



# Sakhalin Energy Investment Company Ltd.

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## DISTRIBUTION AND ABUNDANCE OF GRAY WHALES OFFSHORE NORTHEAST SAKHALIN IN JULY-SEPTEMBER OF 2019

РАСПРЕДЕЛЕНИЕ И ЧИСЛЕННОСТЬ СЕРЫХ КИТОВ В ШЕЛЬФОВЫХ ВОДАХ  
СЕВЕРО-ВОСТОЧНОГО САХАЛИНА В ИЮЛЕ-СЕНТЯБРЕ 2019 Г.

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Сахалинский государственный университет  
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**РАСПРЕДЕЛЕНИЕ И ЧИСЛЕННОСТЬ СЕРЫХ КИТОВ В ШЕЛЬФОВЫХ  
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**ОТЧЕТ ОБ ИССЛЕДОВАНИЯХ  
В РАМКАХ «ПРОГРАММ МОНИТОРИНГА СЕРЫХ КИТОВ  
У СЕВЕРО-ВОСТОЧНОГО ПОБЕРЕЖЬЯ ОСТРОВА САХАЛИН  
на 2019 г.»**

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(SSU)**

**DISTRIBUTION AND ABUNDANCE OF GRAY WHALES  
OFFSHORE NORTHEAST SAKHALIN IN JULY-  
SEPTEMBER OF 2019**

**REPORT ON SURVEYS  
CONDUCTED UNDER THE 2019 PROGRAMS FOR GRAY WHALE  
MONITORING OFFSHORE NORTHEAST SAKHALIN ISLAND**

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Sakhalin Energy Investment Company  
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## **ABSTRACT**

Report on 66 p., 6 tables, 16 figures, 9 references, 2 attachments.

Key words: gray whale, Sakhalin, Piltun, distribution, abundance.

The report provides information on the results of monitoring the distribution and abundance of gray whales offshore northeast Sakhalin carried out in July-September 2019. The surveys were conducted as part of the joint program of Exxon Neftegas Limited and Sakhalin Energy Investment Company Ltd., and the monitoring program of Gazpromneft-Sakhalin LLC.

The data obtained indicate that the gray whale distribution within the Piltun feeding area in July-September of 2019 was generally typical of these waters: in terms of an overall seasonal pattern, their primary gathering location (over 73% of individuals on average over these two months) was in the near-shore waters at the mouth of Piltun Bay, within 3 km offshore at depths of up to 10-15 m. As in the previous 5-6 years, gray whales were observed in the Offshore feeding area throughout all season in its eastern part in water areas with depths from 40-45 to 65-70 m, and their main concentration was observed in the northern part of this water area at a distance of 55-60 km from the island shore.

The total number of gray whales recorded at any one time during synchronized surveys offshore eastern Sakhalin amounted to 160 animals in 2019, which was the highest value of this indicator for the entire period of modern monitoring (since the mid-1980s).

**Survey groups involved in gray whale distribution and abundance monitoring programs:**

**1. Onshore Vehicle-Based Surveys:**

The shore-based surveys in the Piltun feeding area in 2019 were carried out by the teams of observers consisting of P. van der Wolf, V. Chernitsyn, D. Korobov, A. Bobkov, S. Ivanenko, D. Nam, etc.

The designated entity in charge of the operations was the Sakhalin State University (SSU).

**2. Offshore Surveys:**

Vessel-based surveys in the Offshore feeding area in 2019 were carried out on board the *Katun* vessel (ENL) by a group of observers composed of A. Yakovlev (National Research Center of Marine Biology with the Far East Branch of Russia's Academy of Sciences), M. Kozlov, A. Tishchuk, and A. Chesnokov (all from SSU).

O. Mukhametova and A. Semyonov carried out surveys on board the *Siem Sapphire* vessel (Gazpromneft-Sakhalin).

The research group composed of V. Kavun, Candidate of Sciences (Biology), A. Pogonyshev, and Yu. Korobeinikov (all from SSU) carried out surveys on board the *Polar Baikal* vessel (Sakhalin Energy).

Scientific consultant for the scope of the gray whale distribution and abundance monitoring activities was V. A. Vladimirov, Candidate of Sciences (Biology) (from RPO "Marine Mammals Council", Moscow).

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## **INTRODUCTION**

The elevated vulnerability of the Sea of Okhotsk gray whale population listed in category 1 (“endangered” taxa) of the Red Book of the Russian Federation and in the similar category (Endangered) of the Red List of the International Union for Conservation of Nature (IUCN), necessitates the annual monitoring of gray whales in Sakhalin waters, one of the most important components of which is to study the distribution and abundance of these animals during their key summer-autumn feeding period. The gray whale surveys offshore Sakhalin island covered in this report were carried out during the July-September period of 2019 and incorporate the results of gray whale monitoring offshore northeast Sakhalin Island obtained during the execution of both the Joint Program of Exxon Neftegas Limited (ENL) and Sakhalin Energy Investment Company Ltd. (Sakhalin Energy), and the environmental monitoring program of Gazpromneft-Sakhalin LLC (Gazpromneft-Sakhalin, GPN-S). The monitoring programs were approved by the federal executive bodies: the Russian Federation Ministry of Natural Resources (Minprirody of Russia), the Federal Service for Nature Use Oversight (Rosprirodnadzor), and the Federal Fisheries Agency (Rosrybolovstvo) in accordance with the established procedure. Financing and logistics of the entire work scope was provided by ENL, Sakhalin Energy, and Gazpromneft-Sakhalin - the operators of the Sakhalin-1, Sakhalin-2, and Sakhalin-3 oil and gas projects, respectively.

### **1.1 Main Objectives of Vessel- and Shore-Based Monitoring Programs for Gray Whale Distribution Offshore Northeast Sakhalin Island:**

1. Determine seasonal and year-to-year spatial and temporal gray whale distribution patterns in the Piltun and Offshore feeding areas;
2. Determine the total number of whales during the main feeding period in the Piltun and Offshore feeding areas;
3. Collect data on the distribution and abundance of other marine mammal species identified during observations;
4. Identify signs of adverse impacts on the distribution and abundance of gray whales, associated with human activities in the waters off NE Sakhalin.

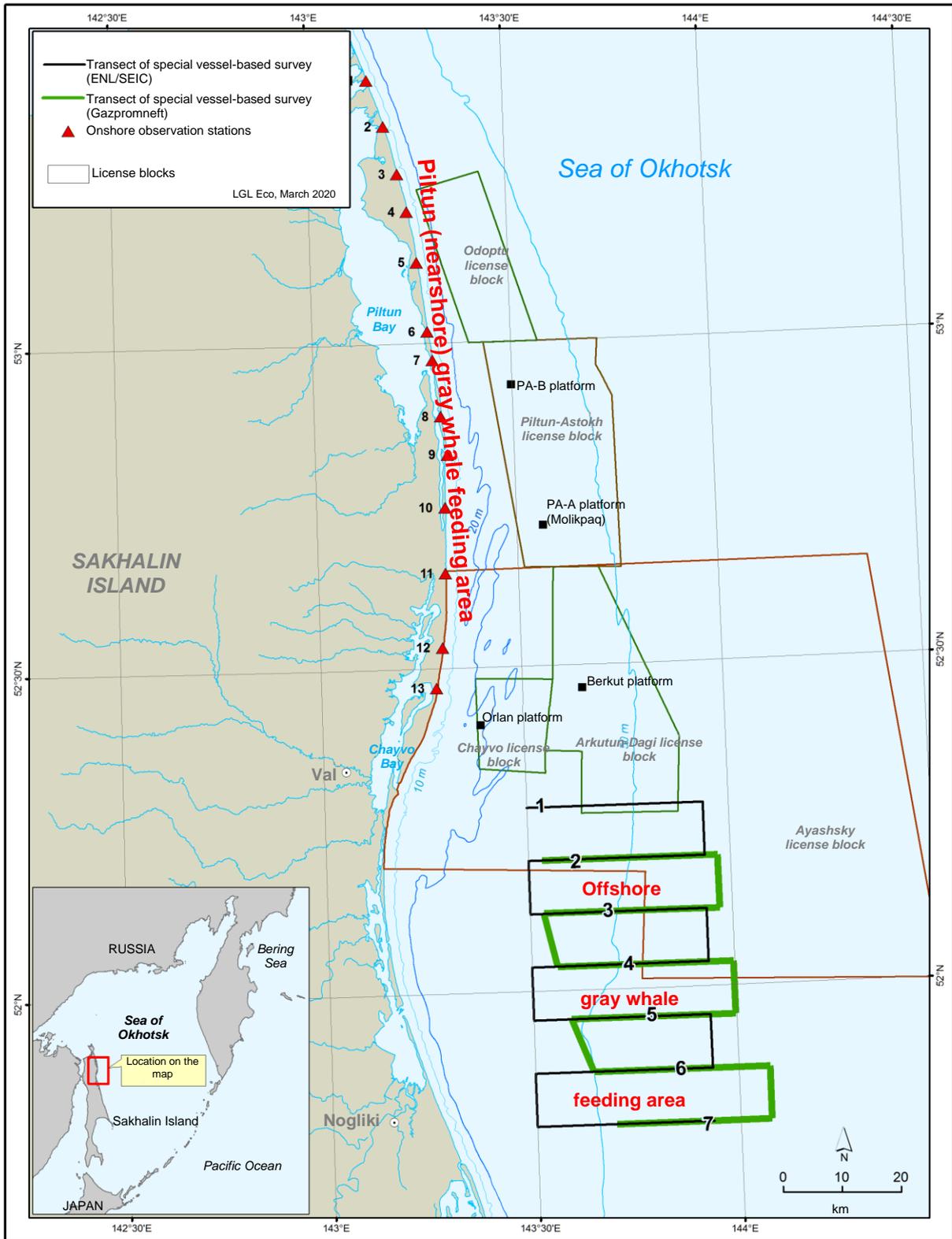
## OPERATIONAL PROCEDURES

The methods for gathering field materials during shore- and vessel-based surveys, followed by their laboratory processing, data analysis, and mapping have been adequately refined and remains practically unchanged over the last 10-12 years. All these methods were covered at length in the past in the relevant sections of the report under the “2011 Joint Program of Gray Whale Monitoring Offshore Northeast Sakhalin Island” (Vladimirov et al., 2012).

In 2019, as in all previous years, the shore-based surveys of the Piltun feeding area were carried out from 13 elevated shore observation stations (OS) by several mobile groups moving from one OS to another on all-terrain vehicles. The location of shore-based OS periodically changes slightly due to erosion of the island coastline, but remains unchanged since 2015 (Figure 2-1).

In 2019, the vessel-based surveys in the Offshore feeding area were carried out mainly on board the *Katun* vessel operating under the ENL program (5 surveys), and to a lesser extent on board the *Siem Sapphire* vessel as part of the GPN-S monitoring program (2 complete surveys); 1 more survey was carried out from the Sakhalin Energy *Polar Baikal* vessel. The surveys were carried out from the *Katun* and *Polar Baikal* vessels according to the same transect grids as in 2018 (the standard grid used by ENL and Sakhalin Energy in recent years). The survey from the GPN-S vessel *Siem Sapphire* covered a largely similar tack grid slightly shifted east to obtain data on the presence of gray whales in the deeper part of the offshore area farther away from the coast (Fig. 2-1).

The direct gray whale observation and location procedure in 2019 remained unchanged, which is why the results of this survey are fully consistent with those in previous years.



**Figure 0-1.** Location of onshore and vehicle-based observation stations of gray whales in the Piltun feeding area and planned transects of vessel-based surveys in the Offshore feeding area in July-September 2019.

During the compilation of the cartographic materials for this report, the total distribution of gray whales throughout the entire monitoring period (July-September) is shown on pseudo-isolinear maps of their occurrence. The characteristics of the spatial distribution of animals over shorter periods of the monitoring season (monthly or throughout the main feeding period), as well as during the sessions of control scanning of the Piltun and Offshore feeding water areas are shown on the so-called “sighting” (point) maps, on which the icons indicate the exact location of each whale or each of their localized pods sighted during the scan.

In addition, it should be noted that the distribution of gray whales according to the surveys conducted from the *Siem Sapphire* and *Polar Baikal* vessels is shown on separate maps rather than the general map based on the combined data from all surveys (including the data obtained from the *Katun* vessel). The latter is due to the fact that, in terms of methodology, the 2019 marine surveys were carried out with some differences: firstly, all three vessels used for the surveys had different height of the bridge from which observations were conducted (which, most likely, affected whale sighting to a certain extent), and secondly, part of the transect grid covered by *Siem Sapphire* differed spatially from the standard grid covered by the *Katun* and *Polar Baikal* vessels. The above circumstances may have affected the comparability of the data obtained during the surveys (especially from the *Polar Baikal*, whose bridge was 2-2.5 times lower than that of *Katun* and *Siem Sapphire*), which is taken into account in the subsequent analysis of the data.

## SURVEY EFFORTS AND ACQUIRED MATERIALS

### 1.2 Shore-Based Surveys

The 2019 field work involving a shore-based survey of gray whales in the Piltun feeding area covered a period of 85 days (July 8 through September 30). During this time, 8 complete synchronized surveys were carried out in this water area – on July 8, 22 and 29, on August 19 and 26, on September 16, 23, and 30. Another survey (September 2) was not carried out completely due to visibility deterioration (thickened fog).

Altogether, 88 sightings of single gray whales or pods were recorded during the shore-based surveys in the Piltun feeding area, and the total number of animals sighted (including those re-sighted) was 96 (Table 3-1).

In addition to gray whales, 6 encounters of minke whales (6 animals) and 3 encounters of harbour porpoises (5 animals) were also recorded in the course of shore-based surveys.

The information on the time and coordinates of all animal encounters is provided in Attachment 1.

