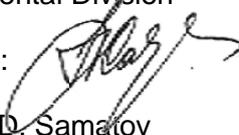




# Sakhalin Energy Investment Company Ltd.

## APPROVED BY

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Signature: 

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Date: 03.12.2021

## Distribution and abundance of gray whales offshore northeast Sakhalin in August-September of 2020

Распределение и численность серых китов в шельфовых водах северо-восточного Сахалина в августе-сентябре 2020 г.

Change document metadata

<b>Document Number</b>	SEIC-HS-03371
<b>Confidentiality Level</b>	Unclassified
<b>Information Custodian</b>	A.D. Samatov, Head of Corporate Environmental Division
<b>Revision Number</b>	01
<b>Issue Purpose</b>	AFU – Approved for Use
<b>Effective Date</b> (corresponds to the approval date unless specified otherwise)	
<b>ACAL ID</b>	N/A

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(подпись)

дата «15» июня 2021 г.



**РАСПРЕДЕЛЕНИЕ И ЧИСЛЕННОСТЬ СЕРЫХ КИТОВ В ШЕЛЬФОВЫХ  
ВОДАХ СЕВЕРО-ВОСТОЧНОГО САХАЛИНА В АВГУСТЕ-СЕНТЯБРЕ 2020 г.**

**ОТЧЕТ ОБ ИССЛЕДОВАНИЯХ  
В РАМКАХ «ПРОГРАММЫ МОНИТОРИНГА СЕРЫХ КИТОВ  
У СЕВЕРО-ВОСТОЧНОГО ПОБЕРЕЖЬЯ ОСТРОВА САХАЛИН  
на 2020 г.»**

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2021**

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**DISTRIBUTION AND ABUNDANCE OF GRAY WHALES  
OFFSHORE NORTHEAST SAKHALIN IN AUGUST-  
SEPTEMBER OF 2020**

**REPORT ON SURVEYS  
CONDUCTED UNDER THE 2020 PROGRAM FOR GRAY WHALE  
MONITORING OFFSHORE NORTHEAST SAKHALIN ISLAND**

**V. A. Vladimirov (RPO Marine Mammals Council), I. A. Timokhin (MSU),  
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**Prepared for  
Sakhalin Energy Investment Company and  
Exxon Neftegas Limited**

**Yuzhno-Sakhalinsk  
2021**

## **ABSTRACT**

Report on 57 p., 6 tables, 15 figures, 7 references, 2 attachments.

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

The report provides information on the results of monitoring the distribution and recorded number of gray whales offshore northeast Sakhalin conducted in late July-September of 2020. The surveys were conducted as part of the corresponding joint program of Exxon Neftegas Limited and Sakhalin Energy Investment Company Ltd.

The data obtained indicate that the gray whale distribution within the Piltun feeding area in August-September of 2020 was generally typical of the last 3 years in terms of an overall seasonal pattern, their primary gathering location (over 79% of animals on average over the entire work period) was in the near-shore waters at the mouth of Piltun Bay, within 2 km from the shore 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 the entire season in its eastern part at depths from 45-55 to 65-70 m, at a distance of up to 60 km from the island shore.

The total number of gray whales recorded at any one time during synchronized surveys offshore eastern Sakhalin in the last 3 years has been at a high level – over 100 animals.

**Composition of survey groups involved in the implementation of the gray whale distribution and abundance monitoring programs:**

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

The shore-based surveys in the Piltun feeding area in 2020 were conducted by two teams of observers:

North team – A. Bobkov (team lead), S. Ivanenko, P. Permyakov, and D. Nam

South team – P. van der Wolf (team lead), A. Bezrukov, A. Kvashnin, M. Pushilin, and V. Chernitsyn.

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

**2. Offshore Surveys:**

Vessel-based surveys in the Offshore feeding area in 2020 were conducted on board the *Polar Baikal* vessel by a research group composed of V. Kavun (team lead), Candidate of Sciences (Biology) and Ye. Lebedev (both from SSU).

The team of experts-observers composed of A. Pogonyshev (team lead), A. Yermoshin (SSU), and M. Matveev (National Scientific Center for Marine Biology with the Far East Branch of Russia's Academy of Sciences) conducted surveys on board the *SCF Endurance* vessel.

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

## TABLE OF CONTENTS

1	INTRODUCTION .....	8
1.1	Main Objectives for Monitoring Gray Whale Distribution Offshore Northeast Sakhalin Island.....	8
2	WORK METHODS.....	9
3	SURVEY EFFORTS AND ACQUIRED MATERIALS.....	12
3.1	Shore-Based Surveys.....	12
3.2	Vessel-Based Surveys .....	13
4	SURVEY RESULTS.....	14
4.1	Distribution and Number of Recorded Gray Whales .....	14
4.1.1	Piltun Feeding Area .....	14
4.1.1.1	Dynamics of the Number of Whales in the Piltun Area.....	14
4.1.1.2	Spatial Distribution and Seasonal Variations of Whales .....	17
4.1.1.3	Distribution of Whales by Distance from Shore and Water Depth .....	22
4.1.2	Offshore Feeding Area.....	24
4.1.2.1	Dynamics of the Number of Simultaneously Sighted Whales .....	24
4.1.2.2	Spatial Distribution of Whales .....	24
4.1.3	Total Number of Gray Whales Recorded Off Northeast Sakhalin.....	26
4.1.4	Size of Whale Pods.....	27
4.1.4.1	Piltun Area.....	27
4.1.4.2	Offshore Area.....	27
4.1.5	Distribution of Females and Calves .....	28
4.2	Sightings of Other Marine Mammal Species .....	29
4.3	Impact of Anthropogenic Factors on Gray Whales .....	33
5	DISCUSSION OF RESULTS.....	33
5.1	Recorded Number of Gray Whales.....	33
5.2	Spatial Distribution of Gray Whales in the Feeding Areas.....	36
6	CONCLUSION .....	40
	ACKNOWLEDGMENTS .....	42
	REFERENCES.....	43

**LIST OF TABLES**

Table 3-2. Number of gray whales and other marine mammal species recorded during vessel-based surveys in the Offshore feeding area in August-September of 2020.....13

Table 4-1. Number of gray whales recorded during shore-based surveys in the Piltun feeding area in late July-September of 2020.....14

Table 4-2. Distribution of gray whales in the Piltun area by water depth in late July-September of 2020 (according to shore-based surveys).....22

Table 4-3. Distribution of gray whales in the Piltun feeding area by distance from shore in late July-September of 2020 (according to shore-based surveys) .....22

Table 4-4. Quantitative data on the pods of gray whales recorded in the Offshore feeding area in 2020 (according to the *Polar Baikal* and *Endurance* survey data) .....28

## LIST OF FIGURES

Figure 2-1. Onshore vehicle-based observation stations of gray whales in the Piltun feeding area in July-September of 2020. ....	10
Figure 2-2. Planned transects of surveys of gray whales in the Offshore feeding area from the <i>Polar Baikal</i> (I) and <i>SCF Endurance</i> (II) vessels in August-September of 2020.....	11
Figure 4-1. Seasonal dynamics of the total number of simultaneous gray whale sightings recorded in the Piltun feeding area according to data from synchronized shore-based surveys conducted in August-September of 2020 .....	16
Figure 4-2. Seasonal variations in the quantitative distribution of gray whales in the Piltun area along the water area sections adjacent to the observation stations (I-IV) and the seasonal average values of the same indicators (V) in the period from late July to late September of 2020 (according to the synchronized and non-synchronized shore-based surveys data).....	18
Figure 4-3. Gray whale sighting points in the Piltun feeding area during shore-based surveys in late July-September of 2020 .....	20
Figure 4-4. The spatial distribution of gray whales recorded in the Piltun feeding area in August-September 2020 according to the data from shore-based surveys (animal sighting frequency per square kilometer) .....	21
Figure 4-5. Distribution of gray whales in the Piltun feeding area by depth (A) and by distance from shore (B) in late August-September of 2020 (according to shore-based surveys).....	23
Figure 4-6. Seasonal changes in location of gray whales in the Offshore feeding area in August-September of 2020 according to the survey data from the <i>Polar Baikal</i> (I) and <i>SCF Endurance</i> vessels (II) .....	25
Figure 4-8. Sightings of other marine mammal species (in addition to gray whales) in the waters of the Piltun area in late July-September of 2020 (according to shore-based surveys).....	30
Figure 4-9. Sightings of other marine mammal species (in addition to gray whales) in the Offshore area in August-September of 2020 (according to vessel-based surveys) .....	32
Figure 5-1. Summary data on multi-year variations of the number of gray whales recorded during the visual surveys and photoidentification conducted offshore northeast Sakhalin in 1989-2020 .....	34
Figure 5-2. Indicators of year-to-year dynamics of whale number recorded in the Piltun feeding area in 2004-2020, according to shore-based surveys during the main feeding season (August-September).....	34
Figure 5-3. Comparative spatial distribution of gray whales in the Piltun feeding area in July – September of 2019 and 2020 (animal sighting frequency per square kilometer according to shore-based surveys) .....	38
Figure 5-4. Comparative spatial distribution of gray whales in the Offshore feeding area according to vessel-based surveys in August-September of 2019 and 2020 (whale sighting frequency per square kilometer) .....	39

# 1 INTRODUCTION

The gray whales (*Eschrichtius robustus*) that feed in the area off the northeast coast of Sakhalin Island are listed as the Sea of Okhotsk gray whale population in the Red Book of the Russian Federation with the designation of having “rarity status” 1 (endangered) under Category CR (critically endangered) and Category I reflecting the level of priority of currently implemented/planned environmental protection measures. The same group of whales, referred to as the western subpopulation, are also listed as Endangered in the Red List of the International Union for Conservation of Nature (IUCN). With this designation, annual monitoring is necessary.

One of the most important components of the monitoring is to study the distribution and numbers of these animals during their key summer-fall feeding period. The work scope of gray whale surveys offshore northeast Sakhalin Island covered in this report was completed during the period from July 28 through September 28, 2020, and incorporated the results of the gray whale monitoring obtained during the implementation of the Joint Program by Exxon Neftegas Limited (ENL) and Sakhalin Energy Investment Company Ltd. (Sakhalin Energy). The monitoring program was duly approved by the federal executive body: the Federal Service for Supervision of Natural Resources Use (Rosprirodnadzor). Financing and logistics of the entire work scope was provided by ENL and Sakhalin Energy - the operators of the Sakhalin-1 and Sakhalin-2 oil and gas projects, respectively.

## 1.1 Main Objectives for Monitoring Gray Whale Distribution Offshore Northeast Sakhalin Island

1. Collect data on spatial distribution of gray whales in the Piltun and Offshore feeding areas;
2. Estimate the number of gray whales during the summer/fall feeding period;
3. Collect data on seasonal and annual changes in the use of the feeding areas by whales;
4. Collect data on the distribution and number of other marine mammal species sighted during the course of the Joint Program activities.

