

## **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 Kushiro**

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### **ABSTRACT**

The seventh survey of the JARPN II coastal component off Kushiro, northeast Japan (northern part of the sub-area 7) was conducted from 5 September to 17 October 2009, using four small-type whaling catcher boats as sampling vessels. The sampling was conducted in the coastal waters within the 50 nautical miles from the Kushiro port, and all whales sampled were landed on the land station in the Kushiro port for biological examination. During the survey, a total of 5,136.2 n. miles (493.8 hours) was searched, 106 schools/ 107 individuals of common minke whales were sighted and 59 whales were sampled. Average body length of sampled whales was 6.13m (SD=1.10, n=36) for males and 5.12m (SD=0.60, n=23) for females, respectively. In males, 12 out of 36 animals were sexually mature, while all females (23 animals) collected were sexually immature. The dominant prey species found in the forestomach contents was walleye pollock *Theragra chalcogramma* (40.7%), followed by krill *Euphausia pacifica* (32.2%), Japanese anchovy *Engraulis japonicus* (22.0%), and Japanese common squid *Todarodes pacificus* (1.7%). Pacific saury *Cololabis saira* was not found. Both the ratio of the whales fed on walleye Pollock, and the ratio of immature whales were high as same as the previous survey conducted in 2008, and these results indicated the difference in feeding habit between mature and immature individuals in the coastal waters off Kushiro in autumn season, as suggested in the previous surveys.

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

### **BACKGROUND**

The full-scale surveys of the second phase of the Japanese Whale Research Program under Special Permit in the western North Pacific (JARPN II) started in 2002 (Government of Japan, 2002). The objectives of the surveys are: i) feeding ecology and ecosystem studies, involving prey consumption by cetaceans, prey preferences of cetaceans and ecosystem modelling, ii) monitoring environmental pollutants in cetaceans and marine ecosystem, and iii) stock structure of whales (Government of Japan, 2002).

The full-scale JARPN II involves two survey components; ‘offshore’ which is covered by the *Nisshin Maru* research vessels and ‘coastal’ which is covered by small-type whaling catcher boats, and the latter one is

necessary to cover the temporal and spatial gaps, which cannot be covered by the *Nisshin maru* research vessels (Government of Japan, 2002).

Based on the results of the two-year feasibility study of the coastal survey component conducted in 2002 off Kushiro and 2003 off Sanriku district (Kishiro, *et al.*, 2003, Yoshida, *et al.*, 2004, Government of Japan, 2004a), the coastal component has been revised to be conducted twice a year, with 60 common minke whales being sampled in each of spring off Sanriku and autumn off Kushiro (Government of Japan, 2004b). After the first revised survey carried out off Kushiro in autumn 2004 (Kishiro, *et al.*, 2005), the coastal survey off Kushiro was conducted annually from 2005 to 2008 (Kishiro, *et al.*, 2006, 2008, Yoshida, *et al.*, 2007, 2009).

In January 2009, the expert workshop to review the ongoing JARPN II programme was carried out in Japan under the IWC/SC, and results of the first six years of the full-scale JARPN II (2002-2007) was reviewed by the scientific specialists (IWC, 2009). Because there was no critical problem in the survey methodology, the survey off Kushiro in 2009 was carried out in principle under the original research plan (Government of Japan 2004b).

This paper presents results of the seventh survey conducted off Kushiro, from 5 September to 17 October in 2009. The survey was authorized by the Government of Japan in compliance with Article VIII of the international convention for the Regulation of Whaling. The National Research Institute of Far Seas Fisheries (NRIFSF), Fisheries Research Agency, planned and conducted the survey cooperate with the Institute of Cetacean Research (ICR) and Tokyo University of Marine Science and Technology.

## **MATERIALS AND METHODS**

### **Research area**

The research area was same to the previous surveys (Kishiro, *et al.*, 2003, 2005, 2006, 2008, Yoshida, *et al.*, 2007, 2009), i.e. the coastal waters off Kushiro, within the 50 nautical miles from the Kushiro port (Fig. 1). This area is included in the northern part of the sub-area 7 determined by the IWC.

### **Research vessels and land station**

Four small-type whaling catcher boats (*Taisho Maru* No. 28 (hereafter referred as 28T; 47.3GT), *Koei Maru* No.75 (75K; 46.0GT), *Sumitomo Maru* No.31 (31S; 32.0GT) and *Katsu Maru* No.7 (7K; 32.0GT) were used as the whale sampling vessels. The sampling survey was conducted from 5 September to 17 October. All whales sampled were landed on the land station (the JARPN II research station) in the Kushiro port for biological examination.

