28T	75K	07K	31S	
Early period (22 April-5 May)	Days	10	10	10	10	40
	Hours	63.4	85.4	65.5	62.2	276.5
	Distance(n.mile)	681.81	790.22	680.57	671.15	2823.76
Late period (6-21 May)	Days	7	7	7	7	28
	Hours	33.4	66.7	39.5	47.9	187.5
	Distance(n.mile)	372.88	627.02	425.26	507.16	1932.32
Total	Days	17	17	17	17	68
	Hours	96.8	152.1	105	110.1	464
	Distance(n.mile)	1054.69	1417.24		1178.31	4756.08

*: 28T; *Taisho Maru* No.28, 75K; *Koei Maru* No.75, 07K; *Katsu Maru* No.7, 31S; *Sumitomo Maru* No.31.

Table 2. List of cetacean species and number of sightings made by four sampling vessels in the 2009 JARPN II coastal surveys off Sanriku.

Period	Species	Primary		Secondary		Total	
		Sch.	Ind.	Sch.	Ind.	Sch.	Ind.
Early period (22 April-5 May)	Common minke whale	65	66	9	9	74	75
	Like minke whale	11	11	1	1	12	12
Late period (6-21 May)	Common minke whale	34	34	3	3	37	37
	Like minke whale	6	6	0	0	6	6
Total	Common minke whale	99	100	12	12	111	112
	Like minke whale	17	17	1	1	18	18

Table 3. Density index of common minke whales by sampling vessels in the 2009 JARPN II coastal survey off Sanriku.

Period	SPUE*1	DI*2
Early period (22 April-5 May)	0.24	2.34
Late period (6-21 May)	0.18	1.76
Total	0.22	2.10

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

*2: No. of primary school sightings per 100 n. miles searching.

Table 4. Summary of biological data and samples collected during the 2009 JARPN II coastal survey off Sanriku.

Samples and data	Number of animals		
	Male	Female	Total
Body length and sex	27	33	60
External body proportion	27	33	60
Photographic record and external character	27	33	60
Diatom film record	27	33	60
Body scar record	27	33	60
Measurements of blubber thickness (5 points)	27	33	60
Detailed measurements of blubber thickness (11 points)	0	0	0
Whole body weight	27	33	60
Body weight by parts	0	0	0
Skin tissues for DNA study	27	33	60
Muscle, liver, kidney, spleen, blubber, heart and ventral groove for various analysis	27	33	60
Urine for various analysis	10	4	14
Muscle, liver, kidney, and blubber for heavy metal analysis	27	33	60
Muscle, liver, kidney, and blubber for organochlorine analysis	27	33	60
Collection of blood plasma	20	25	54
Muscle and vertebra for lipid analysis	0	0	0
Mammary grand; lactation status, measurement and histological sample	-	33	33
Uterine horn; measurements and endometrium sample	-	33	33
Collection of Ovary	-	33	33
Photographic record of fetus	0	1	1
Fetal length and weight	0	1	1
External measurement of fetus	0	1	1
Muscle, liver, kidney, heart, blubber and skin tissues of fetus	0	1	1
Collection of fetus	0	1	1
Testis and epididymis; weight and histological sample	27	-	27
Stomach contents, convenient record	27	33	60
Volume and weight of stomach content in each compartment	27	33	60
Observation of marine debris in stomach	27	33	60
Collection of stomach contents for feeding study	26	29	55
Record of external parasites	27	33	60
Earplug for age determination	27	33	60
Tympanic bulla for age determination	27	33	60
Eye lens for age determination	25	31	56
Largest baleen plate for morphologic study and age determination	27	33	60
Baleen plate measurements (length and breadth)	27	33	60
Photographic record of baleen plate series	27	33	60
Length of baleen series	27	33	60
Vertebral epiphyses sample	24	33	57
Number of ribs	27	33	60
Skull measurement (length and breadth)	23	32	55

*: including a fetus of sex unidentified.

Table 5. Statistics of body length (m) of common minke whales collected during the 2009 JARPN II coastal survey off Sanriku.