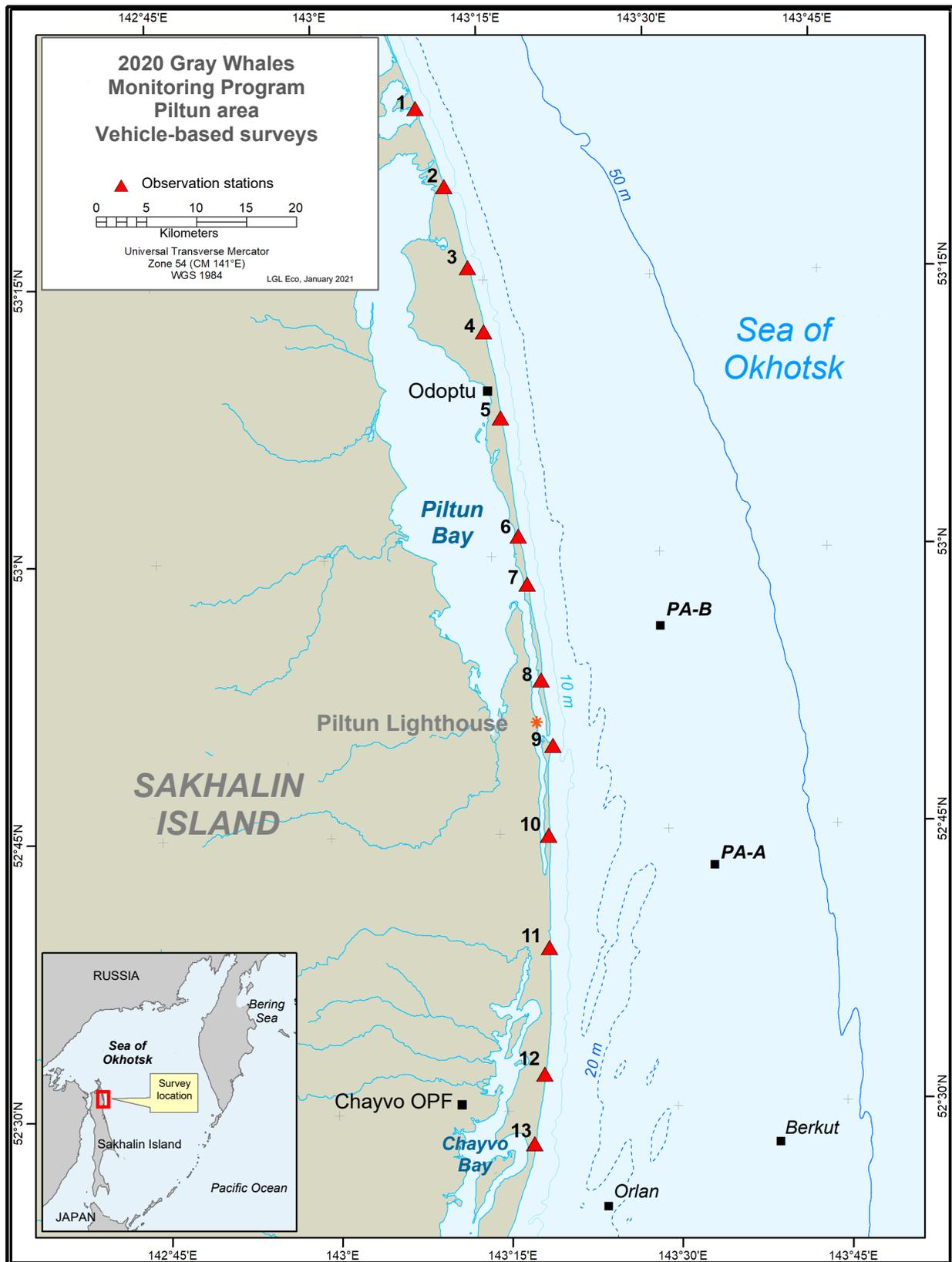
## 2 WORK METHODS

The methods for gathering field materials during shore- and vessel-based surveys, their laboratory processing and analysis, and mapping were covered at length in the relevant sections of the report under the *2011 Joint Program of Gray Whale Monitoring Offshore Northeast Sakhalin Island* (Vladimirov et al., 2012).

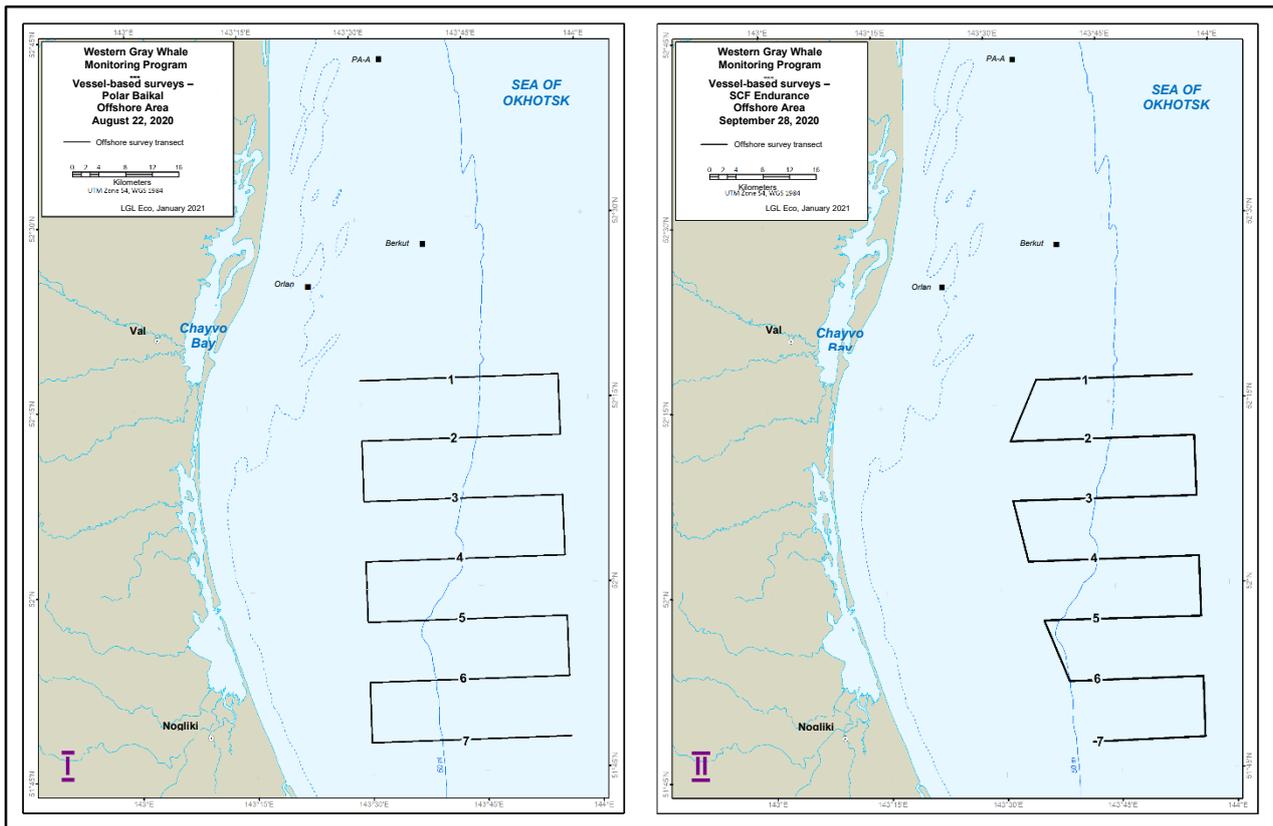
In 2020, as in all previous years, the shore-based surveys in the Piltun feeding area were conducted according to the work procedures from elevated shore observation stations (OS) by two mobile teams – north and south – moving from one OS to another on all-terrain vehicles. Such arrangement of the survey work is dictated by the fact that the coastline adjacent to this feeding area is divided into 2 parts by the mouth of Piltun Bay which presents an insurmountable obstacle for the vehicles. The location of some of the shore-based OS may change slightly in certain years due to erosion of the coastline, but has remained unchanged since 2015 (Fig. 2-1).

In 2020, the vessel-based surveys in the Offshore feeding area were conducted mainly on board two vessels – *Polar Baikal* and *SCF Endurance*. The surveys were conducted according to the same transect grids as in 2019 – from the *Polar Baikal* vessel according to the standard grid used in the recent years, and from the *SCF Endurance* vessel – according to a similar tack grid constrained on the west by the 12-mile zone of the territorial waters of the Russian Federation (Fig. 2-2). Comparison of data (numbers of whales) recorded from the *Polar Baikal* vessel (that has a relatively low bridge) with the results of recording from vessels with higher platforms in 2018-2019 demonstrated that the *Polar Baikal* observations show undercounting of whales during the transect survey conducted in the Offshore area. Therefore, during the field season of 2020, the data obtained during the *Polar Baikal* survey were used to create density maps and analyze distributions, but not to estimate the number of whales.

The procedure for directly observing gray whales and determining their location did not undergo any fundamental changes in 2020. At the same time, both the data from complete surveys conducted in the entire feeding area with fully synchronized start times and the data from non-synchronized surveys obtained during additional recording activities were used in the estimations and preparation of maps for this report based on the results of shore-based surveys in the Piltun feeding area.



**Figure 2-1.** Onshore vehicle-based observation stations of gray whales in the Piltun feeding area in July-September of 2020.



**Figure 2-1.** Planned transects of surveys of gray whales in the Offshore feeding area from the *Polar Baikal* (I) and *SCF Endurance* (II) vessels in August-September of 2020

When calculating the number of whales and preparing cartographic materials for this report using the results of the shore-based surveys conducted in the Piltun feeding area, two types of data were used: (1) the data from complete surveys of the entire feeding area that were strictly synchronized in time of their commencement by the north and south teams at the adjacent OS 8 and 9, and (2) the data from non-synchronized surveys obtained during the course of additional recording activities.

The number of gray whales in the Offshore area was estimated using only the *SCF Endurance* survey data, since the *Polar Baikal* survey data reflect undercounting of animals due to a considerably lower bridge of the vessel.

When mapping collected data, the total distribution of gray whales in the Piltun area throughout the entire monitoring period (late July-September) was analyzed using the combined data from synchronized and non-synchronized surveys and is shown on pseudo-isolinear maps of occurrence (Fig. 4-4 and 4-7). The characteristics of the spatial distribution of gray whales in the Piltun feeding area over shorter intervals within the main feeding period, as well as during each session of the vessel-based control scanning of the Offshore feeding

water area are shown on the so-called “sighting” (point) maps, on which the markings indicate the exact location of each whale or each of their localized pods sighted during the scan (Fig. 4-3 and 4-6). The survey data from both vessels were used to prepare maps of distribution of the animals in the Offshore area.

### 3 SURVEY EFFORTS AND ACQUIRED MATERIALS

#### 3.1 Shore-Based Surveys

The 2020 field work involving a shore-based surveys of gray whales in the Piltun feeding area covered a period of 63 days (July 28 through September 28). During this time, 6 complete strictly synchronized surveys were conducted in the entire water area – on August 6, 22, 30, and on September 12, 21, and 23. In addition, 30 more non-synchronized surveys were conducted, with a difference in the time of their execution at the adjacent key OS 8 and 9 usually within 2 hours (Table 4-1).

281 sightings of solitary gray whales or their pods<sup>1</sup> were recorded during the implementation of the program of the shore-based surveys in the Piltun feeding area during the 2020 field season, and the total number of animals sighted (including those recorded more than once) was 316.

**Table 3-1.** Number of onshore vehicle-based gray whale surveys conducted in the Piltun feeding area in July-September 2020, and their overall results

Month	Complete surveys	Non-synchronized surveys	Partial surveys	Number of whale sightings	Total number of whales recorded
July	-	2	1	21	27
August	3	13	6	132	150
September	3	15	2	128	139
Total:	6	30	9	281	316

In addition to gray whales, 22 encounters of minke whales (22 animals), 11 encounters of orca whales (17 animals), 26 encounters of harbor porpoises (33 animals), 12 encounters of Steller’s sea lions (15 animals) and 1 encounter of a solitary marine mammal of an unidentified species were also recorded in the course of the shore-based surveys.

The information on the time and coordinates of all encounters with the animals is provided in Attachment 2.

---

<sup>1</sup> The term “whale pod” typically means an aggregation of animals (with distances between them not exceeding 5 body lengths).

### 3.2 Vessel-Based Surveys

In 2020, 2 complete vessel surveys were conducted in the Offshore feeding area (Table 3-1), 1 survey each from *Polar Baikal* (on August 22) and *SCF Endurance* (on September 28). The term “complete survey” means that the planned survey route following the transects was fully covered.

During the survey conducted on August 22 from the *Polar Baikal* vessel, 28 encounters of pods and solitary gray whales were recorded (a total of 36 animals), as well as 6 encounters of other marine mammals, all of whom (9 animals) were northern fur seals.

During the survey conducted 5 weeks later on September 28 from the *SCF Endurance* vessel, 56 encounters of pods and solitary gray whales were recorded (a total of 111 animals), as well as 3 encounters of other marine mammals – 1 encounter of a solitary minke whale, 1 encounter of a pod of orca whales (4 animals) and 1 encounter of a solitary northern fur seal.

A total of 84 encounters of pods and solitary gray whales (a total of 147 animals) were recorded during the completed vessel-based surveys (Table 3-1), as well as 9 encounters of other marine mammals – minke whales (1 encounter, 1 animal), orca whales (1 encounter, 4 animals), and northern fur seals (7 encounters, 10 animals).

**Table 3-2.** Number of gray whales and other marine mammal species recorded during vessel-based surveys in the Offshore feeding area in August-September of 2020

Survey date	Vessel name	Species*			
		GW	MW	OW	NFS
22.08.20	Polar Baikal	36			9
28.09.20	Endurance	111	1	4	1
	<b>Total:</b>	<b>147</b>	<b>1</b>	<b>4</b>	<b>10</b>

\* Notes:

GW - gray whale, MW - minke whale, OW – orca whale, NFS - northern fur seal

More detailed information on the gray whales recorded in the Offshore feeding area in 2020 during vessel-based surveys is presented in Sections 4.1.2 and 4.1.4.2 of this report, and the information on other marine mammals is presented in Section 4.2. The information on coordinates and time of animal encounters is provided in Attachment 3.

## 4 SURVEY RESULTS

### 4.1 Distribution and Number of Recorded Gray Whales

#### 4.1.1 Piltun Feeding Area

Weather and logistics allowed us to conduct only 6 shore-based strictly synchronized surveys during July-September 2019 (August 6, 22, and 30, September 12, 21, and 23), as well as 30 non-synchronized and not always complete surveys. The data obtained provide a picture of the specifics of seasonal distribution and the dynamics of the number of whales during the specified period.

##### 4.1.1.1 Dynamics of the Number of Whales in the Piltun Area

The number of gray whales recorded in the waters of the Piltun area during the period from late July to late September of 2020 was, as in recent years of monitoring (2017-2019), very small. Based on the data from all shore-based surveys, the number of individuals did not exceed 15 animals (Table 4-1).