### **Searching and sampling methods**

Searching and sampling methods were almost same with those for the first coastal survey off Kushiro in 2002 (Kishiro *et al.* 2003). The research head office was placed in the research station and controlled the sampling vessels during the survey. All catcher boats were engaged as the sampling vessels. To avoid the concentration of sampling location, the research head office arbitrarily determined the searching area and route (direction from the port) for each sampling vessel in every day, based on the information of the whale distribution. Weather conditions and information on fishing grounds of prey species were also considered. In each vessel, a researcher was on board and recorded the cruise tracks, searching time on effort, sea weather conditions and sighting data. Sighting data would be collected for all baleen whales and sperm whales. The vessel principally continued to cruise and search along the predetermined direction until arrived at 10-30 n. miles from the port, and then freely cruised in the waters within the 50 n. miles radius

from the port. Searching was carried out during the day and the vessels returned to the port every night. Sighting was conducted from the top barrel and upper bridge by all the crews and researcher with vessel speed at about 11 knots. 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. Sampling was made by 50 mm whaling cannon. Once a vessel caught a whale, it returned to the Kushiro 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 lift 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 truck scale.

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

All the whales sampled were biologically examined by researchers at the research station. Research items of the biological studies were summarized in Table 2, with the number of data and samples obtained. These items were related to studies on feeding ecology, stock structure, life historical biology and pollutions.

## **RESULTS**

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

The cruise tracks made by the sampling vessels (28T, 75K, 31S and 7K) during the survey are shown in Fig.2. The searching areas covered widely coastal waters within 30 nautical miles from the Kushiro port. Searching distance and time are shown in Table 1. Here, we defined the searching distance and time as that with sighting effort, i.e. the periods of the searching conducted from the top barrel. During the research period, total searching distance and time were 5,136.2 n. miles and 493.8 hours, respectively.

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

Fig.3 shows distribution of common minke whales sighted by the sampling vessels. Sighting positions widely distributed in inshore areas off Kushiro port to the waters in around 30 n. miles from the port, and relatively concentrated in the southeastern side of the research area on the continental shelf and slope. During the survey, a total of 106 schools/ 107 individuals of common minke whales were sighted, consisting of 97 schools/ 98 individuals of primary sightings and 9 schools/ 9 individuals of secondary sightings (Table 1). These figures probably include some duplicated sightings because sampling vessels searched almost same areas in every day. Density index of common minke whales was calculated as 1.89 for DI (the number of primary sightings of schools per 100 nautical miles searching) and 0.20 for SPUE (the number of primary sightings of schools per 1 hour searching). Of the 107 common minke whales sighted, 59 common minke whales were sampled. In the sampling process, there were no struck and lost animals. Fig.3 showed sighting positions of sampled whales. Distribution of these whales almost covered all of the areas where the sightings were made during the survey period.

### **Sightings of other large cetaceans**

During the survey, a total of 20 schools/ 51 individuals of fin whales, 2 schools/ 5 individuals of sei whales, and 19 schools/ 22 individuals of humpback whales were sighted (Table 1). Sighting positions of those whales were shown in Fig.4.

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

The 59 sampled whales consisted of 36 males and 23 females (sex ratio of males was 0.61). Average body length of the whales was 6.13m (max=8.05, min=4.18, SD=1.10) for males and 5.12m (max=7.00, min=4.54, SD=0.60) for females, respectively (Table 3). Composition of sex and sexual maturity of the whales is listed in Table 4. Male with a single testis weight of 290g or more, and female had at least one corpus luteum or albicans in their ovaries were determined as sexually mature. In males, 12 of 36 individuals (33.3%) were sexually mature. This figure was lower than that of the previous surveys, e.g. 45.7% in 2007, 52.0% in 2006 and 66.7% in 2005, but almost same with last year survey (31.3% in 2008). All females sampled were immature (n=23), and sexually mature females was not observed.

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

Stomach contents of all collected animals were examined except for two, which was broken by harpoon (Table 5). Following the same methods used in the JARPN II feasibility surveys (Fujise, *et al.*, 2002), stomach contents were weighted to the nearest 0.1 Kg by each four chamber in both cases of including and excluding liquid. Then, a sub-sample of stomach contents was collected and frozen for the later laboratory work. Four prey species, walleye pollock *Theragra chalcogramma*, krill *Euphausia pacifica*, Japanese anchovy *Engraulis japonicus*, and Japanese common squid *Todarodes pacificus* were found in the forestomach contents. Among them, walleye pollock was the most dominant prey species. Ratio of the whales mainly fed on walleye pollock was 40.7% or 24 out of 59 whales. Next dominant prey species was krill (32.2% or 19 whales), followed by Japanese anchovy (22.0%) and Japanese common squid (1.7%). Pacific saury *Cololabis saira* was not found. The weights of forestomach contents ranged from 3.72Kg (Japanese anchovy) to 97.6Kg (krill) and average weight was 26.9Kg.

## **DISCUSSION**

The present survey was the seventh survey of the JARPN II coastal component in the autumn season off Kushiro. As same as the previous surveys, bad weather conditions such as typhoons, low atmospheric pressures and thick fog often disturbed research activities. Of total 43 day survey period from 5 September to 17 October, sampling vessels could conduct the research for 25 days or 58.1% of the predetermined days. This figure was almost same in the last year survey (57.1% in 2008). However, we could collect almost same number of a planned sample size of common minke whales in this year. One of the reasons was thought to be the migration of common minke whales. The density index of common minke whales recorded by the sampling vessels in 2009 (DI=1.89) was higher than that of the last year survey (DI=1.67, Yoshida *et al.*, 2009), and this suggested that the migration of common minke whales in 2009 was more abundant than that in 2008. A logistical minor improvement of sampling method (additional sampling while returning to the port) was thought to be also contributed to the progress in catch.

