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Feeding of the bearded seal Erignathus barbatus nauticus
(Pallas) in the Bering Sea during the
spring-summer period

by G.M. Kosygin

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Feeding of the bearded seal *Erignathus barbatus nauticus* (Pallas) (144)*

in the Bering Sea during the spring-summer period

by G.M. Kosygin (TINRO)

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In order to get an idea of the effect abundant herds of pinnipeds have on commercially exploitable species of marine life, it is necessary to have sufficient data on the feeding of these animals. Up to the present time, only the feeding habits of the fur seal (of the North Pacific pinnipeds) have been studied in detail (Panina, 1964, 1965, 1966).

Some of the earliest scientific papers were already informing us that the basic food items of the bearded seal were crustaceans, mollusks, worms and fish (Allen, 1880; Römer und Schaudinn, 1900; Smirnov, 1903; Hyort, 1907; Freund, 1933; Ognev, 1935). The feeding habits of *Erignathus barbatus* have not been studied to the same extent on all the different parts of its range. According to the data of Hyort (1907), K.K. Chapsky (1938, 1963) and M.N. Tarasevich (1963), the bearded seal of the Barents and Kara seas feeds mostly on *Sclerocrangon boreas*, *Sclerocrangon ferox*, *Salinea septemcarinata*, *Mesidothea entomon*, *Mesidothea sabini*, *Spirontocaris polaris*, Hyppolytidae,

*The numbers in the right-hand margin are the pages of the Russian text - translator.

Eualus gaimardii (crustaceans); Buccinum undatum, Buccinum groenlandicum, Buccinum ciliatum (mollusks); arctic cod Boreogadus saida, Pacific sand lance Ammodytes hexapterus marinus and char Salvelinus sp. (fish).

L.N. Popov (1939) and G.L. Rutilevsky (1939) have encountered mollusks, crustaceans and arctic cod in the stomachs of bearded seals caught in the coastal waters of the Taimyr Peninsula. Fairly detailed data are available on the feeding of the bearded seal in the area located between the village of Kivalina and Point Hope (Alaska) on the Chukchi Sea. According to M. Johnson et al. (1966), the basic food items of this seal during the period from November 1960 to June 1961 were shrimps Sclerocrangon boreas, Lebeus groenlandicus, Argis lar and Pandalus goniurus, as well as gastropods. Considerably more information is available on the feeding of the bearded seal in the Sea of Okhotsk, particularly on its western portion. The food items of the seal in this area include Crangonidae, Pandalidae, Hyas coarctatus, Gastropoda, Lamellibranchiata, Cephalopoda, Echiurus echiurus, Holothurioidea, Osmeridae, Zoarcidae, Ammodytes, Gadidae and Pleuronectidae (Pikharev, 1940, 1948; Inukai, 1952; Inukai, 1943; Wilke, 1954). The feeding habits of the Bering bearded seal are known only from a brief report by K. Kenyon (1962) and one of our reports (Kosygin, 1966a) based on the materials of one season.

The purpose of the present paper is to present new data on the feeding of the bearded seal in the Bering Sea during the spring-summer period of 1963-1965. The material was collected during TINRO expeditions to study pinnipeds. The material studied is listed in table 1. Investigations in this area were carried out from March to June. The locations in which the bearded seal was caught are indicated in fig. 1. The method of collecting and processing the material has been described by G.A. Pikharev (1940) and in one of our previous papers (Kosygin, 1966a)*. (145)

*The author expresses his sincere gratitude to G.K. Panina for her assistance in determining the species to which the food items of the bearded seal belong.

Table 1

Material studied to determine the feeding habits of the bearded seal
in the Bering Sea

Period of sampling	No. of analyzed stomachs			Including stomachs:	
	male	female	Total	with food	empty
1963					
March 26th-June 18th	19	46	65	36	29
1964					
April 11th-June 6th	74	173	247	55	192
1965					
April 4th-June 27th	102	151	253	61	192
Total	195	370	565	152	413

