

Cruise Report of the Second Phase of the Japanese Whale Research Program under Special Permit in the Western North Pacific (JARPN II) in 2013 - (Part II) - Coastal component off Sanriku survey

GENTA YASUNAGA¹⁾, TAKEHARU BANDO¹⁾, NOBUYUKI ITOH²⁾, GEN NAKAMURA³⁾, SATOKO INOUE³⁾, NAOKO MIYAKAWA³⁾, ICHIRO KADOWAKI³⁾, MEGUMI TAKAHASHI³⁾, AIKO FUKUMOTO³⁾, KAITA KITAMURA³⁾, YUSUKE FURUYAMA³⁾, NOZOMI KOBAYASHI³⁾, MASAYOSHI OHTA³⁾, HITOMI SATO²⁾, SAEKO KUMAGAI²⁾, NAGISA SAKAMOTO²⁾, HIDEHIRO KATO³⁾

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

2) Association for Community-Based Whaling, 2-5-28, Hakata-eki-higashi, Hakata-ku, Fukuoka, 812-0013, Japan

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

Contact e-mail: yasunaga@cetacean.jp

ABSTRACT

The 2013 survey of the JARPN II coastal component off Sanriku (northeastern Japan, corresponding to a part of sub-area 7), was conducted from 18 April to 3 June, 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 50 n. miles from Ayukawa port in the Sanriku district, and all animals collected were landed at the JARPN II research station established for biological examination in Ayukawa. A total of 7,188.3 n.miles (709.3 hours) was surveyed and 59 schools (59 individuals) of common minke whales were sighted. A total of 34 animals were sampled. Average body length of the animals was 5.02 m (SD: 1.12, n=17) for males and 5.21 m (SD: 0.60, n=17) for females. The body length of both sexes tended to be shorter in recent years. Dominant prey species found in the forestomach of common minke whales collected in the Sendai Bay were juvenile Japanese sand lances, and those collected outside the Sendai Bay were Japanese anchovies. This suggests that common minke whales in the Sendai Bay and in the outside slope feed on different preys. Furthermore, common minke whales significantly fed juvenile sand lances in 2012 and 2013, with the proportion of adult sand lance decreased in recent years. This result indicates that feeding habit of common minke whales in coastal waters off Sanriku changes year by year.

KEYWORDS: COMMON MINKE WHALE; NORTH PACIFIC; FEEDING ECOLOGY; 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 1) Feeding ecology and ecosystem studies, involving prey consumption by cetaceans, prey preferences of cetaceans and ecosystem modeling; 2) Monitoring environmental pollutants in cetaceans and the marine ecosystem; and 3) Stock structure of whales (Government of Japan, 2002).

The JARPN II coastal component using small-type whaling catcher boats started in 2002 to complement the temporal and spatial gap of the offshore components using the Nisshin Maru research vessel. In the original JARPN II plan, the coastal component was presented as a two-year feasibility study to examine the logistic aspects of the methodology (Government of Japan, 2002). The first feasibility survey was carried out in the coastal waters off Kushiro in autumn 2002 (Kishiro *et al.*, 2003) and 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 the logistic aspects of 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, recalculation of required sample size from the survey data suggested that the size should be modified to 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 during 2005 and 2010 year (Yoshida *et al.*, 2006; Goto *et al.*, 2007; Bando *et al.*, 2008, 2011; Yasunaga *et al.*, 2009, 2010). On March 11 2011 the Ayukawa town, including all research facilities of JARPN II, was destroyed by a large earthquake and tsunami. In 2011 the spring coastal survey could not be conducted in Ayukawa. Instead the spring survey in 2011 was conducted in Kushiro. Fortunately the Ayukawa research station was reconstructed and the 2012 survey of the JARPN II coastal component in spring could be conducted in this locality again (Yasunaga *et al.*, 2013).

Here we report the survey carried out in coastal waters off Sanriku from 18 April to 3 June in 2013. 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 in cooperation with the National Research Institute of Far Seas Fisheries and Tokyo University of Marine Science and Technology, and the Association for Community-Based Whaling.

MATERIALS AND METHODS

Research area

The research area was set in the same way as in previous surveys off Sanriku (Yasunaga *et al.*, 2013). The research area comprised coastal water within 50 n. miles from northeastern part of the Japanese main island, Honshu, (Figure

1). The area was divided into Areas 1, 2 and 3 centering on the Ayukawa port (Figure 1). The research area corresponds to the northern part of sub-area 7, established by IWC (1994).

Whale sampling

Four small-type whaling catcher boats were used as sampling vessels: *Taisho Maru* No. 28 (hereinafter referred as 28T; 47.3GT), *Koei Maru* No. 8 (08K; 32.0GT), *Katsu Maru* No.7 (07K; 32.0GT), and *Sumitomo Maru* No.51 (51S; 30.0GT). All the animals sampled were landed on the JARPN II research station established at the Ayukawa port for biological examination. All common minke whales collected were examined biologically by researchers at the research station (Table 1).

