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Feeding habits of Baird's beaked whale *Berardius bairdii*, in the western North Pacific and Sea of Okhotsk off Japan

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ABSTRACT: We examined the stomach contents of 26 Baird's beaked whales caught off the coast of Japan by small-type coastal whalers. The main prey for these whales was rat-tails and hakes in the western North Pacific. Pollock and squids were also important food in the whales collected from the southern Sea of Okhotsk. The prey species found in the stomachs of the whales were almost identical to those caught in bottom-trawl nets at depths greater than about 1000 m in the western North Pacific, which suggests that the Baird's beaked whale forages for prey at depths of about 1000 m or more. Baird's beaked whales in the western North Pacific migrate to waters of 1000–3000 m in depth, where demersal fish are abundant. This implies that Baird's beaked whales migrate to waters where demersal fish, especially rat-tails and hakes, are abundant. Although there is limited information on the feeding habits of ziphiid whales, they are generally thought to prefer squid. The present data suggest that demersal fish are also important prey for ziphiid whales.

KEY WORDS: **Berardius bairdii, *foraging on the bottom*, *hakes*, *rat-tails*, *southern Sea of Okhotsk*, *squid*, *western North Pacific*, *ziphiid***

INTRODUCTION

Baird's beaked whale *Berardius bairdii* is a ziphiid whale that inhabits the North Pacific and adjacent waters. It can reach 12–13 m in body length and 12 tons in body weight.[1] Baird's beaked whales migrate to the coastal waters of the western North Pacific and the southern Sea of Okhotsk in summer.

Ecological knowledge of ziphiid whales, such as, Baird's beaked whale is limited. They are generally thought to feed on squid,[2] but there have been few analyses of stomach contents. In contrast, ziphiid whales are thought to be ecologically important among odontocetes. Kasamatsu and Joyce estimated that ziphiid whales occupy about 70% of all food consumed by odontocetes in the Antarctic.[3] This study implies that ziphiid whales are potentially important to the ocean ecosystem. However, the dearth of feeding habit data makes it difficult to evaluate their ecological role.

Few researchers have identified the prey of Baird's beaked whales. Nishiwaki and Oguro found deep-sea fish in the stomachs of whales collected from the western North Pacific off central Japan.[4] Squid was the most common, but mackerel, sardine, and flat fish were also prey for this species in the western North Pacific off northern Japan, and in the southern Sea of Okhotsk.[4] Walker and Mead collected prey species, including hakes Moridae and rat-tails Macrouridae, from the stomachs of Baird's beaked whales collected from the western North Pacific off the east coast of Honshu, Japan.[5] Balcomb summarized the prey listed in the literature: squids *Gonatus* sp., *Onychoteuthis* sp., *Moroteuthis* sp., skates *Raja* sp., rat-tails *Coryphaenoides* sp., rockfish Scorpaenidae, and octopi *Octopus* sp., *Tremoctopus* sp.[6–8] However, details of the feeding habits of Baird's beaked whales are still limited. In this study, we recorded prey species and also analyzed the mass and abundance of prey items and determined prey size, feeding time, foraging depth, and prey selection for Baird's beaked whales in the

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western North Pacific and the southern Sea of Okhotsk off Japan.

MATERIALS AND METHODS

Japanese small-type whalers operate coastal whaling with permission from the Japanese government, and annually hunt 62 Baird's beaked whales in summer. Of these, 52 are caught in the western North Pacific, and two in the southern Sea of Okhotsk. We collected samples and data from the catches in the western North Pacific and southern Sea of Okhostk (Fig. 1). Sampling was carried out from 5 July to 8 August 1999, at Wada local whaling base on the Pacific coast of central Japan, and from 3 to 9 September 1999, at the Abashiri local whaling base on the Japan coast in the southern Sea of Okhotsk. Wada whalers caught 10 males and 14 females, from 8.85 m to 10.48 m in body length (mean ± SD, 9.95 ± 4.22 m). Abashiri whalers caught a pair of whales; the male was 10.19 m in body length, the female 10.45 m. The harpooned whales were dissected at the local whaling bases. The stomachs were opened carefully and all the solid contents were collected. The inner walls of the stomachs were carefully scrutinized for small parts, which were also collected. The collected contents were frozen until examination.