**Table 0-1.** The number and overall results of the onshore vehicle-based surveys of gray whales covering the Piltun feeding area in July-September of 2019

Month	Odoptu-Piltun section (OS 1-8)		
	Complete surveys	Number of whale sightings	Total number of recorded whales
	<i>n</i>		
July	3	4	4
August	2	10	10
September	3*	30	32
Total	8	44	46

Month	Astokh-Chayvo section (OS 9-13)		
	Complete surveys	Number of whale sightings	Total number of recorded whales
	<i>n</i>		
July	3	19	23
August	2	7	8
September	3*	18	19
Total	8	44	50

Month	Total (OS 1-13)		
	Complete surveys	Number of whale sightings	Total number of recorded whales
	<i>n</i>		
July	3	23	27
August	2	17	18
September	3*	48	51
Total	8	88	96

Note:

The number of sightings of gray whales and the number of recorded animals include all whales and their pods encountered during the work, including the animals recorded in the protocols with the comments “previously encountered” or “possibly previously encountered” from previous observation points, regardless of whether they were sighted during complete or partial surveys.

Complete surveys within a certain section are those during which monitoring was performed at all observation points (OS 1-8 covering the Odoptu-Piltun section and OS 9–13 covering the Astokh-Chayvo section); complete synchronized surveys covering the entire area are the surveys completed within both sections.

\* - one more survey was carried out partially (data on sightings and the number of whales are included in the table)

### **1.3 Vessel-Based Surveys**

From July 18 to September 28, 2019, , 8 complete vessel surveys were carried out in the waters of the Offshore feeding area (Table 3-2), including 5 surveys on board the *Katun* vessel (ENL), 2 surveys from the *Siem Sapphire* vessel (GPN-S), and 1 survey from the *Polar Baikal* vessel (SEIC). The term “complete survey” implies that the planned survey route was fully covered.

From the very beginning, the survey from *Siem Sapphire* conducted on August 16 was carried out in poor visibility conditions; as a result, it was completed by less than 30% of the tacks and was suspended due to deteriorating weather conditions (dense fog). Seven more surveys planned under the GPN-S program on July 31, August 3 and 6, September 1, 6, 29, and October 3 were not possible due to extremely unfavorable weather conditions on these days (dense fog or very rough sea).

Only the data from complete surveys were used in further analysis and discussions of the obtained results. The data of the surveys conducted on August 16 from *Siem Sapphire* and on September 28 from *Polar Baikal* were considered from the perspective of additional qualitative characteristics of the distribution of whales (the reasons for this are explained in Section 2, Operational Procedures).

A total of 357 encounters of pods and individual gray whales were recorded (a total of 631 animals) during the completed surveys, as well as 97 encounters of other marine mammals – minke whales (18 encounters, 20 animals), killer whales (6 encounters, 19 animals), common and Dall’s porpoises (31 encounters, 66 animals, and 7 encounters, 15 animals, respectively), northern fur seals (26 encounters, 27 individual animals), Steller sea lions (3 encounters, 3 animals), larga seal (5 encounters, 5 animals), 1 encounter of a single ringed seal, and 1 encounter of a single seal whose species could not be determined (Table 3-2).

**Table 0-2.** Number of gray whale and other marine mammal sightings during vessel-based surveys covering the Offshore feeding area in July-September of 2019

Vessel name	Survey date	Species *									
		GW	MW	KW	HP	DP	NFS	SL	RS	LS	S (n/d)
<i>Katun</i>	18.07	68	5		12	2					
<i>Katun</i>	11.08	52	5		21		2			5	
<i>Katun</i>	25.08	61	5	3	32	4	18		1		
<i>Katun</i>	4.09	86	3	6	1		2				1
<i>Katun</i>	15.09	151		8			2	1			
	<b>Total:</b>	<b>418</b>	<b>18</b>	<b>17</b>	<b>66</b>	<b>6</b>	<b>24</b>	<b>1</b>	<b>1</b>	<b>5</b>	<b>1</b>
<i>Siem Sapphire</i>	16.08**	6									
<i>Siem Sapphire</i>	22.08	26	1			4					
<i>Siem Sapphire</i>	11.09	132	1	2		2	3	1			
	<b>Total:</b>	<b>164</b>	<b>2</b>	<b>2</b>		<b>6</b>	<b>3</b>	<b>1</b>			
<i>Polar Baikal</i>	28.09	49				3		1			
	<b>Grand total:</b>	<b>631</b>	<b>20</b>	<b>19</b>	<b>66</b>	<b>15</b>	<b>27</b>	<b>3</b>	<b>1</b>	<b>5</b>	<b>1</b>

Notes:

- \* GW - gray whale, MW - minke whale, KW - killer whale, HP - harbour porpoise, DP – Dall’s porpoise, NFS - northern fur seal, SL - sea lion, RS - ringed seal, LS – larga seal, S (n/d) – seal (whose species could not be determined)
- \*\* - the survey was suspended due to deteriorating weather conditions (fog)

More detailed information on the gray whales recorded in the Offshore feeding area in 2019 during vessel-based surveys is presented in Sections 4.1.2 and 4.1.4.2 of this report, while the information on other marine mammals is presented in Section 4.2. Reference data on their observations are provided in Attachment 2.

## **SURVEY RESULTS**

### **1.4 Gray Whale Distribution and Abundance**

#### **1.4.1 Piltun Feeding Area**

Weather and logistics allowed us to conduct only 8 complete shore-based synchronized surveys during July-September 2019, covering the entire feeding area (July 8, 22, and 29, August 19 and 26, September 16, 23, and 30). While the data obtained do not allow us to identify all detailed aspects of seasonal distribution and dynamics of the number of whales during the above period, they nevertheless provide a general idea of the overall nature thereof (for technical and statistical survey findings, see Attachment 1).

##### **1.4.1.1 Dynamics of the Number of Whales Simultaneously Sighted in Piltun Area**

In seasonal terms, based on the data of 8 complete surveys, two periods of increased occurrence of animals were observed in the dynamics of the total number of gray whales in the feeding area (Figure 4-1). During the first period, from the end of the first to the beginning of the third ten-day period of July, the number of whales recorded in the water area reached 14 animals during one survey, then there was a decrease in the occurrence of up to 5 animals at the end of this month, giving way to a gradual, although not always uniform increase in this indicator until the third ten-day period of September, when the number of recorded whales exceeded the July values, increasing to 17 animals (Table 4-1).

The data obtained allows the assumption that the July period (up to the end of its second decade) marks an active migration of animals from the wintering ground to the Piltun feeding area. However, most of the whales who had arrived here left this water area, moving, most likely, to the Offshore feeding area (Table 3-2, Figure 4-7). As a result, the number of gray whales encountered during the surveys decreased from 14 animals as of July 22 to 5 animals as of July 29. Subsequently, the number of animals recorded during the surveys started to increase again, although slower and not at a steady pace, however, by the beginning of the third 10-day period of September (by September 23) the number of whales reached 17, which became the seasonal maximum for this indicator. A gradual autumn exodus of animals from the Piltun feeding area began in the late September, as in most of the previous years, and the number of whales recorded here on September 30 once again decreased to 12 animals (Figure 4-1, Table 4-1). Thus, based on the data collected, the seasonal dynamics of the gray whale population in the Piltun feeding area in the summer-autumn period of 2019 was slightly

different from the dynamics observed in previous years, and was characterized by an increase in the number of animals that continued up to the third 10-day period of September, whereas the period from early August until the second decade of September is usually characterized by a relatively stable number of gray whales present in the area.

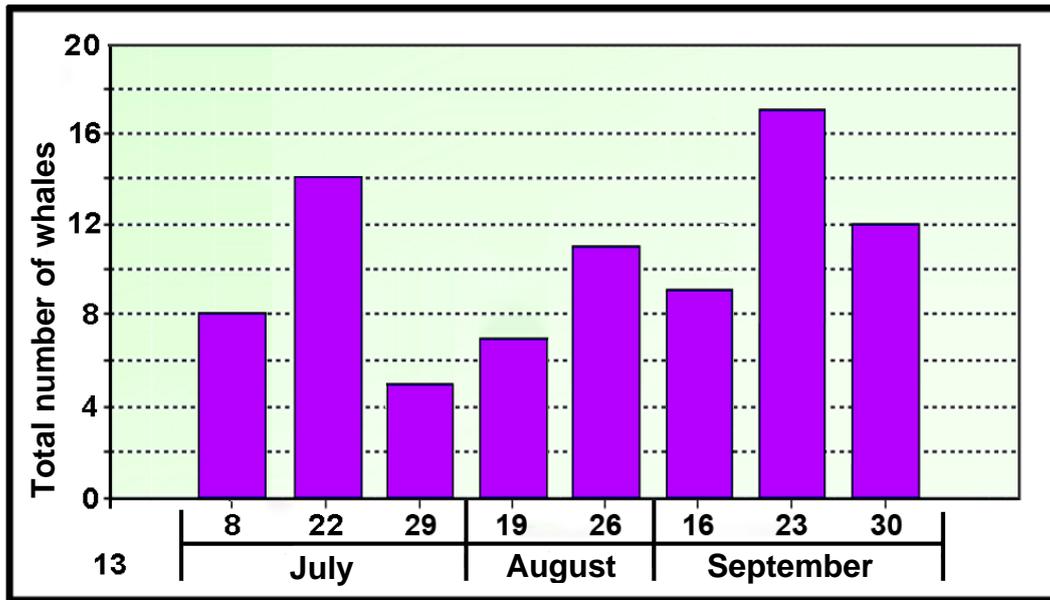
According to complete surveys, the total average seasonal abundance of gray whales present in the Piltun feeding area during July-September 2019 amounted to 10.4 animals/survey. During the main feeding period, which in Eastern Sakhalin is considered to be a 2-month period from August to September, the average number of whales in 2019 turned out to be somewhat higher, amounting to 11.2 animals/survey, which slightly exceeds the number recorded in 2018 (6.4 animals/survey), but is significantly lower than the numbers recorded during the previous 14 years of monitoring (similar situation will be discussed in more detail in Section 5 “Discussion of Results” below).

**Table 0-1.** Number of gray whales recorded during complete shore-based surveys in the Piltun feeding area in July-September of 2019

Survey date	Odoptu-Piltun section (OPS)								Astokh-Chayvo section (ACS)					Subtotal		
	Observation station (OS) number								OS number					OPS	ACS	Total
	1	2	3	4	5	6	7	8	9	10	11	12	13			
July																
8							1	1	2	4				2	6	8
22								2	12					2	12	14
29									3	1		1			5	5
August																
19								4		3				4	3	7
26						3	1	2	5					6	5	11
September																
16								6	3					6	3	9
23								6	6	1	3	1		6	11	17
30	1					1		2	7		1			4	8	12
Total	1					4	2	23	38	9	4	2		30	53	83

**Note:**

Whales recorded in survey protocols with the comment “previously encountered” or “possibly previously encountered” are not included in the table, as well as whales recognized by scientists during the preliminary analysis of the collected data as repeatedly encountered. Empty cells indicate that no whales were present in the area observed from the respective observation point (points).

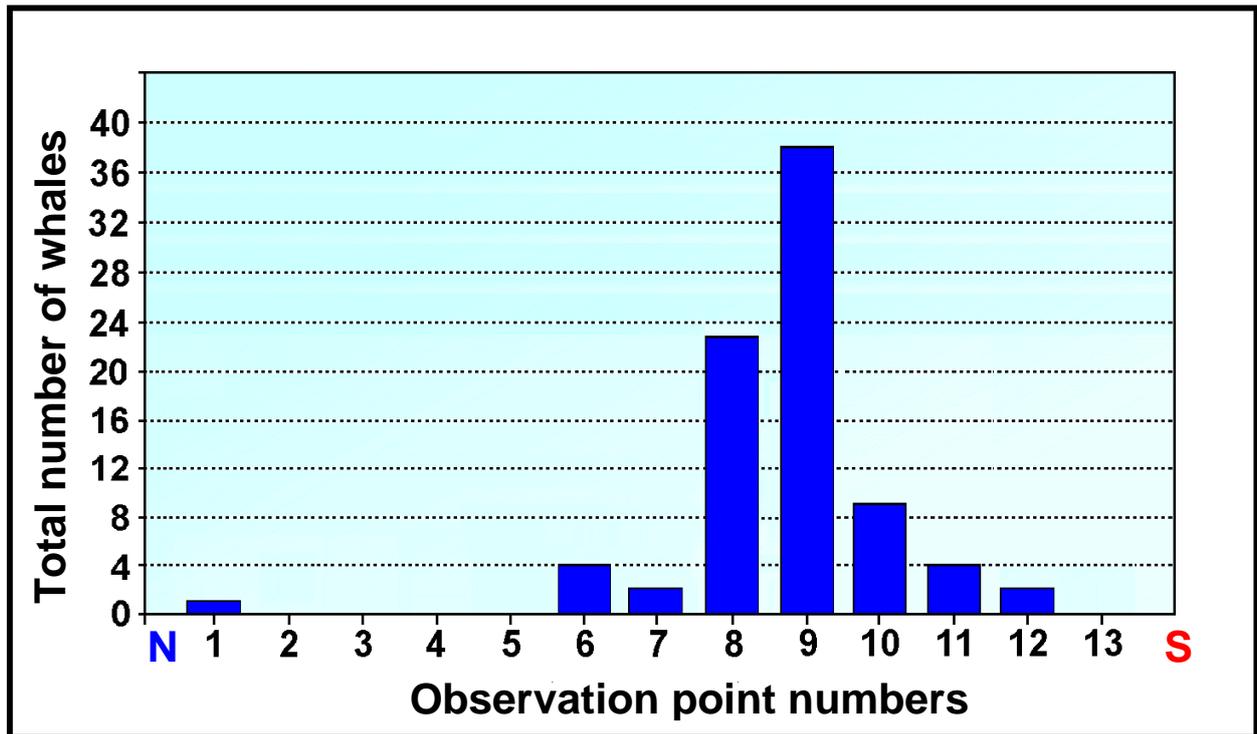


**Figure 0-1.** Seasonal quantitative dynamics of simultaneous gray whale sightings in the Piltun feeding area in July-September 2019 (according to data from complete shore-based surveys)