Period	Male					Female				
	mean	S.D.	Min.	Max.	n	mean	S.D.	Min.	Max.	n
Early period (22 April-5 May)	5.25	0.64	4.31	6.85	14	5.20	0.91	3.78	7.72	22
Late period (6-21 May)	5.03	0.58	4.03	5.80	13	4.96	0.52	4.20	5.95	11
Total	5.14	0.61	4.03	6.85	27	5.12	0.80	3.78	7.72	33

Table 6. Composition of sex and sexual maturity status of common minke whales collected by the 2009 JARPN II coastal survey off Sanriku.

Period	Male					Female						
	Im	M	Uk	Total	Maturity (%)	Imm.	R	P	P&L	Uk	Total	Maturity (%)
Early period (22 April-5 May)	13	1	0	14	0.07	21	0	1	0	0	22	0.05
Late period (6-21 May)	13	0	0	13	0.00	11	0	0	0	0	11	0.00
Total	26	1	0	27	0.04	32	0	1	0	0	33	0.03

Im: Immature, M: Mature, R: Resting, P: Pregnant, P&L: Pregnant and lactating, Uk: Unknown

Table 7. Prey species found in forestomach of common minke whales collected by the 2009 JARPN II coastal survey off Sanriku.

Period	No. of whales observed		Prey species		
			Sand lance	Japanese anchovy	Krill
Early period (22 April-5 May)	34	Number	25	2	7
		Occurrence (%)	73.5	5.9	20.6
Late period (6-21 May)	20	Number	20	-	-
		Occurrence (%)	95.2	-	-
Total	54	Number	45	2	7
		Occurrence (%)	83.3	3.7	13.0

*: removing animals with broken stomach by harpoon.

Table 8. Weight (kg) of forestomach content of common minke whales collected by the 2009 JARPNⅡ coastal survey off Sanriku.

		Japanese sand lance	Japanese anchovy	Krill
Early period	average	10.55	10.66	4.38
（22 April -5 May）	range	(0.6-32.7)	(8.14-13.18)	(0.76-10.92)
Late period	average	8.21		
(6-21 May)	range	(0.54-34.28)		
Total	average	9.51	10.66	4.38
	range	(0.54-34.28)	(8.14-13.18)	(0.76-10.92)

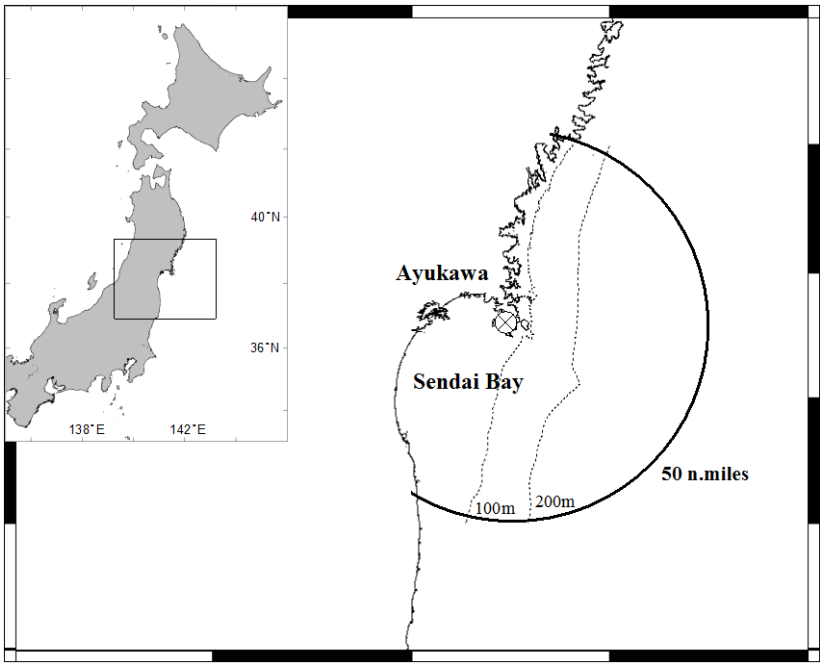


Fig. 1. Research area of the 2009 JARPNII coastal survey off Sanriku.