In the laboratory, contents were thawed and weighed to the nearest gram. Identifiable prey parts included: sagittal otoliths of fish, lower beaks of squid, undigested and half-digested fish, fish skulls containing otoliths, and squid buccal masses with beaks. These parts were sorted into taxonomic groups by comparison with one author's (HO) otolith collection and the collection of cephalopod beaks at the National Science Museum, Tokyo, Japan. References on cephalopod beaks and otoliths were also consulted.[9–11] When possible, undigested and partially digested remains were identified to the species level based on external morphology.

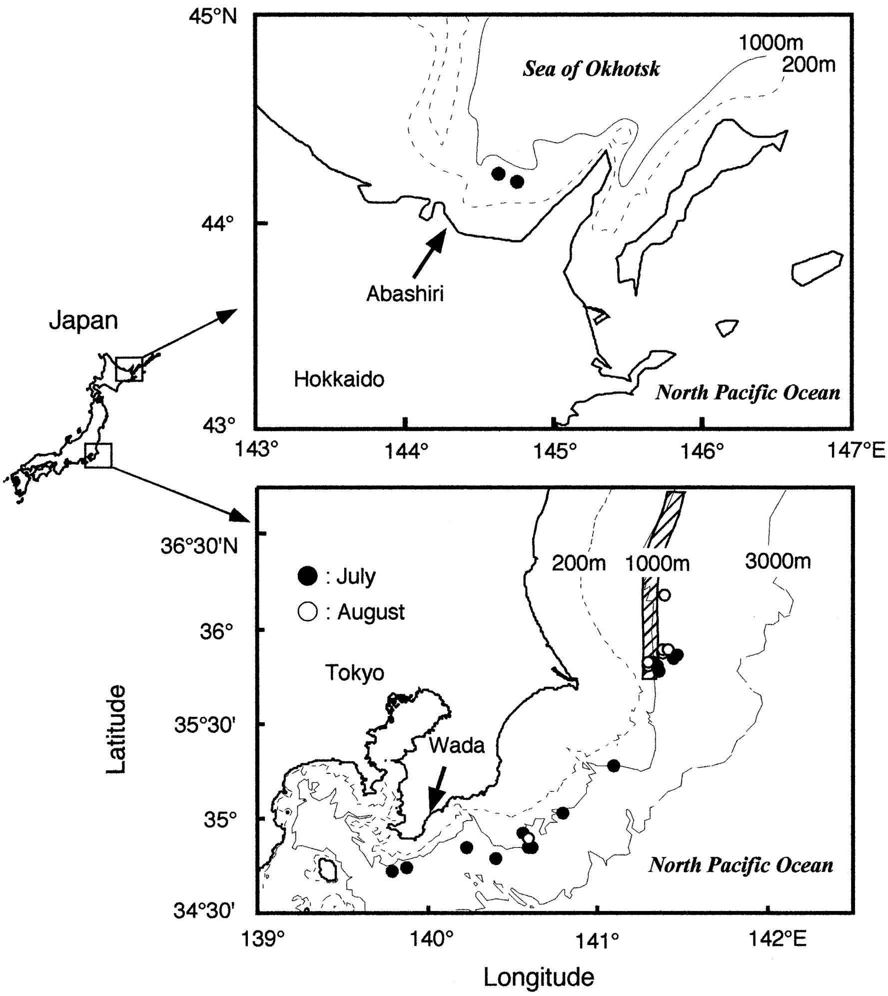

Fig. 1 Catch positions of Baird's beaked whales. Hatched area is sampling area of bottom trawl by Yasui *et al.*[14]

The lower rostral length (LRL) of all undamaged squid beaks and the sagittal otolith length (OL) or otolith height (OH) of all apparently undigested otoliths were measured to the nearest 0.1 mm with vernier calipers. Body length and weight of prey were estimated from the relationships shown in Table 1. The estimated preanal-fin length (PAF) of *Coryphaenoides cinereus* was converted to total length (TL) based on the relationship between preanal length (PAL) and TL with no correction, because the anal and anterior insertion of anal fin is close in this species. The total weight contribution of each prey species present was calculated by multiplying the mean estimated weight by the number of prey.

Data were analyzed by sampling locations for the comparison of geographic variation of food habits.

