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VOLUME II

RESULTS AND DISCUSSION

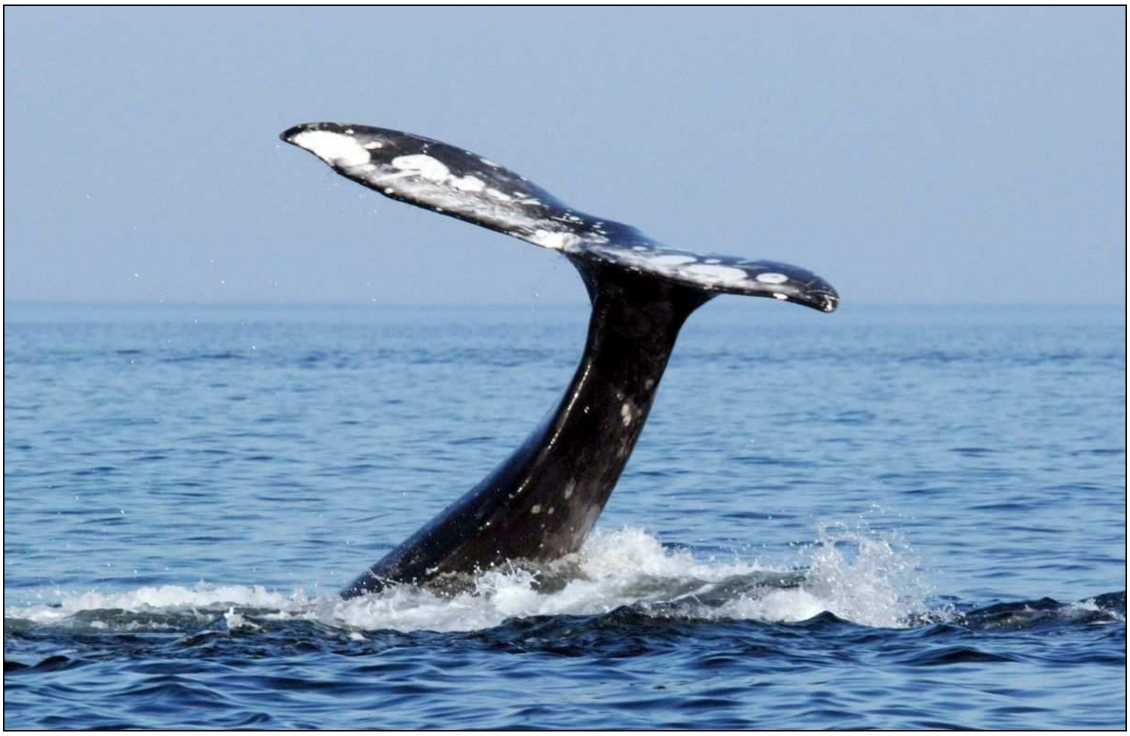

Photo by Yuri Yakovlev

Prepared for
Exxon Neftegas Limited
and
Sakhalin Energy Investment Company Limited

March 2011

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____________________ 2011

DISTRIBUTION AND ABUNDANCE OF WESTERN GRAY WHALES OFF NORTHEAST SAKHALIN ISLAND, AUGUST-SEPTEMBER 2010

(based on data from onshore and vessel-based surveys)

RESEARCH REPORT
UNDER THE "OKHOTSK-KOREAN (WESTERN)
GRAY WHALE MONITORING PROGRAM
OFF THE NORTHEAST COAST OF SAKHALIN ISLAND, 2008-2010"

V. A. Vladimirov (VNIRO), S. P. Starodymov (VNIRO) and
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of the Russian Academy of Sciences),

Prepared for Exxon Neftegas Limited
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Moscow
2011

Russian Federal Research Institute
of Fisheries and Oceanography
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VNIRO Acting Director
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DISTRIBUTION AND ABUNDANCE OF OKHOTSK-KOREAN (WESTERN) GRAY WHALES IN THE WATERS OFF NORTHEAST SAKHALIN ISLAND, AUGUST – SEPTEMBER 2010

(based on data from onshore and vessel-based surveys)

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Prepared for Exxon Neftegas Limited and Sakhalin Energy Investment Company Limited