RESULTS

Searching effort

The whale sampling survey was conducted from 18 April to 3 June, 2013. Cruise tracks by the sampling vessels 28T, 08K, 07K and 51S are shown in Figure 2. The tracks covered widely the coastal waters off Sanriku. Searching distance and time are listed in Table 2, by sampling vessel. Searching distance and time are defined as distance and time recorded under searching activity conducted from the top barrel of the vessels. Total searching distance and time made by the four vessels were 7,188.3 n. miles and 709.3 hours, respectively (Table 2).

Sightings

A total of 59 schools (59 individuals) of common minke whales was sighted during the searching (Table 3, Figure 3). Density index (DI, the number of primary sightings of schools per 100 n.miles searching) of common minke whales within (Area 1) and outside (Areas 2 and 3) the Sendai Bay were calculated as 0.95 and 0.21, respectively (Table 4). Forty four schools (49 individuals) of humpback whales were sighted during the searching (Table 3).

Sampling of common minke whales

A total of 34 common minke whales was sampled. No situation of struck and lost occurred. The sighting positions of sampled animals are shown in Figure 3.

Biological examination

Sex ratio, body length and weight

Research items for the biological examination are summarized in Table 1. The sampled animals consisted of 17 males and 17 females. Sex ratio of males was 0.50. Average body length was 5.02 m (max=7.64, min=3.70) for males and 5.21 m (max=6.14, min=3.84) for females (Table 5, see also Figure 4). The sexual maturity of animals collected is shown in Table 6. All minke whales for both sexes sampled within the Sendai Bay (Area 1) were sexually immature, while two minke whales for males sampled outside the bay were mature.

Prey species of common minke whale

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, in each of the four chambers, for both cases including and excluding liquid contents. In addition a small sample of forestomach contents was collected and frozen for laboratory analysis.

Forestomach contents are listed in Table 7. Juvenile Japanese sand lance (*Ammodytes personatus*) (54.5%, 12 from 22 animals) and adult Japanese sand lance (27.3%, 6 from 22 animals) and Japanese anchovy (*Engraulis japonicus*) (9.1%, 2 from 22 animals) were observed in Area 1, and only Japanese anchovy was observed in two animals in Areas 2 and 3 (Table 7, Figure 5). The maximum net weight of forestomach contents was 58.77 kg, consisting of Japanese anchovy (Table 8).

Observation of marine debris

Observation of marine debris was made in the stomachs of the 34 common minke whales sampled. One plastic piece was found in the third stomach of an individual.

DISCUSSION

Sighting and sampling survey

The present survey was the ninth survey of the JARPEN II coastal component in the spring season off Sanriku. The feasibility survey was conducted in the coastal waters off Sanriku district in spring 2003, and the revised surveys off Sanriku were carried out in spring during 2005 and 2012 year, except in 2011 (Survey could not be conducted in Ayukawa in this year because a large earthquake and tsunami).

As same as the previous surveys, bad weather conditions such as low atmospheric pressures, changeable weather condition and bigger waves often disturbed research activities. Of the total 43 day survey period (from 18 April to 3 June), sampling vessels could conduct the research for 28 days or 59.6% of the predetermined days. The total searching distance made by the four vessels in this survey was the third longest after those in the 2007 and 2010 surveys, and the number of research days in this and 2010 surveys were also longer (Table 9).

The sighting positions of common minke whales in the present survey were concentrated mainly within the Sendai Bay (Figure 3). Whales outside the Sendai Bay were distributed on the shelf region and along the 100-200m isobaths on the slope. The density index (DI) of common minke whales in Area 1 (DI=0.95) was higher than those in Areas 2 and 3 (DI=0.21), suggesting that common minke whales were concentrated in the Sendai Bay (Table 4). The DI in Area 1 in the present survey was lower than those in 2006 (DI=1.83, Goto *et al.*, 2007), 2007 (DI=1.91, Bando *et al.*, 2008), 2008 (DI=1.57, Yasunaga *et al.*, 2009), 2009 (DI=2.08, Yasunaga *et al.*, 2010) and 2012 (DI=2.43, Yasunaga *et al.*, 2013). Furthermore, the DI of Areas 2 and 3 in 2013 was lower than DI in 2010 (DI=0.66, Yasunaga *et al.*, 2011) and 2012 (DI in Area 2=0.43; DI in Area 3=0.49, Yasunaga *et al.*, 2013). The surveys from 2006 to 2010 and 2012 were conducted mainly in Area 1. In Area 1, DIs in 2010 and 2013 were lower than the others.

The reason why 60 animals could not be sampled in the period of the survey in 2010 and 2013 might be explained by either bad weather condition, a decrease of sampling opportunities, research design, sampling efficiency and distribution of whales. The operating ratio (actual survey days / total surveys) in 2010 and 2013 were similar to those of the other surveys (Table 9). The research area was consistently conducted within 30 n.miles in Sendai Bay, Area 1, whereas was occasionally expanded to off Sendai Bay, Areas 2 and 3 in recent years. In 2010 and 2013, sampling efficiency ratio (number of sampled whales / number of total sighting whales) were higher than the others (Table 9). On the other hand, numbers of sighting and density of whales in the years were lower than those in the other years (Table 9). The fishery catch of adult Japanese sand lance at Miyagi prefecture in April 2011 and 2013 were less than those in the other years (Table 9). The most obvious explanation is that whales could stay only a short period of time

in Sendai Bay with few abundance of their prey.

