

Cruise report of the second phase of the Japanese Whale Research Program under Special Permit in the Western North Pacific (JARPN II) in 2008 (Part II) - Coastal component off Kushiro.

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ABSTRACT

The sixth survey of the JARPN II coastal component off Kushiro, northeast Japan (northern part of the sub-area 7) was conducted from 9 September to 20 October 2008, using four small-type whaling catcher boats as sampling vessels. Searching and sampling of common minke whales was conducted in coastal waters within 50 nautical miles from Kushiro port. All the whales collected were landed at the JARPN II research station for biological examination. During the survey, a total of 5,381.4 nautical miles (521.3 hours) was searched, all the 108 schools (110 individuals) of common minke whales were detected, and 50 individuals were sampled. Average body length of the animals was 5.97 m (SD=1.12, Range=4.50-7.72 m, $n=32$) for males and 5.61 m (SD=1.14, Range=3.87-7.94 m, $n=18$) for females. Ten of the 32 males were sexually mature and three females attained maturity, one of which was pregnant. The dominant prey species found from whale forestomach was walleye pollock (*Theragra chalcogramma*, 58.0%), followed by Japanese anchovy (*Engraulis japonicus*, 34.0%), krill (*Euphausia pacifica*, 4.0%), and Japanese common squid (*Todarodes pacificus*, 2.0%). Pacific saury (*Cololabis saira*) was also had, but only two individuals were detected from whale forestomach. The ratio of whales feeding on walleye pollock was highest in the present survey, in comparison with the previous surveys in 2002-2007 (3.4-30.0%). Results of the previous surveys off Kushiro suggest that feeding habit is different between immature and mature whales: immature animals tend to take walleye pollock, while mature whales mainly have Pacific saury and common squid. In the 2008 survey, all but one whales taking walleye pollock were immature, while most of mature whales fed on Japanese anchovy. Furthermore, immature and mature animals fed on different prey species, even if they were sampled at the same positions. These results also indicate the difference in feeding habit between immature and mature common minke whales off Kushiro in autumn season.

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

BACKGROUND

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 survey mainly aimed at i) feeding ecology and ecosystem studies, involving prey consumption by cetaceans, prey preferences of cetaceans and ecosystem modeling, ii) monitoring environmental pollutants in cetaceans and the marine ecosystem, and iii) elucidation of stock structure of whales (Government of Japan, 2002a).

The full-scale JARPN II consists of two survey components, i.e., offshore and coastal components. The JARPN surveys (1994-1999) and the JARPN II feasibility study (2000-2001) revealed that common minke whales are widely distributed from offshore waters into 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). Both the waters are very important fishing grounds. Thus, it is thought that the waters are also very important area for the full-scale JARPN II program. However, the *Nisshin Maru* research vessels can not be operated in near shore areas, because of their movement restrictions in shallow waters and the

presence of fishing gear and many boats. Furthermore, the research vessels are not available from late autumn to early spring. In order to cover the temporal and spatial gap of these vessels, in the full-scale JARPN II, sampling of common minke whales in coastal waters using small-type whaling catcher boats was planned (Government of Japan, 2002a).

In the first two years of the full-scale JARPN II, feasibility studies were conducted, to examine the logistic aspects of the methodology. The first feasibility study was conducted in coastal waters off Kushiro in autumn 2002 and the second one was in coastal waters off Sanriku in spring 2003 (Kishiro *et al.* 2003, Yoshida *et al.* 2004). Since no logistic problem occurred in the studies, it was concluded that the coastal survey could be continued as the component of the full-scale JARPN II, using the same methodology (Government of Japan 2004b, Kato *et al.* 2004), while the survey was revised to be conducted twice a year and to collect 60 common minke whales in each of spring and autumn (Government of Japan 2004a).