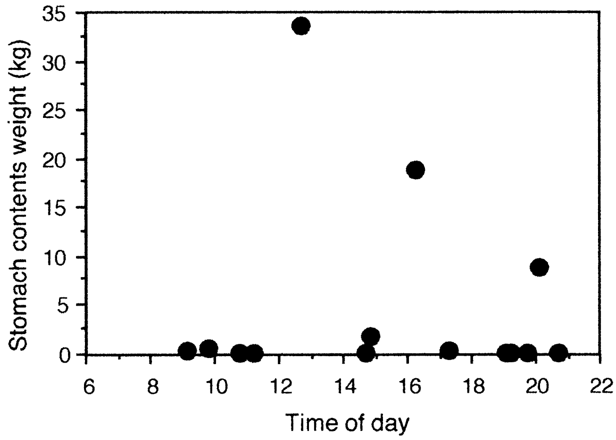

Fig. 2 Weight of stomach contents at the time of catch. Two whales in Abashiri and three whales in Wada were excluded, because of vomiting or broken stomach.

RESULTS

Most of the whale specimens had little in their stomachs; the median weight of the contents was 215 g (mean ± SD, 3.195 ± 8.267 kg; $n = 21$). The weight of stomach contents in reference to the time of catch varied widely, with a peak of 33.7 kg in a whale caught at 12:40 PM (Fig. 2). The three stomachs with contents weighing over 8 kg contained many fresh fish, including 61 *Coryphaenoides longifilis*, 53 *C. acrolepis*, 18 *Antimora microlepis*, five *C. cinereus* and two *Engraulis japonicus*. Other stomachs contained no identifiable fresh fish.

A total of 46 types of prey were found in specimens collected at Wada, including 22 species of squid and nine species of fish (Table 2). Rat-tails and hakes were important prey. *Coryphaenoides longifilis* made up more than half of the total reconstituted prey weight, and *C. acrolepis* was another main prey item. *Laemonema longipes*, *A. microlepis* and *C. cinereus* were also important. Squids, mostly mesopelagic or deep-sea,[12,13] were common but their contribution both in number and reconstituted weight was insignificant. Unidentified crabs were found in the whales' stomachs, but they were also found in the stomachs of the prey fish. This suggests that crabs are secondarily introduced.

In the samples collected at Abashiri, a large species of *Galiteuthis* squid contributed most to reconstituted prey weight, followed by *Theragara chalcogramma*, *Gonatopsis makko*, and *C. pectoralis*. *Laemonema longipes* was important numerically but less so in terms of reconstituted weight.

Stones, pebbles, and other miscellaneous matter, such as, wood, plastic objects, seaweed roots, leaves of terrestrial plants, and fish hooks were also found in the stomachs of specimens collected at both Wada and Abashiri.

Prey ranged in size from 23.5 mm, the dorsal mantle length (DML) of a juvenile *Gonatus* squid, to 1012.5 mm, TL of *C. longifilis*. The estimated DML of most of the squid collected from the stomachs of the Wada specimens ranged from 50 to 350 mm (Fig. 3). The DML size classes of the most abundant prey were 50–100 mm, 100–150 mm, and 200–250 mm, which mainly comprised *Chiroteuthis* sp., *Gonatus* sp., and *Taonius pavo*, respectively. The largest prey item was 656 mm in DML (*Galiteuthis* sp.). Squid taken from Abashiri specimens were bimodal in size (Fig. 3): the smaller peak, 200–250 mm DML, consisted mainly of *G. makko*; the larger peak, 600–650 mm DML, was primarily *Galiteuthis* sp. For fish, large prey items were common. Except for *L. longipes* in Abashiri, most of the fish were larger than 300 mm (Fig. 4).

DISCUSSION

According to Nishiwaki and Oguro, whose research included the years 1965–1969, Baird's beaked whales fed on deep-sea fish in the western North Pacific off central Japan.[4] Walker and Mead found many hakes and rat-tails in the stomach contents of Baird's beaked whales collected in waters off Wada between 1985 and 1987.[5] However, the most common fish was a hake, *Podonema longipes* (*L. longipes*), which was not as abundant in this study. Although the prey species differ somewhat, previous reports and present results suggest that