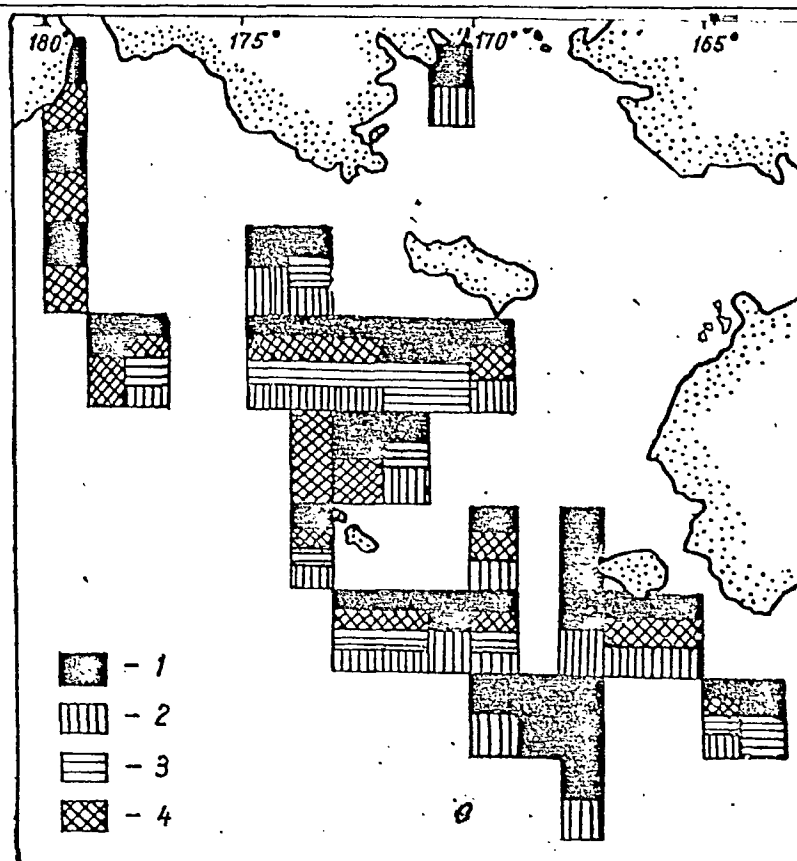


Fig. 1. Locations in which the bearded seal was caught and the distribution of its basic food items.

1 - crustaceans, 2 - mollusks, 3 - worms, 4 - fish.

The qualitative and quantitative composition of the food items
of the bearded seal in the Bering Sea

(146)

An analysis of the stomach contents of bearded seals caught in the Bering Sea during the spring-summer period of 1963-1965 revealed more than 30 species of crustaceans, several species of mollusks and their egg deposits, sponges, approximately 4 species of nematodes and annelids, pogonophores, about 15 species of fish (table 2) and algae. The latter had been observed among the food items of the bearded seal earlier (Zaks, 1929; Popov, 1939).

As indicated in fig. 1, crustaceans and fish were found in the stomachs of bearded seals on almost the entire fishing area during the three years of investigations. Mollusks, annelids and nematodes were not found in the food of the seals caught in Anadyr Gulf, this, apparently, being due to the peculiarities of the distribution of the benthos.

The main food item of the Bering bearded seal was found to be the snow crab Chionoecetes opilio opilio which made up from 53 to 76% of all its food during the spring-summer months of the three years of investigations (table 2). This is probably due to the abundance of the snow crab (Makarov, 1941; Neiman, 1960, 1963) and the seasonal migrations of the bearded seal to the same areas from year to year. The second most frequently occurring crustacean was the visored shrimp Nectocrangon lar lar. The bearded seal also consumed considerable quantities of Pandalus goniurus, Pandalus jordani and Pandalus sp.

The spider crab (Hyas coarctatus) is an important food of the bearded seal on the northern part of the Bering Sea (Kenyon, 1962; Losygin, 1966a). Other crustaceans were encountered in the stomachs of bearded seals either occasionally or in small quantities.

Gastropods are the second most important food of the bearded seal. It was found that this seal fed quite frequently on Octopodidae, the remains

of the latter being encountered in all the full stomachs during certain months. Mollusk egg deposits were found only once in the stomachs examined. Priapulus caudatus was the most frequently encountered worm; Echiurus echiurus being consumed to a lesser degree. Polychaetes, which were an important food item of the bearded seal in 1963, were not observed in the following years.

