

Cruise report of the second phase of the Japanese Whale Research Program under Special Permit in the Western North Pacific (JARPN II) in 2010 (Part III) - Coastal component off Kushiro.

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ABSTRACT

The eighth survey of the JARPN II coastal component off Kushiro, northeast Japan (middle part of the sub-area 7CN) was conducted from 7 September to 6 October 2010, 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 4,151.6 nautical miles (385.0 hours) was searched, all the 125 schools (126 individuals) of common minke whales were detected, and 60 individuals were sampled. Average body length of males was 5.80 m (SD=1.06, Range=4.05-7.70 m, $n=41$) and 5.44 m (SD=0.63, Range=4.49-6.86 m, $n=19$) for females. Nine of the 41 males were sexually mature, but no mature animals were found among the 19 females. Dominant prey species detected from whale forestomach was walleye pollock (*Theragra chalcogramma*, 60.0%), followed by Japanese anchovy (*Engraulis japonicus*, 36.7%) and unidentified fishes (3.3%). No other prey species were observed. The ratio of whales feeding on walleye pollock was highest in the present survey, in comparison with the previous surveys in 2002-2009 (3.4-58.0%). Immature and mature whales fed on different prey species, even if they were collected at close distance: immature animals had walleye Pollock, while matures tended to take Japanese anchovy. These results indicate the difference in feeding habit between immature and mature common minke whales off Kushiro in autumn season, as suggested from the previous surveys.

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 in the coastal component. 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 2008 (Kishiro *et al.* 2006, 2008, Yoshida *et al.* 2007, 2009). 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. Because there was no critical problem in the survey methodology, the seventh survey off Kushiro was carried out in 2009, under the original research plan (Kishiro *et al.* 2010).

Here, we show results of the eighth survey conducted off Kushiro, from 7 September to 6 October 2010. The present survey, which was authorized by the Government of Japan in compliance with Article VIII of the International Convention for the Regulation of Whaling, was also conducted under the original research plan (Government of Japan 2004b). The National Research Institute of Far Seas Fisheries (NRIFSF) of the Fisheries Research Agency planned and conducted the survey, under cooperation of the ICR, Tokyo University of Marine Science and Technology, and the Association for Community-Based Whaling.

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 2002-2009 (Kishiro *et al.* 2003, 2005, 2006, 2008, 2010, Yoshida *et al.* 2007, 2009): the area was in coastal waters within 50 nautical miles from Kushiro port, southeastern Hokkaido (Fig. 1). The area is included in the middle part of the sub-area 7CN, 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 collected were landed at the JARPN II research station established in the Kushiro port, for biological examination. Research period was set for 50 days, from 7 September to 26 October, 2010.

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 was carried out in 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, 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, 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. The data and samples were collected for studies on feeding ecology, stock structure, life history and pollutants.

RESULTS

Searching effort made by sampling vessels

Although the survey period was set for 50 days from 7 September to 26 October, the survey was finished on 6 October. This is because sampling of 60 animals was completed on that day. Of a period of 30 days, sampling vessels could conduct searching for 18 days (60.0%). Other days were not suitable for survey, 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 4,151.6 nautical miles (385.0 hours) was searched.

Sightings made by sampling vessels

All the 125 schools (126 individuals) of common minke whales were sighted during the searching (Table 1, Fig. 2). No cow-calf pairs were observed. Cruise tracks were widely distributed in coastal waters of Kushiro port, whereas sightings of common minke whales concentrated in waters along 200m isobath, particularly on the continental slope southwest of Kushiro. Density index of common minke whales was calculated as 2.34 for DI (the number of primary sightings of schools per 100 nautical miles searching) and 0.25 for SPUE (the number of primary sightings of schools per 1 hour searching). In the last 2009 survey, sampling vessels often encountered large cetaceans in addition to common minke whales: the 41 sightings of baleen whales (fin, sei, or humpback whales) were made. However, only one sighting of humpback whale was recorded in the present survey.

