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ECOLOGY

The Peculiarities of Foraging Migrations of the Korean–Okhotsk Gray Whale (*Eschrichtius robustus*) Population in Russian Waters of the Far Eastern Seas[1]

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Abstract—Photographic identification of the Korean–Okhotsk gray whale *Eschrichtius robustus* population has been conducted since 2002 by researchers of the Institute of Marine Biology at the Far East Branch of the Russian Academy of Sciences (IMB FEB RAS), with financial support provided by Exon Neftegas, Ltd. and Sakhalin Energy Investment Co., in order to study the migration features and biology of this species. In 2008, photo-ID studies were carried out in two areas, off the northeastern coast of Sakhalin Island and off the southeastern coast of Kamchatka. As a result of the studies, 122 whales known from the Sakhalin gray whale catalogue were photographed. Of them, 97 individuals were registered off Sakhalin, 24, off Kamchatka, and one whale was observed at both sites. In addition, 25 more gray whales that had not been sighted off Sakhalin Island before were found off the coast of Kamchatka. Based on these photographic materials, the whales physical and skin conditions were also analyzed. Cases of sightings of gray whales in areas that are remote from their traditional summer and fall feeding grounds in the Far Eastern seas of Russia are discussed.

Key words: gray whale, photo-ID, distribution, Sakhalin, Piltun, Kamchatka, oil-gas projects.

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Studies of the relatively small in number and endangered Korean–Okhotsk (or western) gray whale (*Eschrichtius robustus*) population have been conducted off northeastern Sakhalin Island, Russia since 2002 [4, 6, 10]. The work is performed as a part of the monitoring program financed within the oil and gas projects Sakhalin-1 (operated by Exon Neftegas, Ltd.) and Sakhalin-2 (operated by Sakhalin Energy Investment Co.). Observations generally covered the two traditional feeding areas visited by gray whales in the summer and fall: (1) Piltun area (52°40′–53°30′ N), which stretches along the shore opposite to Piltun Bay, where the whales forage mostly at depths of less than 20 m, and (2) the Offshore area located about 30–40 km off Chaivo Bay (51°50′–52°25′ N), with depths of 35–60 m [2, 12, 22]. Recently, gray whales were also observed off the southeastern coast of the Kamchatka Peninsula [1]. Gray whale sightings took place in the waters of Nalychev Bay with depths of around 30 m in 2004; the animals were also observed in Vestnik Bay at depths of about 15–24 m and in waters of Olga Bay at depths of 5–17 m in 2006–2007 [5, 19].

Observations of the gray whale distribution off Sakhalin Island and the Kamchatka Peninsula shows that the current migration pattern of this species along the Asian coastline needs farther investigation. For this reason, the necessity arose to analyze the peculiarities of the interrelations between Korean–Okhotsk and California–Chukchi (or eastern) gray whale populations with the use of additional data obtained through up-to-date techniques. International practice has shown that many questions about the spatial distribution and biology of marine mammals, particularly cetaceans, can be successfully answered by means of photographic identification [8, 13]. Use of this method for the study of the Korean–Okhotsk population of the Gray Whale (*E. robustus*) made it possible to compose the Sakhalin gray whale catalogue [15, 18], which is updated annually. In this paper, we present the results of our efforts on photoidentification of *E. robustus* individuals sighted offshore Sakhalin Island and the Kamchatka Peninsula in 2008.

MATERIAL AND METHODS

The primary data for the gray whale photo-IDs were collected in two areas off Sakhalin Island during expeditions on the R/V *Akademik Oparin* from June 25 to July 23 and from August 24 to October 10, 2008 (Fig. 1). Between these two periods, while the vessel operated under another program off the West Kamchatka shore and along the Kuril Islands, regular day-

[1] The article was translated by the authors.

