THE DISTRIBUTION AND MIGRATIONS OF WHALES IN THE NORTHEASTERN PART OF THE PACIFIC, CHUKCHI, AND BERING SEAS

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A study of the distribution of the individual whale populations and their migrations is of great significance for organizing and carrying out whaling. As a result of expeditions and scientific-exploratory work over many years in the region of Japan, the Kurile and Commander Islands, as well as in the western Bering Sea, the distribution and migrations are well known for the so-called Asiatic populations that arrive for the summer season in these regions (Zenkovich, 1934, 1937; Tomilin 1937, 1957; Sleptsov, 1952, 1961, 1961a; Klumov, 1956; Omura, 1955, 1958; Nasu, 1957; Nemoto, 1959, and others). The protracted whaling of the basic species over a relatively limited region has led to a certain depletion of their stocks: by 1955, the Commander-Kamchatka regions began to lose their whaling significance (Berzin, 1959). Even earlier, as a result of the destructive catching of whales by foreign whalers, the Okhotsk region had completely lost its importance (Klumov, 1955).

The whales from the American population coming for the summer period into the Aleutian waters of the Bering Sea and the Pacific began to be caught basically only from 1952–1954 with the introduction initially of one and then a second Japanese fleet. In 1957 and 1958, the Soviet whaling fleet began to tap the regions off of Kamchatka, and

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also began to successfully whale in the Aleutian waters. At present, all of the pelagic whaling fleets hunt basically the whales from the American populations.

However, in Soviet and foreign literature, there is virtually no such material on the distribution of whales in the region of Alaska and over the entire northeastern part of the Pacific. The expedition of the Institute of Oceanology under the Academy of Sciences and TINRO in 1951–1956 made only two trips into the Bering Sea, having given basic attention to the Kurile waters. The results of these trips on studying the distribution of cetaceans have not been published except for the small review of S. K. Klumov (1956).

Regular scientific-exploratory work by TINRO began in 1958 from the regions directly off the whaling areas of the "Aleutian" whaling fleet, i.e., from 180º moving gradually to the east. In 1958, the Aleutian waters and the western shore of the Bering Sea were investigated; in 1959, the western part of the Gulf of Alaska, the zone of the continental dropoff of the Bering Sea and the southern part of the Chukchi Sea; in 1960 and 1961, all of the Gulf of Alaska and the Aleutian waters; in 1962, the Aleutian Islands, the Gulf of Alaska, the Pacific coast of North America as far as Vancouver, the Bering Sea and the Chukchi Sea up to 76º N lat.; in the autumn of 1963, we covered the coast of North America from 47º N lat. down to 35º N lat.

Beginning with 1961, regular trips were made during the winter season for discovering the wintering regions of the whales, and the annual cycle was completed for observing the whale distribution. During the winter of 1963–1964, the vessels "Birokan" and "Vazhnyi" carried out scientific exploration from 35 to 20º N lat. and from the Hawaiian Islands (155º W long) to the shores of California. This was the first Soviet research in the proposed areas where the whales of the American population winter.

Observations on the whales from the scientific-exploratory vessels of TINRO in the various years were carried out by V. A. Arsen'ev, N. P. Petukhov, E. A. Tikhomirov, V. M. Latyshev, V. I. Toinin, A. V. Slakon, V. I. Uvarov, and the authors of the present work.

The results of the expeditions of 1958–1959 were published by A. A. Berzin (1959) and V. A. Arsen'ev (1961). These results have been used in certain instances without citing the authors. The remaining materials are published for the first time.

In the present work we have utilized materials from more than two decades of trips made by the scientific-exploratory vessels of TINRO, the material from the scouting vessel of the Administration of the Whaling Fleet, with a scientific group on board, data from whaling by the whaling fleet in 1962–1964 to that degree that the data have clarified and supplemented the scouting data, as well as the logs from whale observation which have been kept on the whaling vessels during the period from 1958 through 1964. The original materials on observing the distribution of whales obtained on the "Vladivostok" whaling base were most kindly made available to us by the scientific coworkers N.V. Doroshenko and M. N. Tarasevich. The data on the distribution of whales in the northeastern part of the Pacific Ocean obtained by us virtually do not depend upon the degree of study on the body of water. The exploratory tacks and the work of the fleet covered virtually all regions of this part of the ocean, and the character of the whale distribution was determined only by the ecological factors and environmental factors.

A description of the whale distribution will be given for the individual species. The distribution of the whales from the Asiatic populations will not be taken up here,

except for those instances when their relationship to the whales from the American population is being investigated.

The Sperm Whale (*Physeter catodon*)

The sperm whale is the basic commercial species in whaling. Nevertheless, the data on the distribution in the Northeastern Pacific Ocean merely indicate the killing of it by the coastal and pelagic whaling bases (Pike, 1954; Tomilin, 1957; Rice, 1963). The waters of the Aleutian Islands and the Bering Sea in this regard have been more studied, but here information on the distribution of sperm whales is limited merely to general descriptions with an indication on the encountering of whales in one or another region (Tomilin, 1936, 1957; Zenkovich, 1937; Sleptsov, 1952; Klumov, 1956;Nau 1957; Arsen'ev, 1961; etc.).

The recent insignificant hunting of sperm whales off the Pacific shores of North America and the lack of study on the habitat of the females from this population led A.G. Tomilin (1957) to propose that there are fewer sperm whales in this portion of the ocean than off the Asiatic shores. The widening whaling of this species with the pelagic fleets and establishing the regions and density of the female accumulations show the abundance of the sperm whales in these populations.

The southern boundary for the distribution of the sperm whales passes through the equatorial regions of the Pacific. The northernmost point for encountering them is in the region of Cape Navarin, approximately 62º N lat. According to the data of M. P. Vinogradov (1949) and V. A. Arsen'ev (1961), the sperm whales are encountered in the

more northerly regions, in particular at 64º N lat., but the reliability of these instances causes some doubt. A. G. Tomilin (1936, 1957) and H. Omura (1955) set the northern boundary for the distribution of the sperm whales from Cape Navarin to the Pribilof Islands. Our abundant data substantiate this.

But, as is known, in contrast to the other cetacean species, the sperm whale shows a difference in selecting the habitat for the males and females, and if the distribution of the males in the Northeastern Pacific has been to some degree studied, very little is known about the regions of the summer habitat of the females. According to the observations of recent years, the northern boundary for the summer range of the females and the young sperm whales lies in the southern part of the Gulf of Alaska, approximately along 50–51º N lat. (Fig. 1). Within the range, the harem sperm whales are distributed unevenly. In the given region, one can establish several areas where the whales are concentrated. The basic mass accumulations of sperm whales are located on a line from 38º N lat. and the 142º W long. northeast up to 45º N lat. and 135º W long., and then northwest along 50º N lat. as far as 138º W long., and then west with a slight extension north up to 52º N lat., and 148º W long.

The largest concentration of schooling whales has been observed in a region with a center at 50º N lat., 138º W long. Another strip runs from 42º N lat., 140º W long., northwest up to 50º N lat., 154º W long. Moreover, a large accumulation of female sperm whales has been noted in the region with a center at 41º N lat. The density and the number of female sperm whale accumulations with young gradually drop to the west.

Out of the designated range, the females and the young animals extend in small

numbers along the Pacific coast of North America, and periodically extend into the Gulf of Alaska. The larger and older females extend further to the north.

According to our observations, the females and the young animals during the spring and autumn go up along the Asiatic coast to Olyutorsk Bay, where they form accumulations in the region of cape Goven and Karagin Island.

Upon reaching a certain age and size, the males leave the regions where the harem animals live, and go up into the more northerly waters. The basic mass of them is localized off Kodiak Islands to the west along the Aleutian chain as far as the Commander Islands. Large permanent accumulations of sperm whales have been observed here south of Kodiak Island, south of Unimak Strait, northwest of Rat Islands, south of the Near islands, and east, south, and northwest of the Commander Islands. Sperm whales have also been discovered in the region of 40-45º N lat. and 170º E long.-175º W long.

In all probability, the regions where sperm whales gather may change over the years, but not significantly. Thus, for example, V. A. Arsen'ev (1961) points out that in 1958–1959, the largest accumulations of sperm whales were observed west of the Near Islands, and this, it turns out, is somewhat further north than the average accumulation area proposed by us for the period from 1958 through 1964.

