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Toshihiro Mogoe, Takeharu Bando, Nobuyuki Ito, Gen  
Nakamura, Hisoka Hiruda, Hiroyuki Oikawa, Tatsuya  
Isoda, Saeko Kumagai, Hitomi Sato, Nagisa  
Sakamoto, Naoko Miyagawa, Megumi Takahashi, Aiko  
Fukumoto, Masayoshi Ota, Yusuke Furuyama, Ayumi  
Hirose



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TOSHIHIRO MOGOE<sup>1</sup>, TAKEHARU BANDO<sup>1</sup>, NOBUYUKI ITO<sup>2</sup>, GEN NAKAMURA<sup>1</sup>, HISOKA HIRUDA<sup>2</sup>, HIROYUKI OIKAWA<sup>1</sup>, TATSUYA ISODA<sup>1</sup>, SAEKO KUMAGAI<sup>2</sup>, HITOMI SATO<sup>2</sup>, NAGISA SAKAMOTO<sup>2</sup>, NAOKO MIYAGAWA<sup>3</sup>, MEGUMI TAKAHASHI<sup>3</sup>, AIKO FUKUMOTO<sup>3</sup>, MASAYOSHI OTA<sup>3</sup>, YUSUKE FURUYAMA<sup>3</sup>, AYUMI HIROSE<sup>3</sup>, KOUICHIRO KATO<sup>3</sup>, RYOUTARO HAYASHI<sup>3</sup>, KOUHEI YOSHII<sup>3</sup>, HIDEYOSHI YOSHIDA<sup>4</sup>, AND HIDEHIRO KATO<sup>3</sup>

<sup>1</sup>The Institute of Cetacean Research, 4-5 Toyomi-cho, Chuo-ku, Tokyo, 104-0055, Japan

<sup>2</sup>Association for Community-Based Whaling, Hakata-Eki-Higashi, Hakata-ku, Fukuoka 812-0013, Japan

<sup>3</sup>Tokyo University of Marine Science and Technology, 4-5-7 Konan, Minato-ku, Tokyo 108-0075, Japan

<sup>4</sup>National Research Institute of Far Seas Fisheries, 2-12-4 Fukuura, Yokohama, Kanagawa, 236-8648, Japan

## ABSTRACT

This paper reported the outline of the Japanese whale research program under special permit in the western North Pacific (JARPN II) in 2014 coastal component off Sanriku. This survey was carried out on the Pacific coast of Japan (the sub-area 7CS) from 26 April to 11 June 2014. Research was set in coastal waters within 50n.miles from the Ayukawa Port in Miyagi Prefecture in the Sanriku district of Japan using four small-type whaling catcher boats as sampling vessels, and all whales sampled were landed on the land research station in Ayukawa. During the survey, a total of 5745.1n.miles (571.1 hours) was surveyed, the 51 schools (51 individuals) of common minke whales were detected and 30 animals were caught. Average body length of the sampled animals was 5.92m (SD=1.11) for males, and 5.78m (SD=1.10) for females. Dominant prey species found in the forestomach were adult sand lance (58.6%), followed by Japanese sardine (13.8%), juvenile sand lance (10.3%), krill (10.3%), and mackerels (6.9%). Among the five prey species observed in this survey, Japanese sardine and mackerels were the first observation in the JARPN II off Sanriku surveys.

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

## BACKGROUND

The full-scale survey of the JARPN II started in 2002, after conducting two year feasibility studies in 2000 and 2001 (Government of Japan, 2002). The objectives of the full-scale research are: i) to study on feeding ecology and ecosystem studies, involving studies of prey consumption by cetaceans, prey preferences of cetaceans and ecosystem modelling; ii) to monitor environmental pollutants; iii) to study on stock structure, particularly for minke whales. Target species are common minke whale (*Balaenoptera acutorostrata*), Bryde's whale (*Balaenoptera edeni*), sei whale (*Balaenoptera borealis*) and sperm whale (*Physeter macrocephalus*). In the full JARPN II plan, the coastal survey component was implemented as a first two-year feasibility study to conduct in 2002 and 2003 (Government of Japan, 2004). Coastal research is conducted by small type whaling catcher boats and has features that cover the temporal and spatial gap, which could not be covered by the *Nisshin Maru* unit. After the two years feasibility survey, the coastal component of JARPN II was revised to be conducted twice a year in spring and autumn. The first revised survey was carried out at off Kushiro in autumn of 2004 (Kishiro *et al.*, 2005). Target species of the coastal component were set at 120 common minke whales (60 common minke whales will be sampled in each season).

The results of these coastal survey has revealed that common minke whales consume various prey species. In the off Kushiro survey, krill (*Euphausia pacifica*), Japanese anchovy (*Engraulis japonicus*), Pacific saury (*Cololabis saira*), walleye pollock (*Theragra chalcogramma*) and Japanese flying squid (*Todarodes pacificus*) were consumed by the common minke whales. On the other hand, krill (*Euphausia pacifica*), Japanese sand lance (*Ammodytes personatus*) and Japanese anchovy (*Engraulis japonicus*) were consumed by whales in the off Sanriku area (Tamura *et al.*, 2009). The findings of different prey species in different year or places suggest the plasticity of prey preference on common minke whales in the coastal area of Japan.