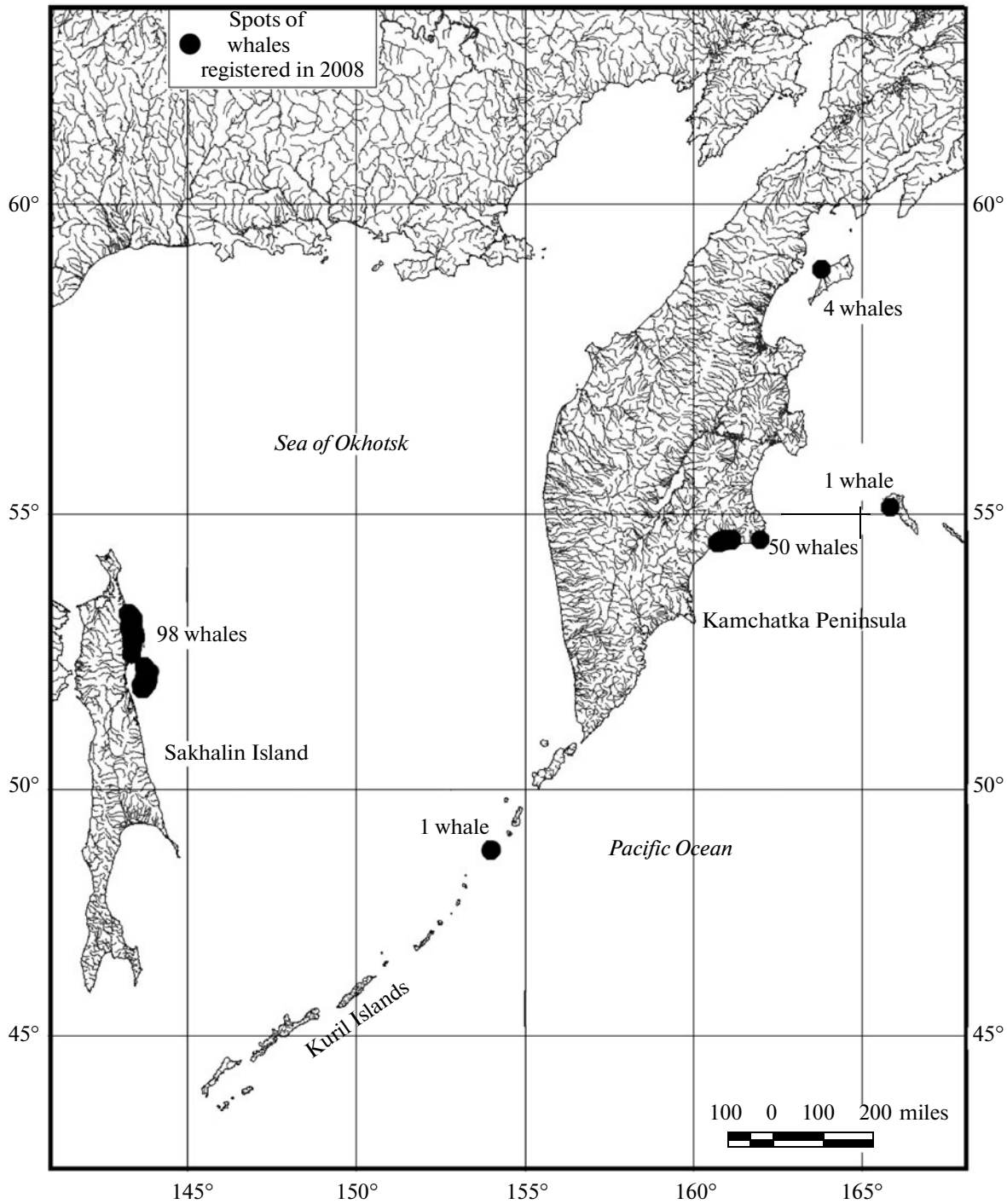

Fig. 1. Distribution of gray whales known from the Sakhalin and Kamchatkan catalogues in waters of Russian Far East in June–October 2008.

time observations of marine animal distributions were also conducted on board.