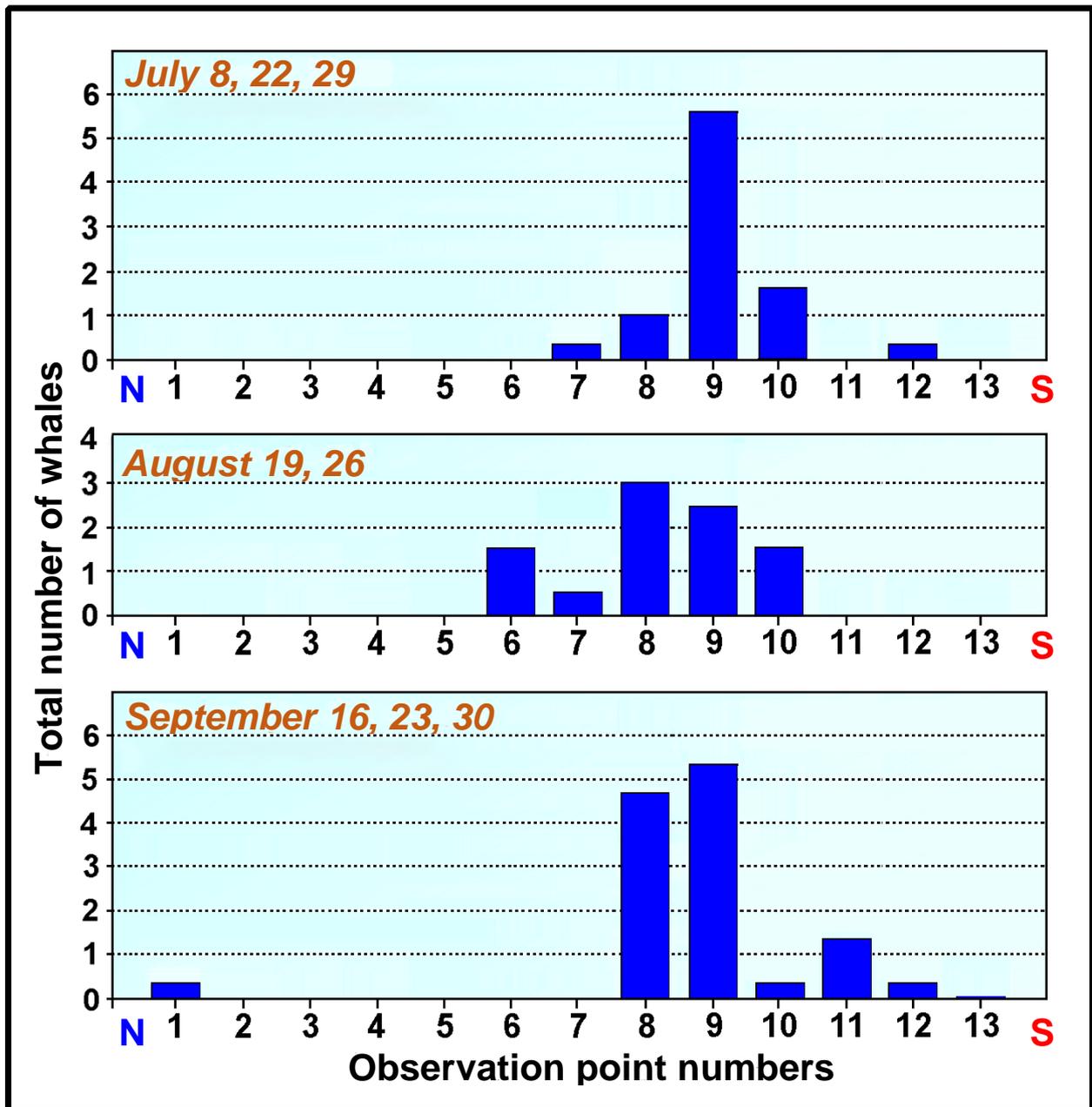
#### 1.4.1.2 Spatial Distribution and Seasonal Variations of Whales

The number of gray whales simultaneously present in the Piltun feeding area during the July-September surveys of 2019 was relatively small with their distribution varying slightly over the monitoring season. As can be seen from the charts based on the analysis of shore-based survey findings throughout the monitoring season (July 8 - September 30), the majority of animals (total of 73.5%) stayed in the water area adjacent to the mouth of the Piltun Bay, mainly near OS 9 and, to a lesser extent, near OS 8 (Figure 4-2). During the season, the concentration of whales in the area opposite these two OS varied slightly, decreasing from 74.1% of the animals recorded in the area in July to 61.1% in the second half of August, and then in September almost returning again to the July level (78.9%) (Table 4-1, Figure 4-3).

Whales were generally present in much smaller numbers to the south and, especially, to the north of this localized estuary zone – only 18.1% of the total number of animals recorded during the season were found on the southern edge of the area (in the area of OS 10-13) and 8.4% to the north (in the area of OS 1-7) (Table 4-1, Figure 4-2). The occurrence of animals in these sections of the feeding area varied seasonally, but there were no obvious trends in these changes. Only in the third ten-day period of September the signs of commencing migration of whales to the south, presumably in the direction of the Offshore feeding area, which are rather typical for this part of the season, began to appear (Figure 4-3).



**Figure 0-2.** Quantitative distribution of gray whales in the Piltun area in July-September 2019 by water area sections adjacent to the observation points (based on the data from complete shore-based surveys)



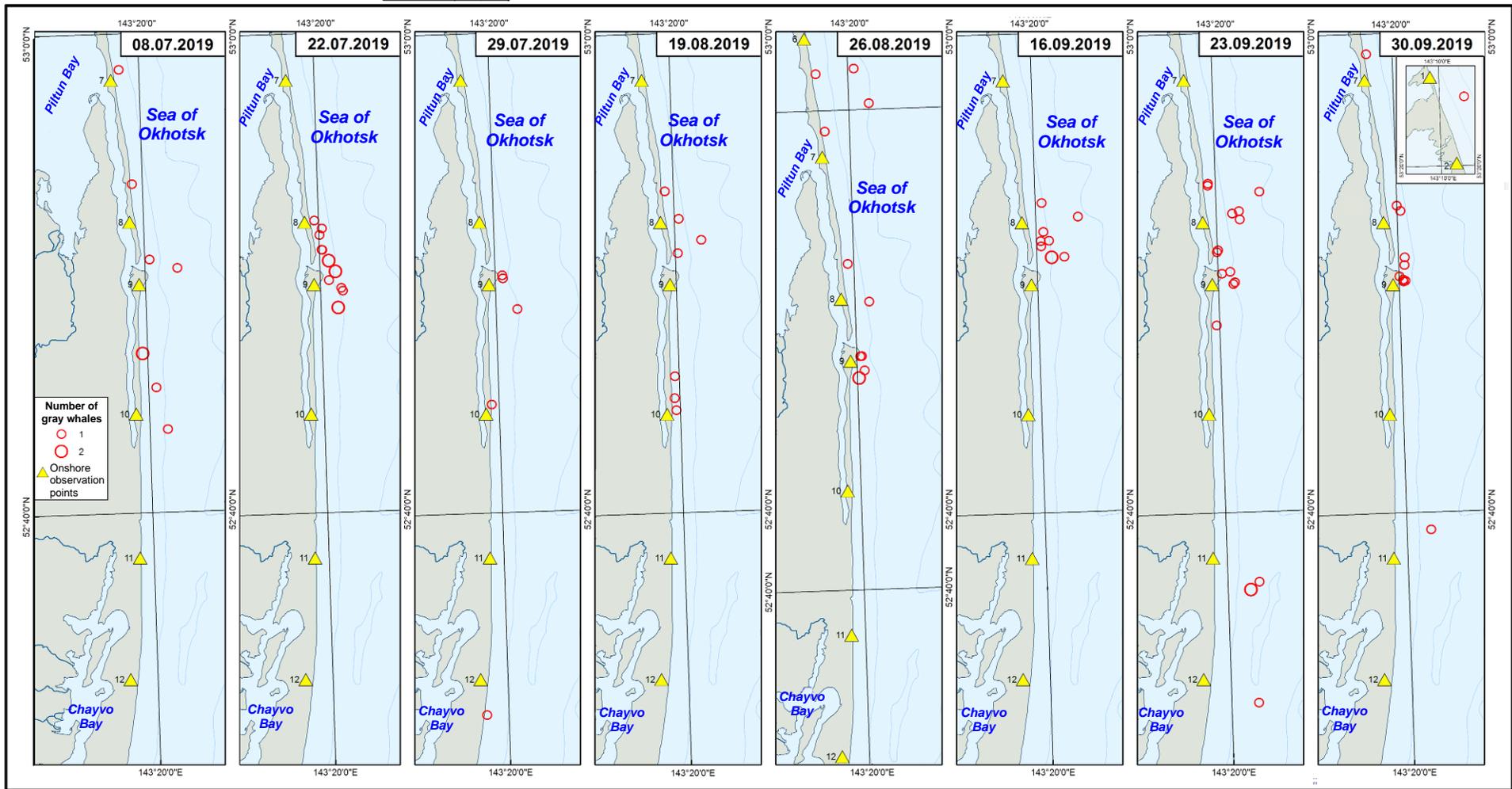
**Figure 0-3.** Seasonal variations in the quantitative distribution of gray whales in the Piltun area in July - September 2019 by water area sections adjacent to the observation points (based on the data from complete shore-based surveys)

The respective maps plotted on the basis of the analysis of gray whales sightings during shore-based surveys provide a spatial characterization of the quantitative aspects of their distribution in the Piltun area as shown above (Figure 4-4). Confirming the facts visualized on the corresponding graphs, the maps show that during the season the whales consistently stayed mainly across the mouth of Piltun Bay, in the area of OS 8 and 9. Occasionally, individual animals would shift slightly from this area, more often to the south, less often to the north (Figure 4-4). In this case, whales did not form concentrated pods, but were distributed more or

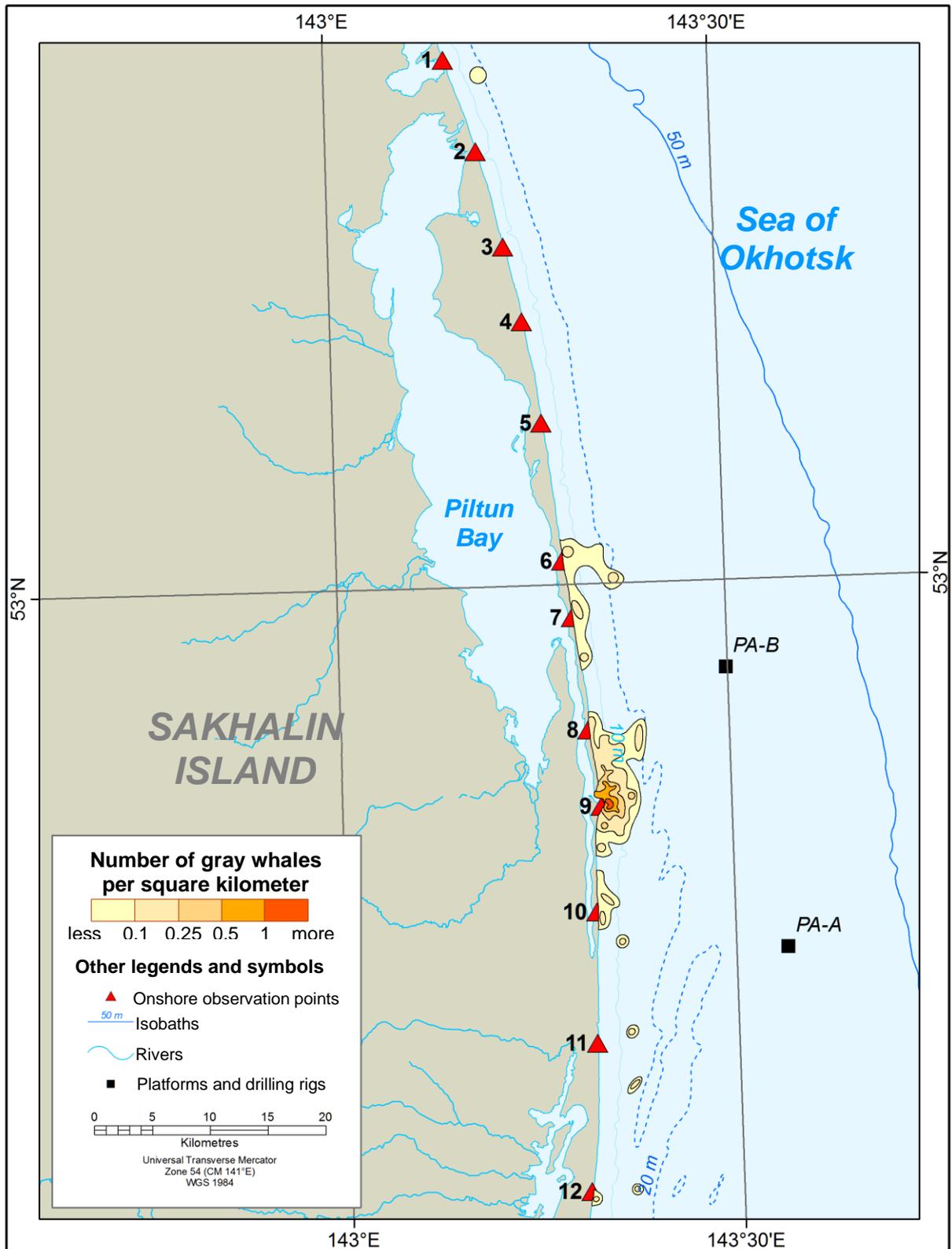
less dispersively over the water area. In the 3<sup>rd</sup> ten-day period of September, with the approach of the autumn migration to the wintering grounds, animals began to appear near the extreme peripheral parts of the area – at OS 1 and 12.