Table 1 Relationships between measured variables and body length or body weight

Species	Regression	y	x	r^2	n	Reference no.
Squids						
Chiroteuthis spp.	$y = 11.4 + 24.46x$	DML (mm)	LRL (mm)	NA	23	28, obtained from *Chiroteuthis* sp.
	$\ln y = -0.241 + 2.7 \ln x$	BW (g)	LRL (mm)	NA	14	28, obtained from *Chiroteuthis* sp.
Berryteuthis magister	$y = -14.021 + 46.214x$	DML (mm)	LRL (mm)	0.91	31	29
	$\ln y = -8.563 + 2.66 \ln x$	BW (g)	DML (mm)	0.99	32	29
Gonatopsis borealis	$y = 17.036 + 35.779x$	DML (mm)	LRL (mm)	0.94	50	30
	$\ln y = 2.145 + 2.037 \ln x$	BW (g)	LRL (mm)	0.93	50	30
Gonatopsis makko	$\ln y = 3.575 + 0.899 \ln x$	DML (mm)	LRL (mm)	0.67	37	31, obtained from *G. middendorffi*
	$\ln y = -0.655 + 3.33 \ln x$	BW (g)	LRL (mm)	NA	20	28, obtained from *Gonatus* spp.
Gonatus onyx	$y = 12.82 + 19.02x$	DML (mm)	LRL (mm)	0.72	NA	32
	$\ln y = 0.086 + 2.13 \ln x$	BW (g)	LRL (mm)	0.82	NA	32
Other Gonatidae spp.	$y = -43.4 + 42.87x$	DML (mm)	LRL (mm)	NA	17	28, obtained from *Gonatus* spp.
	$\ln y = -0.655 + 3.33 \ln x$	BW (g)	LRL (mm)	NA	20	28, obtained from *Gonatus* spp.
Histioteuthis dofleini	$y = -15.9 + 20.61x$	DML (mm)	LRL (mm)	NA	8	28
	$\ln y = 1.342 + 2.44 \ln x$	BW (g)	LRL (mm)	NA	20	33
Histioteuthis spp.	$y = -13.6 + 22.21x$	DML (mm)	LRL (mm)	NA	54	28, obtained from Other *Histioteuthis* spp.
	$\ln y = 1.779 + 2.01 \ln x$	BW (g)	LRL (mm)	NA	35	28, obtained from Other *Histioteuthis* spp.
Onychoteuthis spp.	$y = -28.9 + 61.0x$	DML (mm)	LRL (mm)	0.95	NA	32, obtained from *O. banksi*
	$\ln y = 0.58 + 3.70 \ln x$	BW (g)	LRL (mm)	0.89	NA	32, obtained from *O. banksi*
Moroteuthis loennbergi	$y = -442.33 + 115.51x$	DML (mm)	LRL (mm)	NA	21	28, obtained from *Moroteuthis* sp.
	$y = -0.068 + 3.50 \ln x$	BW (g)	LRL (mm)	NA	30	28, obtained from *Moroteuthis* sp.
Taonius pavo	$y = -12.3 + 61.43x$	DML (mm)	LRL (mm)	NA	72	9
	$\ln y = 0.786 + 2.19 \ln x$	BW (g)	LRL (mm)	NA	74	9
Galiteuthis spp.	$y = 12.2 + 40.78x$	DML (mm)	LRL (mm)	NA	39	9
	$\ln y = 0.728 + 2.34 \ln x$	BW (g)	LRL (mm)	NA	38	9
Ancistrocheirus lesueuri	$y = -41.3 + 40.75x$	DML (mm)	LRL (mm)	NA	23	9
	$\ln y = -0.194 + 3.56 \ln x$	BW (g)	LRL (mm)	NA	21	28