The material was obtained through the well-coordinated operations of an observer in the pilot house and a research team in a Zodiac boat. When the observer sighted a whale or a group of whales, he informed the team in the Zodiac about the location and distance to the animals, their number, and the behavior. At a distance of around 100 m from a whale, researchers began photo and video recording (with a Nikon D2X digital camera equipped with a telephoto lens Nikkor 80–400 mm and a Sony HDR-HC7 digital video camera). At the time of these operations, the position of the boat (and the whale) was fixed with a

Table 1. Number of whales identified off the northeastern coast of Sakhalin Isl. in 2002–2008

Year	Total per year	Number of whales registered earlier						Number of new whales per year	Number of whales from previous years and not sighted in the current year	Number of whales in the catalogue
		2002	2003	2004	2005	2006	2007			
A	B = C + D + E + F + G + H + I	C	D	E	F	G	H	I	J	K = B + J
2002	47	–	–	–	–	–	–	47	–	47
2003	82	35	–	–	–	–	–	47	10	92
2004	96	39	33	–	–	–	–	24	22	118
2005	117	41	40	18	–	–	–	18	19	136
2006	121(5)*	42	37	15	14	–	–	13(5)*	27	148(5)*
2007	125(4)*	40	39	16	10	7	–	13(4)*	35(5)*	160(9)*
2008	98	33	33	17	5	3	2	5	67(9)*	165(9)*

Note: * Whales in brackets have temporary ID Nos. This ID is assigned to an animal that does not have good photographs of its right side in the catalogue.

GPS receiver, and other characteristics of the environment, such as the depth, sea state, presence of other marine mammals or watercraft, the whales mud plumes, etc., were recorded.

The same type of information was collected during the studies in Olga Bay off the Kamchatka Peninsula shore (Fig. 1). Whales were photographed through a Canon 40D digital camera with a 75–300 mm telephoto lens.

Individual gray whales were identified by distinctive marks on their sides and flukes. For this, we used standard photo ID methods, which are described in Special Issue No. 12 of the International Whaling Commission [9]. Left to right side matches were recognized confidently provided all the following criteria were satisfied: (1) the whale was photographed as a solitary individual; (2) two photographic series of both sides of the whale with the same fluke were obtained during one sighting; (3) as a final check, the height, spacing and ratio of the distinctive knuckles in the ridge on the caudal peduncle were considered [7]. A whales body pigmentation was the primary feature used in identifying individuals, and scars and barnacle patches were considered as supplementary signs.

Upon being included into the Sakhalin catalogue, whales recorded off Sakhalin were assigned an ID number starting with KOGWno., and those observed in Kamchatkan waters received the code KamGW with an ID number in the Kamchatka catalogue. If known gray whales were sighted in both regions, then they were assigned dual numbers, for instance, KOGWno. = KamGWno., and included in both catalogues. Special attention was paid to finding whales with various abnormalities in physical condition of their bodies, obvious sloughing, or an anomalous skin condition.

Data obtained in previous years of studies [3, 11, 15, 17] and data from direct counts of gray whales [20] were also used when discussing the results of the photo-ID conducted in 2008.

RESULTS AND DISCUSSION

Number of Identified Gray Whales

The Sakhalin gray whale catalogue created in 2002 and updated annually now numbers 165 identified individuals (Table 1). Among the whales listed in the catalogue, some individuals have been regularly registered off Sakhalin Island for the past 6 years, other ones have not been seen for a long time, and a third group were found for the first time. In 2008, 97 gray whales from the Sakhalin catalogue were sighted on the shelf off Sakhalin Island, 24 individuals from the same catalogue were photographed in Olga Bay, Kamchatka Peninsula, and one whale was seen both off Sakhalin and Kamchatka. Thus, in 2008, we observed 122 whales known by the Sakhalin catalogue (Fig. 2).

Currently the Kamchatka catalogue, which was composed in 2004, numbers 78 gray whales; 39 of them are also included in the Sakhalin catalogue, which means they were sighted off Sakhalin previously. In 2008, among 50 gray whales registered off southeast Kamchatka, 25 individuals had never been observed previously off Sakhalin Island and therefore were not entered in the Sakhalin catalogue. It is now unclear if these whales belong to the Korean–Okhotsk

