All-Union Research Institute of Marine Fisheries and Oceanography
(VNIRO)

Scientific Research Work on Marine Mammals of the Northern Pacific Ocean in 1984/85

c

114 pages

Project 02.05-61 "Marine Mammals", US-USSR Agreement of Protection of the Environment

Moscow, 1986

Translated by S. Pearson and F.H. Fay

Scientific Research Work on Marine Mammals in the North Pacific Ocean in 1984/85

Project 02.05-61 "Marine Mammals", US-USSR Agreement on Cooperation in the Field of the Environmental Protection

Moscow 1986

translated by S. Pearson and F.H. Fay

INTRODUCTION

(3) This report contains materials on scientific investigations of marine mammals of the North Pacific Ocean completed in 1984-1985 in accordance with the US-USSR Agreement on Cooperation in the field of Environmental Protection, Project 02.51-61 "Marine Mammals".

The collection of biological, ecological, morphological and other data on marine mammals was done both by Soviet scientists and on joint Soviet-American and American-Soviet cruises. Some of the work was done at laboratories and museums in the United States. In the period since the last meeting the following expeditions and continuing projects have been conducted:

1. At the time of the commercial cruise of the ZRS Zaslonovo in April-May 1984 into the western part of the Bering Sea biological data were collected and processed on pagophilic seals and walruses (VNIRO, V.N. Sadovov).

2. Soviet scientists working in American museums analyzed craniological collections of ringed seals which inhabit the coasts of Chukotka, Alaska and Canada (Beaufort Sea) in March-April 1984 (Glavrybvod, V.N. Mineev; MoTINRO, G.A. Fedoseev).

3. In March-April 1984, together with American specialists from the Hubbs Research Institute, work was done on the development of nonmetrical characters of the common seal. The population structure of dolphins of the genus Stenella, was also investigated at the Southwest Fisheries Center [La Jolla, CA] (VNIRO: L.A. Popov, IBR AN SSSR: M.V. Mina; Hubbs Research Institute: W. Evans, J. Thomas, B. Stewart, P. Yochem, Southwest Fisheries Center: W. Perrin, D. Walker, J. Barlow).

4. In November-December 1984 there was a joint Soviet-American cruise to the northern part of the Bering Sea on the ZRS Zakharovo for the purpose of studying pagophilic seals and walruses

(VNIRO; A. A. Kibal'chich, G. Kh. Dzhamanov, MoTINRO: Yu. A. Bukhtiyarov; University of Oregon, R. Merrick; Alaska Department of Fish and Game: J. Taylor and J. Sease).

5. In March-April 1985 there was a joint Soviet-American cruise on the ZRS Zakharovo into the commercial fishing zones of the USSR and USA sections in the Bering Sea for the purpose of studying Pacific walruses and pagophilic seals (VNIRO: A.A. Kibal'chich, TINRO: A. M. Trukhin, MoTINRO; Yu. A. Bukhtiyarov; University of Alaska, Institute of Marine Science: F. Fay; National Marine Mammal Laboratory (Seattle, WA: R. Miller;(4) Alaska Department of Fish and Game: J. Burns and K. Frost).

6.Counted the numbers of sea otters on the Commander Islands (VNIRO, V.F. Sevost'yanov) in July 1985.

7. Conducted an expedition for studying sea otters on the Kuril Islands (VNIRO, A.V. Zorin) in August-September 1985.

8. Conducted an expedition for studying sea otters on the Kamchatka Peinsula (VNIRO, K.S. Sidorov; KoTINRO, A. M. Burdin) in August 1985.

9. Conducted an aerial survey on the distribution and abundance of harbor seals on the Kamchatka Peninsula in August 1985 (Kamchatrybvod, V.N. Burkanov).

10. Conducted an aerial count of the numbers of walruses in the commercial fishing zones of the Bering and Chukchi Seas in September-October 1985 (MoTINRO G.A. Fedoseev).

11. The distribution of gray whales in the 1984 season near the coast of the Chukotsk Peninsula. (TINRO, S. A. Blokhin).

12. Summarized materials from observations on the distribution of pygmy blue whales in the Pacific Ocean. (TINRO, A.A. Berzin).

13. The results of aerial observations on the distribution and numbers of cetaceans in the Sea of Okhotsk from 1979 to 1985. (TINRO, A.A. Berzin, V.L. Vladimirov and N.V. Doroshenko).

14. The distribution of pagophilic seals in the Sea of Okhotsk in the winter (MoTINRO, G.A. Fedoseev).

15. The distribution of harbor seal rookeries on the coast of the Sea of Okhotsk (TINRO, G.M. Kosygin, A.M. Trukhin, A.I. Makhnyr'; Kamchatrybvod, V.N. Burkanov).

Director, Soviet section
Project 02.05-61 "Marine Mammals"
L.A. Popov

I. PRIMARY RESULTS OF THE INVESTIGATION OF MARINE MAMMALS IN THE NORTH PACIFIC OCEAN IN 1984/85

(5) L.A. Popov (VNIRO)

The investigation of the marine mammals of the North Pacific Ocean accomplished within the framework of Project 02.05-61 "Marine Mammals" under the US-USSR Agreement on Cooperation in the Field of Environmental Protection 1984/85 includes the area from the Chukchi Sea on the north, south and east to the Kuril Islands and the California coast of the United States. During this time 14 expeditions were conducted and there was work done at stationary bases, including eight national (Soviet), three Soviet-American and three American-Soviet operations. The Soviet participants in these operations were specialists from the marine mammal laboratories of: VNIRO, TINRO, MoTINRO, KoTINRO, and IBR AN SSSR. The American participants were specialists from various universities, the Alaska Department of Fish and Game, the National Marine Mammal Laboratory, Hubbs Research Institute, the Southwest Fisheries Center and others.

Pinniped investigations. In 1984/85 we investigated Pacific walruses since they make up the bulk of commerce for the natives of Chukota and Alaska; the field data were collected during marine expeditions on Soviet ships and airplanes to the exclusive economic zones (EEZ's) of the USSR and USA in the Bering and Chukchi Seas, for determining the numbers of animals in these respective zones.

As a result of the work, we more precisely defined the mating sites of Pacific walruses which are basically confined to two areas of the Bering Sea - south of St. Lawrence Island (the central herd),and from St. Matthew Island to the southeast as far as Bristol Bay (the southeastern herd). We recorded the migration of pregnant females to the ice areas which are north of the mating sites. It was established that females during the course of the yearly life cycle stay longer on the ice than the males; the majority of males spend the summer in the Bering Sea and in the ice free period they go to the coastal hauling grounds; but the females with pups migrate with the ice edge as it moves to the north into the Chukchi Sea. In November-December 1984 during the cruise of the ZRS Zakharovo to the USSR fishing zone in the Bering Sea, the center of a formation of a reproductive group consisting of estrous females and adult males in (6) an active state of spermatogenesis was discovered for the first time northwest of St. Lawrence Island.

An analysis of the age structure of captured walruses (1200 animals) indicated that the age of adult animals remained at the level of past years, as was also the case for the number of pregnant females among the sub-adults (30% to 40%). There appeared to be a high mortality rate among the walrus calves (calculated data); in the first year of life the coefficient of calf mortality at age one month appeared to be: 0.24 in July, 0.3 in August and 0.38 for November-December. The significant mortality of walrus calves indicated a predominance of pregnant females as opposed to

lactating females in the samples. As a result of other work conducted by associates from the marine mammal laboratories of VNIRO, it was ascertained that in recent years the relative number of walrus predators has increased in the Chukchi and Bering Seas (in 1972 - 0.01%) and (in 1985 0.6%).

In autumn 1985, co-workers from the Magadan section of TINRO used an airplane to conduct an aerial survey of the ice and coastal walrus rookeries in the Bering and Chukchi Seas east to Long. 174½ N. We noted the unusual character of distribution of the animals in relation to the peculiarities of the ice conditions in the Chukchi Sea -- the presence of vast fields of pack ice with a denseness of 10 which covered the less favored walrus habitation areas -- to the west and southwest of Wrangel Island and the greatest part of Long Strait. We only noticed open, annual ice with a density of 3 to 9 in the 50 mile nearshore zone from Cape Shelagskiy to Cape Shmidta. We also noted a small number of animals on the coastal rookeries, and scattered groups of walruses were seen in the water at some distance from the rookery. The ice and meteorological conditions during the time of counting were not always favorable for taking a photograph and visually estimating animals which had an affect on the results of the work. The total number of walruses on the ice and coastal rookeries in the study zone was 95,000 to 156,000 animals. A simultaneous count of the numbers of walruses was done by American specialists in the USA's economic zone of the Chukchi Sea. Data collected during the marine expeditions and by the aerial survey counts will be used in determining estimated population size of Pacific walruses, and subsequently determining a rational quota for the take of animals by the natives of Chukotka and Alaska, and to develop necessary recommendations for conservation of the species.

(7) In 1984/85 a large part of the investigation was spent on studying the harbor seal (largha) which is one of the principal or most frequently occurring pagophilic seals in the Bering Sea and the Sea of Okhotsk. The main objectives of the investigation were to map the spring-autumn coastal seal rookeries on the coasts of the Sea of Okhotsk and the Kamchatka Peninsula, and to determine the numbers of animals, particularly during the time that salmon enter the rivers in these regions. This study was done by co-workers from TINRO and Kamchatrybvod using boats, airplanes and time-dependent observation points located at the mouths of certain rivers. In the Sea of Okhotsk, the coasts of Sakhalin Island from Amur Liman were examined where 60 coastal seal rookeries had been recorded with a total of 10,000 animals (together with the nearshore herds). In the remaining part of the sea up to the Shantarskiy Islands, 18 coastal seal rookeries were registered and 13 accumulations of animals in the water (the total number was 4,000 individuals). Also recorded were the population dynamics of the seals, depending on the approach of the salmon, the ebb and flow of the tide, the meteorological conditions; an assumption was formulated about the confinement of animals to their "own" rivers. Along the west coast of the Kamchatka Peninsula in 1984 the number of harbor seals was 13,000 animals, in 1985 the number exceeded

20,000 animals; along the east coast there were over 19,000 animals and of these over 12,000 were in Karaginskiy Bay. At the mouth of certain rivers on the west coast of Kamchatka the largest accumulation of seals was 3,000 to 4,000 animals. In 1986 a proposal was made to continue the mapping of harbor seal rookeries in the Sea of Okhotsk. The material obtained can serve as a basis for developing measures to regulate the numbers of seals in the areas of greatest concentration during salmon runs into the rivers.

It is known that studying independent, separate populations of animals is very valuable for the rational utilization of a biological resource. In view of this a study was done on the presence of morphological differences between populations of ringed seals in osteological collections of a number of museums in the USA. This study enabled us to determine the presence in the nearshore zones of Chukotka and Alaska of a minimum of three localized populations of these seals, whose interrelationship is not yet clear. This would require a complete investigation for determining the boundaries, the degree of independence, the population dynamics and the reproduction of localized populations of ringed seals in the given area. In 1984 at Hubbs Research Institute (San Diego, CA) together with American specialists, we studied the possibility of analyzing the population structure of the common seal by evaluating the similarity of animals (8) according to their coloration, i.e, on the development of nonmetrical characters. It was decided that a method of visual scanning was inappropriate as well as a proposal to use the visual method which was developed for comparing similarities in the color patterns of seals. We basically analyzed the signal which reflects the variation of optical density which was obtasomed obtained while scanning the investigative object, which in this case, was a graph of a specific section of a seal's pelt. In processing scanning data we mathematically analyzed random processes (correlation and harmonic analyses). During discussions it was suggested that work should be conducted in two areas: first, to modify the method of analysis for cetacean color variation and make it more suitable for studying the color variation of seals; and, second, to determine the feasibility of using an optical scanner for resolving this problem.

Long-term results of aerial observations on the winter distribution of seals on the ice in the Sea of Okhotsk were summarized and it was concluded that the emergence of seals on the ice at the beginning of the winter in contrast to their spring arrival was irregular, and the temporary seal rookeries on the ice were formed by migrating individuals for a brief respite. Material was also processed which was obtained from the commercial cruise of the ZRS Zaslonovo into the western part of the Bering Sea (April-May 1984) on the regularity of distribution of seals and walruses depending on the ice conditions which form in a given season, the age and sex composition of the captured animals, the percentage of the correlation between these and other species of seals in the catch and other data which characterize the status of stocks of these species of marine mammals in the USSR's economic

zone of the Bering Sea. In 1985 during the cruise of the ZRS Zakharovo in the western part of the Bering Sea a considerable amount of material was collected which characterized the age and sexual composition of ribbon seals, harbor seals, bearded seals and ringed seals (6053 samples); at the present time it is under preparation. Data were obtained for the first time which verified the occurrence of female ribbon seals which were ovulating at the age of one year and were fertile at the age of two years, which is earlier than had been recorded for ribbon seals in the Sea of Okhotsk. An assumption was also made about the rise in the rate of reproduction of Bering Sea ribbon seals by nearly two times in comparison with those in the first year of the harvest. The more comprehensive results of these pinniped investigtions is reflected in this report.

(9) Cetacean investigations. For a number of years (1979-1985) TINRO specialists conducted aerial surveys in the Sea of Okhotsk on the distribution and numbers of polar [bowhead or Greenland right whales], gray and belukha whales. In the process it was established that the area of the summer-autumn habitation of polar whales was the bays which are located to the south of the Shantarskiy Islands. Their numbers here, however, are insignificant and limited to approximately 100 head. There are still no data on the distribution and numbers of animals in the northern and northeastern areas of the Sea of Okhotsk. A small group of gray whales which evidently belonged to the Okhotsk population was also noticed near the northern and eastern coasts of Sakhalin Island.

During the period of observations more complete data were obtained on the distribution and numbers of belukhas in the Sea of Okhotsk. We noted their confinement to the shallow bays of the sea into which flowed large and small rivers. There were two separate populations of belukhas: 1) the Sakhalin-Amur and 2) the Shantarskiy. The Sakhalin-Amur population occupies the area of Sakhalin Bay and Amur Liman where several hundred animals are usually in evidence. Their numbers fluctuate considerably not only in different months, but over the course of several days; we are assuming the existence in this area of a continuous and permanent grouping of animals. It is apparent that the presence of belukhas in the summer-autumn period in one or the other area is directly related to the movement of salmon, and the shifting of the animals with the migration of ivasi [west Pacific sardine]. The approximate, overall number of the Sakhalin-Amur belukha population is 17,000 - 20,000 animals. The Shantarskiy population is not numerous (approximately 3,000 - 5,000 animals). In June-July the animals usually stay within the accumulations of smelts and herring, and later, in the accumulations of chum salmon. Stable habitation areas for belukhas are also Shelekhov Bay, Gizhiginskaya and Penzhinskaya Bays where their approximate number is 15,000 - 20,000 animals. In our opinion the approximate number of belukhas in the investigation areas of the Sea of Okhotsk, is 35,000 - 40,000 animals.

In 1985 data were also summarized from a number of years on the distribution of such little-studied species of marine mammals as pygmy blue whales. An analysis of these data led us to assume the existence of two populations of animals in the eastern areas of the Pacific Ocean: the Galapagos (eastern Pacific) and the Californian. The area of the first population roughly includes the waters from Lat. 33½ to 10½ S., the second - the waters of the North American continent from Lat. 20½ to 35½ S. We also assumed that the distribution of these whales was not limited to the described areas, and that the animals could be in the warm and also (10) temperate waters of the Pacific, Indian and Atlantic Oceans.

There is a great deal of information available on the summer distribution and areas of concentration of gray whales in the coastal waters of the Chukotsk Peninsula. Observations by TINRO staff in the summer of 1984 on the distribution of whales from coastal points in the area of Cape Chaplina and Mechigmenskaya Bay provide additional information on these questions. It was ascertained that in the area of Cape Chaplina the mass migration of whales near the southeastern coast of the Chukotsk Peninsula began in June and occurred in two pulses (6 June and from 25 June to 8 July). The movements of most of the animals were in a north to northeastly direction. In Mechigmenskaya Bay the greatest concentration of whales in the coastal zone was observed in August; the greatest reduction in the occurrence of animals was from October to November. Most of the animals forage in the bay at distances of seven to eight miles from shore. Data on the distribution of gray whales were obtained at the beginning of September 1983 when a ship investigated the area from Anadyr Bay to the Chukchi Sea. During the cruise to Anadyr Bay 38 gray whales were counted; in the area from Cape Chaplina to Arakamchechen Island there were 120 animals. At Mechigmenskaya Bay and adjacent waters there were 130 animals; from Cape Nunyamo to Cape Dezhnev 60; in the waters near the village of Uelen there were 20 animals. In the period from 2 to 12 September, 380 animals were counted. All of the observed whales were feeding intensively; after surfacing, they remained 50 to 60 s. on the surface, gave 5-6 blows, continuously plunged to depths of 17-25 m., and remained there 2 to 4 minutes.

In 1984 together with American specialists from the Southwest Fisheries Center (La Jolla, CA) we investigated the population structure of dolphins of the genus Stenella for the purpose of evaluating the possibility of using nonmetrical cranial variations for the spotted dolphin (S. attenuata) in order to separate stocks and to identify internal (family) groups. Traits were summarized independent of age and sex, which did not duplicate information and with high reproducibility which could be evaluated by different operators (a total of 23 traits). It was indicated in the assumption that the stock of these dolphins themselves represented a group similar in structure to populations of a number of species of the designated mammals and included a "nucleus" (an aggregate of individuals constantly staying together) and "newcomers"

(individuals only temporarily attached to them). On the basis of the work which was done we also confirmed that there were "coastal" and "oceanic" groups of S. attenuata in the southeastern part of the Pacific Ocean.

(11) Sea otter investigations. During 1985, associates from VNIRO and the Kamchatka section of TINRO made three field trips to investigate sea otters on the Commander and Kuril Islands, and also to the Kamchatka Peninsula.

In July-August we inspected the food resources of the Kamchatka population of sea otters using divers to investigate down to 40 m. We obtained new data on the composition of the coastal community fauna of the Kamchatka Peninsula and also noted the abundant die-offs, a phenomenon which, in turn, adversely affects the fauna of closed bays, with clearly warmed up shallow waters with dense growths of brown algae i.e., a site which plays an essential role in the reproduction and foraging for food objects of sea otters. It was assumed that the reccurrence and duration of the die-off phenomenon on the coast of the Kamchatka Peninsula and the Commander Islands is related to the periodic, explosive activity of the volcanoes of the Kuril-Kamchatka chain. We separated out four types of coastal areas in the current habitation sites of the Kamchatka sea otter population, which were characterized by varying degrees of seismicity and frequency of feeding.

From August to September we also investigated the ecological resources of the Kuril Island sea otter population (Urup Island). We studied the food composition of the animals, the topography and structure of some bottom communities, and the condition of the sea urchin resources. According to this and other features, we evaluated the characteristics of separate biotypes for the purpose of further determining their ecological capacity. We ascertained that the composition of food for Urup Island sea otters was diversified (sea urchins, mollusks, fishes and crustaceans), however, the most preferred food (an occurrence of 100%) was sea urchins. The smallest portion in volume of the rations (20%) after singular occurrences was bivalve mollusks. By weight ratio a significant part of the diet was fishes and crustaceans (73%). It was noted that this food composition was more characteristic for the spring and changed in the other seasons of the year. It should be noted that in the upper littoral zone where brown algae dominated, sea urchins were more abundant and determined the abundance of fish. However, within the boundary of wing-kelp distribution, we noticed patches and spots of sea urchins of younger and middle aged groups severely limited by space, occurring with the abundant algae. Maximum concentrations for biomasses of sea urchins were noted at the limits of the wing-kelp zones. It was established that the Sea of Okhotsk coastal zone of Urup Island was characterized by a more uniform distribution of the biomass of basic food of sea otters than on the Pacific side. The results of the investigation allowed us to assume that presently, the numbers of the Urup group of sea otters (12) was close to the maximum level

from the viewpoint of ecological resources.

On the Commander Islands associates from VNIRO regularly made counts of the numbers of sea otters. On Bering Island in 1983 1310 animals were counted, in 1984 - 1012 animals and in 1985 - 1801 animals. On Mednyy Island the counts were as follows: 737 animals in 1983, 898 in 1984 and 1091 in 1985. In recent years there has been a rather clear tendency towards an increase in the numbers of these animals on the Commander Islands and in 1985 they reached 3000 animals. In 1985 we noticed more dead animals than in previous years in connection with the severe winter and the activity of frequent and prolonged storms.

(13)

2.1 PYGMY BLUE WHALES (BALAENOPTERA MUSCULUS BREVICAUDA) IN THE PACIFIC OCEAN

A.A. Berzin (TINRO)

The smaller forms of the blue whale from the areas of the Crozet Islands and Kerguelen Islands in the Indian Ocean sector of the Antarctic for a long time have been well known to Norwegian and Japanese whalers. It was thought that the range of these whales was primarily restricted by the waters of the aforementioned islands (Ichihara, 1961). Subsequent observations, however, indicated that they covered a large part of the water area of the Indian Ocean from Madagascar to the west to Tasmania in the east and from Lat. 57½ S. to the Gulf of Aden (Yukhov, 1969; Sazhinov, et al. 1970).

Morphological and biological investigations showed significant differences between common blue whales and pygmy blue whales. Proportional measuremeents of body parts show only slight differences. Head size appears larger, with a smaller caudal region; in addition, there is a rather well expressed, relatively lower dorsal fin in the pygmy blue whales (Sazhinov, 1970).

According to data of various authors the onset of sexual maturity for female blue whales occurs with an average body length of 24 m., but for pygmy blue whales at 19.2 m. For male blue whales sexual maturity occurs with a body length of 22.3 m., and for pygmy blue whales at 18.7 m., (Ichihara, 1964, Sazhinov, 1970a).

Based on these investigations V.A. Zemskiy, V.A. Voronin (1964) and T. Ichihara (1964) validated the separation of pygmy blue whales into an independent, taxonomic unit - the subspecies B. m. brevicauda - the short-finned blue whale.

According to investigative and published data, the range of pygmy blue whales is quite wide. A. Aguayo (1974) writes that of 168 blue whales taken near the coast of Peru and delivered to the whaling station at Quintay (Lat. 33½ S., Long. 71½ 42' W.) 10

animals were determined to be pygmy blue whales. These whales were recorded in the eastern areas of the Pacific Ocean.

(14) Two groups of blue whales, consisting of some 20 animals, were sighted in March 1975 during a joint Soviet-American cruise for studying the distribution of cetaceans in the eastern areas of the central Pacific Ocean on the whale catcher Vnushitel'nyi at the coordinates: Lat. 08½ 55'...09½ 07'N., and Long. 93½ 43'...93½ 55' W. They were noticeably (visually) smaller than common blue whales, had a lighter color due to numerous light spots and a shorter caudal fin. The whales stayed in groups of two to three individuals. Two pairs obviously were a male and female and in one pair there was a female with calves, although they were a very large size. The whales remained calm when the ship was quite close. Four of the blue whales which were observed lifted their flukes in the air, reminiscent of the shape of a butterfly, before deep dives. This behavior was never noticed for blue whales in the upper latitudes. We determined that these were pygmy blue whales based on their behavior and external appearance (Berzin, et al., 1976).

After 2 1/2 months the ship intersected this area one more time and again pygmy blue whales were sighted. These whales, evidently, live here continually and belong to the population designated as the eastern Pacific, or, in an analogy with other whales, the Galapagos population of short-finned blue whales (Berzin, 1976, 1978).

R. Kellogg (1928) mentions a habitation area of blue whales in the Panama Canal. Blue whales have been taken in waters off Ecuador. In 1925-26, for example, 68 animals were captured (Tomilin, 1957). Whales have been continually seen near the coast of Peru (Clarke, 1962). Two blue whales were recorded in June 1969 during a scientific research cruise by the whale catcher, Vernyi at Lat. 09½ S., and Long. 82½ W. and two were seen in January 1966 by the scientific research ship Vnushitel'nyi at Lat. 20½ S., and Long. 75½ W.

It is not possible to establish where the boundary occurs for the range between pygmy blue whales and common blue whales. Evidently, blue whales which had been taken earlier at coastal stations in Chile in January-March (160-200 animals), with a complete cessation of whaling from May to September, were apparently common blue whales.

Blue whales were seen in June-July 1980 during a joint Soviet-American cruise on the David Starr Jordan. Thirty-six to forty whales were seen at different latitudes (from Lat. 27½ 49' to 34½ 41' N., however, they were mainly sighted between Lat. 30½ and 34½ N. Solitary animals and groups of up to six animals were seen. We determined that these were pygmy blue whales (15) (according to the same traits as in 1975).

In a series of four sightings of mature whales (evidently with females) the calves stayed close by. Five of the whales sighted showed their flukes while diving.

After a determination of the taxonomic status of the whales which were seen the scientific co-workers on the ship informed us that at the time this same ship made a cruise to the coastal waters off California in September-October 1974, R. Clarke also determined that 37 of the animals which were sighted were pygmy blue whales.

During the joint Soviet-American cruise in 1975, when the whales which were sighted in the area of the Galapagos Islands were first determined to be pygmy blue whales, as the ship moved to the north on 19 June during a search transect near the coast of California at Lat. 24½ 14' N., and Long. 112½ 51' W., two blue whales were seen. On 20 June between Lat. 24½ 19' to 25½ 32' N., and Long. 112½ 45' to 113½ 22'N., another six whales were seen and then somewhat further north 13, 9, 18 and 3 individuals were seen.

Only on one day at the coordinates Lat. 24½ N., Long. 112½ 41' and Lat. 25½ 30'N., Long. 113½ 22' W., were blue whales seen in the amount of 71 individuals. Over a five day period of observations 106 blue whales were sighted. If after a short time 100 animals or more were recorded by one ship, then their general number in this area to a lesser extent was several hundred animals (Berzin, 1978). Unfortunately all whale specialists who participated in this 1975 cruise left the ship in the Panama region, and whales which were seen in the California region were determined to be common blue whales.

After the joint Soviet-American cruise on the NOAA ship, David Starr Jordan, in 1980 we had no doubts that we had seen pygmy blue whales in 1975 in the California region.

Charles Scammon had indicated the presence of blue whales in the area of Baja California. P. Bonnot (1929) called blue whales one of the more numerous species in Baja California. After five years of hunting in the period from 1919 to 1929, 1006 blue whales were taken from this area averaging 150 to 239 animals per year. B.A. Zenkevich (1937) observed the blows of six whales in the area east of the Revillagigedo Islands. Solitary individuals and small groups of blue whales were continually seen north and northwest of these islands.

(16) It is not possible to accurately determine the systematic classification of the blue whales which were seen by TINRO's scientific research ships in the waters of the Hawaiian Islands at the coordinates Lat. 21½ - 22½ N., Long. 170½ - 175½ E., however, one can assume that the blue whales inhabiting this area are probably short-finned or pygmy blue whales.

Behavioral features. According to our observations on pygmy blue whales in the Indian Ocean, they are less mobile than common blue whales (Ivashin, 1972). Our observations in the eastern

areas of the Pacific Ocean verified this feature of their ethology. We noted that in the sightings of pygmy blue whales in the Pacific Ocean, part of them (approximately 20%) showed their flukes. The same behavioral feature for pygmy blue whales was noticed in the Indian Ocean (Ivashin, 1972) and was never noticed for common blue whales. A photograph (Leatherwood, et al., 1976, p. 23) showing the flukes of a blue whale was taken in the waters off California i.e., the habitation area of pygmy blue whales.

The material we obtained from observations on the distribution and numbers of pygmy blue whales and an analysis of information previously accumulated verified the existence of two populations of pygmy blue whales in the eastern areas of the Pacific Ocean. That which we call the eastern Pacific or Hawaiian population occurs, as we have have already tentatively determined, in waters from Lat. 33½ S., to Lat. 10½ N. (Berzin, 1978). The second or California, population occurs in the coastal waters of the North American continent from Lat. 20½ S., to Lat. 35½ N. Evidently, however, the range of short-finned blue whales is not restricted to the areas described, and they can occurr in the warm and temperate waters of other areas of the Pacific, Indian and Atlantic Ocean.

Literature Cited

(17)

Aguayo. A. 1974. Baleen whales of continental Chile. The whaling problem. Cambridge. Harvard University Press.

Berzin, A.A. 1978. The distribution and numbers of whales excluded from harvesting in the Pacific Ocean. Biologiya Morya. No. 4:22-29.

Berzin, A.A., A.F. Volkov and I.F. Moroz. 1976. Soviet-American expedition for studying the cetaceans in the eastern part of the Pacific Ocean. Biologiya Morya, No. 4:74-75.

Bonnot, P. 1929. The whales of California. Calif. Fish and Game. v.15.

Clarke, R. Whale observation and whale marking off the coast of Chile in 1938 and from Ecuador towards and beyond the Galapagos Islands in 1959. Norsk. Hvalf.-tid. no.7.

Ichihara, T. 1961. Blue whales in the waters around Kerguelen Island. Norsk. Hvalf.-tid. no.1.

Tchihara, T. 1964. The pygmy blue whale, Balaenoptera musculus brevicauda, a new subspecies from Antarctic. Norsk. Hvalf.-tid. no.6.

Ivashin, M.V. 1972. Cetaceans. Morskie Mlekopitayushchie. M. Pishchevaya Promushlennost'. p. 109-280.

Kellogg, R. 1928. What is known of the migration of some of the whalebone whales. Annual Report of the Board of Regents of Smithsonian Institution. vol. 6.

Leatherwood, S., D. Caldwell and H. Winn. 1976. Whales, dolphins and porpoises of western North Atlantic. NOAA Tech. Rep. NMFS. Seattle.

Szahinov, E.G. 1970. Morphological differences and properties forming the body proportions of pygmy blue whales. Whales of the Southern Hemisphere. Kaliningrad p. 163-169.

Sazhinov, E.G., 1970a. The onset of sexual and physical maturity for pygmy blue whales (Balaenoptera musculus brevicauda. Ichinara. 1966). Whales of the Southern Hemisphere. Kaliningrad, 1970a p.34-40.

Tomilin, A.G. 1957. Mammals of the USSR and adjacent countries. Kitoobraznye. v.9. M: Nauka. 756p.

Yukhov, V.L. 1969. Observations on cetaceans in the Gulf of Aden and northwestern part of the Arabian Sea. Morskie Mlekopitayushchie. M: Nauka. p. 305-307.

Zemsky, V.A., and V.A. Voronina. 1964. On the question of the pygmy blue whale taxonomic position. Norsk Hvalf.-tid. no.11.

Zenkovich, B.A. 1937. The migration of whales in the North Pacific Ocean. Izv. TINRO. v.10:3-18.

(18)

2.2 RESULTS OF AERIAL SURVEYS FOR STUDYING THE DISTRIBUTION AND NUMBERS OF CETACEANS IN THE SEA OF OKHOTSK 1979 - 1985

A.A. Berzin, V.A. Vladimirov and N.V. Doroshenko (TINRO)

Searching for whales is done with a helicopter (flying altitude of 200 m., with an average speed of 150 km/hr.). When whales are sighted the speed is decreased to 100 km/hr., and the helicopter drops to an altitute suitable for making observations. If necessary the helicopter can make turns of a small radius at places where whales are found which does not allow the animals to get out of the field of vision. Observations on whales and counts of the numbers of animals were made from both sides and from the cockpit of the helicopter by scientific workers and crew members.

In August 1979 a flight was made over the area of the Shantarskiy Islands, Amur Bay and Sakhalin Bay.

In June 1980 we investigated the northern part of the Sea of Okhotsk (Penzhinskaya and Gizhiginskaya Bays). In the first half of April 1981 we examined Tatarskiy Strait and the coastal areas of the western and northern parts of the Sea of Okhotsk in order to clarify the distribution of whales in early spring. We flew around the polynya over Kashevorov Banks (200 km. to the north of Sakhalin Island). In September 1982 we inspected the same areas which were covered in 1979. From the end of August to the beginning of September 1983 we examined the area of Amur Bay (Liman), Sakhalinskiy, Nikolaya, Ul'banskiy, Akademiya, Tugurskiy, Aleksandry Bays and part of Udskaya Bay, the coastal waters of Bol'shoy Shantar Island, the coastal areas of the northwestern and northern parts of the Sea of Okhotsk, Penzhinskaya and Gizhiginskaya Bays and the northwest coast coast of Kamchatka (up to Palana village).