Biological examination

The sex ratio of males of minke whales collected in the present survey (0.50) was similar to those in 2006 (0.43, Goto *et al.*, 2007), 2007 (0.37, Bando *et al.*, 2008), 2008 (0.38, Yasunaga *et al.*, 2009), 2009 (0.45, Yasunaga *et al.*, 2010), 2010 (0.48, Yasunaga *et al.*, 2011) and 2012 (0.48, Yasunaga *et al.*, 2013). Frequency distribution peaks of body length of males of common minke whales collected in the present survey was shorter than those in the previous surveys, while those of females was similar to those in the previous surveys (Figure 4). Furthermore, body length of the both sexes of common minke whales tended to be shorter in recent years.

Juvenile Japanese sand lances were mainly observed in the forestomachs of whales collected from Area 1 while that Japanese anchovy was observed in forestomachs in whales in Areas 2 and 3 (Table 7). This suggests that common minke whales in the Sendai Bay and in the outside slope feed on different preys (Figure 5). Furthermore, minke whales significantly fed juvenile sand lances in 2012 and 2013, with the proportion of adult sand lance decreased in recent years (Figure 6).

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Table 1. Summary of biological data and samples collected during the 2013 JARPN II coastal survey off Sanriku.

Samples and data	Number of animals		
	Male	Female	Total
Body length and sex	17	17	34
External body proportion	17	17	34
Photographic record and external character	17	17	34
Diatom film record	17	17	34
Body scar record	17	17	34
Measurements of blubber thickness (5 points)	17	17	34
Detailed measurements of blubber thickness (11 points)	0	1	1
Whole body weight	17	17	34
Body weight by parts	0	1	1
Skin tissues for DNA study	17	17	34
Muscle, liver, kidney, spleen, blubber, heart and ventral groove for various analysis	17	17	34
Urine for various analysis	5	5	10
Muscle, liver, kidney, and blubber for heavy metal analysis	17	17	34
Muscle, liver, kidney, and blubber for organochlorine analysis	17	17	34
Collection of blood plasma	13	12	25
Muscle and vertebra for lipid analysis	0	1	1
Mammary gland; lactation status, measurement and histological sample	-	17	17
Uterine horn; measurements and endometrium sample	-	17	17
Collection of Ovary	-	17	17
Photographic record of fetus	0	0	0
Fetal length and weight	0	0	0
External measurement of fetus	0	0	0
Muscle, liver, kidney, heart, blubber and skin tissues of fetus	0	0	0
Collection of fetus	0	0	0
Testis and epididymis; weight and histological sample	17	-	17
Stomach contents, convenient record	17	17	34
Volume and weight of stomach content in each compartment	17	17	34
Observation of marine debris in stomach	17	17	34
Collection of stomach contents for feeding study	6	11	17
Record of external parasites	17	17	34
Earplug for age determination	17	17	34
Eye lens for age determination	17	17	34
Largest baleen plate for morphologic study and age determination	17	17	34
Baleen plate measurements (length and breadth)	17	17	34
Photographic record of baleen plate series	17	17	34
Length of baleen series	17	17	34
Vertebral epiphyses sample	2	1	3
Number of ribs	17	17	34
Skull measurement (length and breadth)	17	17	34
Skull measurement (43 points)	7	2	9
Measurements of flipper pigment	10	13	23
Collection and measurement of pelvic bone	5	2	7

Table 2. Searching days, hours and distances by four sampling vessels in the 2013 JARPN II coastal surveys off Sanriku

		Sampling vessels*				Total
		28T	08K	07K	51S	
Total	Days	28	28	28	28	112
	Hours	173.5	187.9	164.9	183.0	709.3
	Distance(n. mile)	1,828.1	1,885.3	1,601.7	1,873.2	7,188.3

* 28T: *Taisho Maru* No.28; 08K: *Kouei Maru* No.8; 07K: *Katsu Maru* No.7, 51S: *Sumitomo Maru* No.51.