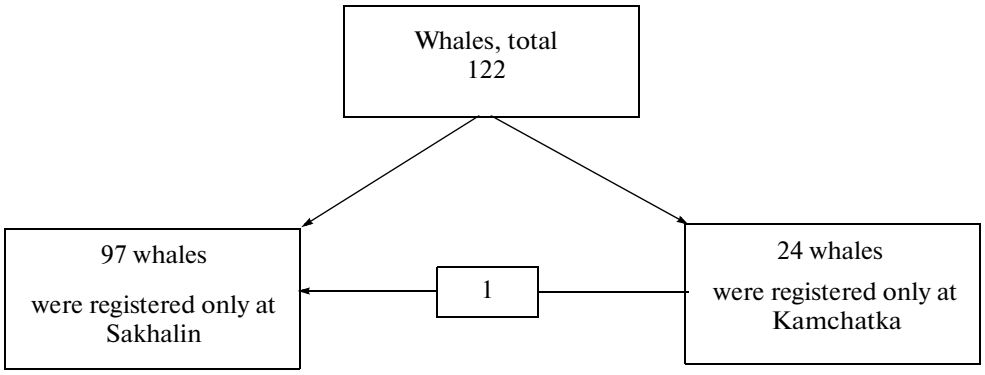

Fig. 2. The number of Gray whales that were registered, (i.e. photoidentified) in Sakhalin and in Olga Bay, Kamchatka, in 2008.

(western) or California–Chukchi (eastern) population.

In 2008, the total number of gray whales identified offshore Sakhalin Island was 98, which was fewer than in 2007 (125 individuals). This can be probably explained by the duration of the studies and the number of whale sightings. Thus, photo-ID studies offshore Sakhalin in 2008 lasted for 29 days and those in 2007 lasted for 62 days. Consequently, the number of registrations of animals in 2007 was about 2.5 times larger.

Gray Whale Movements between Feeding Areas

The data available show that gray whales not only perform seasonal migrations from their wintering sites to the areas where they forage in summer and fall, but also make significant spatial relocations in order to use resources of one or several feeding areas [3, 22]. The spatial relocations of this kind can be divided into intra-annual and inter-annual ones.

Intra-annual relocations of whales between feeding areas can be of various scales. An example of relatively small-scale relocations is whale movements between feeding areas off the northeastern Sakhalin coast. In 2008, of all the 98 whales identified in Sakhalin waters, 36 were sighted only in the Piltun feeding area, another 36, only in the Offshore feeding area, and 25 more whales were registered in both sites (Table 2). This fact indicates that some of whales use both feeding areas in the same season. Furthermore, one whale among those sighted in the Piltun and Offshore feeding areas was also found north of the Piltun area, in the nearshore waters not far from the town of Okha. Cases of intra-annual relocations like these were also recorded previously; in 2007, 38 whales were registered both in the Piltun and the Offshore feeding areas.

Table 2. Grey whale relocations between feeding areas on the northeastern shelf of Sakhalin Isl. in 2002–2008

Year	Number of whales identified in various areas						
	Piltun	Offshore	Piltun and Offshore	Chaivo	Chaivo/Piltun and Chaivo/Offshore	northern areas	Chaivo/Piltun/Offshore
2002	13(12)*	35(34)	1	–	–	–	–
2003	51(47)	35(31)	4	–	–	–	–
2004	95(89)	7(1)	6	–	–	–	–
2005	114(109)	7(2)	5	–	–	5(1)	–
2006	105(67)	33(14)	16	28(7)	19(1)	–	2
2007	93(48)	70(25)	38	20(0)	13(0)	–	7
2008	61(36)	61(36)	25	1(1)	–	1	–

Note: * Whales in brackets were registered only in the areas above.