Following the March 31, 2014 Judgment of the International Court of Justice (ICJ) in the case Whaling in the Antarctic (Australia v. Japan: New Zealand intervening), the Government of Japan voluntarily reviewed the state of JARPN II. Overall research objectives, the research area and research methodology remain the same as those specified in the original JARPN II research plan (SC/56/O1). This voluntary review resulted in the reprioritization of research focus as well as recalculation of sample sizes. The survey concentrated on the study of interactions between whales and fisheries in the coastal area and interactions among whale species in the offshore area as well as a contribution to the management of whales. Sampling of sperm and minke whales in offshore component was suspended because their role in the study of interactions between whales and fisheries in the coastal waters seemed to be limited. Sei whale sample size of 100 (as in the original plan) of which 10 were studied using only non-lethal methods. Bryde's whale sample size of 50 (as in the original plan) of which 25 were studied using only non-lethal methods. A larger number of Bryde's whales were allocated to non-lethal methods because they were better studied than sei whales through the Comprehensive Assessment and the Implementation Review. In coastal component, Minke whale sample size of 114 (57 in each of the spring and autumn season as recalculated with the latest information) of which 12 (6 in each of the periods) were studied using only non-lethal means. A study for verifying the feasibility of using non-lethal methods was carried out.

This paper reported the outline of the JARPN II coastal component off Sanriku survey conducted during the period from 26 April to 11 June 2014, using four small-type whaling catcher boats as sampling vessels in the northeast of Japan (the sub-area 7CS).

## RESEARCH METHODS

### Research area

The research sector was set in the coastal waters off Sanriku, within the 50n.miles from the Ayukawa port, which was same as the previous surveys (Yasunaga *et al.*, 2014). This sector is included in the middle part of the sub-area 7CS of the revised sub areas for the implementation review for western North Pacific common minke whales (IWC, 2012). Research area was divided into 3 sectors. Because of logistical constraint and the accident at the Fukushima nuclear power stations, the southern boundary line of the research area was set in the administrative boundary between Miyagi and Fukushima Prefecture (due east of 37.54°N from land).

### Research vessels, land station and research period

Four small-type whaling catcher boats were used as sampling vessels: *Taisho Maru* No.28 (47.3GT), *Koei Maru* No.8 (32.0GT), *Katsu Maru* No.7 (32.0GT) and *Sumitomo Maru* No.51 (30.0GT). All of the sampled whales were landed on the Ayukawa port, and biological survey and sampling was taken place on the land station (the JARPNII research station) in Ayukawa. Research period was set for 47 days, from 26 April to 11 June, 2014.

### Searching and sampling methods

Searching and sampling methods were similar to the past coastal survey off Sanriku (Yoshida *et al.*, 2004). The research head office was placed in the research station and controlled the sampling vessels during the survey. To avoid the concentration of sampling location, the research head office arbitrarily determined the searching sector and direction from the base-point for each sampling vessel every day. The vessels continued to cruise and search along the predetermined direction from the base-point until arrived at 30n.miles and then freely cruised in the waters within the research area. Sighting activities were carried out during the day and the vessels returned to port every night. Searching effort were conducted within acceptable research condition (weather, visibility and sea conditions), and placed the crew on the top barrel and upper bridge. In each vessel, one dedicated researcher was on board and recorded the cruise tracks, searching time on effort, sea weather conditions, and the species and estimated number of whales in the school when the sighting. Target species for sighting record were all baleen whales, sperm whales and killer whales. And all common minke whales sighted were targeted for sampling, except for the cow-calf pair. When a sighting consisted of more than one animal, first targeted animal was selected following the random sampling digits. 50mm explosive harpoon guns equipped with penthrite grenades were used as the primary killing method. Once a vessel caught a whale, it returned to the Ayukawa port to transport the animal to the research station. While returning to the port, other common minke whales sighted were also targeted for sampling, if the situation allowed. At the port, the sampled whale was lifted up from the vessel using wire nets and a crane and transported to the station by an 11 tons freight trailer. At that time, body weight of the whale was measured with the crane scale.

### **Practicability survey for collection of biopsy and faecal samples**

The survey for collection of biopsy and faecal samples was conducted in this survey. These result were described in SC/66a/SPxx.

### **Biological research on common minke whales**

All sampled whales were biologically examined by researchers at the research station. Research items of the biological studies are summarized in Table 3. These items are related to studies on feeding ecology, stock structure, life history parameters and pollutions. Sexual maturity stage of female was determined by the presence of corpus luteum and/or corpus albicans in either ovary. The male sexual maturity was determined by the weight of one side of the testis (290g or more as mature).