Sampling of common minke whales

Of the 126 common minke whales encountered, 60 animals were collected for biological examination. In the sampling process, struck and lost was not occurred. Sighting positions of animals collected are shown in Figure 2.

Body length, sex ratio, and maturity of animals caught

Research items of biological examination for the 60 common minke whales are summarized in Table 2, with the number of data and samples collected. The animals consisted of 41 males and 19 females. Sex ratio of males to all animals was 68.3%, which is almost same with ratios recorded in the previous surveys off Kushiro in 2002-2009 (61.0-79.7%). Average body length was 5.80 m (SD=1.06, range=4.05-7.70 m) for males and 5.44 m (SD=0.63, range=4.49-6.86 m) for females (Table 3). In males, the most dominant length class was 5.0 m (Fig. 3). For females, there were no animals with length of 7 m or more. Sexual maturity of animals collected is shown in Table 4. In males, 9 of 41 animals were sexually mature (22.0%), but no mature females were obtained. Male maturity ratio was lowest in the present survey, when it is compared with the ratio recorded in the previous 2002-2009 surveys (31.3-68.1%).

Prey species found from common minke whale forestomach

Stomach contents of the 60 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 7.1 kg to 73.9 kg. Average weight was 27.9 kg. Forestomach contents found from the 60 whales are listed in Table 5. Empty stomach was not observed. Dominant prey species was walleye pollock (*Theragra chalcogramma*)(60.0%), followed by Japanese anchovy (*Engraulis japonicus*)(36.7%). No other species including krill (*Euphausia pacifica*), common squid, and Pacific saury were observed. The ratio of whales feeding on walleye pollock was highest in the present survey, in comparison with the previous Kushiro surveys (3.4-58.0%)(see, Fig. 4). In mature animals, only two took walleye Pollock, while other seven animals had Japanese anchovy (Fig. 5). Sighting positions of whales collected in the present survey are shown by their maturity stage and prey species (Fig. 6).

DISCUSSION

In the present survey, bad weather conditions, e.g., low atmospheric pressure and thick fog, often prevented sampling vessels from research activities, as similar to the past surveys. During a survey period of 30 days, the vessels conduct searching for 18 days. Of these, there were only 10 days, on which the vessels could conduct the survey throughout the day. Nevertheless, sampling of 60 animals was completed successfully. Density index of common minke whales recorded by the vessels was higher in the present survey (2.34) than that of the 2009 survey (1.89)(Kishiro *et al.*, 2010), which suggests more whales migrating off Kushiro in the present season. The index was, furthermore, much higher in the first two weeks in 2010. In the period, weather condition was also suitable for searching. It is thought that, from these, sampling of 60 animals was completed.

In the present survey, the most dominant prey species found from whale forestomach was walleye pollock, followed by Japanese anchovy. No other species were found. Most of mature animals had Japanese anchovy: only two animals took walleye Pollock (Fig. 5). Immature and mature animals fed on different prey species, even if they were collected at close distance. Animals having walleye pollock were collected along the 200 m isobath (Fig. 6). On the isobath, however, most of mature animals had Japanese anchovy. These results indicate difference in feeding habit between immature and mature common minke whales off Kushiro in autumn season, as suggested by Kishiro *et al.* (2009).

The number of sightings of baleen whales other than common minke whales was much lower in the present survey: there was only one sighting of humpback whale, while baleen whales (fin, sei, or humpback whales) were detected 41 occasions in the 2009 survey (Kishiro *et al.* 2010). At the survey, the second dominant prey species of common minke whales was krill. Common minke whales collected close to sighting positions of the large cetaceans had krill. From these, Kishiro *et al.* (2009) discussed that krill was abundant around Kushiro during the 2009 survey and hence local migration of large cetaceans into the waters occurred for krill concentration. In the present survey, however, krill was not observed from whale stomach: krill may not have been so abundant off Kushiro and hence only one sighting of the humpback whale was obtained.