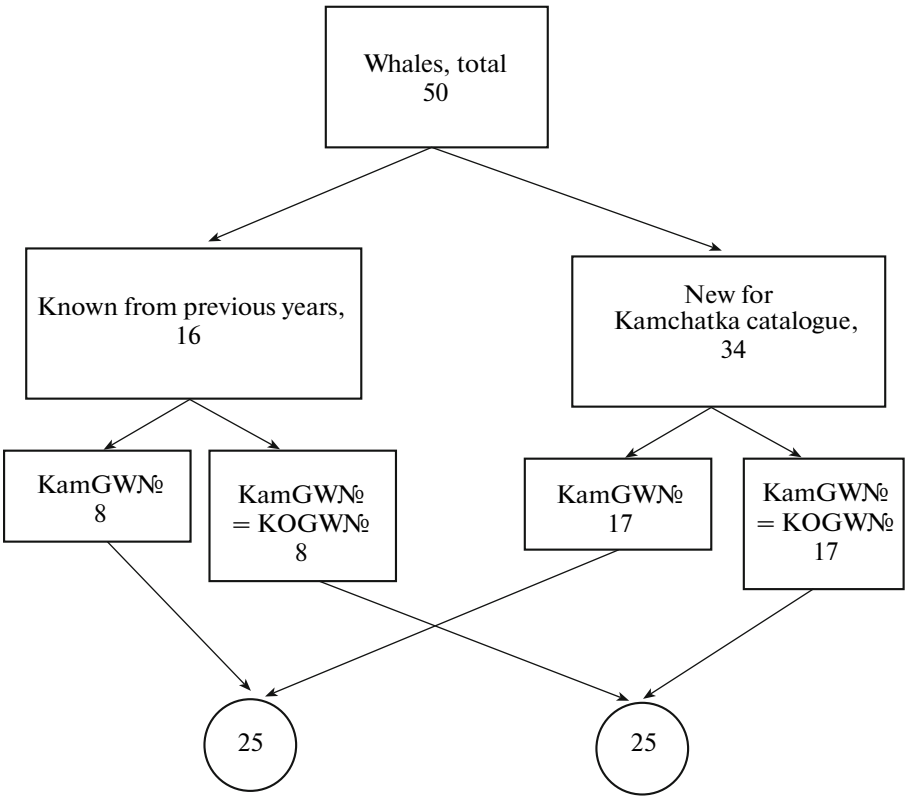

Fig. 3. Gray whales from the Sakhalin catalogue that were registered off the northeastern coast of Sakhalin Isl. (KOGWno.) and in Olga Bay, southeastern coast of the Kamchatka Peninsula, (KamGWno.) in 2008.

It was also established that whales may forage both in Sakhalin waters and off Kamchatka during the same season, which means they make large-scale intra-annual relocations. Two whales in 2006 and one whale in 2008 were first identified off Kamchatka, and later in the season they were found again in the Offshore feeding area off Sakhalin. In 2007, 13 whales sighted off Kamchatka were then observed in Sakhalin waters.

Inter-annual relocations are whale movements between feeding areas over consecutive years. Thus, some of the whales that were seen in 2008 only in the Piltun feeding area were recorded in the Offshore feeding area in previous years. Half of the whales registered in Olga Bay, Kamchatka Peninsula, in 2008 previously had been recorded off Sakhalin (Fig. 3). Those ten whales recorded off the Sakhalin shore in 2008 were also sighted off Kamchatka in 2007. In 2007, 20 of 37 whales identified on the southeastern shelf of Kamchatka had been sighted off Sakhalin in previous years. Similarly, 5 whales of the 13 sighted off Kamchatka in 2006 were also observed off Sakhalin Island both in previous and subsequent years.

It should be mentioned that, besides the previously known areas of whale aggregations that form off the northeastern coast of Sakhalin Island and off the Kamchatka Peninsula in the summer and fall, other areas in far eastern seas exist where representatives of the western gray whale population have been repeatedly observed. After the pictures of three whales photographed in Kekurny Bay on July 13, 2006 and Babushkin Bay on July 28, 2006 in the Northern Sea of Okhotsk, were analyzed the animals were included in the new catalogue under the ID code NOGW [19]. In 2007, one of these whales was sighted both in the Piltun feeding area and in Olga Bay and therefore assigned the ID number KOGW159/KamGW034/NOGW003 in the Sakhalin and Kamchatkan catalogues. Furthermore, one whale that was registered in Olga Bay, Kamchatka Peninsula, in 2007 was then photographed in Zakatny Bay off Shiashkotan Island, Kuril Ridge, in 2008. Later in 2008, this whale was sighted again in Olga Bay (Fig. 1). On June 6, 2008, one whale photographed near Medny Island, Commander Islands, had been encountered in Olga Bay, Kamchatka, in 2007, and then was sighted again in Olga Bay in August 2008. Four gray whales observed off Karaginsky Island, Northeast Kamchatka, on July 8, 2008, previously had not been sighted anywhere else (Fig 1). It is difficult to judge if the new locations of gray whale sightings given above are potential feeding areas for these animals, because data are scarce and no reliable evidence of their foraging there has been obtained. But we may suppose that these are cases of spatial relocations that gray

whales make in search of sites with enough food resources.