Frequency distribution of body length of common minke whales collected in 2009 was similar to those in 2008, but young and small females with body length of 4.5m were collected most, and ratio of large animals with body length of 7m or more was low when it's compared with the previous 2004-2005 surveys (Fig. 5). These results suggested that immature animals were frequently distributed in the research area, and the migration of mature animals into the research area was scarce in the 2009 season.

As same as the results of the 2008 survey, the most dominant prey species found from whale forestomach was walleye pollock, but the composition of prey species was different and next dominant prey was krill in the 2009 survey (Fig. 6). All whales taking walleye Pollock were sexually immature and distributed in the waters southeast coast off Kushiro along 200-500m isobaths on the continental slope region (Fig. 7 and 8). Krill and Japanese anchovy were taken by both immature and mature whales, and common squid was taken by mature whale (Fig. 7). These results were thought to be indicated the difference in feeding habit between mature and immature common minke whales in the coastal waters off

Kushiro in autumn season, as suggested by the results of the previous 2002-2007 surveys (Kishiro *et al.*, 2008, 2009), i. e. immature animals tend to take walleye pollock on the continental shelf and slope regions, while mature whales mainly have Pacific saury and common squid, and both immature and mature whales consumed Japanese anchovy. In the present survey, Pacific saury was not observed in the stomach of sampled whales, and maturity ratio of sampled whales was low. This might be due to a small migration of Pacific saury in the restricted research area in 2009, and as a result, the visit of mature whales that prefer Pacific saury might have been also few in the research area.

One of the features in this year was that there were a lot of sightings of large baleen whales such as fin and humpback whales compared with the ordinary years. In 2009, a total of 51 fin, 5 sei, and 22 humpback whales were sighted (Table 1), but during the total periods from 2002-2008, a total of only three fin, one sei, and six humpback whales sightings were recorded (Kishiro, *et al.*, 2003, 2005, 2006, 2008, Yoshida, *et al.*, 2007, 2009) Although these figures probably include some duplicated sightings, the number of sightings in 2009 was obviously more than that of the previous 2002-2008 surveys. The sighting positions of these whales were overlapped with those of common minke whales (Fig. 4) and stomach contents of minke whales sighted near those whales were krill (Fig.8). Furthermore, krill was the next dominant prey species found in the stomach of common minke whales in 2009. These results implied that the local migration of large baleen whales observed in 2009 might be related to the distribution of krill, and krill might be more abundant in the research area in 2009, as compared with the previous years. However, it was uncertain what those whales were actually eating, and further analysis is needed.

There was no serious practical problem in conducting the surveys and the 2009 coastal survey off Kushiro was conducted successfully.

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Table 1. Searching days, hours, distances, and number of sightings made by the whale sampling survey in the 2009 JARPN II coastal component off Kushiro.

Period	Days	Hours	Distances (n.miles)	Species	Number of sightings					
					Primary		Secondary		Total	
					Sch.	Ind.	Sch.	Ind.	Sch.	Ind.
5 Sept.-17 Oct.	25	493.8	5,136.2	Common minke whale	97	98	9	9	106	107
				Like minke whale	21	21	2	2	23	23
				Fin whale	17	37	3	14	20	51
				Sei whale	2	5	-	-	2	5
				Humpback whale	17	20	2	2	19	22
				Unidentified cetaceans	14	17	2	2	16	19

Table 2. Summary of biological data and samples collected during the 2009 JARPN II coastal survey off Kushiro.

Samples and data	Number of whales		
	Male	Female	Total
Body length and sex	36	23	59
External body proportion	36	23	59
Photographic record and external character	36	23	59
Diatom film record	36	23	59
Body scar record	36	23	59
Measurements of blubber thickness (five points)	36	23	59
Detailed measurements of blubber thickness (eleven points)	1	1	2
Body weight	36	23	59
Body weight by parts	1	1	2
Skin tissues for DNA study	36	23	59
Muscle, liver, kidney and blubber tissues for heavy metal analysis	36	23	59
Muscle, liver, kidney and blubber tissues for organic chlorine analysis	36	23	59
Muscle and blubber tissues for byproduct analysis	36	23	59
Muscle, liver, spleen, heart and blubber tissues for chemical analysis	36	23	59
Urine for chemical analysis	16	5	21
Mammary gland; lactation status, measurement and histological sample	-	23	23
Uterine horn; measurement and endometrium sample	-	23	23
Collection of ovary	-	23	23
Testis and epididymis; weight and histological sample	36	-	36
Stomach content, conventional record	36	23	59
Volume and weight of stomach content in each compartment	36	23	59
Stomach contents for feeding study	31	18	49
Stomach contents for multipurpose study	6	2	8
Record of external parasites	36	23	59
Earplug for age determination	35	23	58
Tympanic bulla for age determination	36	23	59
Largest baleen plate for morphologic study and age determination	36	23	59
Baleen plate measurements (length and breadth)	36	23	59
Photographic record of baleen plate series	36	23	59
Length of each baleen plate series	36	23	59
Crystalline lens in eyeball for age determination	36	23	59
Blood serum for chemical analysis	35	23	58
Vertebral epiphyses sample	36	23	59
Number of ribs	36	23	59
Brain weight	1	1	2
Skull measurement (length and breadth)	36	23	59

Table 3. Body length (m) of common minke whales sampled by the 2009 JARPN II coastal survey off Kushiro.