Moscow
2011

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1. DISTRIBUTION OF GRAY WHALES: SURVEY EFFORT

1.1 VESSEL-BASED SURVEYS

In 2010 vessel-based surveys of gray whales and other marine mammals were conducted offshore northeast Sakhalin from the scientific research vessel *Akademik Oparin* from July 27 through October 5, with offshore work being conducted from August 1-October 1 (62 days). During the expedition, observers conducted systematic surveys (weather permitting) and opportunistic surveys of gray whales and other marine mammals. In 2010, 1056 individuals belonging to 12 species of marine mammals were recorded, including 673 gray whales (Table 1). Several sightings of marine mammals that were not identified were not included in Table 1.

Table 1. Marine mammals recorded from the research ship Akademik Oparin from July 27 through October 5, 2010

	GW	MW	FW	RW	KW	DP	HP	NF	BS	SL	SS	RS	UB	UW	US	Total
July	-	2	1	-	-	32	8	111	-	-			1		1	156
August	296	17	-	-	18	13	52	7	1	5	7	4	2		5	427
September	370	26	-	-	9	12	10	3	-	-						430
October	7		-	3	1	16	1	11	-	-				1		40
Total	673	45	1	3	28	73	71	132	1	5	7	4	3	1	6	1053
% of total	63.91	4.27	0.09	0.28	2.66	6.93	6.74	12.54	0.09	0.47	0.66	0.38	0.28	0.09	0.57	100

GW - gray whale, MW - minke whale, FW – fin whale, RW - right whale, KW - killer whale, DP - dolphin porpoise, HP - harbor porpoise, NF - Northern fur seal, BS - bearded seal, SL - sea lion, SS - spotted seal, RS - ringed seal, IS - ribbon seal, UB - unknown baleen whale, UW – unknown whale, US - unknown seal.

The 2010 transects in the Piltun and Offshore feeding areas, the Arkutun-Dagi, and Piltun-Astokh license area were the same as those used in 2009. As a result, the survey area encompassed all known gray whale feeding grounds in eastern Sakhalin waters. The weather in the two months of survey (i.e. August and September) was generally good, which allowed the research vessel Akademik Oparin to conduct 10 systematic gray whale transect surveys. Four surveys were made in the Offshore Feeding Area, two – in the Piltun Area, and two each in the waters of the Arkutun-Dagi and Piltun-Astokh License Blocks. Two other surveys (in the Piltun-Astokh License Block and Offshore Feeding Area) scheduled for late September were not conducted because of poor weather (Table 2). A total of 155 gray whales were sighted during the systematic surveys in 2010.

Table 2. Dates of gray whale vessel-based surveys conducted on the research ship Akademik Oparin in the waters of NE Sakhalin in August-September 2010

Study area	Survey date		Comments
	Scheduled	Actual	
Offshore	August 3	August 3	
Piltun-Astokh	August 4	August 5	
Piltun	August 15	August 18	
Offshore	August 16	August 19	
Arkutun-Dagi	August 17	August 20	
Piltun-Astokh	August 30	September 1	
Offshore	August 31	September 2	
Arkutun-Dagi	September 14	September 13	
Offshore	September 15	September 14	
Piltun	September 16	September 15	
Piltun-Astokh	September 29	-	Not made because of bad weather
Offshore	September 30	-	Not made because of bad weather

In addition to systematic surveys, opportunistic surveys were conducted during other operations (benthos, photo-ID, acoustic, transit), but due to the non-systematic nature of these surveys, these data were not considered in the analysis, and are only used as an additional source of information whenever there is a requirement to do so.

More detailed information on sightings of marine mammals including gray whales made during the 2010 offshore surveys is provided in the report sections below and in Appendix 1.

1.2 SHORE-BASED SURVEYS

In 2010, gray whale shore-based surveys on Sakhalin were conducted for a period of 54 days (from August 5 through September 27). The first half of August 2010 was characterized by bad weather conditions and poor visibility due to frequent prolonged periods of fogs and rough seas. Only 3 complete synchronized surveys could be made in the first half of August (Table 4).