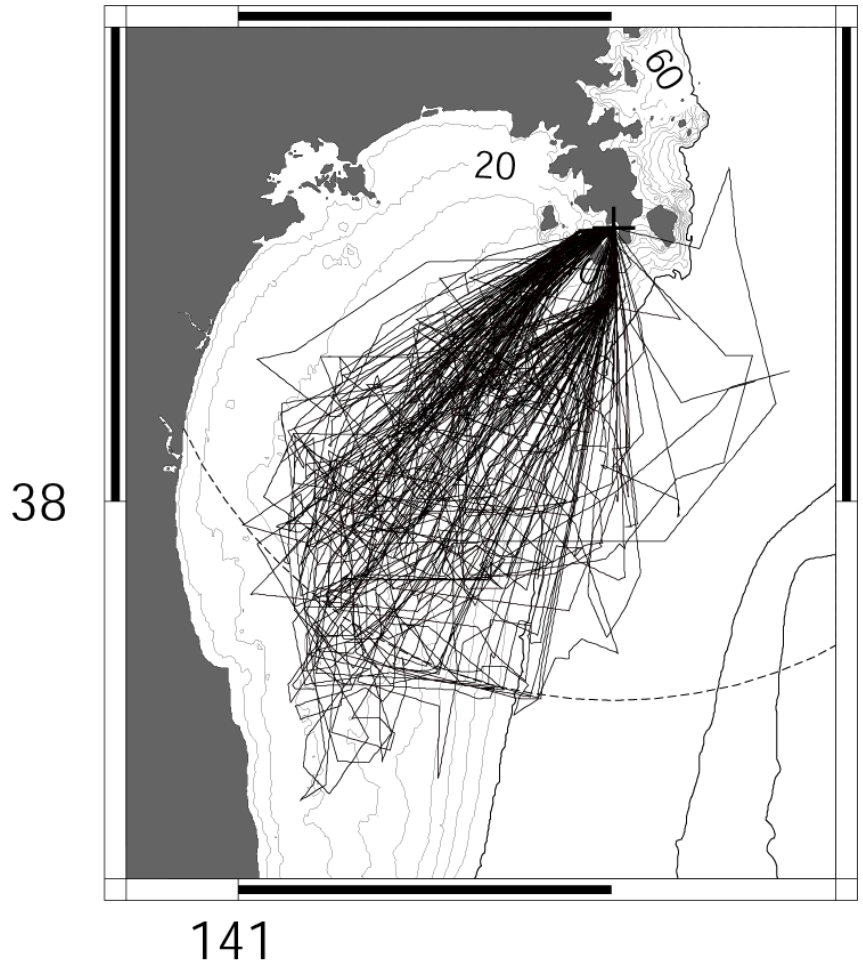


Fig. 2. Cruise trucks made by four sampling vessels in the 2009 JARPNII coastal survey off Sanriku.