From July-October 1984 we inspected Sakhalinskiy Bay, Amur Liman and the Amur up to Mago village. We made an aerial count of the animals in the bays of the Shantarskiy area and the coastal zones which are found in this area of the islands. Investigations in Gizhiginskaya and Penzhinskaya Bays were done at the beginning of September. Observations of gray whales were conducted in July,

August and October.

In 1985 an aerial survey was done in June and September-November. We examined the area of Sakhalinskiy Bay, the Amur from the mouth to Nikolaevsk-na-Amur and bays of the Shantarskiy area. The search for gray whales was done in June, September and November along the northeastern coast of the Sakhalin Peninsula in the same observation areas of 1984.
(19)

When determining the numbers of cetaceans we did not extrapolate and only an actual observation of the numbers of animals was done.

Polar whales. The habitation area of polar whales in the Sea of Okhotsk according to the material from our observations encompasses the bays which are located south of the Shantarskiy Islands (Fig. 1). In summer in Ul'banskiy Bay 20 animals were seen, in Akademiya Bay, including Konstantina Bay, there were 20-40 animals and in Turgurskiy Bay 10 animals were sighted (Table 1).

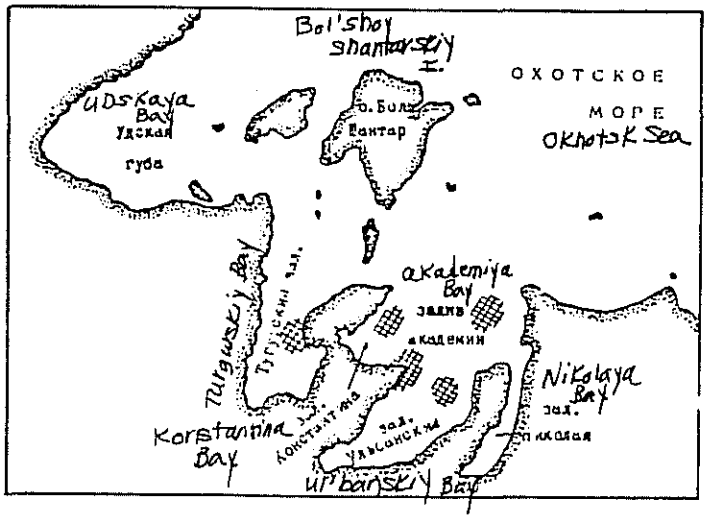


Fig. 1. The distribution of polar whales in the Sea of Okhotsk in the summer-autumn period 1974-1985.

Table 1

The Results of the Aerial Count of Polar Whales in the Sea of Okhotsk

Area	1979		1982		1985		
	1-9 Aug.	1-7 Sept.	30 Aug. 7 Sept.	21-23 Aug. 20 Oct.	June	Sept.	Oct.
Bay							
Turgurskiy	7	-	3	-	16	-	-
Ul'banskiy	20	15	-	11	-	8	12
Akademiya	22	-	39	-	-	1	-
Konstantina	-	13	1	20	-	11	3
Belichiy Is.	6	-	1	-	-	-	-

(20) Depending on the available food base, polar whales can change their summer habitation sites several times. In 1983 the most numbers were seen in Akademiya Bay; in 1984 in Ul'banskiy and Konstantina Bays; in June 1985 - only in Turgurskiy Bay, and in September and October they were sighted in Ul'banskiy and Konstantina Bays.

Unfortunately, over all of these years of observations we did not notice any increase in the numbers of these whales, although in individual years we did see calves (1979) and observed mating.

According to the results of our observations polar whales at the present time are preserved in small numbers (possibly insufficient for the survival of the population) in a restricted coastal section of the southern part of the Shantarskiy area. The number of polar whales in this region is 150 to 200 animals (Berzin, 1982).

During these years there were detailed examinations of all of the coastal areas of the northwestern part of the Sea of Okhotsk. A comparison and analysis of the accumulated information led us to consider that up to 100 polar whales inhabited these areas. There remain the unexplained numbers, the distribution and systematic discovery of right whales in the northern and northwestern areas of the Sea of Okhotsk.

After thorough aerial observations at all of the possible habitation sites of gray whales in the northwestern and northern areas (coastal) of the Sea of Okhotsk in 1979 - 1982, we did not see any of this species of whale. In September 1983 a TINRO associate, G.M. Kosygin, saw about 20 miscellaneous individuals in the coastal waters off the northeastern coast of the Sakhalin Peninsula.

In 1984 we began regular observations on this group of whales (evidently a single breeding group) in different months and in every area possible for the habitation of gray whales near the

Sakhalin Peninsula. After two years of aerial surveys we examined all of the coastal waters off northern and southern Sakhalin - from Cape Yelizavety to Cape Terpeniya, and in the area of Terpeniya Bay. The whales mainly stayed within a restricted area in the summer near the southern part of the large, shallow-water Pil'tun Bay, however, they could be dispersed in coastal zones in a northerly direction up to the latitudes of the Okha River and, perhaps, Cape Yelizavety. Gray whales were never seen south of Pil'tun Bay in the summer.

The whales were either solitary or in groups of two to three individuals at distances of 100...2,000 m. from the shore. There were juvenile (new-born) whales along with the adult animals. During the aerial observations there were (21) clearly visible dirty-green, blurry spots appearing on the surface of the water in the places where the whales surfaced. This confirmed that whales feed on bottom food in the coastal shallow water.

Our comparisons of materials from benthic surveys showed that during the times of the observation the whales stayed in areas of maximum benthic material (over 1000 g/m2) for the western part of the Sea of Okhotsk (according to the material of TINRO associate, V.N. Koblikov).

According to the report of forestry workers located near the entrance to Pil'tun Bay, gray whales have appeared more or less regularly since 1981 in varying numbers in June after the coastal waters are free of ice. We tried to locate gray whales from a helicopter at the beginning of December 1984 in the coastal waters off Sakhalin Island without success; there were none near the northeastern coast of the island along their possible migration route, to the south, nor in the coastal strip up to Cape Terpeniya. There was no doubt that these whales belong to the Okhotsk-Korean population which has been considered "virtually extinct" by most Soviet and American specialists.

A report from a TINRO associate, S.A. Blokhin, inspires some hope. He observed two gray whales in a stretch of shallow water near the coast of west Kamchakta near the mouth of the Opala River which is somewhat south of where they were last seen by Ditmar 100 years ago (1885).

Belukha. Belukhas are found nearly everywhere in the Sea of Okhotsk, however, accumulations form regularly in specific places which are restricted from other parts of its range, and characterized as the shallow water bays into which flow large and small rivers.

As a result of the aerial survey work the distribution of belukhas in the summer-autumn was relatively well studied. According to previous ideas about the population structure of belukhas in the Sea of Okhotsk (Berzin, Yablokov, 1978) a single Sakhalin-Tuguro-Chumikan population inhabited the western areas of the sea. Thus belukhas which live in the area of Sakhalin Strait,

Amur Liman and the Amur are considered to be part of this population. Based on our observations this area was divided into a habitation area for a separate population which we called the Sakhalin-Amur.

The largest number of belukhas according to our aerial surveys was seen within the boundaries of Sakhalin Bay, the Amur Liman and at Zotov Banks. In September 1980 a significant number of belukhas was noticed in Sakhalin Bay near Baydukov Islands and Chkalow (the southern part of Sakhalin Bay), (22) but the largest accumulation was observed in the Zotov Banks area. The greatest number of belukhas in Sakhalin Strait was seen September 14, 1983, on the approach to Zotov Banks and immediately in its area. No less than 200 belukhas were sighted (report of TINRO colleague, G.M. Kosygin).

In August 1984 belukhas were observed both close to Zotov Banks and about five to ten miles from them. Here, we recorded over 400 different animals. However, the number of belukhas near Zotov Banks, as well as in other areas (Baydukov Island, Petroskaya Kosa) fluctuated significantly not only in different months, but through several days, and sometimes during the course of one day. This has been confirmed by subsequent observations. At the beginning of September 1982 approximately 300 belukhas were counted near Zotov Banks and only solitary individuals were seen the following day. At the beginning of August 1984 over a five minute time period approximately 100 belukhas were counted, but after several hours, only two individuals were sighted here. On 6 June 1985 a pod of foraging belukhas consisting of more than 150 animals was seen in the vicinity of Zotov Banks (see Fig. 2b; Table 2).

Table 2

The Results of Counting Belukha in Sakhalin Strait and the Amur river in 1985

Area	June	Sept.	Oct.	Nov.
Zotov Banks	150	1	6	-*
Baydukov Island	60	200	25	15
Petroskaya Kosa	21	-	-	10
Yekateriny Bay	-	-	-	8
Uspenovka village	30	-	3	-
Baykal Bay	2	-	-	-
Amur River	83	2	11	-

*Observations were made, but no belukhas were seen

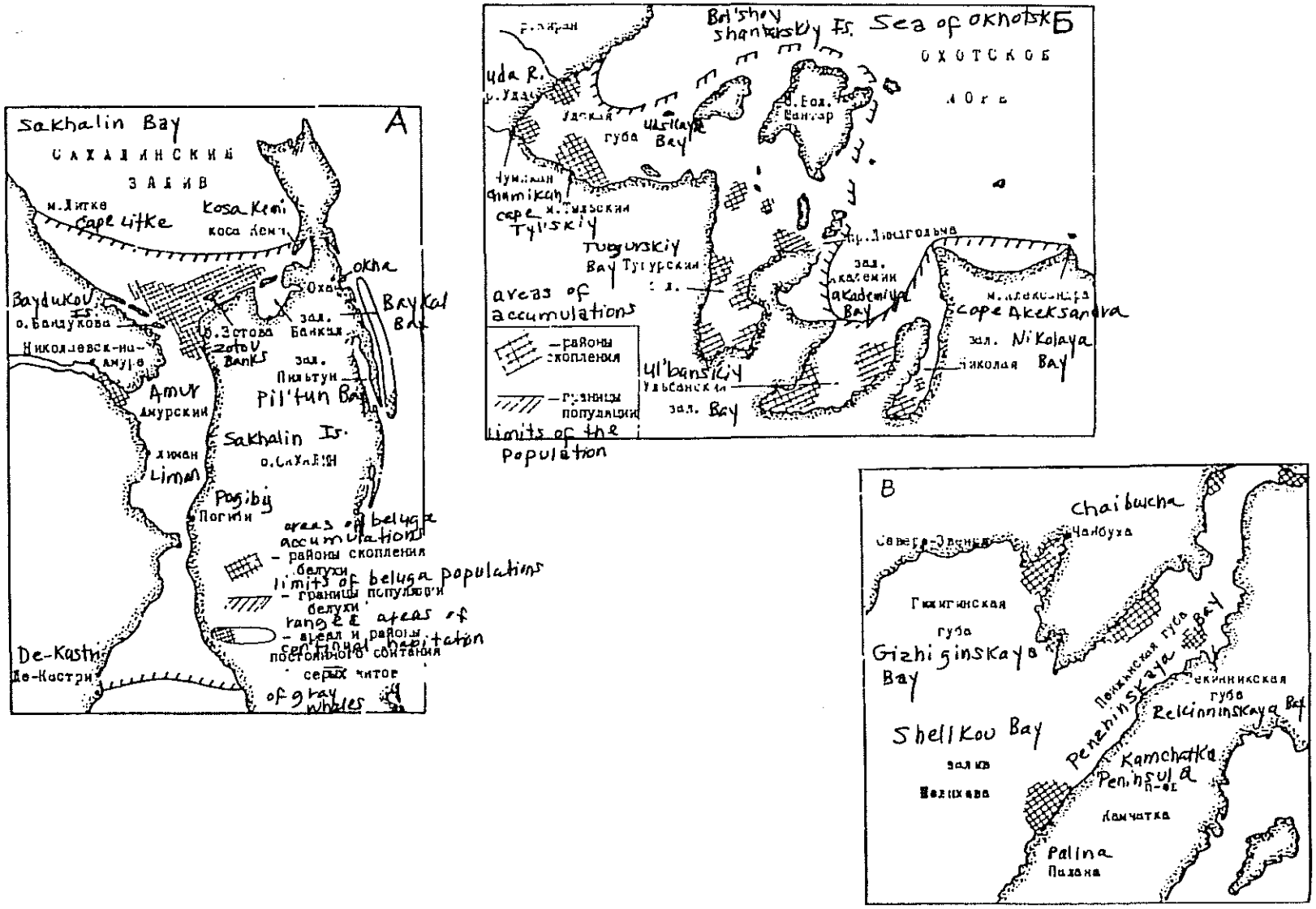


Fig. 2b. The distribution of belukhas in the summer-fall period: A - Sakhalin-Amur population (1979-1985) and gray whales (1983-1985); B - Shantarskiy population (1979-1985): C - Northern Okhotsk population

After 2 hours and 10 to 15 minutes north of the previous route we recorded large groups of belukhas which were moving in a northerly direction. The animals moved in a band 4 to 5 km. long and 500 m. wide. The greatest density was noted in the middle of the accumulation (23). As it turned out, these were belukhas which had been sighted two hours earlier (we verified the Zotov Banks area a second time and only found two belukhas there). On previous days (2-5 June) we had only seen solitary belukhas in the vicinity of Zotov Banks.

The fluctuation of the numbers of belukhas is explained by the fact some belukhas stay here a short time and some of them are found here more or less continually.

The location of its prey species is, of course, a determinative factor in the distribution of belukhas. In the summer-fall period chum and pink salmon predominate in the food and the presence of belukhas in one or another area is directly connected to the run of salmon. At the beginning of September 1985 only two belukhas were counted near Zotov Banks. It turned out that there was no fall run of chum salmon in this area. They passed through to the area of Baydukov Island where a large number of belukhas was sighted (Fig. 2a). In a segment of the route 10 km. long, approximated 200 animals were counted at the beginning of September; at the beginning of July no less than 60 belukhas were counted near Baydukov Island. At the end of October and beginning of November the situation had not changed. Although the total number of belukhas had been greatly reduced in the southern part of Sakhalin Strait most of them, however, had stayed in the area of Baydukov Island. At the same time belukhas were not generally seen near Zotov Banks.

In our opinion Zotov Banks and Baydukov Island can serve as a model for studying the ecology of belukhas.

Belukhas were seen in other areas of Sakhalin Strait. In mid-June 1985 in the area of Petrovskaya Kosa over 20 animals were counted and at least 10 individuals were noted there at the beginning of November. In the area of Cape Perovskiy (Yekateriniy Strait) approximately 10 belukhas were counted at the beginning of November. In the area of Uspenovka village (to the east of Zotov Banks) about 30 belukhas were counted at the beginning of June, and three of them remained here until the end of October. In Baykal Strait two belukhas were seen in June, but none were sighted in October. In previous years belukhas had been seen in great numbers in Baykal Strait. In June 1970 only 40 animals were counted here; in August 1979 - 20 and in September 1984 - 18.

In the vicinity of Pogiby village (Sakhalin Island, southern part of Amur liman) the first belukhas appeared (according to data from questionnaires) between 15-20 April when the bay was still covered with ice. Belukhas only pass through this region from the north, part of them go by Nevel'skogo Strait and go down to Tartarskiy Strait, however, the main part of the animals remain in

the southern part of the bay and Nevel'skogo Strait. (25) A mass movement of belukhas was observed from mid-June. The belukhas stay by the herring and pink salmon and abandon this area with the departure of the fish. In 1985 1000 animals were counted only in the southern part of the bay. Accumulations of 200-300 animals were considered to be normal. The belukhas left Amurskiy Bay on 25 July, despite the fact that the pink salmon run had not yet ceased. The departure of belukhas can be explained by the first appearance of west Pacific sardine schools in Amurskiy Bay. The belukhas evidently migrated behind these fishes, however,it is not known in what direction.

According to data in the literature (Arsen'ev, 1939) belukhas in Amurskiy Bay come from Tartarskiy Strait after the ice breaks up in Terpeniya Bay. According to these data, at the beginning of spring belukhas, "in enormous numbers", appeared at the mouth of Poronay River of this strait and went into the river. At our request M.K. Maminov questioned fishermen at fishing sites and workers of the Poronaiskiy Fishery Collective and explained that belukhas had never been seen at the mouth of the Poronay River.

In the Amur (from the mouth up to Nikolayevsk-na-Amur) belukhas were continually seen basically in the summer. From 60 to 80 animals were counted in this section. In the fall they were mainly noted at the mouth in small numbers. In 1985 at the beginning of June more than 80 belukhas were counted in the Amur, morever, one group consisted of 13 animals, and four belukhas were seen near the piers at Nikolayevsk-na Amur . In 1985 at the end of October in the area of Ozerpakh and Puir villages, 11 belukhas were counted.

In comparison with previous years, however, the numbers of belukhas entering the Amur River have decreased, and evidently, shortened the length of their migration route up into the river. In 1979 and 1980 belukhas were continually seen near Mago village (up to 20 animals). In recent years belukhas have not been seen above Nikolayevsk-na-Amur.

According to our material, after the conclusion of the spring migration of belukhas into Sakhalinskiy Bay they are not widely spread but basically stay in the southern part of the bay. In our view, the northern limits of the population, run from Cape Litke (western part of Sakhalinskiy Bay) up to Kemi Kosa (Sakhalin Island), and south to the latitude of De-Kastri village (Fig. 2,A).

We determined that the total numbers of the Sakhalin-Amur population of belukhas were 17,000-20,000 animals.

Belukhas, which inhabit the range of the area of the Shantarskiy Islands and Nikolaya, Ul'banskiy, Akademiya, Turgurskhiy and Udskiy Bays, were separated into an independent Tuguro-Chumikansk or Shantarskiy population. According to our data the eastern limits passed by Cape (26) Aleksandra, to the north going through Greater Shantarskiy Island and Feklistova, and further to the west to the mainland (Fig. 2,b). In comparison with belukhas of the Sakhalin-Amur population, the belukhas of this area are less numerous, and based on our aerial surveys, did not form accumulations as large as those near Baydukov Island and Zotov Banks. To the west belukhas begin to get noticeable at Nikolaya Bay. At the time of their intensive harvesting, hundreds of pods of these animals were recorded. At the present time groups of no more than 10 animals are recorded here and not at all during the period of observations. For example, belukhas were not seen from 1979 to 1983. From July - October 1984 about 40 animals were registered and in June 1985 7 were recorded and in October 1985 - 3 animals.

There were considerably more belukhas in Ul'banskiy and Turgurskiy Bays. In September 1983 approximately 40 belukhas were seen in Ul'banskiy Bay and at the beginning of July 1984, of the 40 animals which were seen the majority stayed close to the mouth of the Ul'ban River. During the months of summer observations in 1984 in Turgurskiy Bay 130 belukhas were recorded, in addition we noted compact groups of 10-12 animals, as many as in four months of 1985, also more than half of this number was seen in September. Over 30 belukhas were recorded in September 1983 in Lindhol'm Strait and more than 50 near Ptichiy Island (we included the areas of Lindhol'm Strait and Ptichiy in Turgurskiy Bay).

In Udskiy Bay we did not see significant accumulations of belukhas in two years of observations. The largest number (30 animals) was recorded in August 1979. Approximately 25 belukhas were counted in September 1983 and as many were counted near the -mouth of the Uda River in September 1985. According to information from questionnaires, the belukhas arrive at the end of June to the beginning of July and stay amidst the accumulations of smelts and herring, and later in the large chum salmon runs. Belukhas usually form accumulations in the area of Tyl'skiy Beacon, near the mouth of the Uda River and along the coast to the north up to the Kiran River. During one observation in these areas 200-300 animals were counted and in the area of Tyl'skiy Beacon approximately 1000 animals were once observed. Belukhas approach the mouths of rivers during a rising tide.

An analysis of all of the material indicated that the numbers of belukhas annually seen in Udskiy Bay prompted the Chumikan State Fur Farm to inquire about the possibility of a commercial harvest. We presented the necessary material on the numbers of belukhas in

this area and a possible rate for a harvest.

We determined that the total number of belukhas of the Shantarskiy population was 3,000- 5,000 animals.

(27) According to the questionnaires, belukhas were seen to the north and south of Ayan village. In August 1979, 60 km. south of Ayan, about 60 belukhas were observed near the coast; on 25 May 1984 up to 50 belukhas were seen in Fedor Bay (80 km. north of Ayan) amidst an accumulation of herring; in September 1985, 20 belukhas were also counted there. It is not possible to determine the population classification of these belukhas. Shelikov Bay and Gizhiginskaya and Penzhinskaya Bays (Fig. 2,c) are continual habitation areas of belukhas in the Sea of Okhotsk. In spring belukhas concentrate here close to the coast in the accumulations of spawning herring. In May 1980 a school of belukhas consisting of over 3,000 individuals, and extending over 7 km., was observed by a fishing vessel in the area of Yevensk village. In the summer-autumn period belukhas formed significant accumulations in Gizhiginskaya Bay, along the western coasts of Penzhinskaya Bay and at the mouth of the Penzhina River. Over 200 animals were counted in Gizhiginskaya Bay at the beginning of June 1980 and roughly 75 individuals were seen by a TINRO colleague, V.V. Mel'nikova, in Penzhinskaya Bay. In autumn 1983 belukhas were only seen in Penzhinskaya Bay, where over 80 animals were counted on 12-14 September.

Table 3

The Results of the Aerial Survey of Belukhas in the Sea of Okhotsk

	1979	1980	1981	1982	1983	1984	1985
Area	Aug.	June, Sept.	July	Sept.	Aug., Sept.	July, Sept.	June, Sept., Nov.
Amur R.	60*	70	-	-	50	150	100
Bay							
Sakhalinskiy	100	700	120	300	200	500	500
Nikolaya	-	-	-	-	-	37	10
Tugurskiy	50	-	-	-	100	200	125
Ul'banskiy	10	-	-	5	40	200	75
Bay							
Udskiy	30	-	-	-	24	18	25
Gizhiginskaya	-	250	-	-	-	60	-
Penzhinskaya	-	75	-	-	80	130	-

*The number of belukhas counted is rounded-off

At the beginning of September 1984 more than 60 belukhas were counted in Gizhiginskaya Bay and about 50 in Penzhinskaya Bay.

The results of the observations from recent years allowed us to extend the representative range of belukhas along the west coast of the Kamchatka Peninsula. For the first time on 3 September 1984 about 80 belukhas were seen southwest of Rekinninskaya Bay, 20 to 50 km. from (28) the coast of Kamchatka. On 13 July 1984, G.M. Kosygin, a TINRO colleague, reported seeing roughly 150 individuals along the coast from the Tigil' River to Voyampolka River.

The belukhas occurred irregularly in all areas of the Sea of Okhotsk.

According to the material at our disposal we tentatively estimate the belukha population in the northern part of the Sea of Okhotsk to be 15,000 - 20,000 animals, however, we have not yet determined the limits of this population.

Data from the aerial counts of belukhas in the Sea of Okhotsk are summarized in Table 3.

The estimate of the total number of belukhas in the areas surveyed is 35,000 - 45,000 animals.

Literature Cited

Arsen'ev, V.A. 1939. The distribution and migration of belukhas in the Far East. Izv. TINRO, v.15:1-111.

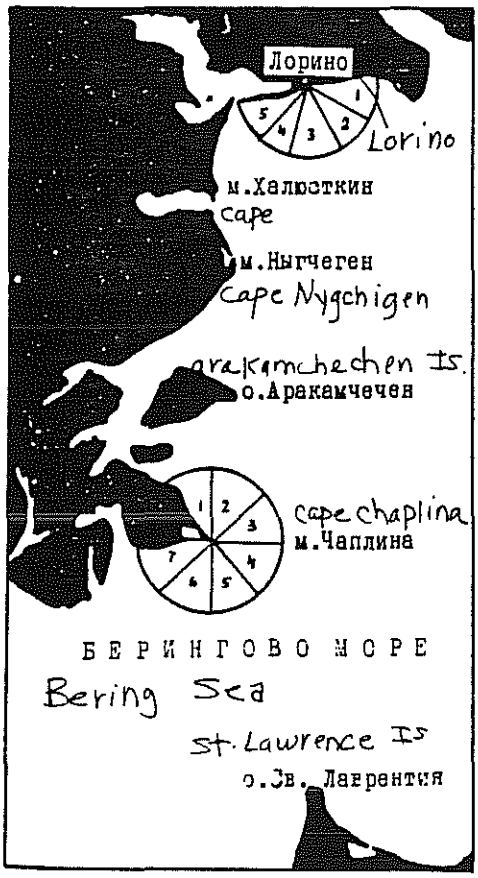
Berzin, A.A. 1982. Whale resources of the Pacific Ocean. The study, preservation and rational utilization of marine mammals: Tezisy Dokladov Vos'mogo Vsesoyuznogo Soveshchaniya. Astrakhan. p. 24-25.

Berzin, A.A., and A.V. Yablokov. 1978. The number and population structure of major exploited species of cetaceans of the World Ocean. Zoolog. Zh. 57(18):1771-1784.

2.3 DATA FROM OBSERVATIONS ON GRAY WHALES FROM OBSERVATION POINTS LOCATED ON THE COASTS OF THE CHUKOTSK PENINSULA

S.A. Blokhin (TINRO)

There is sufficient information in the literature about the winter period of life for gray whales of the California-Chukotsk population and particularly about the character of their distribution near the coasts of North America and the beginning time and route of their migration (Gilman, 1960; Pike, 1962; Gard, 1974; (29) Rice et al., 1981; Darling, 1984 and others).



Location of observation points on the coast of the Chuktosk peninsula and registration zones for gray whales

The summer period of their life in this scheme is poorly studied. We only have general information about the distribution and areas of concentration in the coastal waters of the Chukotsk Peninsula (Zenkovich, 1937; Nikulin, 1946; Zimushko, 1970; Bogoslovskaya et al., 1981; Berzin, 1984 and others).

In 1984 TINRO colleagues began an organization of gray whale observation points at the sites of their largest concentrations near the coast of the Chukotsk Peninsula for the purpose of obtaining data on the specific time of their arrival along the coast of the Peninsula, the numbers at different foraging periods and the specific time for the start of the autumn migration to the winter habitation sites. Obtaining such data would allow us to more accurately evaluate the numbers of gray whales, their dynamics and, consequently, their status of stocks.

In 1984 observations were made of gray whales from two coastal points on the shores of the peninsula. As a result, material was obtained for the first time on certain characteristics of their distribution on the feeding grounds.

Material and methods. One of the most suitable points for observing gray whales along the coast of the Chukotsk Peninsula is Cape Chaplina (drawing) because it projects far into the sea, and it is located along the gray whale migration routes and also within their feeding area. (June - November).

From the 17 m. beacon located here one can clearly scan the sea in a 270° field of vision i.e. in a northern, to eastern, to southern and southwestern direction. Binoculars (X7) were used for making observations of the sea. For convenience all of the observed areas were arbitrarily divided into seven sectors (drawing).

At the end of May there was still ice of different sizes around the cape amidst which there were patches of open water. Depending on the direction and force of the wind and also the currents, the ice conditions there change often, however, there is always a large patch of open water

The coast of Mechigmenskaya Bay and the area of Lorino village were selected as the second places for observation points (drawing). The bay was a constant feeding site for gray whales who came close to the shore here and could be seen even with the naked eye. From the coast which was 20 m. higher than sea level one could clearly inspect the area of Mechigmenskaya Bay with roughly a 180° angle of vision. In order to conveniently register the whales the visual area of the bay was arbitrarily divided into five sectors (drawing) (30). Observations of the sea were done in the morning hours for a period of 30 to 40 minutes. In our opinion this was a sufficient amount of time for recording the maximum number of animals which were within the field of visibility.

The maximum distance from the observation point from which a blow could be seen in good weather was accepted to be 15 to 17 km. from both observation points.
(31) The report only used observations from days when the waves in the sea did not make it difficult to count the whales and the visibility was clear within the limits of the examination area.

Observations from Cape Chaplina. From 22 to 25 May observations were made of the sea from 0720 with two intervals. In this case no whales were recorded within the limits of visibility.

The first gray whales approached Cape Chaplina on 26 May and were sighted in the northeast (Sector 5). They were 8-10 km. from shore. Observations were made for seven hours on this day. Of the 10 gray whales which were detected, seven moved in a westerly direction, occasionally they dove every two to three minutes while showing their flukes. The whales stayed submerged approximately one minute.

On 27 May during eight hours of observations from the cape (Sectors 4-6) seven gray whales were sighted which moved in different directions, often diving and showing their flukes.

On 28 May during eight hours of observations to the south and east of the cape, 19 whales were sighted. They behaved very calmly. Nearly all of the animals stayed at the site, diving frequently

In a subsequent number of observations (up to 2 June) the whales remained nearly continuously: on 29 May 21 animals were counted after eight hours; on 30 May, 29 animals were counted in seven hours; on 1 June 10 animals in four hours, and on 2 June 16 individuals in one and a half hours. The movement of the observed animals was not in one single direction; on 3 June in the area of Cape Chaplina a sharp increase in the numbers of gray whales was noticed. On this day from 0700 to 2100 (after six observations) 180 individuals were counted. Part of the animals remained in one spot, diving frequently and showing their flukes. Most of the whales, however, kept moving: in Sectors 3-4 they swam slowly to the south while diving and then for five to six m. moved towards the west.

On 4 June, 153 whales had been counted over six hours, their movement pattern was nearly the same as for 3 June. On 5 and 6 June the number of gray whales near the cape was also high, however, most of the animals were already moving towards the north. After several days (10-11 June) the direction of the whales' movement changed to the south and southwest, but on 25 to 30 June it again became northerly. During the period from 3 to 30 June, the number of solitary whales observed was rather high and remained approximately at the same level.

From 8 to 17 July the number of whales seen around Cape Chaplina significantly declined, and their movement did not have a definite direction (only on 8 July the whales moved basically in a northerly direction).

(32) On 5 September, while on a whaling vessel we only recorded whales near Cape Chaplina within the limits of Sectors 2 and 3. The animals stayed in place and fed intensively. Approximately 40 whales were counted 10 to 20 km. from shore. In summarizing the observations on gray whales near Cape Chaplina one can state the following:

1. Gray whales appeared in the area of the cape on 26 May (the mean daily air temperature from 26 to 30 May was -1.3°C and the surface temperature of the water was -1.0°).

2. An increased number of gray whales was noted on 3 June.

The data obtained verified the fact that the mass migration of whales near the southeastern coast of the Chukotsk Peninsula begins in June. At this time two periods were noted when the movement of most of the whales was clearly in a northern and northeastern direction (6 June and from 25 June to 8 July respectively). Evidently, in the waters around Cape Chaplina, in 1984 these were peak periods for the mass movement of whales to the north, during which time they were seen diving and feeding. On the remaining days the whales' movements were not in one direction.

3. Judging from the whales which were observed in Sectors 5 and 6, generally, moving in a westerly direction, the final stage of the gray whale migration to the Bering and Chukchi Seas went past Cape Chaplina by St. Lawrence Island, from where one group of whales moved towards Anadyr Bay and the other group further to the north. Our data very definitely confirms the accuracy of schemes of migration routes for gray whales of the California-Chukotsk population which was proposed by Braham (1984).

Observations from the coast of Mechigmenskaya Bay. According to reports from sites of marine hunters, in 1984 solitary gray whales in the waters adjacent to Mechigmenskaya Bay (the bay itself was closed by ice) were already noticed at the end of May. The first group of whales consisting of eight to ten animals was recorded here in the first part of June. At this time there was only ice in the shallow waters of the bay, whereas there was no ice in the southern part. According to the hunters an increase in the number of whales was usually noticed in July when the bay was completely ice-free.

At the time of our first seaward observations, done on 6 August, there were 20 gray whales uniformly distributed in Sectors 2-4 (drawing) within the visibility limits which were 8-12 km. from shore. During the observations the animals remained in one place making partial dives and showing their (33) flukes. Judging from the blows and the silhouette they were small animals (9 to 10

m.).

In August the observations of the sea were done over a 10 day period with a daily average of 49 whales noted in the bay. The majority of these animals occurred singly in Sectors 2-3, 7 to 8 km. and further from shore. The whales behaved calmly; they fed intensively, not making any directional movements. The whales which were observed were small (an average of 9 to 10 m.).