In the Bering Sea, many sperm whales have been noted in the region south of the Pribilof Islands, with the greatest concentration north of Atka Island. In the western part of the Bering Sea, sperm whales are distributed from Karagin Island in the east approximately along 58º N lat. to a longitude of 180º, and then northwest toward Dezhnev Bay, and further along the coast southwest as far as Karagin Island, forming a

clearly noticeable ring with a center approximately at 59º N lat., 175º E long. In small numbers, sperm whales have also been encountered in the region of Bowers Bank. Along the continental dropoff, sperm whales are evenly distributed, without forming any noticeable accumulations, but the highest whale concentration has been observed approximately mid-distance from the Pribilof Islands to Cape Navarin. It is interesting to point out that in this region we observed the largest male sperm whales, with an average length of 14.1 m and a maximum of 17.3 m.

As was already pointed out, sperm whales form several types of groupings which are homogeneous in terms of composition: male groupings, mixed groupings of mature females and small males, and groups consisting of females of similar size and age (and frequently of the same physiological state). In making a detailed study of this situation, we, on the basis of analyzing our materials, feel that the homogeneity of the groupings may be manifested also on a smaller scale, for example, in the same dimensions of the embryos in the females. According to the statement of M. N. Tarasevich and N. V. Doroshenko, sperm whales from the northeastern part of the Pacific form different male groupings from animals that are close in terms of size and age on the summer range, and the different male groupings appear in the various regions at different times. As a whole, in the Bering Sea waters one will ordinarily find larger males in comparison with the Pacific ones.

Until recently very little was known about the region where sperm whales winter. Whales had been caught in insignificant numbers close to the shores of California and the Baja California peninsula (Pike, 1954; Tomilin, 1957; Rice, 1963). According to our data, the wintering region of sperm whales is located south of 35º N lat., and stretches

approximately from the Hawaiian Islands to California. Thus, in the period from January through February 1964, sperm whales were spotted by scientific-exploratory vessels at 24º30' N lat. and 135º30' W long., at 32º N lat. and 137º W long., at 22º N lat. and 149º30' W long., and at 22º N lat. and 112º W long. It may be assumed that a large portion of sperm whales winter relatively closer to the American shore than to the Hawaiian Islands.

A. G. Tomilin (1936), M. M. Sleptsov (1952), and others have already pointed out instances of wintering of a small number of sperm whales in the region of the Commander and Kurile Islands. Observations by TINRO coworkers A. A. Berzin and E. A. Tikhomirov made in December, 1955, from the whaling vessel "Musson" also show a significant number of sperm whales, including the small schooling males and females remaining for the winter season in the region of the middle and southern Kurile Islands. Analogous data have been obtained from other scientific-exploratory vessels. In the designated regions sperm whales can be found regularly during the winter season, sometimes forming accumulations up to 80-100 head, as was observed in January 1964, north of the eastern part of the Aleutian Islands. In the Gulf of Alaska, during the winter sperm whales are rarely encountered and in small numbers. In the waters of central California, male sperm whales can be found constantly during the winter (Rice 1963).

Until recently, nothing was known on the migratory paths of sperm whales from the American population, aside from a general scheme according to which sperm whales moved from the California region along the American coast toward the Aleutian Islands. There is the statement by M. M. Sleptsov (1952) and S. K. Klumov (1956) on the moving of sperm whales toward the Commander Islands from the east. In the opinion of S. K.

Klumov, not only sperm whales of the American population can be found off the Aleutian Islands, but also whales from the Asiatic population, and somewhere near 180º there is an overlapping of their ranges.

Back in 1952, M. M. Sleptsov was somewhat perplexed by the absence of any information on the migrations of sperm whales from the Commander Islands to Kamchatka which could not help but be noticed if they did exist. A. A. Berzin (1959), on the basis of his observations and analyzing whaling materials, advanced the opinion that sperm whales come to the region of the Commander Islands only from the east, from the American coast. Our following research substantiated this thesis. But we certainly could not deny the possibility that sperm whales move along the Aleutian chain to the west as is indicated from the results of tagging whales by the Japanese researchers (Kawakami and Ichihara, 1958).

On the basis of observations on the direction of the whales' movements carried out from scientific-exploratory and whaling vessels, we feel that the migration of sperm whales into the northeastern Pacific occurs not along a single "road" running off the North American coast, but by several paths from the wintering regions mentioned above toward the eastern Aleutian Islands and the Gulf of Alaska. Large groupings of sperm whales with the beginning of the migration season (significantly extended in time) run to the north, each from its own wintering area. According to the materials of our observations, one can identify several migration paths: one path runs along the coast of America (approximately along 130º W long.) up to 50º N lat., and from there a portion of the population extends toward the Alexander Archipelago, while another turns west to the region of 50º and 150º W long.; another path runs across the open ocean along 145–150º

W long., also up to 50º N lat., and a third path runs approximately along 162–167º W long. up to the eastern Aleutian Islands. From here some whales turn toward Kodiak Island and into the northern part of the Gulf of Alaska, while others move west and reach the Commander Islands. A portion of the sperm whale population [illegible two words], the Bering Sea through the straits of the eastern Aleutian Islands, and along the continental dropoff reaches the Asian coast.

From the wintering areas, the movement of sperm whales begins at the end of March and the beginning of April and continues in May. The first sperm whales are noticed in the region of the Aleutian Islands in March, and it is quite possible that among them there are individuals that had spent the winter here. The basic arrival of sperm whales in this region can be observed in April, with a rise in the abundance in May.

According to the statement of M. N. Tarasevich and N. V. Doroshenko, in April sperm whale accumulations form basically on the Bering Sea side of the Aleutian chain, directly off the islands, and by summer the area of distribution increases.

During the voyage on the "Aleutian" whaling fleet in 1957–1959, we observed the arrival of females and small males in the latitudes of the Commander Islands, the western Aleutians* during the early spring and late autumn season. The entire summer season would seemingly be the most favorable, but there were no small males in this region. In line with this, the information of Tarasevich and Doroshenko seems somewhat strange, as they assert that the younger animals arrive earliest off the Aleutian Islands, and after them the larger whales begin to appear by summer. The autumn migration of sperm whales begins in September and runs along the same paths. A small number of

* In general, the runs of females to the north have also been noticed by other authors previously (Sleptsov, 1952, 1961, etc.).

sperm whales, as we have pointed out, sometimes remains in the summer region for the entire winter. The sperm whales are distributed unevenly over their range, and this depends upon the location of the food objects that are specific for the species, and above all squid. Indicative in this regard is the distribution of sperm whales east of Cape Olyutorsk (Fig. 1). One can see a characteristic location of whales along the periphery of a circle with a center at 59° N lat. and 175º E long. If we compare this distribution of sperm whales with the distribution of squid (and precisely the species of primary significance in the diet of sperm whales), according to the data from all the Soviet and foreign expeditionary vessels (Akimushkin, 1963), then we will see an unusually clear coincidence in the distribution of whales and squid. As will be pointed out below, in this region one can observe a cyclonic nature to the current. Unfortunately, the questions concerning the pattern of squid distribution up to now have not been studied, and for this reason we are forced to view the distribution of sperm whales in line with the oceanological conditions in the various regions of the whale habitat.

It has been pointed out that the regions with the highest concentration of sperm whales are confined to the places where there is a sharp drop in depth, and this in turn causes the formation of the cyclonic current, bringing about an upwelling of deep waters which are rich in biogenic matter, and helping to form a good food supply. The significant distance offshore of the zone with the drop in depth is a reason for the wider distribution of sperm whales and their large accumulation south of the Aleutian Islands, in comparison with the Bering Sea side.

The accumulations of sperm whales between Unimak Islands as far as Cape Navarin and the Pribilof Islands, i.e., a great distance away from the Aleutian Islands into

the Bering Sea, can be explained by the warm Pacific waters which come up here and which mix with the cold northern waters, as well as by the sharp dropoff. Analogous phenomena can be found in the southern part of the Gulf of Alaska, where with a general depth of 2,000–3,000 m, there are sharp rises in the bottom, the depth above which sometimes reaches 400 m. The largest accumulation of sperm whales is located close to the slopes of these underwater mountains.