Ommastrephes bartrami	$y = 52.7 + 27.61x$	DML (mm)	LRL (mm)	0.96	NA	32
	$\ln y = 1.834 + 2.07 \ln x$	BW (g)	LRL (mm)	0.98	NA	32
Ornithoteuthis volatilis	$y = -16.96 + 38.81x$	DML (mm)	LRL (mm)	0.93	NA	32
	$\ln y = 0.165 + 2.66 \ln x$	BW (g)	LRL (mm)	0.95	NA	32
Todarodes pacificus	$y = 18.53 + 37.44x$	DML (mm)	LRL (mm)	0.97	NA	32
	$\ln y = 1.11 + 2.64 \ln x$	BW (g)	LRL (mm)	0.98	NA	32
Other ommastrephidae	$y = 52.7 + 27.61x$	DML (mm)	LRL (mm)	0.96	NA	32, obtained from *O. bartrami*
spp.	$\ln y = 1.834 + 2.07 \ln x$	BW (g)	LRL (mm)	0.98	NA	32, obtained from *O. bartrami*
Fishes						
Coryphaenoides acrolepis	$y = -71.311 + 21.74x$	PAL (mm)	OL (mm)	0.91	94	Present study
	$y = 52.105 + 2.7354x$	TL (mm)	PAL (mm)	0.95	376	19
	$\ln y = -4.121 + 4.28 \ln x$	BW (g)	OL (mm)	0.96	94	Present study
Coryphaenoides cinereus	$y = -13.75 + 21.44x$	PAF (mm)	OH (mm)	0.91	248	Walker WA. pers. comm., 2002
	$y = 64.468 + 3.2421x$	TL (mm)	PAL (mm)	0.78	42	19
	$\ln y = -10.05 + 3.21 \ln x$	BW (g)	PAF (mm)	0.99	242	Walker WA. pers. comm., 2002
Coryphaenoides longifilis	$y = 5.378 + 13.177x$	PAL (mm)	OL (mm)	0.93	51	Present study
	$y = 7.9608 + 3.7226x$	TL (mm)	PAL (mm)	0.96	139	19
	$\ln y = -1.181 + 3.027 \ln x$	BW (g)	OL (mm)	0.96	51	Present study
Coryphaenoides pectoralis	$\ln y = -3.481 + 3.979 \ln x$	BW (g)	OL (mm)	0.95	72	Present study
Antimora microlepis	$\ln y = 3.996 + 1.27 \ln x$	BW (g)	OL (mm)	0.52	11	Present study
Laemonema longipes	$y = -160.759 + 63.291x$	SL (mm)	OL (mm)	0.98	206	Nobetsu T. pers. comm., 2001
	$\ln y = -6.366 + 5.587 \ln x$	BW (g)	OL (mm)	0.99	206	Nobetsu T. pers. comm., 2001
Theragra chalcogramma	$y = -9.77 + 3.175x$	FL (cm)	OL (mm)	0.97	98	34
	$\ln y = -4.867 + 2.906 \ln x$	BW (g)	FL (cm)	0.998	109	34

BW, body weight; DML, dorsal mantle length; FL, fork length; LRL, lower rostral length; NA, not available; OH, otolith height; OL, otolith length; PAF, preanal fin length; PAL, preanal length; SL, standard body length; TL, total length.