In September seaward observations where boundaries and structure of which, in many cases, define the principal approach for gathering the kind of information needed for appraisal of the stocks, as well as for regulating the numbers of these animals.

There were 12 days of seaward observations in October. During one obseration an average of 28 whales was seen. In this month a large number of animals stayed in groups of 5-20 individuals. We did not notice any directional movement during the observation period. The whales were also small (9-10 m.), however, sometimes judging from their blows and silhouette, there were larger animals among them. The majority of the whales stayed in Sectors 2-4, 8 km. and further from shore.

On 7 November within the limits of visibility 10 gray whales were counted which were found in Sectors 2-3, 8 to 12 m., from the shore.

On 9 November only one whale was seen in Sector 2, 8-9 km. from shore. On this same day while the whale catchers were tracking from Lorino village to the approach to Cape Khalyustkin, we saw several solitary whales of small sizes (9-10 m.). During a crossing of one hour 8 animals were counted. At the time of a subsequent crossing up to Cape Nygchigen, along which passes the southern boundary of Mechigmenskaya Bay, about 30 whales were counted in an hour and a half. Individuals noticed near the cape itself were much larger than from the bay.

The observations done in November indicated that in this month the gray whales were not yet at the foraging sites near the coast of the Chukotsk Peninsula, however, they were considerably less numerous here than in previous months. The whales moved in various directions, making partial dives.

Observations on gray whales in Mechigmenskaya Bay indicated the following: (34)

1. The location of the site at Lorino village was convenient for setting up an observation point because in the areas which can be examined from here, there are always gray whales staying in the bay during the foraging period.

2. The 1984 observations indicted that most of the whale concentrations in the nearshore zone of Mechigmenskaya Bay (up to 15 km.) were noted in August. During this month an average of 50 animals was seen over 40 to 50 minutes; in September-October there

were, respectively, 29 and 28 individuals. In November the numbers of whales in the gulf decreased significantly and there were approximately 5 individuals.

3. Most of the gray whales in Mechigmenskaya Bay in the vicinity of Lorino village foraged seven to eight km. from shore and farther. Solitary individuals would approach for a short time at distances of 200-500 m. Gray whales reacted rather calmly to the vessel standing at anchor, swimming up to it at a close distance.

4. Judging from the blow and silhouette of the whales Mechigmenskaya Bay is a foraging place for juvenile animals who have not attained sexual maturity.

5. The whalers did not notice any unidirectional movements during the observation period. As a rule, the animals stayed in one place, diving often and showing their flukes.

Based on the data which were obtained we can assume that the migration routes for gray whales in the vicinity of Mechigmenskaya Bay pass far from shore (beyond the field of vision). However, the number and location of whales which were observed here was not constant at different times, and consequently, this particulr bay serves as a place where whales spend a short length of time in their residence near the Chukotsk Peninsula.

In October we noticed the formation of whales into groups which was indicative of the beginning of the mass migration of whales in a given month to the areas of the wintering grounds.

Conclusions

The investigation which was conducted in 1984 confirmed the suitability of Cape Chaplina for setting up an observation point. We have obtained the first data about the time when the whales come to the Chukotsk Peninsula, the directionality of their movements, and the numbers of animals here in May - July. We also noted the suitabiity of the shore in the vicinity of Lorino village for setting up an observation point. From this observation point we obtained the first information on the distribution of whales in the bay, and their population dynamics here from August to November.

(35) On the whole it was deemed necessary to continue the counting operations from observation points on the coast of the Chukotsk Peninsula, not only to expand knowledge on the mechanisms governing the distribution of whales in the waters of the Bering Sea, but also to allow one to trace the population dynamics of the animals in one or another area, and subsequently, to record its possible variations.

Literature cited

Berzin, A.A. 1984. Soviet studies of the distribution and number of gray whales in the Bering and Chukchi Seas, from 1968 to 1982. The Gray whale, Eshrichtius robustus. Academic Press, Inc.

Bogoslovskaya, L.S., L.M. Votrogov and T.N. Semenova. 1981. Feeding habits of the gray whales off the Chukotsk Peninsula. Rep. Int. Whal. Comm. 31.

Braham, H.W. 1984. Distribution and migration of gray whales in Alaska, In: The gray whale, Eschrichtius robustus. Acadmic Press, Inc. 11.

Darling, J.D. 1984. Gray whales off Vancouver Island, British Columbia. The gray whale, Eschrichtius robustus. Academic Press, Inc.

Gard, R. 1974. Aerial census of gray whales in Baja California lagoons, 1970 and 1973, with notes on behavior, mortality and conservation. Calif. Fish Game. 60(3).

Gilmore, R.M. 1960. Census and migration of the California gray whale. Nor. Hvalfangst-Tid. 49.

Nikulin, P.G. 1946. The distribution of cetaceans in the seas surrounding the Chukotsk Peninsula. Izvestiya TINRO, 22:255-257.

Pike, G.C. 1962. Migration and feeding of the gray whale (Eschrichtius robustus). J. Fish. Res. Bd. Can., 19.

Rice, D.W., A.A., Wolman and D.E. Withrow. 1981. Gray whales on the winter ground in Baja California. Rep. Int. Whal. Comm. 31.

Zenkevich, B.A. 1937. More about the California gray whale. Vestnik, Dal'nevostochnogo Filiala ANSSSR. no.23:91-103.22

Zimushko, V.V. 1970. Aerial-visual count of the numbers and observation of the distribution of gray whales in the coastal waters of Chukotka. Izvestiya TINRO, v.71:289-294.

(36)

2.4 OBSERVATIONS ON THE DISTRIBUTION, NUMBERS AND BEHAVIOR OF GRAY WHALES (ESCHRICHTIUS ROBUSTUS) NEAR THE COAST OF CHUKOTKA IN SEPTEMBER 1983

S.A. Blokhin (TINRO)

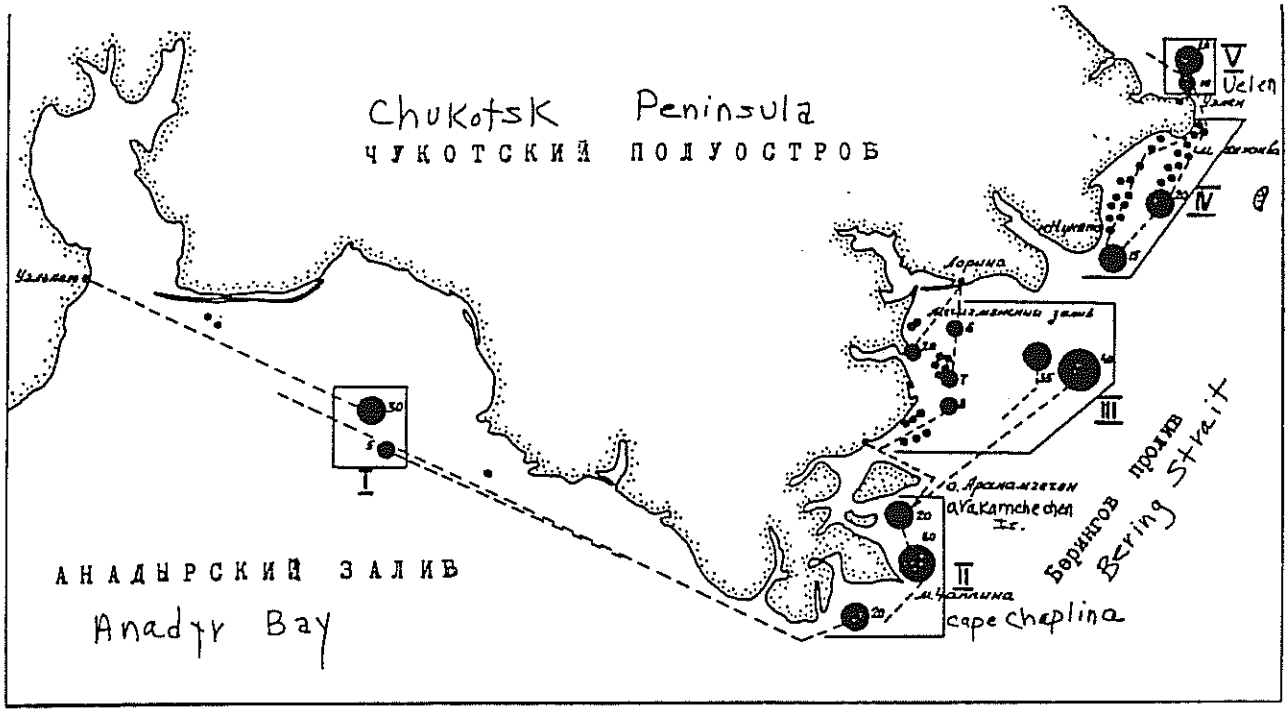
Observations conducted from 1969 to 1978 from the whale catcher Zvezdnyi allowed us to divide the main areas of gray whale concentrations near the coast of Chukotka (Votrogov, Bogoslovskaya, 1980). The mechanisms of the distribution of the whales on the feeding grounds in the summer-autumn period is still not clear, therefore, it is necessary to extend the investigation on the given question.

In 1983 we made a count of the numbers of gray whales in their main capture areas near the coast of the Chukotsk Peninsula from 2 to 12 September during the commercial harvest by the K/S Zvezdnyi*. At the time the area from Anadyr Bay to the Chukchi Sea was examined (drawing). We divided the sites where whales occurred into five areas (drawing).

Region I. (Anadyr Bay). While passing through Anadyr Bay on 4 September from east to west five whales were seen at Lat. 65° 54' N., Long. 176°40'W. Subsequently during the time of the hunt from 0900 to 1500 in the sector at Lat. 65° 01' N., Long. 176° 51' W. we counted aproximately 30 gray whales. Two of the whales were noticed in the immediate vicinity (2 to 3 miles) of Kosa Meechkin Island. On the following day during a repeat tracking of Anadyr Bay there were no whales seen in those areas where they had been sighted the day before, and only one whale was noted at Lat. 64° 40' N., Long. 175° 17' W. Thirty-eight gray whales were counted in all of Anadyr Bay.

Region II. (From Cape Chaplina to Aramkamchechen Island). Whales were sighted here on 5 September at Lat. 64° 17' N., Long. 172° 39' W. the ship turned into the drift amidst a group of whales consisting of approximately 20 individuals. The animals did not appear to be markedly disturbed, however, they gradually cleared away from the whale catcher. In the morning of the next day the ship was at Lat. 64° 16' N., Long. 172° 24' W. where there were no whales. When the ship moved to the northwest no gray whales were seen. Only at the approach to Arakamchechen

*The author thanks the Captain, P.A. Karpechkin, of the Zvezdnyi and the ship's crew for their assistance in conducting the work



Gray whale encounter sites. Numbers indicate the number of animals which were seen. The dashed lines indicate the ship's course and the black circles are the water area which was excavated.

Island, at a segment of the route (38) which extended 10 to 15 miles were 20 animals counted. During a repeat visit to this area (after three days) approximately 15 whales were counted. On this same day on the approach to Cape Chaplina over the course of one hour approximately 70-80 whales were counted. When the ship passed through this area several days earlier no whales had been noted. In a total of three sections inspected in this region approximately 120 gray whales were recorded.

Region III (Mechigmenskaya Bay and its adjacent waters). While passing by Lorino village on 2 September we saw two groups of gray whales of six and seven animals each. Approximately 20 whales were seen close to Cape Khalyustkin. The largest number (about 40 animals) of gray whales in this region was seen on 6 September in an area centered at Lat. 65° 16' N., Long. 171° 04' W. The density of the animals here was greater than the other areas. In all of the seven sections of Region 3 approximately 130 gray whales were recorded.

Region IV (from Cape Nunyamo to Cape Dezhnev). While crossing from Cape Dezhnev to Cape Nunyamo on 7 September we observed whales in very close to the coast. Under conditions of limited visibility opposite Cape Nunyamo we counted eight gray whales. At the same site the following morning with improving weather conditions, we recorded approximately 15 gray whales. After a slight shift to the northeast to Lat. 65° 34' N., Long. 170° 27'W., and Lat. 65° 48' N., Long. 169° 52' W., we recorded about 20 whales. Solitary individuals were continually seen during the subsequent movement of the ship towards Cape Dezhnev. A total of 60 gray whales was counted in this region.

Region V (waters adjacent to Uelen village). At the approach towards Uelen on 7 September we saw 10 gray whales four to five miles from shore. We saw three minke whales (Balaenoptera acutorostrata). Further north of this sighting we saw 20 gray whales after two hours of observation. The whales which we saw in the waters off Uelen were smaller (8.5 to 10 m.) than the animals in other areas. During the next day, in the second half of the day, we again went through this region, at this time we only saw two whales five to six miles from shore. Approximately 30 gray whales were recorded in the waters adjacent to Uelen.

Judging from the material obtained, the principle areas of gray whale occurrences were large in size and, could hold large numbers of animals (39); this can only be determined by making transects. In a total of nine days of observations approximately 380 gray whales and three minke whales were counted.

A characteristic behavioral feature of the gray whales seen in all of the regions was the intensive feeding with a similar degree of activity during the daylight hours of a 24 hour period. Evidence of feeding indicted by a change in the color of the water to light green or a yellowish-brown in places where they were diving, and was caused by partial washing away of the animals'

foraging contents, scooped up from the bottom. These "calling cards" were clearly visible at great distances and were indicative of the presence of foraging animals. Birds, in large numbers, stayed near the sites where whales occurred flying down towards the places where the animals appeared at the surface. The presence of birds in the same area was often an indicator of the presence of whales. The depth of the places where whales were found was 17 to 40 m.

The observations of foraging whales in Mechigmenskaya Bay allowed us to clarify certain mechanisms of their behavior. After diving the animals come to the surface in 50 to 60 s., and make five to six exhalations - inhalations (blows). Before a prolonged dive the whale shows its flukes, but the duration of the dive can vary between one whale to another from two to four minutes. This kind of behavior can change over the course of several hours when the animals are practically in one area several hundred square meters in size. This type of behavior is characteristic for smaller sized whales (9 to 10 m.) which are foraging four to five miles from shore at depths of 17 to 25 m. The maximum amount of time spent under water (5 min., 40 s.) was observed for an animal 12 to 13 m., long which was feeding far from shore at depths of 35 to 40 m.

As a rule, gray whales on the feeding grounds maintained small distances between individuals. However, the distance could increase or decrease over a certain length of time. This circumstance and also the fact that a portion of the animals are under water at any given time, made it difficult to make an exact count at any particular place over a short interval of time. Only after following up on the animals could we accurately make a count of them in a group.

We encountered migrating whales in two instances. In the area of Cape Nunyamo we saw three whales moving to the northwest; one whale was recorded opposite Cape Dezhnev. Animals which did not stay in one spot and after staying under water less than a minute, continued on one course.

(40) We were witnesses to an instance when a harpooned whale was not deserted by a whale with whom it was paired. The attempts to take the associated whale during the slow pulling up of the wounded animals to the ship's side were unsuccessful: the latter abandoned the harpooned whale only when the distance between itself and the ship was the minimal distance needed to fire a harpoon.

We were particularly interested to find gray whales in the immediate vicinity of Cape Khalystkin (Region III, see drawing) where the whale catcher did not make a port of call during the time of the harvest (we inspected this from a whale boat). According to local hunters from Lorino village the whales continually stayed here in the summer-autumn months. We did not find animals in a number of rather large lagoons with capes. For similar areas where small inlets, lagoons and rivers discharged along the coast of

Chukotka, there were many whales, but as a rule, these areas were not frequented by whalers. This, apparently, explains the absence of some of these areas on maps for basic accumulations of gray whales given in the report of Votrogov and Bogoslovskaya, 1980. The information cited by these authors regarding the presence of whales in the immediate vicinity of the shore of Anadyr Bay was also received from hunters in the coastal villages.

During the passage through Andyr Bay we did not find gray whales in some of the areas designated in Votrogov and Bogoslovskaya's report (1980) as main sites for finding whales. At the same time, we did find a large number of whales somewhat southeast of the Arakamchechen Island and north of Uelen, whereas, the aforementioned report did not note the presence of animals here.

We were especially interested in the fact that there were no gray whales in some sections of Regions I and V after they had been recorded here the day before, also by the fact that whales were not sighted on 6 September in the area of Cape Chaplina, but on 9 September large accumulations of these animals were seen in that area. Many were noted in the area of Cape Chaplina in the summer-autumn period in 1969, but in 1970 no animals were sighted there. In September 1982, a large accumulation of gray whales (about 140 individuals) was sighted in the same area. There were approximately 60 whales in the center of a 20 square mile area (Doroshenko and Kolesnikov, 1984).

Some notable features of gray whale distribution in the coastal waters of the Chukotsk Peninsula confirm that there is a daily migration within the limits of a small (41) area and also that there is variability in the presence of animals on their foraging grounds both by month and year (Votorogov and Bogoslovskaya, 1980; Bogoslovskaya, Votrogov and Semenova, 1981).

As is known, gray whales come to the waters of Chukotka for feeding, their distribution here, therefore,is rather dependent upon the presence and availability of their main food (amphipods). Evidently, the species composition of the food objects of gray whales in different areas is not stable; the biomass of some of these species undergoes significant changes not only by year, but by month. In relation to this in searching for food objects which form dense accumulations, the whales can be redistributed in the coastal waters off Chukotka which was noted in our observations and also by other researchers.

Literature Cited

Bogoslovskaya, L.S., L.M. Votrogov and L.M. Semenova. 1982. Distribution and feeding of gray whales off Chukotka in the summer and autumn of 1981. Rep. Int. Whal. Comm. 32.

Doroshenko, N.V., and V.N. Kolesnikov. 1984. Results of the investigation of marine mammals in the Bering and Chukchi Seas on the ship, "Entuziast" in 1982. Scientific-Research Works on Marine Mammals in the North Pacific Ocean in 1982/83, p. 8-15. M.

Votrogov, L.M., and L.S. Bogoslovskaya, 1980. Gray whales off the Chukotka Peninsula. Rep. Int. Whal. Comm. 30.

2.5 SCLERODENTINE IN THE TEETH OF MARINE MAMMALS

G.A. Klevezal' (IBR AN SSSR)
and K. Dzh. Phillips (Hofstra University)

Sclerodentine (transparent dentine) in odontology designates the part of the dentine on which the dentinal canals are not visible. Because dentine is hypermineralized, the dentinal canals are filled with salty nitrates, and the spurs of the odontoblasts have degenerated. These sections appear to be very white by going from light to dark in reflection. In humans sclerodentine occurs during middle age, and also (42) with the slow decay of the teeth and the intensiveness of their grinding down or injury. In microsections of the teeth of many mammals, primarily true seals, these sections of increased transparency can be seen on which there is no noticeable inherent tooth lamination of dentine.

We examined cross sectional and longitudinal microsections and polished sections of pinniped teeth (43 ringed seals, 17 Caspian seals, 20 common seals, 39 ribbon seals, and 20 northern fur seals); and cetacean teeth (12 white-sided dolpins, 16 belukhas and 140 sperm whales) and also their predator (35 Arctic foxes). Transparent zones of dentine with all signs of typical sclerodentine were detected in the teeth of all of the investigated pinnipeds, two species of whales and the foxes. There were no signs of dentine in the teeth of sperm whales.

Sclerodentine was only found in adult individuals: for ribbon seals three years of age; for ringed and Capsian seals five to six years of age; for common seals and northern fur seals from seven years of age. However, there did not appear to be any correlation between the area occupied by the sclerodentine and the age of the individual. There was also no connection between the presence of sclerodentine and decay and the degree of wear of the teeth. Decay was not found in any instance. In 54% of the cases where sclerodentine was found in the canines of ringed seals , the canines themseles did not have signs of wear, in the remaining instances the location of the sclerodentine on the teeth was not

in character for the grinding down of the latter. Sclerodentine was well developed in the teeth of white-sided dolphins whose teeth were only slightly ground down and it was weakly developed in the intensively ground down teeth of belukhas.

Sclerodentine was most developed in the Caspian seal, in addition, the area of the tooth occupied by sclerodentine always included the first annual layer. For the remaining pinnipeds there was great individual variabiity in the location of sclerodentine on the teeth. For belukha it was only evident in a peripheral part of the teeth, at first in the transparent strips of the annual layers, then in sections of the non-transparent strips which were adjacent to them. Sclerodentine was found in the canines of all of the investigated foxes, in addition, of all of the individuals from fur farms its location on the teeth was the same, but for free ranging foxes there was individual variability for its location.

Based on the data obtained we present the following hypothesis. The formation of sclerodentine - a normal development for mammals - is related to the fact that after the formation of the basic mass of teeth, surplus mineral salts undergo a secondary mineralization of the already formed dentine. The constitution of the limits of the hypermineralization, which is characterized (43) by the formation of sclerodentine, at first affects those sections of the dentine whose primary mineralization was the greatest, since in the area of the sclerodentine processes, odontoblasts die off; thus, in the sections of the dentine towards the periphery, a secondary mineralization is not possible, and the mineralization can only occur in the section between the dentine and the pulp cavity. If this hypothesis is correct, then one could judge the degree of primary mineralization from the annual layers of dentine, and, consequently, about the relativity of the content of mineral salts in the diets of individuals in different years of their life.

2.6 A BRIEF SUMMARY OF THE INVESTIGATION OF THE POPULATION STRUCTURES OF DOLPHINS OF THE GENUS STENELLA

M.V. Mina (IBR AN SSSR)

We evaluated the possibility of using nonmetrical variation of cranial characters for the spotted dolphin, S. attenuata and the long-snout dolphin, S. longirostris for separating the stock and clarifying intra-stock (family) groups. The work was conducted at the Southwest Fisheries Center (La Jolla, California) with W. Perrin and J. Walker.

Twenty-eight characters were selected which were independent of the age and sex of the individuals, and were highly reproducibile when evaluated by different operators.

In the first stage we made a comparison of the different sets of sex characters sampled from S. attenuata and two selected from S. longirostris. The similarities were evaluated according to

Zhivotovskiy's criteria (Yablokov, et al., 1983**). The correlations were done on an IBM VAX. The original program, NONMETR, which was used was developed by J. Walker. Errors were discovered in the original data, the elimination of which led to a variation of the estimate of similarity obtained by Yablokov et al., (1983***). The precision of the differences between the species, S. attenuata and S. longirostris was lost, however, the evaluation of the phenetic relationships sampled did not change within the species S. attenuata. Samples taken far from the coasts were combined. Samples taken from the nearshore zone were sharply set apart from the previous samples. This confirmed the assumption about the presence (44) of a "coastal" and "oceanic" group of S. attenuata in the southeastern part of the Pacific Ocean. We decided to continue the work using only samples from S. attenuata having excluded samples of S. longirostris from examination.

In the second stage of the work the similarity was analyzed between individuals which belonged to one stock and to different stocks. We used a method of cluster analysis. Indices of differences were used for a number of characters, in order to separate individuals. The hoped for results were obtained by a classification of individuals into pairs from the extracted samples using 15 characters. There were two large clusters: one included individuals from one sample and the other individuals who fell into the other sample. In addition to this many of the individuals fell into the category of mixed clusters. Increasing the number of characters which was used and changing their composition did not allow an increase in the accuracy of separation or it even made the picture worse.

Judging from the data obtained, the stock of dolphins develops groups similar in structure to the population structure of some species of terrestrial animals and includes a "nucleus" -the aggregate of individuals constantly staying together, and also "roamers" - the individuals temporarily connected to the nucleus.

In order to verify the assumptions formulated above and further develop methods for analyzing nonmetrical variation it is necessary to find a method for comparing dendrograms which reflect the phenetic relationships which would allow one to precisely evaluate the contrasts of separate samples and whether the separations obtained are significantly different.

** A.V. Yablokov, W.F. Perrin and M.V. Mina. 1983. Evaluation of phenetic relationships of dolphin classification based on analysis of non-metrical cranial variations. Zool. Zh. 62(12):1887-1896.

*** A.V. Yablokov ,W.F. Perrin and M.V. Mina. 1983. Evaluation of phenetic relationshipsof dolphin classification based on analysis of non-meterical cranialvariations. Zool. Zh. 62(12):1887-1896.

(45)

3. RESEARCH ON PINNIPEDS

3.1 DISTRIBUTION AND NUMBER OF SPOTTED SEALS ON THE COAST OF KAMCHATKA IN AUGUST 1985.

V. N. Burkanov (Kamchatrybvod)

In summer, in the vicinity of the mouths of the salmon spawning rivers of Kamchatka, the spotted seal (Phoca largha Pall. 1811) forms considerable aggregations (Lun', 1936; Tikhomirov, 1966; Ostroumov, 1967; Chugunkov, 1970; Burkanov, 1983). The literature gives the number of these seals only at a few of the rivers or parts of the coast. A complete, one-time investigation of the coastal waters of the entire peninsula in the period of passage by spawning salmon has not been conducted previously.

From 1 to 12 August 1985, a large part of the coastal waters of Kamchatka was investigated with an AN-2 aircraft along the western coast from the Ozernyi River to Cape Teva and along the eastern coast from Cape Olyutorskii to Cape Shipunskii, including Karaginskii Island. Because of unfavorable meteorological conditions, Penzhin Bay, the southeastern coast, and a small part around the Kronotskii Peninsula were not surveyed.

Observation and counting of the animals were conducted by one observer from the co-pilot's position. The flight passed over the sea 400 to 500 m out from the surf line and at an altitude of 150 to 300 m, depending on the meteorological conditions. The average speed was 160 km/hr. In constant view of the observer was a strip of coastal water 350 to 450 m wide, extending out from the edge of the surf. In the mouths of rivers and places where spotted seals had congregated, we circled to obtain a precise total number of animals. The results of this aerovisual investigation are shown in Fig. 1.

Western coast. Uneven distribution of spotted seals was noted. The majority of large groups were in the mouths of such rivers as the Bol'shaya (3.7 thous. head), Utka (2.5 to 2.8 thous.), Mukhina (1.2 thous.), Moroshechnaya (4.0 thous.), Khairyuzova-Belogolovaya (1.0 thous.), and Tigil' (3.0 thous. head). Herds numbering about 1.5 thousand specimens were counted on reefs to the north of the Palan River. Smaller aggregations were in the mouths of the rivers Yavina (100 head), Opala-Golygina (400), Mitoga (65), Severnaya Mitoga (350), Khomutina (100), Uchkhala or Uksusnaya (350), Mysovaya (250), Bol'shaya Vorovskaya (180), Oblukovina (500), Icha (250), Saichik (200), Sopochnaya (350), north mouth of the Kvachina (100), and in the mouth of the Lesnaya (150 head). North of the Tigil' River, in

(46)

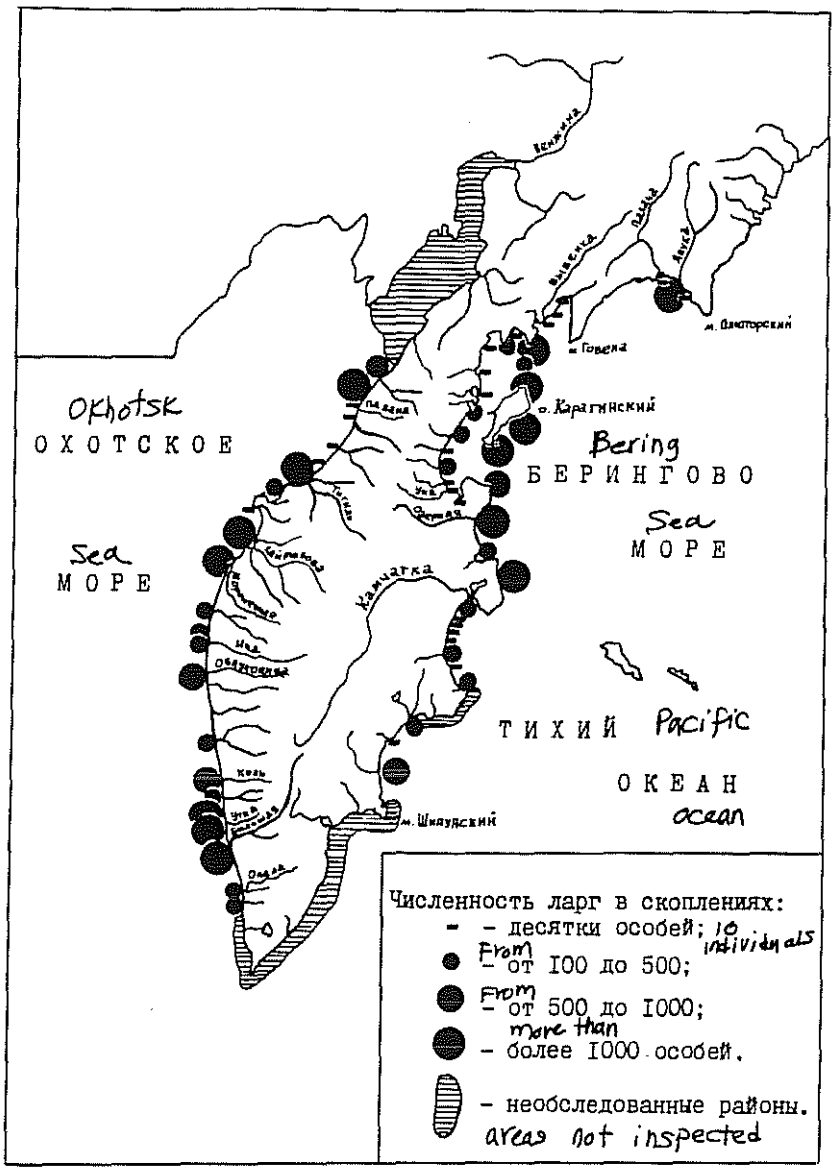


Fig. 1. Distribution and number of spotted seals on the coast of Kamchatka in the begining of August 1985.

the (47) mouths of the Amanina, Voyampolka, Kakhtana, Pyatibratka, and Palana, smaller groups of seals (from 5 to 20-30 specimens) were counted. The overall number of spotted seals on the investigated part of the western coast amounted to 20.2 thousand individuals.

The number of spotted seals determined by us in 1984 (Kosygin et al., this compendium) for the entire western coast was 13 thousand head, which proved to be understated, because we utilized the YAK-40 aircraft for the survey. The minimal speed of the AN-2 aircraft was less than half that of the YAK-40, which allowed

more detailed inspection of the coast. Thus, a more reliable count of 20.2 thousand specimens was obtained, although this also requires further refinement as will be described below.

Eastern coast. Here the distribution of spotted seals was notably more uneven. The basic mass of animals at the time of the survey was concentrated in Karaginskii Bay and in the northern part of Ozernovskii Bay. The majority of large groups were observed about Karaginskii Island: at the northern end there were 2.2 thousand head; in the central part of the eastern coast there were 3.5 thousand, and on the southern end of the island, 3.6 thousand head were counted. At Cape Ozernyi there were 700 head; between Cape Yuzhnyi and the mouth of the Ozernaya River we saw 1.8 thousand head; about Verkhoturov Island were 300-400 head, and on the reefs at Neupokoeva Rocks, 1.1 thousand indivuals were present.

Groups ranging in size from 100 to 250 individuals were noted at the mouths of the rivers Rusakova, Dranka, and Karaga, and on the northern side of Cape Il'pyrskii. Groups numbering from 10 to 50 or 60 individuals were observed at the mouths of the Ol'khovayam, Kichiga, Tymlat, Ivashka, Khailyulia, and Uka Rivers, in Ossora Bay, and on the delta of the Malamvayam.

In Korf Bay, the seals were noted in Geka Inlet (7 head) and about two small islets and rocks in the mouth of the Vyvenka (90 head); between the Vyvenka and Medvezhka Rivers, there were several small groups totalling about 70 individuals, and in the mouth of the Skrytoi there were 92 individuals. In the mouth of the Kultushnoi and along the whole eastern coast of Korf Bay, seals were not observed.

In Olyutorskii Gulf, large groups of spotted seals were located in the mouth and lower course of the Apuka River (1.3 thous. head). In Anana Bay, only one spotted seal was found; in the delta of the Kavacha there were 10 specimens; and in the mouth of the Pakhacha there were 60. In important sectors of the shore of Olyutorskii Gulf, from Cape Kreshchennogo Ognem to Cape Goven, seals were not found. This part was inspected during strong westerly winds (25 m/s) and heavy surf 4-5/10), which possibly affected the results of the survey.

