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On the basis of a comparison of walrus abundance at the Verkhoturov rookery at the beginning of June (about 2000 walruses) and at the end of August (up to 6000), one can hypothesize that two-thirds of the Kamchatka walruses participate in the breeding process. The rest of the animals overwinter in the Khatyrka—Navarin area, gradually moving southward with the ice drift. It is these walruses that become part of the experimental harvest, though the effect of selectivity is not excluded (see A.A. Kibalchich. Age and sexual structure. Areas of walrus hunting and the reproductive condition of the Pacific walrus. IN: Conducting Surveys of the Pacific Walrus. Moscow: VNIRO, 1985, p. 27—43).

Migrations of the Pacific walrus and the dynamics of its abundance at hauling-out grounds

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This study is based on our own observations of 1983—1985, hydrological data on the ice surveys of the Pevek Hydrometeorologic Administration, as well as data from the literature.

Migrations. Many researchers mention the seasonal habitats of the walrus, and, therefore, the migrations of these animals northward (from the Bering Sea to the Chukchi Sea) in spring, and southward in autumn (Nikulin, 1940; Krylov, 1968; Fedoseyev, Goltsev, 1975; Fedoseyev, 1984). Using the results of aerial surveys, S.Ye. Belikova, Yu.A. Gorbunova and V.I. Shilnikova (1984) conducted a detailed study of the northward migration of walruses by month for 1971—1979.

Based on the ice surveys for 1984—1985, walruses were noted in the open sea in the area between St. Lawrence Is. (USA) and the Bering Strait in February, March and April. Twenty walruses were noted here in February 1985, 51 walruses in March, and one walrus in April. As we know, the main walrus groups are found much farther south during these

months, i.e. at 57°—62° N. lat, in the vicinity of the southern ice edge (Fedoseyev, 1982). At the end of March—April, large congregations of walruses were noted simultaneously in the Anadyr Gulf and north of St. Lawrence Is. In April 1984, 7 groups and more than 1500 walruses were spotted in the Anadyr Gulf from aircraft. At the same time, 5 groups and 320 walruses were seen south of the Bering Strait. Eleven walruses were encountered much farther north of the Bering Strait, at 68° N. lat. At the same time, 3 groups and 51 walruses were noted in the open sea at 58° N. lat. 750 km southeast of Cape Navarin.

According to our observations, the migration of walruses in the Chukchi Sea continues in June, July and August. During these months, the animals continue to leave the rookeries of the Anadyr Gulf. The migration of walruses eastward has been noted by sea hunters in the coastal villages of southeastern Chukotka—Enmelene, Nunligrane and Sirenikakh.

Therefore, the "spring" migration northward extends over a time period of 5—6 months (from March—April to August) and a geographic distance of 1500—2000 km (this distance separated the northernmost and southernmost groups of walruses in April 1984). The largest congregations of walruses in the vicinity of the Bering Strait were observed in May—June (Belikov et al., 1984). According to the observations at the rookery on Arakamchechen Is. located 160 km south of the Bering Strait, the "autumn" migration begins during the third 10-day period of August. From 1983 to 1985, the approach of the walruses from the north was noted within a short span of time, from August 26th to August 31st. On 29 August 1977, the walruses approached from the north (Kibalchich, 1978). According to our observations, the approach of the walruses from the north took place on 26—28 August in 1983, on 27—28 August in 1984, and on 30—31 August in 1985. The 1985 observations in the Chukchi and Bering seas in the vicinity of the Bering Strait from vessels and helicopters showed that the mass migration of walruses from the north took place in October—November, and continued possibly in December. Large congregations of walruses were noted on the ice in the coastal zone from Cape Serdtse-Kamen to Cape Inchoun on 27—28 October (10,000—15,000 walruses counted); hundreds of walruses were noted in the Bering Strait from a helicopter from 31 Octrober to 7 November; from 2000 to 3000

walruses in two groups were spotted from a helicopter on young pancake ice southeast of the St. Lawrence Gulf on 21 November. These periods of migration coincide with the hydrologic data of ice surveys and the data of S.Ye. Belikov et al. (1984) on the Bering Strait area. The "autumn" migration in the Bering Strait area probably ends in the middle or at the end of December.