Table 3. List of searching effort and number of sightings made by four sampling vessels in the 2013 JARPN II coastal surveys off Sanriku

Area	Searching distance (n.miles)	Species	Primary		Secondary		Total	
			Sch.	Ind.	Sch.	Ind.	Sch.	Ind.
Area 1	5290.4	Common minke whale	50	50	5	5	55	55
		Like minke whale	24	24	1	1	25	25
		Humpback whale	31	34	0	0	31	34
Areas 2 and 3	1897.9	Common minke whale	4	4	0	0	4	4
		Like minke whale	4	4	0	0	4	4
		Humpback whale	13	15	0	0	13	15
Total	7188.3	Common minke whale	54	54	5	5	59	59
		Like minke whale	28	28	1	1	29	29
		Humpback whale	44	49	0	0	44	49

Table 4. Density index of common minke whales in the 2013 JARPN II coastal survey off Sanriku

Area	SPUE* ¹	DI* ²
Area 1	0.095	0.95
Areas 2 and 3	0.022	0.21
Total	0.076	0.75

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

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

Table 5. Body length (m) of common minke whales collected during the 2013 JARPN II coastal survey off Sanriku

Area	Male					Female				
	mean	S.D.	Min.	Max.	n	mean	S.D.	Min.	Max.	n
Area 1	4.69	0.69	3.70	5.73	15	5.21	0.60	3.84	6.14	17
Areas 2 and 3	7.52	0.13	7.39	7.64	2	-	-	-	-	-
Total	5.02	1.12	3.70	7.64	17	5.21	0.60	3.84	6.14	0

Table 6. Sex and sexual maturity status of common minke whales collected by the 2013 JARPN II coastal survey off Sanriku

Area	Male				Female					
	Im	M	Total	Maturity (%)	Im.	R	P	P&L	Total	Maturity (%)
Area 1	15	0	15	0.0	17	0	0	0	17	0.0
Areas 2 and 3	0	2	2	100.0	0	0	0	0	0	0.0
Total	27	2	17	11.8	17	0	0	0	17	0.0

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

Table 7. Prey species found in forestomach of common minke whales collected by the 2013 JARPN II coastal survey off Sanriku (animals with broken stomach were removed)

Area	No. of whales observed	Prey species				
		Sand lance (adult)	Sand lance (juvenile)	Japanese anchovy	Empty	
Area 1	22	Number	6	12	2	2
		Occurrence (%)	27.3	54.5	9.1	9.1
Areas 2 and 3	2	Number	0	0	2	0
		Occurrence (%)	0	0	100	0
Total	24	Number	6	12	4	2
		Occurrence (%)	25.0	50.0	16.7	8.3

Table 8. Weight (kg) of forestomach content of common minke whales collected by the 2013 JARPN II coastal survey off Sanriku

Area		Prey species		
		Sand lance (adult)	Sand lance (juvenile)	Japanese anchovy
Area 1	average	9.87	6.90	2.11
	range	1.15-24.27	0.18-36.25	0.6-3.62
Areas 2 and 3	average	-	-	47.37
	range	-	-	35.97-58.77
Total	average	9.87	6.90	24.74
	range	1.15-24.27	0.18-36.25	0.6-58.77

Table 9. The comparison among the indice related to sampling of common minke whales during from 2003 to 2013 in JARPN II surveys.

Year	Number of sampled whales	Searching distance (n.miles)	Operating rate*	Number of sightings				Dnsity Index (sch./100 n.mile)	Sampling efficiency ratio**	Fisheries catch (t) of adult sandlances in Miyagi pref. in April
				Primary		Total				
				Sch.	Ind.	Sch.	Ind.			
2003	50	3,834	0.72	157	161	184	188	4.09	0.27	1,772
2004										2,944
2005	60	5,246	0.66	168	171	202	205	3.20	0.29	977
2006	60	6,340	0.72	116	118	139	143	1.83	0.42	2,026
2007	57	7,794	0.63	149	153	166	171	1.91	0.33	1,595
2008	60	5,276	0.69	83	85	94	96	1.57	0.63	993
2009	60	4,756	0.57	99	100	111	112	2.08	0.54	1,265
2010	45	8,957	0.64	59	59	62	62	0.66	0.73	319
2011										1,052
2012	60	6,488	0.62	88	90	95	97	1.36	0.62	1,056
2013	34	7,188	0.60	54	54	59	59	0.75	0.58	664