The sightability indicators for gray whales in the Piltun area in July-September 2019 were low. The maximum abundance in a single mini-aggregation near the mouth of the bay was 1.18 individuals per square kilometer, while in other sections the frequency of sightings dropped to less than 0.1 individual per square kilometer (Figure 4-5).

On the whole, irrespective of the quantitative characteristics of gray whales distribution in the Piltun feeding area in July-September of 2019, its spatial pattern may be considered fairly typical of this water area, with most of the sighted whales being concentrated near the mouth of Piltun Bay and less sightability in the northern and southern parts of the area.



**Figure 0-4.** Gray whale encounter points in the Piltun feeding area during complete shore-based surveys in July-September 2019



**Figure 0-5.** The overall spatial distribution of gray whales in the Piltun feeding area in July-September 2019 based on the data from complete shore-based surveys (animal sighting frequency per 1 square kilometer)

### 1.4.1.3 Whale Distribution by Distance from Shore and Water Depth

The distribution of gray whales by distance from the shore, calculated on the basis of shore-based survey findings, suggests that, during the summer-fall season of 2019, the overwhelming majority of whales in the Piltun feeding area (92.9% specimens on average) stayed in near-shore waters within not more than 3 km from the water line, with most animals (69.7%) staying within a 2 km strip (Table 4-2). In these areas, the concentration of animals at a distance of up to 3 km basically did not differ: the average concentration of animals within these bounds in the northern Odoptu-Piltun section was 93.2% versus 92.0% in the southern Astokh-Chayvo section (Table 4-2, Figure 4-6). An unusually large number of whales was recorded in 2019 in the water area closest to shore, at a distance of up to 0.5 km from the water line: for the area as a whole 35.7%, including 37.3% in the Odoptu-Piltun section and 32.0% in Astokh-Chayvo section. Relatively few animals were seen at a distance of 3-5 km from shore (7.1%), and not a single one was seen at a distance farther than 5 km.

**Table 0-2.** Distribution of gray whales in the Piltun feeding area by distance from shore in July-September of 2019 (based on complete shore counts)

Distance (km)	Number of whales (%)		
	Odoptu-Piltun section	Astokh-Chayvo section	Piltun area as a whole
0-0.5	37.3	32.0	35.7
0.5-1	25.4	12.0	21.4
1-2	20.3	28.0	22.6
2-3	10.2	20.0	13.2
3-5	6.8	8.0	7.1
>5	0	0	0

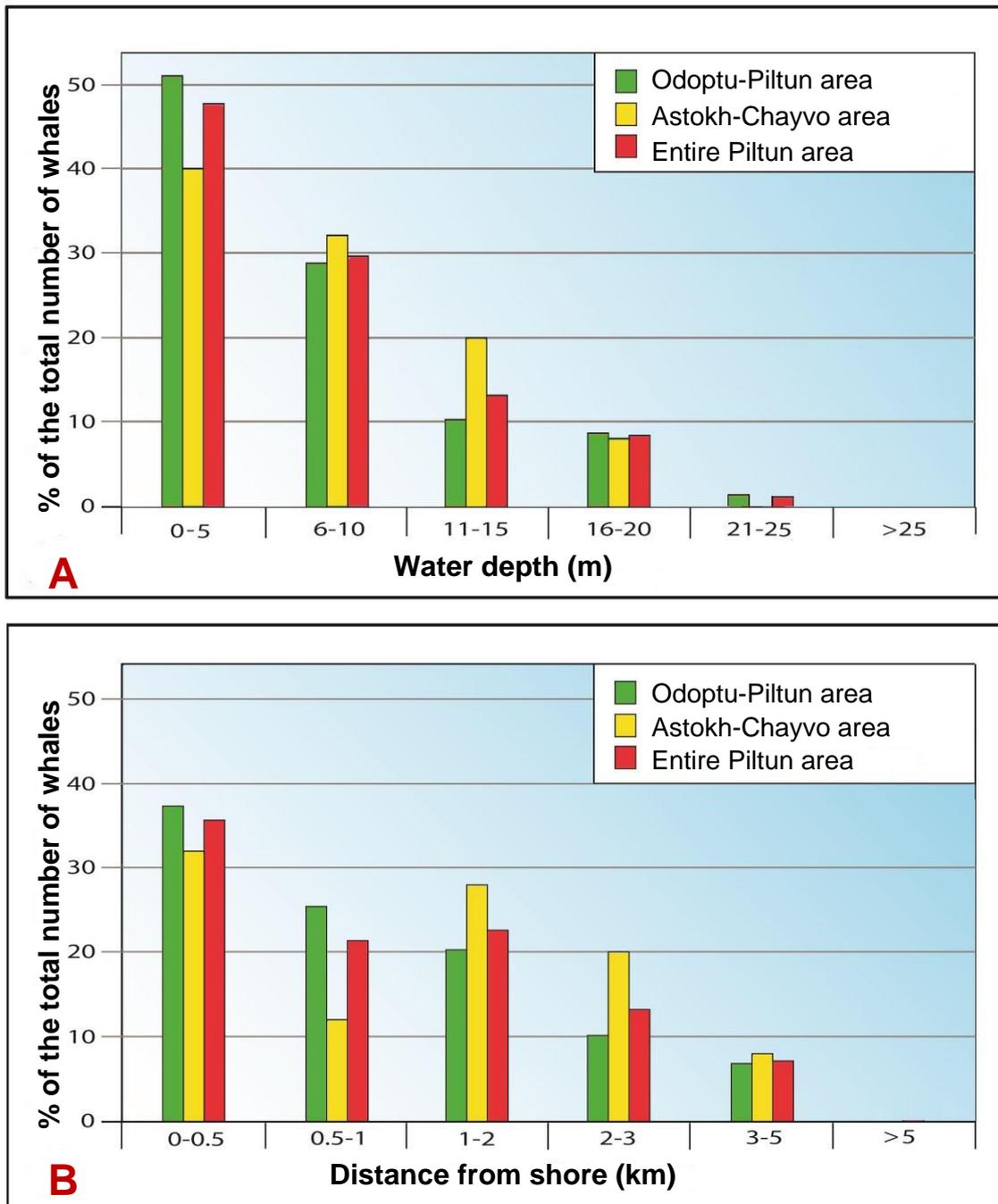
The overall distribution of gray whales by water depths in the Piltun feeding area in July-September 2019 was consistent with that by distance from shore, since these two parameters are functionally correlated. Most whales (90.5%) preferred water depths down to 15 m throughout the season, by far most of them (77.4% on average) were observed at depths of up to 10 m. The highest concentration of whales, more than 40-50%, was recorded in the shallowest zone, up to a 5-meter depth line. There were no fundamental differences in the distribution of whales by water depth in the water area sections (Table 4-3, Figure 4-6).

**Table 0-3.** Distribution of gray whales in the Piltun feeding area by water depth in July-September of 2019 (based on complete shore counts)

Depth (m)	Number of whales (%)		
	Odoptu-Piltun section	Astokh-Chayvo section	Piltun area as a whole
0-5	50.8	40.0	47.6
6-10	28.8	32.0	29.8

Depth (m)	Number of whales (%)		
	Odoptu-Piltun section	Astokh-Chayvo section	Piltun area as a whole
11-15	10.2	20.0	13.1
16-20	8.5	8.0	8.3
21-25	1.7	0	1.2
>25	0	0	0

The overall distribution of gray whales in the Piltun feeding area by distance from shore and by depth in 2019 was similar to the previous year's indicators. A clear difference noted was the significant increase of the presence of animals in the shallowest coastal zone of the water area, at a distance of up to 0.5 km from the coastline with depths of up to 5 m.



**Figure 0-6.** Distribution of gray whales in Piltun feeding area by depth (A) and by distance from shore (B) in July-September of 2019 (based on complete shore-based surveys)

### 1.4.2 Offshore Feeding Area

Five special vessel-based transect surveys of gray whales were conducted from the *Katun* vessel in the Offshore feeding area during the period from July 18 to September 15, 2019 (see Section 3.2). They covered the entire water area and allowed to obtain representative

data on the abundance of animals and the nature of their distribution there during the summer-autumn period and to compile appropriate maps.

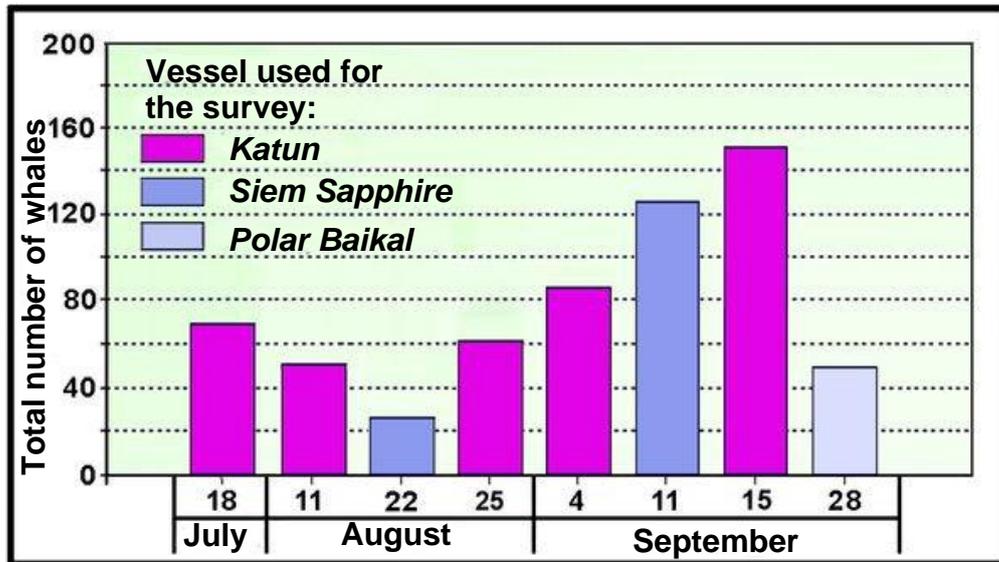
The results of surveys from *Siem Sapphire* carried out in August-October 2018 (Vladimirov et al., 2019) and in August-September 2019 made it possible to obtain reliable data on the abundance and distribution of gray whales in the deep-water part of the Offshore feeding area (east of the standard transect grid), where whale spouting was observed regularly, but detailed information on the abundance and nature of their distribution in previous years was not available.

#### **1.4.2.1 Dynamics of the Number of Simultaneously Sighted Whales**

A total of 68 gray whales were recorded during the first complete vessel-based survey conducted in the Offshore feeding area from the *Katun* vessel (ENL) on July 18, 2019; 52 animals were recorded during the follow-up complete vessel-based survey on August 11; 61 animals were recorded during the third complete vessel-based survey on August 25; 86 animals were recorded during the fourth survey conducted on September 4; and, finally, 151 animals were recorded during the last survey conducted on September 15. Two complete surveys in the Offshore area from the GPN-S *Siem Sapphire* vessel (August 22 and September 11) yielded 26 and 126<sup>1</sup> whales, respectively, which was lower than during the surveys carried out on similar dates (August 25 and September 15) from the ENL *Katun* vessel. On September 28, another survey was carried out from the Sakhalin Energy *Polar Baikal* vessel on the same tack grid that was covered by *Katun*, but its result (49 whales) was 3 times lower than the survey data from the *Katun* vessel obtained 13 days earlier (Table 3-2, Figure 4-7). Most likely, the latter was due to the significantly lower height of the *Polar Baikal* vessel and, accordingly, a much lower visibility of the water area from its bridge. Therefore, the data of this survey are not taken into account when considering the abundance of whales in the Offshore area in comparison with similar data obtained during the surveys from significantly higher vessels.

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<sup>1</sup> - the latter number excludes 6 individuals who were recorded by the observers in the survey protocol as “possibly the same whales” (i.e. presumably sighted for the second time).



**Figure 0-7.** Seasonal dynamics of the number of gray whales simultaneously sighted in the Offshore feeding area in July-September 2019 (according to complete surveys from all vessels)

Thus, in 2019, the maximum number of gray whales was recorded in the waters of the Offshore area on September 15 and amounted to 151 individuals. This number turned out to be the highest value of their abundance in these waters for the entire monitoring period, significantly exceeding the same indicator for the previous year (124 individuals). At the same time, the average number of gray whales concentrating in the Offshore area from mid-July to mid-September 2019 estimated according to survey data from *Katun* and *Siem Sapphire* (82.3 individuals) was slightly lower than the data for the same period of 2018 obtained from the same vessel - *Siem Sapphire* (91.3 individuals). Perhaps this difference, albeit insignificant, may be explained by a slightly larger proportional number of surveys conducted in July-August 2019 compared to the same months of 2018 (57.1% vs. 50.0%), since it has long been established that the number of whales in the Offshore area in the summer months is always lower than in the fall, and this may have affected the overall result.

However, if we compare the data of the whale abundance surveys obtained from the observation points on the *Katun* and *Siem Sapphire* vessels comparable in terms of their height only for September of 2018 and 2019 (i.e., for the periods of maximum concentration of gray whales in the Offshore area), it turns out that in 2019 the average number of whales was slightly higher than in the previous year (121.0 individuals versus 117.0).