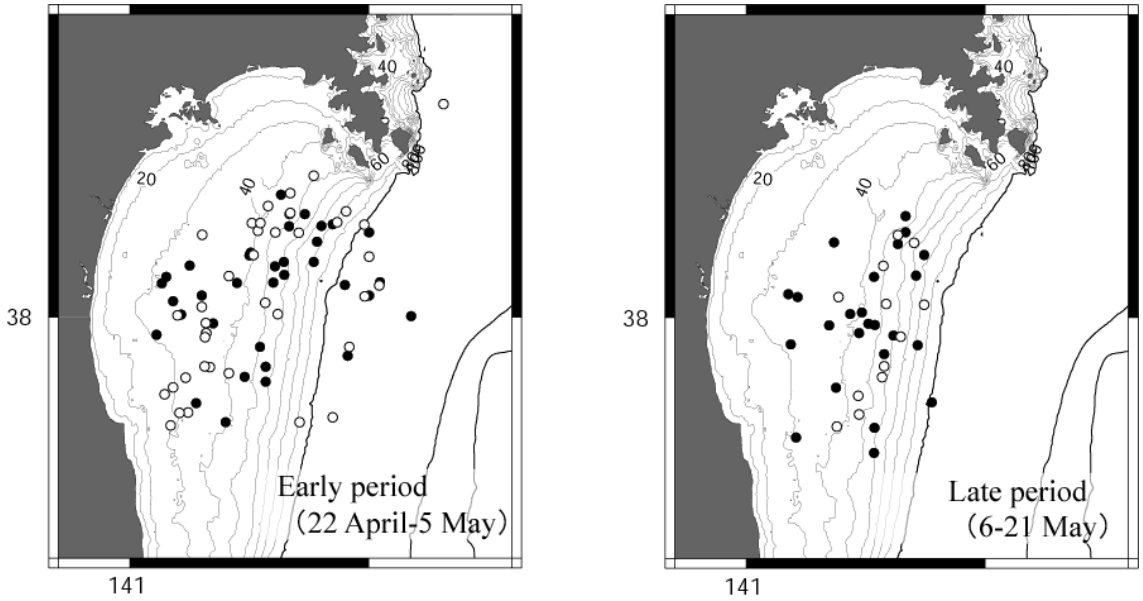


Fig. 3. Sighting positions of common minke whales made by sampling vessels in the 2009 JARPNⅡ coastal survey off Sanriku (●:sighting and sampled; ○: only sighting)

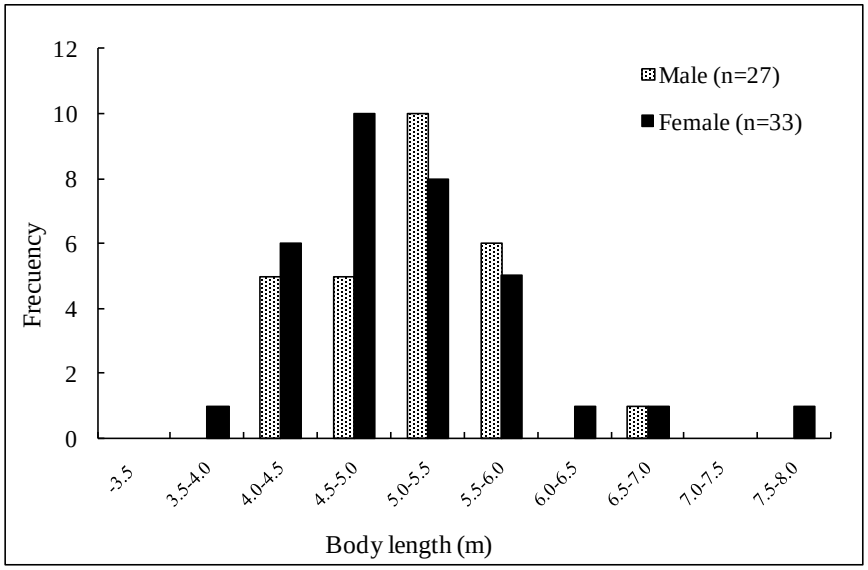


Fig. 4. Frequency of body length of common minke whales is taken in the 2009 JARPNII coastal survey by sex.

Appendix 1

Coastal prey species survey of JARPN II off Sanriku in 2009

Hiroto Murase[1], Keiichi Onodera[2], Kiyoshi Matsubara[2] and TakafumiSuzuki[2]

[1] The Institute of Cetacean Research, 4-5 Toyomi-cho, Chuo-ku, Tokyo 104-0055, Japan
[2] Miyagi Prefecture Fisheries Technology Institute, 97-6 Sodenohama, Watanoha, Ishinomaki, Miyagi 986-2135, Japan

ABSTRACT

A prey species survey was conducted in the coastal region off Sanriku, northeastern Japan in spring 2009 as a part of JARPNII coastal component off Sanriku. The survey was conducted concurrently with a sampling survey of common minke whales. The survey period was from 20 April to 1 May. Five stratified blocks were surveyed. Zigzag tracklines were set in the blocks. A trawler type RV, Takuyo-maru, conducted the survey. Acoustic data were recorded continuously along tracklines by a quantitative echosounder. Samplings using a midwater trawl net were conducted at 9 stations to identify species and size compositions of acoustic backscatterings. Vertical oceanographic conditions were recorded at 33 stations by using a CTD. Subsurface oceanographic conditions were recorded continuously along tracklines.

INTRODUCTION

JARPN II is designs to contribute to conservation and sustainable use of marine living resources including whales in the western North Pacific, especially within Japan's EEZ (Government of Japan, 2002). One of the major objectives of JARPNII is to evaluate feeding ecology and ecosystem studies, involving studies of prey consumption by cetaceans, prey preference of cetaceans and ecosystem modeling. To accomplish the goal, sampling survey of common minke whales (*Balaenoptera acutorostrata*) and survey on biomass estimation of their prey species have been conducted concurrently off Sanriku, Japan since 2003 as a JARPNII coastal component. In this document, the results of the prey species survey off Sanriku in 2009 are presented.