The first revised full-scale survey was carried out in coastal waters off Kushiro in autumn 2004 (Kishiro *et al.* 2005), then the coastal survey was conducted annually from 2005 to 2007 (Kishiro *et al.* 2006, 2008, Yoshida *et al.* 2007). Here, we show results of the sixth survey conducted off Kushiro, from 9 September to 20 October 2008. The survey was authorized by the Government of Japan in compliance with Article VIII of the International Convention for the Regulation of Whaling. At the request of the Institute of Cetacean Research (ICR), the National Research Institute of Far Seas Fisheries (NRIFSF), of the Fisheries Research Agency, took the lead in the planning and conduct of the survey, under cooperation of the ICR, Tokyo University of Marine Science and Technology, and the Japan Small-type Whaling Association.

In January 2009, the JARPN II review workshop was carried out in Japan under the IWC/SC, where the progress made in the first six years of the full-scale JARPN II (2002-2007) was reviewed by the scientific specialists. Although the present survey was conducted after the first six years period, the survey was carried out under the original revised plan (Government of Japan 2004a) because it was started before the workshop.

MATERIALS AND METHODS

Research area

Research area was set in the same waters where the previous JARPN II coastal surveys off Kushiro were conducted in 2002-2007 (Kishiro *et al.* 2003, 2005, 2006, 2008, Yoshida *et al.* 2007): the area was in coastal waters within 50 nautical miles from Kushiro port, southeastern Hokkaido (Fig. 1). This is included in the northern part of the sub-area 7, established by the IWC.

Research vessels, station, and period

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). All the common minke whales sampled were landed at the JARPN II research station established in the Kushiro port, for biological examination. Research period was set for 42 days, from 9 September to 20 October, 2006.

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 established in the research station controlled the sampling vessels during the survey. In order to avoid concentration of searching effort, the office determined searching areas and routes of the vessels every day, from weather conditions, whale distribution, and information on fishing grounds of coastal fisheries. Searching activity was carried out during the daytime and the vessels returned to the port every night. A researcher was on board each of the vessels and recorded sighting and sampling information, e.g., coordinates and time of common minke whale sighting and sampling made, weather conditions, and vessel activity. Sighting information was also recorded for other baleen whales and sperm whales. Searching was conducted by crews and researchers from the top barrel and upper bridge of vessels running at around 10.5 knots. All common minke whales sighted were targeted for sampling, except cow-calf pairs. When a school consisted of more than 1 animal, an individual was selected randomly from the school and then collected. Once a vessel caught a whale, it returned to the Kushiro port as soon as possible, to transport the animal sampled to the research station. While returning to the port, even if the vessel sighted other common minke whales, it did not catch the animals. At the port,

animals were lifted from the vessel by the crane, using a wire net and then carried to the station by the 11-ton freight trailer. At that time, body weight of animals was measured with the truck scale.

Biological research on common minke whales collected

All the whales sampled were examined by biological researchers at the research station. Research items are listed in Table 2. These data and samples were collected for studies on feeding ecology, stock structure, life history and pollutants.

RESULTS

Searching effort made by sampling vessels

Of the 42 days period predetermined for the 2008 survey, the sampling vessels could conduct searching only for 24 days (57.1% of the predetermined days), from bad weather conditions, e.g., low atmospheric pressure and thick fog. Cruise tracks made by the vessels are shown in Figure 2. Searching distance and time are given in Table 1. Here, searching distance and time are defined as distance and time recorded under searching activity conducted by crews from the top barrel of the vessels. During the survey, a total of 5,381.4 nautical miles (521.3 hours) was searched.

Common minke whale sightings made by sampling vessels

All the 108 schools (110 individuals) of common minke whales were detected during the searching (Table 1, Fig. 2). No cow-calf pairs were encountered. Sightings of a humpback and two sperm whales were also made. Cruise tracks were widely distributed in coastal waters south of Kushiro port, whereas sightings of common minke whales concentrated in waters along 200m isobath, particularly on the continental slope southeast of Kushiro. Density index of common minke whales was calculated as 1.67 for DI (the number of primary sightings of schools per 100 nautical miles searching) and 0.17 for SPUE (the number of primary sightings of schools per 1 hour searching).

Sampling of common minke whales

Of the 110 common minke whales sighted, 50 animals were collected for biological examination. In the sampling process, struck and lost occurred in one case. Sighting positions of animals collected are shown in Figure 2.