Thus, the dependency of sperm whale distribution upon a sharp change in bottom depth and the cyclical nature of the currents, which also is frequently related to bottom relief, can be observed rather clearly over the entire summer range of sperm whales in the northeastern part of the Pacific and Bering Sea. Characteristically, during the migration the sperm whales keep to the regions with the same hydrological and hydrographic characteristics (the region of the Hawaiian range).

The Humpback Whale (*Megaptera nodosa)*

The majority of specialists (Kellogg, 1928; Zenkovich, 1937; Tomilin, 1957; Clarke, 1957, and others) feel that in the northern Pacific there are two humpback populations—the Asiatic and the American—that have different wintering areas and migratory paths. The question of a separation of humpbacks on the summer pastures has still not been finally resolved.

Prior to the 1960's, humpbacks were virtually not hunted in the northeastern Pacific, and expeditionary work had not been carried out, and for this reason there is very little information on the distribution of the humpback and their migrations.

The first general scheme for the migrations and distribution of the two humpback populations in the northern Pacific was given by Kellogg (1928), and this scheme, with a few changes, has continued to be used up to the present (Zenkovich, 1937; Mackintosh, 1946; Sleptsov, 1952; Tomilin, 1957, 1960; Clarke, 1957; and others).

The question of the distribution of humpbacks in the region of the summer range also has been repeatedly taken up by various authors, but unfortunately they have given only a general boundary for the distribution of humpbacks with an indication of individual encounterings of the whales in the various regions of the range. The year-round reconnaissance over a number of years and the intensive humpback whaling in recent years have made it possible to accumulate detailed materials on the character of their distribution (Fig. 2).

We support the generally recognized opinion that there is an American and an Asiatic population, while giving it a somewhat different sense, which will be taken up below. The area of the summer distribution of humpbacks lies from Vancouver Islands on the western shore of North America to the southern part of the Chukchi Sea inclusively. The quantitative relationship of humpbacks in the various regions of their summer range is shown in Table 1, compiled from the results of observations made in 1962 from two scientific-exploratory vessels. The time and the regions of the observations were approximately the same.

Region	Number of Encountered Humpbacks (head)	%
from Prince of Wales Island to Vancouver Island	10	1.4
from western part of Gulf of Alaska to Fox Islands	531	75.0
western Aleutian Islands (to Fox Islands)	17	2.4

Bristol Bay	48	6.8
center and dropoff of Bering Sea	2	0.3
western part of Bering Sea	40	5.7
northern part of Bering Sea	54	7.7
Chukchi Sea	5	0.7

As one can see from the table given, the largest number of whales was encountered from the region south of the eastern Aleutian Islands to the western part of the Gulf of Alaska and north of Unimak Strait, i.e., approximately from 170º W long. to 145º W long. Here they encountered up to 75% of all sighted whales. The given region may be conditionally accepted as the center of the summer habitat area of the humpback, from where the whales spread through the other regions of their summer habitat.

Along the American coast, humpback whales descend as far down as Vancouver Island, without forming large accumulations anywhere, with the exception of the regions of the Alexander Archipelago and the Queen Charlotte Islands, where individual groups are encountered up to 20 head. In the west, single whales and small groups are encountered along the entire Aleutian chain on the Pacific side and the region of the Commander Islands. It should be pointed out that here the boundary for the distribution of the humpback does not drop south of 50º N lat., and this we have taken up in detail in reviewing the patterns in the distribution of baleen whales.

In the Bering Sea, humpback whales form accumulations south of Nunivak Island, close to Cape Newenham, between the Pribilof Islands and Cape Newenham, in the region of Cape Navarin, in Anadyr' Bay, and somewhat north of St. Lawrence Island.

Scattered accumulations of humpbacks have been observed east of the Pribilof Islands. Moreover, single whales have been observed in the regions of Cape Olyutorsk

and Olyutosk Bay, west of St. Lawrence Island, in Mechigment Bay, and south of the Pribilof Islands. As a very rare exception, humpback whales have been encountered in the region of Bowers Bank and along the continental dropoff in the central region of the Bering Sea. According to B. A. Zenkovich (1937) and V. A. Arsen'ev (1961), humpbacks are encountered off Karagin Island and in the region of Severo-Glubokaya and Nataliya Bays.

In the Chukchi Sea, humpback whales form permanent accumulations in the region of Cape Serdtse-Kamen', and single whales are observed along the shore of Chukotia as far as Cape Vankarem. R. Kellogg (1928), B. A. Zenkovich (1937), M. M. Sleptsov (1952), and others give information on the distribution of humpback whales in the waters of southern Kamchatka, the Kurile Islands, and the Sea of Okhotsk. In recent years cases of recording humpback whales in these regions are few, and this clearly has been the consequence of excessive whaling.

There is very limited information on the wintering regions of humpbacks. As is known, they have been constantly killed during the winter period in the region of Baja California (Pike, 1954; Tomilin, 1957). From the scientific-exploratory vessel "Birokan" on 18 January 1964, a humpback whale was observed at a point at 36º N lat. and 153º E long. In the region of California, from the vessel "Vazhnyi", three humpbacks were spotted on 11 January 1964 at 21º N lat. and 112º5' W long. Humpbacks may also winter in the region of the eastern Aleutian Islands, where they have been observed in a small number during December 1964.

In California waters, the movement of the humpback to the north has been noted from March and April (Kellogg, 1928; Zenkovich, 1937; Rice, 1963). According to the

statement by N. V. Doroshenko, the first appearance of the humpback in the waters of the Gulf of Alaska is timed to the second ten-day period of April, and in May their abundance rises. In the region of the western Aleutian Islands, humpbacks begin to be encountered at the end of June and the beginning of July. At the same time they have been observed by us in Bristol Bay and in the region of Cape Newenham. In the Chukchi Sea, according to the observations of P. G. Nikulin (1946), the whales arrive in July and remain there until September (in October humpbacks were no longer observed). In July and August the humpbacks arrive in Anadyr' Bay. From here, in all probability, they spread south to Olyutorsk Bay, where they are encountered from the end of August. The vessels of the whaling fleet did not find humpbacks in the region of Olyutorsk Bay in August, while in the region of Cape Navarin accumulations of whales of this species were observed. At the beginning of September, humpbacks began to be encountered in the region of Olyutorsk Bay.

According to the scheme proposed by Kellogg (1928), the whales of the Asiatic population migrate from wintering areas in the regions of Okinawa, the Bonin Islands, the Marshalls, and the Marianas north along the coast of Japan toward the Kurile Islands, in the Sea of Okhotsk, and toward the coast of Kamchatka. The American population moves from the coasts of California and Mexico along the American coast toward the Gulf of Alaska and the eastern Aleutian Islands, and from there the whales go up to the Bering Straits. Subsequently some scientists (Zenkovich, 1937; Sleptsov, 1952; Tomilin, 1957; Clarke, 1957; and others) continued to adhere to this scheme until tagging established that three humpbacks had gone from the shores of Japan as far as the Alaskan Peninsula and the eastern part of the Aleutian chain (Omura and Kawakami, 1956). In

line with this, A. G. Tomilin (1960) proposed to change somewhat the scheme of humpback migrations. He proposed that humpbacks of the Asiatic herd, in going up as far as the latitude of southern Kamchatka, pass along the Aleutian Islands to the east, while whales of the American population go from the Gulf of Alaska to the west.

On the basis of observations from scientific-exploratory vessels, whaling information, and processing a large number of whale observation logs, we feel that although the scheme of A. G. Tomilin corresponds more to the modern data, nevertheless, it does not yet eliminate the basic contradictions.

In the region of the southern Japanese islands, the number of humpbacks during the winter season is very significant, if one can judge from the kill of them in the region of Okinawa, where a total of 5–6 whalers caught 167–290 head in 1958–1960, while in the region of the northern Kurile Islands and southern Kamchatka, during these years humpbacks were noted only singly. Thus, with the existing migratory schemes of Kellogg-Tomilin, humpbacks that wintered in the region of Okinawa disappeared virtually without a trace during the spring–summer–autumn period. On the other hand, in the California-Mexico region, there has at no time during the winter been such a number of humpbacks as in the western part of the Gulf of Alaska and off of the eastern Aleutian Islands. The movement of whales along the Aleutian Islands in June–July has been noted only in a westerly direction. Beginning with September, in the regions of the western Aleutian Islands, one can note a departure of the whales in an easterly direction. As observations have shown from scientific-exploratory and whaling vessels, during the autumn months humpbacks from the regions south of Kodiak Island and Unimak Strait

depart not in a southeasterly direction, as might be expected from the Tomilin scheme, but to the southwest.