Table 2 Contributions in the stomach contents of *Berardius bairdi*

Prey items		% Occurrence		% Number		% Weight	
Family	Species	Abashiri	Wada	Abashiri	Wada	Abashiri	Wada
Cephaolopods							
Ommastrephidae	*Ommastrephes bartrami*	–	4.17	–	0.11	–	0.04
	Ornithoteuthis volatilis	–	4.17	–	0.11	–	0.01
	Todarodes pacificus	–	4.17	–	0.11	–	0.10
	Ommastrephidae sp.	–	4.17	–	0.11	–	0.01
Onychoteuthidae	*Onychoteuthis banksi*	–	8.33	–	0.32	–	0.10
	Onychoteuthis borealijaponica	–	4.17	–	0.11	–	0.10
	Moloteuthis loennbergi	–	8.33	–	0.32	–	0.23
Gonatidae	*Gonatus onyx*	50.00	16.67	2.02	1.19	0.56	0.16
	Gonatus berryi	50.00	20.83	2.02	0.76	1.64	0.23
	Gonatus madokai	–	4.17	–	0.11	–	NA
	Gonatus pyros	–	16.67	–	0.65	–	0.22
	Gonatopisis borealis	–	25.00	–	0.86	–	0.43
	Gonatopsis makko	50.00	–	6.06	–	11.51	–
	Gonatus sp.	–	37.50	–	5.30	–	0.55
	Gonatus spp. juvenile	–	16.67	–	0.86	–	0.02
Enoploteuthidae	*Enoploteuthis chuni*	–	12.50	–	1.08	–	NA
	Watasenia scintillans	–	4.17	–	0.11	–	NA
Ancistrocheiridae	*Ancistrocheirus lesueuri*	–	4.17	–	0.11	–	0.13
Histioteuhidae	*Histioteuthis dofleini*	–	4.17	–	0.11	–	0.10
	Histioteuthis c. inermis	–	4.17	–	0.32	–	0.13
Chiroteuthidae	*Chiroteuthis imperator*	–	25.00	–	3.24	–	0.11
	Chiroteuthis calyx	–	4.17	–	0.22	–	NA
	Chiroteuthis sp.	–	8.33	–	0.22	–	NA
	Valbyteuthis ?	–	8.33	–	0.22	–	NA
Grimalditeuthidae	*Grimalditeuthis bonplandi*	–	4.17	–	0.11	–	NA
Cranchiidae	*Taonius pavo*	50.00	66.67	2.02	7.46	1.42	1.02
	Galiteuthis phyllura	–	25.00	–	1.08	–	0.15
	Galiteuthis large sp.	50.00	4.17	12.12	0.22	47.85	0.58
Octopus	*Ciirrothauma* sp.	–	4.17	–	0.11	–	NA
	Octopus spp.	–	8.33	–	0.32	–	NA
Teleosts							
Moridae	*Antimora microlepis*	–	8.33	–	0.97	–	3.83
	Laemonema longipes	50.00	45.83	33.33	6.11	3.29	4.15
	Moridae sp.	–	25.00	–	1.51	–	NA
Gadidae	*Theragra chalcogramma*	50.00	–	13.13	–	26.38	–
	Gadidae sp.	–	12.50	–	1.24	–	NA
Macrouridae	*Albatrossia pectralis*	–	4.17	–	0.05	–	NA
	Coryphaenoides pectoralis	50.00	4.17	4.04	0.27	6.50	NA
	Coryphaenoides longifilis	–	37.50	–	29.62	–	69.26
	Coryphaenoides acrolepis	–	20.83	–	4.49	–	16.77
	Coryphaenoides cinereus	50.00	37.50	3.03	8.86	0.84	1.57
	Macrouridae sp.	–	4.17	–	0.05	–	NA
Macrouroididae	*Squalogadus modificatus*	–	4.17	–	0.11	–	NA
Zoarcidae	*Bentholocara molle*	–	4.17	–	0.05	–	NA
Engraulidae	*Engraulis japonicus*	–	4.17	–	0.16	–	NA
Unknown families	Type 114	–	4.17	–	0.05	–	NA
	Type 115	–	4.17	–	0.05	–	NA
Unknown eroded otolith		100.00	75.00	22.22	20.54	NA	NA
Crustaceans (unknown crab and shrimp)		–	50.0	–	NA	NA	NA
Stone and pebbles		50.00	66.67	NA	NA	NA	NA
Miscellaneous matter		–	37.50	–	NA	–	NA
Absolute number in total		2 whales	24 whales	49.5 prey	925 prey	15.14 kg	439.51 kg

Number of fish prey is expressed in half number of total otoliths. NA, no available.

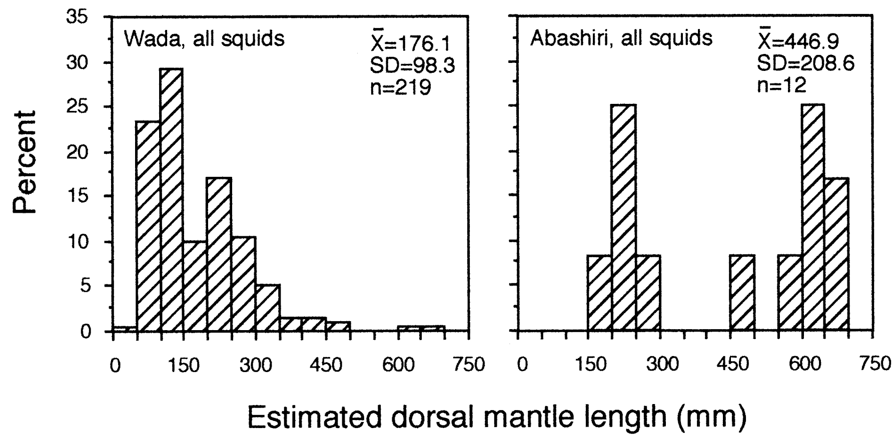

Fig. 3 Size spectrum of prey squid.