*: Actural survey days/ Total surveys

** : Number of sampled whales / number of total sighting whales

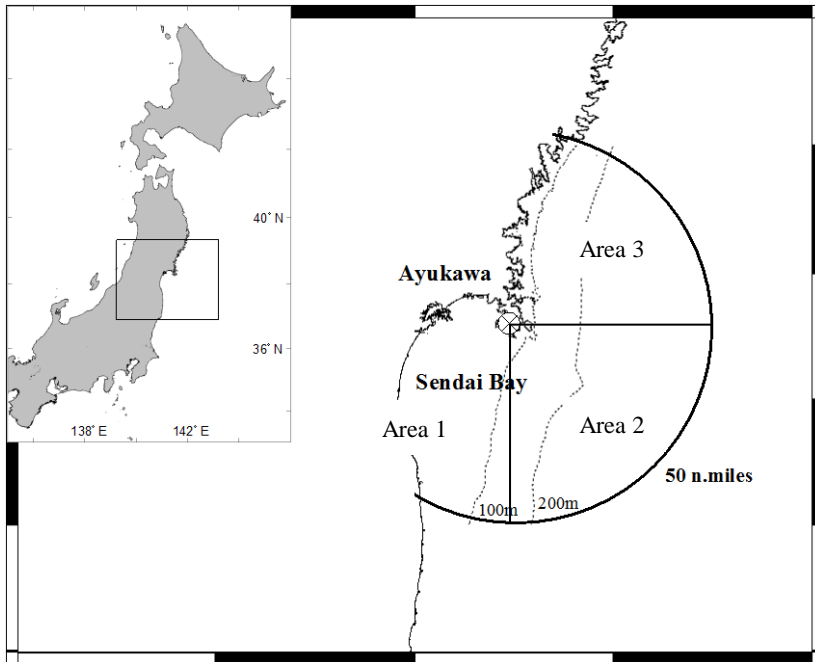


Figure 1. Research area of the 2013 JARPN II coastal survey off Sanriku

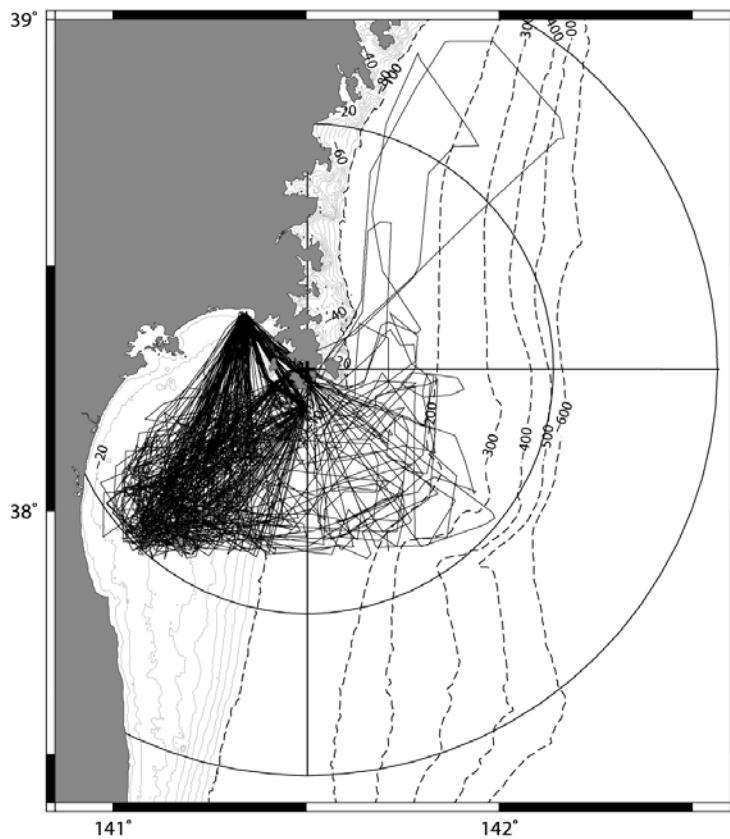


Figure 2. Cruise tracks by four sampling vessels in the 2013 JARPN II coastal survey off Sanriku

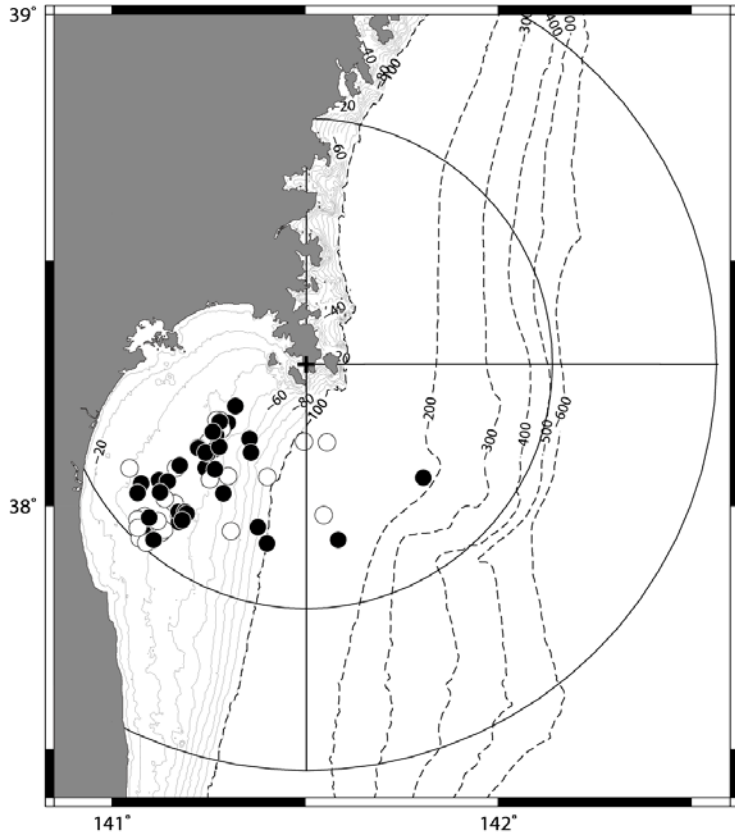


Figure 3. Sighting positions of common minke whales in the 2013 JARPN II coastal survey off Sanriku (●:sighting and sampled; ○: only sighting)