**Table 4-1.** Number of gray whales recorded during shore-based surveys in the Piltun feeding area in late July-September of 2020

Survey date	Odoptu-Piltun section (OPS)								Astokh-Chayvo section (ACS)					Subtotal		
	Observation station (OS) number								Observation station (OS) number					OPS	ACS	Total
	1	2	3	4	5	6	7	8	9	10	11	12	13			
July																
28	x	x	x	x	x	x	x	x	x	x	1		x		1	
29**		x	x	x	x			1	12		1			1	13	14
30**		x	x	x	x			2	8	2			x	2	10	12
August																
3**	x	x						1	8					1	8	9
4**	x	x				1			2			x	x	1	2	3
5		1						x						1		
6*								<b>2***</b>	<b>2</b>		<b>1</b>			<b>2</b>	<b>3</b>	<b>5</b>
7								1	x				x	1		
8**								1	4	1		1		1	6	7
9**	x	x	x				1	1	6			1	1	2	8	10
10**		x				x	x	4	6			x	x	4	6	10
11	x	x	x	x	x	x	x	x	x	x	1				1	
13**								1	8	2		x	x	1	10	11
14**								1	6	2				1	8	9
15**	x	x	x	x					11						11	11
19			x	x	x	x	x	x	2						2	

Survey date	Odoptu-Piltun section (OPS)								Astokh-Chayvo section (ACS)					Subtotal			
	Observation station (OS) number								Observation station (OS) number					OPS	ACS	Total	
	1	2	3	4	5	6	7	8	9	10	11	12	13				
20	x	x	x	x	x	x	x	x	6	1					7		
21**								1	7	2				1	9	10	
<b>22*</b>								<b>2</b>	<b>2</b>					<b>2</b>	<b>2</b>	<b>4</b>	
23**	x	x	x	x	x	x			6			x	x		6	6	
24**								2	5					2	5	7	
27**									3	1					4	4	
29**								1	3	6	1		1		4	8	12
<b>30*</b>								<b>1</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>1</b>			<b>6</b>	<b>8</b>	<b>14</b>
31						1	x	x	3				2	1	5		
September																	
5	x						x	x	x	3					3		
7**	x				x			4	2					4	2	6	
8**	x							6	6	1				6	7	13	
9**	x							2	7		x	x	x	2	7	9	
11**	x	x						5	3	1	2			5	6	11	
<b>12*</b>								<b>4</b>	<b>2</b>					<b>4</b>	<b>2</b>	<b>6</b>	
13**								2	2					2	2	4	
14**						2	3	6	1	1				11	2	13	
15**		1	2	1	1	3			4	2		1		8	7	15	
16**								4	4				1	4	5	9	
17**	x	x						1	3					1	3	4	
20**								2	1	1				2	2	4	
<b>21*</b>								<b>3</b>	<b>1</b>		<b>1</b>			<b>3</b>	<b>2</b>	<b>5</b>	
22**						1		1	5					2	5	7	
<b>23*</b>								<b>1</b>	<b>3</b>					<b>1</b>	<b>3</b>	<b>4</b>	
24**	x							1	4					1	4	5	
25**								2	3					2	3	5	
26**					1			1	2	3		x	x	2	5	7	
27**										6		1			7	7	
28					x	x	x	x	x	x	x	2			2		
Grand Total		2	2	1	2	8	9	68	170	33	8	9	2	94	223	293	

**Note:**

The cells with crosses mean that the survey was not conducted in the observation area from this observation station on the specified day for one reason or another. Empty cells indicate that no whales were present in the water area adjacent to this observation station.

\* - complete strictly synchronized surveys

\*\* - non-synchronized surveys used in the analysis

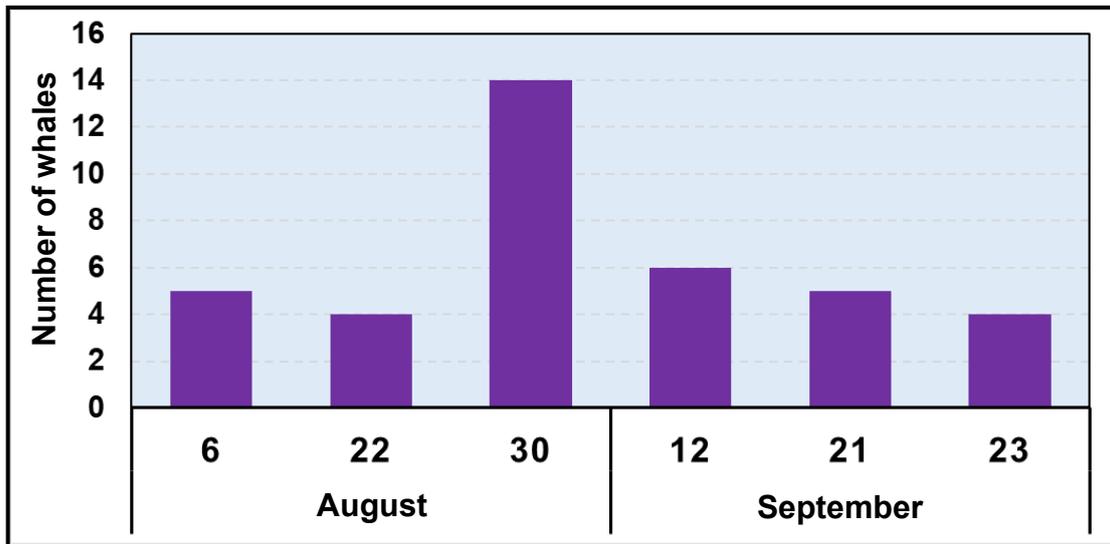
\*\*\* - female with calf

The number of all animals sighted in the area is shown in the OPS and ACS columns.

The “Subtotal” column indicates the total number of whales recorded as of this date, provided that strictly synchronized or non-synchronized surveys were conducted in the areas of OS 8 and 9; otherwise, the total number of recorded whales is not indicated, and their number at the sites is shown in italics.

The “Grand Total” line shows the total number of all recorded whales.

From a seasonal perspective, the dynamics of the total number of gray whales in the Piltun feeding area, as reflected by the survey data, varied in 2020 by almost constant relatively short-term fluctuations, and often the number of animals changed from day to day by several orders of magnitude.



**Figure 4-1.** Seasonal dynamics of the total number of simultaneous gray whales recorded in the Piltun feeding area according to data from synchronized shore-based surveys conducted in August-September of 2020

However, in terms of longer half-month intervals of the season during most of the monitoring period the total number of recorded animals (based on all surveys) varied slightly – on average, from 7.2 in August to 9.6 animals in September (SD = 3.9 and 4.0, respectively), the minimum and maximum numbers also basically did not change over half-month intervals, amounting to 4-5 and 14-15 animals, respectively (Fig. 4.2-I-III). Only at the very end of the season (in the second half of September) the process of disintegration of this feeding aggregation began, and the total average number of whales decreased to 5.7 animals (SD = 1.7). In the area of the main feeding OS 8-9 it also decreased from 7.2 animals in the previous 1.5 months to 3.9 animals; at the same time, the range of variations in their total number decreased to 4-9 animals (Tables 4-1, 4.2-I-IV).

According to the 2020 synchronized surveys only, the average number of whales was 6.3 individuals (SD=3.8). At the same time, based on the results of all surveys conducted in the Piltun feeding area, which were recognized as representative, the final average seasonal

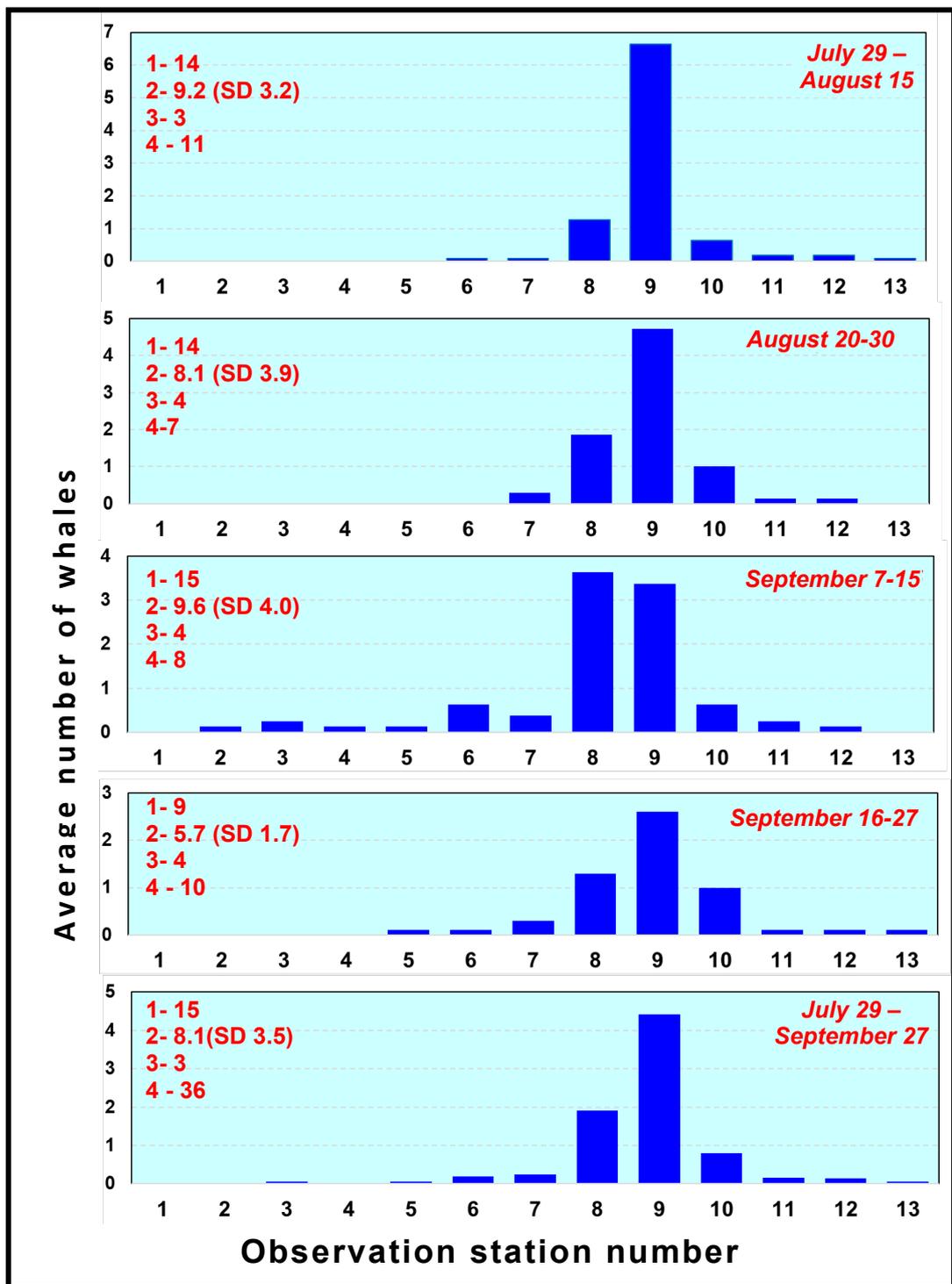
number of gray whales recorded in the Piltun feeding area from late July to late September of 2020 (according to all surveys used in the analysis) was 8.1 animals (SD = 3.5).

The maximum number of whales recorded during the synchronized survey was 14 (August 30), which is close to the maximum number of whales recorded during the non-synchronized survey on September 15 (15 animals).

#### **4.1.1.2 Spatial Distribution and Seasonal Variations of Whales**

As was already noted, the number of gray whales simultaneously present in the Piltun feeding area in late July-September of 2020 was very small with their distribution basically not varying over the season. As can be seen from Table 4-1 and the respective charts based on the analysis of shore-based survey results (Fig. 4-2), throughout the monitoring season (July 28 - September 27), the overwhelming majority of animals (total of 78.1%) stayed localized near the mouth of Piltun Bay, mainly around OS 9 (54.5%) and, to a lesser extent, in the zone of OS 8 (23.6%). In the water areas immediately adjacent to these stations from the north and south, the number of whales sharply decreased, and further towards the peripheral parts of the feeding area their occurrence decreased to the level of irregular detection of solitary animals. Only 14.4% of the total number of animals recorded during the season was encountered on the southern edge of the area (in the zones of OS 10-13), and 7.5% - northwardly (in the zones of OS 1-7) -.

During the second half of September, there was a noticeable decrease in the total number of gray whales in the Piltun area, which is observed every year during this period (Fig. 4-2-IV).