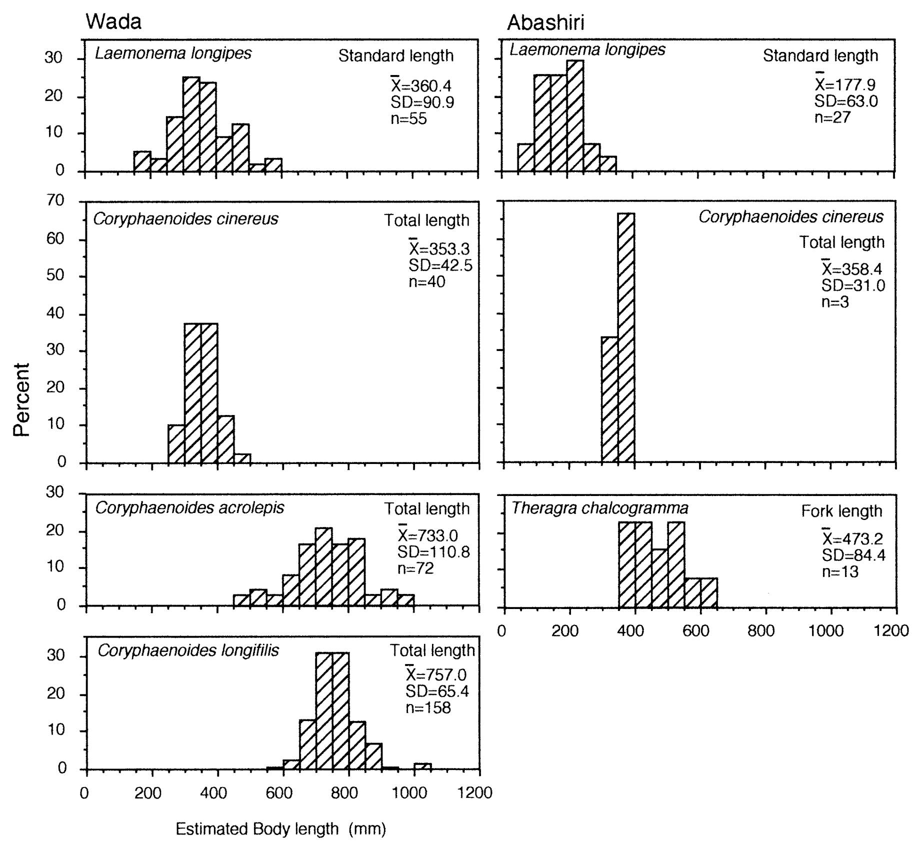

Fig. 4 Size spectrum of prey fish. Sample size is number of measured otoliths.

demersal fish have been the main prey of Baird's beaked whales in the western North Pacific off central Japan since the 1960s. In the southern Sea of Okhotsk, squid have been designated the most common prey, but we also found many *L. longipes* and *T. chalcogramma* in Abashiri specimens.[4] Demersal fish may also be important prey in the southern Sea of Okhotsk.

The abundance of demersal prey items (e.g. rat-tails, hakes and pollock) found in the specimens described here suggests that Baird's beaked whales dive to the bottom to forage. The whales were caught at depths of about 1000 m, which confirms that Baird's beaked whales can dive at least that deep. The fish species collected by research bottom-trawl nets in January 1978 in the area off-shore of Ibaraki prefecture, north-east of Wada (Fig. 1), especially those from 1100 to 1300 m,[14] were almost identical to the results of the stomach-content analysis of the Wada specimens reported here (Fig. 5). This trawl provided data for fish assemblages in winter, but because seasonal

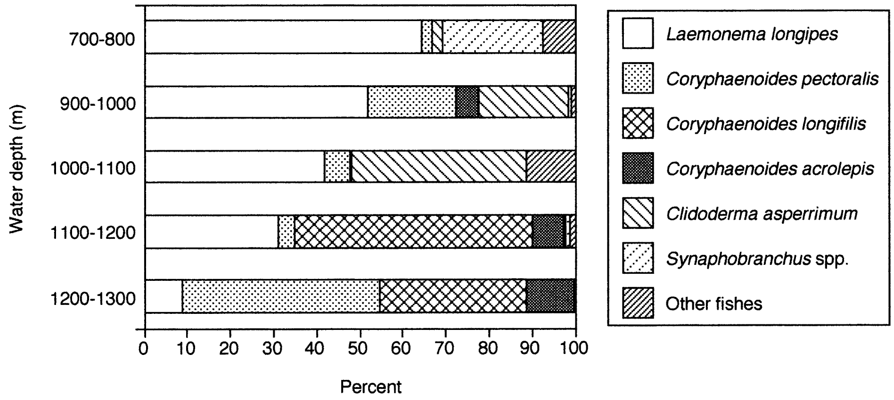

Fig. 5 Relative biomass of demersal fish collected by bottom trawl in the area off Ibaraki. Data from Yasui *et al.*[14] Data in the depth 800–900 m is excluded because of apparent error in the original data.