Sex ratio, body length and weight of animals caught

Research items of biological examination for the 50 individuals are summarized in Table 2, with the number of data and samples collected. The animals consisted of 32 males and 18 females. Sex ratio of males to all the animals was 0.64, which is almost same with ratios recorded in the previous surveys off Kushiro in 2002-2007.

Average body length was 5.97 m (SD=1.12, range=4.50-7.72 m) for males and 5.61 m (SD=1.14, range=3.87-7.94 m) for females (Table 3). In males, large animals with body length of 7 m or more were collected in all the period. However, occurrence frequency of the large males was lowest in the present survey, in comparison with the previous Kushiro surveys in 2002-2007. In the previous surveys, males with body length of 7 m were recorded most frequently, whereas animals with body length of 4.5m were collected most in the 2008 survey (Fig. 3). For females, obvious difference could not be found in body length frequency among animals collected in all the 2002-2008 surveys, possibly from their small sample size. Sexual maturity of animals collected is shown in Table 4. In males, 10 of 32 animals were sexually mature (31.3%), and three of 18 females attained sexual maturity (16.7%), of these a female was pregnant. The male maturity ratio was lowest in the present survey, when it is compared with the ratio recorded in the previous 2002-2007 Kushiro surveys (45.2-68.1%).

Prey species found from common minke whale forestomach

Stomach contents of the 50 animals collected were examined. Following the same methods used in the JARPN II feasibility survey conducted in 2001 (Fujise, *et al.*, 2002), stomach contents were weighed to the nearest 0.1 Kg, by each of four chambers. Weights were recorded both including and excluding liquid contents. A small quantity of stomach contents was collected and frozen for laboratory analysis. Weight of forestomach contents including liquid ranged from 2.68 kg (walleye pollock) to 72.92 kg (Japanese anchovy). Forestomach contents found from the 50 whales are listed in Table 5. Empty stomach was observed in one case. Dominant prey species was walleye pollock (*Theragra chalcogramma*)(58.0%,

observed in 29 animals), followed by Japanese anchovy (*Engraulis japonicus*)(34.0%), krill (*Euphausia pacifica*)(4.0%), and common squid (*Todarodes pacificus*)(2.0%). Pacific saury (*Cololabis saira*) was also taken, but only two individuals were detected from whale stomach. The ratio of whales feeding on walleye pollock was highest in the present survey, in comparison with the previous Kushiro surveys (3.4-30.0%)(Fig. 4). In the 2008 survey, all but one whales taking walleye pollock were immature, while most of mature whales fed on Japanese anchovy (Fig. 5). Sighting positions of whales collected in the 2008 survey are shown by their maturity stage and prey species (Fig. 6).

DISCUSSION

The present survey was the sixth survey of the JARPN II coastal component off Kushiro. No practical problems occurred in the present survey, whereas bad weather conditions, e.g., low atmospheric pressure and thick fog, often disturbed the research activities. Of the 42 days period predetermined for the 2008 survey, sampling vessels could conduct searching only for 24 days (57.1% of the predetermined days). This ratio was lowest, in comparison with the previous Kushiro surveys in 2002-2007. Furthermore, the present survey was 10 days shorter in the survey period than the last 2007 survey. Nevertheless, we could collect the same number of animals as sampled in the last survey.

In the present survey, young and small animals were collected most frequently. Occurrence frequency of large males with body length of 7 m or more was lowest in the 2008 survey, when it is compared with the previous 2002-2007 Kushiro surveys, where the large males collected most frequently (Fig. 3). In the 2008 survey, small animals with body length of 4.5m were collected most. Furthermore, male maturity ratio was also lowest. These results imply that, in the 2008 autumn season, younger and smaller males are relatively abundant in coastal waters off Kushiro. For females, such tendency could not be detected, possibly from small sample size (see, Fig. 3).