**Figure 4-2.** Seasonal variations in the quantitative distribution of gray whales in the Piltun area along the water area sections adjacent to the observation stations (I-IV) and the seasonal average values of the same indicators (V) in the period from late July to late September of 2020 (according to the synchronized and non-synchronized shore-based surveys data)

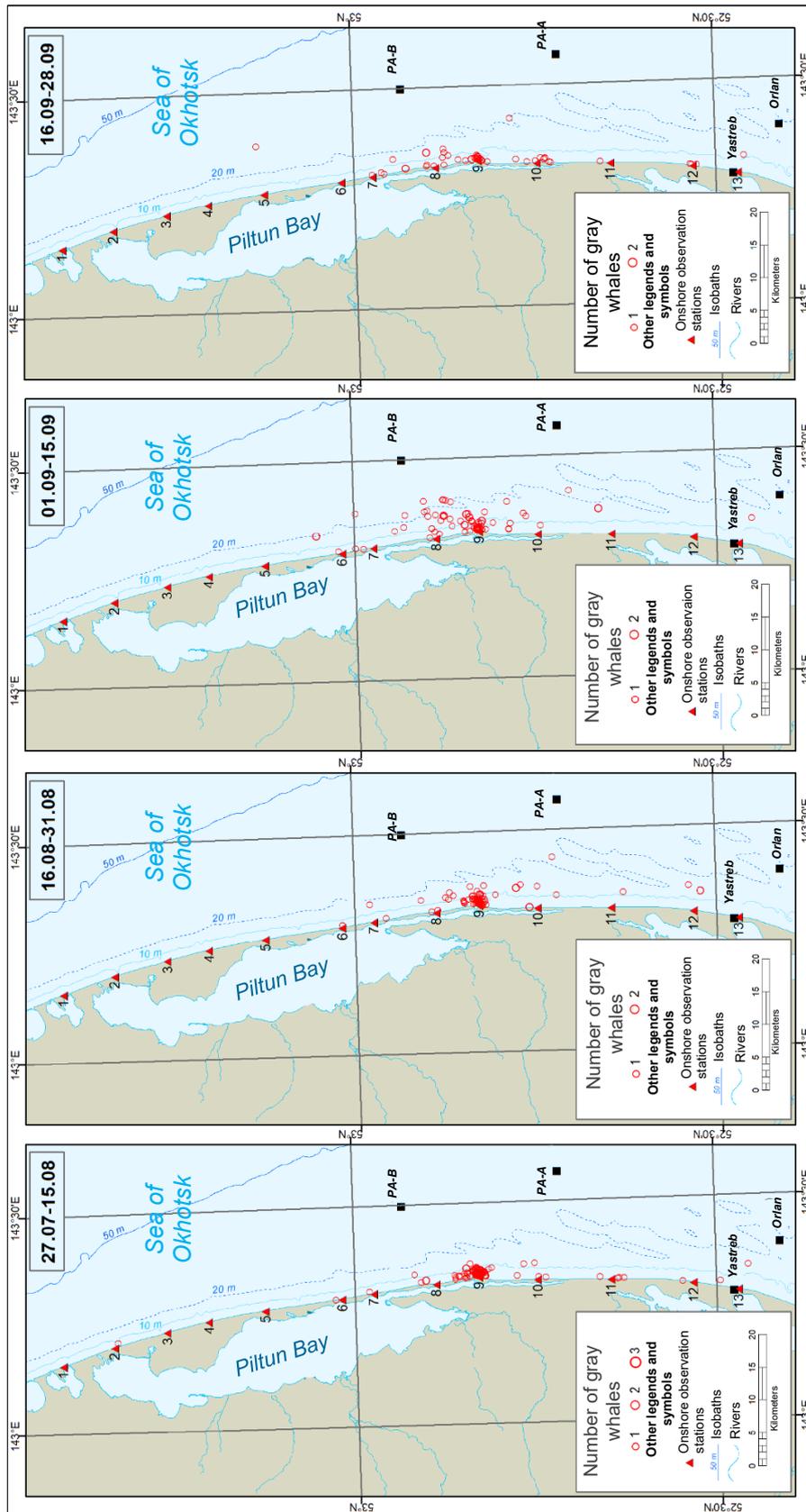
Note:

**1** – the maximum number of whales recorded during 1 survey; **2** – the arithmetic mean number of whales recorded cumulatively during all surveys in July-September (number of animals per survey); **3** – the minimum number of whales recorded during 1 survey; **4** – the number of surveys during the work period used in the calculation.

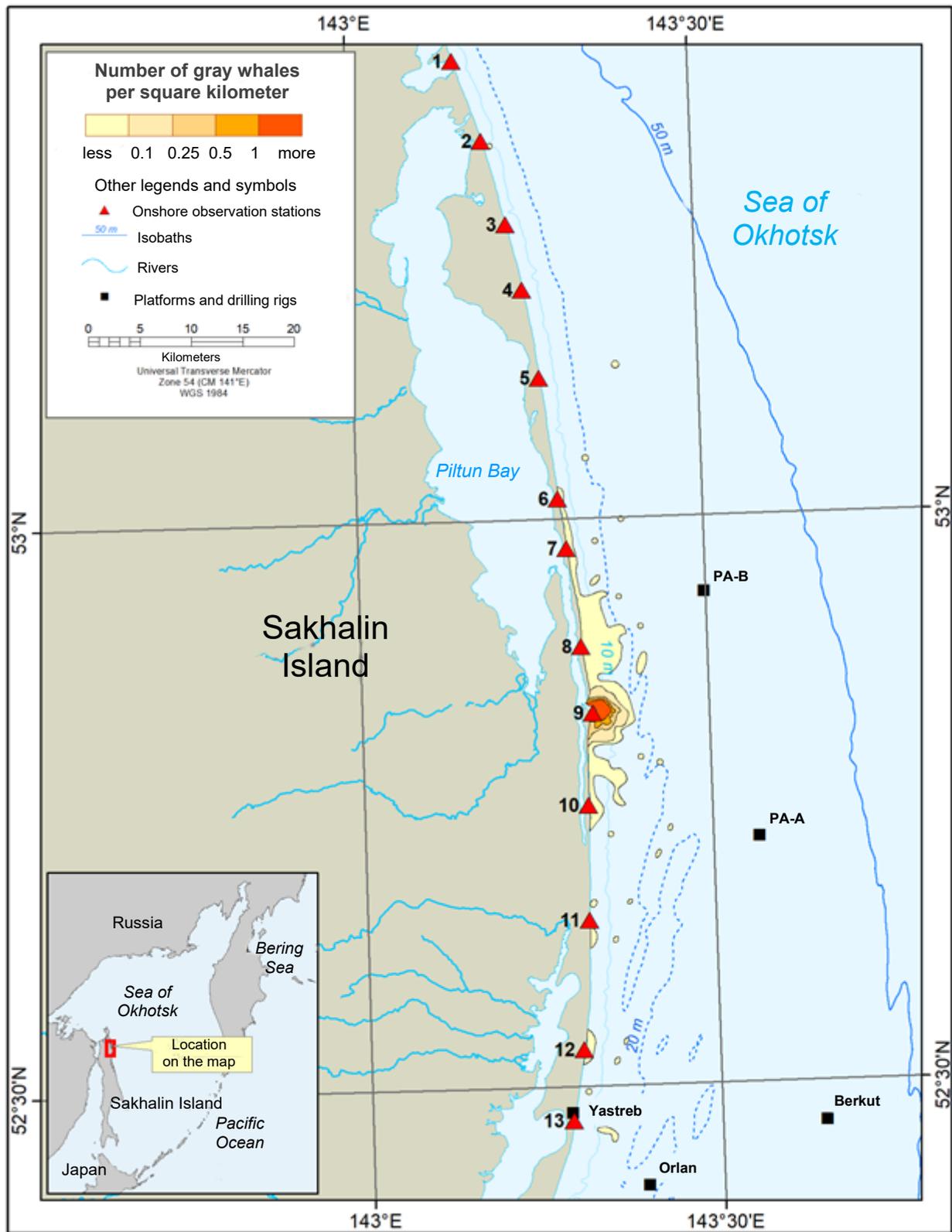
The maps plotted based on the analysis of calculations of average gray whales sightings during the shore-based surveys provide a spatial characterization of the quantitative specifics of their locations in the Piltun area as shown above. The maps show that during the season the whales consistently stayed mainly near the mouth of Piltun Bay, primarily in the area of OS 9. In this case, whales did not form concentrated pods outside of this clearly localized aggregation, but were distributed over the water area within the boundaries from OS 5-6 in the north to OS 12-13 in the south. At the same time, as the distance from the central near-mouth accumulation increased, the concentration of animals became more dispersed. In the 3<sup>rd</sup> ten-day period of September, with the approach of the fall migration to the wintering grounds, whales in the Piltun area became more scattered (Fig. 4.3).

The sighting frequency indicators for gray whales in the Piltun area in July-September of 2020 were low. The maximum sighting frequency in a single mini-aggregation near the mouth of the bay (the area did not exceed 4 x 4 km) was 2.04 animals per square kilometer in one of its micro-areas, but outside this aggregation, the frequency of sightings almost immediately dropped to less than 0.1 animal per square kilometer (Fig. 4-4).

On the whole, its spatial pattern in the Piltun area in August-September of 2020 may be considered typical of this water area in recent years (2018-2019), when the majority of animals coming here for feeding was concentrated in the waters immediately adjacent to the mouth of Piltun Bay (in the zone of OS 8-9), with lower sighting frequency in the northern and southern parts of the area (Vladimirov et al., 2019, 2020).



**Figure 4-3.** Gray whale sighting points in the Piltun feeding area during shore-based surveys in late July-September of 2020



**Figure 4-4.** The spatial distribution of gray whales recorded in the Piltun feeding area in August-September 2020 according to the data from shore-based surveys (animal sighting frequency per square kilometer)

#### 4.1.1.3 Distribution of Whales by Distance from Shore and Water Depth

The distribution of gray whales by water depth in the Piltun feeding area in late July - September of 2020, calculated using the shore-based surveys data, was characterized, as in the previous years (Attachment 1, Vladimirov et al., 2019, 2020), by the concentration of most animals (93.2%) in waters with depths of up to 15 m; however, their primary concentration (66.8%) was observed at depths of up to 5 m. At the same time, 1.5 times more whales stayed in this shallowest part of the Astokh-Chayvo (southern) section of the water area than in the Odoptu-Piltun (northern) section (Table 4-2, Fig. 4.5-A), which was due to the bathymetry of the nearshore area.

**Table 4-2.** Distribution of gray whales in the Piltun area by water depth in late July-September of 2020 (according to shore-based surveys)

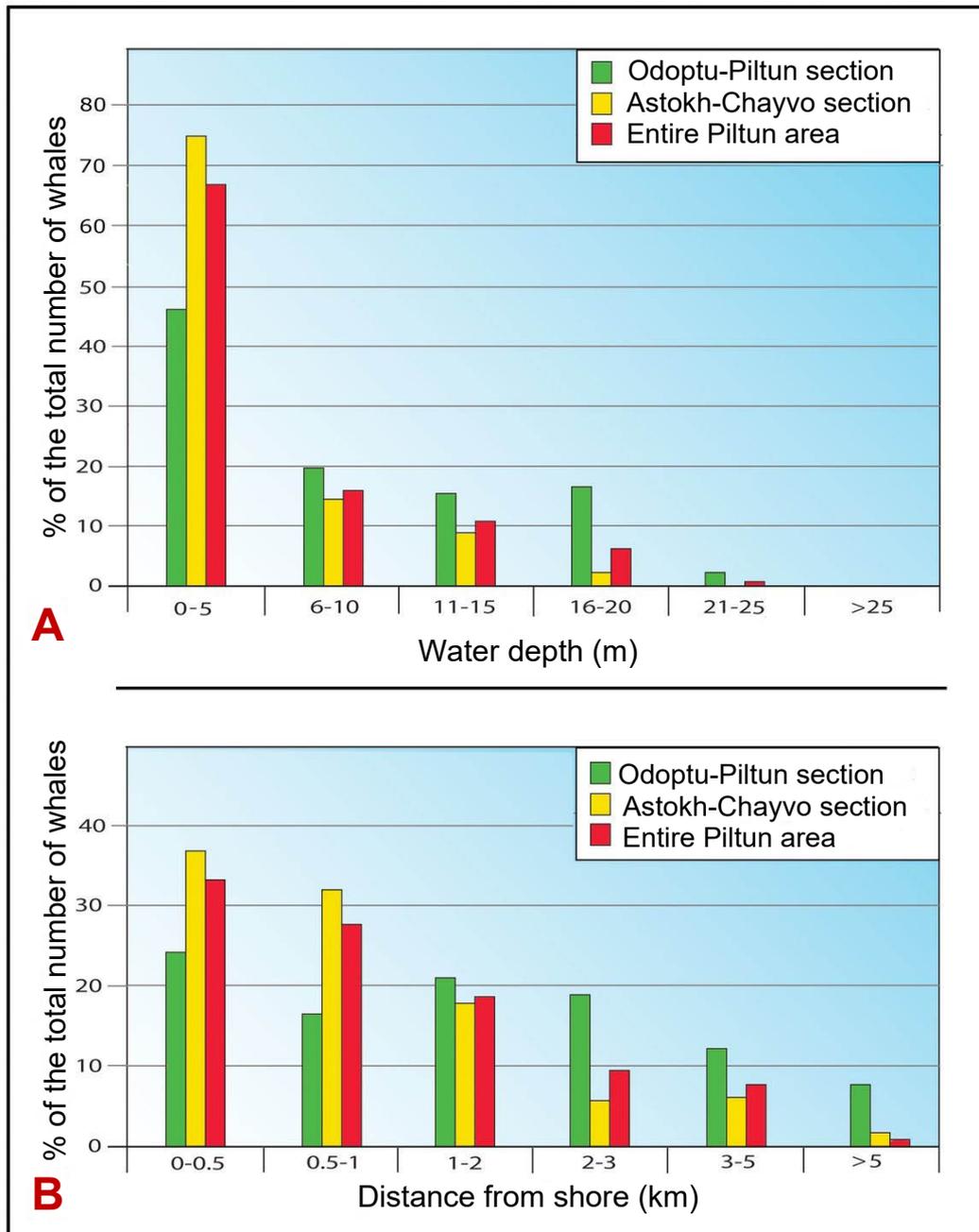
Water depth (m)	Number of whales (%)		
	Odoptu-Piltun section	Astokh-Chayvo section	Total for Piltun area
0-5	46.1	74.8	66.8
6-10	19.8	14.3	15.8
11-15	15.4	8.7	10.6
16-20	16.5	2.2	6.2
21-25	2.2	0	0.6
>25	0	0	0