## **RESULTS**

### **Searching effort by sampling vessels**

The cruise tracks made by the sampling vessels during the research periods are shown in Figure 1. Searching efforts were mainly covering at least south-western part of the whole research area. Table 1 shows an outline of the sighting activities. During the 47 days of predetermined survey periods, the sampling vessels conducted searching for only 19 days (40% of the predetermined days). Out of 28 days of cancellation in the research cruise, the most frequent reason was an unsuitable weather conditions, e.g., low atmospheric pressure and fog. The research engaged ratio in this survey was the lowest through the former surveys of the coastal component. During the survey, a total of 571.1 hours of searching was conducted and 5745.1n.miles was covered of effort.

### **Sightings and sampling of common minke whales**

Figure 2 showed distribution of sighted and sampled common minke whales by the sampling vessels. A total of 51 schools (51 individuals) of common minke whales consisted of 50 schools (50 individuals) of primary sighting and 1 school (1 individual) of secondly sighting, were sighted during the survey period. Density index of common minke whales was calculated as 0.87 for DI (the number of primary sightings per 100n.miles searching effort) and 0.09 for SPUE (the number of primary sighting per 1 hour searching effort). Out of 51 schools (51 individuals), 49 schools (49 individuals) were targeted for sampling and 30 individuals were sampled for biological research. Sampling efficiency (the rate of successful sampling for targeted whales) was 0.61. In the sampling process, there was no struck and lost animals.

### **Sighting of other large whales**

Two species of baleen whales excluding common minke whales, and one toothed whales were identified during the research period. Figure 3 plotted sighting position of humpback, fin and unknown large whales, and Table 2 showed the number of sightings for these 4 species including common minke whales during the survey. Humpback whales were distributed widely along the 100m depth contour line. Five schools/ five individuals of fin whales were confirmed in less than 20n.miles from Ayukawa port.

### **Sex ratio, body length and maturity of common minke whales caught**

Thirty sampled whales were consisted of 16 males and 14 females (sex ratio of males was 0.53). Body length of sampled whales was summarized in Table 4. Average body length of the whales were 5.92m (min=4.10m, max=7.65m, SD=1.11m) for males, and 5.78m (min=4.15m, max=8.09m, SD=1.10m) for females. Immature whales ranged from 4.10m to 7.53m (4.10-7.53m in males, 4.15-6.45m in females). Mature whales ranged from 7.07m to 8.09m (7.07-7.65m in males, 7.70-8.09m in female respectively). Table 5 summarised reproductive status of common minke whales sampled. Two whales were pregnant and they had singleton fetuses. Body length of each foetus was less than 10cm (sex unknown) and 205cm (female), respectively.

### **Prey species of common minke whale found in the stomach**

The weight of stomach contents was obtained by the same methods used in the offshore component of the JARPN II. Stomach contents were weighted to the nearest 0.1kg by each of four chambers including and excluding liquid

(Fujise *et al.*, 2002). The weight of stomach contents including liquid in forestomach ranged from between 0.0kg and 47.3kg, and average weight was 13.8kg (0.54% of body weight; Figure 5). Table 6 provides the composition of the dominant prey species obtained from forestomach contents in common minke whales. Four prey species were confirmed in the stomach contents of 29 individuals from 30 samples, and dominant prey species was adult sand lance (58.6%), followed by Japanese sardine (13.8%), juvenile sand lance (10.3%), krill (10.3%) and mackerels (6.9%). Japanese sardine and mackerels were firstly recorded as dominant prey species of common minke whales sampled in the JARPN II survey off Sanriku.

### Observation of marine debris

Marine debris was detected from stomach of 2 matured animals. Ingested debris were two pieces of wood and a piece of plastic. No whale entanglement in fishing gear was recognized by the observation from the body surface of all sampled animals.

## DISCUSSIONS

The JARPN II coastal component off Sanriku in the spring season of 2014 was conducted using the small-type whaling catcher boats. This report provided the continued data of biological study in the coastal region off Sanriku. By restoring and re-establishment of the infrastructure at the port of Ayukawa from the extensive damage caused by the great East Japan earthquake on 11 March 2011, we could use the port as a home port as before. The sampling vessels conducted the research for 19 days (40.0%) out of 47 days of total survey period. The ratio of research days was the lowest in those of the off Sanriku surveys so far. On the whole, the poor weather conditions such as heavy strong winds or poor visibility reduced sighting efforts. Although the composition and distribution of whale species were similar to the previous survey, the low value of the DI for common minke whales was seen. Although DI was not so large, dense distribution area of common minke whales was formed in the Sendai Bay same as the past surveys. For the reason that all vessels have investigated the same area every day, sighting record is probably including some duplicated sightings.

In this survey, mean body length of sampled whales was larger than that of the recent 5 years. These differences were considered that the difference in migration timing between mature and immature whales. A characteristic of the biological observation in the present survey is the case that a large foetus (205.5cm in body length) found in the coast of Sanriku. In the past survey off Sanriku, the largest body length of foetus in the previous survey was 223.0cm in body length sampled in 2005. Kato (1992) suggested difference of conception date between Sea of Japan (J-stock) and North Pacific and Okhotsk Sea (O-stock) stocks of common minke whales. These large foetuses collected in spring season would indicate mixing of these stocks.