MATERIALS AND METHODS

While the sampling survey of minke whales was conducted in the coastal waters within the 50 n.miles (mainly within 30 n.miles) from Ayukawa, Miyagi prefecture, Japan, the prey species survey was conducted in wider area at depths between 20 m and 200 m from 37º 40' N to 38º 15' N off Sanriku, northeastern Japan, to elucidate the distribution and abundance of main prey species. Seven survey blocks (A-G) have been set within the survey block since 2005 for the purpose of biomass estimation of prey species based on a stratified random sampling method using echosoudner data (Fig 1a). Stratification of blocks was based on bottom depth (20, 40, 100, and 200m) and political boundary (boundary between Miyagi and Fukushima prefecture). Because of logistical constraint, only 5 blocks (B, C, D, E and F) was surveyed in 2009 (Fig. 1b). A zigzag track

line was set to cover each block. The waypoints of planned tracklines in each block were shown in Table 1.

The prey species survey was conducted from 20 April to 1 May. The survey was conducted during the daytime from an hour after sunrise to an hour before sunset. Acoustic, trawl and oceanographic surveys were conducted using a trawler-type RV, "Takuyo maru" (Miyagi prefecture, 120 GT). Data of distribution and abundance of the prey species were recorded by a quantitative echosounder, EK500 (Simrad, Norway) with operating frequency at 38, 120 and 200 kHz. The RV steamed at 9-10 knots along the tracklines. Acoustic data were stored with an aid of software, Echoview (Sonar Data, Austlaria). A calibration was carried out in the survey area on 14 April using the copper sphere technique described in EK 500 manual. Vertical oceanographic observations were conducted with CTD. Subsurface (approximately 5m water depth) temperature, salinity and chlorophyll-a were recorded every minute (in time) along the tracklines.

Trawl sampling was conducted to identify the species and size compositions of targeting echosigns. The trawl net had a mouth opening of 7 m (width) by 3.5 m (height) and a 3 mm liner cod end. The depth and the height of the mouth of the net were monitored with a net recorder. Towing speed of the trawl net was 2-4 knots. Catches of trawl were identified to the species level and weighed aboard the vessel. For the major species, a sample of 100 animals was taken, and lengths and weights were measured. Scale and standard lengths were used to Japanese anchovy (*Engraulis japonicus*) and sand lance (adult and juvenile, *Ammodytes personatus*), respectively. Total length from the tip of the rostrum to the end of the telson was used for krill (*Euphausia pacifica*). Some frozen samples were taken for further analysis in the laboratory.

RESULTS

The planned tracklines were almost surveyed by the quantitative echosounder. Trawl was towed at 9 stations. A summary of the midwater trawl samplings was shown in Table 2. CTD casts were conducted at 33 stations. Continuous monitoring of subsurface temperature indicated that water temperature was warmer than an average year. Backscatterings of juvenile sand lance was sparse in the entire survey area probably due to warmer sea temperate. In contrast, adult sand lance was observed in all blocks except Block D. In addition, high density of Japanese anchovy was observed in Block B, C and F. Distributuion pattens of fishes could be related to the warm water temperature. Krill was observed Block C and D. In Block C, krill was observed in the area where bottom depth was deeper than 40 m. Detailed analysis will be conducted in the laboratory and the results will be presented in the near future.

ACKNOWLEDGEMENT

We would like to thank the captain of RV "Takuyo-Maru", Mr. Hiroaki Kimura, and his crews who assisted us to collect a valuable data set. This survey was supported by Fisheries Agency of Japan, Miyagi Prefecture and the Institute of Cetacean Research. We thank to these institutions for their support.

REFERENCES

Government of Japan. 2002. Research Plan for Cetacean Studies in the Western North Pacific

under Special Permit (JARPN II). IWC/SC/54/O2 submitted to the 54th IWC Scientific Committee Meeting, 115pp.

Table 1. Waypoints and planed lines.