The overall distribution of gray whales by the distance from shore was consistent with their distribution by water depth, since these two parameters are functionally correlated. The survey data indicate that, in general, in the summer-fall season of 2020, most whales in the Piltun feeding area (79.5% on average) kept close to shore, at a distance of up to 2 km from the water edge with some predominance (33.2%) in the 500-meter coastal strip (Table 4-3). The concentration of animals in the nearshore area differed by area as in the case with the distribution by water depth: at a distance of up to 1 km from the coast, 1.7 times more whales stayed in the waters of the Astokh-Chayvo (southern) section than in the northern Odoptu-Piltun section (68.8% versus 40.7% – Table 4-3, Fig. 4.5-B).

**Table 4-3.** Distribution of gray whales in the Piltun feeding area by distance from shore in late July-September of 2020 (according to shore-based surveys)

Distance from shore (km)	Number of whales (%)		
	Odoptu-Piltun section	Astokh-Chayvo section	Total for Piltun area
0-0.5	24.2	36.8	33.2
0.5-1	16.5	32.0	27.7
1-2	20.8	17.8	18.6

Distance from shore (km)	Number of whales (%)		
	Odoptu-Piltun section	Astokh-Chayvo section	Total for Piltun area
2-3	18.7	5.6	9.3
3-5	12.1	6.1	7.8
>5	7.7	1.7	3.4



**Figure 4-5.** Distribution of gray whales in the Piltun feeding area by depth (A) and by distance from shore (B) in late August-September of 2020 (according to shore-based surveys)

#### **4.1.2 Offshore Feeding Area**

In 2020, two vessel-based transect surveys of gray whales were conducted from *Polar Baikal* (August 22) and *SCF Endurance* (September 28) in the Offshore feeding area (see Section 3.2). These surveys covered the entire water area twice which made it possible to obtain the data on the pattern of the animals' distribution in that area in late summer and first half of fall, and to plot the corresponding maps.

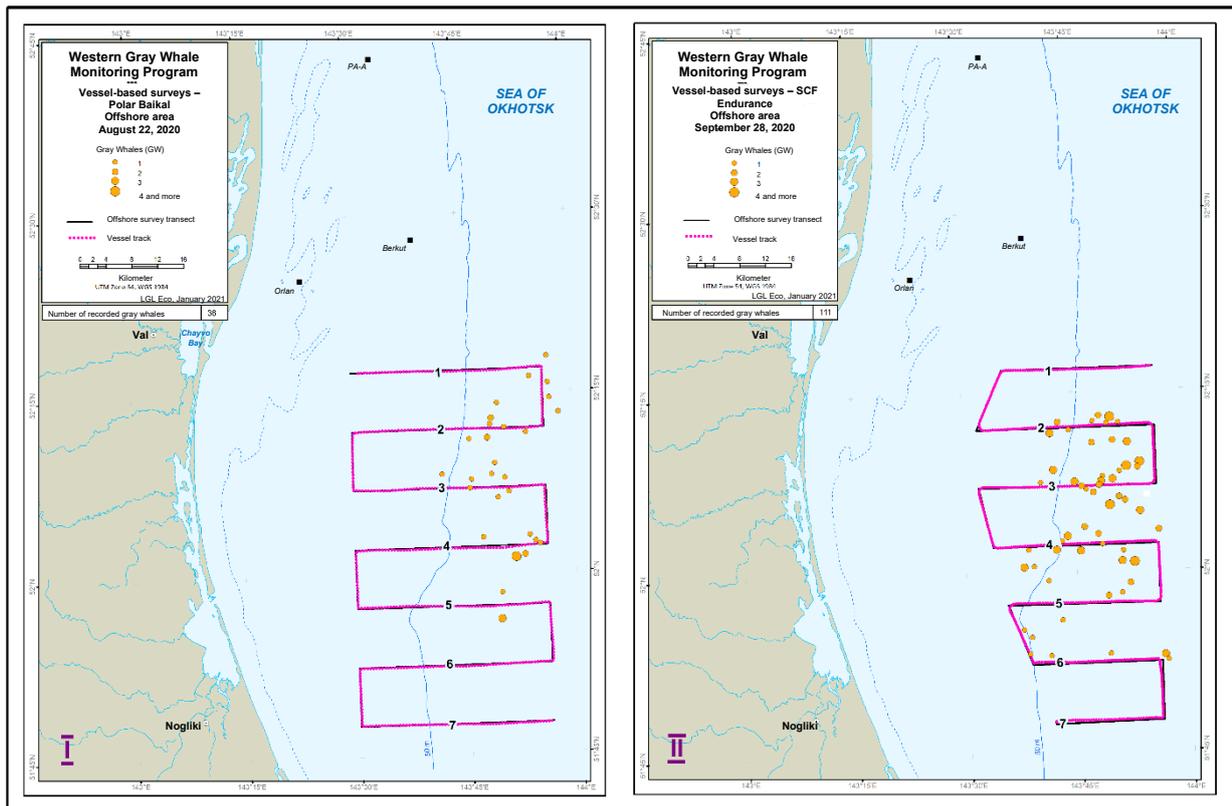
##### **4.1.2.1 Dynamics of the Number of Simultaneously Sighted Whales**

During the vessel-based survey in the Offshore area conducted from the *Polar Baikal* vessel on August 22, 2020, 36 gray whales were recorded in that area. During the second survey conducted in that area on September 28 from the *SCF Endurance* vessel, significantly more gray whales (111 animals) were sighted in the same water area.

Most likely, such a significant difference in the numbers recorded was due to the fact that the height of the bridge of the *SCF Endurance* vessel (14.6 m), from which the survey was conducted, exceeded that of the *Polar Baikal* (6.7 m) more than 2 times, and this undoubtedly ensured better visibility of the surveyed water area and detectability of whales, especially those surfacing at a great distance from the vessel. Considering the above, the *Polar Baikal* survey data are not taken into account in the estimation of the number of gray whales that stayed in the Offshore area in 2020. However, that did not prevent the use of these data as additional information for analyzing the distribution of the animals.

##### **4.1.2.2 Spatial Distribution of Whales**

In general, based on the two surveys conducted in the Offshore feeding area, one may say that in 2020 gray whales stayed, although as a dispersed, but still a single and sufficiently compact 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 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 (Fig. 4-6).

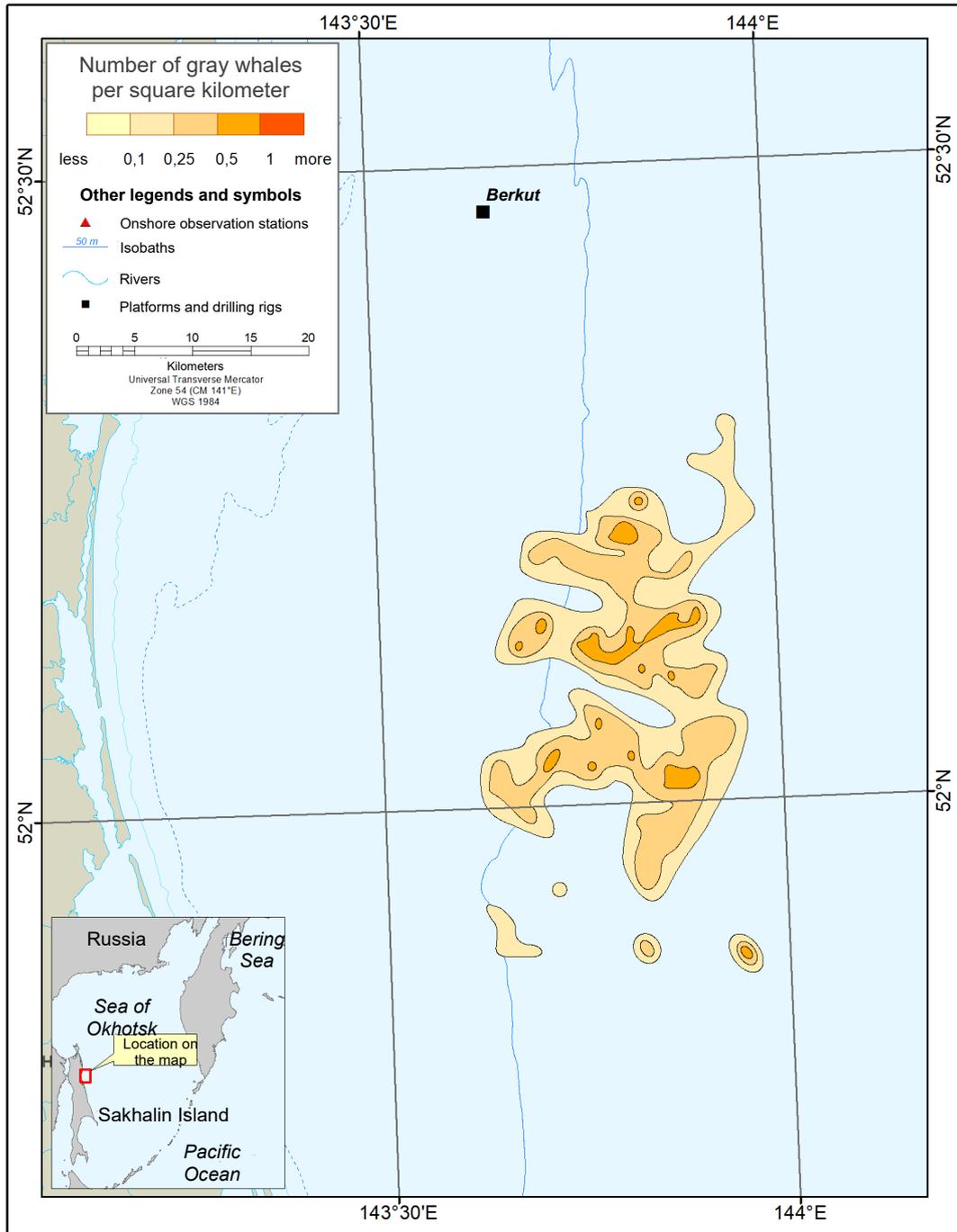


**Figure 4-1.** Seasonal changes in location of gray whales in the Offshore feeding area in August-September of 2020 according to the survey data from the *Polar Baikal* (I) and *SCF Endurance* vessels (II)

At the same time, the feeding aggregation of gray whales shifted slightly to the south from August to September – if in the 3<sup>rd</sup> ten-day period of August they were sighted throughout the surveyed water area from transect 1 to transect 5, then by the end of September their aggregation shifted by about 10 km to the south, into the water area from transect 2 to transect 6 (Fig. 4.6).

The summarized data from both surveys showed that they were characterized by an unevenly scattered distribution pattern over the water area (Fig. 4.7). This was probably due to the similar distribution pattern of forage benthic organisms in the feeding area, but it is possible that the results of only two surveys do not give a holistic representative picture of the distribution of animals.

In terms of the pattern of gray whales' concentration as a function of distance from the coast, according to the survey data, most whales stayed in the Offshore area in 2020, as in the previous year, mainly between 143°45'E and 143°55'E, 50-60 km from the coast (Fig. 4-7), where their peak occurrence exceeded 0.88 animals/km<sup>2</sup>.



**Figure 4-7.** Spatial distribution of gray whales recorded in the Offshore feeding area in August-September of 2020 (animal sighting frequency per square kilometer according to the combined survey data from the *Polar Baikal* and *Endurance* vessels)

#### 4.1.3 Total Number of Gray Whales Recorded Off Northeast Sakhalin

The shore-based survey in the Piltun feeding area and vessel-based survey in the Offshore area conducted one day apart (September 27<sup>th</sup> and 28<sup>th</sup> respectively) allowed us to estimate the total number of gray whales encountered simultaneously within the East Sakhalin

feeding region, which amounted to 118 animals (7 animals in the Piltun area and 111 in the Offshore area).