We propose the following scheme for the migration of humpbacks. A portion of the American whale population moves from the coasts of California toward the eastern Aleutian Islands, while another portion goes along the coast and is localized in the regions of the Queen Charlotte Islands and the Alexander Archipelago. Humpbacks from the Asiatic population migrate along the coasts of Japan, in keeping to the Kuroshio current which is abundant in various foods, and then depart to the open ocean along with the Northern Pacific current, and also leave toward the eastern Aleutian Islands. From here a portion of the population goes west along the chain, and another into the Bering Sea and the Chukchi Sea. A small number of humpbacks from Anadyr' Bay descends down the Asiatic coast of the Bering Sea to the region of Olyutorsk Bay. The autumn migration of humpbacks occurs, in all probability, in the reverse order.

The scheme that we have proposed here corresponds to all of the available information and facts on the distribution and migration of humpbacks. However, we must accumulate further information to substantiate it.

At present, as a result of intensive whaling by several fleets, humpback stocks are very greatly depleted, and the question has arisen of prohibiting their killing in the northern part of the Pacific.

The Finback Whale (*Balaenoptera physalus)*

In the northern part of the Pacific, the finback is encountered from the Chukchi Sea to the subtropical latitudes, without descending, as a rule, further south than Baja California along the North American coast or south of Taiwan on the Asiatic side (Tomilin, 1957). In the given article, we will investigate the distribution of the finback only in the northeastern Pacific and the Chukchi Sea.

The finback is the most numerous of the rorquals and has great whaling significance, and for this reason it has attracted the attention of researchers more often than other whales. R. Kellogg (1928) was the first to give a schematic description of the distribution and seasonal migrations of the finback. Interesting observations on their distribution in Far Eastern waters that have corrected the Kellogg scheme were made by B. A. Zenkovich (1937), A. G. Tomilin (1937, 1957), P. G. Nikulin (1946), M. M. Sleptsov (1952), and V. A. Arsen'ev (1961), K. Nasu (1957), and others.

Within a broad range finbacks are distributed unevenly (Fig. 3). Regular accumulations can be noted west of the Alexander Archipelago, east of Cape St. Ilias (the northern part of the Gulf of Alaska), and from the Shumagin Islands to the Trinity Islands (south of Kodiak Island). In addition to this, finback accumulations have also been noted off Vancouver Island (approximately at 132º W long.) and in the region of 52º N lat. and 147º W long.

Along the Pacific side of the Aleutian Islands, whales are encountered in small numbers, without descending, like the other species of baleen whales, south of 50º N lat. and 175º E long., where accumulations of finbacks and single humpbacks have been observed during the summer season (July). South of the Fox Island, finbacks are encountered more frequently, but they do not form noticeable accumulations here.

According to our observations, they prefer to keep to the Bering Sea side of the Aleutian Islands, and are encountered periodically over the entire extent from the Commander Islands to Unimak Strait.

In Bristol Bay there are few finbacks. The number of them increases south of the Pribilof Islands, where in the summertime they are encountered continuously and form accumulations, particularly north of Seguam Island (the Aleutian chain), and also north and east of the Pribilof Islands, and at 61º N lat. between St. Matthew and Nunivak Islands.

In the central part of the Bering Sea, finbacks have been encountered in a region west of St. Matthew Island and along the continental dropoff, but they do not remain here for a protracted period of time according to our data, but are observed in transit, as was pointed out by K. Nasu in his work (1957).

In the western regions of the Bering Sea, during the summertime finback whales range from Cape Navarin to Karagin Island. Here the whale abundance is relatively low, and only in the region of Cape Rubikon, south of Cape Olyutorsk, and south of Cape Goven, do small accumulations form periodically. Rather large whale accumulations were sighted by us in 1964, in the Commander Straits, northwest of the Bering Islands, and south, east, and northeast of Mednyi [Copper] Island.

In Anadyr' Bay, finbacks are encountered in the central and southwestern parts. Large periodic accumulations in the region of Bukhta Ugol'naya [Coal Bay] are common in the middle of August. Finbacks avoid the northwestern and northeastern parts of Anadyr' Bay, and this we have related to the uneven distribution of a food supply over the expanse of the bay.

In the northern part of the Bering Sea, there are many fewer finbacks: in small numbers north of the Northwest Cape, St. Lawrence Island, and west of this island.

In the Chukchi Sea finbacks form accumulations periodically in the region north of Cape Serdtse-Kamen'. Single whales have also been observed in the region of the Neskan-Pil'gyn Lagoon. Finbacks have not been noted west of the designated region.

According to the data of M. M. Sleptsov (1961), the whales go up to the Long Strait, and to Wrangell and Geral'd Islands. In the remaining regions of the range, finbacks keep in small isolated groups. The data on wintering regions are very limited. In January 1963, from the scientific-research vessel "Birokan" were observed a group of 20 finbacks in the Gulf of Alaska at 58º N lat. and 148º03' W long. According to a statement by B. A. Zenkovich (1937), finbacks have been seen year-round off the Commander Islands. Nor should one exclude the possibility that a small number of finbacks winters in other regions, along the southern side of the Aleutian chain and the oceanic coasts of North America. But the basic mass of whales migrates south to Baja California. At the end of February 1964, finbacks were observed from the scientific-exploratory vessel "Vazhnyi" in the region of 37º N lat. and 138º W long. B. A. Zenkovich (1937) encountered finbacks in 1933 off the Revilla Gigedo Islands (Mexico). According to the data of R. Kellogg, from 1919 through 1929, off the shores of California they killed 551 whales, and at the same time six whales off of Baja California.

The following is known on the migration time of finbacks in the northeastern part of the Pacific. In March, according to the data of R. Kellogg (1928), finbacks appeared around Vancouver Island. In May and June, according to B. A. Zenkovich (1937), they passed in large numbers along the Aleutian Islands and near Alaska. Rice (1963) points

out that off the shores of central California, finbacks can be found chiefly from the beginning of May through the middle of September, with a peak from the middle of May to the beginning of June, and from the middle of July to the beginning of September. According to the data of our observations from the TINRO vessels, finbacks appeared in the region of the eastern Aleutian Islands and in the Gulf of Alaska as early as April, in May and June, and were most numerous in the region of the western Aleutian Islands and south of the Pribilof Islands. The whales arrived in the Olyutorsk Bay in July (Zenkovich, 1937; Sleptsov, 1952; Tomilin, 1957). At the same time they have been observed in the region of St. Matthew Island, Cape Navarin, and Anadyr' Bay, and the first whales passed the Bering Strait and entered the Chukchi Sea (Nikulin, 1948). The reverse migration from the Chukchi Sea begins in September, and single whales passing the Bering Straits can be observed sometimes until October. In September there is a mass departure of finbacks from the Bering Sea. Finbacks will remain off the Aleutian Islands and the shore of North America until November, as has been observed at times in the region of Olyutorsk Bay and off the Commander Islands (Zenkovich, 1937).

The scheme for the migration paths of finbacks was given for the first time by R. Kellogg (1928). According to this scheme, whales of the Asiatic population move from the shores of Japan along the Kurile Islands, Kamchatka, and the western shore of the Bering Sea to the Bering Straits and into the Chukchi Sea. Whales of the American population, however, travel from California along the American coast also to the Bering Straits and into the Chukchi Sea. Kellogg assumes that these two populations intermingle in the region of the Bering Straits.

The following researchers (Zenkovich, 1937; Tomilin, 1937, 1957; Sleptsov, 1952; Klumov, 1955; Clarke, 1957; and others) to one degree or another have reported the given scheme. The question was merely raised of at what point and to what degree these populations intermingled.

The first results of tagging finbacks in this portion of the ocean (Omura, 1957; Nemoto, 1959; Fujino, 1960) have shown a significant movement of the whales both in easterly and westerly directions. For this reason, we are in agreement with the opinion of Omura (1957) that the question of the presence of local whale populations should be resolved basically not from the summer distribution of the whales in the foraging areas, but from their breeding grounds (wintering areas), although the conservation of the whales for a definite migration route must be considered, because this can explain the catching of tagged whales approximately in the same region and at the same time.