Block B

Waypoint	Latitude				Longitude				Course (degree)	Distance (n.mile)
B1	38	-	21.2	N	141	-	21.7	E	250	9.4
B2	38	-	18.0	N	141	-	10.5	E	121	7.8
B3	38	-	14.0	N	141	-	19.1	E	255	2.0
B4	38	-	13.5	N	141	-	16.7	E	255	1.5
B5	38	-	13.1	N	141	-	14.8	E	256	12.5
B6	38	-	10.0	N	140	-	59.4	E	107	13.7
B7	38	-	06.0	N	141	-	16.0	E	255	15.4
B8	38	-	02.0	N	140	-	57.1	E	107	13.6
B9	37	-	58.0	N	141	-	13.6	E	249	11.3
B10	37	-	54.0	N	141	-	00.2	E	-	-
									Total	87.2

Block C

Waypoint	Latitude				Longitude				Course (degree)	Distance (n.mile)
C1	38	-	15.0	N	141	-	37.1	E	262	5.1
C2	38	-	14.3	N	141	-	30.7	E	252	0.3
C3	38	-	14.2	N	141	-	30.3	E	270	0.2
C4	38	-	14.2	N	141	-	30.1	E	258	0.5
C5	38	-	14.1	N	141	-	29.5	E	262	8.9
C6	38	-	12.9	N	141	-	18.3	E	262	0.7
C7	38	-	12.8	N	141	-	17.4	E	261	2.0
C8	38	-	12.5	N	141	-	14.9	E	102	12.4
C9	38	-	10.0	N	141	-	30.3	E	257	11.4
C10	38	-	07.5	N	141	-	16.2	E	106	8.9
C11	38	-	05.0	N	141	-	27.1	E	255	9.9
C12	38	-	02.5	N	141	-	15.0	E	107	8.7
C13	38	-	00.0	N	141	-	25.6	E	255	9.7
C14	37	-	57.5	N	141	-	13.7	E	106	9.0
C15	37	-	55.0	N	141	-	24.6	E	255	3.9
C16	37	-	54.0	N	141	-	19.8	E	-	-
									Total	91.5

Block D

Waypoint	Latitude				Longitude				Course (degree)	Distance (n.mile)
D1	38	-	15.0	N	141	-	41.5	E	253	6.9
D2	38	-	13.0	N	141	-	33.1	E	108	13.1
D3	38	-	09.0	N	141	-	49.0	E	257	17.7
D4	38	-	05.0	N	141	-	27.1	E	104	17.0
D5	38	-	01.0	N	141	-	48.0	E	258	19.0
D6	37	-	57.0	N	141	-	24.5	E	108	9.8
D7	37	-	54.0	N	141	-	36.3	E	-	-
									Total	83.5

Block E

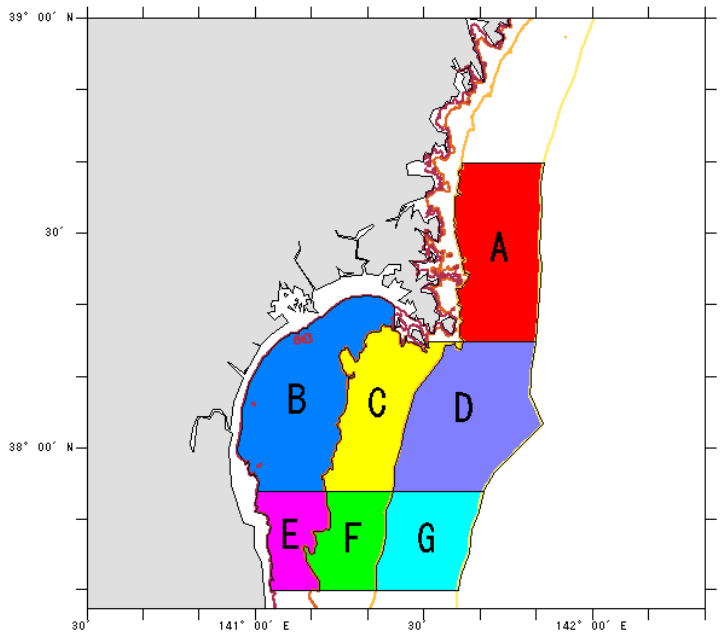
Waypoint	Latitude				Longitude				Course (degree)	Distance (n.mile)
E1	37	-	54.0	N	141	-	05.3	E	105	5.9
E2	37	-	52.5	N	141	-	12.5	E	253	8.4
E3	37	-	50.0	N	141	-	02.3	E	111	7.0
E4	37	-	47.5	N	141	-	10.6	E	249	6.8
E5	37	-	45.0	N	141	-	02.6	E	113	6.4
E6	37	-	42.5	N	141	-	10.1	E	247	6.4
E7	37	-	40.0	N	141	-	02.7	E	-	-
									Total	41.0