Figure 4 shows the composition of prey species of common minke whales off Sanriku during the seasons 2003–2014. Krill and anchovy changed the appearance rate, although the dominant prey species remained as sand lance. In recent years, juvenile sand lance (less than 10cm) newly appeared as prey species of common minke whales. In 2014, Japanese sardine and mackerels were found firstly as prey species of common minke whales. Both species were dominant prey species of common minke whales in the areas around Japan during commercial whaling period, which were from 1960s to late 1980s (Kasamatsu and Tanaka, 1992).

This report provided the continued data of biological and ecological information of common minke whales in the off Sanriku region.

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Table 1

Summary of search effort (hours and distances) conducted during the 2014 JARPN II coastal component off Sanriku.

	sampling vessels				Total
	28T	08K	07K	51S	
Days	19	19	19	19	76
Hours	151.0	135.4	145.5	139.2	571.1
Distance(n.miles)	1522.0	1353.2	1420.2	1449.6	5745.1

Density index of common minke whales was 0.87 for DI (the number of primary sighted schools per 100n. miles) and 0.09 for SPUE (the number of primary sighted schools per 1 hour searching).

Table 2

Summary of whale sightings conducted by sampling vessels in whole research area.

Species	Primary		Secondary		Total	
	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.
First half period (26 Apr - 18 May)						
common minke whale	33	33	1	1	34	34
like minke whale	18	18	2	2	20	20
fin whale	2	2	0	0	2	2
humpback whale	25	29	1	2	26	31
unknown large whale	1	1	0	0	1	1
Second half period (19 May - 11 Jun)						
common minke whale	17	17	0	0	17	17
like minke whale	12	12	1	1	13	13
fin whale	3	3	0	0	3	3
humpback whale	16	19	0	0	16	19
unknown large whale	2	2	0	0	2	2
Total						
common minke whale	50	50	1	1	51	51
like minke whale	30	30	3	3	33	33
fin whale	5	5	0	0	5	5
humpback whale	41	48	1	2	42	50
unknown large whale	3	3	0	0	3	3

Table 3

Summary of biological data and samples collected in the 2014 JARPN II coastal survey off Sanriku.

Samples and data	Number of animals		
	Male	Female	Total
Body length and sex	16	14	30
External body proportion	16	14	30
Photographic record and external body character	16	14	30
Diatom film record	16	14	30
Body scar record	16	14	30
Measurements of blubber thickness (5 points)	16	14	30
Whole body weight	16	14	30
Skin tissues for DNA study	16	14	30
Muscle, liver, kidney, spleen, blubber, heart and ventral groove for various analysis	16	14	30
Urine for various analysis	16	14	30
Muscle, liver, kidney, and blubber for heavy metal analysis	16	14	30
Muscle, liver, kidney and blubber for organochlorine analysis	16	14	30
Collection of blood plasma	15	8	23
Mammary gland; lactation status, measurement and histological sample	-	14	14
Uterine horn; measurements and endometrium sample	-	14	14
Collection of Ovary	-	14	14
Photographic record of foetus	-	-	2*
Foetal length and weight	-	-	2*
Skin tissues for DNA study of foetus	-	-	1
External measurement of foetus	-	-	1
Muscle, liver, kidney, heart, blubber and skin tissues of foetus	-	-	1
Eye lens of foetus for age determination	-	-	1
Collection of foetus	-	-	2*
Testis and epididymis; weight and histological sample	16	-	16
Stomach contents, convenient record	16	14	30
Volume and weight of stomach content in each compartment	16	14	30
Observation of marine debris in stomach	16	14	30
Collection of stomach contents for feeding study	15	11	26
Record of external parasites	16	14	30
Earplug for age determination	15	14	29
Eye lens for age determination	16	14	30
Largest baleen plate for morphologic study and age determination	1	2	3
Baleen plate measurements (length and breadth)	16	14	30
Photographic record of baleen plate series	16	14	30
Length of baleen series	16	14	30
Vertebral epiphyses sample	6	4	10
Number of ribs	16	14	30
Skull measurement (length and breadth)	16	14	30
Skull measurement (detail)	0	3**	3**
Measurement of the skull around nasal bone	15	13**	28**
Content of large intestine	1	2	3
Measurement and sampling of pelvic bone	0	2**	2**
External measurement of nostril	16	14**	30**
Measurement of flipper white patch	16	14**	30**

\*: including a foetus of sex unidentified; \*\*: including one female foetus.



Table 4

Mean body length of common minke whales sampled in 2014 JARPN II coastal component off Sanriku.

Period	Male					Female				
	Mean	SD	Min	Max	N	Mean	SD	Min	Max	N
First half period (26 Apr - 18 May)	5.78	0.78	4.89	7.10	6	5.64	0.99	4.15	8.09	13
Second half period (19 May - 11 Jun)	6.01	1.31	4.10	7.65	10	7.70		7.70	7.70	1
Total	5.92	1.11	4.1	7.65	16	5.78	1.1	4.15	8.09	14

Table 5

Reproductive status of common minke whales sampled in 2014 JARPN II coastal component off Sanriku.