Period	Male					Female				
	Mean	S.D.	Min.	Max.	n	Mean	S.D.	Min.	Max.	n
5 Sept.- 15 Sept.	5.74	0.58	5.17	6.32	3	5.37	0.62	4.72	6.44	7
16 Sept. - 30 Sept.	6.39	1.25	4.60	8.05	16	5.14	0.78	4.62	7.00	8
1 Oct. -15 Oct.	5.92	1.05	4.18	7.36	12	4.88	0.27	4.54	5.35	7
16 Oct. -17 Oct.	6.03	0.99	4.87	7.06	5	4.75	-	4.75	4.75	1
Total	6.13	1.10	4.18	8.05	36	5.12	0.60	4.54	7.00	23

Table 4. Composition of sex and sexual maturity of common minke whales sampled by the 2009 JARPN II coastal survey off Kushiro.

Period	Male				Female							Sex ratio (%males)
	Imm.	Mat.	Total	Maturity (%)	Imm.	Rest.	Lact.	Preg.	Total	Pregnancy (%) <sup>*1</sup>	Maturity (%)	
5 Sept.-15 Sept.	3	0	3	0.0	7	0	0	0	7	-	0.0	30.0
16 Sept.- 30 Sept.	9	7	16	43.8	8	0	0	0	8	-	0.0	66.7
1 Oct.- 15 Oct.	9	3	12	25.0	7	0	0	0	7	-	0.0	63.2
16 Oct.- 17 Oct.	3	2	5	40.0	1	0	0	0	1	-	0.0	83.3
Total	24	12	36	33.3	23	0	0	0	23	-	0.0	61.0

\*1: Apparent pregnancy rate

Table 5. Number of common minke whales by major prey species found in their forestomach contents sampled by the 2009 JARPN II coastal survey off Kushiro.

Period	No. of whales (%)						
	Walleye pollock	Krill	Japanese anchovy	Pacific saury	Common Squid	Unknown*	Total
5 Sept.-15 Sept.	3 (30.0)	2 (20.0)	3 (30.0)	0 (-)	0 (-)	2 (20.0)	10
16 Sept.- 30 Sept.	12 (50.0)	7 (29.2)	5 (20.8)	0 (-)	0 (-)	0 (-)	24
1 Oct.- 15 Oct.	8 (42.1)	7 (36.8)	3 (15.8)	0 (-)	1 (5.3)	0 (-)	19
16 Oct.- 17 Oct.	1 (16.7)	3 (50.0)	2 (33.3)	0 (-)	0 (-)	0 (-)	6
Total	24 (40.7)	19 (32.2)	13 (22.0)	0 (-)	1 (1.7)	2 (3.4)	59