(48)In the southern part of Ozernoi Bay, small groups of spotted seals were located in the mouths of the Zaaltynnoi, Altyna, and Stolbovoi rivers, as well as on Capes Baklanova and Pokatii. The overall number amounted to 160 head.

In the vicinity of Soldatskaya Bay (Kamchatka Peninsula), a large group of spotted seals numbering 1.7 thousand specimens was observed.

In Kamchatka Bay, the spotted seal is distributed rather uniformly. A group numbering about 100 specimens was observed in the mouth of the Kamchatka, 25 were on Chayachii Islet, 60 on Cape Kryugera, 50 in the mouth of the Chetvertoi, 70 on Cape Krasnogo, about 50 on Cape Shubert, 58 in the mouth of the Andryanovka, more than 150 in the mouth of the Storozha, and about 130 head were on the reef near Cape Kamenistyi. Moreover, single spotted seals were noted along the entire shore of the bay. The total in the narrow strip of coastal waters of Kamchatka Bay amounted to not many more than 750 individuals.

Part of the coast of the Kronotskii Peninsula, from Cape Kronotskii to Ol'ga Bay, was not inspected due to fog. In Kronotskii Bay, an aggregation of spotted seals was noted in the mouth and delta of the Kronotskii River (230 head), in the mouth and delta of the Semlyachik River (16), and about the mouth of the Karymskaya (20), Berezovaya (10), and Zhupanova (30) rivers. The largest group of spotted seals was located on the reef islets of Morzhovoi haulout (500 specimens).

The overall number of spotted seals in the strip of coastal waters surveyed on the eastern coast amounted to 19.3 thousand specimens, of which 12.5 thousand were in Karaginskii Gulf.

Thus, preliminary data were obtained on the numbers of spotted seals in summer along the greatest part of the western and eastern coasts of the Kamchatka Peninsula. These data require verification and refinement, since the method used for surveying the seals has two essential defects: (1) there is subjectivity in the visual estimation of large aggregations of seals (especially when they are swimming), and (2) a significant number of seals may be outside of the 450-m-wide strip of coastal waters that is surveyed.

Dynamics of numbers of spotted seals on the coast. It is known that the number of seals about the different rivers varies widely in the course of the spawning movements of the salmon, probably in connection with the irregularity of the latter's approach to the coast and rivers. In some rivers, the passage of salmon begins earlier and is intensive and of short duration; in some, it begins later and is prolonged; in others, it is divided into several periods. Depending on this, (49) the number of seals also oscillates around individual rivers. The migration takes place "alongshore", from the mouth of one river (where the passage of fishes has diminished) to the mouth of another (where the approach of fishes has grown), as well as "perpendicular to shore", i.e., (50) with dispersal of the animals and in pursuit of salmon or other schooling fishes in the sea.

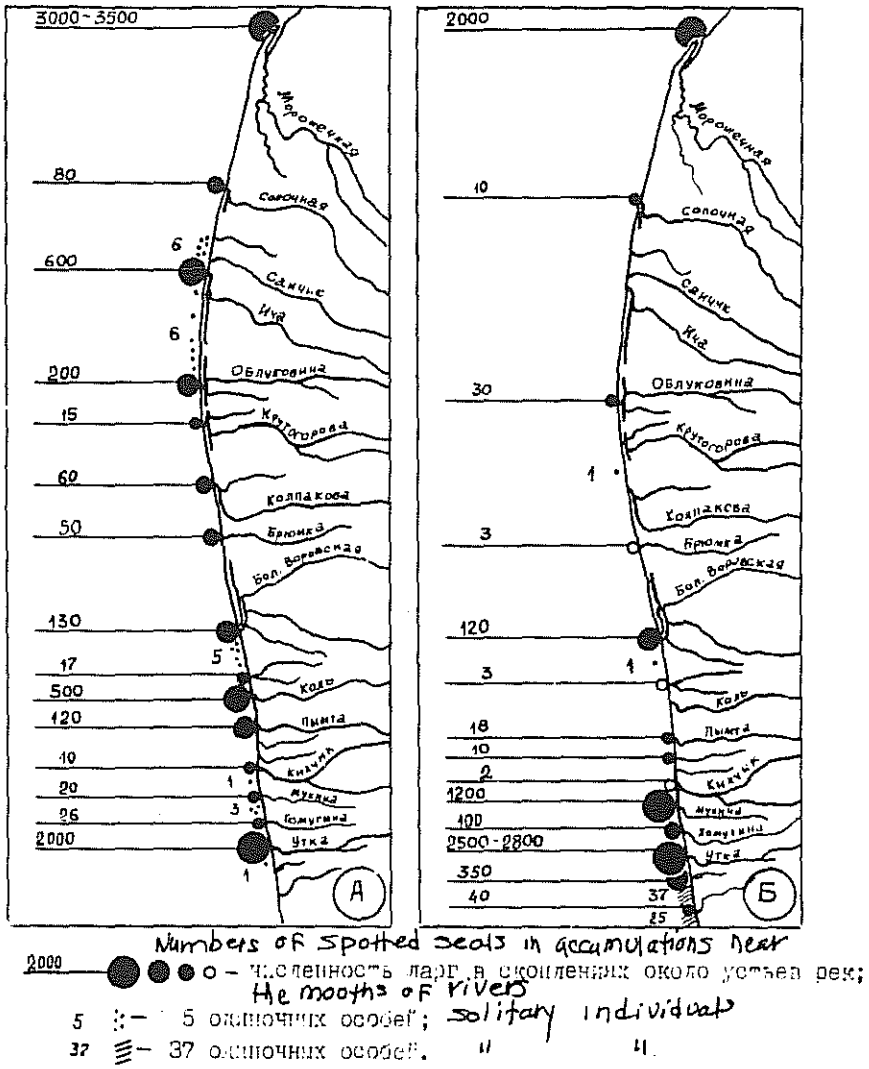


Fig. 2. Distribution and numbers of spotted seals on part of the western coast of Kamchatka, during surveys on 18-19 July (A) and 12 August 1985 (B).

Thus, the map of the distribution of spotted seals in Fig. 1 appears as an "instant photograph." Over time, it can change markedly, as shown by the results of two aerial surveys along a 450-km part of the western coast in 1985 (Fig. 2). Before the movement of pink salmon on the 20th of July, the distribution of seals was rather uniform. In the second ten days of August, when salmon usually approach the central part of the coast, the map of the distribution changed sharply: the basic mass of seals became concentrated in the southern part of the area about the mouths of the Utka and Mukhina rivers. In normal years, a mass movement of pink salmon into these rivers begins at that time. In the central part of the coast at that time, the seals are practically absent. The number of spotted seals is reduced in the mouth of Moroshechnaya. Although the overall number of seals in the area

in both counts remained nearly unchanged, one can see that the seals migrated along the shore from the mouths of the Pymta, Kol', Bryumka, Kolpakova, Oblukovina, Icha, and Sopochnaya rivers, and part of the animals moved from the Moroshechnaya River to the mouths of the Mukhina, Khomutina, Utka, and Severnaya Mitoga rivers, covering a distance of several hundred kilometers. At the same time, taking into condideration the shortcomings of the survey method, one cannot deny the possibility that part of the spotted seals also immigrated "perpendicular to the shore". In the northern and central parts of the area, there could have been migration from the shore out into the sea, i.e. beyond the limits of the survey strip; in the southern part, it could have been from the sea to the mouths of the rivers.

Literature Cited

Burkanov, V. N. 1983. Results of aerial observation of the coastal haulouts of spotted seals on the Kamchatka Peninsula in 1982. Biological Problems of the North, pt. 2, Magadan.

Chugunkov, D. I. 1970. Observations of spotted seals on the Utkinskii haulout. Izvestiya TINRO, vol. 70.

Lun', S. S. 1936. The pinnipeds of western Kamchatka (Tigil'skii area). Trudy VNIRO, vol. 3.

Ostroumov, A. G. 1967. Some information on the number of pinnipeds -- spotted and ringed seals -- in the coastal waters of Kamchatka. Questions of the Geography of Kamchatka, no. 5.

Tikhomirov, E. A. 1966. Some data concerning the distribution and biology of the spotted seal in the Okhotsk Sea in the summer-autumn period and the organization of its harvest. Izvestiya TINRO, vol. 58.

(51)

3.2 MATERIALS CONCERNING THE BIOLOGY OF THE RIBBON SEAL AND BEARDED SEAL OF THE BERING SEA (CRUISE OF THE ZRS "ZAKHAROVO," 1985)

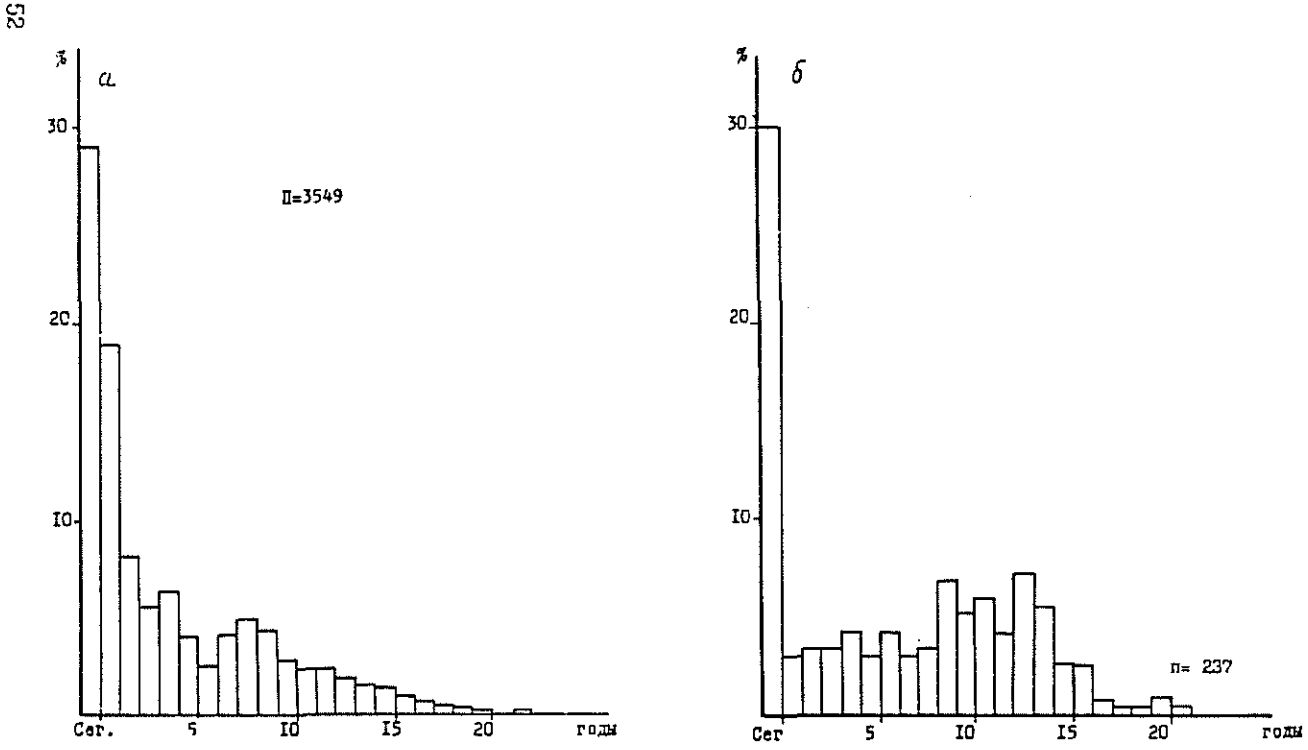
Y. A. Bukhtiyarov (MoTINRO)

In March to August 1985, at the time of the work of the Soviet-American expedition for study of pinnipeds of the northwestern part of the Pacific Ocean, materials were collected concerning the age/sex composition of the catch and the reproduction of ribbon and bearded seals of the western part of the Bering Sea. Out of a total of 4527 specimens, 3549 ribbon seals and 237 bearded seals were sampled for age/sex composition, and 655 and 88 specimens, respectively, were sampled for reproductive information.

Analysis of the data obtained showed that, for all of the ribbon seals except the pups of the year, males predominated; indeed, for age classes 7, 8, 9, 10, 12, and 15 years, males were 2 to 3 times more numerous than females. For the whole catch, males made up 55.9% and females 44.1%, which confirmed the data from the previous year about the selective harvesting of males (Razlivalov and Bukhtiyarov, 1982). As a result of determining the ages, it was established that the pups of the year and the 1-yr-old ribbon seals made up about half (47.8%) of the seals taken (Fig. a), which is primarily a function of the harvesting method (the tendency is to catch more molting pups and yearlings of both sexes, which produce mainly high quality fur). The dynamics of the catch of pups of this species shows that they comprised 18% up to 13 May, 52.9% from 13 to 24 May, and their share fell to 11.6% from 25 May to the end of the harvest.

We reviewed the materials characterizing the reproduction of ribbon seals in 1984-85. For the first time in the Bering Sea, we found ovulating females at an age of one year and parturient females at two years of age. Such early entrance of females into reproduction was thought to be a peculiarity of the Okhotsk ribbon seal (Fedoseev, 1973). It was established also that the present rate of reproduction of the ribbon seal is nearly two times greater than it was during the first years of the harvest, although the proportion of females ovulating for the first time decreased from 27.4% in 1961-63 to 16.2% in 1980-85 (53) (Bukhtiyarov, 1982). In our opinion, this is connected not only with reduction in barrenness but most of all with the fact that practically all of the females ovulating for the first time at present (particularly at the age of two years) have been bred and are bearing progeny, whereas earlier such specimens amounted to only 55%.

Materials concerning the age/sex composition and reproduction of the bearded seal were collected principally in Anadyr Gulf. Because of their small numbers, it is not possible to reach any basic conclusions. It is possible only to note that, as before (Razlivalov and Bukhtiyarov, 1982), females predominated over males in the harvested bearded seals (54.9 and 45.1%, respectively), and there was a high proportion of young of the year in the catch in Karaginskii Bay (Fig. b). Analysis of the ovaries of 88 females showed that immature specimens amounted to 12.5%, first ovulations 6.8%, multiparous 78.4%, and barren 2.3%.



Age structure of the catch of ribbon seals (a) and bearded seals (b) in the western part of the Bering Sea.

Literature Cited

Bukhtiyarov, Y. A. 1982. New data on reproduction of the ribbon seal in the Bering Sea. Studies, protection, and rational utilization of marine mammals. Astrakhan. p. 54-55.

Razlivalov, E. V., and Y. A. Bukhtiyarov. 1982. Age-sex structure of the catch of seals in the Bering Sea. Studies, protection, and rational utilization of marine mammals. Astrakhan. p. 308-309.

Fedoseev, G. A. 1973. Morpho-ecological characteristics of the population of ribbon seals and the basis of protection of their stocks. Izvestiya TINRO, vol. 86.

(53)

3.3. MATERIALS CONCERNING THE BIOLOGY OF PINNIPEDS OF THE NORTHERN PART OF THE BERING SEA IN THE WINTER PERIOD (ZRS "ZAKHAROVO", 1984)

A. A. Kibal'chich and G. KH. Dzhamanov (VNIRO)

This Soviet-American cruise was conducted for the purpose of investigating the biology of marine mammals of the Bering Sea in November-December of 1984 on the ZRS "ZAKHAROVO." The dates of the expedition were selected (54) because of the importance of this little studied period in the life of seals and the walrus. Also, the possibility of conducting an animal harvest in the autumn-winter period needed to be ascertained.

The increasing numbers of the Pacific population of the walrus in recent years and the concurrent indication by American scientists that its reproductive capacity was reduced required collection of materials for clarification of the survival rate of the young in the first year of life. The plan was to study the distribution, composition of groups, and other aspects of the life of these marine mammals in this period, which is a difficult one for them.

Hydrometiorological conditions and distribution of pinnipeds. On 17 November, a group of American scientists was received on board the ZRS "Zakharovo" in the port of Dutch Harbor. According to the latest data, there was no ice in the American zone of the Bering Sea at that time, so the ship proceeded into Pavla Bay on the Koryak coast to begin a survey of the waters adjoining to the Koryak-Chukchi coast (Fig. 1.).

On the 22nd of November in Natalya and Peter and Paul Bays, ice was completely absent and a few swimming larga seals were observed. The first two walruses appeared in Kresta Bay, in the vicinity of the Meechken haulout. The animals lay on the conglomerated nilas and gray ice, formed by strong winds out of the north. Farther to the east along the coast, the ship followed the open water, and only in a traverse of Arakamchechen Island was an ice field (young gray and nilas) encountered. Continuous fields of ice stretched from there to Bering Strait, where, in the latitude of Ratmanov Island, the ship turned to the south, having met impenetrable 10/10 ice. Harvestable aggregations of walruses (herds of several animals on the ice) were discovered on 27 November at the latitude of Mechigmen Bay. Still larger concentrations of walruses were recorded a little farther south on 28 and 29 November (Fig. 2). There on the ice were females, some with calves and some barren, migrating from the Chukchi Sea. Probably these were the first animals descending into lower latitudes for the winter. On 9 December, on a traverse of Cape Chaplin, the first males were discovered and taken. Apparently, the nucleus of the western reproductive group is generated in this region (Fay et al., 1984) and moves farther south as the ice forms.

This was confirmed further by observations and samples from the area to the northwest of Cape Sevuokuk, St. Lawrence Island, where adult males predominated, migrating northward to meet with the females.

The hydrometeorological conditions at the time of this work were extremely severe. The average temperature from 20 November to 13 December in the places where our investigations were conducted amounted to -11.3°C, and the wind speed was 11.3 m/sec. On only 5 days was the wind speed 5 m/sec or less; on the remaining days, it amounted to 25 m/sec, and occasionally rose to 40 m/sec. Under such conditions, the harvesting of walruses was extremely difficult, hence the total number of captured animals was small (137 head).

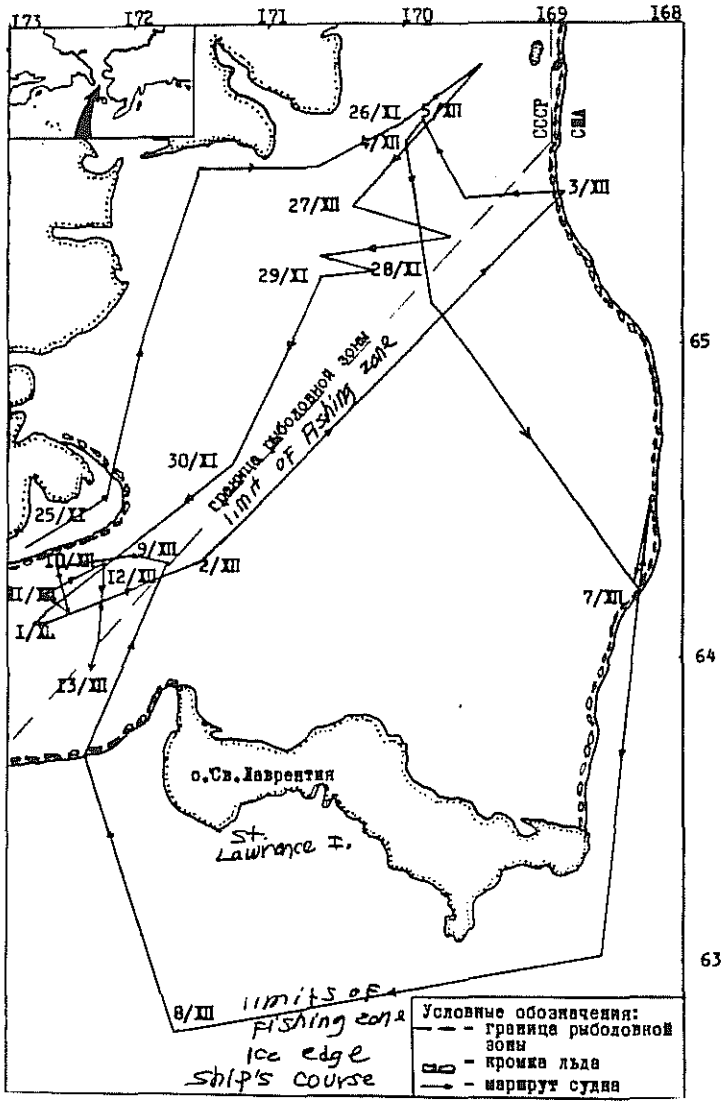


Fig. 1. Diagram of the cruise track of the ZRS "Zakharovo" in the Bering Sea in November-December 1984.

(56)

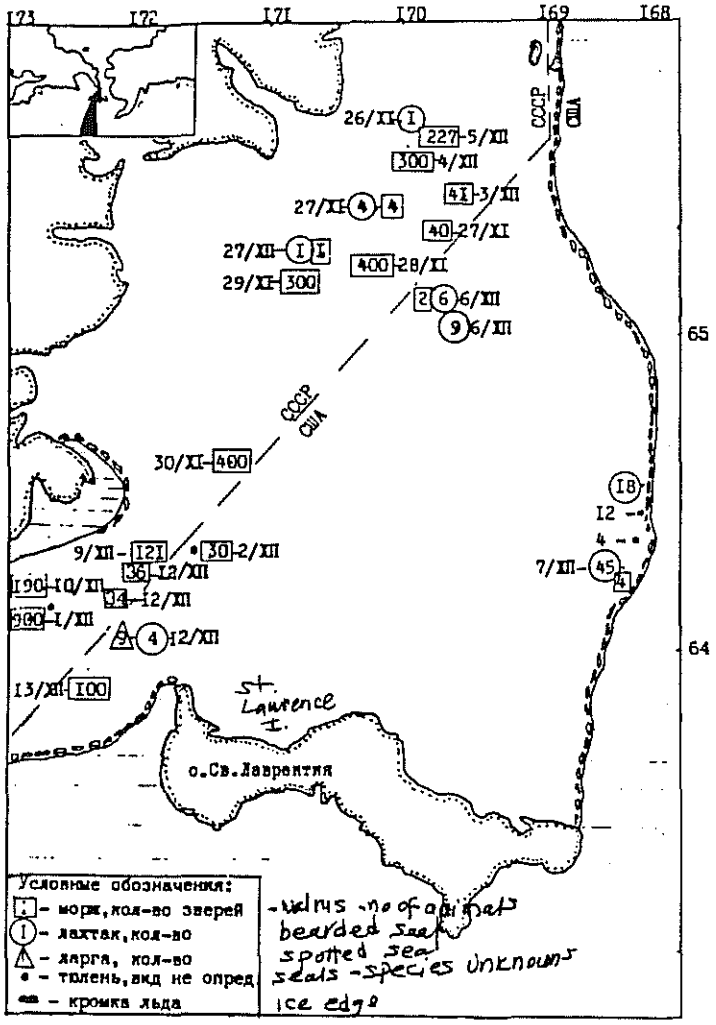


Fig. 2. Distribution of pinnipeds.

(57) Reproductive condition of the walruses. According to previous data, the peak of copulation of the Pacific walrus extends from January to February (Kibal'chich, 1982; Fay et al. 1984). The materials from this cruise corroborate that. Among 96 mature females, there was not one with mature follicles in the ovaries; 10 of those had follicles, but the diameter of them did not exceed 12 mm. The majority of the maturing follicles were recorded in old animals. Two females had hemorrhagic follicles measuring 18x24 and 3x8 mm. Corpora lutea measuring 20x25, 13x24 and 21x25, appeared in three other females, apparently the result of false pregnancy, since there were no embryos or signs of abortions in the uterus. All this indicates that ovulation still had not begun in the females.

The ages and condition of the sexual organs of the female walruses are presented in Table 1. From them, it is apparent that the percent of pregnant animals is larger than of lactating animals. The difference between the number of parous and the

number lactating in a given year indicates the quantity of females whose calves have perished. Of course, it would be somewhat more realistic to include animals with abortions in various stages of pregnancy, since it is a long interval to the time of obtaining the sample. Consequently, the mortality of the young from abortions amounts to about 38%. This figure is higher than was determined by other investigations (Fedoseev and Gol'tsev, 1969; Kibalchich, 1982; Fay, 1982; DeMaster, 1984). From 96 mature females 30 (31%) proved to be pregnant. For 17 embryonic males the minimal mass amounted to 9.5 kg., the maximum 18 kg, and the average 13.86 kg. For embryonic females, these indicators were 6.6 kg; 16.6 kg, and 12.6 kg, respectively. Already in such a phase of embryonal development, distinct sexual dimorphism in size and mass of the body is evident in walruses. The males are larger than the females on the average by 1 kg.

In the period of the cruise, 29 males were taken, of which 6 were juveniles, two were between 11 and 13 years old, and 21 were older than 14 years. In the 18 adult animals, Active spermatazoa were found in the 18 adult males, which also confirms the thesis about late winter breeding of walruses.

Morphometric data obtained in the cruise (weight, zoological length, straight length, length of tusks, etc.) continued to be average in value. A comparative computation of the average thickness of the blubber in the females, as regards reproductive physiology in different seasons, is given in Table 2.

From the data in Table 2, it is apparent that all of the mature females are better fed in winter than in summer, the thickness of the fat layer in them having increased on the average by 5.7 mm; td = 5.18. Some of others are "improved" (58) pregnant animals, in which the indicators are increased by 9.5 mm with a td of 5. In parous and lactating females, the amount of fat practically does not increase, and in a few of the "completely" barren animals, the thickness of the blubber layer increased on the average by 4.4 mm, with a td of 2.69.

Возраст, лет Age years	Ш	Беременные pregnant	Лактирующие lactating	Рожавшие в 1984 г. gave birth in 1984	Лактирующие из рожавших lactating from birth	Неювенильные juvenile
I	4	–	–	–	–	4
2	5	–	–	–	–	5
4	I	–	–	–	–	I
6	2	–	–	–	–	2
9	I	–	–	–	–	–
I0	I	I	–	–	–	–
II	3	2	–	I	–	–
I2	9	3	I	3	I	3
I3	6	2	I	I	–	I
I4	6	2	–	I	I	–
I5	5	2	I	2	–	–
I6	7	3	I	–	–	–
I7	2	–	2	2	2	–
I8	6	3	3	3	3	–
I9	5	I	I	2	I	–
20	II	3	2	3	I	–
2I	9	2	4	3	3	–
22	4	2	2	2	2	–
23	I	–	–	–	–	–
24	3	I	–	–	–	–
25	8	I	3	3	2	–
26	3	I	–	–	–	–
27	2	I	–	–	–	–
29	I	I	I	–	–	–
33	I	–	–	–	–	–
35	I	–	I	–	–	–
36	I	–	I	–	–	–
Всего: total	I08	30/3I%	22/33,9%	26/27%	I6/6I,5%	I6/I5%

Table 1. Age and condition of the sexual organs of female walruses.

(59)

physiological condition of females Физиологическое состояние самок	n	Август August	n	Ноябрь–декабрь November
Все половозрелые All mature	300	29,7±0,46	90	35,4±I,0
Беременные Pregnant	90	3I,9±0,62	29	4I,4±I,8
Рожавшие в данном году, не лактирующие (потерявшие детенышей) Gave birth in given year, not lactating (lost pup)	3I	26,9±I,25	9	28,2±3,2
Лактирующие Lactating	84	27,4±0,88	I9	29,3±I,2
Яловые Non-breeding	95	30,7±0,85	28	35,I±I,4

Table 2. Thickness of the fat layer (in mm) in the vicinity of the sternum in female walruses in relation to the time of the year and the physiological condition of their reproductive organs

As a result of the investigation, it has been found that early in the winter (November-December) the nucleus of the reproductive groups is formed in the vicinity of Cape Chaplin and Tkachen Bay.

Heat and ovogenesis still had not begun, the largest follicles in the females being up to 12 mm in diameter.

Seventy eight percent of the adult males were found in the stage of active spermatogenesis.

The comparative amount of pregnant females (31%) exceeded the number of lactating females (23%), which attests to the high mortality of young walruses in the period of milk feeding. According to preliminary calculations, it amounts to about 30% in December.

Spatial segregation of pregnant females was noted.

Literature Cited

DeMaster, D. K. 1984. An analysis of a hypothetical population of walruses. Soviet-American Cooperative Research on Marine Mammals, vol. 1 - Pinnipeds.

Fay, F. H. 1982. Ecology and biology of the Pacific walrus, Odobenus rosmarus divergens Illiger. North American Fauna 74, Fish and wildlife Service, Washington, D. C.

Fay, F. H., G. C. Ray, and A. A. Kibal'chich. 1984. Time and location of mating and associated behavior of the Pacific walrus, Odobenus rosmarus divergens Illiger.

Fedoseev, G. A., and V. N. Gol'tsev. 1969. Age-sex structure and reproductive capacity of the population of the Pacific walrus. Zoological Journal 48(3):407-413.

Kibal'chich, A. A. 1982. On the time of breeding and polygamy of the Pacific walrus. Abstracts of works second convention of oceanology. Part 6. Sevastopol'. p. 92-93.

(60)

3.4. LARGA HAULOUTS ON THE SHORES OF THE OKHOTSK SEA

G. M. Kosygin (TINRO), A. M. Trukhin (TINRO)
V. N. Burkanov (Kamchatrybvod), and A. N. Makhnyr' (TINRO)

As is known, the larga (Phoca largha Pallas) is an important industrial animal, harvested not only on the ice but on the shore, as well. Data on the haulouts of the largha on the shores of the Okhotsk Sea were obtained 20 to 30 years ago and only for a few areas (Freiman, 1936; Lun', 1936; Pikharev, 1940; Naumov, 1941; Tikhomirov, 1966; Krylov et al., 1964; Belkin et al., 1969; Chugunkov, 1970). We have succeeded in gathering new materials.

The work was carried out from the fishery patrol ship "NEVA," from an MI-8 helicopter, and from a YAK-40 airplane (altitude of flight 100-200 m), as well as by expeditions on shore. Surveys of the seals were carried out in July to October 1982-1985.* Surveys of the animals were conducted visually and with the help of photography. For behaviors, we observed from camouflaged observation points situated near the mouths of rivers.

Numbers of animals on the haulouts. In the literature, there is only brief information about the numbers of seals on the individial haulouts on Sakhalin Island (Nikolaev, 1973). In September 1983, we located 60 haulouts and coastal congregations of largas along its coastal zone (Fig. 1). Probably, the greater part of the animals present were in the water at the time of high tide. Haulouts were located along the eastern shore, principally on southern half of the island. The largest haulouts were located in the following places: Cape Efstafiya (436 head); Mordvinov Gulf (380); mouth of the Simau River (800); at the settlement of Starodubskii (on the southern haulout 985, on the northern haulout 624); southern Pugachevka River (475); on Tyulenii Island (300 and in September of 1984 about 1000 head lay there, according to data of photographic survey of R. N. Lakeeva); and Kamen' Siroiva (1000 head).

*Surveys on the island of Sakhalin were conducted partly by Senior Fishery Inspector V.I. Lebedev of the Sakhalinrybvod.

(61)

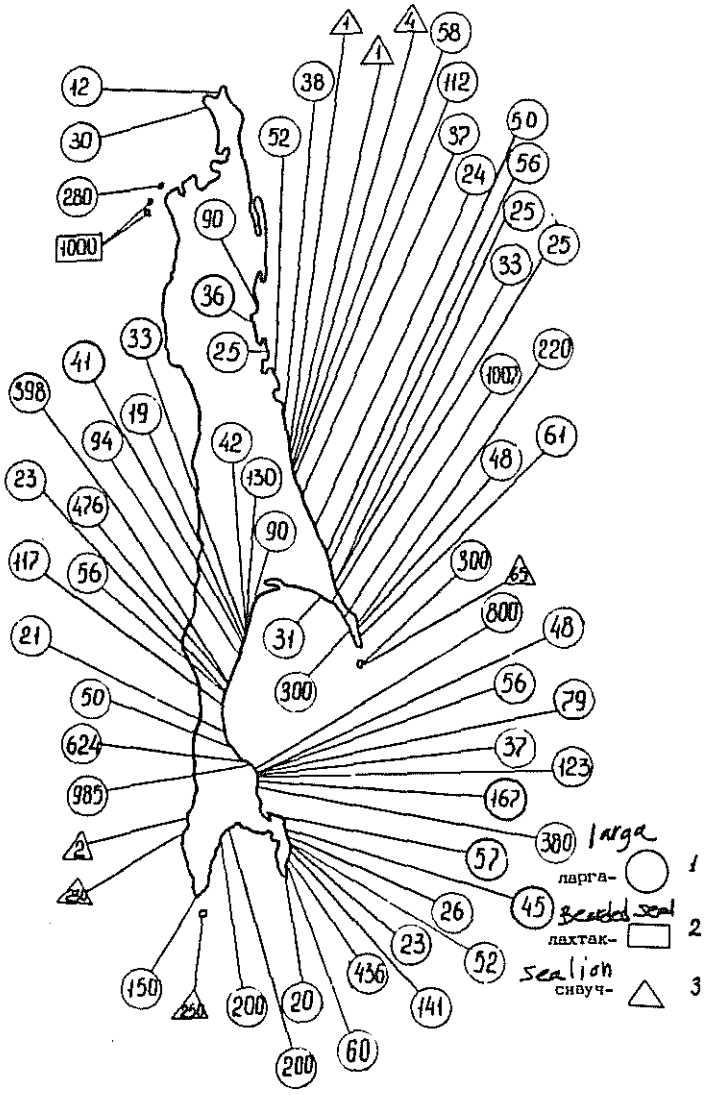


Fig. 1. Number of largas, bearded seals, and sea lions on the haulouts.