There was no serious practical problem in conducting the surveys. The 2010 coastal survey off Kushiro was completed successfully.

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Table 1. Searching days, distances, hours, and number of cetacean sightings made during the 2010 JARPN II coastal survey off Kushiro.

Period	Days	Distances (n. miles)	Hours	Number of sightings*			
				Species	Primary (Ind/Sch)	Secondary (Ind/Sch)	Total (Ind/Sch)
9/7-10/6	18	4151.6	385.0	Common minke whale	98/97	28/28	126/125
				Like minke whale	18/18	2/2	20/20
				Humpback whale	1/1	0/0	0/0
				Unknown large whale	15/15	0/0	15/15

*: 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	41	19	60
External body proportion	41	19	60
Photographic record and external character	41	19	60
Diatom film record	41	19	60
Body scar record	41	19	60
Measurements of blubber thickness (five points)	40	19	59
Detailed measurements of blubber thickness (11 points)	1	0	1
Body weight	41	19	60
Body weight by parts	1	0	1
Skin tissues for DNA analysis	41	19	60
Muscle, liver, kidney, spleen, blubber, heart, and ventral groove for various analysis	41	19	60
Urine for various analysis	14	1	15
Muscle, liver, kidney, and blubber for heavy metal analysis	41	19	60
Muscle, liver, kidney, and blubber for organochlorine analysis	41	19	60
Collection of blood plasma	30	12	42
Mammary gland, lactation status, measurement and histological sample	-	18	18
Uterine horn, measurements and endometrium sample	-	19	19
Collection of ovary	-	19	19
Foetus	0	0	0
Testis and epididymis, weight and histological sample	41	-	41
Stomach contents, convenient record	41	19	60
Volume and weight of stomach content in each compartment	41	19	60
Observation of marine debris in stomach	41	19	60
Collection of stomach contents for feeding study	33	15	48
Record of external parasites	41	19	60
Earplug for age determination	41	19	60
Tympanic bulla for age determination	41	19	60
Eye lens for age determination	41	19	60
Largest baleen plate for morphologic study and age determination	41	19	60
Baleen plate measurements (length and breadth)	41	19	60
Photographic record of baleen plate series	41	19	60
Length of baleen series	41	19	60
Vertebral epiphyses sample	41	19	60
Number of ribs	41	19	60
Skull measurement (length and breadth)	41	19	60

Table 3. Statistics of body length (m) of common minke whales sampled during the 2010 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>
9/7 – 9/12	6.06	1.14	4.05	7.57	20	5.12	0.56	4.49	6.27	8
9/13 – 9/18	5.51	0.92	4.62	7.48	11	5.53	0.27	5.10	5.78	5
9/19 – 9/24	6.62	1.53	5.53	7.70	2	6.86	-	6.86	6.86	1
9/25 – 9/30	5.03	0.23	4.82	5.28	3	-	-	-	-	0
10/1 – 10/6	5.53	0.93	4.49	6.98	5	5.56	0.65	4.80	6.30	5
Total (9/7 – 10/6)	5.80	1.06	4.05	7.70	41	5.44	0.63	4.49	6.86	19

Table 4. Composition of sex and sexual maturity of common minke whales sampled during the 2010 JARPN II coastal survey off Kushiro.

Period	Male				Female					
	Im	M	Total	Maturity(%)	Im	R	P	Total	Maturity(%)	Pregnancy(%)*
9/7 - 9/12	14	6	20	30.0	8	0	0	8	0.0	-
9/13 - 9/18	10	1	11	9.1	5	0	0	5	0.0	-
9/19 - 9/24	1	1	2	50.0	1	0	0	1	0.0	-
9/25 - 9/30	3	0	3	0.0	-	-	-	0	0.0	-
10/1 - 10/6	4	1	5	20.0	5	0	0	5	0.0	-
Total (9/7 - 10/6)	32	9	41	22.0	19	0	0	19	0.0	-

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 2010 JARPN II coastal survey off Kushiro.