Various researchers have dwelt on the feeding of the Atlantic and Pacific bearded seal on fish. Large fish up to 25 cm long have been encountered by Römer et al. (1900). The authors assume that these were rock gunnel. Arctic cod, deepwater redfish, gobies, flounder, walleye pollock, capelin and poacher have been encountered by I. Hyort (1907), L. Freund (1933), L.N. Popov (1939), G.L. Rutilevsky (1939), K.K. Chapsky (1938, 1963), G.A. Pikharev (1940), K. Kenyon and V. Scheffer (1955), F. Wilke (1954), Y.E. King (1964) and E.A. Tikhomirov (1966c).

According to our materials, the fish ration of the bearded seals caught in the Bering Sea was most diverse both in quality and quantity in 1964. The most frequently occurring fish were the daubed shanny (Leptoclinius maculatus) and righteye flounders (table 2). We also encountered capelin (Mallotus villosus), pope's-eye grenadier (Coryphaenoides cinereus), navaga (Eliginus gracilis), Nozawa's prickleback (Stichaeus nozawae), walleye pollock (Theragra chalcogramma), Scorpenidae, pale eelpout (Licodes palearis arcticus), Pacific spiny lump sucker (Eumicrotremus orbis), pond smelt (Hypomesus olidus) and fish eggs (species not identified), however these were of little importance as food items for the bearded seal.

As we can see, the species composition of the fish consumed by the bearded seal is quite extensive, arctic cod (Boreogadus saida) being a highly important food of the Atlantic bearded seal (Chapsky, 1938, 1963), and the daubed shanny and righteye flounders the major food items of the Pacific bearded seal. (according to our data). (147)

Table 2 indicates that some of these food items dropped from the feeding spectrum of the bearded seal during certain years. For example, in 1965 we did not encounter the shrimp Crangon dalli which had been one of the foods of the bearded seal in previous years; polychaetes were an important food in 1963, but were not encountered in the following years of investigations; the daubed shanny, which was found in abundance in 1963 and 1965, was not noted in 1964. Perhaps this was due to the migrations from former habitats of some of the animals, e.g. fish, that had served as food for the bearded seal. The main cause, apparently, were the ice conditions. Continuous fields of pack ice may close off the favourite foraging grounds of the bearded seal for lengthy periods, forcing the animal to move to other areas where the qualitative composition of its food will differ.

Therefore, the main food items of the bearded seal in the Bering Sea during the spring-summer period of 1963-1965 were the snow crab, visored shrimp, gastropods and octopuses. The constancy of the species composition of the animals consumed by the bearded seal is, apparently, due to the fact that this seal keeps to approximately the same places in the Bering Sea from year to year (Kosygin, 1966b; Tikhomirov, 1966b; Tikhomirov and Kosygin, 1966).

While studying the literature and materials of the first expedition in 1963, we came to the conclusion that the feeding habits of the bearded seal in the Sea of Okhotsk and Bering Sea during the spring-summer months are similar (Kosygin, 1966a). Subsequent investigations have confirmed this.

The accumulation of data on the quantitative characteristics of the food of bearded seals is highly important for both scientific and practical purposes.

The food that was found in the stomachs of the Bering seals during the spring-summer months of 1963-1965 and the degree to which it had been digested indicated a certain tendency of different age groups to forage at

a particular time. For example, we observed that young bearded seals foraged mostly during the first half of the day, while mature individuals consumed their food in the afternoon (fig. 2). We did not hunt at night, and so do not have any information on the feeding of the bearded seal during the night hours. We have examined a number of stomachs taken from animals caught during the early hours of the morning. These also contained highly digested food, which permits us to assume that the bearded seal also forages at night.

It has already been noted that the stomach contents of the animal can be most diverse from the standpoint of species composition, or, in certain cases, homogeneous (Kosygin, 1966a). The bearded seal has been known to consume up to 50 snow crabs. Crabs of different sizes and digested to various degrees have been found in the food bolus; the width of their carapace varied from 20 to 85 mm; in many cases these were females with eggs. In the stomach of one bearded seal we found the highly digested remains of 390 snow crabs which were, undoubtedly, consumed by the animal over a period of several feedings. The bearded seal usually consumed not more than 15-20 of the other crustaceans (e.g. shrimps) at a time. Only once, in May 1965, were 650 individuals of Pandalus goniurus removed from the stomach (148) of this animal.