Block F

Waypoint	Latitude				Longitude				Course (degree)	Distance (n.mile)
F1	37	-	54.0	N	141	-	12.3	E	106	9.0
F2	37	-	51.5	N	141	-	23.3	E	253	8.4
F3	37	-	49.0	N	141	-	13.2	E	108	8.0
F4	37	-	46.5	N	141	-	22.8	E	257	11.1
F5	37	-	44.0	N	141	-	09.1	E	104	10.1
F6	37	-	41.5	N	141	-	21.4	E	255	5.9
F7	37	-	40.0	N	141	-	14.2	E	-	-
									Total	52.5

Table 2. A summary of the trawl sampling.

Station		St-1	St-2	St-3	St-4	St-5	St-6	St-7	St-8	St-9
Block		B	B	B	B	C	D	E	F	F
Date		20 Apr.	20 Apr.	22 Apr.	22 Apr.	24 Apr.	28Apr.	29 Apr.	30 Apr.	30 Apr.
Time		10:49	14:42	12:06	15:35	11:58	10:23	6:58	10:01	13:59
Latitude		38-15N	38-06N	38-02N	37-55N	38-08N	38-04N	37-51N	37-42N	37-50N
Longitude		141-16E	141-14E	141-01E	141-06E	141-19E	141-29E	141-09E	141-14E	141-19E
Temp (°C) by depth	0 m	10.5	10.5	10.9	11.2	9.8	9.5	10.9	11.4	11.0
	10 m	9.9	10.1	10.4	10.2	9.2	9.1	10.2	10.4	9.6
	20 m	9.3	9.1	8.9	7.9	9.4	9.1	10.1	10.3	9.3
	30 m	7.7	7.6			9.3	9.1	8.1	9.5	8.5
	40 m					7.9	8.3		9.0	7.4
	50 m						7.5		7.6	6.9
	75 m						6.8			
	100 m						6.6			
	Bottom (m)	7.7 (36m)	7.6 (33m)	8.3 (23m)	7.8 (27m)	7.7 (47m)	6.5 (106m)	7.8 (35m)	7.5 (61m)	6.9 (57m)
Trawl sampling depth (m)		20-30	15-30	20	5-20	0-20	30-100	0-20	20	60
Major sampled species		Japanese anchovy	Sand lance (adult)	Sand lance (adult)	Sand lance (adult)	Japanese anchovy	Krill	Sand lance (adult)	Sand lance (adult)	Japanese anchovy



(a)

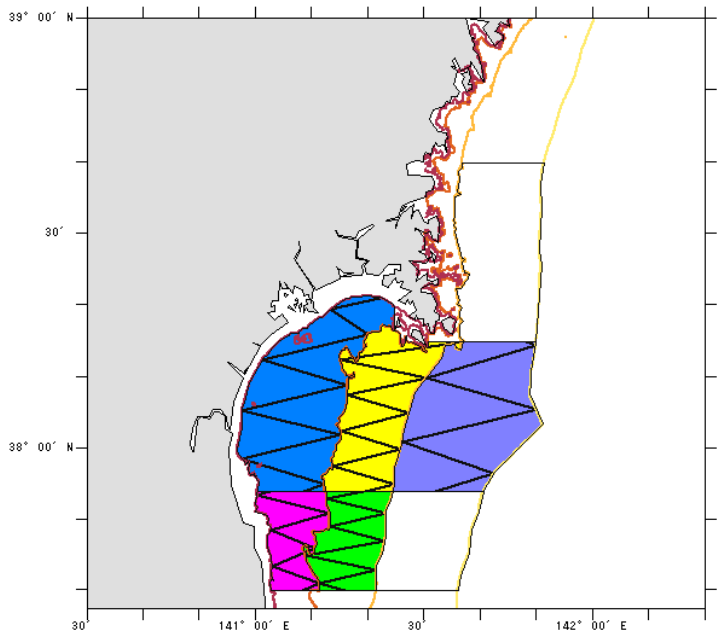


Fig. 1. Survey Blocks (a) and planed tracklines in 2009 (b). Block A and G were not surveyed in 2009.