(62) In the Amur delta, southwest of the village of Rybnovsk on the river bank, two previously unknown haulouts were recorded (overall number up to 1000 head).

The total number of largas on the coast of Sakhalin is about 10 thousand head, which is several times greater than the numbers specified by A. M. Nikolaev (1973). According to our observations and questionnaire data, the number of largas on the haulouts of Sakhalin Island can increase by 2-3 times in the course of the summer.

On the Kuril Islands, the haulouts of largas are few (Fig. 2), and the number of seals on them comparatively small (Belkin et al., 1969; Kuzin et al., 1984). The majority of large haulouts are recorded on the northern Kurils. At present on the Kuril Islands, there are about 3000 largas (Kuzin et al., 1984). In this group of largas, there are unusual ecological and morphological traits and forms of its populations (Kosygin, 1975; Kosygin et al., 1975).

On the western coast of Kamchatka, from Cape Lopatka to the mouth of the Lesnoi, we recorded 30 haulouts (Fig. 3), the largest of which were arranged as follows: in the mouth of the Opaly (400 head), the Bol'shoi (5000); in Lake Bol'shoi (350); the mouth of the Utka (4000), the Moroshechnoi (600); the northern mouth of the Kvachina (625), and by Cape Pyatbratskii (400). By observation from boats, all-terrain vehicles, and motor boats, we determined that, along the 2- to 3-km-wide coastal strip of sea there were rather many largas. Alongside the all-terrain vehicle, standing at anchor for only 4 hours on 19 August 1985 within 3 km of the mouth Vorovskoi, 22 largas of different colors and sizes swam by. On examination of part of the shore there, we estimated 13 thous. head.

Knowledge about the haulouts on the remaining parts of the shore of the Okhotsk Sea as far as the Shantar Islands is either fragmentary or the current status of the numbers of animals on them is unknown. Half a century ago, 16-20 thous. largas were estimated to be on the haulouts of the Shantar Islands (Pikharev, 1940). In this region in 1985, according to the aerial survey data, about 5 thous. seals were recorded on 18 haulouts and 13 shore aggregations (Fig. 2), among which were 645 bearded seals and upwards of 4 thous. largas. Moreover, largas and bearded seals were found in the water singly and in groups of up to 8 individuals in the straits between the islands of the Shantar Archipelago, at distances of 30-40 km from shore. During our surveys, large haulouts were located on the Utichii Islands (400 largas, 110 bearded seals); Ptichii (500 largas, 80 bearded seals), and Sivuchi Kamni (450 largas, 100 bearded seals).

We estimated about 29 thous. head of largas on all of the coastline of the Okhotsk Sea examined by us. Our observations have shown that in the period of mass passage of salmon, the number of largas on shore can increase by 2 to 3 times. If this is true for all haulouts and shore aggregations that we examined, then it is probable that not more than 90 thous. head of largas reside there.

(63)

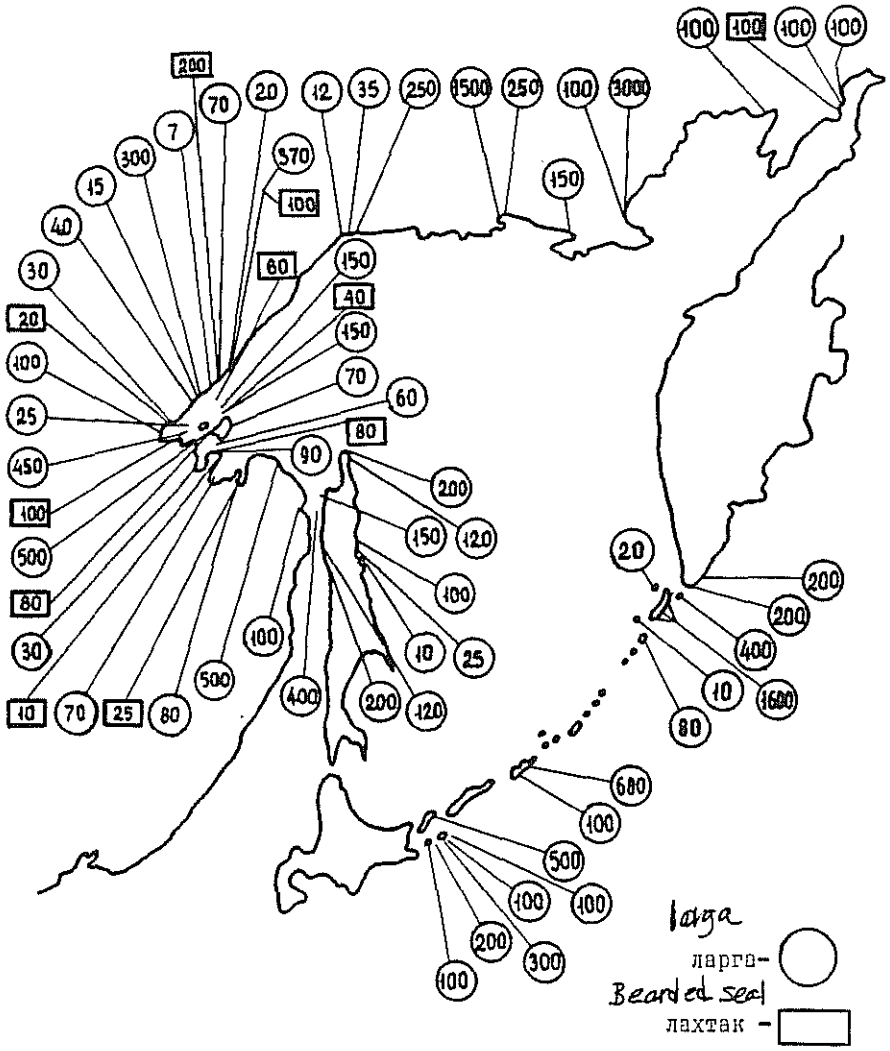


Fig. 2. Distribution of haulouts of largas and bearded seals on the Kuril Islands.

(64)

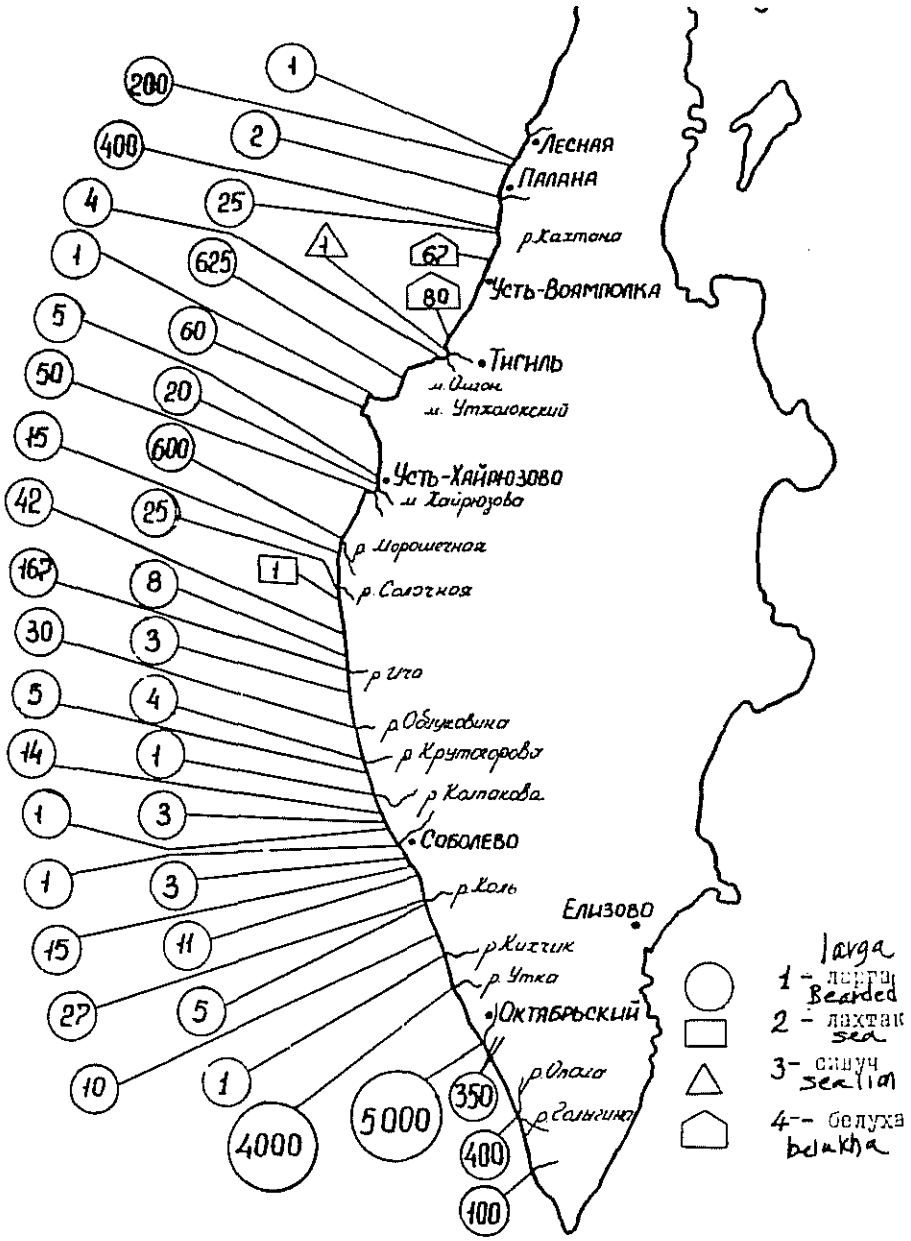


Fig. 3. Distribution of herds of largas, bearded seals, sea lions, and belukhas on the western coast of Kamchatka.

Unknown is the proportion of largas (65) that is not estimated, because they stay in the water beyond the shoreline. Possibly, not more than 20 thous. largas will be found on the remainder of the coastline of the Okhotsk Sea that was not examined. Due to absence of data about the number of largas on all parts of the range, it is difficult to estimate their total numbers. Probably, not more than 150-200 thous. largas live in the Okhotsk Sea. Haulouts of largas are distributed on gravel spits, sandy shores, nearshore rocks, cliffs, peat mounds, and islands covered by high grass. Haulouts are formed on the seashore and river banks. Three haulouts were discovered on the freshwater outlet of Lake Bol'shoi. These haulouts were situated at a distance of 5-7 km from the sea. Our materials confirm the opinions of S. Y. Freiman and T. A. Pikharev (1941) on the matter of haulouts being formed in places where there is a food base, together with a sheltered place for rest.

Behavioral traits. We observed a distinct relationship between the number of animals situated on the haulout and the stage of the tides (Fig. 4a). In this connection for such haulouts as Starodubskoi, given the number of seals lying on the haulout at a particular level of rising or falling tide, one can estimate the overall number of animals that utilizes the haulout. The numbers of largas on the different haulouts are dynamic (Figs 4b,c,d,e).

On haulouts of different types, the animals lie in different ways. In the mouth of the Utka, for example, the aggregation is formed mainly by successive groups of seals passing by the cape; on Srednii Island (Bol'shoi River), on the other hand, the animals gather in the shallows and, on the ebb tide, they haul out onto the emergent bars. In the latter way, the aggregations develop quickly. Thus, on 23 July 1985 at 1300 hrs, 160 largas lay in the shallows; 30 min later there were already 530, and after 50 min there were 1050 animals. The third way of formation of haulouts is by addition of animals to an already full haulout, causing increased density of the herd.

In Fig. 4b,c, it is apparent that a marked increase in number of largas in the vicinity of the mouth of the Utka took place in the middle of August. According to the data of P. V. Andrienko (personal information), who has resided on the Utka about 40 yrs, the passage of shoals of pink salmon begins in the second 10 days of August. At that time, largas approach the mouth of that river. Apparently, they "know" about the date of arrival of the salmon. In 1984, autumn storms swept sand into the mouth of the Severnoi Mitoga, covering it up and closing its outlet into the sea. Regardless of that, a congregation of largas remained nearby the former mouth. This attests to the hypothesis that the largas appear in the mouth of "their own" river.

(66-67)

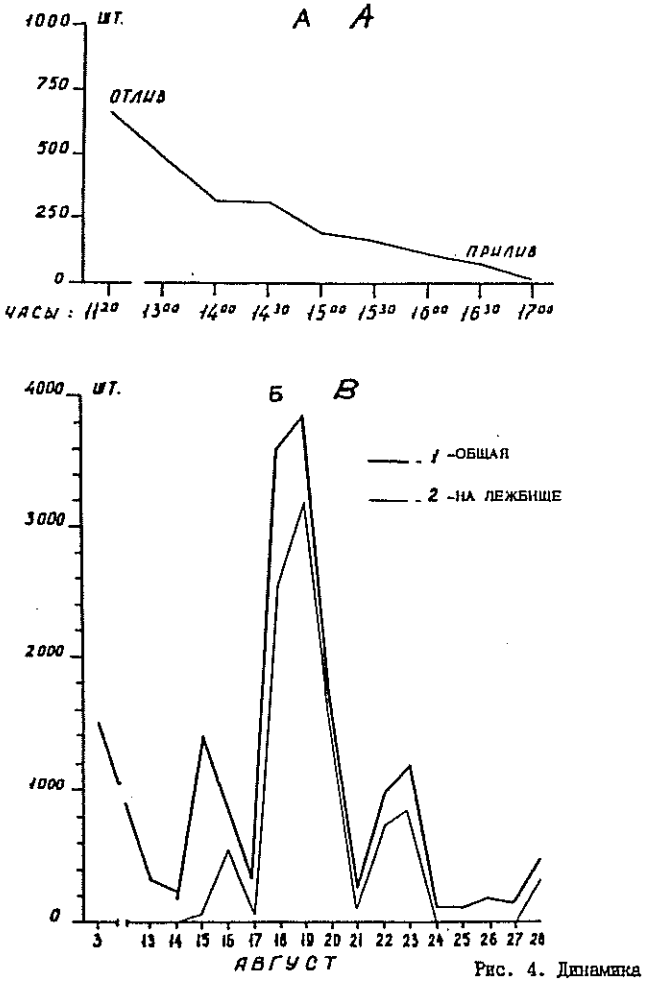


Рис. 4. Динамика численности ларги:

А – на Южном Стародубском лежбище (о. Сахалин) 23 августа 1983 г.; Б – на Уткинском лежбище в августе 1984 г.; В – в районе р. Утка в 1985 г.; Г – в районе устья Утки в 1985 г.; Д – на лежбище в оз. Большое

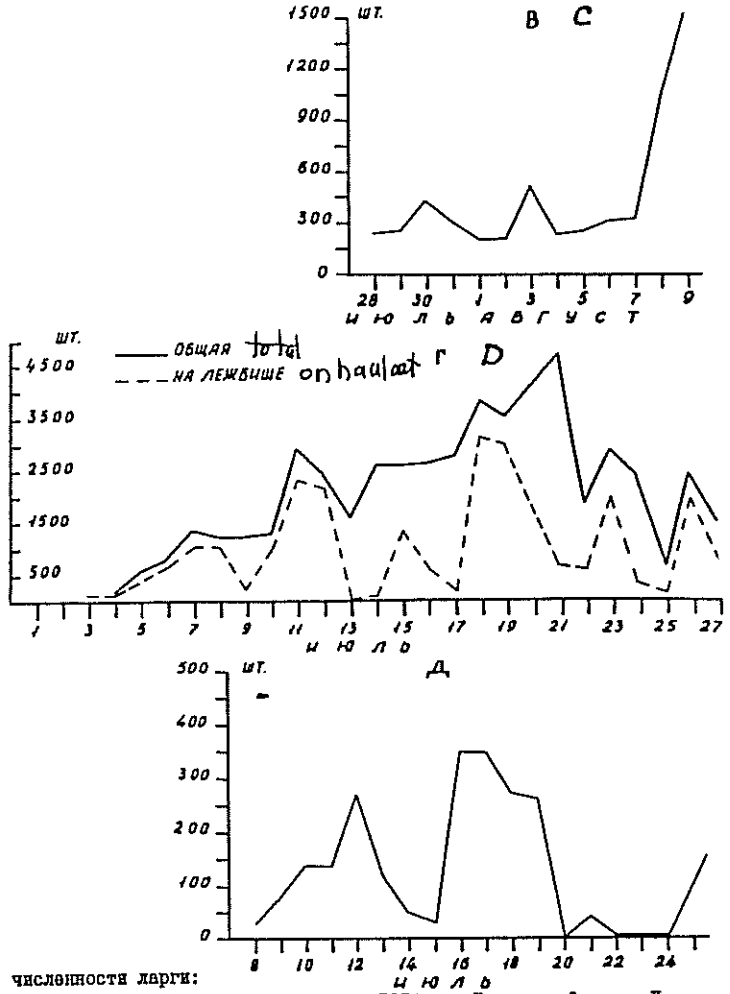


Fig. 4. Dynamics of numbers of largas. A - on the South Starodubskii haulout (Sakhalin I.) 23 August 1983; B - on the Utkinskii haulout in August 1984; C - in the vicinity of the Utka River in 1985; D - in the vicinity of the mouth of the Utka in 1985; E - on the haulout in Lake Bol'shoi.

From analysis of materials concerning the year-round (68) distribution of the larga (Pikharev, 1940; Tikhomirov, 1961a; Belkin et al., 1961; Kosygin et al., 1984), supplemented by our 3-years of observations on the haulouts, it is possible to hypothesize that basically the same animals appear on specific haulouts from year to year. Two of the above observations point to the idea that the hauling out of largas is not due to accidental aggregation but to a grouping of seals mutually related by multi-year utilization of one and the same part of the coast. On the haulout in the mouth of the Utka, the presence pups, young of the year, yearlings, and other animals of older age appears to bear witness to the fact that here is a large group of largas that is related also by birth.

From 80 hours of observations, we obtained information on the feeding behavior of the larga. The majority of the seals hunted in the estuary and adjacent parts of the sea and far fewer in the rivers. Principally the young seals fed in the Utka River, but in the Bol'shoi River there were animals of different ages. The manner of their hunting varied: they searched for their catch underwater in the river at the time of declining tide, they attacked passing fishes from shore and in the waters thrown out onto the shore, they blocked the route of passage in the river with their body and attacked at the moment of contiguity with the fishes. Their methods of retention of the catch also varied: by the head, by the tail, at right angles to the body by the back or by the belly. Large largas swallowed male pink salmon in 10-30 sec, doing this in the characteristic pose (neck high out of the water). Female pink salmon and arctic char were eaten up by the animals in 2-5 sec. The largas fed on large fishes for up to 50 min, devouring them in pieces. The largas not infrequently took away the catch from each other, either in the water or on shore. Two or three animals sometimes tore up and shared fish in pieces. Often the seals dove with ther catch, in order to eat it under the water, where, apparently,
they could conceal it from competitors, which were not only other seals but gulls, as well.

In the overwhelming majority of cases, the seals swallowed the fishes whole. Earlier, Chugunkov (1970) reported cases of seals having eaten only the heads, internal organs, or abdomens of the fishes. The seals tore up salmon either by shaking the head or by biting off pieces, holding the catch between the flippers. We also observed these traits of behavior many times in the mouths of the rivers.

In 1984, at the time of observation of the feeding behavior of the seals, we recorded 452 cases of largas catching salmonid fishes (coho, chum, and pink salmon, arctic char, and other trout). In 113 cases, we succeeded in ascertaining which part of the body of pink salmon the larga siezed: 72 fishes were caught by the head (63.7%), 31 fishes (27.4%) crosswise of the body, 10 fishes (8.4%)

by the tail. In (69) 28 (6.4%) of the 452 cases, the living salmon escaped, wounded. In the seines of fishermen of the Petropavlovsk state fishery, about 5% of the salmon had such wounds (personal information from game warden A. M. Bessmertnykh). The fishes escaped from the seals through the following circumstances: fish were seized unsuccessfully, for example by the tail; the catch was dropped through accidental collision of seals; the seals were trying to rob the catch from each other; the seals were distracted by chase or attack by gulls.

That largas eat salmon has been known for a long time, and appraisal of this phenomenon has not been uniform (Tikhomirov, 1961; Chugunkov et al., 1984; Bukhtiyarov, 1984). Our data allow us to say that the larga, like any predator, inflicts damage to the stocks of salmon.

Literature Cited

Belkin, A. N., Kosygin, G. M., and Panin, K. I. 1969. New materials concerning the characteristics of the insular seal. Marine Mammals. VNIRO, Moscow. p. 157-175.

Bukhtiyarov, Y. A. 1984. Food of seals of the northern part of the Okhotsk Sea in the summer-autumn period. p. 23-30 in Marine Mammals of the Far East. Vladivostok.

Burkanov, V. N. 1982. Results of aerial observations of the coastal haulouts of largas on the Kamchatka Peninsula in 1982. Biological Problems of the North, part 2. Magadan. 109 p.

Chugunkov, D. I. 1970. Obserrvations of the spotted seal of the Utkinskii haulout. Izv. TINRO 70:154-168.

Chugunkov, D. I., Dobrynina, M. V., and Andrienko, P. V. 1984. Wounding of salmon by largas Phoca largha. Marine Mammals of the Far East. Vladivostok. p. 31-38.

Freiman, S. IU. 1936. Materials from the harvest on the biology of seals of the Far East. Trudy VNIRO 3:188-203.

Kosygin, G. M. 1975. Some supplementary data on the populational characteristics of North Pacific pinnipeds. Marine Mammals, part 1. Kiev. p. 149-151.

Kosygin, G. M., Kuzin, A. E., and Petrova, V. A. 1975. The larga of the Kuril Islands. Marine Mammals, part 1. Kiev. p. 149-151.

Kosygin, G. M., Trukhin, A. M., and Velizhanin, A. G. 1984. Winter distribution of seals in the Okhotsk Sea. Marine Mammals of the Far East. Vladivostok. p. 99-107.

Krylov, V. I., Fedoseev, G. A., and Shustov, A. P. 1964. Pinnipeds of the Far East. Food Industry, Moscow. 58 p.

Kuzin, A. E., Maminov, M. K., and Perlov, A. S. 1984. The number of pinnipeds and sea otters on the Kuril Islands. Marine Mammals. Vladivostok. p. 54-70.

(70) Lun', S. S. 1936. Pinnipeds of western Kamchatka (Tigil'skii region). Trudy VNIRO 3:212-216.

Naumov, S. P. 1941. Seals Pinnipedia of the Okhotsk Sea (mainly of its southwestern part). Scientific Proceedings of Moscow University 24(2):19-74.

Nikolaev, A. M. 1973. On the distribution of true seals near Sakhalin in the autumn. Izv. TINRO 91:93-94.

Pikharev, G. A. 1940. Seals of the southwestern part of the Okhotsk Sea. Izv. TINRO 20:61-99.

Tikhomirov, E. A. 1961. To expand the catch of largas. Fishery Industry of the Far East 1961(8):10-12.

Tikhomirov, E. A. 1961a. Distribution and migration of seals in the waters of the Far East. Transactions of the Conference of the Ichthyological Commission. Acad. Sci. USSR, Moscow. p. 199-210.

Tikhomirov, E. A. 1966. Some data on the distribution and biology of the larga in the Okhotsk Sea in the summer-autumn period and organization of its harvest. Izv. TINRO 58:105-115.

(70)

3.5. SHORT SUMMARY OF INVESTIGATIONS OF SEALS OF THE CALIFORNIA COAST

L. A. Popov (VNIRO)

During March-April 1984, research was conducted jointly with American specialists from the Hubbs-Sea World Research Institute (San Diego, California) on a collection of materials for revealing the nonmetrical characters of the coastal form of the harbor or common seal, a species, widely distributed along the Canadian and American coasts of the North Pacific, from Alaska to Mexico. Moreover, field materials were gathered and literature analyzed on the question of distribution and (71) numbers of seals residing along the California coast and islands.

The taxonomic affiliation, geography, and populational structure of the coastal form of common seal remain little understood. New approaches to partial solution of these problems appear to be in the development of methods for analysis of the populational structure, based on appraisal of analogous characters, such as the coloration of individuals, i.e. the appearance of nonmetrical characters. Such a method already has been successfully used for study of populational structure of several cetaceans (Evans and Iablokov, 1983).* However, the coloration of the common seal is so varied and complicated for analysis that utilization of the method developed for whales is extremely difficult, since it does not successfully separate out clearcut, descrete characters. This opinion is born out by the analysis of the collected materials. At "Sea World" and "Marineland," we examined photographs in black and white and color of more than 30 seals from different patrts of the state of California, Oregon, Washington, and Mexico. For each animal there was a "passport," which contained all of the necessary data. Charts and graphs were developed, in which the results of inspection of the different parts of the body of the animals were recorded, as well as data from analysis of the colored and black-white positives. The coloration of the body of the animal and the character of the spots on the dorsal, lateral, and ventral sides of the body were noted, as well as those on the head, neck, fore and hind flippers, and tail.

Analysis of the material obtained by the visual method proved to be unacceptable, because of the peculiarities of coloration of the animals. In the search for a methodical approach to analysis of the collected materials, it was proposed that a method developed for comparison of structural characteristics be applied in the analysis of the coloration of the seals. The basis of the method lies in the analytical signal reflecting change in optical density of the object scanned, in this case a specific portion of the hide of the seal. For processing the data obtained by scanning, a mathematical device for analysis of probability (correlational or harmonic analyses) was used.

In conclusion from the results of the work, it was recognized that:

(72) 1) the method used for analysis of the variation in coloration of cetaceans needs to be modified for study of the variation in coloration of seals;

2) the possibility for utilization of optical-structural mechanical analysis for solution of the problem needs to be investigated.

---

*W. Evans and A.V. Yablokov. 1983. Variation of the coloration of cetaceans. Nauka, Moscow. pp. 3-129.

The California coast and adjacent Channel Islands (San Miguel, Santa Rosa, Santa Barbara, Santa Catalina, and San Clemente) are populated by several species of pinnipeds. Representative of the family of eared seals are the northern fur seal (which began to develop harems on San Miguel Island in 1961), the Californa sea lion, the Guadalupe fur seal, and the Steller sea lion; of the true seals there are two -- the common or harbor seal and the northern elephant seal. Analysis of the data on the distribution and numbers of those species shows that, of all of the islands of the Channel archipelago, the most densely inhabited by seals is San Miguel island. The most numerous here is the northern elephant seal (nearly 40 thous. head); in second place in numbers is the California sea lion (about 30 thous.). The number of northern fur seals varies from 2.2 to 3.0 thous.; there are about 1 thous. common seals; Steller sea lions and Guadalupe fur seals occur here singly.

The islands of Santa Rosa and Santa Cruz are inhabited primarily by common seals, the number on the former probably exceeding 1 thous. and on the latter, 0.5 thousand. California sea lions also occur in small quantities on these islands (a little more than 100 on each island).

On San Nicolas live principally California sea lions (a little more than 20 thousand); also common on this island are northern elephant seals (more than 8 thous.) and common seals (more than 700).

On the other islands of the archipelago, the number of seals is significantly lower. Thus, on Anacapa Island there are about 300 California sea lions, about 200 common seals, and a few northern elephant seals; on Santa Barbara Island, the number of California sea lions amounts to 3 thous., northern elephant seals are more than 3 thous., common seals occur individually. On the well inhabited island of Santa Catalina the number of seals is unknown, about 300 common seals reside there and a few tens of California sea lions. San Clemente Island is inhabited basically by California sea lions (more than 1200 individuals); the number of common (73) seals there is not great (not many more than 100 head), and northern elephant seals occur singly.

On the Channel Islands overall, the number of northern elephant seals amounts to about 50 thous., of California sea lions more than 55 thous., common seals (including the Channel Islands and the coast of the state of California) about 3.5 thous., northern fur seals about 3 thous. As already noted, the Steller sea lion is encountered singly on the most northern island of the archipelago (San Miguel), apparently, this is the southern boundary of its range in the North Pacific.

3.6. MATERIALS ON THE BIOLOGY OF PINNIPEDS OF THE BERING SEA (ZRS "ZASLONOVO," 1984)

V. N. Sadovov (VNIRO)

This work was conducted in the western part of the Bering Sea (Fig. 1). The seals were taken in areas I to IV; the walruses were taken in areas V to VII. Biological material was gathered and processed by standard methods.

Ice Conditions. In the northern part of Karaginskii Gulf, in Olyutorskii Gulf, and along the Koryak coast in March-April, the predominant ice types were nilas, gray, and gray-white ice at densities of 5-9/10; in Anadyr Gulf there were fields of white ice of 9-10/10 density. The location of the ice edge, composed of shuga and pancake ice, did not differ from the multiyear average. In this period there was still intensive ice formation, as a result of which a considerable expanse of the water surface was covered by an unbroken layer of gray ice. In the second half of April, ice formation ceased, and the conditions in all areas were of drifting ice. Due to the predominance of north and northwest winds in the end of April to the begining of May, breakup and dispersal of the ice cover took place. In the middle of May, the ice practically disappeared from the northern part of Karaginskii and Olyutorskii Gulfs, as well as from the adjoining Koryak coast, from Cape Olyutorskii to Cape Navarin. A small ice field consisting of 4-7/10 of gray-white and white ice was preserved in the coastal region between 61° and 62°N.

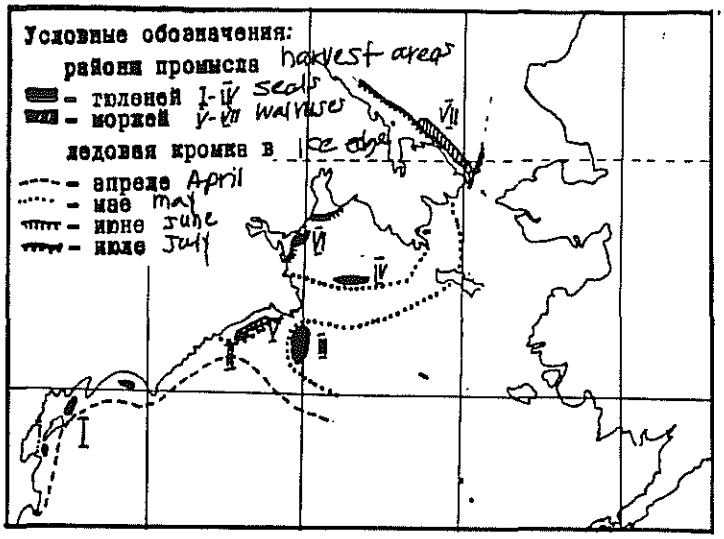


Fig. 1. Area of harvest of pinnipeds and location of the ice edge in the western part of the Bering Sea in 1984: I - Kara-ginskii and Olyutorskii gulfs (from 14 April to 1 May); II and V - Koryak coast (end of March to beginning of April, 2-14 May); III - area southeast of Cape Navarin (16 May to 11 June); IV and VI - Anadyr Gulf (26 May to 17 June); VII - southwestern part of the Chukchi Sea (1 to 13 July).

In the middle of May in the northern part of the Bering Sea, the ice cover was divided into two parts, with an ice-free area extending from Cape Navarin to St. Lawrence Island and then to Mechigmen Gulf. The southern ice field was composed of white ice with a density of 6-9/10, and the Anadyr Gulf ice field was predominantly of hummocky white ice at concentrations of 3-8/10.