Therefore, the period of the "autumn" migration lasts for about five months. As a result, the Pacific walrus population spends about 10 months in migration; during this time, a large part of the population covers long distances. If we take the Bering Strait as a reference point, two waves of intensive migration of walruses are noted here annually, northward in spring (May—June) and southward in autumn (October—November). The organization of annual observations in the Bering Strait will enable us to verify the periods and intensity of the seasonal migrations of walruses. The migration of walruses to the Chukchi Sea for the summer is attributed by researchers to their strong attachment to the ice, especially the females and their pups (Fedoseyev, 1982). Our observations at hauling-out grounds in 1983—1985 and the observations of Kamchatrybvod inspectors (Pinigin, Pryanishnikov, 1975) have shown that in summer, with the disappearance of ice on the Bering Sea, a large number of walruses remains in the coastal zone and haul out at rookeries in the Karaginski Gulf off Kamchatka Peninsula, at rookeries in the Anadyr Gulf (Russkaya Koshka, Meyechkin sand bar, Redkin sand bar), and at rookeries in the vicinity of Bering Strait (Nuneangan Is., Arakamchechen Is.). The total number of walruses living here in summer (July—August) has been estimated at 50,000—60,000, 30,000—40,000 of these being females and their pups. In August 1985, females constituted about 68% of the total numbers at the Meyechkin rookery, and about 50% in August and about 80% in June at the Redkin rookery. At the rookery on Arakamchechen Is., the females and pups constituted from 0.2% to 1.0% of the total numbers at in 1984—1985. Female walruses predominated in the harvests of the hunting villages of the Anadyr Gulf. This points to the signficant quantitative and qualitative changes in the population of the Pacific walrus.

These observations have revealed the previously unknown capacity of walruses to form large permanent coastal rookeries at which females and their pups predominate. Permanent, temporary and sporadic walrus rookeries have been described in the literature (Goltsev, 1968). All this points to the fact that ice is not a compulsory factor in the life of walruses during the summer—autumn period. We assume that the Pacific walrus population could spend the entire year in the Bering Sea. All the conditions necessary for this exist there, namely vast shallow areas with depths up to 100 m in the northern and eastern part of the sea (the area of these shallow parts with an isobath limited to 100 metres covers approximately 600,000 km^2, which is about 1.5 times greater than the 100-metre-deep area of the Chukchi Sea. The distribution of walruses in the Chukchi Sea is restricted by the ice conditions). The shallow waters of the Bering Sea abound in feed for walruses, as well as islands and other places that are suitable as hauling-out grounds during the ice-free period, where the walruses, including the females and their pups, form their rookeries in summer. Nevertheless, a large part of the walrus population, which numbers over 300,000 at present, migrates annually to the Chukchi Sea. Seasonal migrations took place earlier, when the population consisted of only 50,000 individuals (Krylov, 1968). We believe that the seasonal migrations of the walrus can be explained by their origin. Ye.M. Anbinder (1978) believes that walruses similar to the present-day species found their way into the northern part of the Pacific Ocean via the Arctic Basin.

Dynamics of walrus abundance at hauling-out grounds. Observations at the rookeries of Arakamchechen, and the Redkin, Meyechkin and Russkaya Koshka sand bars (Fig. 1) during the summer—autumn months of 1983—1985 have shown that the walrus numbers at the rookeries change with a certain cyclicity. Twelve peaks of abundance were noted on Arakamchechen Is. from 1 July to 20 September 1983. The time interval between the peaks of abundance is from 3 to 8 days (5.77 days on the average). In 1984, the peak of abundance set in at intervals of 5.75 days on the average (observation period from July 14th to August 28th), and in 1985 every 5.70 days (observation period from July 12th to October 4th). These figures were 5.1 days and 6.0 days in 1984 and 1985 respectively

for the Redkin sand bar, 6.1 days in 1985 on the Meyechkin sand bar, and 7.6 days in 1985 on Russkaya Koshka.

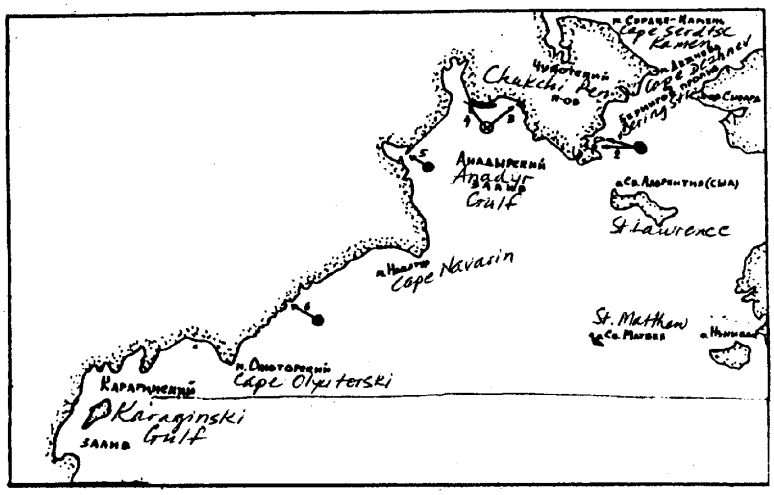

Fig. 1. Walrus rookeries in the Bering Sea in August—September 1985:

o - rookeries with females predominating;
● - male rookeries: 1 - Arakamchechen Is., 2 - Nuneangan Is., 3 - Redkin sand bar, 4 - Meyechkin sand bar, 5 - Russkaya Koshka, 6 - Bogoslov Is. in Natalia Bay