The present results show that the dominant prey species found from whale forestomach was walleye pollock. The ratio of whales feeding on walleye pollock was about over twice or more in the present survey as high as the animals collected in the previous surveys (Fig. 4). Kishiro *et al.* (2008) suggested that feeding habit is different between immature and mature common minke whales off Kushiro in autumn season: immature animals tend to take walleye pollock, while mature whales mainly have Pacific saury and common squid. In the 2008 survey, all but one whales taking walleye pollock were immature, while most of mature whales fed on Japanese anchovy (Fig. 5). Furthermore, immature and mature animals fed on different prey species, even if they were sampled at the same positions (Fig. 6): immature animals fed on walleye Pollock, while mature whales took Japanese anchovy there. These results indicate the difference in feeding habit between immature and mature common minke whales off Kushiro, as Kishiro *et al.* (2008), in which it is suggested that immature animals tend to take walleye pollock, while mature whales mainly have Pacific saury and common squid.

The present survey indicates that immature males appear to be relatively abundant off Kushiro in the autumn of 2008 (see, Fig. 3). Possibly, this resulted in high frequently of whales feeding on walleye pollock in the present survey (Fig. 4). From the 2008 survey, we could accumulate further information on feeding habits of common minke whales migrating off Kushiro in autumn season.

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Table 1. Searching days, distances, hours, and number of cetacean sightings made during the 2008 JARPN II coastal survey off Kushiro.

Period	Days	Distances (n. miles)	Hours	Species	Number of sightings*		
					Primary (Ind/Sch)	Secondary (Ind/Sch)	Total (Ind/Sch)
9/9-10/20	24	5381.4	521.3	Common minke whale	92/90	18/18	110/108
				Like minke whale	24/24	1/1	25/25
				Humpback whale	1/1	0/0	1/1
				Sperm whale	2/1	0/0	2/1
				Unidentified large whale	2/2	0/0	2/2

*: The number probably includes some duplicated sightings made by plural vessels.

Table 2. Summary of biological data and samples collected during the 2008 JARPN II coastal survey off Kushiro.

Samples and data	Number of animals		
	Male	Female	Total
Body length and sex	32	18	50
External body proportion	32	18	50
Photographic record and external character	32	18	50
Diatom film record	32	18	50
Body scar record	32	18	50
Measurements of blubber thickness (5 points)	29	16	45
Detailed measurements of blubber thickness (11 points)	3	2	5
Body weight	32	18	50
Body weight by parts	3	2	5
Skin tissues for DNA analysis	32	18	50
Muscle, liver, kidney, spleen, blubber, heart, and ventral groove for various analysis	32	18	50
Urine for various analysis	15	5	20
Muscle, liver, kidney, and blubber for heavy metal analysis	32	18	50
Muscle, liver, kidney, and blubber for organochlorine analysis	32	18	50
Collection of blood plasma	24	11	35
Muscle and vertebrae for lipid analysis	3	2	5
Mammary gland, lactation status, measurement and histological sample	-	18	18
Uterine horn, measurements and endometrium sample	-	18	18
Collection of ovary	-	18	18
Photographic record of foetus	1	0	1
Foetal length and weight	1	0	1
External measurement of foetus	1	0	1
Muscle, liver, kidney, heart, blubber, and skin tissues of foetus	1	0	1
Testis and epididymis, weight and histological sample	32	-	32
Stomach contents, convenient record	32	18	50
Volume and weight of stomach content in each compartment	32	18	50
Observation of marine debris in stomach	32	18	50
Stomach contents for feeding study	32	15	47
Record of external parasites	32	18	50
Earplug for age determination	31	18	49
Tympanic bulla for age determination	31	18	49
Eye lens for age determination	32	18	50
Largest baleen plate for morphologic study and age determination	32	18	50
Baleen plate measurements (length and breadth)	32	18	50
Photographic record of baleen plate series	32	18	50
Length of baleen series	32	18	50
Vertebral epiphyses sample	31	18	49
Number of ribs	32	18	50
Skull measurement (length and width)	31	18	49

Table 3. Statistics of body length (m) of common minke whales sampled during the 2008 JARPN II coastal survey off Kushiro.