In the end of May and beginning of June, the ice cover that remained in the vicinity of the Anadyr estuary and Kresta Bay consisted of melting white and grey ice. In the mouths of the bays, the density of ice amounted to 7-10/10, but the extensions into Anadyr Gulf were breaking up, and the concentration did not exceed 1-3/10.

In the second half of June, the ice in the western part of the Bering Sea disappeared. In the southwestern part of the Chukch Sea the ice cover was formed of drifting multiyear ice, which moved in relation to the direction and speed of the wind.

(75) Distribution of pinnipeds in the harvest areas. Seals.

In April, the harvest of seals was carried out in Karaginskii and Olyutorskii gulfs (Fig. 1,I), where the catch was made up mainly of largas (81.8%) and, principally in the northern part of Karaginskii Gulf, bearded seals (12.0%). Ribbon seals were encountered rarely in this period, and the catch of them was insignificant (5.8%). The taking of ringed seals was prohibited in this area, hence they amounted to less than 1% of the catch (Fig. 2,I)

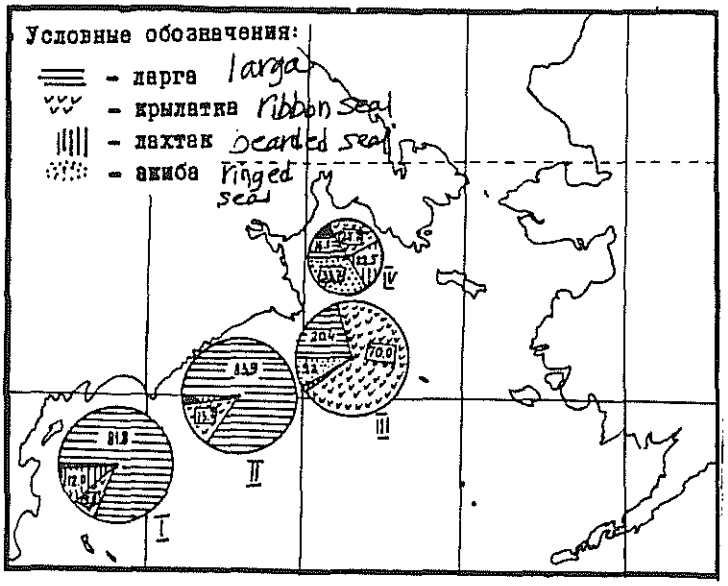


Fig. 2. Percentage relationship of seals in the areas of the harvest. The symbols designate the same areas as in Fig. 1.

In the middle of May on the drifting ice along the Koryak coast, congregations of largas, ribbon seals, and ringed seals were noted (Fig. 1,II). The density of the animals lying here on the ice was considerably higher than in area I, probably because of the limits of the ice field. These congregations were composed primarily of newly molted young or molting animals. The harvest here, as in the previous area, was composed of mainly of largas (83.9% of the overall catch). An increased proportion of ribbon seals and ringed seals was noticeable (13.7 and 2.4%, respectively; cf. Fig. 2,II). Bearded seals were noted singly on the shore ice of the bays and gulfs in this area and more rarely on the drifting ice.

(76) In the second half of May to beginning of June, aggregations of seals appeared on the ice field situated to the southeast of Cape Navarin (Fig. 1,III). The harvest there was conducted within the coordinates 61°01' to 61°05'N and 179°01'E to 179°01'W where the greater part was of ribbon and spotted seals, comprising 70.0 and 20.4% of the catch, respectively; ringed and bearded seals amounted to 9.2 and 0.4%, respectively (Fig. 2,III).

At the time of the search for congregations of bearded seals, in the end of May and beginning of June, the harvest of pinnipeds was conducted in Anadyr Gulf (Fig. 1,IV). Ringed seals in the catch from this area amounted to 33.7%, ribbon seals 27.7%, bearded seals 22.5%, and largas 16.1% (Fig. 2,IV). The larga and ribbon seals were noted most often were noted on the drifting white ice, the ringed seals on the shore ice of the bays and gulfs and on small drifting floes. The bearded seals lay on fields of gray-white ice.

Walruses. In the end of March to the beginning of April, as well as in the beginning of May, the harvest of walruses was conducted on the ice situated in the vicinity of the Khatyrka River (Fig. 1,V). In the literature (Kibal'chich, 1981), this was called the "Khatyrka group." Characteristically it is composed of males of different ages that do not take part in reproduction. The animals lay on the drifting ice in small groups of two to ten and, in May, up to 30 to 40 individuals. In the area within the coordinates 61°20' to 61°26' and 173°50' to 174°10' E, walruses were found in the water, even in the presence of ice favorable for haulouts. In the area bounded by 61°20' to 61°25' and 175°10' to 174°15' E, they hauled out on the ice but abandoned it when it moved into more southern areas.

In the middle of June, with the movement of drifting ice from the gulfs and bays along the coast of the western and northwestern parts of Anadyr Gulf, larger congregations of walruses were noted. The animals lay in groups, often of more than fifty individuals per floe; occasionally, on small pieces of ice we found also individual females with newborn calves.

In the beginning of July, after the disappearance of the ice in the Bering Sea, the harvest of walruses was conducted in the southwestern part of the Chukchi Sea (Fig. 1, VII). Large concentrations of animals were noted on fields of multi-year drift ice, and their numbers in individual herds amounted to some hundreds. A considerable part of the walruses was situated in the water, and they were moving in a western and northwestern direction, along the edge of the ice.

Age-Sex Composition of the Catch. The age-sex structure of the harvest samples of pinnipeds is based on objectively characterized distribution of animals, according to their areas of residence in a specific period (77) (Razlivalov and Bukhtiyarov, 1982). In the Bering Sea, there are three local populations of the larga: Karaginskii, Anadyrskii, and Alaskan (Gol'tsev et al., 1975, 1978; Fedoseev, 1984), and three populations of ringed seals: Karaginskii, Anadyr, and in the bays of the Bering Strait region, from Cape Chaplin to Cape Dezhnev (Fedoseev, 1984). Ribbon and bearded seals form single populations, although within them exist weakly differentiated reproductive groupings (Shustov, 1970; Kosygin and Popov, 1972; Fedoseev, 1984).

The age-sex composition of the catch of largas examined by us is given seperately for the Karaginskii and Anadyrskii populations (Fig. 3A, Table 1). The composition of ribbon and bearded seals was not divided by region of the catch (Fig. 3B,b, Table 1), nor was that for ringed seals, because of non-representativeness of the collected material, which was examined only for sex ratio by age groups (Table 1).

Analysis of the catch of seals showed a considerable predominance of young of the year, independent of area and time of the catch. Thus, in the first area the proportion (all species) amounted to 43.3%; in the second it was 68.3%; in the third it was 54.7%, and in the fourth, 62.4% (Table 2). Most of the catch apparently has little destructive effect on the overall status of the population, since it is made up mainly of young, and there is high natural mortality of the seals in the first year of life, anyway.

The catches of largas and ribbon seals were predominantly of 1- to 5-year-old animals (i.e., excluding the young of the year), which made up 57.0% of the largas in the Karaginskii and Anadyr populations and 47.9% of the ribbon seals (Figs. 3A,a,b and 3B,a). A predominance of young animals in the catch is characteristic for stable and growing populations of animals (Odum, 1975), hence it probably can be employed as an index of the safe state of harvested populations.

Histograms constructed from the data on age structure of the catch show the stable status of the Karaginskii population of largas and of the ribbon seals (Figs. 3A,b and 3B,a). A small

number of 5-year-old animals was observed in the sample for all species in the Anadyr region. In the claws of many specimens of ribbon seals, we observed deformations of the tissues in the 5- to 6-year annuli, apparently due to extremely unfavorable conditions in the winter of 1979.

Females predominated in the Karaginskii population of largas, where they comprised 54.6% of all of the age groups combined (Table 1). In the Anadyr population, the newborn young also were predominantly females (52.8%), but the juvenile and adult animals were mainly males (61.8 and 59.7%, respectively).

(78)

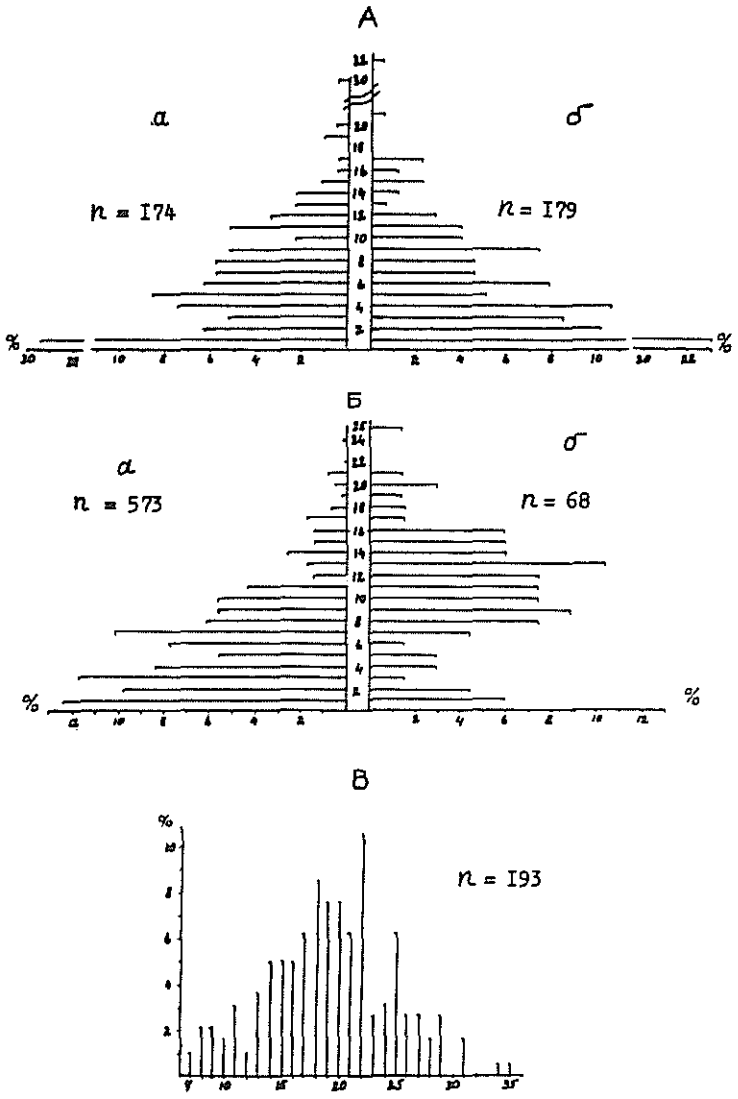


Fig. 3. Age structure of the catch: A - largas of the (a) Karaginskii and (b) Anadyrskii populations; B(a) - ribbon seals and (b) bearded seals; C - walruses

(79)

Table 1. Proportions of males and females in the catch of seals by age group.

Age group (yrs)	Larga				Ribbon		Bearded		Ringed	
	Karaginsk		Anadyrsk							
	M	F	M	F	M	F	M	F	M	F
0	45.4	54.6	47.2	52.8	49.5	50.5	44.1	55.9	41.3	58.7
1-5	45.4	54.6	61.8	38.2	47.1	52.9	66.7	33.3	50.0	50.0
>5	45.3	54.7	59.7	40.3	60.5	39.5	30.4	69.6	28.6	71.4
n	304		626		1011		127		238	

Table 2. Percent of young of the year in the catch by harvest region.

Area	Large	Ribbon	Bearded	Ringed	Total
I	42.8	(31.0)*	52.6	—	43.3
II	60.4	81.8	—	100	63.3
III	73.5	41.3	—	91.5	54.7
IV	(97.0)	36.6	39.4	77.1	62.4
Overall	62.0	43.3	46.5	84.5	55.3

*Percent from a selection of less than 50 individuals.

In the catch of ribbon seals, the sex ratio of young of the year was nearly 1:1; in the juveniles (1-5 yrs), females were slightly predominant (52.9%), but the adults were mainly males (60.5%).

The age composition in the catch of bearded seals (Fig. 3 B,b) cannot be a reflection of the overall status of the population, because the harvest was conducted selectively and the natural distribution of the animals is mainly in the shallow waters of the coastal region. The predominance of offspring and mature females in the catch can be explained by the conduct of the harvest, since in the period of birth, the females with young are located close to the edge of the ice, and the immature animals lay in the depths of the ice fields, where they are less accessible for harvest. Among the offspring and the 1- to 5-year-olds, females amount to 55.9 and 33.3%, respectively; among the adults, females made up 69.6%. The considerable (80) predominance of adult females in the catch apparently can be explained by their close attachment to their young. We observed more than once how the females did not abandon even dead young.

Females predominated also in the catch of ring seals, amounting to 58.7 and 71.4%, respectively, of the offspring and mature animals. Since the catching of ring seals was conducted principally in the birthing congregations, the high percentage of adult females also suggests close attachement of them to their young.

The age composition of the catch of walruses was investigated in a partial sample of the material without separation according to the area of harvest (Fig. 3 B). The selective harvest of males not taking part in reproduction (mainly the Khatyrskii group) cannot be considered as characteristic of the age composition of the whole population.

Literature Cited

Fedoseev, G. A. 1984. Morpho-ecological distinctions in populations of the larga (Phoca largha) and ribbon seal (Histriophoca fasciata) of the Bering Sea. Marine Mammals of the Far East. Vladivostok. p. 108-120.

Gol'tsev, V. N., V. N. Popov, and M. V. Yurakno. 1975. On the localization of herds of Bering Sea largas. Marine Mammals. Naukova Dumka, Kiev. p. 100-102.

Gol'tsev, V. N., M. V. Yurakno, and V. N. Popov. 1978. On the localization of Karaginskii and Anadyrskii populations of the Bering Sea larga (Phoca vitulina largha). Zoological Zhurnal 2.

Kibal'chich, A. A. 1981. Materials on the biology of the Pacific walrus from the cruise of ZRS ZAGORSKI in the western part of the Bering Sea in 1980. Scientific Investigational Works on the Marine Mammals of the Northern Part of the Pacific Ocean. Moscow. p. 7-12.

Kosygin, G. M., and V. N. Popov. 1972. On the localization of herds of the bearded seal. Theses of reports of the Fifth All Union Conference on Marine Mammals, Pt. 1. Makhachkala. p. 38-40.

Odum, E. 1975. Basic ecology. Translation from English. Mir, Moscow. 740 pages.

Razlivalov, Y. V., and Y. A. Bukhtiyarov. 1982. Age-sex composition of the catch of seals in the Bering Sea. Theses of Reports of the Eighth All-Union Conference on Marine Mammals. Astrakhan. p. 306-307.

Shustov, A. P. 1970. Geographical variation of the ribbon seal. Izv. TINRO 70:138-148.

3.7. CONCERNING THE AGGREGATIONS OF SEALS ON THE DEVELOPING ICE OF THE OKHOTSK SEA IN DECEMBER-JANUARY

G. A. Fedoseev (MoTINRO)

The first knowledge about the formation of aggregations of seals on the young, forming ice in November-December in the coastal zone of the bays and gulfs of the northern part of the Okhotsk Sea was recorded at the time of hunting expeditions in 1929-1931. In a summary of these materials, S. Y. Freiman indicated that aggregations of seals on the ice were noted in Tauiskii Bay, in Zabiyaka, Babushkina, Sredinii, and Kekurnii Gulfs, from Yamskii Bay to Cape Ostrovnoi, as well as in Penzhinskii Bay, in the

vicinity of the Chaibukha River, and the Taigonos Peninsula. Analysis of the development of the shore-based harvest of seals in the Okhotsk Sea also bears witness to the passage of seals later in the fall into the bays and gulfs, where long ago the catch took place in the slush ice.

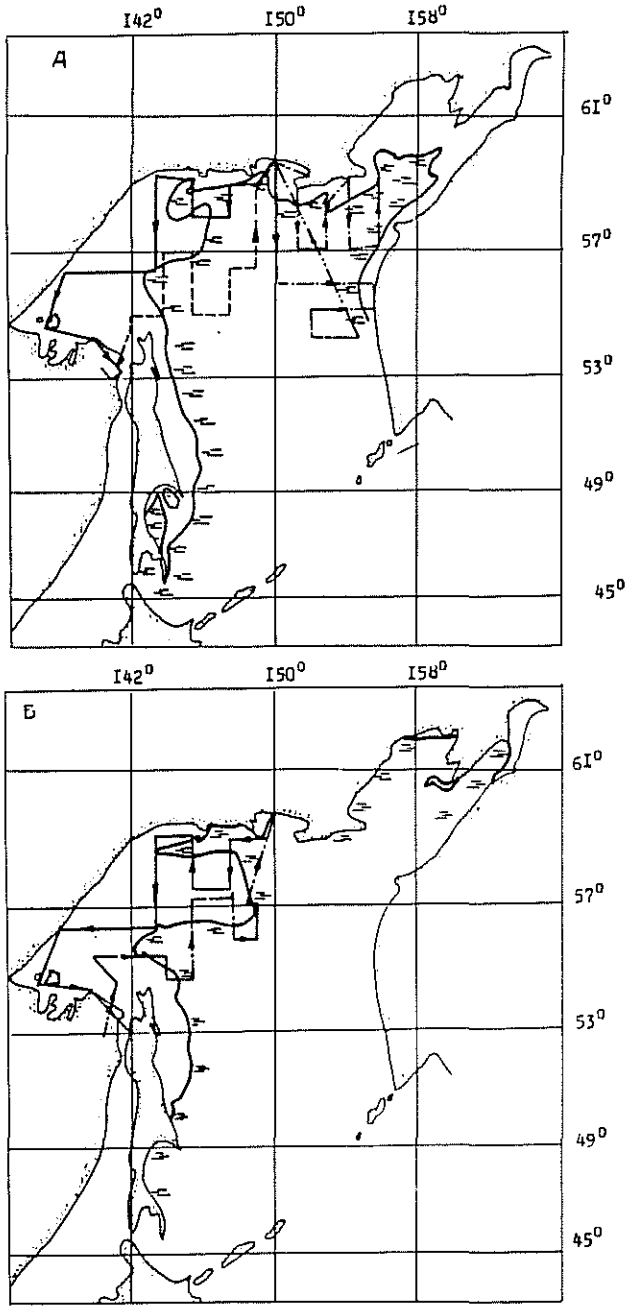
The above indications of direct and indirect knowledge about the aggregations of seals in the autumn-winter period were not sufficient for broad interpretation of this question. Hence, from 1974 to 1983, periodic flights were conducted in an IL-14 aircraft at 200 m altitude for the purpose of searching for seals on the newly forming ice of the Okhotsk Sea in December - January.*

The first of the flights was conducted in connection with the ice reconnaisance in 1974. Overall, three flights were completed in the second ten days of December in the north-western part of the sea and in Tauiskii Bay and its approaches. The most active ice formation was noticed in the western part of the sea and to the north of Sakhalin Island (Fig. 1A). Seals were recorded on the ice in only two areas, however, near Okhotsk (scattered groups of ringed and bearded seals) and in Tauiskii Bay, where largas were found, inaddition to ringed and bearded seals.

Flights were carried out in 1977 also in connection with the ice reconnaissance work of the Kolyma Section of the Hydrometeriorological Service. This was in the middle of December in the northwestern part of the Okhotsk Sea, in the approaches to Tauiskii Gulf and in Shelikhov Strait (Fig. 1B). In that year, aggregations of seals (ringed, bearded, and larga) were met in Tauiskii Bay, about Motykleiskii and Amakhtonskii inlets, and at Spafar'ev Island.

*In addition to the author, other observers took part in the exploratory flights, namely V.N. Gol'tsev (in 1974 and 1977), E.V. Razlivalov (in 1980-83), and G.G. Bobrova (in 1982)

(82)



(83)

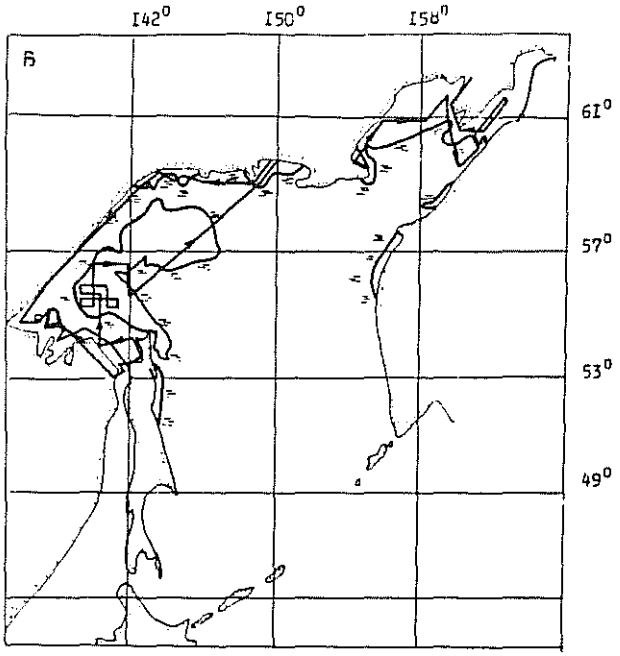


Fig. 1. Diagram of the ice fields and flight paths in December of 1974 (A), 1977 (B), and 1980 (C).

In Yamskii Bay, individual ringed and bearded seals were found, and the number of these species somewhat were greater about Takhtoyamska. Single animals lying on the ice (ringed and bearded seals) were noted also in the nearshore zone, from Cape Varkhalamskii to the Taigonos Peninsula.

In 1980, the search for aggregations on the forming ice was conducted from an airplane leased by the Magadan section of TINRO. The pattern of flights is shown in Fig 1,C. The time available for the flights, however, was not sufficient (40 hours), so the search for seals, as in previous years, was carried out with only the difference that we examined mainly the gray and gray-white ice, on which the animals usually prefer to lie at that time.

Massive aggregations of ringed seals in that year were noted in the western part of Tauiskii Bay. Here lay scattered bearded seals. The number of animals in this region was not estimated, since the herds of seals on the ice were appearing (84) at the end of the day, as our flight time ended with the approach of twilight. In contrast to previous years, we found great concentrations of herds of ringed seals in narrow cracks and polynas of the gray ice, in the vicinity of Chaibukha and Khalpili Island (Gizhiginskii Bay). The animals did not lay on the ice, but large groups remained in the water. Possibly at this time the ringed seal was feeding on schooling fishes. The size of the herds amounted to more than 1000 head, animals were concentrated in narrow polynas not greated than 50 to 100 m wide. The largest of the polynyas resembled a narrow, meandering river in the field of

gray and gray-white ice.

From the observations in 1980, of particular interest was the appearance of a massive concentration of ribbon seals to the southwest of Ion Island, in the zone of ice formation in the open sea. The congregation of ribbon seals was so considerable that we conducted an aerial survey of them along transects (Fig. 2), for later extrapolation to the entire ice field.

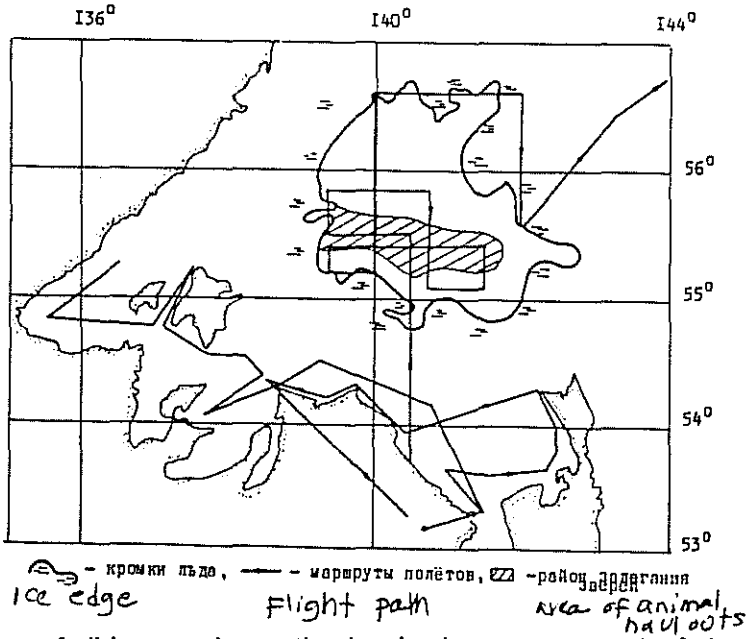


Fig. 2. The concentration of ribbon seals on the ice in the western part of the Okhotsk Sea in December 1980.

The meteorological conditions in that area were unfavorable: the day before (7 December) a powerful storm with snow showers passed through. Strong (85) turbulence and icing of the aircraft forced us return to the airport. On the following day, (8 December), when the cyclone swept to the north, we again launched an attempt to inspect the given ice field. The weather was overcast, but there were no strong winds, and the ice had been well covered with snow the day before. Possibly, the passage of the strong storm on 7 December and subsequent calmness was conducive to mass emergence of the ribbon seals onto the ice. The extremely high density of animals was striking. Sometimes we counted up to 94 specimens in a 5-minute flight (cf. Fig. 2), which rarely has been noted in this species, even in the peak of the molt in spring, when the aggregations of seals are at their maximal density. The ribbon seals lay only in the center of the ice field, on gray and gray-white ice, which was beginning to be covered by snow. The extent of the aerial transects on which ribbon seals were sighted amounted to 286.5 km (transects where there were no animals were not considered), and the total area of the survey strips (200 m

wide) amounted to 57.3 km.

In that area 583 animals were recorded; that is, the average density amounted to 10.2 animals per km^2. Extrapolation of this to the total area in which the ribbon seals lay (6,800 km^2) showed that there were perhaps 70,000 animals in this area.

In 1981, three survey flights were conducted from 10 to 17 December (Fig. 3A). In that year, there was very little ice. In the narrow bands of ice in Yamskii Bay, ribbon seals lay singly, and single ringed and bearded seals also were noted from there to Cape Viliginskii, as in the previous years. The largest aggregations of bearded seals were encountered also in the mouth of Penzhinskii Bay.

Along the western shore of the sea, from Okhotsk to the Shantar Islands, the ice was in the form of narrow bands and small patches and was situated close to the shore. Animals were not found on it, however.

In 1982, a more detailed inspection of the ice and search for animals was conducted from 3 to 14 and from 27 to 29 December (120 flying hours) and from 22 to 26 January (35 hr). After that time, three and in some regions four examinations of the ice were conducted (Fig. 3B). In the winter of 1982/3, the entire area of ice coverage of the sea exceeded the average of many years. One would expect that, in the presence of a large amount of ice, the seals should appear more often on its surface, but this did not occur. Single seals on the ice (ringed and spotted) were noted along the edge at the Shantar Islands, in Sakhalin Gulf, in the coastal part of Yamskii Bay (from Cape Iretskii to the Takhtoyama River), and in Gizhiginskii Bay.

(86)

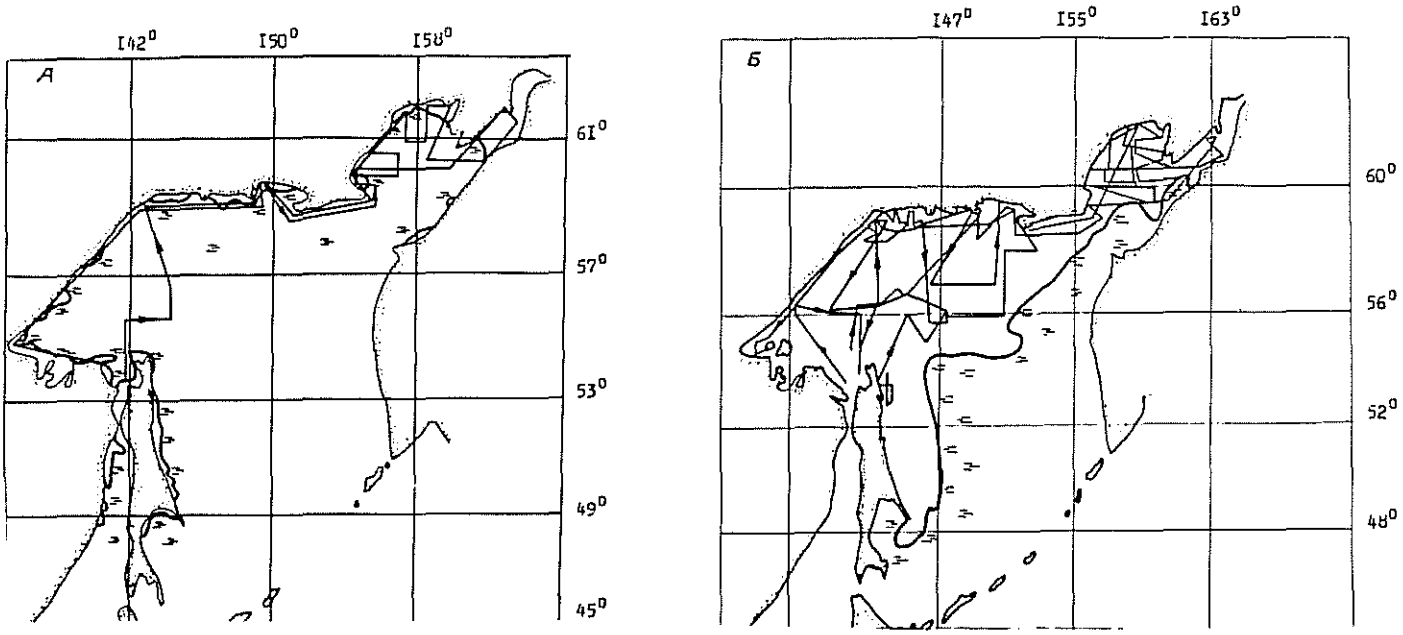


Fig. 3. Diagram of the ice fields and transects flown in December 1981 (A) and 1982 (B).

(87) The exception was Tauiskii Bay, where mass emergence onto the ice by ringed and bearded seals was recorded repeatedly, particularly in Amakhtonskii Inlet and on the western side of the Spafar'eva Islands.

Observations conducted in January 1983 during an aerial survey by the Sakhalin Fisheries, showed that ringed and bearded seals were present in Tauiskii Bay but in considerably lesser quantities than in December. Small herds of ringed seals were noted in the water between the Spafar'ev Islands and the Lisyanskii Peninsula.

Data on the distribution of seals in the beginning of the winter showed that herds form on the ice in some years in Gizhiginskii Bay (vicinity of Chaibukha to Khalpili Island), in the entrance to Penzhin Bay, in Yamskii Bay, from there to Cape Ostrovnyi, in Tauiskii Bay, from the vicinity of Okhotsk to the Ul'ya River, and at the Shantar Islands. In the open part of the sea, mass aggregations of ribbon seals were recorded to the southwest of Ion Island (Fig. 4).

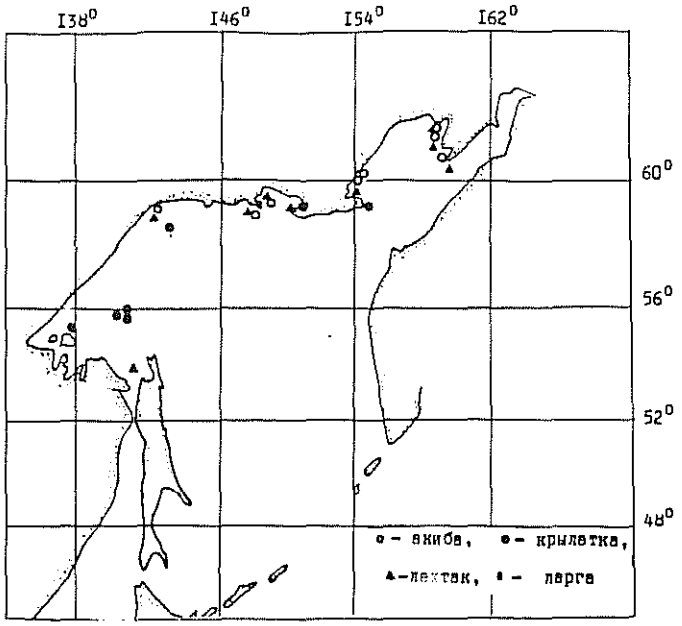


Fig. 4. Diagram of the distribution of seals on the ice in the Okhotsk Sea (in November-December), from materials of investigations in 1974, 1977, and 1980-82.