The remains of gastropods included only the "legs", the maximum number (105) being found in a mature female. A great number of opercles of Gastropoda was frequently found in the remains of food. For example, 500 of them ranging from 11 to 31 mm in size were encountered in a year-old male.

Undigested cephalopods were rarely encountered in the stomachs of bearded seals. The food bolus usually contained the beaks of Octopodidae. One of the stomachs contained 55 of them.

There is no unanimous opinion among researchers as to the importance of fish in the nutrition of the bearded seal. Certain zoologists believe

it is an occasional food (Tikhomirov, 1961); other consider the absence of fish in the food of the bearded seal to be of a characteristic nature (Polutov et al., 1965); still others indicate that the bearded seal consumes small quantities of fish (Loganov, 1939; Inukai, 1942; Bobrinsky et al., 1965), while K.K. Chapsky (1938, 1963) writes that arctic cod is an important food of the Atlantic bearded seal.

According to our data, fish is an important food item of the Pacific bearded seal. This has been confirmed by the abundant species composition of the fish consumed by this seal and the regular occurrence of these fish species in the food of the bearded seal. The maximum weight of a food bolus consisting of fish has been observed in a female aged 11+ yrs. Her stomach contained 400 capelins weighing a total 2.7 kg, of which 195 specimens were well preserved. The stomachs of other bearded seals caught in 1963 each contained 180 daubed shannies and Far Eastern sand lances (Kosygin, 1966a). Stomachs containing 25, 50 and 138 daubed shannies each were encountered in 1965.

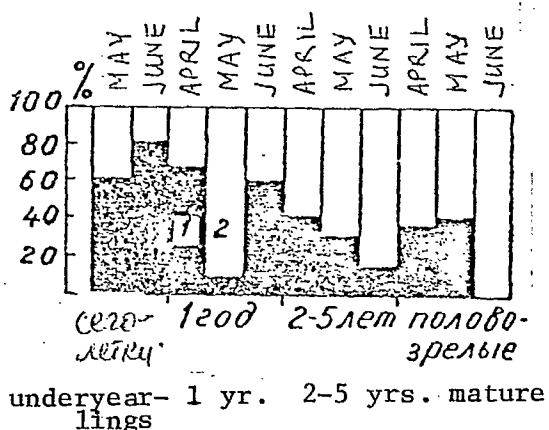


Fig. 2. The amount of food found in the stomachs of bearded seals caught in the Bering Sea.

1 - from 0.600 to 12.00 hours; 2 - from 12.00 to 21.00 hours.



Fig. 3. Stomachs of bearded seals containing remains of food during the spring months.

1 - April, 2 - May, 3 - June, 4 - empty stomachs

The maximum weight of the food bolus (2.77 kg) was observed in a year-old female bearded seal. We have never encountered stomachs containing close to 4 kg of food, as has been observed by G.L. Rutilevsky (1939) for bearded seals caught in the vicinity of the Chelyuskin Peninsula.

The average weight of the food bolus in most bearded seals is less in June than in May. Our material, apparently, reflects one of the regularities in the feeding habits of the bearded seal, i.e. a certain decrease in the intake of food during the summer months. This is depicted in fig. 3 which shows that the specific weight of full stomachs is somewhat higher in April than in May or June.

C o n c l u s i o n s

1. We have studied 565 stomachs of bearded seals caught on the Bering Sea during the spring-summer months of 1963-1965. 152 of the stomachs were found to contain food.

2. An analysis of the stomach contents revealed more than 30 species of crustaceans, several species of mollusks and their egg deposits, sponges, approximately 4 species of annelids and nematodes, pogonophores and close to 15 species of fish.

The bearded seal was found to consume mostly the snow crab and the visored shrimp (of the crustaceans), as well as gastropods and octopuses

Table 2

The frequency of occurrence on the Bering Sea of the food items preferred by the bearded seal