Period	Male					Female				
	Mean	S.D.	Min.	Max.	<i>n</i>	Mean	S.D.	Min.	Max.	<i>n</i>
9/9 - 9/20	5.70	1.13	4.50	7.55	15	5.72	1.23	4.57	7.94	9
9/21 - 9/30	5.83	1.20	4.64	7.51	4	5.17	0.32	4.84	5.61	4
10/1 - 10/10	6.45	1.30	4.95	7.72	5	5.30	1.27	3.87	6.30	3
10/11 - 10/20	6.26	1.00	4.70	7.50	8	6.47	1.92	5.11	7.82	2
Total	5.97	1.12	4.50	7.72	32	5.61	1.14	3.87	7.94	18

Table 4. Composition of sex and sexual maturity of common minke whales sampled during the 2008 JARPN II coastal survey off Kushiro.

Period	Male				Female					
	Im	M	Total	Maturity(%)	Im	R	P	Total	Maturity(%)	Pregnancy(%)*
9/9 - 9/20	11	4	15	26.7	7	1	1	9	22.2	50.0
9/21 - 9/30	3	1	4	25.0	4	0	0	4	0.0	-
10/1 - 10/10	2	3	5	60.0	3	0	0	3	0.0	-
10/11 - 10/20	6	2	8	25.0	1	1	0	2	50.0	0.0
Total	22	10	32	31.3	15	2	1	18	16.7	33.3

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

*: Apparent pregnancy ratio.

Table 5. Number of common minke whales by major prey species found in forestomach, sampled during the 2008 JARPN II coastal survey off Kushiro.

Period	Number of whales (%)						Total
	Japanese anchovy	Pacific saury*	Walleye Pollock	Krill	Common squid	Empty	
9/9 - 9/20	3 (12.5)	0 (0.0)	17 (70.8)	2 (8.3)	1 (4.2)	1 (4.2)	24
9/21 - 9/30	2 (25.0)	0 (0.0)	6 (75.0)	0 (0.0)	0 (0.0)	0 (0.0)	8
10/1 - 10/10	6 (75.0)	0 (0.0)	2 (25.0)	0 (0.0)	0 (0.0)	0 (0.0)	8
10/11 - 10/20	6 (60.0)	0 (0.0)	4 (40.0)	0 (0.0)	0 (0.0)	0 (0.0)	10
Total	17 (34.0)	0 (0.0)	29 (58.0)	2 (4.0)	1 (2.0)	1 (2.0)	50

*: Only two individuals were found from whale stomach.