Regarding the seasonal dynamics of the abundance of whales in the Offshore area in 2019 (Figure 4-7), it can be stated that, over the period from mid-July to the 3rd ten-day period of August, their number decreased evenly (from 68 to 26 individuals), but then started to increase from survey to survey, reaching almost 90 individuals by early September, more than 125 individuals by the beginning of the 2nd ten-day period of that month, and more than 150 individuals by the middle of that ten-day period.

#### **1.4.2.2 Spatial Distribution of Whales**

During the complete surveys conducted in the Offshore feeding area, it was found that throughout the entire 2019 season gray whales stayed there as a single, although heterogeneous (dispersed-group), aggregation in the eastern part of the area, in waters with depths mainly from 50-55 to 65-70 m. However, at the end of August-September they also started appearing, albeit in a relatively small number, in the section of the water area with shallower depths – up to 35-40 m (Figure 4-6).

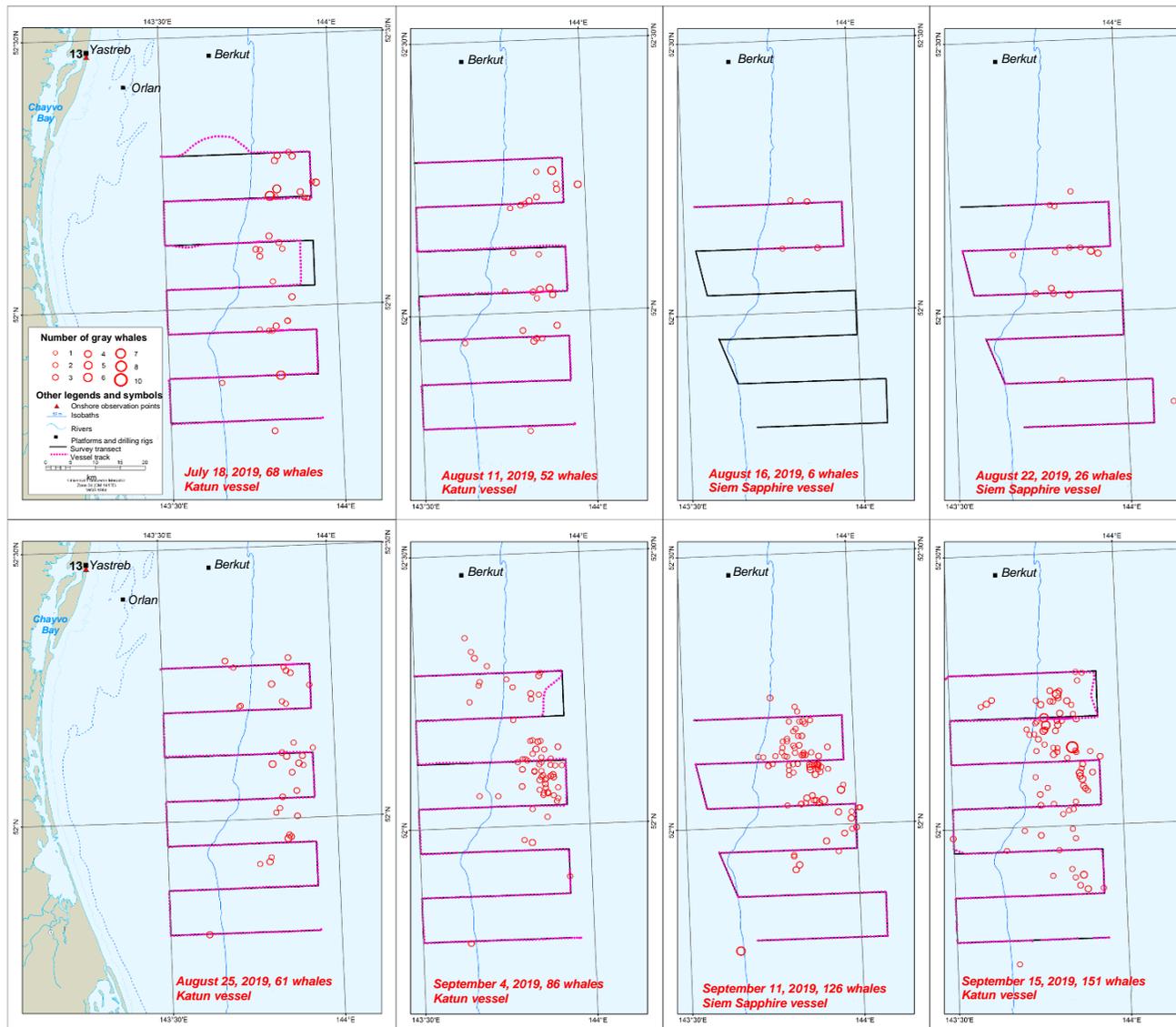
Moreover, throughout the season (from July to the end of September), the degree of aggregation (grouping) of animals gradually increased. In July-August, they were scattered throughout the surveyed water area from transect 1 to transect 7 with a very gradual trend towards the formation of a slightly denser cluster in the northern part of the area during the season (transects 1-4). However, by early September, a small but discernible aggregation of up to 55-60 animals was formed in the eastern part of transects 3-4. By mid-September, an accumulation that had formed at the beginning of the month in the northern part of the Offshore feeding area doubled in size by area and number to up to 125-130 animals, covering the water area section between transects 1 and 4, from about 52°03'N to 52°15'N (Figure 4-8).

In terms of the nature of their concentration as a function of distance from the Sakhalin coast, in 2019, based on the data from the *Katun* and *Siem Sapphire* surveys, gray whales stayed in the Offshore area mainly between 144°50' and 144°55'E, 55-60 km from the island, where their peak occurrence in some spots exceeded 0.5 individuals/km<sup>2</sup> (Figure 4-9).

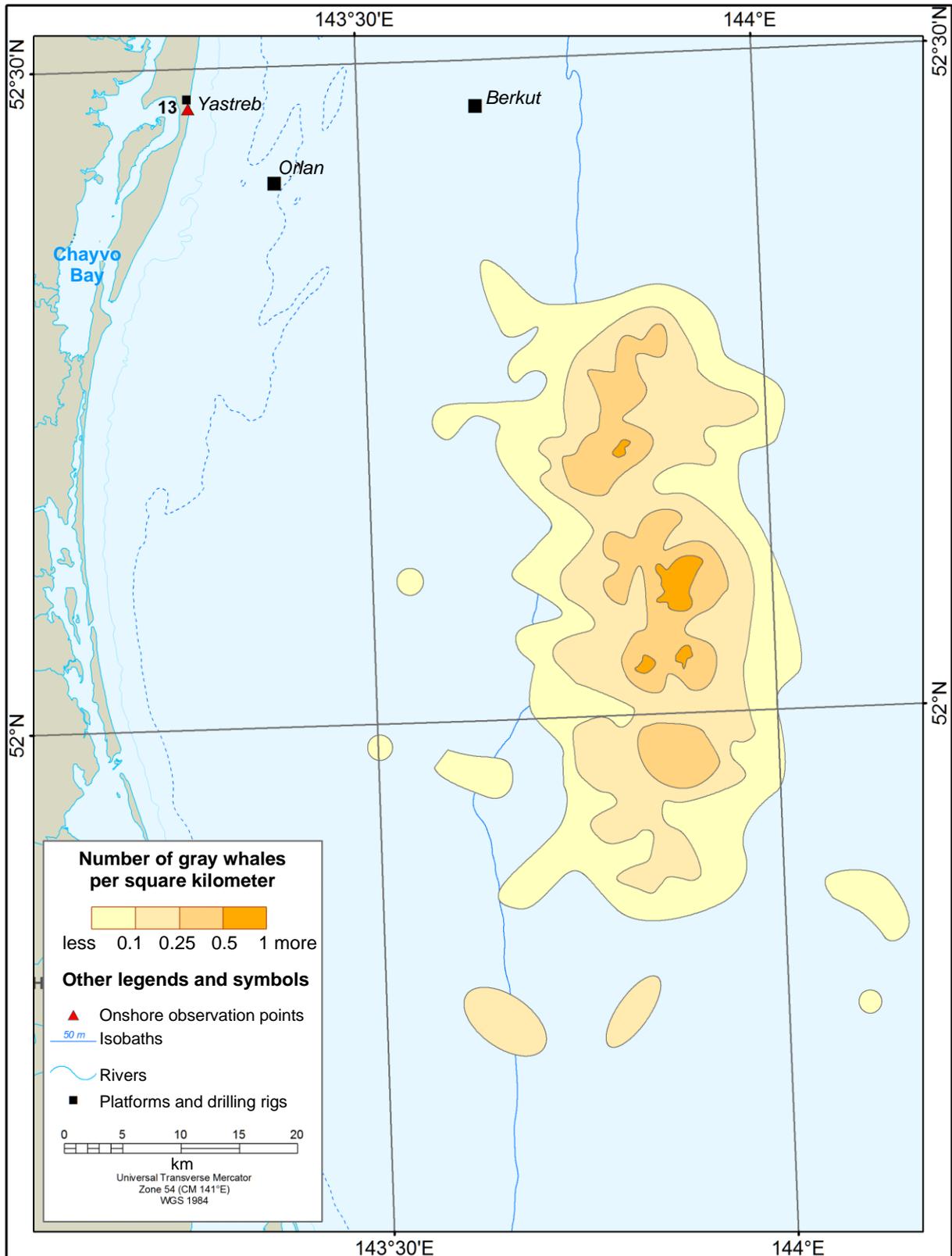
Generally, the number of whales in the eastern part of the Offshore feeding area decreases rapidly with distance from shore, and beyond 144°55'E they are sighted as single animals (Figure 4-8).

The survey data obtained from the SEIC *Polar Baikal* vessel on September 28, 2019, yielded similar results: the vast majority of gray whales were recorded in the eastern third of survey transects No. 2-4 (Figure 4-10).

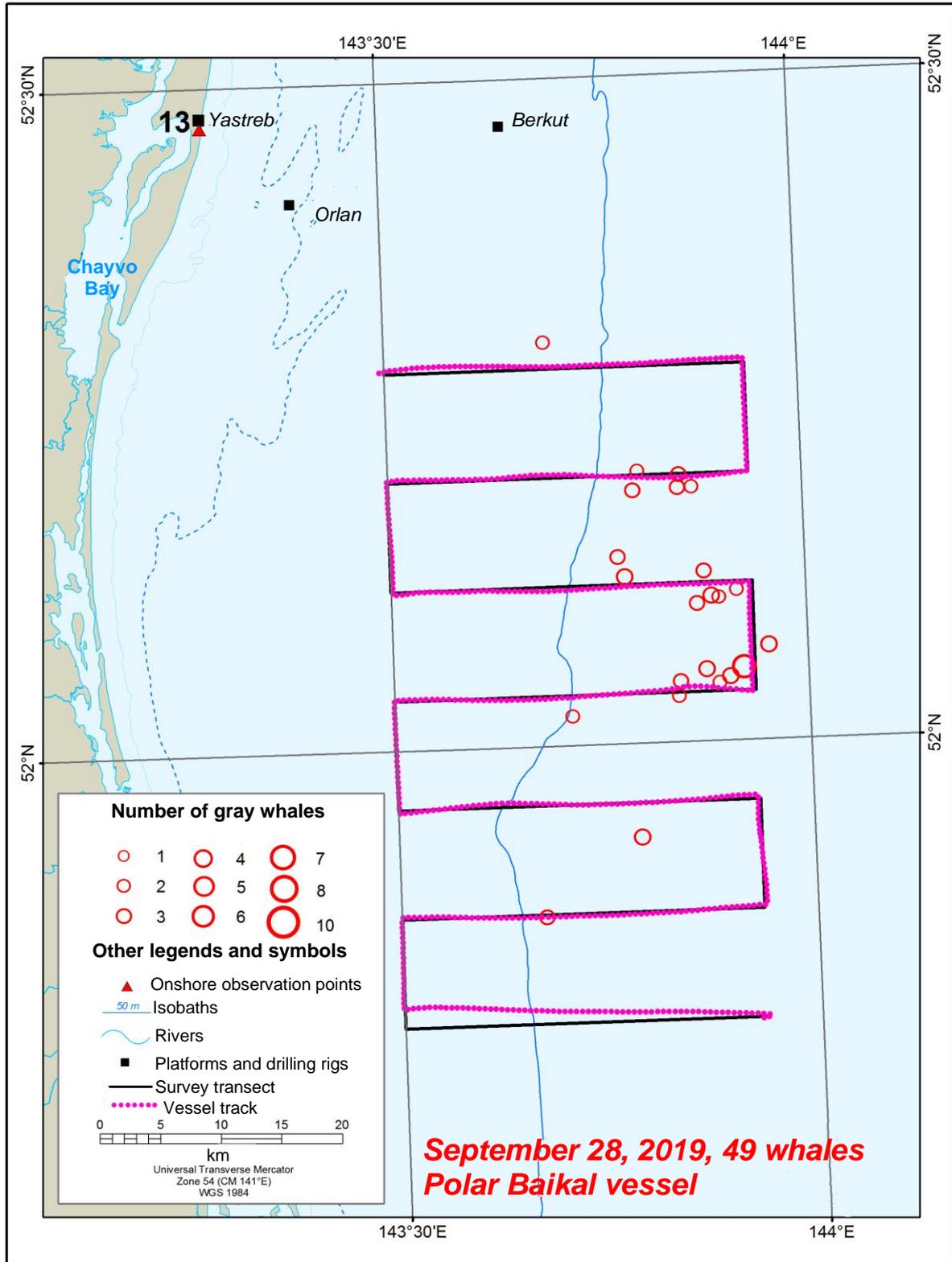
In general, gray whales remained in the Offshore area in 2019 as a more or less compact aggregation with increased concentration in the northern part of the feeding area, within a zone with depths of 50-65 m.