\*Stomach was broken by harpoon



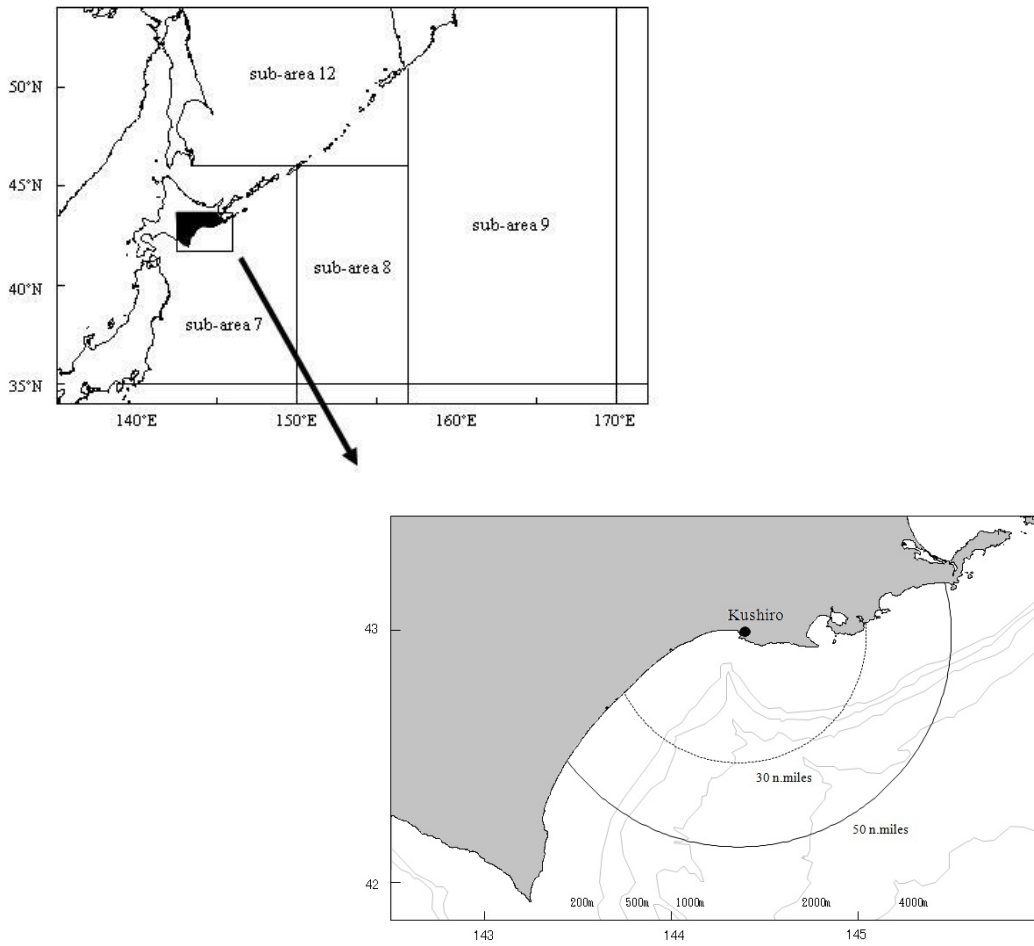


Fig.1. The IWC sub-area for western North Pacific minke whales (upper) and research area for the 2009 JARPN II coastal component off Kushiro (lower).

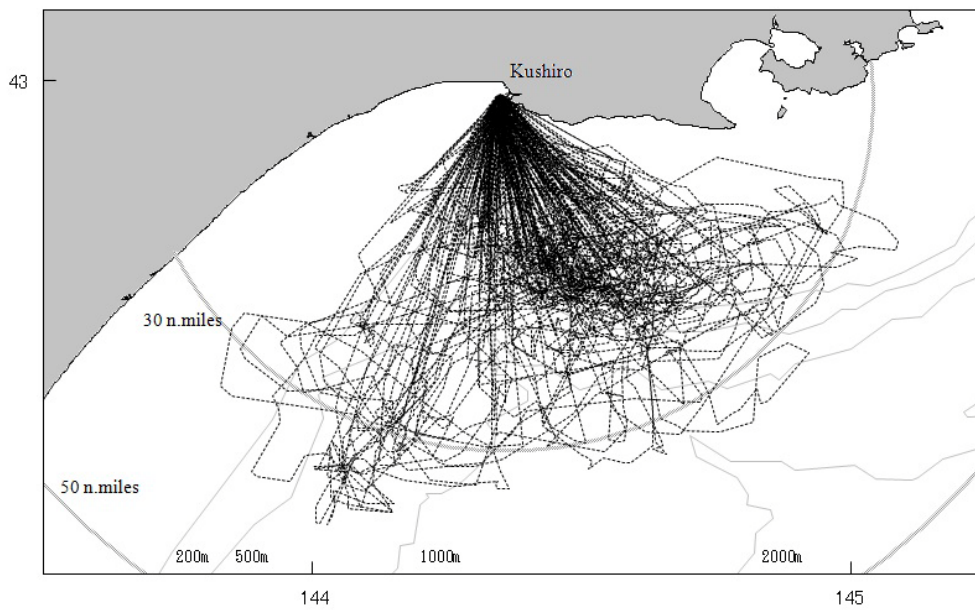


Fig.2. Cruise tracks of the whale sampling survey in the 2009 coastal component off Kushiro.

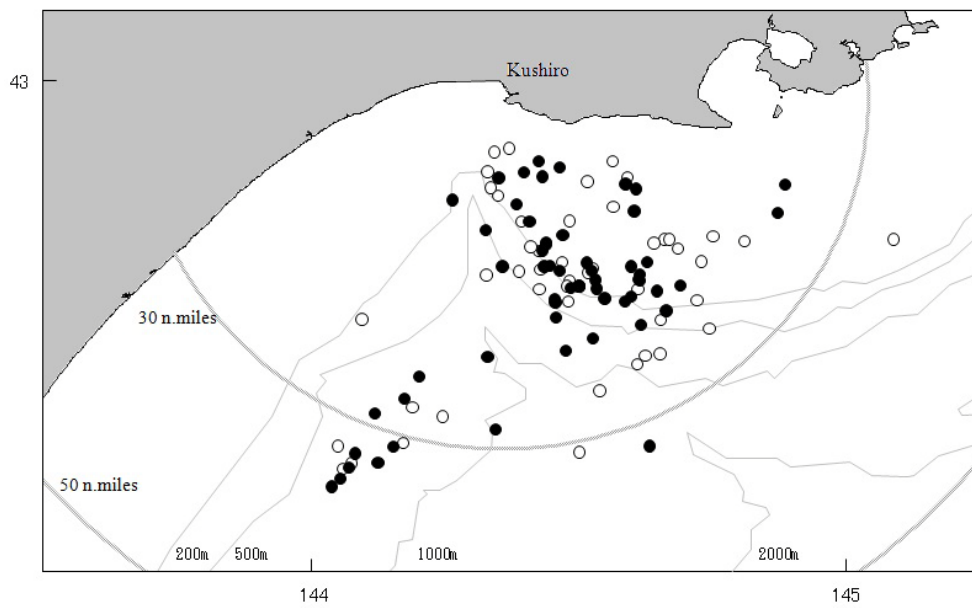


Fig.3. Sighting positions of common minke whales made by the whale sampling survey in the 2009 coastal component off Kushiro. Closed circle indicates sighting position of sampled whale.