Period	Number of whales (%)						Total
	Japanese anchovy	Pacific saury	Walleye Pollock	Krill	Common squid	Unidentified species	
9/7 - 9/12	13 (46.4)	0 (0.0)	15 (53.6)	0 (0.0)	0 (0.0)	0 (0.0)	28
9/13 - 9/18	5 (31.3)	0 (0.0)	9 (56.3)	0 (0.0)	0 (0.0)	2 (12.5)	16
9/19 - 9/24	2 (66.7)	0 (0.0)	1 (33.3)	0 (0.0)	0 (0.0)	0 (0.0)	3
9/25 - 9/30	0 (0.0)	0 (0.0)	3 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	3
10/1 - 10/6	2 (20.0)	0 (0.0)	8 (80.0)	0 (0.0)	0 (0.0)	0 (0.0)	10
Total (9/7 - 10/6)	22 (36.7)	0 (0.0)	36 (60.0)	0 (0.0)	0 (0.0)	2 (3.3)	60

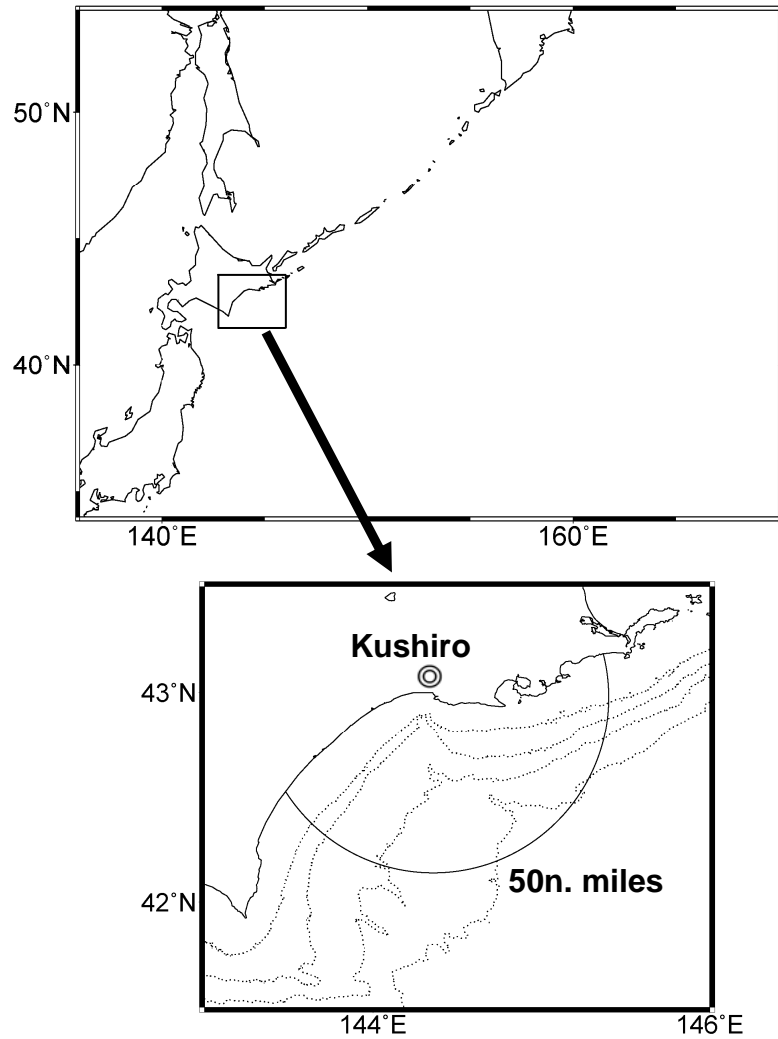


Figure 1. Research area set for the 2010 JARPN II coastal survey off Kushiro. Isobaths are 100m, 200m, 1000m, and 2000m.