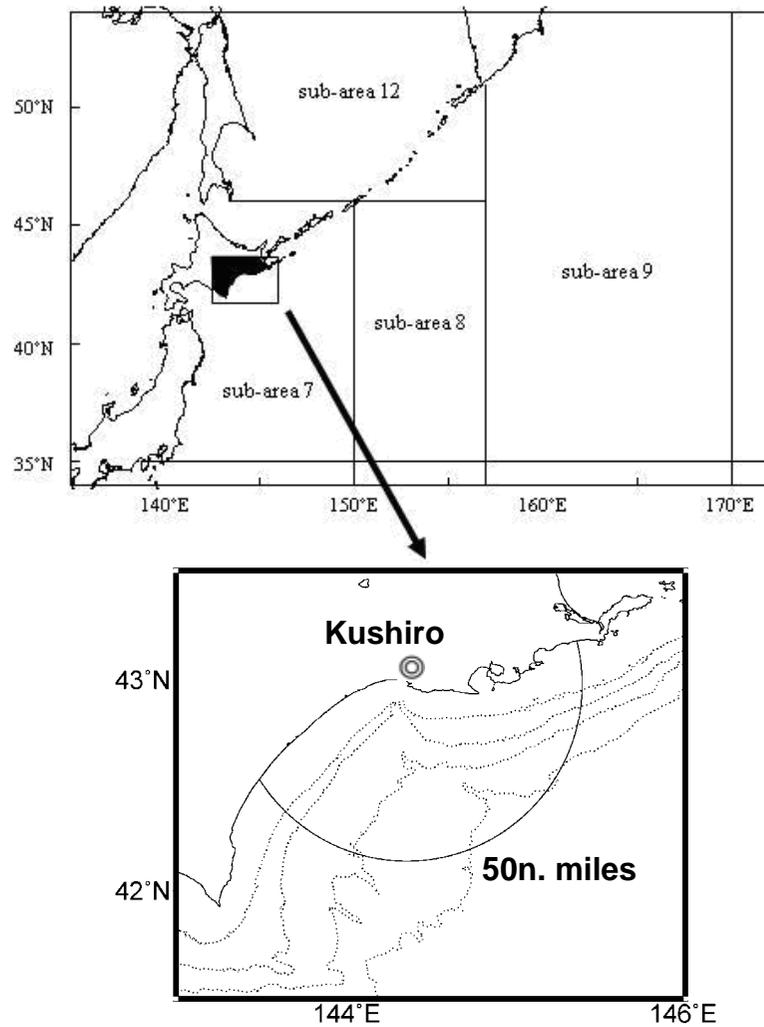


Figure 1. Research area set for the 2008 JARPN II coastal survey off Kushiro. The area is contained in the northern part of the sub-area 7 established by the IWC. Isobaths are 100m, 200m, 1000m, and 2000m.

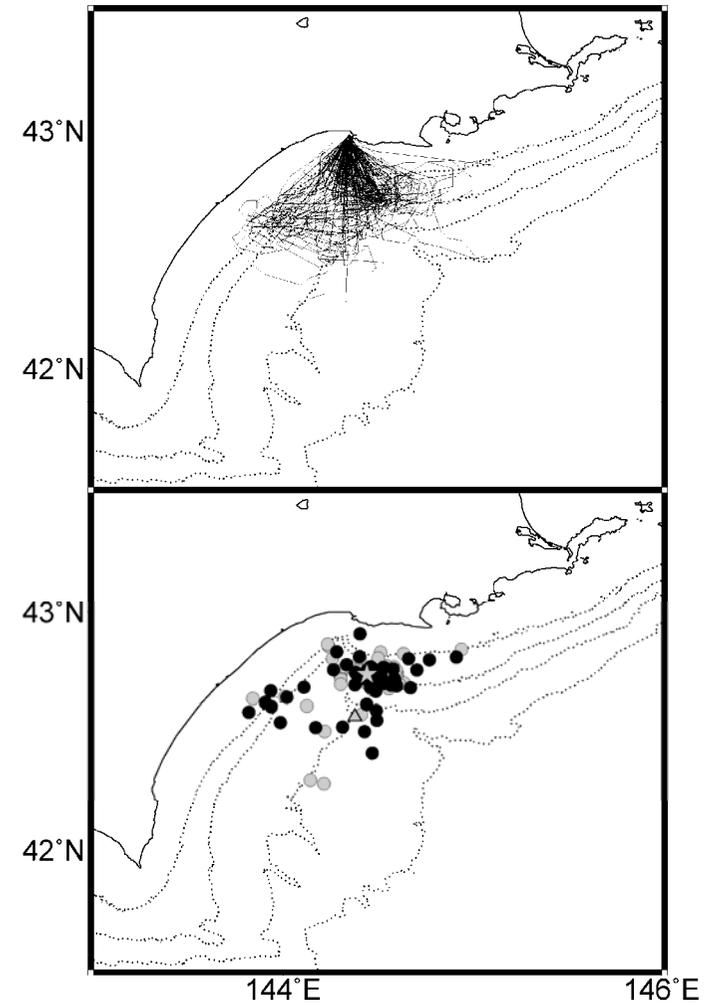


Figure 2. Cruise tracks (upper) and sighting positions (lower) of common minke (circle), humpback (star), and sperm (triangle) whales made by sampling vessels during the 2008 JARPN II coastal survey off Kushiro. Black circles are sighting positions of common minke whales sampled. Isobaths are 100m, 200m, 1000m, and 2000m.