On the basis of the observations carried out during the scientific-exploratory trips in 1958–1964, considering the results of tagging, we propose to somewhat correct the existing scheme for the migration of the finback. In the spring season the whales move north from California along the American coast approximately up to Vancouver Island, where the migration paths split: a smaller portion of the population goes along the coast further north to the Queen Charlotte Islands and the Alexander Archipelago, while a larger portion turns west approximately at 50º N lat. to 160º W long. From here one route goes northeast past Kodiak Island toward the northern part of the Gulf of Alaska, while another path passes across the straits of the eastern Aleutian Islands into the Bering Sea, from where one portion of the population heads toward Cape Navarin along the

continental dropoff, and another along the American shore passes into the Chukchi Sea. A third route is along the Aleutian chain west toward the Commander Islands.

Whales of the Asiatic population move north along the Kurile Islands and southern Kamchatka to the Commander Islands, where a part turns east toward the eastern Aleutian Islands, while another part passes along the Asiatic coast further to the north, and possibly also enters the Chukchi Sea.

Nor should we exclude the possibility of Asiatic whales arriving off the eastern Aleutian Islands from the open ocean. Thus, in March 1962, a large group of finbacks was observed moving in a northeasterly direction at 48º30' N lat. and 165º20' W long.

Having encountered a rich feeding region on their path, whales may keep here for a protracted period of time, and some of them may remain for the entire summer. This can explain the large fluctuation in the abundance of whales over the years observed by P. G. Nikulin (1946) in the Chukchi Sea. The large males ordinarily go north, while the smaller ones remain further south (Sleptsov, 1952). But in favorable years it is possible that the small whales may also extend far into the northern waters.

The autumn migration of the finback occurs in the reverse direction along the same routes, but the whales travel more rapidly, according to our observations, and do not remain anywhere for a long period of time. For this reason, the autumn migration of the finback occurs in a shorter period of time than the spring migration.

The Blue Whale (*Balaenoptera musculus*)

The questions concerning the distribution and migration of the blue whale in the northeastern Pacific and the Bering Sea have been taken up by many scientists, beginning with R. Kellogg (1928), who gave a general scheme for the migration of the whales. But while the distribution of blue whales in the northwestern Pacific at present has been studied rather well and basically due to the work of Soviet zoologists (Zenkovich, 1937; Sleptsov, 1952, 1961; Tomilin, 1957; and others), information on the distribution of the whales in the northeastern Pacific has remained approximately on the level of the 1930's. Up to now the probability of blue whales inhabiting the Chukchi and Bering Seas has not been clear.

B. A. Zenkovich (1937) and A. G. Tomilin (1957), in referring to the observations of the indigenous population of Chukotia, assumed the possibility that blue whales enter through the Bering Straits into the Chukchi Sea. M. M. Sleptsov (1952, 1961) points to the encountering of a large group (up to 80 head) of blue whales in 1939 in the region of Cape Serdtse-Kamen', and several whales between the settlement of Vankarem and the Bering Straits in 1943. P. G. Nikulin (1946) did not encounter any blue whales during seven years of observations in the region of the Bering Straits and Cape Serdtse-Kamen'. Japanese researchers (Nasu, 1957; Nemoto, 1959; and others), on the basis of materials from Japanese whaling, deny the possibility of finding blue whales not only in the Chukchi but also in the Bering Sea. There is the statement of V. A. Arsen'ev (1961) on the present distribution of blue whales in the region of the Aleutian Islands and in the Bering Sea.

In the general range of blue whales in the northeastern Pacific, one can note three rather clearly distinct regions (Fig. 4). The first region stretches in a narrow strip along

the oceanic side of the Aleutian chain from 170º E long. to 175º W long., and a second from 170 to 160º W long. South of 50º N lat., the whales are encountered very rarely in these two regions. In the given regions blue whales are relatively sparse, more or less equally distributed over the entire body of water, and do not form marked accumulations. A small periodic concentration of whales can be observed only southeast of the Near Islands, south of the Rat Islands, and south of Unalaska Island. A third region where the blue whales are found begins southeast of Kodiak Island and stretches across the northern part of the Gulf of Alaska along the coast of North America approximately to Vancouver Island. Here one can establish several areas with relatively large whale accumulations: west of the Queen Charlotte Islands and the Alexander Archipelago, and in the northern part of the Gulf of Alaska. The abundance of blue whales in this region is rather high: research and whaling vessels here have sighted more than 300 blue whales.

In the Bering Sea, blue whales (7 head) were observed in 1959 only south of the Pribilof Islands (Arsen'ev, 1961). During other trips in this region they were not encountered, and probably come here very rarely. Over the remaining expanse of the Bering Sea and in the Chukchi Sea, blue whales have not been sighted in all recent years.

The distribution of blue whales over the summer foraging pastures is directly dependent upon the distribution of the basic food objects—the euphausiids *Euphausia pacifica* and *Thysanoessa inermis* (Nemoto, 1959; E. I. Betesheva, 1961; Rice, 1963, and others).

The dependency is particularly well seen in comparing the map for the distribution of these plankton species (according to Brinton, 1952) with the distribution of blue whales (see Fig. 4). In regions where there are no euphausiids, the whales are

virtually not encountered, and this can explain the presence of the three separate regions in the summer range of blue whales.

Very little is known about the wintering regions of blue whales. There are merely the general indications of catching them in the region of California (Pike, 1954; Rice, 1963, and others). On this basis, A. G. Tomilin (1957) has proposed that blue whales winter between California and Japan. B. A. Zenkovich (1937) observed the blowing of blue whales in the region east of the Revilla Gigedo Islands in November.

In January 1964, blue whales were observed from the scientific-exploratory vessels of TINRO northeast of the Hawaiian Islands at a point at 24º20' N lat. and 153º15' W long., and close to the coasts of California at 22º N lat. and 112º W long. Consequently, it may be assumed that the wintering regions of blue whales lie within the limits from 160º W long. to the coasts of California, although one should not exclude the possibility that there are two separate wintering regions, one off the Hawaiian Islands and the other off the California coast. In the more northerly regions, blue whales probably do not remain for the winter, but depart into the zone south of the tropics.

According to our materials, the spring migration of blue whales begins in April–May. The whales travel north along the American shore of the Pacific. Thus, in May 1963, blue whales migrating north were observed at 41–42º N lat. and 130º W long. In the region of Vancouver Island, as we assume, the migrating route splits. A portion of the population travels north along the coast, spreading out along the Queen Charlotte Islands, the Alexander Archipelago, and in the northern part of the Gulf of Alaska (Fig. 4), while another portion turns west and migrates approximately along 50º N lat. toward the

Aleutian Islands. This can be seen from encountering whales moving west in April at 48º57' N lat. and 151º51' W long., and in May at 49º20' N lat. and 139º W long.

The autumn migration of blue whales begins in September and occurs in the reverse direction. Thus, in September 1963 whales moving south were observed at 39º58' W lat. and 127º36' W long. It has also been pointed out that the whales leave the Queen Charlotte Islands in a southerly direction.

The Gray Whale (*Eschrichtius gibbosus*)

The gray whale, as is known, is encountered only in the northern Pacific. It is generally assumed that there are two populations—American and Asiatic—which have different wintering and summering regions. The range and the paths of the seasonal movements of the gray whale, in comparison with other cetacean species, have been the best studied, and this can be explained by the sharply expressed seasonal migrations of these whales and the custom of coming close to shore.

The first published observations on the migrations of the gray whale were those of S. Seammon (1886—cited in Zenkovich, 1937), who gave a general description for the movement of this species along the western coast of North America. R. Kellogg made a more detailed study of these questions (1928) and proposed a scheme for the range and migration of the gray whale that has not lost its significance at present. B. A. Zenkovich (1937) states encounterings of the whales in the Bering and Chukchi Seas. In the period from 1937 to 1943, regular observations on gray whales in the regions of the Bering Straits and Cape Serdtse-Kamen' were conducted by P. G. Nikulin (1946). More recently

questions relating to the distribution and migration of gray whales have been the subject of work by M. M. Sleptsov (1952, 1961), A. G. Tomilin (1957), and others. At present there is no information on the distribution of gray whales from the Asiatic population in Soviet waters.