A total of 19 complete synchronized surveys in the Odoptu-Piltun section covering stations 1-8 and Astokh-Chayvo section covering stations 9-13 were made over the entire Piltun Area in 2010. Additionally, four complete asynchronous surveys were made in only one of the areas (i.e., one survey in the Odoptu-Piltun Sector and three in the Astokh-Chayvo Section). During these completed asynchronous surveys, the other area were precluded due to poor weather. In another 23 cases, surveys that had already started were suspended because of deterioration in the weather (poor visibility or rough seas). The total survey effort in 2010 was 101 hours and 12 minutes (Table 3). In terms of survey efficiency (i.e. the number of complete synchronized surveys made during the season) 2010 was above average. In comparison, in 2004 and 2005, when the weather was better, observers managed to conduct more complete synchronized surveys (24 and 23 surveys, respectively) in the same period (from August 5 through September 27), 17 and 13 synchronized surveys were made in 2007 and 2009, respectively, and in 2006 and 2008, when the weather was worse, only 5 and 9 surveys were made, respectively.

Table 3. Duration and results of shore-based surveys of gray whales in the Piltun Area (August-September 2010)

Month	Odoptu-Piltun Area (Survey Stations 1-8)					
	Full Surveys [3]		Partial Surveys		Number of whale sightings [2]	Number of individuals
	n	*hours*[1]	*n*	*hours*		
August	9	21:27	5	5:23	284	359
September	11	26:13	9	8:24	494	635
Total	20	47:40	14	13:47	778	994

Month	Astokh-Chayvo Area (Survey Stations 9-13)					
	Full Surveys [3]		Partial Surveys		Number of whale sightings [2]	Number of individuals
	n	*hours*[2]	*n*	*hours*		
August	11	16:52	3	2:42	116	143
September	11	16:52	6	2:42	51	58
Total	22	33:44	8	5:24	167	201

Month	Total							
	Full Surveys				Partial surveys		Number of whale sightings[2]	Number of individuals[2]
	Synchronous [3]		Asynchronous					
	n	*Time*[1]	*n*	*Time*	*n*	*time*		
August	9	35:15	2	3:04	8	8:05	400	502
September	10	39:10	2	3:55	15	11:06	545	693
Total	19	74:25	4	6:59	23	19:11	945	1195

[1] The times indicated in the table include only the time spent directly on observations; time spent in travel to the stations and from one point to another is not included.

[2] The number of gray whale sightings and the number of surveyed animals include all recorded whales and groups of whales including those spotted outside the 1-minute sector scanning periods ("out of scan")

[3] Full surveys in the same area are those during which monitoring was performed on the same day at all survey stations (survey stations 1–8 in the Odoptu-Piltun section and 9–13 in the Astokh-Chayvo section); complete synchronous surveys are defined as simultaneous surveys carried out in both sections; asynchronous surveys are complete surveys performed within these areas at different times. Partial surveys are those that for some reason were not carried out at all monitoring stations.

There were a total of 945 gray whale sightings during the shore surveys in the Piltun Area in 2010, including 1195 individuals (Table 3). Detailed information on all cetacean sightings in 2010, including gray whales, during shore-based surveys is given in the following sections of the report and in Appendix 2.

2. STUDY RESULTS

2.1 GRAY WHALE DISTRIBUTION AND ABUNDANCE

2.1.1 Piltun Area

Shore-Based Surveys

As in past years, the shore-based surveys yielded the most detailed information on temporal and spatial variation in gray whale distribution in the Piltun Feeding Area. However, due to poor weather in the first half of August 2010 only 3 synchronized surveys could be completed, which makes it difficult to get a detailed picture of changes in whale abundance and distribution during this period. Data acquired during the rest of the survey season were more useful in assessing gray whale abundance and distribution patterns.

Spatial and Seasonal Distribution

The results of the shore-based surveys made in the Piltun Area in 2010 are summarized in Table 4. To further analyze the distribution of gray whales within the surveyed area, the survey area was divided into 1 x 1 km cells, and the average density of whales within each cell was estimated according to the methodology described in Volume 1 Chapter 2 Distribution Methods). The resulting average estimated density maps illustrate variations in gray whale distribution and abundance within the Piltun area.