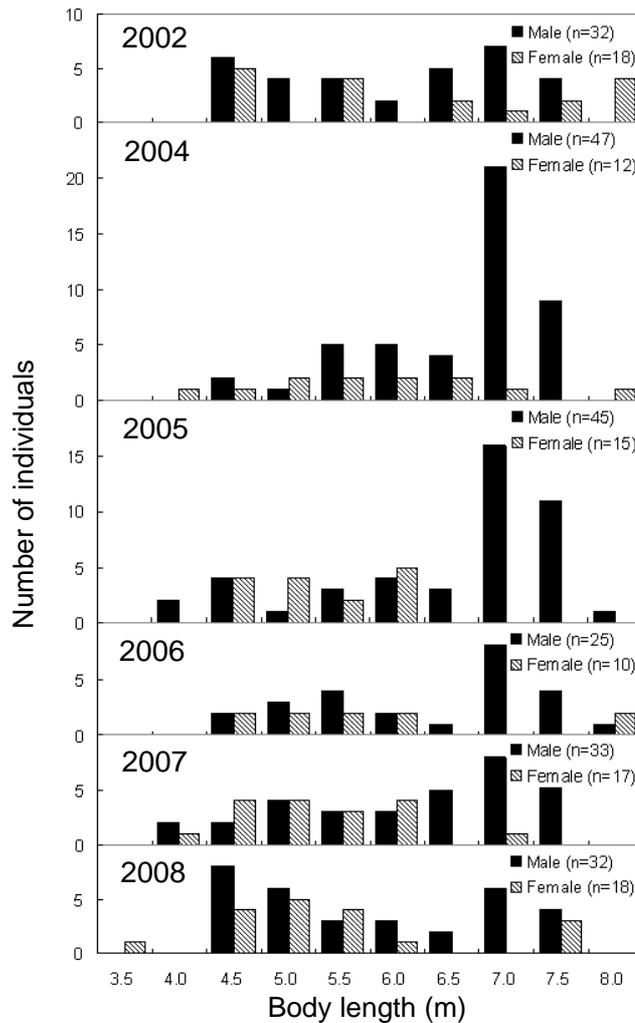


Figure 3. Body length frequency of common minke whales sampled during the 2008 JARPN II coastal survey off Kushiro, with comparison to results of the previous 2002-2007 surveys.

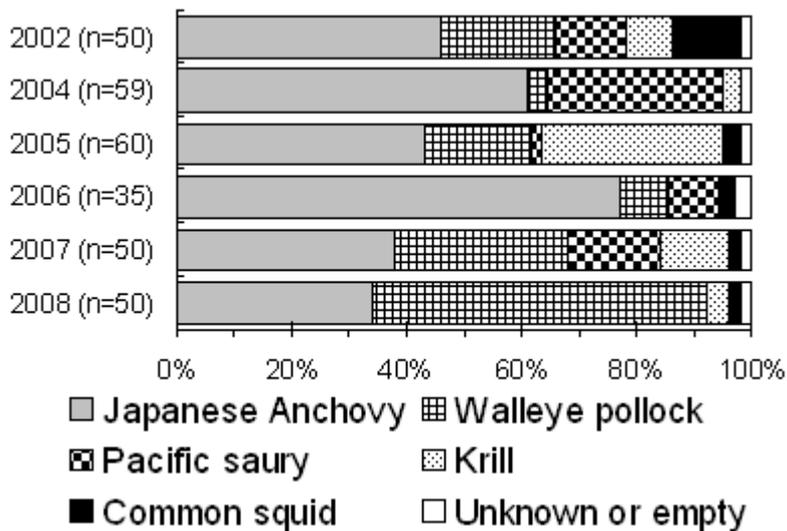


Figure 4. Composition of prey species of common minke whales sampled during the 2008 JARPN II coastal survey off Kushiro, with comparison to results of the previous 2002-2007 surveys.