The questions relating to the distribution and migration of the American gray whale population in foreign waters have been the subject of numerous works by foreign researchers from materials of recent years: R. Gilmore (1955, 1960) on counting the abundance of gray whales during their migration off the shores of California; Maher (1960) who has written on the constant encounterings of gray whales in July, August, and September beyond 70º W lat. in the region of Cape Barrow and the village of Wainwright; F. Wilke and K. Fiseus (1961), D. Rice (1961) and others.

In the present work we have generalized all the literary sources and the numerous data from the scientific-exploratory trips in the period from 1958 through 1964.

During summer gray whales are encountered in the following regions: along the western coast of the Bering Sea, single whales enter Severo-Glubokaya and Nataliya Bays, south in the region of Olyutorsk Bay, gray whales were never noticed during numerous trips of the research vessels.

In moving north, gray whales were observed more and more frequently, and in the region of Cape Navarin they form large permanent accumulations numbering up to 200 and more head.

In Anadyr' Bay, gray whales occupy not the entire area, but only the coastal zone in the southwestern part of the bay, from Cape Navarin to Tymnga Lagoon, and in the northeastern part from Cape Retkon to Northwest Cape (St. Lawrence Island). In the

region from the Anadyr' estuary to Cross Bay, gray whales were not sighted. The whales are unevenly distributed in the designated region, and while they form large accumulations in the southwestern region, in the northeastern they are encountered as scattered single whales or in small groups. Such a distribution is directly dependent upon the distribution of the benthic organisms, basically invertebrates, and this will be taken up in detail below.

In the northern part of the Bering Sea and in the Bering Straits, gray whales form large accumulations in a region north of St. Lawrence Island, Chukchi Cape, Mechigment Bay, Lawrence Bay and Cape Dezhnev. Close to the American coast of the Bering Sea, our vessels did not carry out any observations, but in the literature there is no information on this question. For this reason, in the given region the range of gray whales can approximately be drawn along a line connecting North East Cape (St. Lawrence Island) and Prince of Wales (the Seward Peninsula) (Fig. 5).

In the Chukchi Sea, large permanent accumulations of gray whales have been sighted in the region from Cape Dezhnev to Cape Serdtse-Kamen' and north up to 69º N lat. To the west the abundance of the whales drops sharply, and in the region of the Nutauge and Tenkergyn-Pil'gyn Lagoons, one will observe only single whales, and for this reason we consider the latter lagoon to be the western boundary for the range of gray whales in the Chukchi Sea.

In the American sector of the Arctic, a small number of gray whales has been sighted in the period from 1 through 10 August 1962. The northernmost point for encountering whales by our vessels was Cape Lisburne.

According to the data of the American researchers (Wilke and Fiseus, 1961), gray whales are constantly found in Kotzebue Sound, where in August accumulations were sighted up to 100 head. W. Maher (1960) indicates finding gray whales in the region of Wainwright and Cape Barrow basically along the edge of the ice.

Proceeding from these data, it can be felt that the eastern boundary for the range of gray whales reaches as far as Cape Barrow, where the whales are regularly found.

The winter range of gray whales is in the region of California, without dropping, however, below 20º N lat. (Seammon, 1886—cited in Zenkovich, 1937). They reach the greatest abundance in the Seammon, Black-Warrior, Ballenas, and San Ignacio Lagoons, and in Viscaino Bay and Magdalena Bay (Gilmore, 1960).

The time during which the whales have been observed in different regions of their range is shown in Table 2 compiled basically from the materials of our researchers using also data from the literature.

In the given table one can clearly trace the time of seasonal migrations for the gray whale. The beginning of spring migration for gray whales from the California waters varies over the years and is extremely extended. Thus, according to the data of B. A. Zenkovich (1937), the expedition of the Norwegian company “Vega” operated in 1924–1926 in Magdalena Bay up to 7 April and did not encounter gray whales migrating north. In 1963, two pairs of gray whales were sighted from the vessel “Buran” in the region of Chirikov Island on 3 April. Evidently the maximum of the spring migration is reached in the middle of May, but continues up to the middle of June. N. V. Doroshenko sighted large gray whale accumulations (up to 100 head) on a parallel

Table 2

Regions	Months											
	XI	XII	I	II	III	IV	V	VI	VII	VIII	IX	X
Chukchi Sea								+	+	+	+	+
Bering Strait								+	+	+	+	+
northern part of Bering Sea								+	+	+	+	+
Anadyr Bay									+	+	+	
Cape Navarin									+	+	+	
Cape Olyutorsk									+	+	+	
eastern Aleutian Islands						+	+	+				
Gulf of Alaska						+	+	+				
Vancouver Island	+	+	+	+	+	+						+
California	+	+	+	+	+	+	+					

with Unalaska Island on 16 May 1963. In 1964, we sighted accumulations of gray whales on 26 April in the region of Chirikov Island and on 17 June east of the Shumagin Islands. F. Wilke and K. Fiseus (1961) encountered gray whales on 11 May 1957 around Cape Narrow between Kodiak and Ugak Islands. There also is the statement that recently there are more frequent instances where groups of gray whales remain during the summertime off the coasts of Oregon and northern California (Gilmore, 1960).

The appearance of the first whales in the northern part of the Bering Sea and in the Bering Straits has been noticed in June (Nikulin, 1946). At the same time the whales appear in the Chukchi Sea. The most massive appearance of gray whales, according to the data of P. G. Nikulin (1946), is in August and consisted of 1,307 specimens, which is approximately 77% of the total number of tagged gray whales.

According to our data, the whales begin to appear in Anadyr' Bay and to the south in July. They have not been sighted in these regions earlier. Analogous information is found in B. A. Zenkovich (1937), M. M. Sleptsov (1952), and others. The whales reach Cape Barrow in July (Maher, 1960).

The autumn migration of gray whales begins in September–October. The whales leave the summer grounds first from the region of Severo-Glubokaya Bay to Cape Navarin. At the end of August and the beginning of September, groups of gray whales have been sighted in the region of Cape Navarin. One month later in this same region as well as to the south there were none. At this time the migration of gray whales also begins in the Chukchi Sea. B. A. Zenkovich (1937) sighted a population here in September (approximately up to 200 head) moving from northwest to southeast. We propose that these were migrating animals. Off Cape Barrow, according to the statement of W. Maher (1960), they were not sighted after the middle of September.

At the end of September, the large accumulations of migrating gray whales have been encountered north of St. Lawrence Island. At this time only one whale was sighted over all the western waters of the Bering Sea. There were no gray whales in the Bering Straits later than October (Nikulin, 1946), and at this time, probably the leaving of the whales for the wintering regions is completely over.

In October gray whales appear off the coast of Vancouver Island, and in December–February off the coasts of California (Gilmore, 1955, 1960; Tomilin, 1957; Rice, 1961; and others). However, like other whales species, gray whales may remain in the summer regions. Thus, they have been observed in the Bering Sea up to November (Tomilin, 1957), and according to the statement of A. P. Shustov, a group of gray whales

spent the winter in a large stationary open expanse in the ice south of St. Lawrence Island.

Observations in recent years make it possible to introduce certain corrections into the existing notion on the migration paths of gray whales. We do not agree with R. Gilmore (1955, 1960) and M. M. Sleptsov (1961) who feel that gray whales migrate during the spring along the Aleutian Islands from east to west, because they have never been sighted off the western Aleutians. There is also some doubt that gray whales cross the Gulf of Alaska along 50-55º N lat. (R. Gilmore, 1955) during the migration. In this regard, it seems to us that the schemes of R. Kellogg (1928), A. G. Tomilin (1937), B. A. Zenkovich (1937), and Ichihara (1958) are more suitable, although they do not describe the distribution of the whales in the Bering and Chukchi Seas completely accurately.

We propose that gray whales migrate north along the American coast, past Vancouver Island, the Queen Charlotte Islands, the Alexander Archipelago, Kodiak and Shumagin Islands, through the straits of the eastern Aleutian Islands, entering the Bering Sea, and along the American coast toward the northern part of the Bering Sea. From here a portion of the population passes into the Chukchi Sea, spreading west and east of the strait, while another portion follows along the Asiatic coasts of the Bering Sea to the southeast and appears in Anadyr' Bay, off Cape Navarin, and further south as far as Severo-Glubokaya Bay. This can explain the later appearance of the whales in the designated regions. The autumn migration of gray whales occurs in the reverse direction.