(88) More often ringed and bearded seals lie on the ice at that time; largas and ribbon seals are not found there annually.

In contrast to their behavior in spring, the seals come out onto the ice irregularly in the beginning of winter. Apparently, their irregular appearance on the ice in the beginning of winter depends the time when migrating individuals require a short rest, which is connected with a physiological processes, as it is in the spring (i.e., with birth and the molt).

3.8. ANALYSIS OF THE CRANIOLOGICAL CHARACTERS OF RINGED SEALS OF THE COASTAL WATERS OF CHUKOTKA AND ALASKA

G. A. Fedoseev (MoTINRO) and V. N. Mineev (Glavrybvod SSSR)

The ringed seal, which inhabits the coastal zone of the Chukchi Peninsula and Alaska, is one of the main objectives of the harvest by native populations of this region. In the not too distant past, the catch of ringed seals on the Chukchi Peninsula alone amounted to 40,000 head. In current times, the populations of the Chukchi Peninsula and Alaska annually catch about 15,000 of these seals.

For rational utilization of the stocks of ringed seals, it is important to study the independence of separate populations, the boundariess and structure of which, in many cases, define the principal approach for gathering the kind of information needed for appraisal of the stocks, as well as for regulating the numbers of these animals.

For study of intraspecific and populational structure, the method of analysis of morphological characters, which has been applied extensively (Yablokov, 1966), has been utilized successfully also in investigation of the ringed seals of far eastern seas (Fedoseev, 1967). The absence of materials from that species from the American economic zone, however, prevented comparative morphological analysis of the animals inhabiting the coastal waters of Chukotka and Alaska.

In the present paper, we utilized materials collected by G. A. Fedoseev on the coast of the Chukchi Peninsula (Seniavin Strait) and collections (89) of skulls from the nearshore region of Alaska (Points Barrow and Hope), processed by the authors in museums in the USA.*

A statistical treatment of the variation in a series of measurements of skulls and an evaluation of the probability of the observed differences in characters were accomplished by the methods of P. F. Rokitskii (1961). Unfortunately, the sex of the animals was not indicated for all skulls in the museum collections, so the analysis of the characters was conducted without allowance for sexual variation.

According to the data of the statistically processed craniological characters (Table 1, Fig. 1), the skulls of seals from Seniavin Strait and the vicinity of Point Barrow are very similar, and those from Seniavin are larger than the skulls from seals in the vicinity of Point Hope.

Evaluation of the probability of the differences of skull characters (see figure) showed that the samples from all areas differed one way or another from each other. The degree of those differences, however, was not the same. Notably, the samples from similar areas (Seniavin Strait and Barrow) showed differences in characters associated with the oral cavity (width of the palate, length of the upper toothrow, height of the lower jaw). Possibly such variation has adaptive value in retalation with the specific foods of the seals in the indicated areas.

It is notable also that the probability of difference between samples appeared in nearly all of the investigated characters of the samples from the closest areas, Barrow -- Hope on the one hand, and Hope -- Seniavin on the other, whereas comparison of the samples from the extreme points of the inspected range (Barrow -- Seniavin) showed difference only in 4 characters out of 26. The given chance variation in the plastic characters does not agree

*The authors express thanks to the Soviet-American commission for Protection of the Environment and the Ministry of Fisheries USSR for assistance in this work, as well as to American colleagues J. Burns (Alaska Department of Fish and Game), Dr. Fay (University of Alaska), Dr. Mead (Smithsonian Institution, Washington), Marie Lawrence (American Museum of Natural History, New York), and Dr. Rutsmoser (Museum of Harvard University, Cambridge).

with concept of clinal variation widely confirmed in the scientific literature (i.e., when the variation tends to be in the direction of increasing or decreasing size).

In our opinion, the size criteria of the skulls reflect the peculiarities of the overall development (growth) of the animals under different circumstances. Apparently, the ringed seals in the vicinity of Point Hope, as in the vicinity of Cape Inchoun, give birth on the drifting ice or on shorefast ice that breaks up early (Fedoseev, 1965), whereas those seals inhabiting the vicinity

Table 1. Statistics from the craniological materal from ringed seals.

Character	Point Barrow					Point Hope					Bering Strait				
	n	M	±m	G	c.v.	n	M	±m	G	c.v.	n	M	±m	G	c.v.
1. Length of skull	26	I70,I	0,85	4,3	2,5	25	I66,0	I,0	5,0	3,0	35	I7I,8	I,5	8,9	5,2
2. Basal length	26	I58,I	0,85	4,3	2,7	26	I54,8	I,I	5,6	3,6	35	I60,6	I,4	8,3	5,2
3. Occipito-nasal length	26	I44,I	0,85	4,3	3,0	25	I4I,7	0,9	4,5	3,2	35	I45,0	I,2	7,0	4,8
4. Palatal length	23	70,5	0,70	3,4	4,8	25	66,2	I,2	6,0	9,0	35	69,0	0,8	4,7	6,8
5. Palatal width	29	37,3	0,30	I,6	4,3	27	36,0	0,5	2,6	7,2	35	35,2	0,5	3,0	8,4
6. Length of upper toothrow	26	5I,6	0,4	2,0	3,9	27	48,6	0,6	3,I	6,4	35	54,2	0,7	4,I	7,6
7. Snout width	22	25,7	0,2	0,9	3,5	25	24,4	0,3	I,5	6,I	35	26,3	0,3	I,8	6,7
8. Mastoid width	26	I02,8	0,7	3,6	3,5	27	I00,5	0,7	3,6	3,6	35	I04,5	0,8	4,7	4,5
9. Width of cranium	26	86,8	0,9	4,6	5,3	26	83,8	0,5	2,5	3,0	33	86,3	0,6	3,4	2,0
10. Width of nares	23	22,6	0,3	I,3	5,7	24	22,0	0,2	I,0	4,2	34	22,4	0,6	2,3	I0,4
11. Length of nasals	25	37,2	0,6	3,0	8,0	26	38,4	0,9	4,6	I2,0	35	39,I	0,8	4,7	I2,I
12. Width of nasals	22	II,9	0,3	I,4	II,8	25	II,7	0,2	I,0	8,5	34	I2,3	0,2	I,2	9,8
13. Interorbital width	26	5,6	0,2	I,0	I7,8	26	5,6	0,2	I,0	I8,2	35	5,8	0,2	I,2	20,4
14. Condylar width	25	55,6	0,5	2,5	4,5	26	54,3	0,4	2,0	3,8	35	56,2	0,5	3,0	5,2
15. Height of the cranium	22	58,8	0,3	I,4	2,4	26	57,5	0,4	2,0	3,5	35	58,7	0,5	3,0	5,I
16. Height of zygomatic arch	26	I6,8	0,3	I,5	8,9	26	I6,8	0,2	I,0	6,0	34	I7,2	0,3	I,7	I0,2
17. Length of auditory bulla	26	35,4	0,3	I,5	4,2	27	34,3	0,4	2,0	5,8	33	35,5	0,3	I,7	4,8
18. Width of auditory bulla	26	36,6	0,2	I,0	2,7	27	35,5	0,4	2,0	5,8	33	36,7	0,3	I,7	4,7
19. Zygomatic width	26	I0I,8	I,0	5,0	4,9	27	99,5	0,6	3,I	3,I	35	I03,0	0,7	4,I	4,0
20. Length of facial part	26	90,6	0,6	3,0	3,3	26	87,9	0,7	3,6	4,0	35	86,4	0,8	4,7	5,5
21. Length of cranial part	-	-	-	-	-	26	78,0	0,9	4,6	5,9	-	-	-	-	-
22. Length of zygomatic arch	23	47,8	0,6	2,9	6,0	27	46,3	0,4	2,0	4,5	-	-	-	-	-
23. Length of lower jaw	24	I07,2	0,5	2,4	2,2	27	I03,I	0,7	3,6	3,5	33	I07,4	I,I	6,3	5,9
24. Height of lower jaw	24	43,9	0,6	2,9	6,6	27	42,6	0,6	3,I	7,3	33	47,5	0,5	2,9	6,0
25. Height of the last molar	24	I6,8	0,2	I,0	5,9	27	I6,3	0,2	I,0	6,4	33	I7,0	0,3	I,7	9,8
26. Length of the lower toothrow	24	45,6	0,3	I,5	3,3	27	44,I	0,5	2,6	5,9	33	44,7	0,5	2,9	6,4

(91)

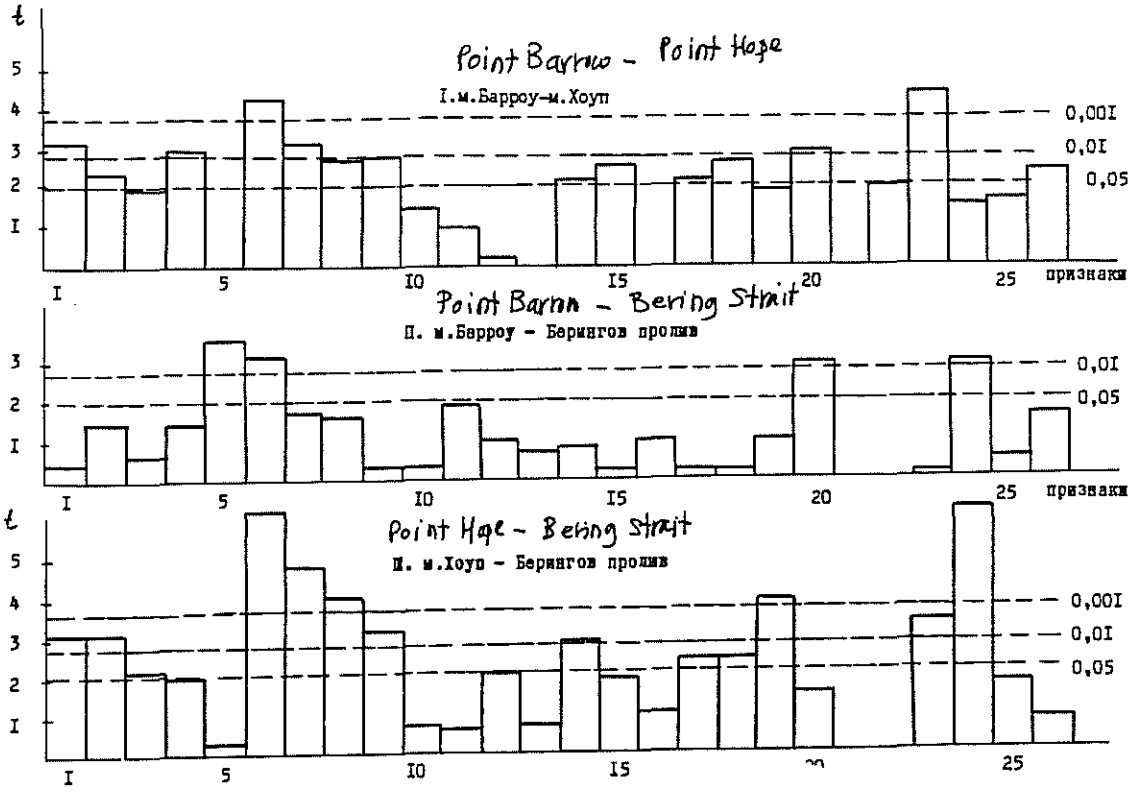


Fig. 1. Probability of statistical difference in characters of the skulls of ringed seals from areas in Alaska and Chukotka according to Student's criterion (t).

(92) of Seniavin Strait and Point Barrow breed in shorefast ice that is destroyed very late (in July). As was shown earlier (Fedoseev, 1967), the seal pups produced on the shorefast ice feed on milk for amore prolonged period than do the seals inhabiting the drifting ice. Hence, where the period of milk feeding of the seal pups is more prolonged, the animals reach a larger size. The possibility cannot be excluded also that natural selection "works" on increasing the size in the circumstances of the shorefast ice. During residence amongst the drifting ice, the animals of smaller size may have greater chance for survival.

The apparent morphological diversity of the ringed seals in the areas investigated allows us to assume that, in the nearshore waters of Chukotka and Alaska, at least three local populations of this species exist, but the interrelationships among them so far remain unclear, due to insufficient study of their ecology.

Supplementary studies for determination of the borders of the range, degree of independence, dynamics of numbers, and reproduction of the local populations of ringed seals in the nearshore waters of Alaska and Chukotka are essential.

List of utilized literature

Fedoseev, G. A. 1965. Comparative characteristics of populations of ringed seals in the nearshore waters of the Chukchi Peninsula. Izv. TINRO 59:194-212.

Fedoseev, G. A. 1967. Comparative morpho-ecological characteristics of ringed seals of the Okhotsk Sea and nearshore waters of the Chukchi Peninsula. Author's abstract of dissertation in competition for the academic degree of Cand. Biol. Sci. Moscow. 17 p.

Rokitskii, P. F. 1961. Basic variational statistics for biologists. Minsk.

Yablokov, A. V. 1966. Variation of mammals. Nauka, Moscow. 363 p.

(93)

3.9. DISTRIBUTION AND NUMBER OF WALRUSES IN THE EASTERN ARCTIC AND BERING SEA, AUTUMN 1985.

G. A. Fedoseev and E. V. Razlivalov (MoTINRO)

Aerovisual surveys of walruses in the summer-autumn period have been conducted since 1960. Only since 1975, however, has this work been carried out over the entire range of habitat, including the neutral and territorial waters of the USSR and the USA. In 1985 as in 1975 and 1980, synchronous aerial surveys of the walrus were carried out in the two zones: the Soviet side conducted observations of the coastal haulouts on its territory and on ice of the East Siberian and Chukchi seas to 174°W; the Americans worked eastward from there and on the coast of the peninsula of Alaska.

The survey of walruses was conducted with an IL-14 aircraft. The first reconnaissance flights were carried out from 13 to 15 September, and the actual aerial surveys of walruses took place from 26 September to 14 October over the ice in the Chukchi Sea and the coastal haulouts of the Chukchi Peninsula, and from 29 October to 1 November on the coastal haulouts of Karaginskii and Olyutorskii Gulfs, washing the northeastern coast of the peninsula of Kamchatka. The survey of walruses on the ice was conducted in transects at an altitude of 200 m; the width of the field of view amounted to 500 m (on the whole, the general characteristics of the distribution were noted also of animals situated at greater distances from the aircraft). For definition of the density of the walruses lying on the ice, only those animals that were within the 500 m zone were taken into account. The observations were carried out simultaneously by two observers and partly by the pilot. The resultant observations were recorded on a chart with corrections for actual location of the walruses. At the beginning [of each flight?], with calculation of the flying speed, the route was marked off in 5-min intervals, and the number of animals sighted in that time [was entered] on the section of the survey. Such a procedure for transfering observations onto the chart allowed the location of the aircraft to be defined by computation of the route, since there was no automatic navigational computer system on board. In the following, the areas inhabited by the walruses have been

plotted on the chart according to the points where the animals were located.

The area [km^2] of the places inhabited was determined, and extrapolation was accomplished (the total number of animals was calculated from the mean density per km^2 in the surveyed strips).

The coastal haulouts were surveyed by means of aerial photography, and the walruses were counted on the photographs in the laboratory. The overall duration of the flights amounted to about 140 hrs (or 30,800 km) of searching, (94) and the actual survey of walruses consumed 103 hrs, with 22,660 km of surveyed transects.

In the beginning, an attempt was made to inspect the coastal haulouts of northeastern Kamchatka. However, unfavorable conditions for flight (13 September) did not permit us to survey Bogoslov Island or Capes Anana, Seryi, and Goven, where walrus herds can develop. On that day, we examined only the coasts of Karaginskii and Verkhoturov Island. There were no walruses lying there, but there were small groups in the water to the north and west of Verkhoturov Island. On 14 September, we surveyed the haulouts on Meechken and Rudder spits, on Arakamchechen and Nuniangan islands, on capes Nunyamo, Dezhnev, Inchoun, Inkigur, and Serdtse-Kamen, but there were no walruses there, either. Flights over the ice on 15 September also were without results, since the walruses were not found in the traditional areas. On that day, walruses were found only in the end of a flight about Shalaurov Island (entrance of Nol'de Bay). The work was resumed from 26 September to 14 October (Fig. 1,A). A detailed investigation of the ice fields showed that the walruses were dispersed in rather isolated concentrations in the coastal zone, from Chaun Bay to Cape Schmidt (Fig. 1B). The majority of the large, separate concentrations were recorded between Cape Shelagskii and Nol'de Bay, and from the vicinity of Cape Billings to Pil'gen Lagoon and east of Cape Schmidt. South of Wrangel Island, there were very few. Such a distribution of walruses on the ice has not been noted ever before in the previous years' aerial surveys (1960,1970,1975,1980), and it was due to the peculiar ice conditions of this year. In the last three weeks of September and first half of October 1985, fields of heavy, multiyear pack ice, compacted to 10/10, covered the favorite habitats of the walruses to the west and southwest of Wrangel Island and in most of Long Strait. Only in the 50-mile-wide nearshore zone from Cape Shelagskii to Cape Schmidt were there areas of scattered first year ice, compacted to 3 to 9/10 coverage. With such ice conditions, the walruses inhabited a very marginal part of the ice. The distribution of walruses in the ice fields is shown in Fig. 1B, and the characteristics of the congregations and numbers of animals are given in Table 1. These materials show that the walruses, in spite of the mozaic character of the distribution, inhabited two basic areas: the East Siberian Sea (from Cape Shelagskii to Nol'de Bay) and Long Strait, principally in the southern parts (from Pil'gin Lagoon to Cape Schmidt).

In parts of the area, especially in area 8 (see Fig. 1B), the walruses were very highly concentrated. There, on one of the legs of the (97) flight track, 5 min into the sampling strip, 3570

walruses were encountered.

(95)

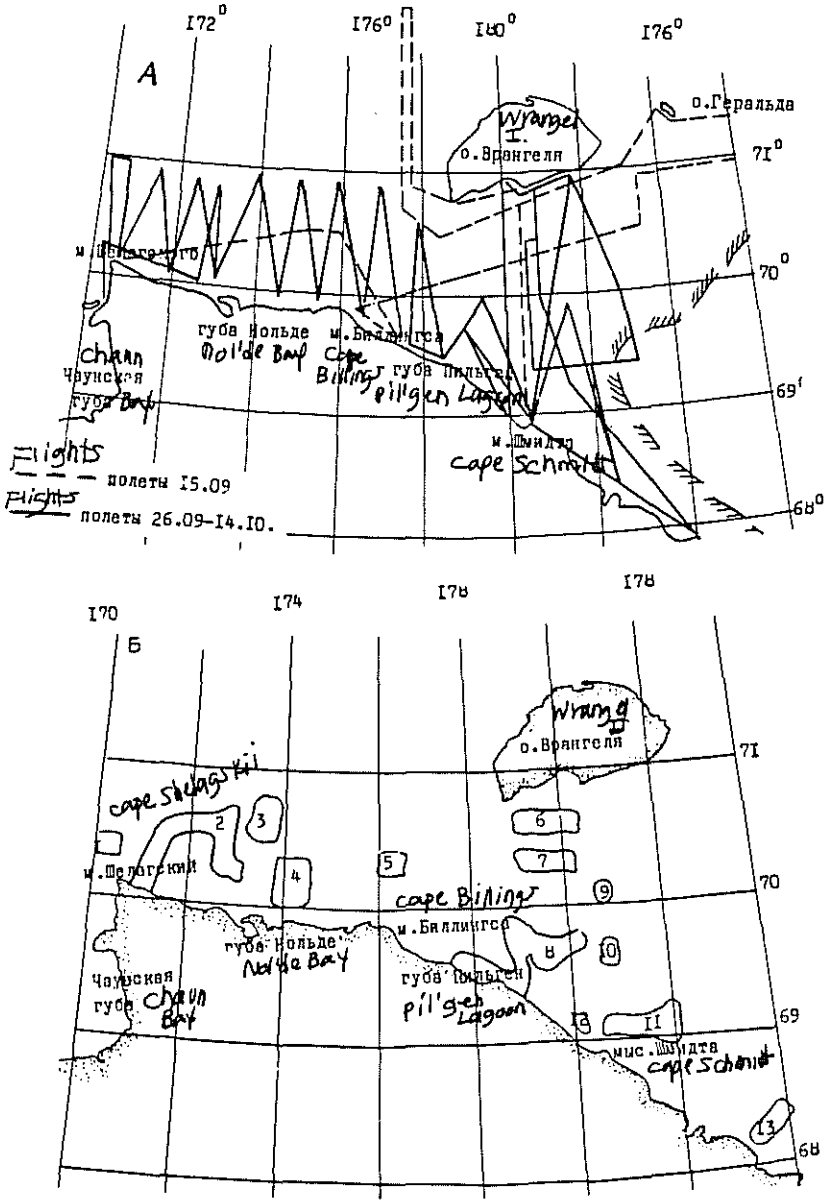


Fig. 1. Diagram of transects of the aerial survey of walruses on the ice (A) and in the period from 26 September to 14 October 1985 (B). Numerals in the areas conform with those in Table 1.

(96)

Table 1. Data from the counts of walruses on the ice of the East Siberian and Chukchi seas (width of strip 500 m).

Area no.*	Date of survey	Length of transects on which walruses found (km)	Area surveyed (km^2)	No. of animals found	Density: animals per km^2	Area of extrapolation (km^2)	Number of walruses
1	27/IX	17	8.5	1	0.11	268	29.0
2	27-28/IX	178	89	533	5.98	2040	12199
3	28/IX	36	18	103	5.72	766	4382
4	28/IX	38	19	173	9.1	916	8336
5	28/IX	20	10	10	1	400	400
6	29/IX	18	9	120	13.3	766	10188
7	29/IX	18	9	5	0.55	606	333
8	29/IX,4/X	256	128	645(+3570)	5.03	2333	11735+3570
8**	29/IX,4/X	256	128	4215	32.9	2333	76756
9	29/IX	16	8	6	0.75	180	135
10	7/X	20	10	5	0.5	188	94
11	29/IX,6/X	122	61	72	1.18	1200	1416
12	29/IX	16	8	60	7.5	122	915
13	29/IX	14	7	5	0.71	490	348
Total,1st method		769	384.5	1738(+3570)		10275	54080
Total,2nd method		-	-	-	-	-	115531

* Numbers of areas inhabited by walruses, corresponding to numbers shown in Fig. 1.

**In this row, the number and density of animals per km^2, as well as the extrapolated number of walruses include the 3570 head encountered at one point; in the row above, however, those animals were not included in the average density.

This was two times more than the quantity on all other transects of that flight. Apparently, this was a pre-migrational congregation of walruses. For extrapolation of the number in the given area, the total was computed by two methods. For the first method, the recorded congregation of walruses (3570 individuals) was not included in the computation of average density for that area (see Table 1) but was added to the resultant value. For the other method, this number was entered into the average density. The total numbers of walruses, therefore, amounted to a little more than 15,000 and 76,824 individuals, respectively. This also influenced the final appraisal of numbers of walruses inhabiting the ice. That is, they amounted to about 54 and 116 thousand head, respectively.

The materials from the aerophotography of the haulouts of walruses (Table 2, Fig. 2) showed that the number of animals varied significantly from day to day and, in several cases, the walruses abandoned the haulouts. Departure of walruses from the haulouts is an ordinary phenomenon, caused by many factors, which will not be analyzed here. The walruses in most cases did not go far from the haulout but dispersed in small groups in the water, within a radius up to

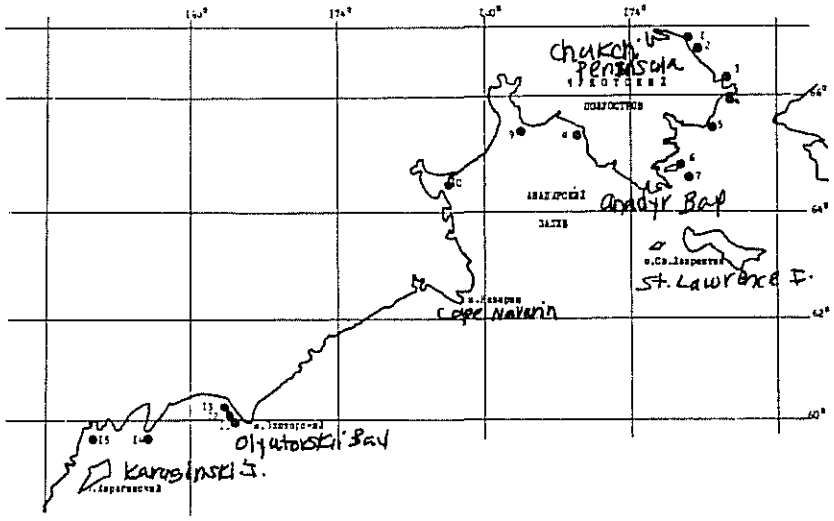


Fig. 2. Disposition of the coastal herds of walruses, autumn 1885 (numbers correspond to those in Table 2.

(98) 50-70 km. Since conditions were not always favorable for photography and visual counting, for appraisal of the number of walruses we took into account [previous] data concerning maximal occupancy of the haulout (see Table 2).

Table 2. Results of the counts of walruses on the coastal haulouts in 1985.

Table 2. Results of the counts of walruses on the coastal haulouts in 1985

ulout .from g.2	Location of haulout or its name	Date	Method for determing the number of walruses	Number of animals
1.	C. Serdtse-Kamen	14/X		5454
2.	Cape Inkigur	14/X		876
3.	Inchounskoe	14/X		1037
4.	Cape Dezhnev	14/X		842
5.	Nunyamo	11/X	Aerial photography	5945
6.	Arakamchechen	13/X		3073
7.	Nuniangan I.	11/X		1076
8.	Rudderskoe	12/X		7888
9.	Meechken Spit	5/X		666
10.	Russkaya Koshka	11/X		715
11.	Cape Anana	31/X		500
12.	Cape Seryi	31/X		500
13.	Northwest of Cape Seriyi	31/X	Aerialvisual count	1500
14.	Cape Goven	1/X		4000
15.	Verkhoturov I.	1/X		5500
	TOTAL			39572

On the northern coast of the Chukchi Peninsula, walruses were few (about 18% of the number on all of the haulouts). Probably, this was due to the fact that, at the time of the aerial survey, the walruses still had not begun their migration from the ice. This was indicated also by the absence of walruses from Idlidlya Island, which apparently is the first place that they approach at the time of their passage from the Chukchi to the Bering Sea. There were few even on the haulout on Cape Dezhnev.

The prolonged delay of walruses on the ice in the Chukchi Sea was favored by the delayed beginning of winter, with frequent passage of cyclones and thaws. For this reason, there was little chance for repeated counting of the same animals on the ice and on the coastal haulouts.

The total number of walruses on the ice and coastal haulouts in the area surveyed by us amounted to 95-156 thousand head.

4. SEA OTTER INVESTIGATION
A.V. Zorin (VNIRO)

4.1 Results of sea otter investigations of the Kuril Islands in 1985

(99)

At the present stage of the investigation we had at our disposal long term data about the numbers of sea otters on the Kuril Islands, some information about the comparative morphology of animals from different parts of this range, their reproduction and mortality. There remains the little studied problem of the status of the ecological resources of the population and the degree of its utilization whose value was particularly emphasized during a discussion of the results of studying the Commander Island sea otter population. Hence, the field investigation program in 1985 was aimed at collecting materials on feeding, food resources and a classification of animal habitats.

Materials and methods. The investigations were conducted from August to September in the inshore zone of Urup Island and the northeastern terminus of Iturup Island from the ship and with a motor boat and also on shore in the northeastern half of Urup Island. We studied the topography and composition of bottom communities, the structure of sea urchin accumulations, the characteristics of individual biotypes and the composition of the animals' food. Underwater works were done by divers in the littoral zone of Urup Island using a method of sampling areas and transect observations. On the coast we conducted a course of observations, collecting and analyzing the feces and wastes of invertebrates.

The condition of the food resources was evaluated using a method approved on the Commander Islands from 1979 to 1982 which was based on using the age characteristics of accumulations of sea urchins as an indicating device (Sidorov, et al., 1982; Zorin, 1984).

Results of the investigation. While examining the shore line of Urup Island traces were found of some winter and spring rookeries of sea otters. An analysis of the experiments at these sites was done, supplemented by observations on the feeding by the animals, allowing us to approximately determine the spectrum of their feeding during the indicated periods (Fig. 1).

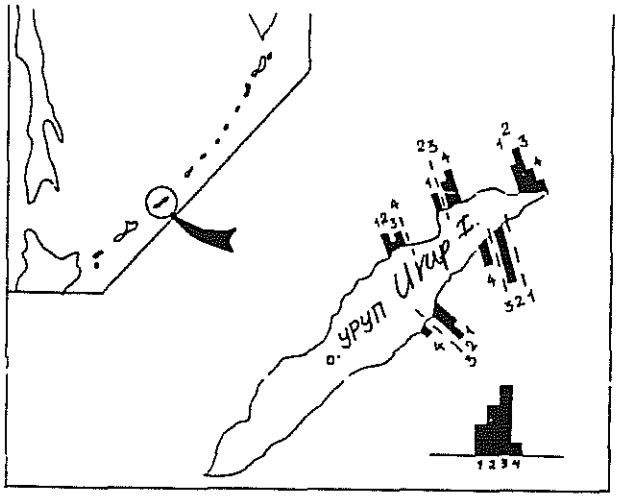


Fig. 1. Scheme of the investigation area and the food composition of ses otters according to an analysis of experiments at the sites of winter and summer rookeries.

1. Sea urchins; 2. Fishes 3. Crustaceans 4. Mollusks

The overall composition of the food varied (fishes, sea urchins, crustaceans and mollusks), and the indices of occurrence and the volume in the food clumps of each of the components was basically different (Table).

Composition of sea otter's food

Components of food	Occurrence %	Volume in the food clumps, %
sea urchins	100	20
fishes	22	31
crustaceans	87	42
mollusks	50	7

(100)

The Pacific coast of Urup Island has a larger, according to area, zone of shallow water (up to 20 m.) than the Sea of Okhotsk. At the same time a significant part of it is formed by the movement of the sea bottom which has an effect on the abundance, topography and structure of bottom communities. Thus, if for the Okhotsk Sea side of Urup Island it is characterized by an alaria field of the marginal or zonal type, extending along the shore line and is often repeating its bends, then for the Pacific Ocean side it is a discontinuous field with a feather-like structure, oriented at an angle to the shore line, or in separate, small patches.

With respect to the zone of alaria (a depth of 8 - 12 m.) there is distributed a biomass of sea urchins which enter in the structure of the assemblages of these algae. In the vertical

structure of the assemblages of these algae. In the vertical distribution of the biomass, sea urchins influence the depth and character of the sea bottom and in the zone of brown algae - their abundance. There is noticeably a nearly total absence of echinoderms and bi-valve mollusks (101) at depths of 0 to 6-8 m. in a majority of the examination areas. The stoney, and most frequently, boulder-sandy bed (4 - 8 m.) of this layer, as a rule is covered by a solid carpet of laminaria with communities of greenlings, perch and goby.

At depths over 8 m. and to the outer limits of the zone of alaria (12 - 14 m.) in the stoney bed there are predominantly Alaria sp.+....+ + Strengilocent, in which brown algae is most often dominant.

The maximum density of the biomass of sea urchins is approximately 5 kg/m.^{2} which is characteristic for the 12 m. isobath along the coast of the Sea of Okhotsk. The concentration of the biomass can be even higher at certain points of the Pacific coast, but this hardly increases the absolute significance of the biomass in a given area since echinoderms distributed here are less than uniform. Separate specimens of sea urchins occurred at depths of 40 m.

The size-age characteristics of the sea urchins vary according to the depth equal to the biomass (Fig. 2). Considering that in the investigation period the seasonal, vertical migration of these echinoderms still does not have a substantial effect on their distribution by age groups, these variations were assumed to be the result of the feeding activity of predators.