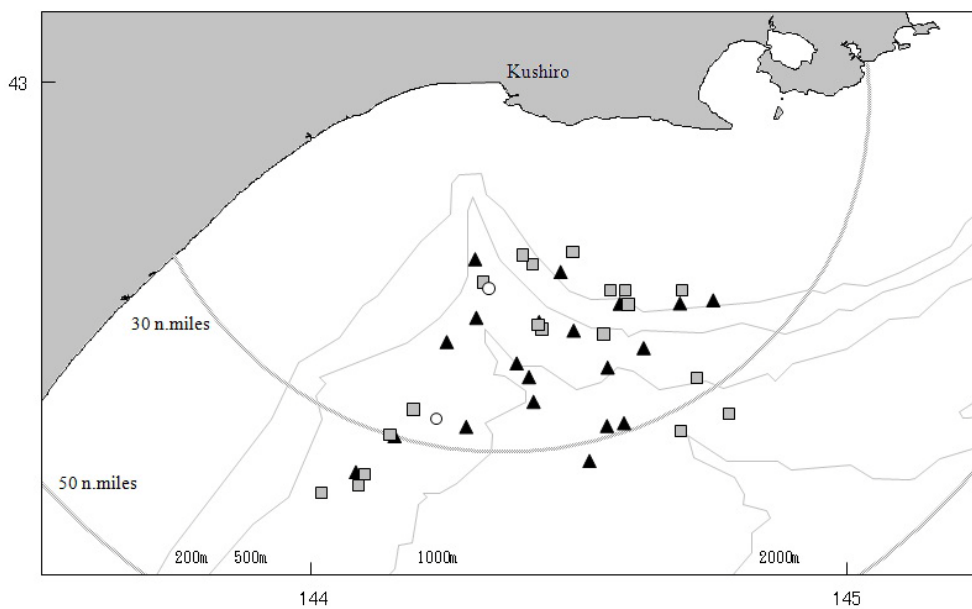


Fig.4. Sighting positions of fin whales (closed triangle), humpback whales (grey square), and sei whales (open circle) made by the whale sampling survey in the 2009 coastal component off Kushiro.