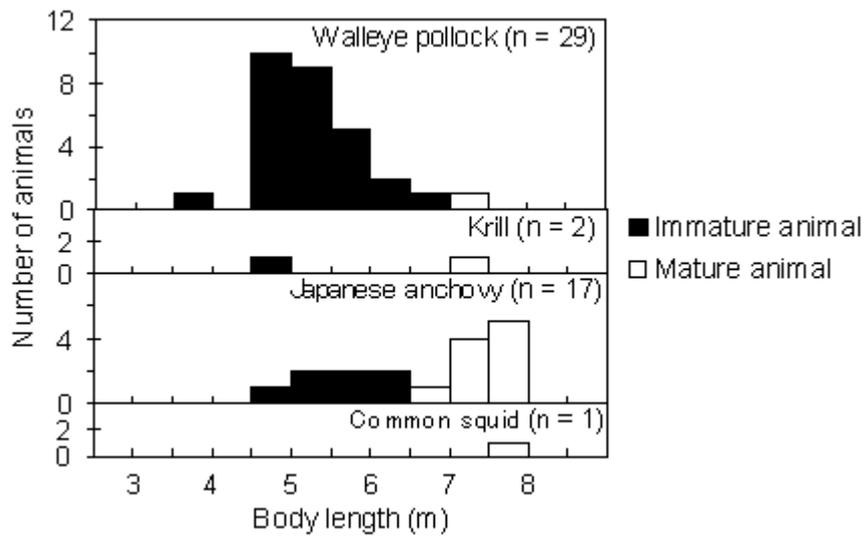


Figure 5. Sexual maturity and body length frequency of common minke whales by their prey species found in forestomach in the 2008 JARPN II coastal survey off Kushiro.

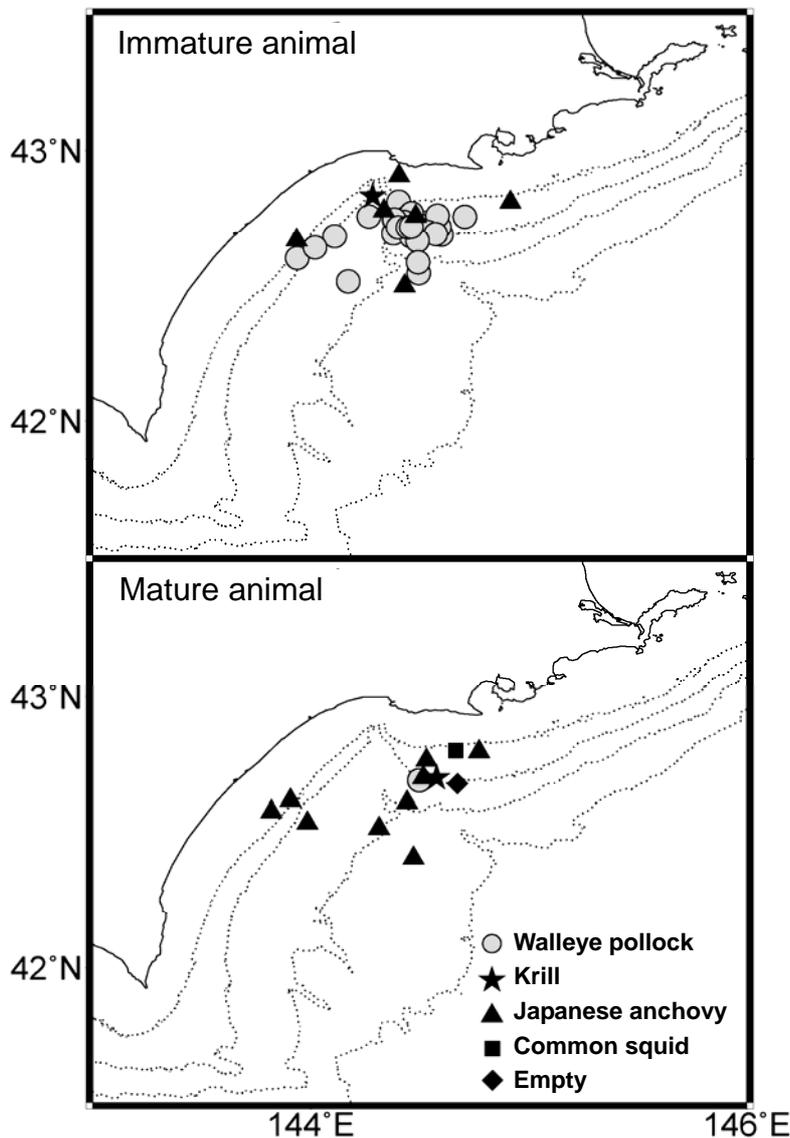


Figure 6. Sighting positions of common minke whales sampled during the 2008 JARPN II coastal survey off Kushiro, shown by their maturity stage and prey species. Isobaths are 100m, 200m, 1000m, and 2000m.