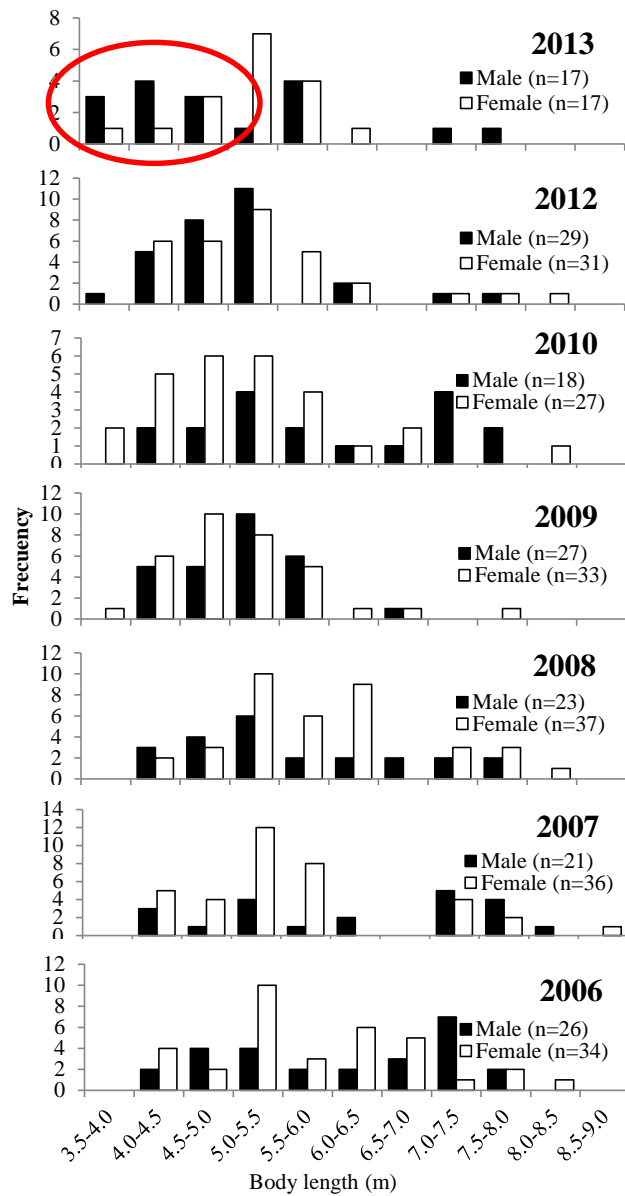


Figure 4. Frequency of body length of common minke whales sampled in the 2013 JARPN II coastal survey off Sanriku by sex

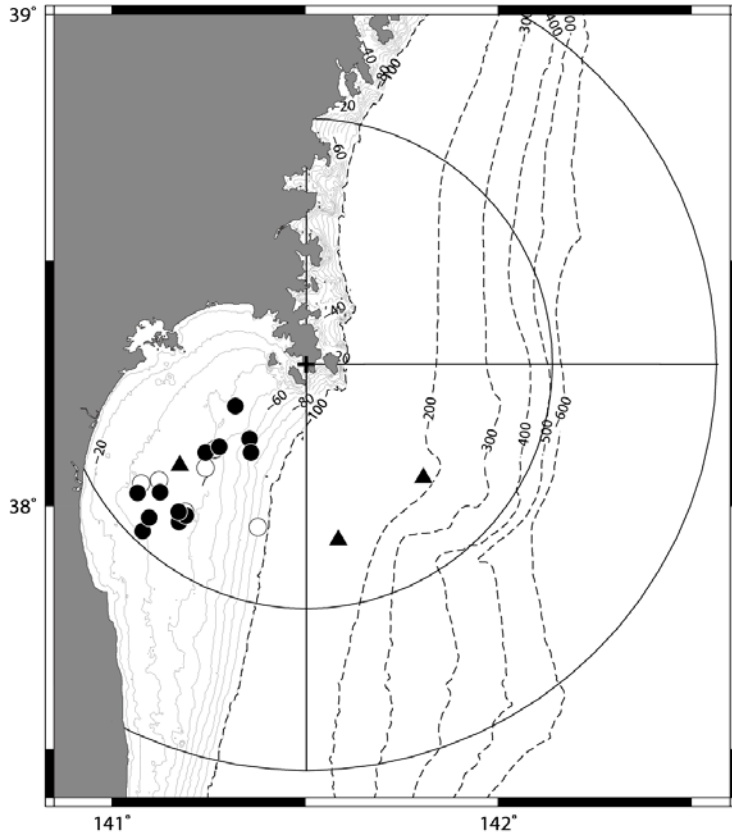


Figure 5. Sighting position of common minke whales sampled in the 2013 JARPN II coastal survey off Sanriku by major prey species. (○: adult of Japanese sand lance; ●: juvenile of Japanese sand lance; ▲: Japanese anchovy)