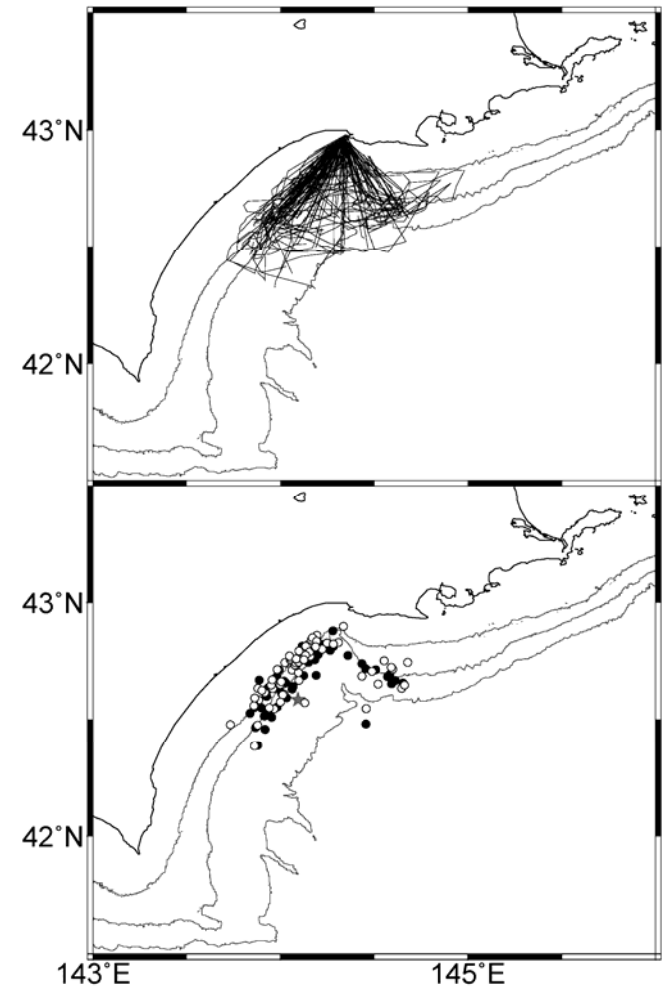


Figure 2. Cruise tracks (upper) and sighting positions (lower) of common minke whales made by sampling vessels during the 2010 JARPN II coastal survey off Kushiro. Black circles are sighting positions of common minke whales collected. Isobaths are 100m, 200m, and 1000m.