Period	Male				Femal					Sex ratio (% males)
	Imm	Mat	Total	Maturity (%)	Imm	Mat (Preg)	Total	Pregnancy (%)	Maturity (%)	
First half period (26 Apr - 18 May)	5	1	6	16.7	12	1 (1)	13	100.0	7.7	31.6
Second half period (19 May - 11 Jun)	7	3	10	30.0	0	1 (1)	1	100.0	100.0	90.9
Total	12	4	16	25.0	12	2 (2)	14	100	14.3	53.3

Imm: Immature; Mat: Mature; Preg: Pregnant

Table 6

Number of common minke whales of major prey species found in their forestomach contents sampled by the 2014 JARPN II coastal component off Sanriku\*.

Period	No. of whales (%)					
	Sand lance		Krill	Mackerels	Japanese sardine	Total
	Adult	Juvenile				
First half period (26 Apr - 18 May)	14(48.3%)	3(10.3%)	0(0.0%)	1(3.4%)	0(0.0%)	18(62.1%)
Second half period (19 May - 11 Jun)	3(10.3%)	0(0.0%)	3(10.3%)	1(3.4%)	4(13.8%)	11(37.9%)
Total	17(58.6%)	3(10.3%)	3(10.3%)	2(6.9%)	4(13.8%)	29(100.0%)

\*: Excluding one animal with empty stomach.

Table 7

Weight of forestomach contents of common minke whales by the 2014 JARPN II coastal component off Sanriku\*.

Period		Sand lance		Krill	Mackerels	Japanese sardine
		Adult	Juvenile			
First half period (26 Apr - 18 May)	Average	12.48	15.6			
	Range	(0.95 - 38.75)	(12.4 - 18.60)			
Second half period (19 May - 11 Jun)	Average	5.05		11.46	13.73	25.82
	Range	(3.75 - 6.35)		(2.50 - 25.14)	(13.73)	(13.24 - 47.27)
Total	Average	11.33	15.6	11.46	13.73	25.82
	Range	(0.95 - 38.75)	(12.4 - 18.60)	(2.50 - 25.14)	(13.73)	(13.24 - 47.27)

\*: Excluding 1 animal with empty stomach and 5 animals with stomach broken by harpoon.

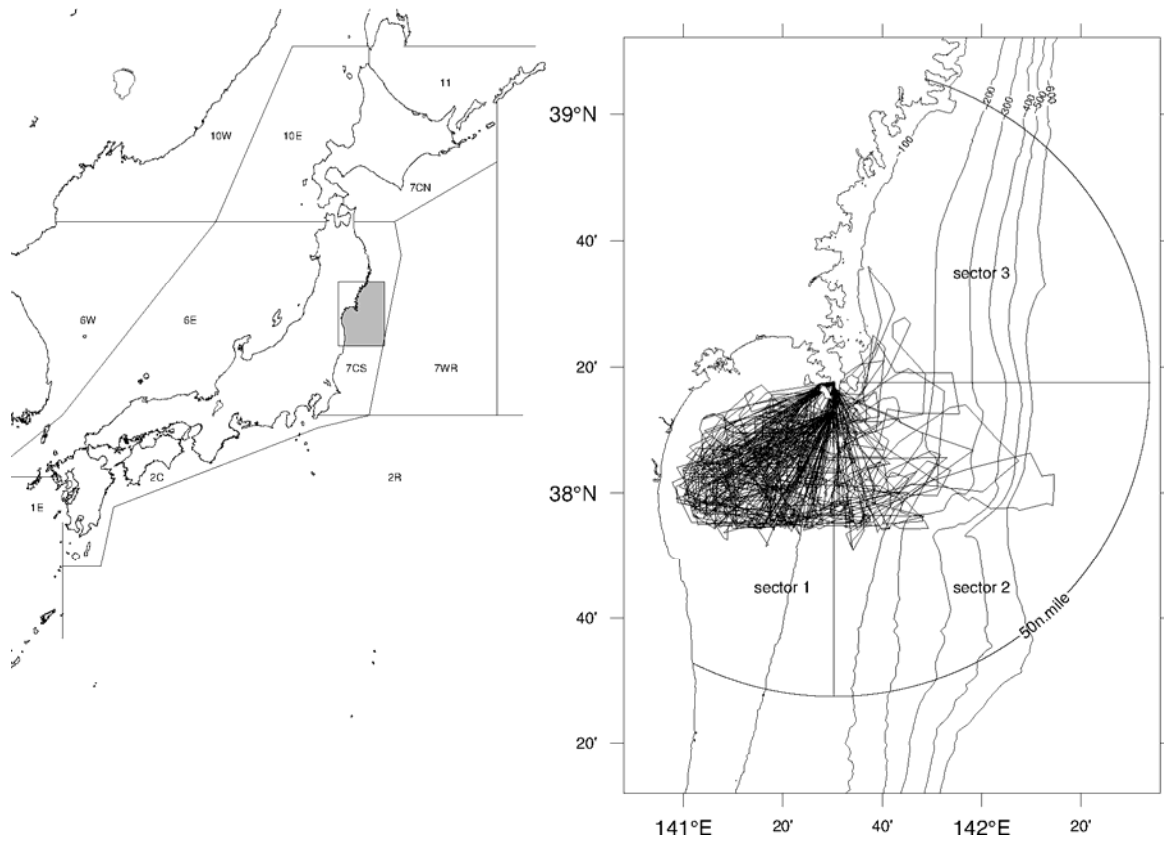


Figure 1. Geographical location of research area and track lines of four sampling vessels in 2014 JARPN II coastal component off Sanriku.