The distribution of gray whales within their summer range depends completely upon the availability of food and its accessibility. Let us investigate these factors from the example of the Bering Sea.

Gray whales ordinarily avoid deep-water areas, remaining, as a rule, along the shores, in the bays, shallow sounds, lagoons, and even in shallows, where it is almost impossible to swim (Tomilin, 1957). In this regard, a significant portion of the Bering Sea has excellent conditions. Both the western and the eastern shores are heavily incised, and depths from 0 to 50 meters cover above 20% of the total area of the sea (Gershanovich, 1963). In the eastern part of the Bering Sea, shallows occupy a larger area than in the western part, and for this reason we can rightly expect the greater density of gray whales there. In actuality this is not the case. Scientific-exploratory vessels only encountered a group of three gray whales once in September, south of St. Lawrence Island at 62º34' N lat. and 169º W long., and the group was moving south. In foreign sources there are no accurate data on the habitat of gray whales in the eastern part of the Bering Sea.

Thus, the presence of shallow areas still does not determine the distribution of these whales. Let us investigate the food factor. In the summer habitat gray whales feed exclusively on benthic organisms (Zenkovich, 1934, 1937). According to the data of A. A. Neiman (1963), the biomass of benthos on the shelf of the Bering Sea is distributed in the following manner (Fig. 5):

southeastern region—55 g/m^2

Koryak shore—220 g/m^2

Anadyr' Bay—468 g/m^2

Chirikov Basin—905 g/m^2

Chukchi Sea—213 g/m^2 (according to Makarov).

In comparing these data with the map for the distribution of gray whales, we can clearly see the dependency of whale distribution upon the state of the food supply. The southeastern region, which is shallow but poor in food, is avoided by the whales, which travel further west, but on the contrary, in the regions of Anadyr' Bay, Cape Navarin, the Bering Strait, and the Chukchi Sea, regular accumulations of gray whales have been observed. There is an even more visible dependency of gray whale distribution upon the amount of benthic invertebrates in Anadyr' Bay, where the southwestern portion of the bay, which is rich in benthos, has a greater whale density than the northeastern. In the region from the Anadyr' estuary as far as Cross Bay, where there is very little benthos, there are no whales. In comparing the map of the gray whale range with the map of benthos distribution, we come to the conclusion that the whales are encountered only in regions that have a benthos supply of 100 g/m^2 and above. Areas with less benthos are avoided by the whales as poor in food.

As is known, up to the present the abundance of gray whales has been rising. V. M. Latyshev and V. I. Troinin counted 1,033 whales in 1962 from two scientific-exploratory vessels, and of them 333 were in a region from Severo-Glubokaya Bay up to Anadyr' Bay (inclusively), 266 in the Northern Bering Sea, and 474 whales in the Chukchi Sea. R. Gilmore (1960), who counted gray whales in the breeding areas in shallow lagoons, has set the abundance of the whales at 5,000 head. D. Rice (1961) feels that the abundance of the whales is 6,069 head on the average (with a minimum of 3,984 and a maximum of 8,449 head). Both authors assume that M. M. Sleptsov (1961) feels that the abundance of gray whales by 1961 has reached 2,500–3,000 head.

The Pacific Right Whale (*Eubalaena glasialis sieboldii*)

The data in the literature on the distribution of the Pacific right whale in the northeastern Pacific are very sparse. P. Van Beneden (1868—cited in Tomilin, 1957) drew the northern boundary of the distribution of right whales from the island of Hokkaido to the Commander Islands and further along the Aleutian chain to Alaska. A. G. Tomilin (1957) feels that this boundary should be shifted further north, because American whalers prior to the 19th century caught these whales off of St. Matthew and St. Lawrence Islands, Prince of Wales Cape, and the village of Townsend (1935). G. Pike (1954) indicates encountering and killing right whales in the Gulf of Alaska and in the region of Vancouver Island. According to old sources in literature, right whales winter on the American side of the Pacific in a region around 28º N lat. There is information that right whales are also encountered in the region of the Hawaiian Islands (J. Reingard, 1866—cited in Tomilin, 1957).

The materials collected by the Bering Sea expedition of TINRO in 1958–1964 have significantly supplemented the available statements on the distribution of the right whale in the northeastern Pacific (Fig. 6).

The region of the greatest accumulations of right whales is in the western part of the Gulf of Alaska, within the limits of approximately 151 to 145º W long. The southern boundary of this region runs along 50º N lat. In other regions, the abundance of the right whale falls sharply. In the southeastern direction, along the American shore, rare single right whales were observed by our vessels as far as Chichagov Island. According to the data of G. Pike (1954), the shore stations at the beginning of the century killed a very

small number of right whales in the region of the Queen Charlotte and Vancouver Islands, but the author did not indicate at what time of the year the whales were killed. It is quite probable that these were migrating animals. The range of right whales extends west along the Aleutian chain on the oceanic side as far as the Commander Islands, however without descending, like the other types of baleen whales, south of 50º N lat. The right whales in this region are spread more or less evenly, and their number here is not great.

In the Bering Sea, right whales are encountered only in the southeastern corner, in a region limited approximately by a line connecting Atka, St. Matthew, and Nunivak Islands. Small accumulations of right whales in this region were sighted north of Amukta Strait, between Pribilof and Nunivak Islands, and between the Pribilof Islands and Bristol Bay. H. Omura (1958) points out that right whales are encountered most frequently in this region north of Unimak Strait, but out data do not substantiate this. The northernmost encounter of the right whale is at 58º30' N lat. and 167º32' W long.

Virtually nothing is known about the migration paths of the right whale in the northeastern Pacific. In the opinion of the majority of researchers, whales from the American population migrate south along the western coast of North America.

Right whales migrating north have been sighted in May in the regions approximately of 50º N lat., 140º W long. and 51º N lat., 150º W long. In January 1964, the scientific-exploratory vessel "Birokan" encountered a right whale in the open sea at 40º N lat. and 157º W long. We assume that right whales in their seasonal migrations do not follow any definite paths, but move along a broad front, which can be seen from the

encounter of a right whale by a whaling vessel in October 1962 at 45º N lat. and 161º E long., moving southeast.

Right whales enter the Bering Sea basically through Unimak Strait, but one should also not exclude passing through the other straits of the Aleutian chain. The abundance of the right whale, which has been depleted by the, has remained low up to the present. The complete prohibition of hunting this species approved by the 1964 International Convention undoubtedly will have a favorable influence on restoring the number of whales, but this goes on slowly. This can be seen from the fact that, for example, according to the data of scientific-exploratory vessels, in the northeastern Pacific a total of only 200 right whales was encountered during all of 1963. In the majority of instances they were found in pairs or alone, and only very rarely in groups of 4–5 animals.

In reviewing the paths of seasonal migrations for whales in the northeastern Pacific, the authors of the present work have indicated for all of the whale species not a single route, as was done by preceding researchers, but rather several migration paths, and only for right whales have indicated a shift along a broad front from the wintering region to the summer regions. However, we feel it possible to assume that all whale species, with the exception of the gray whale which is closely linked with shallow depths, migrate not along a single or even two or three definite routes, for example along the Asiatic and American shores, but rather follow numerous routes that are permanent for every group of population. As a whole, such movement is close to a movement along a broad front.

In regions that have the most favorable conditions, these paths can merge, and during the spring–autumn migrations, here there are more whales than in other places. Such paths are observed relatively close the continental coast, close to the continental dropoff of the Bering Sea, the ridge of islands, the underwater Hawaiian range, the confluences of cold and warm waters, etc., and this is caused by the corresponding ecological conditions.

On the Townsend map (1935) it is indicated that sperm whales are distributed evenly over the entire subtropical zone from the coast of America to Asia. According to the scheme of the 1930's, all of these whales traveled thousands of miles to the coast of the continents in order to then follow along them to the Aleutian Islands, which were relatively close the wintering regions, if they went to them by going straight north.

The scheme of R. Kellogg (1928) can be explained by the fact that the whale migrations were studied close to the shores of both continents.