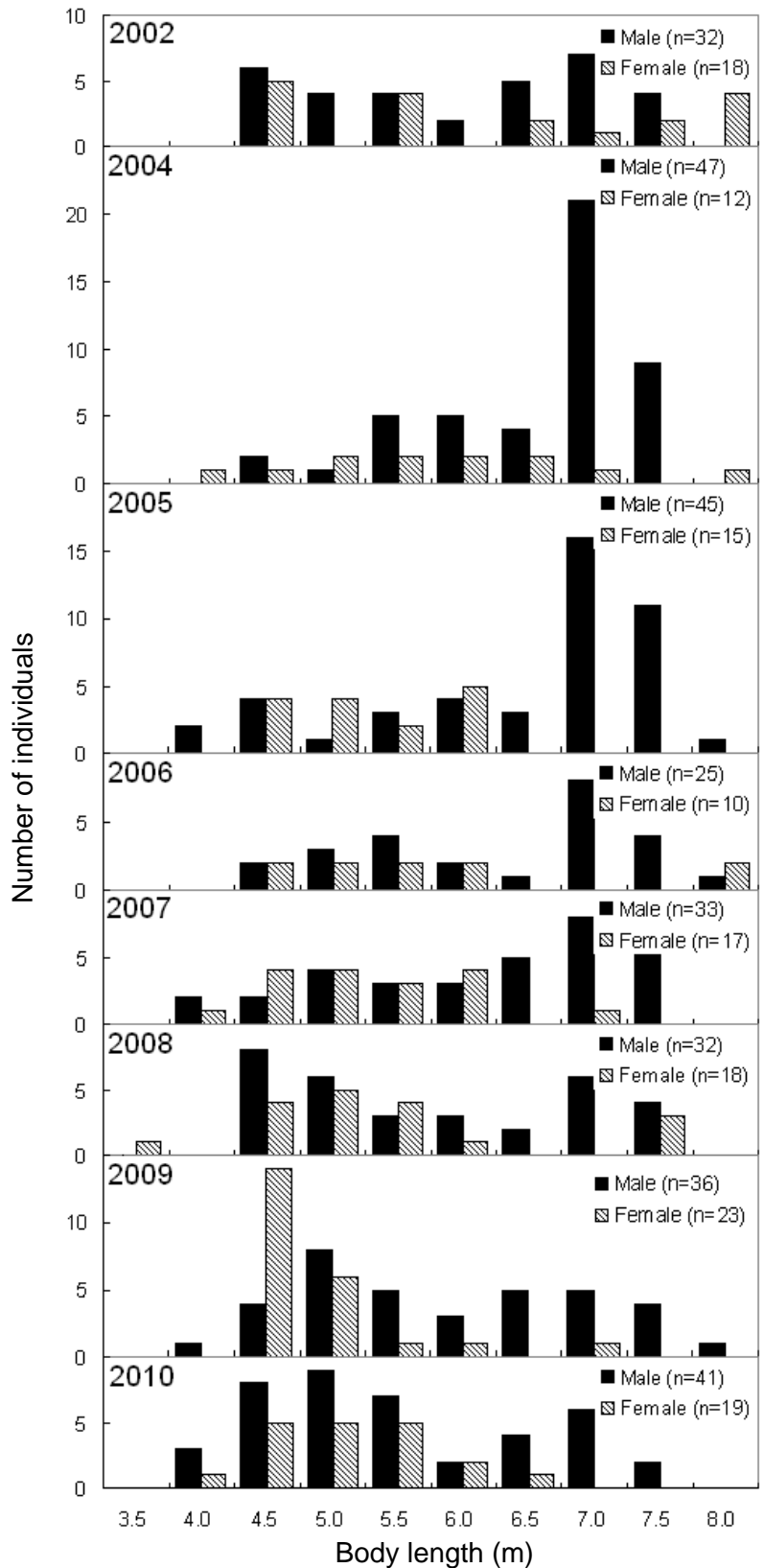


Figure 3. Body length frequency of common minke whales sampled during the 2010 JARPN II coastal survey off Kushiro, with comparison to results of the previous 2002-2009 surveys.