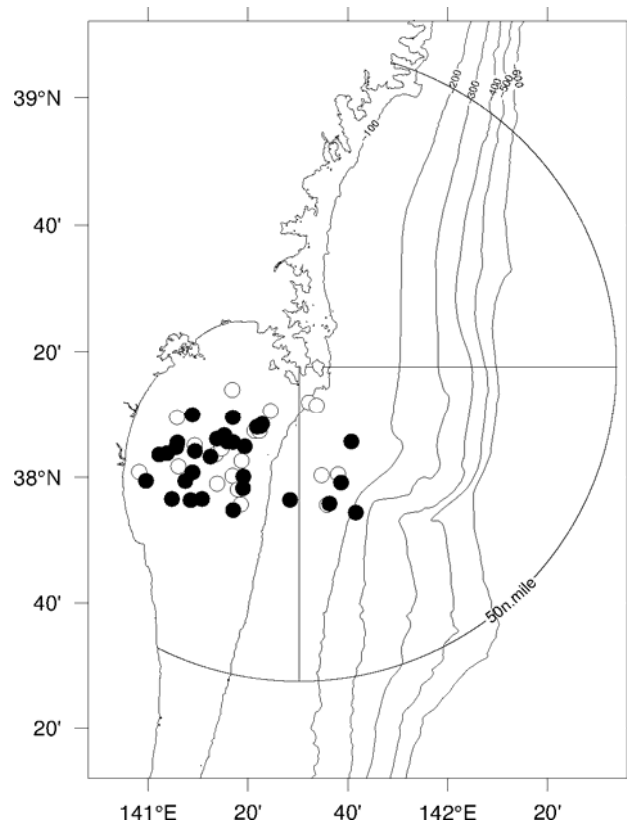


Figure 2. Distribution of all sightings of common minke whales sighted by sampling vessels in 2014 JARPN II coastal component off Sanriku. Closed circle: sighting and sampling school; open circle: only sighting school.

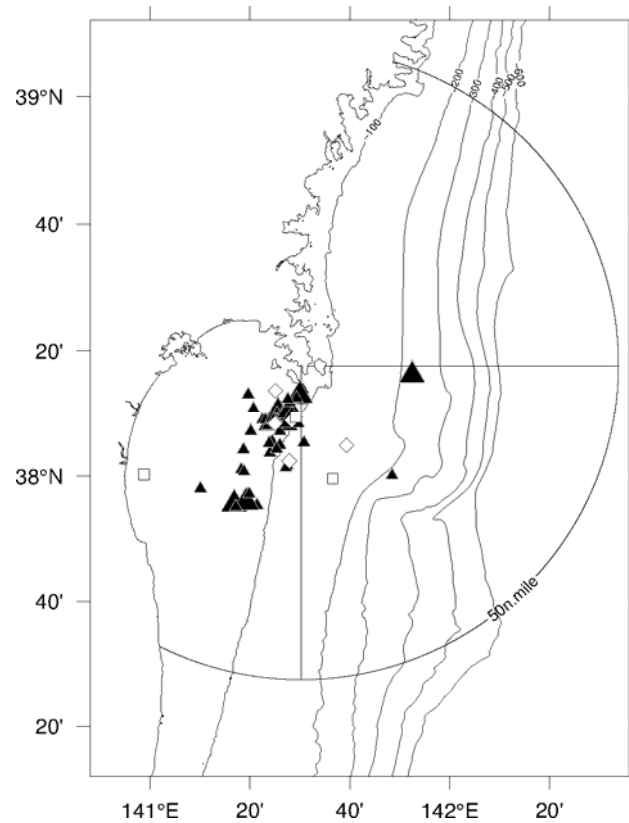


Figure 3. Distribution of all sightings of fin, humpback and unknown large whales sighted by sampling vessels in 2014 JARPN II coastal component off Sanriku. Closed triangle: humpback whales; open rhomb: fin whale; open square: unknown large whales. The size of the plot means school size (1 to 3).