**Figure 0-8.** Seasonal changes in location of gray whales in the Offshore feeding area in July-September 2019 (according to complete survey data from the ENL *Katun* vessel and the GPN-S *Siem Sapphire* vessel)



**Figure 0-9.** Overall spatial distribution of gray whales in the Offshore feeding area in July-September 2019 (animal sighting frequency per 1 square kilometer based on the data from complete surveys from *Katun* and *Siem Sapphire* vessels)



**Figure 0-10.** Localization of gray whales in the Offshore feeding area on September 28, 2019 (according to complete survey data from the SEIC *Polar Baikal* vessel)

### **1.4.3 Total Count of Gray Whale Foraging Group Offshore Northeast Sakhalin**

Synchronized vessel-based survey in the Offshore feeding area and shore-based surveys in Piltun feeding area (September 15<sup>th</sup> and 16<sup>th</sup> respectively) allowed us to estimate the total number of gray whales occurring simultaneously within the East Sakhalin feeding area, which amounted to 160 animals (151 specimens in the Offshore feeding area and 9 – in Piltun feeding area).

Conducting such surveys with a minimum time interval virtually eliminates the likelihood of double counting or undercounting of whales due to their migration from one area to another between their surveys, thus, the data obtained give fairly accurate values of the concurrent number of gray whales in the entire feeding area at the time of the survey. Therefore, the resulting number (160 individuals) was adopted as a reliable estimate of the maximum concurrent number of gray whales recorded in 2019 in two known feeding areas (Piltun and Offshore) during the shore-based and vessel-based surveys under the monitoring programs implemented by ENL/Sakhalin Energy and Gazpromneft-Sakhalin. This is the highest indicator for the entire contemporary monitoring period.

### **1.4.4 Size of Whale Pods**

#### **1.4.4.1 Piltun Area**

Gray whale pod size estimate resulted from observations in the Piltun feeding area in July-September of 2019 during the shore-based surveys. During this period, based on the data on 88 gray whale sightings (totally 96 specimens), the whales were predominantly (in 80 cases, i.e., in 90.9% of the sightings) observed to be solitary, accounting for 83.3% of all sighted animals (Table 3-1, Attachment 1). In 8 cases (9.1% of sightings), the pods of two animals were registered, totaling up to 16.7% of all sightings. No larger pods were observed in 2019.

In seasonal terms, there were more sightings of pods of 2 animals in July (17.4%), and in August-September the number reduced to 5.9-6.3%. The number of single whales' sightings increased respectively from 82.6% in July up to 93.7-94.1% in August-September.

The average seasonal number of whales in pod was 1.09 animals.

Compared to the previous year, the frequency of single whales occurrences slightly reduced (from 94.1 to 90.9%), hence, the occurrence frequency for pods of 2 animals slightly increased (from 5.9 to 9.1%).

### 1.4.4.2 Offshore Area

During 5 surveys conducted from the *Katun* vessel in the Offshore feeding area within the period from July 18 through September 15, 2019, 233 sightings were registered, with a total of 418 animals recorded. Thus, the average number of animals per pod per season was 1.79. Single whales were sighted most frequently (56.6% of occurrences), then, in a descending order, pods of 2 and 3 animals (24.0 and 12.0% of occurrences, respectively). Occasionally, the pods of 4 whales were sighted (3.9% of occurrences), and very rarely bigger pods of 5-10 animals were observed in 0.4-0.9% of occurrences (Table 4-4).

In the course of two complete surveys and one partial survey carried out in the same feeding area from the *Siem Sapphire* vessel in August-September 2019, a total of 97 sightings of gray whales were recorded; the total number of whales was 157. Most of these were single whales (61.9% of sightings/38.2% of individuals). Pods of 2 animals were observed less frequently (22.7% of sightings/28.0% of individuals); the larger the pods, the less often they were sighted (Table 4-4). The average seasonal number of whales in a pod, according to the data from *Siem Sapphire* (1.62 individuals), turned out to be slightly lower than during the surveys from the *Katun* vessel; the percentages of pods with different numbers of animals also varied. The latter, probably, was associated with a somewhat inconsistent assessment of whether animals belonged to a certain pod by observers from different vessels. However, this does not have a significant effect on the final conclusions regarding the quantitative structure of the group, since, in general, they are fully consistent, indicating a clear prevalence (in terms of occurrence) of single animals in the Offshore feeding area.

**Table 0-4.** Quantitative composition of gray whale pods recorded in the Offshore feeding area in 2019 (per surveys from the *Katun* and *Siem Sapphire* vessels)

Month (number of sightings/number of animals)	Pod size (number of animals)																	
	1		2		3		4		5		6		7		8		10	
	% of the number of sightings	% of the number of animals	% of the number of sightings	% of the number of animals	% of the number of sightings	% of the number of animals	% of the number of sightings	% of the number of animals	% of the number of sightings	% of the number of animals	% of the number of sightings	% of the number of animals	% of the number of sightings	% of the number of animals	% of the number of sightings	% of the number of animals	% of the number of sightings	% of the number of animals
<b><i>Katun</i></b>																		
July (29/68)	44.8	19.1	17.2	14.6	24.1	30.9	3.5	5.9	3.5	7.3	---	---	3.5	10.3	3.5	11.8	---	---
August (58/113)	43.1	22.1	29.3	30.1	19.0	29.2	6.9	14.2	1.7	4.4	---	---	---	---	---	---	---	---
September (146/237)	64.4	39.7	23.3	28.7	6.8	12.6	2.7	6.7	---	---	1.4	5.1	0.7	3.0	---	---	0.7	4.2
<b>Total (233/418):</b>	<b>56.6</b>	<b>31.6</b>	<b>24.0</b>	<b>26.8</b>	<b>12.0</b>	<b>20.1</b>	<b>3.9</b>	<b>8.6</b>	<b>0.9</b>	<b>2.4</b>	<b>0.9</b>	<b>2.9</b>	<b>0.9</b>	<b>3.3</b>	<b>0.4</b>	<b>1.9</b>	<b>0.4</b>	<b>2.4</b>
<b><i>Siem Sapphire</i></b>																		
August (19/32)	57.9	34.4	26.3	31.2	5.3	9.4	10.5	25.0	---	---	---	---	---	---	---	---	---	---
September (78/125)	62.8	39.2	21.8	27.2	11.5	21.6	1.3	3.2	1.3	4.0	1.3	4.8	---	---	---	---	---	---
<b>Total (97/157)</b>	<b>61.9</b>	<b>38.2</b>	<b>22.7</b>	<b>28.0</b>	<b>10.3</b>	<b>19.1</b>	<b>3.1</b>	<b>7.7</b>	<b>1.0</b>	<b>3.2</b>	<b>1.0</b>	<b>3.8</b>	---	---	---	---	---	---

In general, the gray whales foraging in the Offshore area in 2019, formed groups significantly more often, with the pod sizes considerably bigger, compared to the animals in the Piltun area. It might be associated with the specific features of forage resources in the named areas (varying distribution and concentration of aquatic organism species biomass available for foraging), as well as with differences in the social structure and inter-individual relationships between the animals residing in the different foraging habitats.

#### **1.4.5 Distribution of Cows and Calves**

In 2019, there were no sightings of “cow-calf” couples nor of calves separated from their mothers during monitoring campaign in the Piltun feeding area. However, it should be noted, that due to the logistics and methodological specifics of the shore-based monitoring techniques, it is rather difficult to identify cow-calf couples during the survey, and therefore, the lack of registered occurrences does not mean their actual absence. More accurate pertinent information is provided by the results of photo identification in summer 2019, when 22 calves were registered, of which 19 calves were sighted with cows and 3 calves without cows (Yakovlev et al., 2020).

And similar to the previous years, not a single cow-calf couple or an independent calf separated from the mother was sighted in the Offshore feeding area during the vessel-based surveys.

#### **1.5 Sightings of Other Marine Mammal Species**

During the surveys carried out offshore Northeast Sakhalin in July-September of 2019, eight other marine mammal species were sighted in addition to gray whales.

In the Offshore feeding area, the marine mammal species not related to the gray whales were sighted 97 times from the *Katun*, *Siem Sapphire*, and *Polar Baikal* vessels during the vessel-based surveys, and their total number was 157 animals.

- 18 sightings of Minke whale (*Balaenoptera acutorostrata*) – 16 single and 2 couples (total of 20 animals). They mainly stayed in the southern part of the surveyed area. (Figure 4-12).

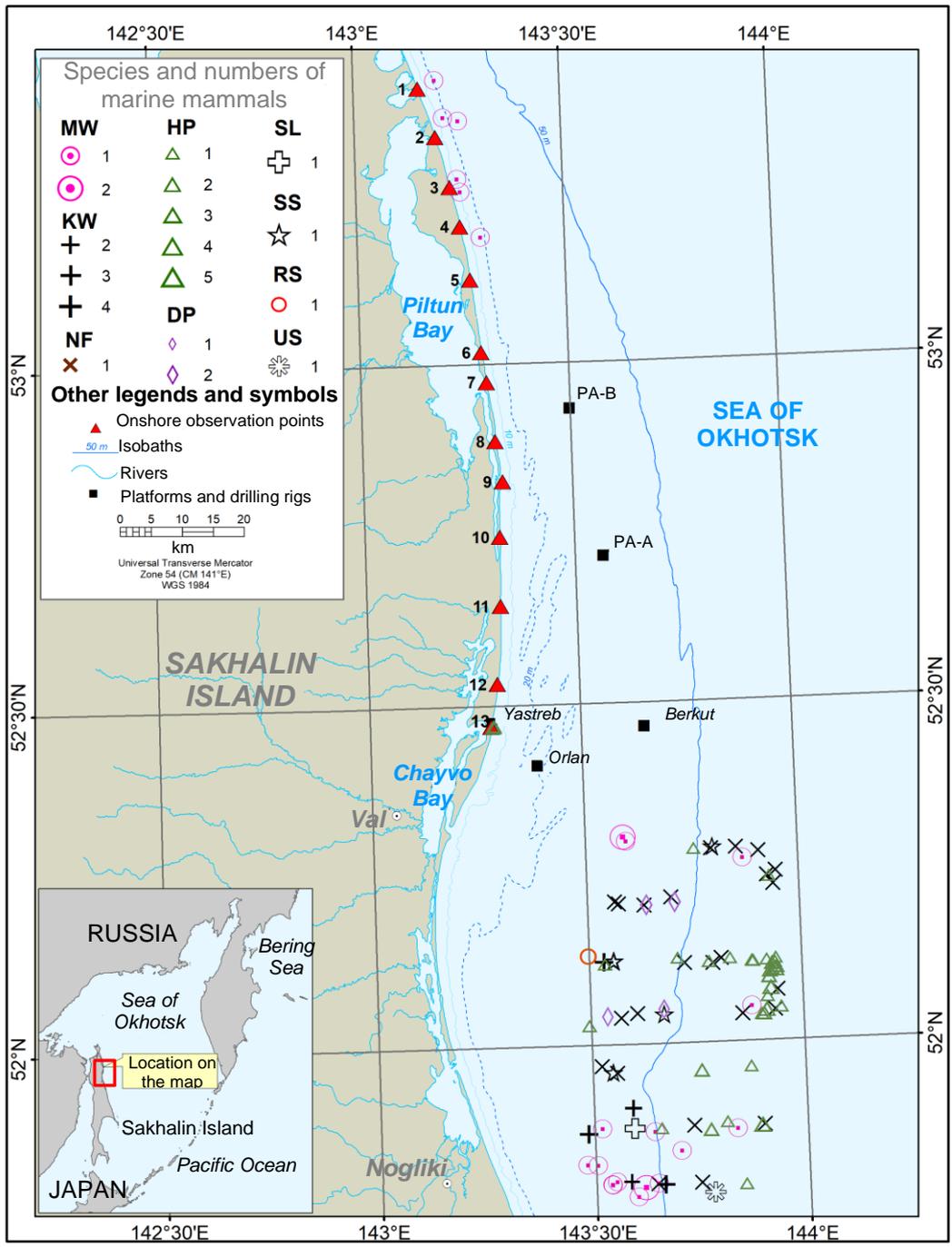
- 6 sightings of Killer whale (*Orcinus orca*), also mainly in the southern part of the Offshore area – pods of 4 animals were sighted 3 times, pods of 2 animals were sighted 2 times, and a pod of 3 animals was sighted once (total of 19 animals).

- Of small cetaceans, harbour porpoises *Phocoena phocoena* were sighted more often (31 encounters/ 66 specimens), occasionally Dall's porpoises *Phocoenoides dalli* were encountered (7 sightings, 15 animals). All of them were mainly concentrated in the central and northern parts of the area (Figure 4-12).

- Of the pinnipeds, Alaska fur seals (*Callorhinus ursinus*), encountered across the entire area, were registered 26 times; the vast majority of the sightings (25) were of single animals, with one pair encountered (total of 27 animals).

- In the southern and central parts of the Offshore area, the sightings of minor numbers of single spotted seals (*Phoca largha*) - 5 encounters, Steller sea lions (*Eumetopias jubatus*) – 3 encounters, and ringed seals (*Phoca hispida*) – 1 encounter were registered. In one sighting a seal species was not identified with high confidence.

During the shore-based surveys, in the northern outskirts of the Piltun area, near points OS 1-4, in addition to the gray whales, there were 6 single Minke whales sighted (2 early in July and 4 late in August), and near the most southerly point OS 13 – 3 occurrences with harbour porpoises (1 pod of 3 specimens and 2 single animals) were registered in the second half of August. As for the encounter with 4 Minke whales on August 26<sup>th</sup> near the adjacent OS 2 and 3 within about 30-40 minutes of each other, it is quite probable these were the same animals (Figure 4-12).