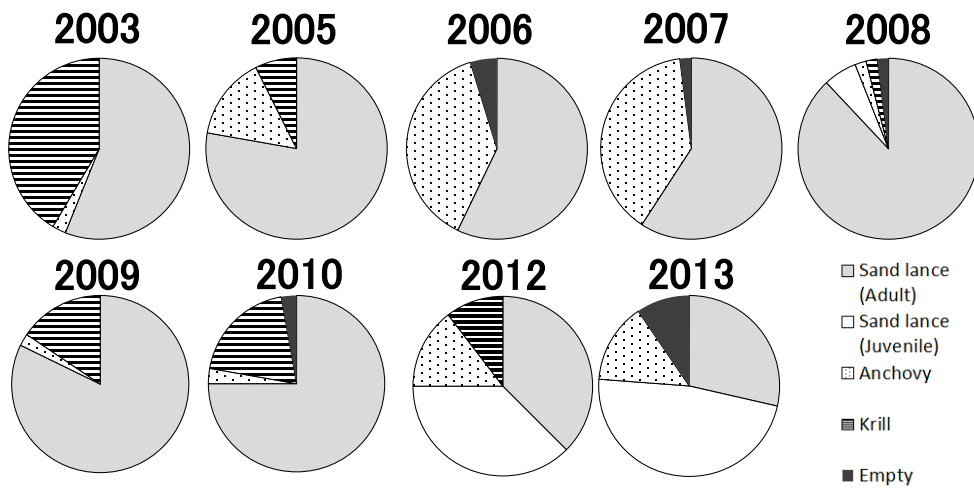


Figure 6. Occurrence composition of prey items found in foreguts of common minke whales sampled in the JARPN II coastal surveys off Sanriku during a period of 2003 and 2013.

Appendix

Report of the coastal prey species survey off Sanriku in 2013

Takeshi Onodera¹⁾ and Genta Yasunaga²⁾

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

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

ABSTRACT

A prey species survey was conducted in the coastal region off Sanriku, northeastern Japan in spring 2010 as a part of JARPNII coastal component off Sanriku. The survey was conducted concurrently with a sampling survey of common minke whales. The survey was conducted in April (16 - 24April) and May (21- 23May). Four stratified blocks (A, B, C and D Survey Blocks) were surveyed in April and two blocks (B and C Survey Blocks) were surveyed in May. 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 8 stations to identify species and body 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 designed 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 study feeding ecology of cetaceans and ecosystem studies, involving studies of prey consumption by cetaceans, prey preference of cetaceans and ecosystem modeling. To accomplish the goal, a sampling survey of common minke whales (*Balaenoptera acutorostrata*) and a survey on biomass estimation of their prey species have been conducted concurrently off Sanriku, Japan as the JARPNII coast component since 2003, except for 2011 when the Great East Japan Earthquake affected greatly the region.

In this document the results of the prey species survey off Sanriku in 2013 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 bottom depths between 20 m and 200 m from 37° 54' N to 38° 40' 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 echo-sounder data. Four survey blocks (A-D) was set in 2013. Three blocks (E, F and G) could not conduct the survey due to logistical reason (Fig 1). 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 and Fukushima nuclear accident, only 4 blocks (A, B, C and D) were surveyed in April, only 2 blocks (B, C,) were surveyed in May in 2013 (Fig. 1). A zigzag track line was set in each block. The waypoints of planned tracklines in each block were shown in Table 1.

The survey was conducted in April (16 - 24 April) and May (21 - 23 May). Same blocks and tracklines were surveyed in April and May to see whether occurrence patterns of prey species were different between the months. 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, Australia). A calibration was carried out in the survey area on 15 April and on 20 May 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 8 stations. A summary of the midwater trawl samplings was shown in Table 2. CTD casts were conducted at 33 stations. Occurrences of prey species were different between April and May. In April, backscatterings of juvenile sand lance and krill were observed while these of adult sand lance and Japanese anchovy were rarely observed. In May, number of backscatterings of Japanese anchovy was increased. Backscatterings of juvenile sand lance, adult sand lance and krill were also observed in May. 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-Mar*”, Mr. Tatsuo Kanomata, 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 Association for Community-Based Whaling. We thank these institutions for their support.

REFERENCES

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Table 1. Waypoints and planed lines

Block A

Waypoint	Latitude				Longitude				Course (degree)	Distance (n.mile)
A1	38	-	15.0	N	141	-	50.5	E	308	13.0
A2	38	-	23.0	N	141	-	37.5	E	57	12.7
A3	38	-	30.0	N	141	-	51.0	E	302	13.3
A4	38	-	37.0	N	141	-	36.5	E	76	12.1
A5	38	-	40.0	N	141	-	51.5	E	-	-
									Total	51.1