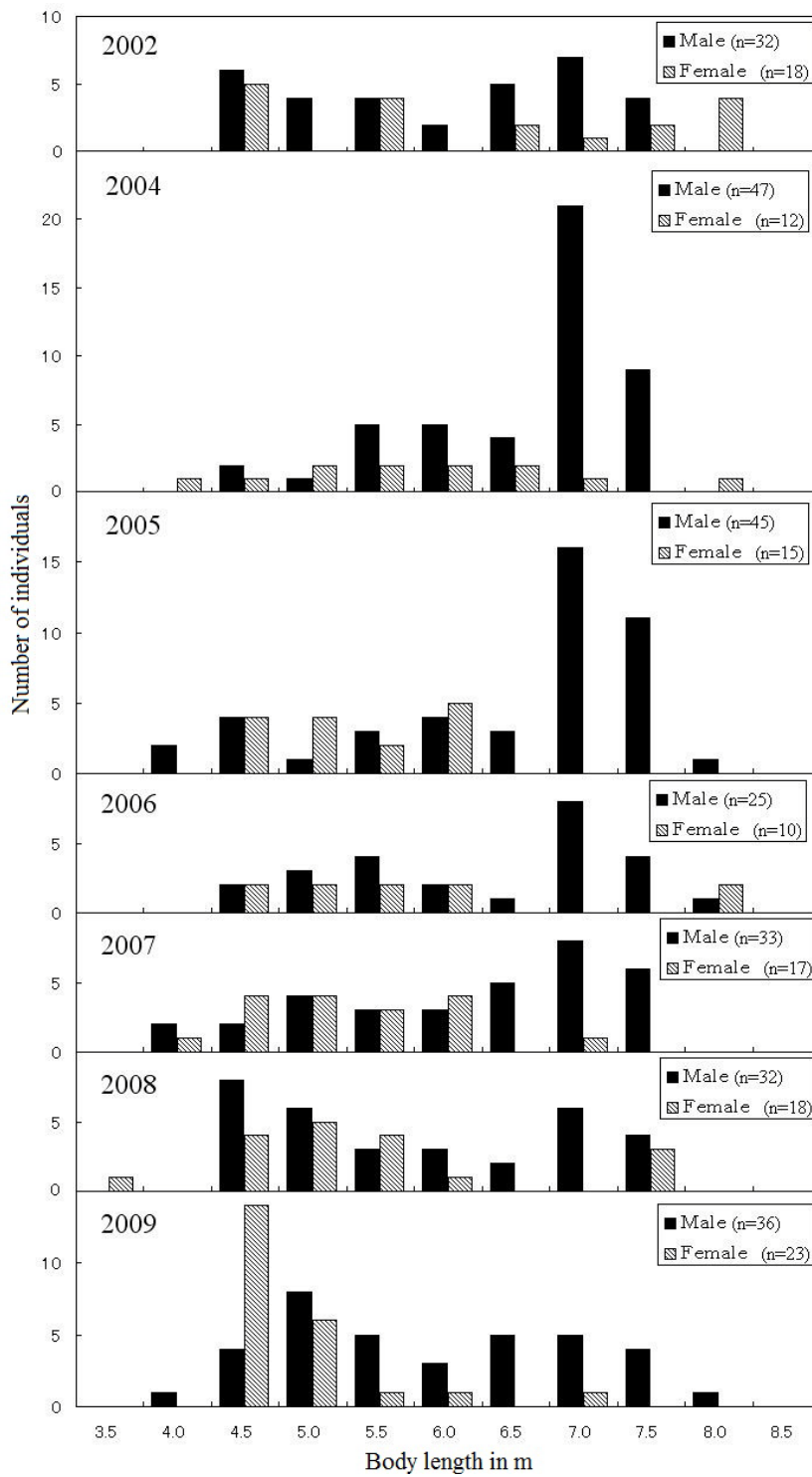


Fig 5. Body length frequency of common minke whales sampled during the 2009 coastal survey off Kushiro, with comparison to results of the previous 2002-2008 surveys.

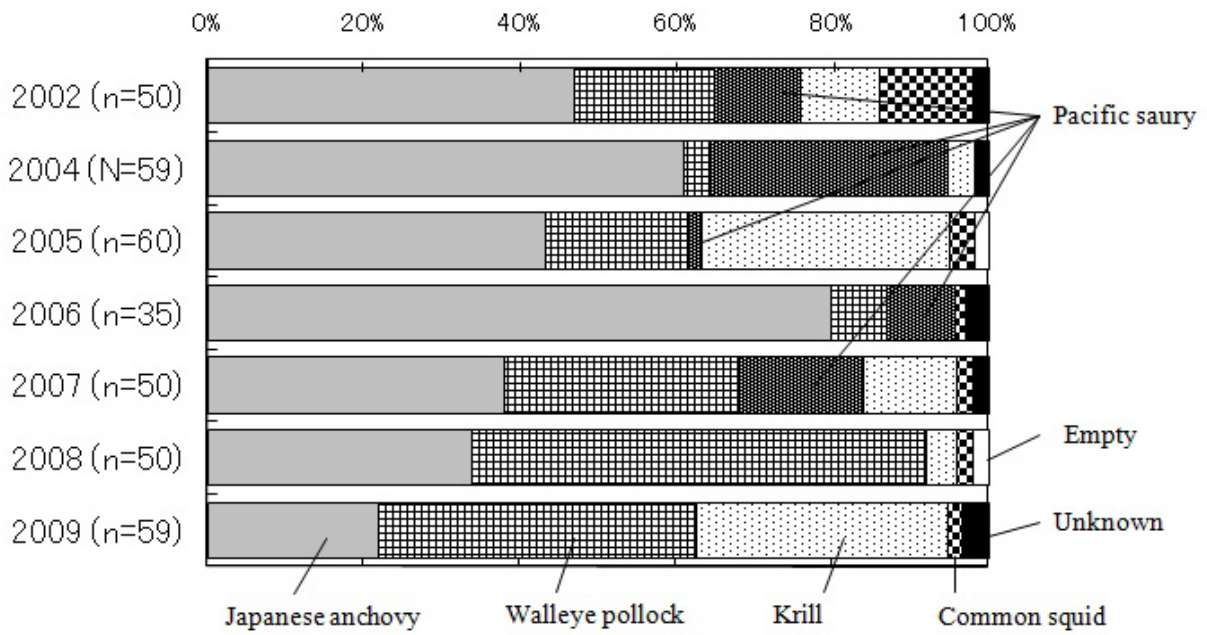


Fig. 6. Composition of prey species of common minke whales sampled during the 2009 coastal survey off Kushiro, with comparison to results of the previous 2002-2008 surveys.