**Figure 0-11.** Sightings of other marine mammal species (in addition to gray whales) offshore northeast Sakhalin in July-September of 2019 (based on the shore- and vessel-based surveys)

The dates and exact coordinates of all the sightings of cetaceans (other than gray whales) and pinnipeds can be found in Attachments 1 and 2.

## **1.6 Impact of Anthropogenic Factors on Gray Whales**

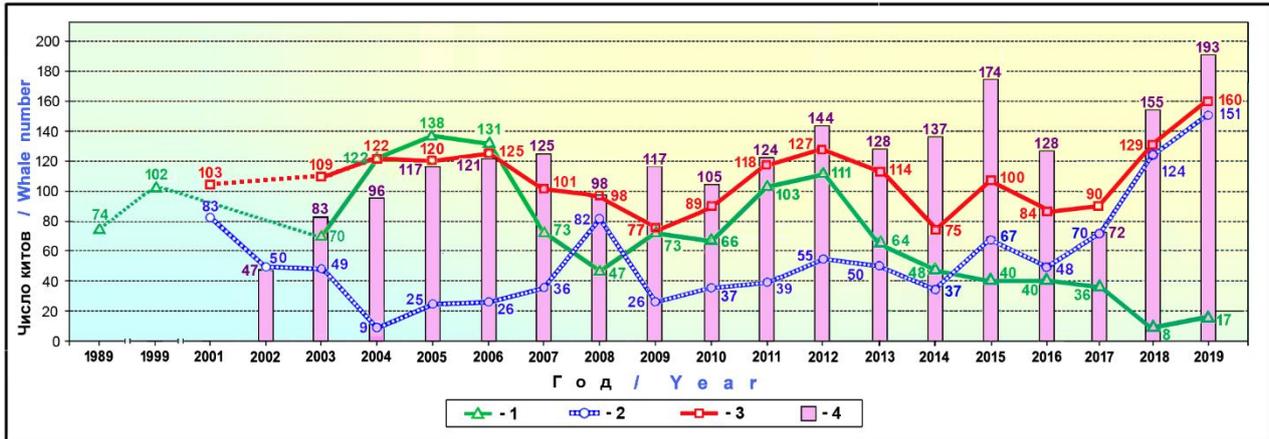
Throughout the monitoring campaign in July-September of 2019, there were no visual signs found to show any direct man-made impact on distribution and population of gray whales during foraging season offshore northeast Sakhalin.

## **DISCUSSION OF RESULTS**

The shore-based surveys of gray whales in the Piltun feeding area and vessel-based surveys in the Offshore feeding area performed in July-September of 2019 allowed to acquire hands-on data on the Sakhalin gray whale foraging group, which is important for comprehensive evaluation of its current status.

### **Abundance of Gray Whales**

According to the results of the vessel-based monitoring in the Offshore foraging area, the number of the gray whales feeding there, obviously tends to grow, starting from 2009-2010, especially in the recent years (Figure 5-1). In 2019, during monitoring in this water area, 151 gray whales were registered, what is exceeded significantly the similar number for the previous year (124 specimens) and the maximum records of all preceding years of monitoring campaigns performed in this area under the joint program of gray whales' Sakhalin group monitoring, when the maximum number of whales registered in the area was only 82-83 specimens (in 2001 and 2008). Along with that, however, it is necessary to consider the multiple changes of the vessels used for monitoring in the Offshore area through many years of the program, which involved changes of monitoring point elevations to 8-10 m above the sea level in some years (versus 18-25 m in 2018-2019). This fact, no doubt, influenced the efficiency of the whales' sighting, especially at a long distance; thus, in some years of monitoring in this area, especially during the period of 2012-2017, a certain under-count of the whales was probable, nevertheless, not distorting the general dynamic trend of their abundance in the Offshore area indicating a rapid increase in the number of animals concentrating there during the feeding season over the past years (Figure 5-1).

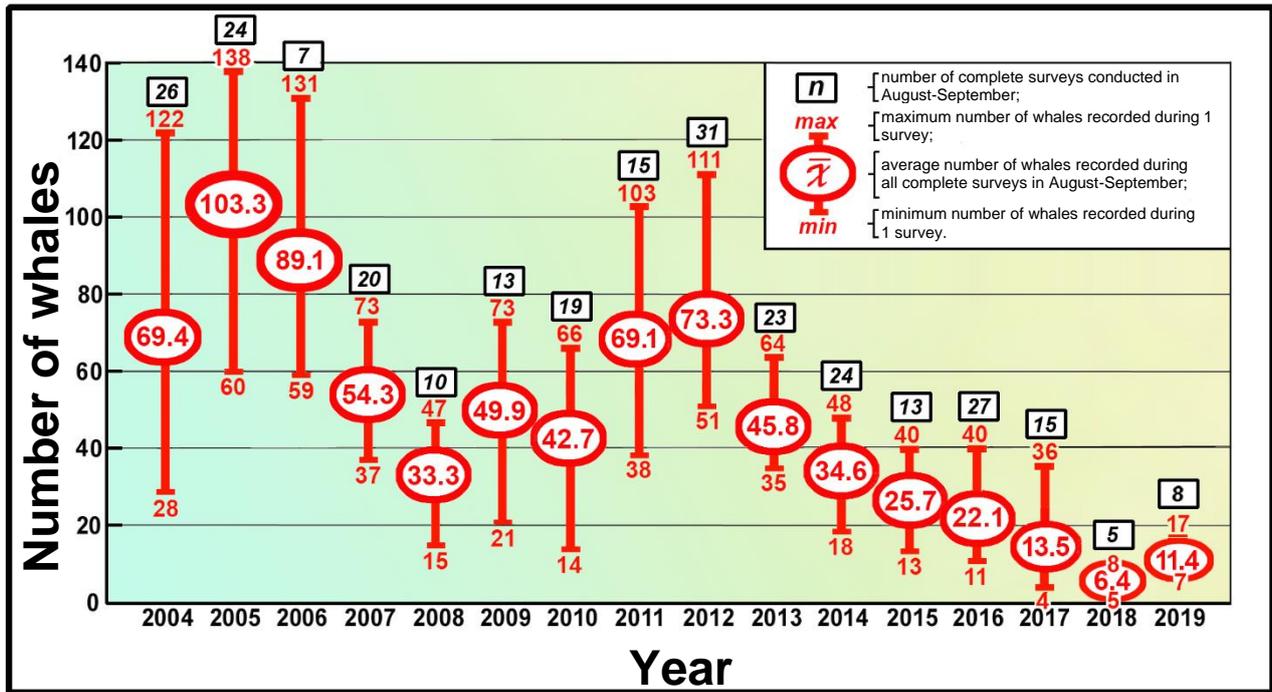


**Figure 0-1.** Summary of variations in the numbers of gray whales in the East Sakhalin feeding area in 1989-2019

Notes:

- 1 – the maximum number of whales sighted simultaneously in the Piltun feeding area (according to aerial survey in 1989-1999 and shore-based surveys in later years);
- 2 – the maximum number of whales sighted simultaneously in the Offshore feeding area (according to vessel-based surveys);
- 3 – the maximum total number of whales recorded simultaneously in both feeding areas (according to synchronized shore- and vessel-based surveys);
- 4 – the total number of whales recorded offshore northeast Sakhalin, based on photo identification results (Yakovlev et al., 2020).

In the Piltun feeding area, the reverse situation was generally observed: the number of sighted whales started declining steadily there since 2012. In 2018, the number decreased to its current pessimism (8 specimens), but grew somewhat in 2019, reaching the seasonal maximum of 17 specimens (Figure 5-1). The average seasonal numbers for whales occurrences in the Piltun area demonstrate that it was equal to 73.1 specimens per survey in 2012 during the main foraging season, then it reduced by more than ten-fold by 2018 – down to 6.4 specimens/survey; however, in 2019, the trend towards reduction discontinued and the animals' occurrences notably increased up to 11.4 specimens/survey (Figure 5-2).



**Figure 0-2.** Statistical indicators of whale population dynamics in the Piltun feeding area in 2004-2019, based on complete survey results during the main feeding season (August-September)

The growth of gray whales population in the Offshore area, observed during the recent years, apparently and primarily is due to migration of the animals there from the Piltun area, where the trophic environment, evidently unfavorable for whales' feeding, developed over the current decade, seemingly as a result of the decrease of available foraging resources (Labai et al., 2018). Similar migrations of the gray whales from one feeding area into another, occurring during major changes in the trophic environment in either of these two areas of Sakhalin, were observed earlier (for example, in 2003-2005). This trend allows to consider these areas as "interconnected vessels", with the animals' re-distribution between them ensuring relative stability in the total population of the gray whales in the east Sakhalin foraging area (Vladimirov et al., 2011; Vladimirov et al., 2019; Vladimirov et al., 2012).

As for the gray whales population in the Piltun area in 2019 is concerned, it should be noted that the photo-identification campaign performed at the same time in the same area, registered significantly more whales, than the survey – over 90 specimens (Yakovlev et al., 2020). Such significant difference in the outcome numbers (17 versus 90+ specimens), both characterizing the same parameter (though using different techniques) – population of animals, is attributable to the specifics of those two techniques. The single sessions of both photo-identification (hereinafter "PID") and monitoring surveys register the number of

animals present in the area at that specific moment, thus, their results are - fully comparable. On the other hand, during multiple season-long PID sessions (this is what usually takes place as part of the gray whales monitoring program), the resulting number includes both the animals staying in the surveyed area during the entire season (hence, registered more than once), and those entering the area just for a short time (i.e. single encounters). In other words, PID provides credible information regarding the total number of animals that have visited any subject area during a given season (or its part), however, does not provide the details regarding the number of the animals that stay in the area, once having entered it, for the entire season, and how many soon leave the area due to one or another reason (more often, apparently, because of the forage deficit) and migrate searching for more favorable foraging sites. With PID results, such difference between the character of the whales' presence can be determined only based on the number of the personally identified specimens encounters throughout the season - if they are sighted more than once, it can be interpreted as the sign of their continuous presence in the surveyed water area, but if the encounters of some specimens are single (more often), it cannot be definitively interpreted as an indicator of their short-time presence in the area, since there are no guarantees that all the whales present in the water area, were detected and pictured during the PID session/s.

Using the same approach for the data from visual route shore-based surveys, it should be noted that such surveys also register only the actual number of whales present in the given water area at the specific moment of a survey. And if part of the whales registered during the photo-shooting leave the area almost immediately afterwards, not staying there for any longer, then the outcome data for sure appear to be more or less below the PID results. Obviously, such situation occurred in the Piltun area in 2019: while the number of the whales registered during the PID campaign throughout the season was high, the majority of animals passed through the area. And relatively few of them were there simultaneously - mostly nursing cows and offspring not capable yet to forage in the deep Offshore area, which could be unsafe for them due to the danger of killer whales attacks (Yakovlev et al., 2020).

Therefore, the comparative review of data on the whales population in the feeding areas acquired during monitoring and PID campaigns, allows to determine the specific features of the East-Sakhalin group's intra-population organization and the pattern of their feeding sites use. At the same time, comparative analysis of these data supports the assumption that due to the deficit of the foraging resources for gray whales in the Piltun feeding area, the whales coming to the area to feed leave it soon for other feeding grounds. Therefore, the actual number

of the animals registered in Piltun water area during the surveys was significantly below the PID number.

As to the total population of gray whales in the grouping in East Sakhalin waters, we will reiterate that in 2019, based on PID data, the number of whales was 193 (Yakovlev et al., 2020), significantly exceeding the number obtained from surveys (160 whales). A similar situation (photo ID data exceeding surveys) is observed virtually in all recent years, starting in 2012 (Figure 5-1), indicating, as in the above case in the Piltun feeding area, that it evidently became typical for the entire Sakhalin feeding group that arrived there to move for feeding to other areas. For example, in 2004-2006, almost all whales that arrived for wintering apparently remained primarily offshore NE Sakhalin through the summer/fall season, which is supported by the similarity of the PID and survey data, but starting in 2007-2009, and even more actively starting in 2012, they also apparently began to use other areas more actively for feeding, including in the East Kamchatka coastal waters, judging from the PID data (Figure 5-1). Apparently, it was precisely for this reason that the total population of gray whales recorded at a single point in time in the Sakhalin region during surveys in 2005-2012, which in most cases was rather close to or actually identical to the numbers obtained during PID surveys, generally became lower than the PID numbers after 2012, which identified both the whales continuously inhabiting the area and those that were temporarily visiting it and departed prior to the survey.

It is possible, of course, that the observed differences in the numbers of whales recorded during the surveys and during PID may, to a certain degree, be also associated with the fact that the PID water area is usually larger than that of the surveys, so, naturally, more gray whales can be encountered there.

In summarizing the issues related to the current abundance of gray whales concentrated in NE Sakhalin waters, we may point out that their total number in 2019, which according to the PID data was a minimum of 193 whales, is actually even higher, considering that during PID surveys it is never practically possible to detect all whales located in the operations area, which is supported by studies run in parallel using satellite tagging (Mate et al., 2015).

New mathematical modeling data showed that the estimated number of gray whales of the Sakhalin feeding group totals 219-245 animals. The annual growth rates in the abundance of this feeding group over the last 20 years was estimated by J. Cooke and his co-authors as 4.3-5.4% (Cooke, 2019), which allows to have an optimistic view of their prospects. In viewing them as a single subpopulation, such numbers made it possible to lower its environmental

protection status on the IUCN Red List, moving it from the category of taxa considered Critically Endangered to just Endangered.