Conducting such surveys with a minimum time interval significantly reduces the likelihood of double counting or undercounting of whales due to their migration from one area to another between the surveys. Due to the above, the data obtained give fairly accurate values of the concurrent number of gray whales in the entire feeding region at the time of the survey. Therefore, the resulting total number (at least 118 animals) was adopted as a reliable estimate of the number of gray whales concurrently recorded in 2020 in two known feeding areas off eastern Sakhalin (Piltun and Offshore) during the shore-based and vessel-based surveys. In principle, this indicator is close to the values characteristic of the recent years of the monitoring period (2012-2018), which is also demonstrated by the chart in Fig. 5-1.

#### **4.1.4 Size of Whale Pods**

##### **4.1.4.1 Piltun Area**

Gray whale pod size estimate resulted from the observations in the Piltun feeding area during the shore-based surveys in late July-September of 2020. During this period, the whales were predominantly (88.5% of the sightings) observed to be solitary accounting for 79.7% of all recorded animals (Attachment 2).

11.5% of sightings were of pods of two animals accounting for 20.3% of all sightings. In seasonal terms, there were more sightings of pods of 2 animals (62.2%) in late July – August; in September their number decreased to 17 (37.8%). No larger pods were observed in 2020 (as in 2019).

The average seasonal number of whales in a pod was 1.13 animals.

Compared with the previous year, the frequency of solitary whales occurrences slightly decreased (from 90.9 to 88.5 %), consequently, the occurrence frequency for pods of 2 animals slightly increased (from 9.1 to 11.5 %).

##### **4.1.4.2 Offshore Area**

Based on the data from the two surveys conducted in Offshore feeding area on August 22 and September 28, the average number of animals per pod during the season was 1.75 individuals (Table 4-4). However, comparison of results of each survey demonstrated a substantial difference: in the last ten-day period of August, the number was 1.29, and in late September it was 1.98.

The numbers of pods that included a certain number of animals differed significantly as well, thus, they were not combined and are provided below for each individual survey.

During the survey conducted on August 22 in the Offshore feeding area from the *Polar Baikal* vessel, solitary whales were sighted most frequently, accounting for 82.1% of encounters and 63.9% of the individuals recorded; in declining order, they were followed by pods consisting of 2, 3, and 4 animals (10.7% / 16.7%, 3.6% / 8.3% and 3.6% / 11.1%, respectively). Larger aggregations have not been encountered (Table 4-4).

During the survey conducted in the same feeding area from the *Endurance* vessel on September 28, 2020, solitary whale sightings were predominant as well, but to a significantly lesser extent, accounting for 42.8% of encounters / 21.6% of animals (whose total number was 111). Whales comprising couples accounted for 25.0% of encounters (25.2% of individuals), while three-whale pods were sighted somewhat less frequently (23.2% of encounters / 35.1% of individuals); four-whale pods accounted for 8.9% of encounters (18.1% of individuals - Table 4.4).

**Table 4-1.** Quantitative data on the pods of gray whales recorded in the Offshore feeding area in 2020 (according to the *Polar Baikal* and *Endurance* survey data)

Month (number of encounters / number of individuals)	Pod size (number of individuals)							
	1		2		3		4	
	% of the number of encounters	% of the number of individuals	% of the number of encounters	% of the number of individuals	% of the number of encounters	% of the number of individuals	% of the number of encounters	% of the number of individuals
<i>Polar Baikal</i>								
August (28/36)	82.1	63.9	10.7	16.7	3.6	8.3	3.6	11.1
<i>Endurance</i>								
September (56/111)	42.9	21.6	25.0	25.2	23.2	35.1	8.9	18.1

Generally, the gray whales feeding in the Offshore area throughout the season in 2020 formed aggregations much more frequently than in the Piltun area. Special attention should be given to the fact that all of the pods sighted in the Piltun area were couples.

#### 4.1.5 Distribution of Females and Calves

In 2020, only one sighting of a female gray whale with a suckling calf was recorded on August 6<sup>th</sup> near the Piltun Bay mouth (Table 4-1) during the monitoring efforts in the Piltun feeding area. However, it should be noted, that due to the logistics and methodological specifics of the shore-based monitoring methods, it is not always easy to identify mother-calf pairs

during the survey; therefore, the lack of recorded occurrences does not mean their actual absence. More accurate information on this is provided by the photo identification results.

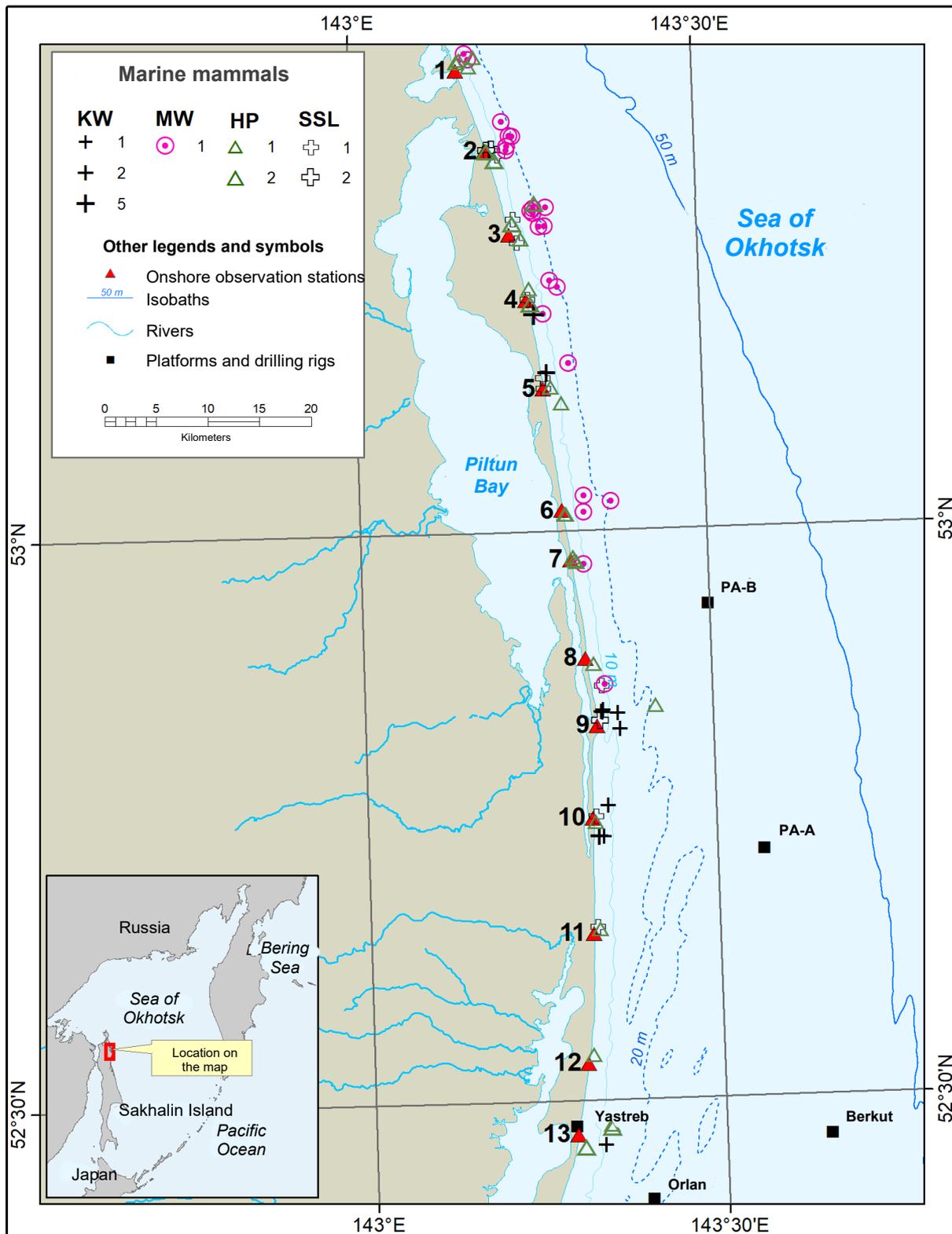
As in the previous years, not a single mother-calf pair or a solitary calf was sighted in the Offshore feeding area during the vessel-based surveys.

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

In August-September of 2020, four other marine mammal species were sighted in the survey area offshore northeast Sakhalin in addition to gray whales.

The following was recorded in the course of the shore-based surveys:

- ❖ 22 sightings of solitary minke whales (*Balaenoptera acutorostrata*), all of them were sighted in the northern deeper part of the area, and most of them (16 animals) in August.
- ❖ 11 sightings of killer whales (*Orcinus orca*) in the Piltun area waters, mainly in September. Solitary animals were observed most often (9 sightings), pairs were observed two times, and a pod of 5 animals – once (on August 12<sup>th</sup> near OS 4, approximately 430 m from the shore). A total of 17 animals of the species were recorded.
- ❖ Of small cetaceans, harbour porpoises *Phocoena phocoena* were sighted in the waters of the area more often (26 sightings / 33 animals) throughout the season across the area.
- ❖ Of the pinnipeds, Steller's sea lions (*Eumetopias jubatus*) were sighted in small numbers, more often in the northern part of the area – 12 sightings / 15 animals.
- ❖ In one instance, a sighted marine mammal taxon could not be identified accurately due to its significant distance from the shore (approximately 4 km).



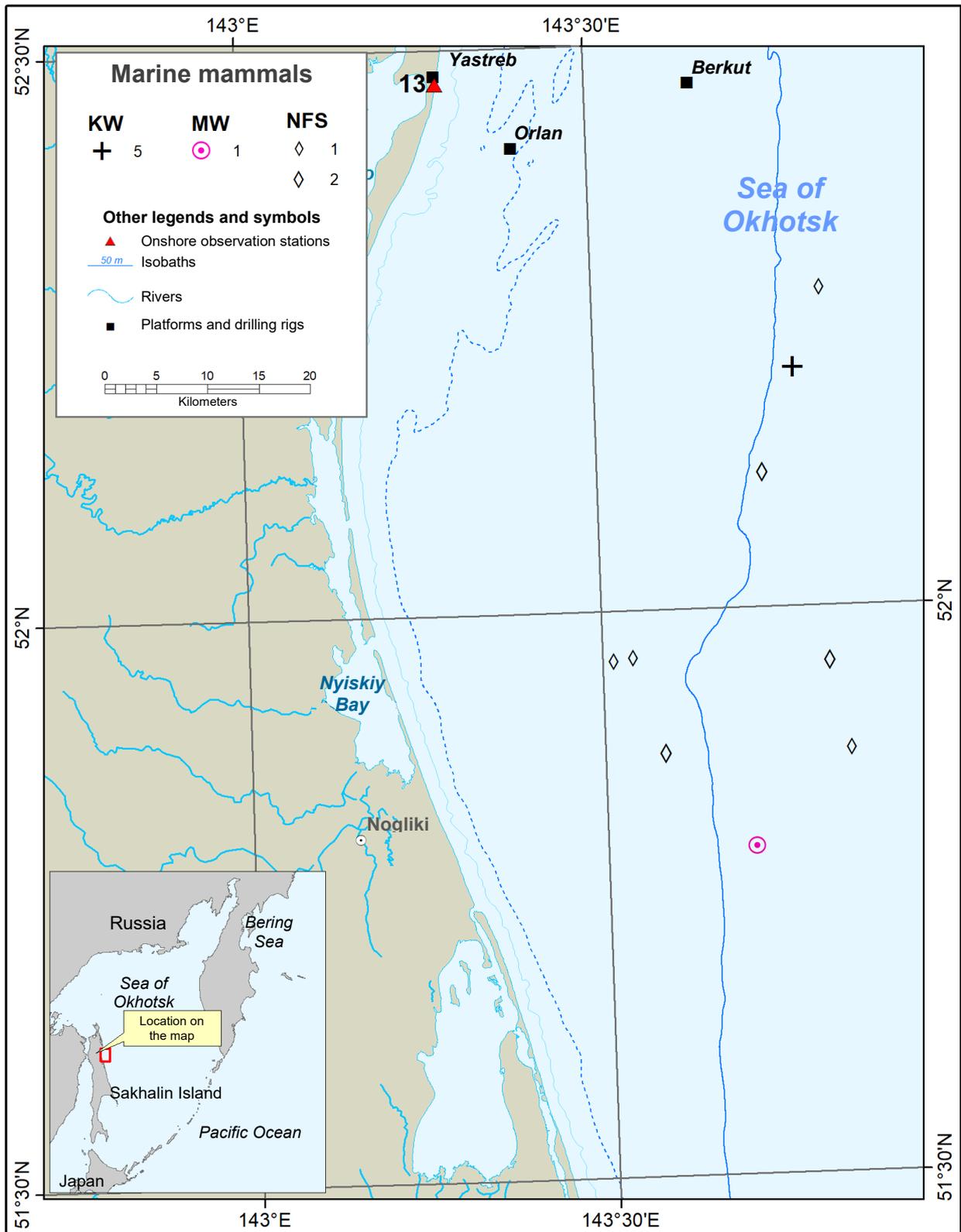
**Figure 4-2.** Sightings of other marine mammal species (in addition to gray whales) in the waters of the Piltun area in late July-September of 2020 (according to shore-based surveys)

**Note:**

KW – killer whale, MW – minke whale, SSL – Steller’s sea lion, HP – harbour porpoise

In the Offshore feeding area, the marine mammal species other than gray whales were sighted 9 times from the *Polar Baikal* and *Endurance* vessels during the vessel-based surveys (Fig. 4.9), and their total number was 15:

- ❖ 1 sighting of lesser rorqual or minke whale (*Balaenoptera acutorostrata*) in the southern part of the surveyed area.
- ❖ 1 sighting of killer whales (*Orcinus orca*) in the northern part of the Offshore area – in a pod of 4 animals.
- ❖ 7 sightings of northern fur seals (*Callorhinus ursinus*), mainly in the southern part of the area – 4 times with solitary animals and 3 times with pairs (Fig. 4.9), a total of 10 animals.