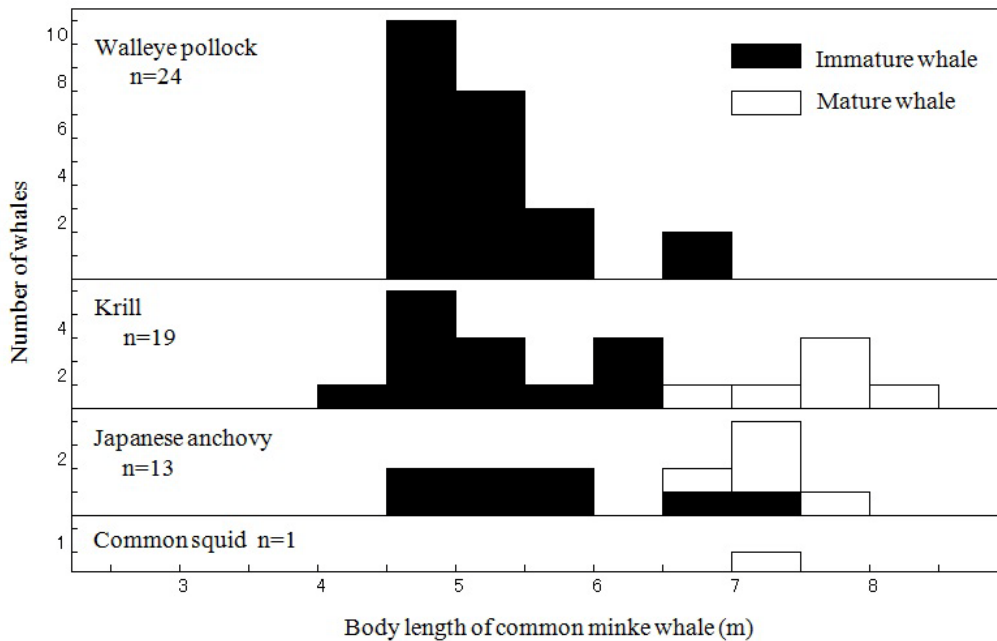


Fig.7. Sexual maturity and body length frequency of common minke whales by their major prey species found in the forestomach in the 2009 coastal survey off Kushiro.

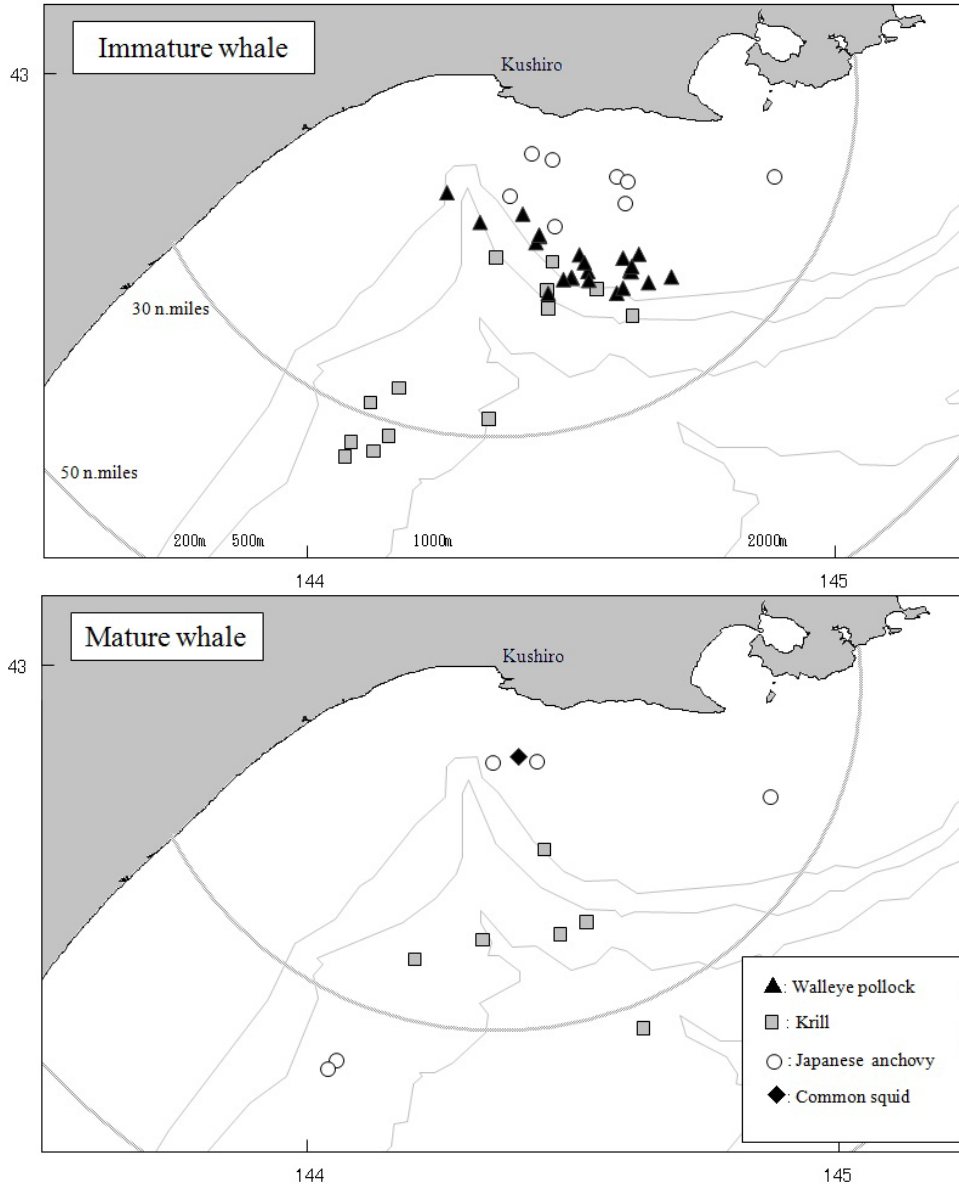


Fig.8. Sighting positions of common minke whales in the 2009 coastal survey off Kushiro by their sexual maturity and major prey species found in the forestomach