All the data acquired during monitoring in recent years allow us to infer that the total abundance of the Sakhalin feeding group of gray whales is gradually nearing (or has even reached) the maximum that this region's food resources can support. However, a special comprehensive and detailed analysis of the overall situation is required for a balanced assessment of the validity of this assumption.

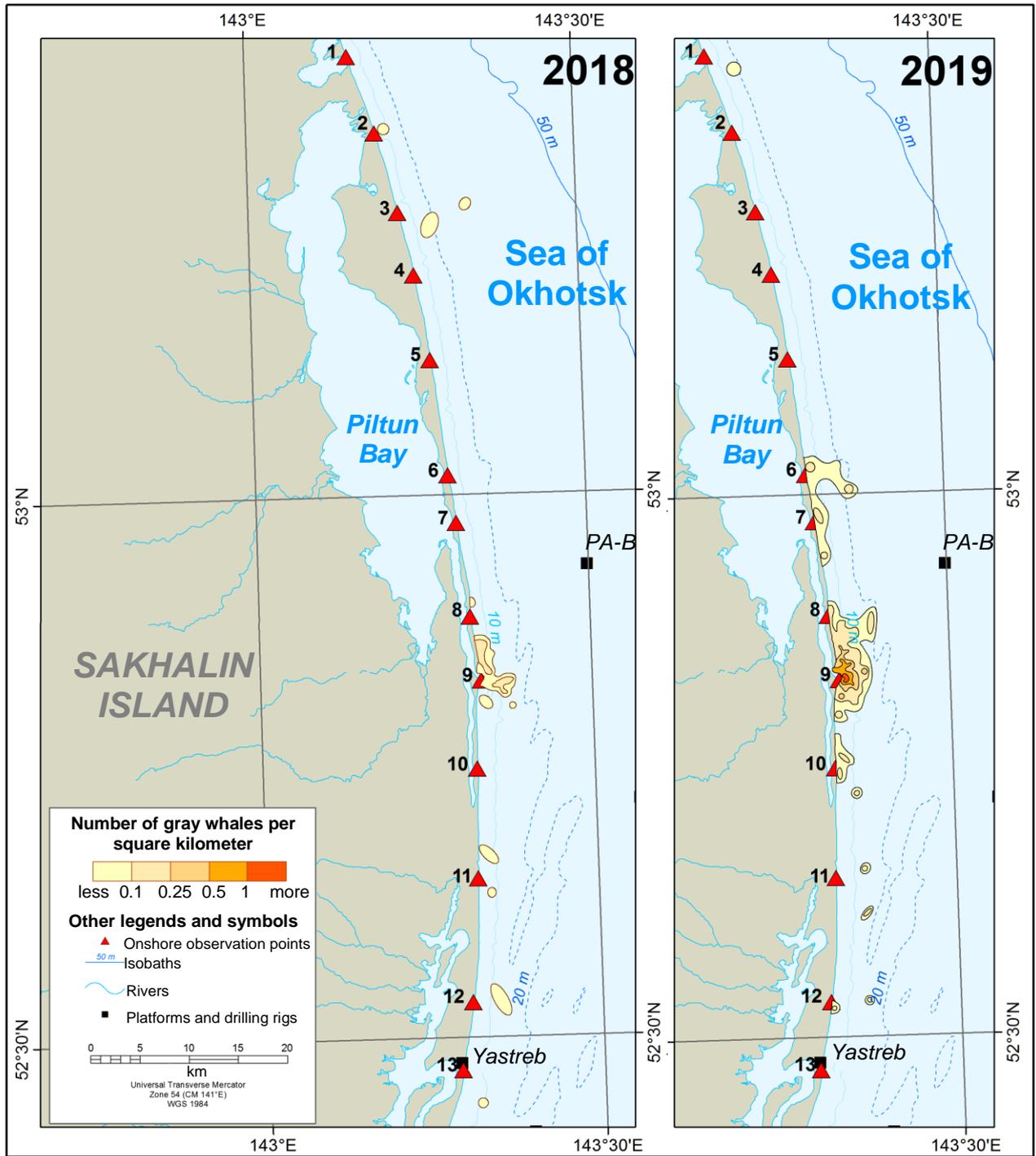
### **Spatial Distribution of Gray Whales in the Feeding Areas**

Generalized pseudoisoline maps of gray whale distribution within their feeding habitats offshore NE Sakhalin Island show that the general gray whale distribution in both the Piltun and Offshore areas in July-September of 2019 essentially remained typical for this area and was similar to that of 2018 (Figure 5-3 and 5-4). In general, during these months of 2019, the two of which (August-September) constitute the main feeding period for these animals, their prevailing concentration in the Piltun area (average for the season — over 73%) was constantly observed in a limited part of the water area immediately adjacent to the mouth of Piltun Bay (in the area of OS 8-9), which was also the case during the vast majority of years of the ongoing monitoring. Their maximum occurrence frequency there in 2019 was 1.18 whales/km<sup>2</sup> (Figure 5-4).

Outside of this near-mouth mini-conglomeration, whales were sighted in a very scattered manner in 2019, based on survey data, most often singly: in the northern half of the area, in the aquatic areas of OS 1-7 – a total number of 7 whales through the entire season, and in the south, in the area of OS 11-13 – 6 total during the season. In addition, what stands out is that whales were not observed there continuously throughout the entire season, but were only encountered periodically (Table 4-1, Figures 4-3 and 4-4).

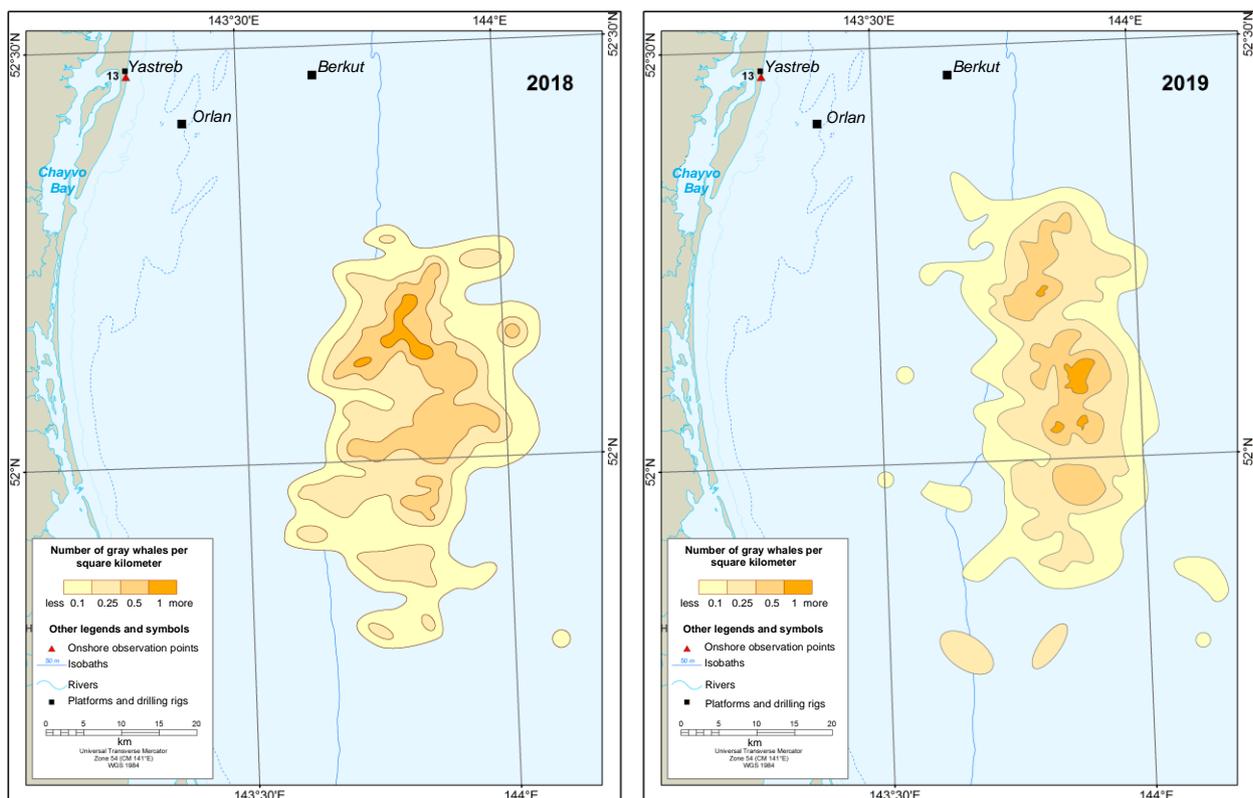
We should also touch on the change noted in 2019 in comparison with the previous year with regard to gray whale distribution in the Piltun feeding area by distance from the shore and by water depth, which was manifested in an increased concentration of whales in the shallower nearshore zone at a distance of up to 0.5 km from the coastline with depths of up to 5 m. While in 2018 18.4% of whales were present on average during the season based on the distance index and 36.9% based on the depth index, in 2019 these numbers were 35.7% (+17.3%) and 47.6% (+10.7%), respectively. This change in whale distribution was most likely related to an shift in the presence and concentration of preferred whale food sources or due to

the fact that the few gray whales that remained in the area were mainly represented by cow-calf pairs and calves who had separated from their mothers and preferred to feed at minimal depths near the shore.



**Figure 0-3.** Comparative spatial distribution of gray whales in the Piltun feeding area in July-September 2018 and 2019 (whale occurrence frequency per 1 km<sup>2</sup> based on complete shore-based surveys)

In 2019, as in the previous year, gray whales in the Offshore feeding area generally stayed together and fed in a single, albeit non-homogeneous accumulation in its eastern part, but at somewhat greater depths: while in 2018 they were observed in the water area with depths ranging from 40-45 to 65-70 m, almost none of them were encountered in 2019 in the area extending to the 50 m isobath. At the same time, as the season progressed, there was a gradual increase in the concentration of whales in the northern part of the feeding area, with the formation of a localized aggregation there in September, within which their maximum occurrence frequency exceeded 0.5 whales/km<sup>2</sup> (Figure 5-4). In addition, a certain number of whales appeared in the shallower part of this area, in waters with depths of less than 50 m, where they were not present in July and the first half of August and only singly in the last third of August (Figure 4-8). It should also be noted that the occurrence of gray whales in the Offshore feeding area east of 144° E, based on the data of the surveys conducted in this part of the water area in the last 2 years (2018 and 2019) from the *Siem Sapphire* vessel, decreases sharply (Figures 4-10 and 5-4). Therefore, we can assume that the actual feeding zone of gray whales in the Offshore area currently extends no more than 60 km from the Sakhalin shore.



**Figure 0-4.** Comparative spatial distribution of gray whales in the Offshore feeding area based on complete surveys in July-September 2018 from *Siem Sapphire* and in 2019 from *Katun* and *Siem Sapphire* vessels (whale sighting frequency per 1 km<sup>2</sup>)

This type of whale distribution in the Offshore area (i.e., formation of a cluster in the eastern deepest part of the region with a varying degree of aggregation) has been observed for 10 years (since 2009). There was also initially a gradual shifting of the feeding aggregation within this area to the south along the 50-meter isobath. However, in 2018-2019, the feeding aggregation began to move back to the north (Figure 5-4), and it is fair to assume that the Offshore area is also experiencing periodic changes in the spatial distribution of food resources, although it is likely that their total biomass can support the whales feeding there.

In summary, it is reasonable to state that, overall, the Sakhalin feeding group of gray whales is currently in a rather good and stable condition, and, based on the total abundance indicator, has reached the maximum values (in comparison with the data of the previous years of monitoring studies) according to both counting observations and photo ID data.

Nevertheless, monitoring must continue, both in the Offshore feeding area that has become more important in recent years and in the nearshore Piltun area, which is the key habitat for cows with nursing calves and young whales, i.e., the active reproductive core of the Sakhalin group and perhaps even of the entire Sea of Okhotsk population.

## CONCLUSION

The results of vessel-based and shore-based surveys carried out in 2019 as part of the Gray Whale Monitoring Program off the northeast coast of Sakhalin Island yielded the following conclusions on the presence, abundance, and distribution of gray whales in their feeding areas, as well as on the overall present condition of their Sakhalin foraging group:

1. The spatial distribution of gray whales in the Piltun feeding area in July-September of 2019 was on the whole typical of these waters, just as in the overwhelming majority of years under the monitoring program. Most of the whales (on average more than 73% of individuals) were in the near-shore waters at the mouth of Piltun Bay, within 3 km offshore at depths down to 10-15 m.

2. The average seasonal abundance of gray whales that were concentrated in the Piltun area in 2019 showed a growth trend, exceeding the 2018 numbers by 78% (from 6.4 to 11.4 animals), and an increase in the maximum seasonal values from 8 to 17 whales.

3. In the Offshore feeding area, as during all previous years of monitoring, gray whales concentrated throughout the season in its eastern part in water depths from 35-40 to 65-70 m, but over the last two years their primary gathering location shifted approximately 20 km to the north compared to prior years. In the seaward part of the water area, the occurrence of animals beyond 144° E (i.e. more than 60 km from the Sakhalin shore) sharply decreases, and this longitude may currently be considered as the actual eastern boundary of this feeding area.

4. The maximum number of gray whales recorded in 2019 during vessel-based surveys in the Offshore feeding area turned out to be the highest for the entire 20-year period of observations and totaled 151 whales.

5. The one-time total gray whale abundance in East Sakhalin waters as recorded by surveys in 2019 – simultaneously in the Piltun and Offshore areas -- was 160 whales, which is its highest value throughout the entire contemporary monitoring period for this feeding group (starting in the 1980s).

6. The 2019 results of the monitoring of the abundance and distribution of gray whales characterizes the current status of their Sakhalin feeding group as entirely stable, at their population peak, and with a further growth trend.

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