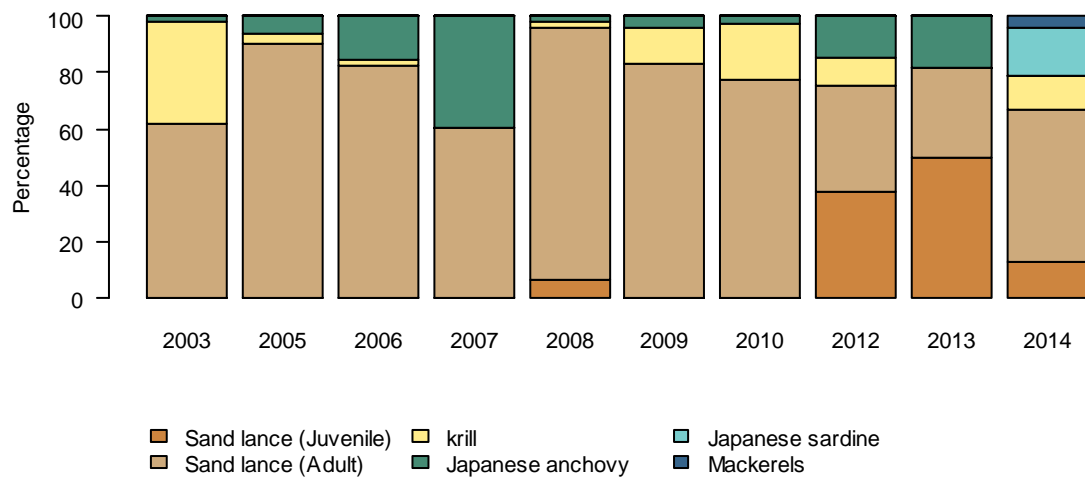


Figure 4. The yearly composition of dominant prey species which were found in the fore stomach of common minke whales in JARPN II coastal component off Sanriku during the seasons 2003–2014. Individuals which have broken fore stomach by a harpoon or have empty fore stomach were excluded from the analysis.

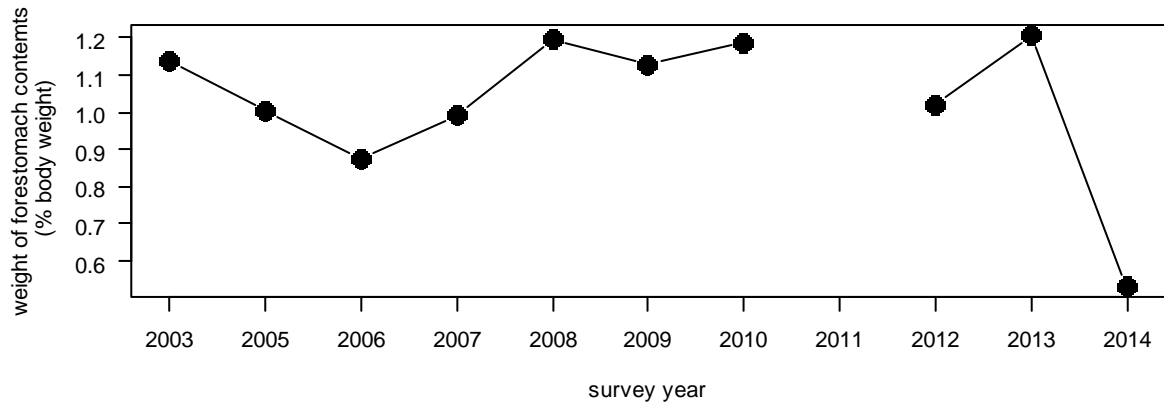


Figure 5. Yearly changes in weight of forestomach contents (% of body weight) of common minke whales during the seasons 2003–2014 in JARPN II coastal component off Sanriku. It is missing value for the great East Japan earth quake in 2011.

# Appendix

## Report of the coastal prey species survey off Sanriku in 2014

MASAKATSU INADA<sup>1</sup>, TAKEHARU BANDO<sup>2</sup> AND TOSHIHIRO MOGOE<sup>2</sup>

<sup>1</sup>Miyagi Prefecture Fisheries Technology Institute, 97-6 Sodenohama, Watanoha, Ishinomaki, Miyagi 986-2135, Japan

<sup>2</sup>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 May (7- 14May). Four stratified blocks (A, B, C and D Survey Blocks) were surveyed in May. Zigzag tracklines were set in the blocks. A trawler type RV, *Miyashio*, conducted the survey. Acoustic data were recorded continuously along tracklines by a quantitative echosounder. Samplings using a midwater bongo net were conducted at 5 stations to identify species and body size compositions of acoustic backscatterings. Vertical oceanographic conditions were recorded at 19 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 2014 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 2014. 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 May (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 May (7 - 14 May). The survey was conducted during the daytime from an hour after sunrise to an hour before sunset. Acoustic, bongo net and oceanographic surveys were conducted using a trawler-type new RV, "*Miyashio*" (Miyagi prefecture, 199 GT). Data of distribution and abundance

of the prey species were recorded by a quantitative echosounder, EK60 (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 30 April using the copper sphere technique described in EK60 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.

Bongo net sampling was conducted to identify the species and size compositions of targeting echosigns. The trawl net had a diameter of 0.7 m and a 3 mm liner cod end. Towing speed of the bongo net was 2-4 knots. Catches of bongo net 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. Bongo net was towed at 5 stations. A summary of the midwater bongo net samplings was shown in Table 2. CTD casts were conducted at 19 stations. In May, backscattering of adult sand lance were observed in southern Sendai bay and backscattering of juvenile sand lance were observed in northern Sendai bay and backscattering of krill were observed off the coast of Sendai bay. 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 “*Miyashio*”, 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 Institute of Cetacean Research. We thank 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). Paper SC/54/O2 presented to the IWC Scientific Committee, June 2002 (unpublished). 115pp.