Block B

Waypoint	Latitude				Longitude				Course (degree)	Distance (n.mile)
B1	37	-	54.0	N	141	-	00.5	E	75	9.4
B2	37	-	56.5	N	141	-	12.0	E	296	12.7
B3	38	-	02.0	N	140	-	57.5	E	72	15.8
B4	38	-	07.0	N	141	-	16.5	E	299	12.5
B5	38	-	13.0	N	141	-	02.5	E	78	14.9
B6	38	-	16.0	N	141	-	21.0	E	356	5.5
B7	38	-	21.5	N	141	-	20.5	E	-	-
									Total	70.8

Block C

Waypoint	Latitude				Longitude				Course (degree)	Distance (n.mile)
C1	38	-	15.0	N	141	-	32.5	E	169	2.0
C2	38	-	13.0	N	141	-	33.0	E	252	13.2
C3	38	-	09.0	N	141	-	17.0	E	116	9.2
C4	38	-	05.0	N	141	-	27.5	E	247	10.3
C5	38	-	01.0	N	141	-	15.5	E	118	8.5
C6	37	-	57.0	N	141	-	25.0	E	180	3.0
C7	37	-	54.0	N	141	-	12.5	E	-	-
									Total	46.2

Block D

Waypoint	Latitude				Longitude				Course (degree)	Distance (n.mile)
D1	38	-	15.0	N	141	-	50.5	E	258	14.1
D2	38	-	12.0	N	141	-	33.0	E	119	16.3
D3	38	-	04.0	N	141	-	51.0	E	249	22.0
D4	37	-	56.0	N	141	-	25.0	E	99	12.8
D5	37	-	54.0	N	141	-	41.0	E	-	-
									Total	65.2

Table 2. A summary of the trawl sampling

Station	St-1	St-2	St-3	St-4	St-5	St-6	
Block	B	B	B	B	C	C	
Date	16 Apr.	16 Apr.	18 Apr.	18 Apr.	20 Apr.	20 Apr.	
Time	8:40	11:01	11:17	13:38	8:35	13:16	
Latitude	38-14N	38-10N	38-03N	37-57N	38-11N	37-58N	
Longitude	141-15E	141-09E	141-01E	141-09E	141-28E	141-21E	
Temp (°C) by depth	0 m	8.9	9.0	9.2	9.9	8.3	8.7
	10 m	8.4	8.1	8.3	9.7	8.0	8.4
	20 m	8.2	7.6	7.9	9.6	7.6	7.8
	30 m	7.7			8.2	6.6	6.6
	40 m					7.0	6.8
	50 m					7.0	7.0
	75 m						6.8
	100 m						
	Bottom (m)	7.7 (37m)	7.6 (28m)	7.9 (21m)	8.2 (32m)	6.5 (70m)	6.4 (82m)
Trawl sampling depth (m)	25-35	10-20	15-20	10-15	70	60	
Major sampled species	Sand lance (juvenile)	Sand lance (juvenile)	Sand lance (juvenile)	Sand lance (juvenile)	<i>Maurolicus japonicus</i>	Krill	

Station	St-7	St-8				
Block	D	B				
Date	23 Apr.	21 May.				
Time	13:31	11:02				
Latitude	37-59N	38-10N				
Longitude	141-34E	141-09E				
Temp (°C) by depth	0 m	8.8	16.4			
	10 m	8.6	11.4			
	20 m	8.5	10.3			
	30 m	9.5				
	40 m	6.0				
	50 m	4.5				
	75 m	6.0				
	100 m	6.2				
	Bottom (m)	6.0 (136m)	8.5 (27m)			
Trawl sampling depth (m)	20-60	20-25				
Major sampled species	Krill	Jelly fish				

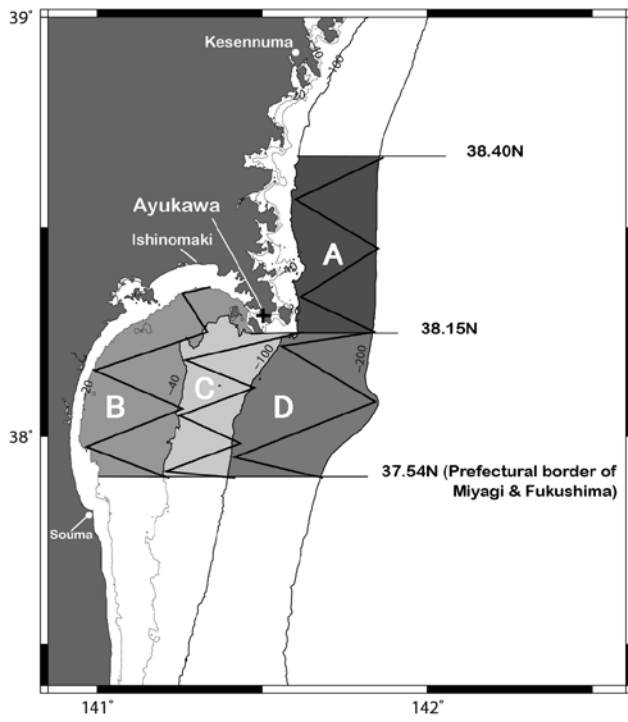


Fig. 1. Survey Blocks and planned tracklines in 2013