A particularly distinct rhythmicity of minimum and maximum walrus numbers rookeries was observed on Arakamchechen Is. in July—August. During this period, the peaks of abundance were noted every 5—6 days. The minimum walrus numbers at the rookery showed the same periodicity. Subsequently, the rhythm was greatly altered by storms. By comparing the graphs depicting the dynamics of walrus abundance at all four rookeries in 1985, we can see that they are generally identical at all four. Opposite phenomena were observed twice in August. The first time was from the 15th to the 20th of August, i.e. a mass approach reaching maximum numbers took place at the Arakamchechen, Redkin and Meyechkin rookeries, followed by the departure of the animals into the sea, while at the same time, the numbers decreased and then increased at the Russkaya Koshka rookery. The second arhythmic period occurred on August 21—25. i.e. the maximum number of animals appeared at the Arakamchechen and Russkaya Koshka rookeries, and the lowest number at the Meyechkin and Redkin rookeries. During the rest of the observation periods in July—September 1985, the walrus numbers at the four

rookeries fluctuated roughly in synchronism. Comparing the dynamics of walrus numbers at the four rookeries, we should take the following into account: 1) the great distance between the rookeries (Fig. 1); 2) the significant differences in the composition of the animals hauling out at these rookeries; 3) the highly significant differences in the local weather conditions. With these conditions in view, the synchronism of walrus activity in a vast area of water evokes an even greater interest (Fig. 2).

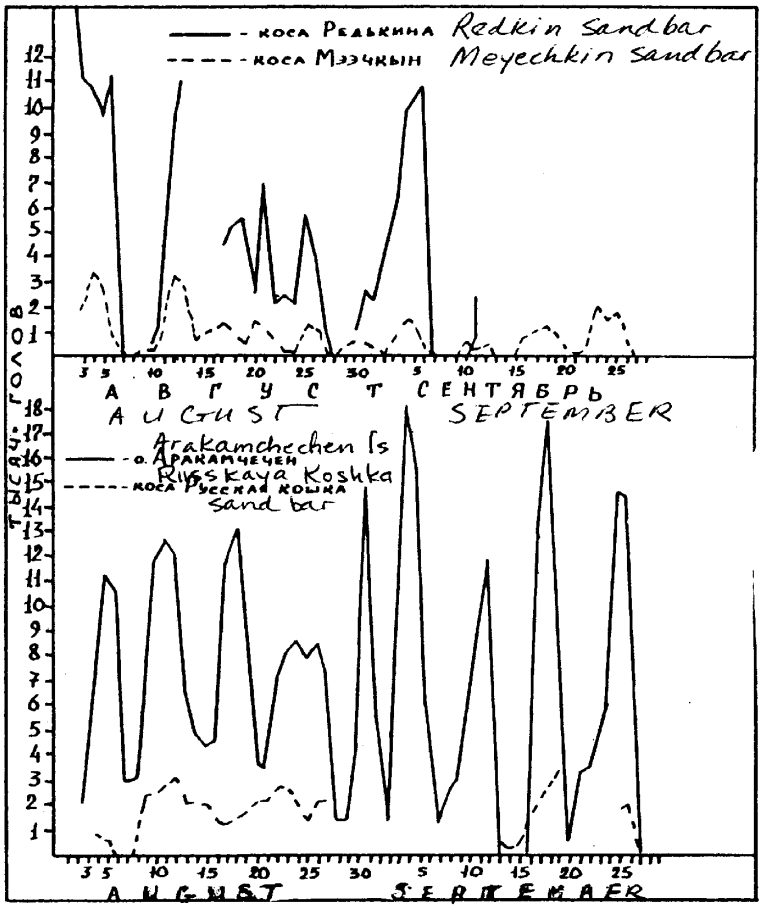

Fig. 2. Dynamics of walrus abundance at the rookeries of the Bering Sea in August—September 1985

Daily activity. In 1985, the surveys of walrus abundance at all four rookeries were carried out twice daily, in the morning and in the evening. Based on the example of the Arakamchechen rookery, we established that 64% of the peaks of walrus abundance at the rookery come in the evening, and 36% in the morning. Having divided the observations into two periods (the calm period from12 July to16 August, and the period of regular and intense storms from17 August to 30 September), we obtained a more

detailed picture [a sentence or two is missing in the Russian text; the missing sentence ends with the words ....38%, evening 62%. - transl.]. During the second period, the morning peaks of abundance amounted to 33%, and the evening ones to 67%. Therefore, regardless of the significant changes in weather conditions, the peaks of walrus anundance at the rookeries in two out of three cases come in the evening.

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