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	298	10.7
A2	38	-	20.0	N	141	-	38.0	E	53	9.9
A3	38	-	26.0	N	141	-	48.0	E	318	9.4
A4	38	-	33.0	N	141	-	40.0	E	50	10.8
A5	38	-	40.0	N	141	-	50.5	E	-	-
									Total	40.7

## Block B

Waypoint	Latitude				Longitude				Course (degree)	Distance (n.mile)
B1	37	-	54.0	N	141	-	00.0	E	66	10.8
B2	37	-	58.5	N	141	-	12.5	E	304	9.9
B3	38	-	04.0	N	141	-	02.0	E	69	11.4
B4	38	-	08.0	N	141	-	15.5	E	295	10.5
B5	38	-	12.5	N	141	-	03.5	E	79	13.6
B6	38	-	15.0	N	141	-	20.5	E	326	7.8
B7	38	-	21.5	N	141	-	15.0	E	-	-
									Total	64.0

## Block C

Waypoint	Latitude				Longitude				Course (degree)	Distance (n.mile)
C1	38	-	15.0	N	141	-	25.0	E	122	3.7
C2	38	-	13.0	N	141	-	29.0	E	259	8.0
C3	38	-	11.5	N	141	-	19.0	E	130	9.3
C4	38	-	05.5	N	141	-	28.0	E	247	10.3
C5	38	-	01.5	N	141	-	16.0	E	131	5.3
C6	37	-	58.0	N	141	-	21.0	E	230	6.2
C7	37	-	54.0	N	141	-	15.0	E	-	-
									Total	42.7

## Block D

Waypoint	Latitude				Longitude				Course (degree)	Distance (n.mile)
D1	38	-	15.0	N	141	-	51.5	E	232	13.9
D2	38	-	06.5	N	141	-	37.5	E	102	9.3
D3	38	-	04.5	N	141	-	49.0	E	245	17.8
D4	37	-	57.0	N	141	-	28.5	E	108	9.6
D5	37	-	54.0	N	141	-	40.0	E	-	-
									Total	50.6

Table 2. A summary of the Bongo net sampling

Station	St-1	St-2	St-3	St-4	St-5	
Block	B	B	D	A	C	
Date	7 May.	8 May.	11 May.	12 May.	14 May.	
Time	10:34	12:08	13:32	8:48	9:39	
Latitude	38-12N	38-04N	37-58N	38-21N	38-09N	
Longitude	141-07E	141-02E	141-30E	141-40E	141-24E	
Temp (°C) by depth	0m	13.4	13.9	12.9	8.2	13.7
	10m	12.9	12.8	12.6	6.6	13.5
	20m	11.0	9.9	13.2	4.6	12.7
	30m			9.4	3.8	10.7
	40m			8.1	4.4	9.6
	50m			7.3	6.2	8.2
	75m			3.8	6.6	
	100m			3.6	6.7	
	Bottom (m)	8.2 (25m)	8.4 (25m)	3.8 (128m)	6.3 (138m)	6.3 (70m)
Trawl sampling depth (m)	29					
Major sampled species	Sand lance (juvenile)	Jellyfish	Krill Copepod	Copepod	Copepod	



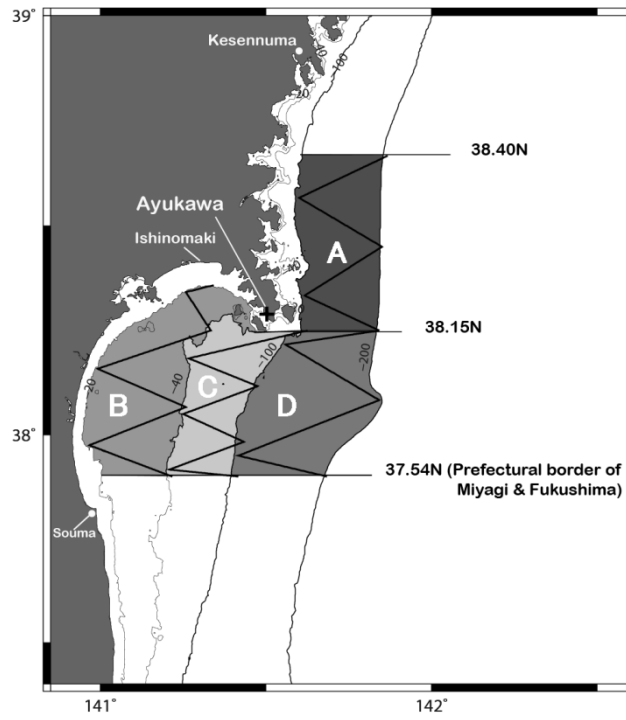


Fig. 1. Survey Blocks and planned tracklines in 2014