Data on the movements of young whales are of great interest. A total of eight whales first recorded as calves off Sakhalin in 2007 were photographed in Olga Bay, Kamchatka Peninsula, in the following year. A whale identified as a suckling calf in the Piltun feeding area in 2004 was never seen there subsequently but was regularly registered off Kamchatka in 2006, 2007, and 2008. Similarly, two calves that were identified first in the Piltun area in 2003 were observed only off Kamchatka during the 3 years noted above. One whale that was identified as a calf off Sakhalin in 2005 was repeatedly sighted there in 2006 and 2007 and then photographed off Kamchatka in 2007 and 2008.

Mother–Calf Pairs

Unlike other categories of whales, mother-calf pairs were registered only in the Piltun feeding area until 2008. They were observed most frequently in shallow waters near the Piltun Bay opening, in the sites of higher concentrations of benthic organisms, where mothers teach their offspring to forage from July through mid September. In 2008, three cow–calf pairs and two independent young whales, possibly calves, were photographed in the Piltun feeding area.

In 2008, for the first time in the entire period of studies one cow–calf pair was recorded in Olga Bay, Kamchatka Peninsula. Previously, this mother was recorded offshore Sakhalin in 2002–2006 and in Olga Bay, Kamchatka, in 2007. In 2003, the female brought her calf to Sakhalin. The low occurrence of mother–calf pairs in Kamchatkan waters can be more probably explained by the smaller scale and shorter duration of gray whale observations, as compared to those conducted off Sakhalin.

The Physical Conditions of Whales

As we showed earlier in materials collected in 2005–2007, characteristics of the bodys physical condition (BPC) in the underfed and sometimes very emaciated whales that arrive to feed offshore Sakhalin Island in the spring greatly improve during summer [16].

In 2008, the BPC in 20 whales (including three nursing cows) photographed offshore Sakhalin in the beginning of the season was lower than the normal level. For the summer and fall season, the body condition of eight whales improved to the normal level. However the rest of the animals either did not restore their normal BPC or were not observed in the late season. Furthermore, five of the six nursing cows that had subnormal body conditions in 2007 were again photographed in 2008 when all five had regained their optimum physical state. As in previous years, the body condition of all the calves recorded in 2008 fitted the optimum.

The high-quality photographs also allowed evaluations of skin condition. In 2008, no whales were recorded with skin sloughing, as had been the case previously [21]. However, two individuals had noticeable white patches of an unknown nature on their skin; the same had been earlier observed in western grey whales [14].

CONCLUSIONS

Based on the results presented here, it can be concluded that adult individuals of the studied population of gray whales perform intra- and interannual relocations between the Piltun, Offshore, and Kamchatkan areas. One of the probable explanations of a behavior like this is changes in food abundance, although comprehensive monitoring studies of the composition and resources of benthos and nektobenthos in the newly discovered areas of whale sightings are needed to substantiate this statement.

Half of the gray whales listed in the Kamchatka catalogue (39 of 78 individuals) probably belong to the western population, while the affiliation of the other half remains unclear. The same can be said about the whales identified off the southeastern shore of Kamchatka in 2008; half of them (25 of 50) had been earlier included in the Sakhalin catalogue, and the population status of the remaining ones is undetermined. These results allow us to make two suppositions: (1) a substantial proportion of gray whales of unknown origination belong to the western population but they have not been sighted near Sakhalin Island to date; or (2) these gray whales belong to the eastern population. In the former case, it is necessary to ascertain why individuals of the western population have not been registered near Sakhalin Island. With the latter supposition, we can assume that gray whales of the eastern and western populations are not sufficiently isolated from one another geographically, and an overlap of their ranges exists in feeding areas.

The recent gray whale sightings in the Northern Sea of Okhotsk, off Shiashkotan Island, Kuril Ridge, and off Medny Island, Aleutian Ridge, indicate that these animals can be encountered in places other than off northeast Sakhalin Island or southeast Kamchatka. However, up to this time, encounters like these have remained sporadic and it is still poorly known why and how frequently these sites are visited by gray whales.

To better understand the degree to which western grey whales have fidelity to certain feeding areas, to reveal peculiarities in the movements made by animals between the feeding areas, to establish the frequency of their visits, and to find the causes of these movements, we need additional data that would cover the entire variety of gray whale habitats and the routes of their seasonal migrations.

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