**Figure 4-9.** Sightings of other marine mammal species (in addition to gray whales) in the Offshore area in August-September of 2020 (according to vessel-based surveys)

Note:

KW – killer whale, MW – minke whale, NFS – northern fur seal

The dates and exact coordinates of all sightings of cetaceans other than gray whales are given in Attachments 1 and 2.

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

No active construction, seismic acquisition or other activities associated with high noise levels were conducted offshore northeast Sakhalin Island in the summer of 2020.

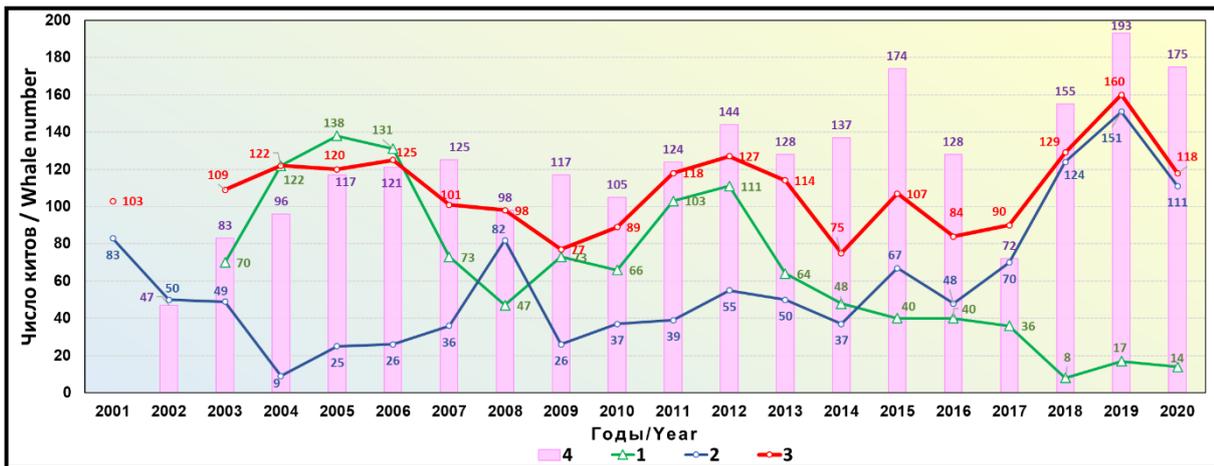
During the monitoring observations conducted in August-September of 2020, no abnormalities (potentially related to the impact of anthropogenic/man-made factors) were observed in terms of behavior, distribution or changes in the recorded number of gray whales offshore the northeast coast of Sakhalin Island.

## **5 DISCUSSION OF RESULTS**

The shore-based surveys of gray whales in the Piltun feeding area and vessel-based surveys in the Offshore feeding area conducted from late August through late September 2020 allowed the acquisition of data on the Sakhalin gray whale feeding group, making it possible to evaluate its current status.

### **5.1 Recorded Number of Gray Whales**

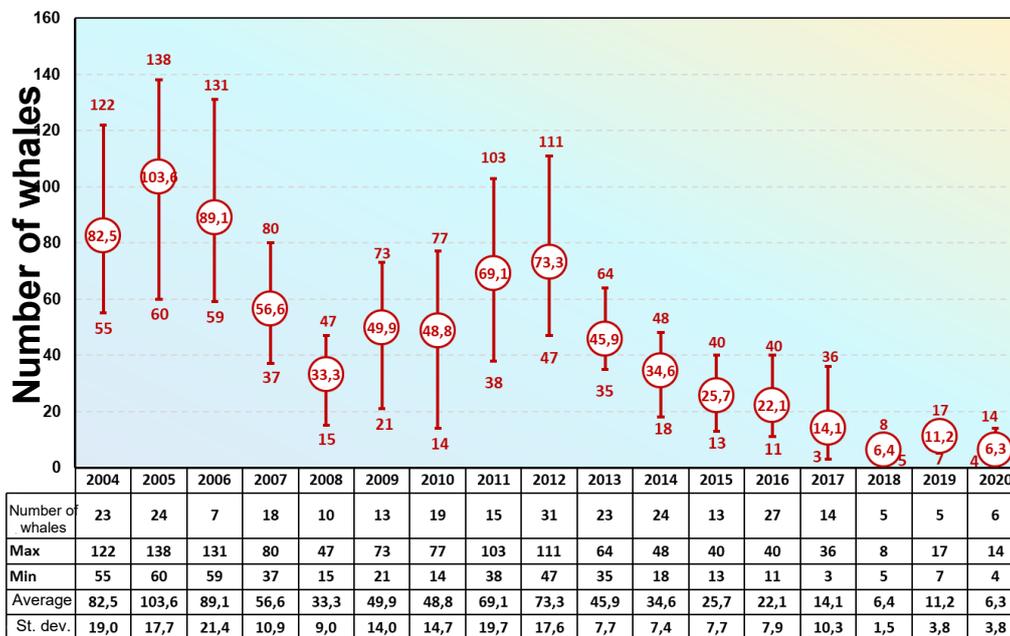
According to the results of the annual shore-based counting monitoring, a decrease in the recorded number of gray whales feeding in the nearshore Piltun area during the summer-fall months was observed in the recent years. The number of whales sighted there started declining steadily since 2012, and by 2018-2020 dropped to the current level (Fig. 5.1). The indicators of sighting frequency of whales in the Piltun water area indicate that in 2012 it averaged 73.1 animals per survey during the main feeding season, and by 2018 it decreased by more than ten-fold to 6.4 animals/survey, and though in 2019 the sighting frequency of animals increased somewhat, having reached 11.4 animals/survey, in 2020 it decreased again to 6.3 animals/survey (Fig. 5.2). The maximum numbers of whales recorded during the season within this period also drastically decreased from 103-111 animals in 2011-2012 to 14-17 animals in 2019-2020 (Fig. 5.1, 5.2).



**Figure 5-1.** Summary data on multi-year variations of the number of gray whales recorded during the visual surveys and photoidentification conducted offshore northeast Sakhalin in 1989-2020

**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).



**Figure 5-2.** Indicators of year-to-year dynamics of whale number recorded in the Piltun feeding area in 2004-2020, according to shore-based surveys during the main feeding season (August-September)

According to the vessel-based monitoring data, the reverse situation takes place (on a year-to-year basis) in the waters of the Offshore feeding area. The maximum recorded numbers of whales feeding there significantly increased over the last decade, especially over recent years – from 26-39 animals in 2009-2011 up to more than 100 animals in 2018-2020 (Fig. 5.1). In 2020, the maximum number of 111 whales was recorded here during the surveys (Fig. 5.1).

The growing number of gray whales in the Offshore area, observed during recent years, apparently and primarily happened due to the migration of the animals there from the Piltun area, where the trophic environment, evidently unfavorable for whales feeding, developed in the last few years, seemingly, as a result of the decrease in available foraging resources there (Labay et al., 2019). Similar redistribution of gray whales between the neighboring feeding habitats, occurring during major changes in the trophic environment in either of these two areas, were observed earlier (for example, in 2003-2005). The latter gives reason to believe that such process supports relative stability of the total gray whale number concentrated in the east Sakhalin feeding region (Vladimirov et al., 2019).

More detailed data on the gray whale number in the Piltun water area in 2020, makes us to point out that the photo-identification conducted at the same time in the same area, resulted in recording more than twice as many whales than the observation surveys – 32 animals (Yakovlev et al., 2021). The difference in the resulting numbers from the observation surveys and photo-identification (hereinafter, “PhID”) of animals, both characterizing the same parameter, though using different techniques – the number of the animals, is due to the specifics of these two methods. During multiple season-long PhID sessions, the resulting number includes both the animals staying in the surveyed area during the entire season (hence, recorded more than once), and those entering the area just for a short time (i.e. single encounters). The distribution surveys indicate only the actual number of whales present in the surveyed water area at the time of the survey, which is naturally almost always lower than the PhID results.

This is precisely the situation that apparently took place in the Piltun area in 2020 - about half of the 32 whales recorded there over the season using the PhID method obviously passed through its waters, and only slightly less than half (maximum 15 animals) remained in the waters of the coastal region and its immediate vicinity. At the same time, there were mainly females, apparently, feeding calves and young animals, for which feeding in the deep-water Offshore area is still difficult and, possibly, unsafe in terms of vulnerability to attacks by killer whales.

As far as the overall recorded number of gray whales feeding in the east Sakhalin waters in the summer-fall months is concerned, we will reiterate that in 2020, based on the PhID data, it was 175 whales (Yakovlev et al., 2021), exceeding the similar value from the observation surveys almost by 1.5 (118 whales). A similar situation (photo ID data exceeding survey data) is observed virtually in all recent years, starting in 2012 (Fig. 5-1), indicating, as in the above case in the Piltun feeding area, that it evidently became typical of the entire Sakhalin feeding group that arrived there to move for feeding to other regions. For example, in 2004-2006, almost all whales that arrived for wintering apparently remained primarily offshore northeast Sakhalin through the summer-fall season, which is supported by the similarity of the PhID and survey data, but starting in 2007-2009, and especially starting from 2012, they also apparently began to use other areas more actively for feeding, including the East Kamchatka coastal waters, based on the PhID data (Fig. 5-1). Apparently, it was precisely for this reason that the total number of gray whales recorded at a single point in time in the Sakhalin region during observation surveys of 2005-2012, which in most cases was rather close to or actually identical to the numbers obtained during the PhID surveys, after 2012 generally became lower than the PhID numbers, which included both the whales that switched to permanent dwelling in this water area (over the season) and those that were temporarily visiting it and departed prior to the survey, and during the last ones – only the animals that stayed through the entire summer-fall season. [sic]

Summarizing the issues related to the current number of gray whales concentrated in the northeast Sakhalin waters, we may state that their total number in 2020, which according to the PhID data was at least 175 whales, is most likely somewhat higher, considering that during the PhID it is never practically possible to record all whales present in the operations area, which is supported by satellite tagging studies run in parallel (Mate et al., 2015).