changes in environmental factors, such as, water temperature in the bottom layer, are generally expected to be minor, seasonal variation of the fauna on the bottom is considered to be stable. Therefore, present comparison of our data with the trawl sample suggests that the prey composition accurately reflects the demersal fish assemblage of 1100–1300 m depth. Sighting surveys have reported that Baird's beaked whales have been observed in waters at 1000–3000 m deep.[15,16] Yasui *et al.* showed that the biomass of demersal fish off Ibaraki sharply increases below 800 m.[14] Summer migration of Baird's beaked whales off the Pacific coast of Japan may relate to the area where prey is abundant.

Some toothed whales, especially the smaller dolphins, feed on mesopelagic prey at night. Common dolphins *Delphinus delphis* in the western North Pacific, and Dall's porpoises *Phocoenoides dalli* in the Sea of Okhotsk, feed on myctophids at night.[17,18] This nocturnal feeding relates to the vertical migration of prey to shallower waters at night. However, we found that the weight of Baird's beaked whale stomach contents peaked during the daytime, when the contents included many fresh deep-sea fish. This suggests that Baird's beaked whales forage on the ocean bottom, even during the day. The ability to dive to the bottom probably means that Baird's beaked whales do not have to rely on the vertical migration of prey, unlike dolphins. However, many specimens collected during the day had nearly empty stomachs so it is unlikely that daytime is the species' main feeding time.

Most of the squids eaten by Baird's beaked whales are mesopelagic species but especially the smaller squids perform diurnal vertical migration to be distributed evenly in epipelagic layers at night. They show ontogenetic vertical decent to inhabit mesopelagic or deeper layers.[12] Most of the prey squid in this study were >10 cm, which suggests that they are at least at the subadult stage and distributed in the mesopelagic or deeper layer of the sea. Although prey contributions suggest that the whales mainly forage on prey at the sea bottom, squids in the stomach contents suggest the possibility of whales feeding in the mesopelagic or deeper layers.

For rat-tails, TL at sexual maturity of females is 376 mm, 700 mm and 760 mm for *C. cinereus*, *C. acrolepis* and *C. longifilis*, respectively. The males are smaller than the females.[19] The mean total lengths of *Coryphaenoides* spp. fed upon by Baird's beaked whales were greater or almost the same lengths as female fish at sexual maturity.

Our data suggest that Baird's beaked whales feed on prey of a wide range of sizes. However, rat-tails, such as, *C. acrolepis* have a long string-like tail, which may skew the size comparison with other prey items. Tollit *et al.* pointed out that size estimates based on otoliths, the length of which are reduced by digestion, may lead to underestimation of body length.[20] However, selection of apparently undigested otoliths, as in this study, yields accurate estimates of the fishes' body lengths.[21] Size variation of prey items may result in an underestimation of the mass contribution by smaller prey, because smaller prey items are probably digested faster than larger prey. However, this bias is probably not serious in the present study because larger prey items, such as, rat-tails are apparently primary prey items even in numerical contribution.

Our results suggest that demersal fish are among the main prey items for whales of the ziphiid family. Researchers previously thought that ziphiid whales prefer squid,[2] based on analyses of the stomach contents of bottlenose whales *Hyperoodon* spp.[22–24] The few stomach-content analyses of beaked whales of the genus *Mesoplodon* suggest that they generally prefer mesopelagic squid and fish.[25] Limited analyses suggested that the primary prey of Cuvier's beaked whale *Ziphius cavirostris* is squid, but Nishiwaki and Oguro found deep-sea fish in their stomachs in the western North Pacific off the east coast of Honshu, Japan.[26,27] Dietary studies of whales in the ziphiid family have been carried out sporadically and opportunistically (i.e. after a stranding), so the data are limited in value. Our data and those from some previous studies suggest that beaked whales feed on deep-sea fish on the slope of the continental shelf. This may suggest that their diving ability to the bottom extends the available prey selection. Further study is needed to evaluate the possible ecological importance of beaked whales.

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