Species composition of food items	Date bearded seal caught					
	1963		1964		1965	
	no. of stomachs	%	no. of stomachs	%	no. of stomachs	%
1	2	3	4	5	6	7
<u>Crustaceans</u>						
Chionoecetes opilio opilio	19	53	38	69	46	76
Chionoecetes sp.	3	8	—	—	—	—
Erimacrus isenbeckii	3	8	5	9	—	—
Hyas coarctatus	3	8	—	—	2	3
Paralithodes brevipes	—	—	3	5	—	—
Paralithodes sp.	—	—	2	4	—	—
Anomura, Brachyura	7	19	—	—	—	—
Pagurus splendescens	1	3	—	—	—	—
Pagurus rathbuni	—	—	2	4	—	—
Pagurus undosus	—	—	1	2	—	—
Pagurus sp.	2	6	—	—	—	—
Crangon dalli	3	8	10	18	—	—
Crangon sp.	1	3	2	4	2	3
Eualus gaimardii	1	3	—	—	1	2
Eualus macilenta	4	11	—	—	1	2
Eualus sp.	—	—	1	2	—	—
Nectocrangon lar lar	8	22	14	25	16	26
Pandalus goniurus	1	3	6	11	10	16
Pandalus jordani	1	3	1	2	—	—
Pandalus sp.	2	6	2	4	4	7
Sclerocrangon boreas	1	3	—	—	2	3
Sclerocrangon sp.	1	3	—	—	4	7
Spirontocaris arcuata	—	—	—	—	3	5
Anonyx nugax	—	—	2	4	4	7
Anonyx multiarticulatus	—	—	1	2	—	—
Nototropis sp.	—	—	—	—	1	2
Rhachotropis aculeata	—	—	—	—	3	5
Socarnes bidenticulatus	—	—	1	2	—	—
Stegocephalus sp.	—	—	—	—	1	2
Synidothea bicuspidata	—	—	1	2	—	—
Synidothea sp.	—	—	1	2	1	2
Lebbeus groenlandica	—	—	—	—	2	3
Lebbeus sp.	—	—	—	—	4	7
Mysidae	2	6	—	—	—	—
<u>Mollusks</u>						
Octopodidae	1	3	22	40	11	18
Ioldia hyperborea	—	—	—	—	1	2
Leda pernula	1	3	—	—	1	2
Nucula sp.	—	—	—	—	2	3
Polynices pallidus	7	19	—	—	—	—
Polynices sp.	4	11	—	—	—	—
Gastropoda	7	19	28	51	25	41
Mollusk egg deposits	1	3	—	—	—	—
<u>Sponges</u>						
Spongia	1	3	—	—	1	2
<u>Annelids and nematodes</u>						
Echiurus echiurus	—	—	2	4	1	2
Pectinaria hiperborea	—	—	1	2	—	—
Polychaeta sp.	8	22	—	—	—	—
Priapulid caudatus	2	6	8	15	7	11
<u>Pogonophores</u>						
Pogonophora	—	—	2	4	1	2

Table 2 (Continued)

1	2	3	4	5	6	7
<u>Fish</u>						
<i>Ammodytes hexapterus</i>	2	6	—	—	—	—
<i>Coryphaenoides cinereus</i>	—	—	1	2	—	—
<i>Eleginus gracilis</i>	—	—	1	2	—	—
<i>Eumicrotremus orbis</i>	—	—	—	—	2	3
<i>Hypomesus olidus</i>	—	—	1	2	—	—
<i>Lepidopsetta bilineata</i>	3	8	—	—	8	13
<i>Lepidochinus maculatus</i>	—	—	—	—	3	5
<i>Lycodes (palearis arcticus)</i>	—	—	3	5	—	—
<i>Mallotus villosus</i>	1	3	—	—	—	—
Pleuroneclidae	—	—	5	9	—	—
Scorpenidae	—	—	1	2	—	—
<i>Stichaeus nozawae</i>	—	—	1	2	—	—
<i>Theragra chalcogramma</i>	—	—	1	2	—	—
Eggs (unidentified species)	—	—	1	2	—	—
Unidentified remains of fish	1	3	9	16	7	11

(150)

(of the mollusks). *Priapulus caudatus* was the most preferred nematode, and the daubed shanny the most preferred fish.

3. Judging by the presence of food in the stomach and the degree to which it had been digested, we found that during the spring-summer months of 1963-1965, young bearded seals foraged mostly during the first half of the day, while the more mature individuals hunted in the afternoon. The maximum weight of the food bolus (2.77 kg) was observed in a year-old female. The mean weight of the food bolus in most of the animals is less in June than in May. The specific weight of full stomachs is somewhat greater in April than in May or June.

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