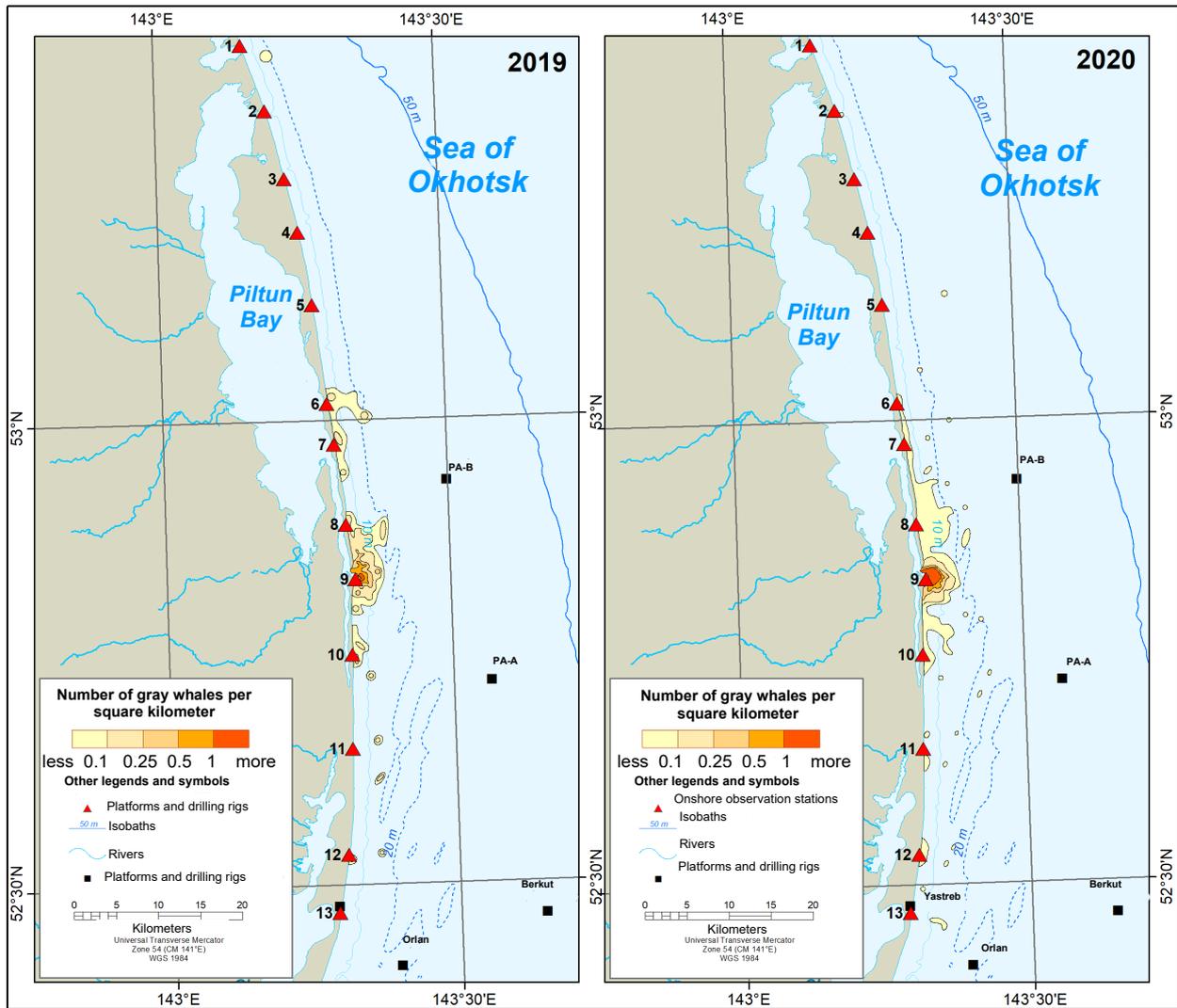
New mathematical modeling data showed that the estimated number of gray whales of the Sakhalin feeding group totals 219-245 animals, and the annual growth rates of its number over the past 20 years has been estimated at 4.3-5.4%, (Cooke, 2019 ), which gives us grounds to optimistically assess its prospects. Such demographic indicators were the basis for downgrading the conservation status of this subpopulation on the IUCN Red List and to reassigning its category from taxa *Critically Endangered* to simply *Endangered* .

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

Generalized pseudo-isoline maps of gray whale distribution within their feeding habitats offshore northeast Sakhalin Island show that the general pattern of distribution in

both the Piltun and Offshore areas in late July-September of 2020 essentially remained typical of this area in recent years and was similar to that of 2019 (Figs. 5-3 and 5-4). In general, during these months of 2020 coinciding with the main feeding period for these animals, their prevailing concentration in the Piltun area (over 79% on average for the season) was constantly observed in a limited part of the water area immediately adjacent to the mouth of Piltun Bay (in the zone of OS 8-9), which was also the case during the overwhelming majority of the years of the ongoing monitoring (Fig. 5.3). Their maximum occurrence frequency there in 2020 was 2.04 whales, which is 73% higher than in 2019 (1.18 whales/km<sup>2</sup>).

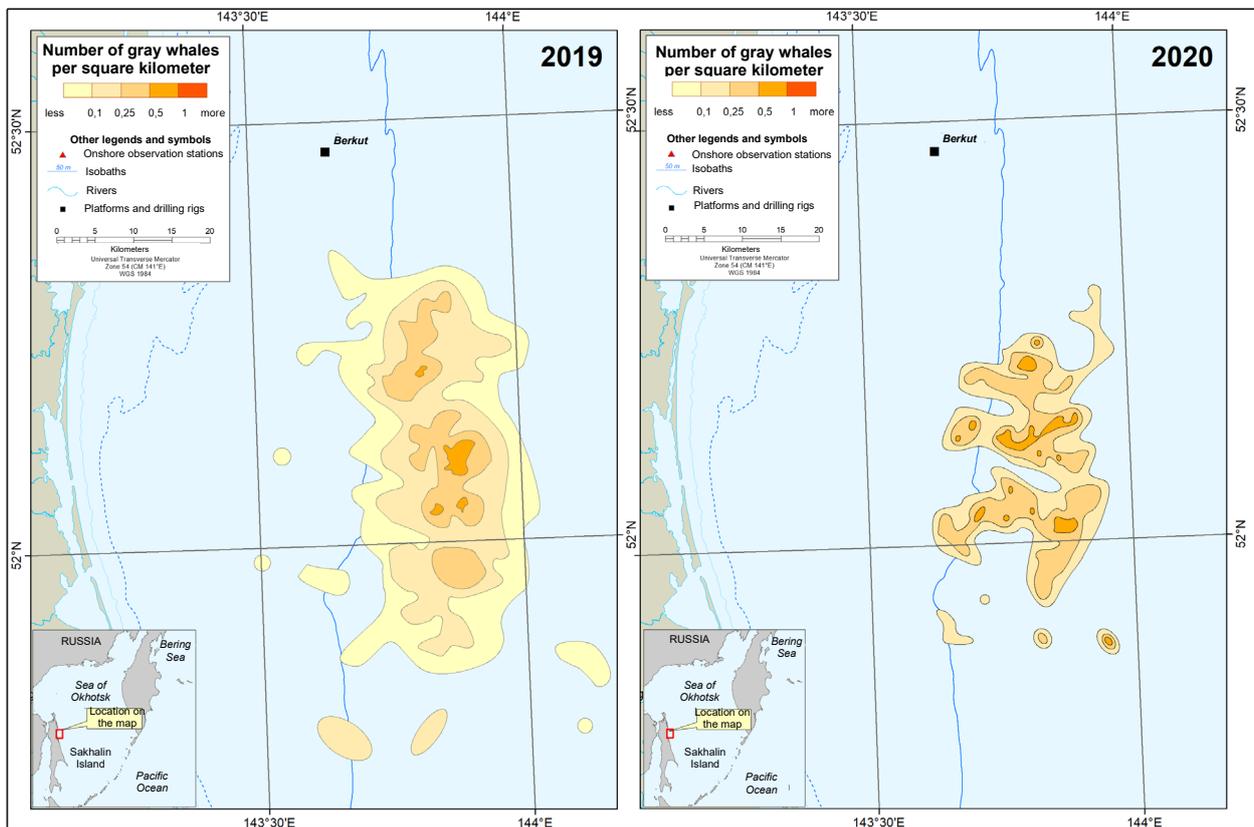
Outside of this near-mouth mini-conglomeration, whales were sighted in a very scattered manner in 2020, based on survey data: a total number of 13 animals over the season in the northern half of the area (in the water areas of OS 1-7), and 13 animals in the south (in the zone of OS 11-13). At the same time, it is noteworthy that the animals were not observed there constantly throughout the season, but were encountered only periodically. (Table 4-1 and Fig. 4-3).



**Figure 5-1.** Comparative spatial distribution of gray whales in the Piltun feeding area in July – September of 2019 and 2020 (animal sighting frequency per square kilometer according to shore-based surveys)

We should also touch on the change noted in 2020 in comparison with the previous years with regard to gray whale distribution in the Piltun feeding area by water depth, which was manifested in further increase in the concentration of whales in the most shallow nearshore zone of the water area with depths of up to 5 m. If in 2018, on average 36.9% of total number of gray whales recorded in the area were present there over the season, in 2019 this number was 47.6%, i.e. it increased by 10.7%, and in 2020 – already 66.8% (+19.2%) (Attachment 1). This observed change in whale distribution was most likely related to a year-to-year progressing shift of the existing aggregations of preferred whale food sources toward the coastline, or it can be justified by the fact that the few gray whales that still remain in the area become more represented by mother-calf pairs and calves who had separated from their mothers and preferred to feed at minimal depths near the shore.

In 2020, as in the previous season of 2019, gray whales in the Offshore feeding area generally stayed together in a single, albeit non-homogeneous aggregation in its eastern part, in the water area with depths ranging from 45-55 to 65-70 m (Fig. 5-4). Based on the data of the observation surveys conducted over the last 3 years (2018 - 2020), we can assume that the main feeding zone of gray whales in the Offshore area currently extends no more than 60 km from the Sakhalin shore.



**Figure 5-3.** Comparative spatial distribution of gray whales in the Offshore feeding area according to vessel-based surveys in August-September of 2019 and 2020 (whale sighting frequency per square kilometer)

The pattern of gray whales spatial distribution in the Offshore feeding area in 2020 was markedly different from that of 2019 in its scatteredness (Fig. 5.4), which may have been due to precisely this type of the forage benthos distribution in the feeding area. However, it is possible that the fact that the 2019 map was built based on the generalized data of eight conducted surveys, and the 2020 map was built based on the generalized data of only two surveys, plus one of them one was performed from a low vessel with the limited sweep of vision over the water area, could have played a role, as a result the total number of recorded gray whales, which served as the basis for calculations and mapping of sightings, for 2019 exceeded that for 2020 by almost 4 times (582 animals versus 147).

Based on the counting monitoring results, the Sakhalin feeding group of gray whales, in general, is currently in a rather good condition, which is confirmed by the data of the simultaneous photoidentification monitoring. The above is validated by Cooke's mathematical modeling data (Cooke, 2019), which demonstrated that the abundance of the Sakhalin feeding group has been increasing over the last 20 years at an annual rate of 4.3-5.4%.

## **6 CONCLUSION**

The results of the vessel-based and shore-based surveys completed in 2020 as part of the Gray Whale Monitoring Program off the northeast coast of Sakhalin Island allowed us to draw the following conclusions:

1. The spatial distribution of gray whales in the Piltun feeding area in late July-September of 2020 was generally typical of the recent years. In terms of the season-wide aspect, the main concentration of whales (on average more than 79% of animals) stayed in the nearshore waters immediately adjacent to the mouth of Piltun Bay, within 2 km from the shore at depths of up to 10-15 m.
2. The average seasonal number of gray whales concentrating in the Piltun area in the last three years remains at the lowest level for all years of the monitoring program, with minor annual fluctuations, but without any pronounced trend, amounting in 2020 to an average of 6.3 animals per season (SD = 3.8) with a maximum of 14 animals.
3. In the last three years (2018-2020), a tendency has been observed for concentration of animals in the shallowest coastal zone of the near-mouth Piltun waters with depths of up to 5 m – from 36.9% of the total number of gray whales recorded in the area in 2018 to 47.6% in 2019 and up to 66.8% in 2020, which may be due to the changes in feeding conditions occurring there.
4. In the Offshore feeding area, throughout the entire season of 2020, as during all recent years of monitoring, the majority of gray whales concentrated in its eastern part at water depths from 45-50 to 65-70 m, at a distance of more than 60 km from the Sakhalin shore, i.e. up to 144°0' E.
5. The maximum number of gray whales recorded in 2020 during the vessel-based surveys in the Offshore feeding area was 111 animals, which is somewhat lower than during the previous two years.
6. The total number of gray whales concurrently recorded in the east Sakhalin waters during the surveys in 2020 (simultaneously in the Piltun and Offshore areas) was

118 animals, which is significantly lower than in 2018-2019. The above is primarily related to fluctuations in the number of whales observed in the Offshore area waters, with the animals currently staying in the area far outnumbering those in the Piltun area, which determines the dynamics of their total numbers in the feeding habitat.

7. The 2020 gray whale abundance and distribution monitoring results together with J. Cooke's estimates suggest that the current condition of the Sakhalin feeding group is generally quite satisfactory, with prospects for further increase in abundance.

## **ACKNOWLEDGMENTS**

We express our most sincere appreciation to the large group of people who took part in planning and organizing the complex of observation surveys for 2020 and in coordinating the process of reporting materials preparation: E.N. Kalinin, V.V. Efremov, M. Scott (all from Exxon Neftegas Limited), A.D. Samatov, S.A. Vinogradov, S.P. Starodymov (all from Sakhalin Energy Investment Company Ltd.), I.N. Zhmaev (LGL Eco LLC), G.V. Dumenko (Sakhalin State University), as well as the crews of the *SCF Endurance* and *Polar Baikal* vessels that provided support for the offshore surveys.

Special thanks go to all shore- and vessel-based marine mammal observers actively involved in the field data acquisition.

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## Attachment 1

Distribution of whales by distance from shore and water depth

Distribution of gray whales in the Piltun area by depth in 2018-2020

Water depth (m)	Percentage of whales		
	2018	2019	2020
0-5	36.8	47.6	66.8
6-10	36.8	29.8	15.8
11-15	18.5	13.1	10.6
16-20	0.0	8.3	6.2
21-25	5.3	1.2	0.6
>25	2.6	0	0

Distribution of gray whales in the Piltun area by distance from shore in 2018-2020

Distance from shore (km)	Percentage of whales		
	2018	2019	2020
0-0.5	18.4	35.7	33.2
0.5-1	15.8	21.4	27.7
1-2	28.9	22.6	18.6
2-3	15.8	13.2	9.3
3-5	13.2	7.1	7.8
>5	7.9	0	3.4