In analyzing the data obtained, one can conclude that for the majority of whale species, one must give up the concept of "American" and "Asiatic" populations which has separated them and confined the whales to the corresponding coast. This, however, does not negate the localness of the whale populations.

Certain Patterns in the Distribution of Whales

Let us briefly take up a very complex and as yet insufficiently studied question concerning the patterns in whale distribution. As we can see from Figs. 1–6, the distribution of cetaceans in the northeastern Pacific and the Bering Sea is extremely

uneven. The basic factor influencing the distribution of whales is the food objects and their availability. This dependency can be seen particularly well from the example of the distribution for gray and blue whales and partially sperm whales, which was mentioned above. There is also a similar relationship for other whale species, but unfortunately in Soviet and foreign literature there are virtually no data on the feeding of whales in the studied region or on the patterns of distribution for their basic food objects. For this reason, we are forced to view the distribution of whales as dependent upon the hydrological conditions, although this dependency is not direct but rather indirect.

Japanese researchers have tried to establish a relationship between the distribution of whales and water temperature, and have established that for the blue whale the optimum temperature varies from 8 to 25º, for the finback from 5 to 30º, and for the humpback and sei whale from 5 to 25º. In considering the superb temperature regulation of whales (Tomilin, 1960), on our behalf we feel that there can be no question about a direct dependency of whale distribution upon water temperature. There is no clear link between water temperature and the distribution of whale food, because in the first place, for each species of food object one can observe fluctuations in optimal temperatures, and secondly, a large number of species of food objects is encountered in the various zoogeographical zones.

For elaborating the patterns in the distribution of baleen whales in the Aleutian and Alaskan waters, we have compared our map of whale distribution with isolated data on water salinity in the designated regions. It turned out that in the studied region baleen whales keep only to the waters having a surface salinity below 32.5 o/oo. In water with a

higher salinity, the whales are encountered in a small number, and then probably only in passing.

Thus, the isohaline of 32.5 o/oo was a type of boundary for the summer range of baleen whales, as can be clearly seen on the map (Fig. 7). In the southwestern and northeastern parts of the Gulf of Alaska and in the region of the eastern Aleutian Islands, the isohaline of 32.5 o/oo moves away from the shores, and this can be explained by the freshening influence of runoff of continental waters in the first two regions and the thawing ice in the third region. The distribution of the whales expands along with the isohaline. And, conversely, in the region west of Kodiak Island, where there is a strong current, the freshened zone is constricted, and this also influences the distribution of whales. The elevated water salinity can also explain the fact that baleen whales are virtually not encountered south of 50º N lat. along the Aleutian Islands, as we indicated above.

E. I. Chernyi (1962) feels that in the Antarctic, the optimum salinity for whales is around 34 o/oo. We have determined the optimum salinity in the Northeastern Pacific, and have completely affirmed the opinion of E. I. Chernyi that in the various regions of the world ocean, optimum salinity will vary for baleen whales. Materials concerning the distribution of water salinity in the Bering Sea are very incomplete, but they make it possible to assume that there optimum salinity is approximately the same as in the northeastern Pacific.

It is perfectly clear that water salinity is only a unique indicator pointing to a great biological productivity of a region, since it, in turn, depends upon many factors which help to enrich the surface water layers with biogenic substances and to raise their

biological productivity. Among such factors are the various dynamic processes of the ocean, the runoff of continental waters, atmospheric precipitation, etc.

Water salinity influences the distribution of whales not directly, but indirectly through the food objects. In turn, in the process of evolution whales have developed the ability to react to a change in water salinity by using the chemoreceptors (Yablokov, 1961) and to find foraging areas that are rich in food (Chernyi, 1962). Unfortunately, the question concerning the relationship between plankton distribution and water salinity up to now has remained little studied.

In whales the conservatism for a definite salinity is so high that in some instances they may pass through regions which are rich in plankton but having a somewhat different uncustomary salinity. Otherwise it would be difficult to explain the above-mentioned instances based on years of observations on the movement of whales.

In contrast to baleen whales, sperm whales keep to regions with a water salinity above 33 o/oo, and this is explained by the stenohalinity of cephalopods which prefer water with an elevated salinity (Kondakov, 1940).

But water salinity alone sometimes cannot explain certain particular features in the distribution of whales, for example, their density in various regions of the range. We have been able to show a relationship between the distribution of whales and the systems of cyclonic currents, which, in contrast to the anti-cyclonic currents, help to bring up deep waters with an elevated content of biogens. With the presence of the anti-cyclonic currents in the central part of the Gulf of Alaska, southwest of Vancouver Island, in the central part of the Bering Sea, and north of the Pribilof Islands, whales are very rarely encountered. Conversely, with the cyclonic currents, whales are located along the center

of the turbulence, as is the case for baleen whales south of the Pribilof Islands, or along its periphery, as is observed for the sperm whale in the Western Bering Sea (Fig. 8).

The distribution of baleen whales according to species also has particular features, and humpbacks and blue whales have their separate regions: blue whales are found in the eastern part of the Gulf of Alaska, while humpbacks are around the eastern Aleutian Islands. Between these two species, in the western part of the Gulf of Alaska, one will find the habitat of right whales. Such a distribution of baleen whales can be explained by the difference in the feeding of these species, and also by the location of basic food objects over the regions. The material available at present on the feeding of whales in the northeastern part of the Pacific Ocean is so small that it does not make it possible to make decisive conclusions.

According to the ecological classification of cetaceans that was proposed by A. G. Tomilin (1954), the structure of the baleen apparatus of right whales is adapted to feeding only on small plankton (*Calanus*), and for this reason they have been put in the group of microplanktophages. Consequently, we may assume that in the western part of the Gulf of Alaska there is a predominance of small forms in the general plankton mass.

All of the rorquals according to the same classification would be put in one type, the macroplanktophage. However, the results of observations have indicated a great difference in the feeding of various rorqual species. Thus, blue whales basically feed on plankton and do not eat fish, which makes up a significant although not leading place in the diet of humpbacks. In this regard it is interesting to point out that finbacks ecologically are a more plastic species, feeding equally on fish as well as on plankton, and are encountered both among humpbacks and among blue whales. Further

accumulation of materials on the feeding of baleen whales in the northeastern Pacific make it possible to explain the existing differences in the distribution of whales.

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Figure captions:

Fig. 1. The distribution of the sperm whale: 1—number of whales more than 50 head; 2—number of whales more than 15–20 head; 3—number of whales more than 1–3 head; 4—the direction of the spring migration; 5—the distribution of squid (according to Akimushkin, 1963).

Fig. 2. The distribution of the humpback whale: 1—number of whales more than 50 head; 2—number of whales more than 15–20 head; 3—number of whales more than 1–3 head; 4—the direction of the spring migration.

Fig. 3. The distribution of the finback whale: 1—number of whales more than 50 head; 2—number of whales more than 15–20 head; 3—number of whales more than 1–3 head; 4—the direction of the spring migration.

Fig. 4. The distribution of the blue whale: 1—number of whales more than 15–20 head; 2—number of whales more than 1–3 head; 3—the direction of spring migration; 4—distribution of *Euphausia pacifica*; 5—distribution of *Thysanoessa inermis* (according to Brinton, 1962).

Fig. 5. Distribution of the gray whale: 1—number of whales more than 50 head; 2—number of whales more than 15–20 head; 3—number of whales more than 1–3 head; 4—direction of spring migration; 5—benthos biomass less than 50 g/m^2; 6—benthos biomass 100–400 g/m^2; benthos biomass above 400 g/m^2 (according to Neiman, 1963).

Fig. 6. Distribution of the Pacific right whale: 1—number of whales 15–20 head; 2—number of whales 1–3 head; 3—direction of spring migration.

Fig. 7. The dependency of the distribution of baleen whales upon salinity in the surface water layer: 1—Number of whales above 50 head; 2— number of whales more than 15–20 head; 3—the isohaline of 32.5 o/oo (according to Nasu, 1957; Bennot, 1959)

Fig. 8. The dependency of whale distribution on currents: 1—number of whales more than 50 heard; 2—number of whales more than 15–20 head; 3—direction of currents (according to Nasu, 1957; Bogdanov, 1961; Natarov, 1963).