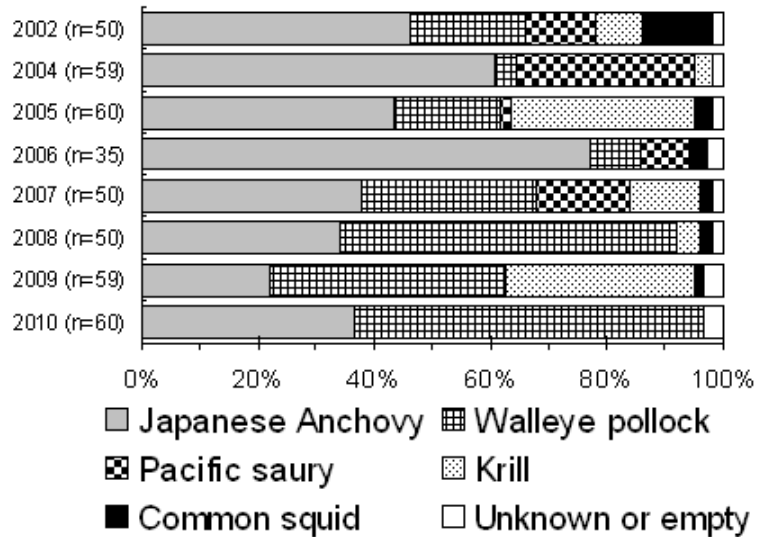


Figure 4. Composition of prey species of common minke whales sampled during the 2010 JARPN II coastal survey off Kushiro, with comparison to results of the previous 2002-2009 surveys.

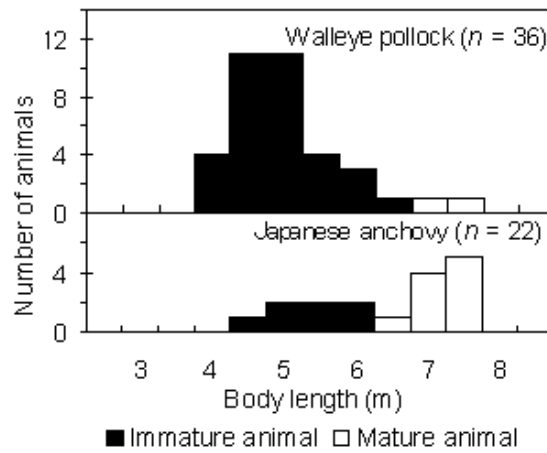


Figure 5. Sexual maturity and body length frequency of common minke whales by their prey species found in forestomach in the 2010 JARPN II coastal survey off Kushiro.

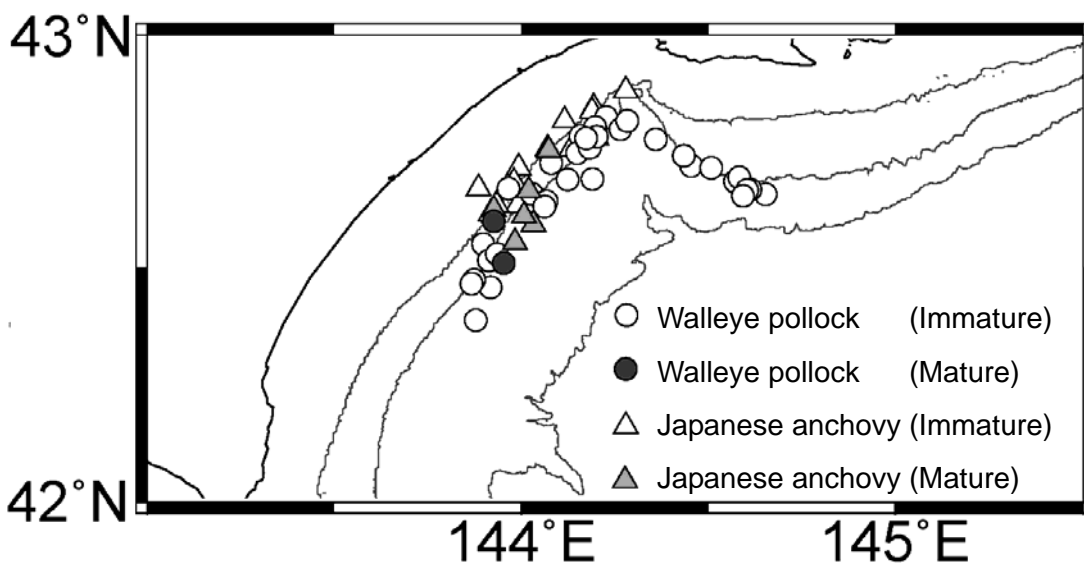


Figure 6. Sighting positions of common minke whales collected during the 2010 JARPN II coastal survey off Kushiro, shown by their maturity stage and prey species. Isobaths are 100m, 200m, and 1000m.