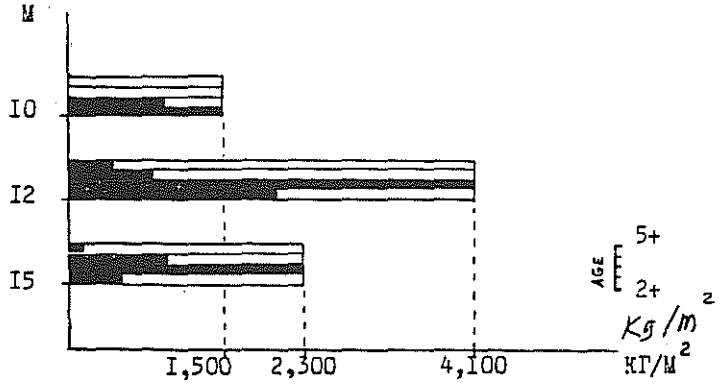


Fig. 2 The distribution of the biomass and age structure of sea urchin accumulations near the Okhotsk Sea coast of Urup Island (August - September, 1985) by depth

No concentrations of bivalve mollusks were found. In the sea flotsam along the tide line, the shells of the mollusks (in particular, Mytilus sp., and Modiolus sp.) were extremely rare. It was also unusual to see the carapaces of sea urchins and crustaceans.

(102)

The properties of separate biotypes were evaluated according to certain attributes including the protection from abiotic

stresses in the winter and summer and the abundance and structure of the feeding communities. A reinforcement and further analysis of the materials are required.

Discussion of the results. NUMBERS AND POPULATION STATUS. In the last 15 years the numbers of sea otters in the area has been relatively stable (approximately 2,000 animals) with a tendency to increase (Kuzin et al., 1984). Here their distribution on Urup Island (approximately 80% of the total number) can be called random or random groupings but on Iturup Island the animals occupy only the northeastern part which is closest to Urup Island. From 1967 to 1970 a nearly twofold increase noted in the latter group coincided with a decrease in the number of sea otters on Urup Island by more than 20%. A similar development was noted in a group of sea otters on Simushir Island (north of Urup Island). Therefore we could not consider that the concentrations of animals on the islands adjacent to Urup Island were independent groups or populations.

In connection with this controversy a question remains about the population status of the island group of Kuril sea otters. It seemed most probable to us that they represented an essentially, singular Kuril population with two (or more) "population centers", the most inhabitants and with historically stable accumulations which served as sources for the regular population or a mixing of the groups of animals in the adjacent microranges. In the absence of a harvest the oscillation of the numbers of sea otters on these islands like Urup and Paramushir, and consequently the mass migration of animals to other islands was inevitable as a result of the limiting factors related to density. Historically the southern limits of the overall range did not go as far as the boundaries of Urup Island, and this, in combination with the other data, allowed us to consider the limitations of an aboriginal harvest as factors which supported the optimal density of the population and restrained migration activity.

The existence of some independent populations of sea otters on the Kuril Islands was confirmed by data from TINRO specialists about certain differences in the meristic traits of animals from different islands. However, these arguments for a time could not be accepted since the variability of the indicated traits within the boundaries of the entire range and the separate groups was not established and the sample size was insufficient.

FOOD RESOURCES. The absolute domination of brown algae in the upper littoral layer, in our opinion, confirms the lack of balance in these communities as a result (103) of the elimination of sea urchins due to the high density of predators. A similar process developed in the lower contours of the trophic zones of sea otters where a "rejuvenation" and thinning out by the predators of the echinoderm population is displaced at the outer edges or within the limits of the thickets of Alaria.

The composition of their food gives an indication of the elevated density of the population of sea otters (if not the maximum). The remainder of the more preferred form of food according to the occurrence in the food clumps was sea urchins

which make up on the average only a fifth of the part of the masses of the food clumps, whereas their portion in the energy balance of predators is still less. Less accessible and even seasonal food (fishes, crabs and large shrimps) predominate in the diet. We assume that in defined bottom communities there occurs (or originates) a structural variation at the level of the microconsumer giving rise to a prolonged increase in the numbers of sea otters. Here, not only did the species diversity of the communities vary, but the principal relationship between its basic members: the competition between algae and sea urchins---on the commensual fish and algae.

Unfortunately it was not possible to clarify when in a community of laminaria the upper stratum of a co-dominant species (sea urchins) was replaced by another (fishes) and to what degree the given process was reflected in the variation of the animals' diet. It is known that on the Commander Islands directly in front of the beginning depression of the Mednyi population of sea otters starting with 70 animals, a significant deviation was noted from the traditional food composition, and particularly there was a sharp decrease of sea urchins in the food clumps portion and an increase in the portion of bivalve mollusks. Unlike the Mednyi sea otters, in the Urup groups of animals these variations could take place long before a population crisis, combined with a surplus density. It is also possible that the process of changing the composition of the food here is more smooth and was prolonged due to the basic resources being less preferred or a secondary food, which was not noticed in the Mednyi population.

Judging from the above statements the question about the variation of sea otter diets is representative of some kind of phase or reflects one or another stage of the development of a population, presented by us as more important for the development of methods for the operative and complex monitoring of the composition of sea otter resources.

LITERATURE CITED

Kuzin, A.E., M.K. Maminov and A.S. Perlov.
1984. The numbers of pinnipeds and sea otters on the Kuril Islands. Morskie Mlekopitayushchie Dal'nego Vostoka. Vladivostok. TINRO p. 54-70.

Sidorov, K.S., A.V. Zorin and V.F. Sevost'yanov.
1982. Results of the underwater investigations of the food bases of sea otters on the Commander Islands (1979-1981). Izuchenie, okhrana i ratsiional'noe ispol'zovanie morskikh mlekopitayushchikh. Tez. Dokl. VIII Vsesoyuznoe Soveshchanie. Astrakhan', p. 326-327.

Zorin, A.V. 1984. Distributionn of the biomasses of the main food of sea otters on the Commander Islands (results of investigations 1979- 1982). Nauchno-issledovatel'skii raboty (104) po morskim mlekopitayushchim severnoi chasti Tikhogo Okeana in 1982/83. M. VNIRO, p. 68-75.

4.2 POPULATION DYNAMICS AND NATURAL MORTALITY IN THE COMMANDER ISLAND SEA OTTER POPULATION

V.F. SEVOST'YANOV AND I.A. LIPILINA (VNIRO)

The most important ecological characteristics of the composition of a sea otter population are the variation of its numbers and the natural mortality. The biology of the sea otter makes it especially difficult to obtain precise information on these questions.

As in previous years, we determined these indices by methods of sea counts (from ships and motor boats) and fixed stationary observations on the coasts of Bering and Mednyi Islands.

When dead sea otters were found on the shore we took the body measurements and determined the sex and age. The condition of the internal organs was described at the time of the necropsy. Pathological material was taken from recently dead animals. Pieces of tissue were fixed in 10% formalin; helminths in 10% formalin were prepared in a physiological solution (Barbagallo liquid). In addition to the pathological changes in the organs, we took pictures of external, healthy tissue for comparison.

Data are presented in Table 1 on the population dynamics and natural mortality of sea otters which we collected over the past three years. Table 2 presents the age and sex structure of the dead animals.

With the long range forecasting for the development of the Commander Island population of sea otters for the Mednyi group, judging from the capacity of the habitat, we determined the asymptotic level of growth to be 1100 - 1200 animals. During the last three years the growth of the Mednyi group mainly occurred due to an increase of the reproductive potential on the background (105) of established food components of the sea otters in the bottom biocenoses (sea urchins, mollusks and others). In comparison with a periodic depression of the population when we noted the remains of up to 100 dead sea otters, the natural mortality at the present time can be considered to be within the normal range. Thus, the Mednyi group of the Commander Island population of sea otters has practically attained the optimal level and the fluctuation of its numbers relative to this level will be insignificant. There was quite an abrupt increase in the numbers of sea otters on Bering Island in 1985 which we were only able to explain as errors we allowed in 1984 while conducting counts under unfavorable weather conditions. At the present time sea otters are assimilated in all areas suitable for their habitation. Capes Monaty, Tolstoy and North West are areas of the largest concentratiions of these animals: here the numbers of sea otters fluctuates from 150 to 300 animals at each of the indicated capes.

Table 1
The population dynamics and natural mortality of sea otters

Год year	Одиночные животные solitary animals	Самки с детенышами females with pups	Численность популяции number of population	Количество павших каланов, голов no. of dead sea otters	Смертность, % mortality
		На о-ве Беринга* Bering I.			
I983	9I8	I96	I3I0	38	2,8
I984	592	2I0	I0I2/	58	5,7
I985	I357	222	I80I	236	II,6
		На о-ве Медный** Mednyi I.			
I983	467	I35	737	5	0,7
I984	492	203	898	2I	2,2
I985	497	297	I09I	25	2,2

* The natural mortality is expressed in the overall numbers of the population (according to sea count data) and the number of dead animals. Despite the fact that the sea counts were conducted in June and the number of dead animals was taken a year previously, this calculation is proper because in June the death of sea otters almost ceases.

** Data on the number of dead animals on Mednyi Island does not account for the natural mortality because it is only based on the finding of skeletal remains in the summer period on the coastal beaches.

(106)
Table 2
Variation of the age and sex structure of dead sea otters

Год year	Количество павших животных, голов no. of dead animals	Половая структура, % общего количества павших sexual structure % of total no. dead		Возрастная структура, % от общего количества павших age structure % of total no. of dead animals		
		самцы males	самки females	взрослые adults	кошлаки kids	медведки cubs
		На о-ве Беринга* Bering I.				
I983	38	79	7,9	I00	-	-
I984	58	57	I7,0	I00	-	-
I985	236	86	II,C	93	4	3
		На о-ве Медный** Mednyi I.				
I983	5	60	40	I00	-	-
I984	2I	24	I0	I00	-	-
I985	25	36	20	36	64	-

* The sex of the animals was not determinable in 1983 for 13.1%; in 1984 for 26%; in 1985 for 3% of the total number of dead animals

** The sex of animals not determinable in 1984 was 66%; in 1985 for 44% of the total number of dead animals

A large part of the dead sea otters on Bering Island were found close to their winter coastal rookeries, often directly on their territory. The peak of sea otter mortality on Bering Island occurred from February to May; these months are characterized by negative water and air temperatures combined with strong, storm winds on the Commander Islands.

In 1985 on Bering Island the number of sea otter deaths was higher than in previous years caused by a very vigorous winter (frequent and prolonged storms, unusually low air temperatures for the Commander Islands and landfast ice; in March 1985 in a single day the air temperature dropped -15°C, and the average monthly temperature was a -6.2°C, while the average, long-term temperature for this month was -3.1°C.

The main diseases of sea otters on Bering Island were pneumonia and gastroenteritis, associated in many instances with suppurations of bloody transpirations in the cavity, by a proliferation of connective tissue in the lungs along the course of the trachea. These signs occurred in the animals regardless of sex and age (in particular, inflammation of the lungs and enteritis were noticed in female cubs who had died (107) during storms. As a rule, these sea otters were exhausted, and there was no food in their stomach or intestinal tract.

Another common illness of Bering Sea sea otters is paraphimosis. Like the first two illnesses this disease is primarily found in older or weakened animals.

Sea otters are animals with a very high level of metabolic material. This organism requires constant, energetic replenishment. It is evident that in stressful situations (prolonged storms, forced migrations, anthropogenic actions, etc.) that a disturbance of the energy balance occurs and as a result, there is an autointoxication of the important life systems due to a modification of the permeability of the trachea and other processes which are unknown to us. In this case there is a failure of the normal function of the vegetative nervous system (a symmetrical necrosis of the limbs we noticed on Cape Lopatka - a phenomenon of a nerve-trophic character) created due to the condition of the development of a latent stimulus of a microbial or virous occurrence which in turn gives rise to the short-lived course of these diseases such as gastoenteritis and pneumonia.

Our assumptions about the nature of the occurrence and the cause of pathological processes in the organisms of sea otters to a significant degree are hypothetical and require additional verification which we tried to obtain in the process of experiments for the sea otters in captivity.

4.3 INVESTIGATION OF THE FOOD RESOURCES OF KAMCHATKA SEA OTTERS

K.S. SIDOROV (VNIRO) AND A.M. BURDIN (KoTINRO

In July-August in 1985 KoTINRO together with the Laboratory for Underwater Investigations - VNIRO, examined the coastal communities of the Sea of Okhotsk coastline of the Kamchatka Peninsula from Cape Sivuchiy to Cape Lopatka, including the northern Kuril Islands (Shumshu Island and the island volcano of Atlasov - Alaid) and further up to the Kronotskiy Peninsula from the Pacific Ocean side. The overall extent of the coastline examined was approximately 500 nautical miles. Since the time of the investigations done off the side of the vessel, Vityaz from 1949 to 1955 on the inventory of the fauna of the Kamchatka Peninsula (Kuznetsov, 1963) similar extensive investigations were done for the first time with the help of diving methods (108) including photographing the underwater terrain. The examinations were done for making a reconnoitering evalution of the food bases of sea otters by area and clarifying the causes of the significant migration-immigration fluctuations of the numbers of sea otters at the junction of the Kamchatka-Kuril volcanic-tectonic arc, which in the past years accompanied their high natural mortality.

Works done according to a single standardized method of divingestigation were completed in 1979-1981 while studying the food base of the Commander Island sea otters (Sidorov, et al. 1982) from which was taken as a base a method of diving stations and a review of a cross section of waters with depths up to 40 m. Diving sections were marked beforehand on a map, at sites where sea otter accumulations had been noticed and also for a comparison of sites where there were none. The number of stations in each section was determined in processing the works depending on the relief and character of the sea bottom.

Along with the underwater observations we examined the littoral zone and the storm-tossed flotsam of macrophytes and the zoobenthos in it. At the stations the necessary hydrological measurements were done and samples of plankton were removed from the upper 10 meter water layer for clarifying the population dynamics and the subsidence period of the larvae of the masses of species of sublittoral invertebrates. In order to control the sampling catch we set up two crab catchers and made a controlled catch. Also taken at the same time were water samples, algae, plankton, food objects of sea otters and also tissue from dead sea otters and birds for determining the content of rare-earth and heavy metals. During the investigation period from 25 July to 15 August, 25 dives were done which included 56 diving stations. We examined up to 80 km. of the littoral zone on foot.

We divided the coast of the Kamchatka Peninsula into the following regions according to the degree of protection from unfavorable environmental factors (hydrometeorological conditions, seismic activity and tsunamis) and the existence of acceptable food objects for the sea otters.

I. Southwest Kamchatka, where from Cape Lopatka to Cape Sivuchiy at the time of the spring counts in 1985, huge groups

of sea otters were counted (up to 400 animals) with a total number higher than 600 animals. We described the area found on the back side of the Kuril-Kamchatka volcanic tectonic chain as characterized by low seismic and tsunami activity which facilitates the accumulation of the soft, sedimentary sea bottom and the clusters of developing infauna. Vast, sandy beaches extend for many miles from the Lopatka Reef to Cape Sivuchiy (the outer (109) point of a group of sea otter accumulations along the west coast) occasionally it is interrupted by spurs of the Kamchatka mountain range which outcrops into the sea as rocky capes (Capes Campbell and Sivuchiy). The sides of the range act as protection for the area of Campbell Bay and Maria Bay from hurricane winds (up to 5-0 m/s) from a northern and northeastern direction, which are prevalent south of the Kamchatka Peninsula in the winter and which aid the build up of the abundance of sediment (up to 2000 mm) and with it the biogenous elements of volcanic origin.

During the period of our investigation the bottom communities of the southwestern coast of the Kamchatka Peninsula were depleted as was the group of sea otters themselves (about 50 animals). Due to the prevalence in the sublittoral of a sandy sea bottom, covered with a brown film of diatomaceous overgrowths which is the most dominant position occupied by the biocenosis of sand dollars Echinarachinius parma and Natica clausa (up to 200 g/ m^2 while sea urchins were represented only by large individuals (over 10 years old) with a carapace diameter of more than 75 mm.

The largest feeding communities of the solid sea bottom were supplanted by sand in the uppermost layers of the sublittoral, in the areas of the rocky capes and underwater ridges where the dominant species were Mytilus edulis, Littorina sitchana, L. kurilla, and Acmea cassia. Mussels occurred in a narrow, discontinuous band with accumulations of biomasses (from 1 to 3 or 4 kg.) from the northern part of Cape Campbell to Cape Sivuchiy where they go down into the sublittoral zone to depths of 2 to 3 m. forming a rather thick colony above a brush of barnacles (Balanus cariosus). During storms the brushes with other mussels are easily peeled off the rocky substrata, entering the surf which easily serve as supplemental food for the sea otters. The size of the mussels (from 3 to 7 cm.) increases in a northern direction. The not abundant, but adequately thick fields of Alaria fistulosa were confined to the rocky capes and mainly to the area of Campbell Island where from the very deep southern sides on the rocky chain one goes toward the zero point depth, completely replacing the zone of mussels and barnacles. Communities of brown algae (Alaria sp. and Laminaria sp.) like the Commander Islands are characterized by low feedability (10 grams per $1m^2$) available as objects (Modiolus, L. sitchana, Telmessus sp.) for the sea otters. The largest biomass of feeding benthos (100 - 200 g/m^2) was concentrated at depths from 12 - 13 m. in a narrow boundary zone (approximately 15 m. wide) of algae and sedimentary soil with sand and hermit crabs (up to 40 - 50 individuals $/m^2$) amd other stone crabs.

(110)

Here there were gobies and sculpins (Myoxocephalus). The preferred food for sea otters was sea urchins of the genus Strongylocentrotus, as on Kamchatka, as well as king crab (Paralithodes camtschatica and P. brevipes) which occurred singly

along the entire southwestern coast. A small accumulation of flounder (Pleuronectidae) was only found in the northern part of Campbell Bay. King crab were found there in the surf (depth of 2 - 3 m.) (the carapace size was 5 to 7 cm).

The absence of brittle stars was noticed in the entire area particularly absent was the common, indicator species Ophiopholis aculeata, and also the very abundant (up to 2 kg/m^2 for all of western Kamchatka representative infauna of the mollusks Siliqua alta, Spisula, Mya sp. and Piranidia (Neiman, 1969). At the time of numerous storms their shell are discharged into the littoral, especially in the area of the Western rookery of sea otters, which led us to assume the existence here of a sufficiently abundant infauna of bivalve mollusks which are available to the sea otters (mollusks burrow into sediment up to 0.5 m.) only during the period of winter storms due to the erosion of the sandy bottom at depths greater than 10 - 15 m. or because of the departure of most of the mollusks to the upper sediments with earthquakes and winter kill (asphixiation of aquatic animals) in the benthic layer.

Significant fluctuations of the surface waters temperatures (12 - 13°C) during a flood tide and 5 - 7°C during an ebb tide) causes an intensive off and the removal here of both the littoral plankton of the Kamchatka Peninsula, due to the "carrying away of carcasses" and one obtains the luxurious development of the fauna of mollusks - seston eaters. However, the abundance of cold-killed organisms in the benthic layer, especially in abnormally warm and sunny years (for example the summer of 1984) can lead to a vigorous, catastrophic die-off similar to the die-off in the area of the Peruvian upwelling. On the bottom we found a large number of remains of mollusk shells filled with black, silty sands with the odor of hydrogen sulfide, which confirmed the occurrence here of a recent tragedy. It is possible to explain this by the paucity of food resources for the sea otters in this area, including the abnormality in the approach to spawning of some commercial objects (salmon, flounders and crabs) during the investigation period.

On the whole the southwestern coast of the Kamchatka Peninsula according to food and protective features should be regarded as a seasonal habitation site for sea otters; the ability to maintain a large feeding load for a numerous population only in periods favorable to these hydrodynamic conditions (storms) or in an period of a mass movement of anadromous, commercial fish and crustaceans.

(111)

Southeastern coast of the Kamchatka Peninsula including Shumshu Island, where the numbers of sea otters can fluctuate from several hundreds to several thousand animals. In the area encompassing the coast from Utashud Island to Cape Lopatka, is included the northeast coast of Shumshu Island, which itself represents a frontal side of the Kuril-Kamchatka volcanic tectonic arc which in addition to the maximal, oceanic breakers, experience maximum waves from seismic shocks.In connection with this the coast nearly has the form of a straight line and is devoid of sheltered bays. Spurs of the east Kamchatka range, serving as a watershed for the numerous streams here, smoothed by capes falling off into the ocean and going further into the sea in the form of underwater ridges, platforms and dikes which form wide shallow waters with a

complex mosaic of rocky ground. The bouldery-coarse gravel littoral is represented by a poor composition of species which are native to the oceanic heavy surf of the coast. In separate parts there are well expressed "dead zones". A mussel zone is nearly absent. At the same time the marine snail L. kurilla can reach 2 - 3 kg/m^2 in the concealed biomass. In the sublittoral down to depths of 20 m. a biocenoses of laminaria is distributed. A thin field of A. fistulosa occurs along the length of the entire coast at depths from 5 to 14-15 m. forming dense accumulations only in the areas of Utashud Island, Gavrushkin Rock, Three Sisters and the southeast coast of Shumshu. The field of algae due to the appearance in them of winter kill (Sidorov, 1982) has a low level of feedability like the southeast coast. The few lenoks and greenlings (Hexagrammos and Pleurogrammus) are found only in the limits of the algae. The numbers of these fishes increases in the Kuril Straits where the laminaria is washed by the colder waters of the Sea of Okhotsk which is obstructed by winter kill.

Sea urchins particularly Strongylocentrotus polyacantus is distributed everywhere from the boundaries of dense thickets of laminaria where in the interval of the depths from 15 - 20 m. the biomass comprises from 450 to 80-100 g/m^2. These indices are not large, however, considering the vastness of the shallow waters which extend to distances three miles from the coast, the general stock of sea urchins can be considered to be significant, despite such negative factors as the presence of sea otter predators and the presence in the preceding period of unfavorable conditions for the settling of larvae. The latter is confirmed by the predominance in the samples of sea urchins of medium sizes (30 - 40 mm) and the near absence of juvenile accumulations in 1984-1985.

We did not find powerful shoals of Modiolus and Mytilus from biomasses up to 10 kg/m^2 and more were described for this area by A.P. Kuznetsov (1963) (112). Exceptional accumulations (up to 10 individuals /m^2 were only seen for the northern oyster (P. macrochisma). Modiolus and mussels were seldom found in the rhizoids and sometimes on the the stems of laminaria while rising over the level of the bottom. On the sandy bottoms the dominant biocenoses of sand dollars, E. parma was more abundant further north of Cape Gavryushkin rocks in the direction of Vestnik Bay (biomass of 800 - 900 g/m^2). Here we noted accumulations of sand lances (Ammodytes hexapterus) (5 - 6 individuals/m^2) and juvenile flounder (sizes of 10 - 15 cm.) Live mollusks were also not encountered in Vestnik Bay.

Along the entire area we noticed the low transparency of the water depending on the increased organic contents suspended in the water mass at depths of 5 to 20-30 m. It is likely that a consequence of this is the outburst of the number of amphipods from the family Corophiidae, which form its dwellings from organic residues.

The controlled catch at the coast indicated the absence of crabs and fishes in the indigeneous places of their habitation. There were no crabs at Kurbatova Bank where they were caught in June 1985.

Along the northeast coast of Shumshu Island, from Cape Kurbatova to Cape Pochtareva, along which is carried out the warmer and more productive water from Maria Bay (1st region) in the coastal, shallow-water zone from the water line to the reefs with dense fields of sea cabbage, we saw a strong winter kill. The water temperature reached 15 - 16 °C, the water was characterized by a large organic content and an intensive production of hydrogen sulfide, its color varying from coffee-brown to black. The littoral, especially in the area of Cape Pochtareva, with the shells of dead mollusks and acorn barnacles on them were uniformly covered by a black layer of sulphuric iron sulfide. We found carcasses of sea otter here. The indicated winter kill likely was extended by the probable winter-kill phenomenon in Maria Bay, whose flow of water here is fed from the many fields of sea cabbage. As a source of additional eutrophication of the coast of the northern Kuril Islands one can consider the abundant carrying away of biogeneous and toxic elements from numerous hydrothermal sources and rivers from the Sea of Okhotsk side. The plentiful biogeneous elements and the higher temperatures of the warmed-up coastal water stimulates the vigorous growth of the fields of algae, particularly from the Pacific coast side. Further out to sea, beyond the boundaries of the algae fields, we noticed groups of sea otters (about 350 animals) including females with pups.

Despite the somewhat depressed condition of the coastal communities the food resources in this area due to the vastness of the shallow water zones (113) beyond the limits of the Alaria fields were found to be in a satisfactory state and were a means to suppport the press of a significant number of sea otters. The concentration of sea otters into larger groups and their temporary departure from this basic feeding zone was rather more connected with the seismic conditions than with the depletion of the food resources.

3. The volcanic island of Atlasova Alaid. We only examined the east coast of the island-volcano of Atlasova which is located in the Sea of Okhotsk, 40 km. to the west of Shumshu Island. The steep, underwater sides of the volcano contribute to the rise of deep, cold water and the extreme low (2 - 3°C) temperatures even in the summer inhibit the blooming in the water because here the transparency exceeds 15 - 16 m. A narrow zone of laminaria presses towards the upper line of the sublittoral which here is dominated by a biocenosis of the sea urchins, S. polyacanthus (a biomass of 3.5 to 4.0 kg/m^2 and as prevailing sizes of carapaces of 70 - 80 mm.). Perhaps in this unique place on the Kamchatka Peninsula and the Commander Islands where, as with the Near Islands (Attu Island) in the Aleutian chain (Charles et al., 1978, the population of sea urchins "controls" the algae communities on the coast. Among the algae and rocks there are rather numerous greenlings (Hexagrammos) and beginning with depths of 7 - 8 m. a biocenosis of gigantic sea anemones (Metridium senile) is dominant and crayfish and hermit crabs.

Since 1972 Alaid has been in a state of constant activity, manifested in explosive ruptures and a series of valcanic earthquakes; it is probably why we did not find sea otters or other marine mammals in the water area of the island.

4. East-Central Kamchatka. In this region there is a vast territory between 52° and 56° including the Kamchatka Peninsula. The areas of our investigation in a northern direction were limited by the last points where grouped accumulations of sea otters occurred, namely, the southeastern part of Kronotskiy Peninsula, where for some time past there was supported a group of sea otters of about 300 animals (according to a report from the director of the Kronotskiy Preserve, A.S. Alekseev). In the region of three wide, rather shallow waters bays (Avachinskiy, Kronotskiy and Kamchatskiy) which is dominated by a distribution of the biocenoses, E. parma, and by a dispersion distribution of its biomass from 200 to 800 g/m^2. The most favorable feeding and weather conditions for sea otter's habitation are confined to the southeastern end of the Shipunskiy, Kronotskiy and Kamchatka Peninsulas. However, particularly toward the underwater eastern terminus of these peninsulas basically is a confined thickening of the epicenters of enough parts for the Kuril-Kamchatka focal zone of earthquakes, and having here bays of the fjord type (Morzhovaya Bay) which increase the tsunami danger.

(114)

We found the most uniformly distributed biomass (more than 6 kg/m^2 of the sea urchins, S. polyacanthus, in the east section in the area of Cape Ostriy north of the mouth of Kozlova River to the boundaries of the dispersed algae, Alaria fistulosa and Thalasiophyllum clatrum. A mass of separate sea urchins reached 450g. with a diameter up to 120 mm. In addition to sea urchins, in the assemblages there were sea slugs (Doridiдae) and sea cucumbers (Cucumaria japonica) and brittle stars.

South of Cape Kozlova (Section 22) water temperatures increased up to 10°C, its transparency dropped to 6 - 7 m. and the biomass of sea urchins was sharply reduced to 600 - 800g/m^2 with some increase of the biomasses of sea slugs (up to 300 g/m^2) and brittle stars. The biomass of sea urchins can be reduced both due to being eaten out by sea otters and due to a worsening of the environmental conditions which are connected with the river flow.

Further in a direction of the closed part of Kronotskiy Bay, in Ol'ga Inlet, the temperature rises up to 14 - 15°C and the water transparency due to the large amount of suspended, starting from depths of 5 m. and towards the bottom (10 - 15 m.) decreases towards Naoshup' Island and it picked up types of valves from dead mollusks and carapaces of stickleback crabs with a strong odor of hydrogen sulfide. The zone of dead animals was located far to the south up to Kupanovo village and at considerable distances from the shore to depths of 20 - 25 m. In those months when the visibility permitted (less than 0.5 m.), we noticed a black suspension in the demersal layer of carapaces of dead mollusks and the remains of sea urchin disks. Living E. parma were only found a considerable distance from shore (about 2 miles) beyond the 25 m. isobath.

The oxygen content in the surface layer (data from Kronotskiy Reserve co-worker, P. Sarychev) forming a 30% saturation, was sharply reduced to a trace (about 5%) at depths of 10 m. and dropped to 0 in the demersal layer at depths of 15 m., where hydrogen sulfide was present (0.5 mg/l.). Deeper than 30 m. the saturation of the water with oxygen again was reduced to 100%.

In the littoral in the middle part of Kronotskiy Bay (Semyachik liman) we observed a massive growth of coastal Calanus in the form of an extended belt.

Winter-kill from the blooming water appeared in Morzhovaya Inlet where it was recorded to depths of 5 - 6 m. even though it was found in a depressed condition the abundant sea urchins S. droelachiniensis (up to 2 kg/m^2) and mollusks of the family, Cardidae were lying directly on the surface of the bottom, but at depths of 10 - 20 m. there were many dead stickleback crabs and snow crabs (Chionoicetes), and also bivalve mollusks from the families Cardidae and Myidae.

(115)

At the time of our previous visit to the inlets in September 1980, it was literally clogged with juvenile mollusks and snow crabs with carapace sizes of 3 - 4 cm. The water transparency in the inlets was good (8 - 10 m.). At the actual time the bottom was covered with dead snow crabs with sizes of 12 - 15 cm. and the water thickness was filled with organic suspended matter (visibility less than 0.5 m.) in the demersal layer. Crabs which had gotten trapped in this zone lost motor activity and died at the entrance to the inlet, at depths of 30 m. the horizontal visibility again increased, we noticed groups of accumulations (up to 10 - 15 individuals) of stickleback crabs with a weak, defensive reaction. The same picture was observed in other inlets of a similar type.

The good and rather stable food base in this region was mainly concentrated in areas of peninsulas, however, it could be utilized more easily only by nomadic groups of sea otters, since with the exception of the southern part of the Kronotskiy Peninsula, here there was no clearly protected feeding places in the winter which is the most important period for sea otters.

Conclusions

A study was done for the first time of the Kamchatka population of sea otters. There was an underwater examination of its food resources with the help of divers down to depths of 40 m. Despite the reconnaisance character of the investigation new data were obtained about the conditon of coastal associations of the Kamchatka Peninsula, which were significantly different from the last hydrological report on this area covering a 50 year period. The outlined plan continued a more detailed investigation on the given region with mapping and an evaluation of the feeding area.

The vast winter-kill phenomenon discovered on the coast of the Kamchatka Peninsula had an adverse effect primarily on the fauna of closed inlets, clearly warmed up shallow waters with dense brown algae i.e., a place which plays a significant role in the reproduction and foraging of the young of many commercial objects, including the food objects of sea otters.

The recurrence and extent of the winter-kill phenomenon on the shores of the Kamchatka Peninsula, like the Commander Islands, we related to the periodic explosive activities of the volcanoes of the Kuril-Kamchatka arc. We separated out four tupes of coastal

habitat sites for the Kamchatka population of sea otters which were charcterized by different degrees of seismicity and the security of food.

LITERATURE CITED

Kuznetsov, A.P. 1963. Benthic, invertebrate fauna of the pre-Kamchatka water of the Pacific Ocean and northern Kuril Islands. M. Izd. AN SSR. 320p.

Neiman, A.A. 1964. Benthos of the west Kamchatka shelf. Trudy. VNIRO. v.65:223-232.

Sidorov, K.A. 1982. The affect of volcanic activity and solar-atmospheric connection on the ecosystem of the Commander Islands. 8th All-Union conference on the study, preservation and rational use of marine mammals. Astrakhan. 5-8 October. 1982. Astrakhan. p. 322-324.

Sidorov, K.S. 1982. The role of volcanism and cyclonic activity in the formation of the bottom communities of the Commander Islands. Scientific-technical, "The use of physical irritants in the development of the marine fishing industry". Klaipeda, April, 1982 Moscow. PMV. VNIP. p. 83-84.

Simenstad, C.A., J.A. Estes and K.W. Kenyon. 1978. Aleut sea otters and alternate stable-state communities.ßcience 200 (4340).

TABLE OF CONTENTS

21.III.90