Table 4. Results of shore-based surveys in the Piltun Area, August-September 2010

Survey date	Odoptu-Piltun Area (OPA)								Astokh-Chayvo Area (ACA)					Total *		
	Stations (OPA)								Stations (ACA)					OPA	ACA	Total
	1	2	3	4	5	6	7	8	9	10	11	12	13			
August																
5									13	0	0	0	0		13	(13)
7	1	3	6	6	3	5	10	10	16	5	3	1	0	44	25	69
8	2	2	2	4	8	10	12	3	8	7	0	0	1	43	16	59
9	0	2	4	6	5	5	3	5	12	4	0	0	1	30	17	47
10	5	0												*(5)*		*(5)*
18	0	0	0	0	3	0	7	1	2	1	0	0	0	11	3	14
19	0	2	1	7	5	8	3	2	11	3	0	0	0	28	14	42
20	1	0	0	6	5	6	0	5	8	0	0	0	0	23	8	31
23	8	0	0	5	4	7	7	3	11	1	0	0	0	34	12	46
24	3	14	3								0	0	0	*(20)*	*(0)*	*(20)*
25	2	9	4	5							0	0	0	*(20)*	*(0)*	*(20)*
26	7	7	1	1							0	0	0	*(16)*	*(0)*	*(16)*
27	7	1	0	0	0	12	11	5	11	4	0	0	0	36	15	51
28	1	1	0	1	1	6	12	3	7	2	0	0	0	25	9	34
29				1	1	7	10	5	10	1	0	0	0	*(24)*	11	*(35)*
September																
1	0	2	3	4	3	6	3					2	2	*(21)*	*(4)*	(25)
2	0	0	0	4	6	18	13	1	7	0	0	1	0	42	8	50
3	2	3	7	6	14	18	9	8	5	4	1	0	0	67	10	77
4	2													*(2)*		(2)
5	1	3	2	14	7	16	3	3	8	0	0	0	0	49	8	57
6	0	3	12	10	5	0	6	0	7	0	0	0	0	36	7	43
7	0													*(0)*		*(0)*
8	1	1												*(2)*		*(2)*
12	0	5	3										1	*(8)*	*(1)*	*(9)*
13	0	2												*(2)*	*(0)*	*(2)*
14	0	0	20	16	6	2	10	3	2	1	2	1	0	57	6	63
15	1	3	10	10	7	8	10	3	2					52	*(2)*	*(54)*
17	2	3	5	12	12	14	8	2	1	0	0	0	0	58	1	59
18	1	2	4	9	18	12	3	0	4	1	0	0	0	49	5	54
19	0	7	10	14	5	7	1	8	1	2	1	0	0	52	4	56
20	0	10	7											*(17)*		*(17)*
23	1	3	2	16	4	8			0	0	0	0	0	*(34)*	0	*(34)*
25	0	7	23	12	0	0	1	0	0	1	0	0	0	43	1	44
26	0	4	9										0	*(13)*	*(0)*	*(13)*
27	0	3	8	10	6	3	1	0	1	0	0	0	0	31	1	32
28													0		*(0)*	*(0)*

** - The results of completed surveys are in regular font, partial surveys are in italics within parentheses. Empty cells mean that no survey was conducted. The "Total" column gives the results of both complete synchronized and partial surveys over the entire feeding area. Whales re-sighted from adjacent survey stations are included in the table.*

First half of August

In 2010 the onshore gray whale surveys in the Piltun Area began on August 5, but because of bad weather only three complete surveys were made in the first half of this month (August 7-9). The average whale abundance in the area amounted to 58.3 individuals on these days with a range between of 47 to 69 whales (Table 4). The number of observed whales declined over the three-day survey period. This decline could be attributed to the movement out of the area of a large number of whales (36 individuals) observed on August 7 in the vicinity of survey stations 7-9 (Table 4). Potentially, the whales were either in transit and/or searching for optimal foraging areas.

The distribution of gray whales in the waters of the Piltun Area at the end of the first third of August was characterized by the concentration of most of the whales at the center of the survey area from survey stations 4 to 10 (Figure 1), accounting for 85.7% of total whales (Table 4). But they were not evenly distributed in the area. There were 3 groups of whales observed in the areas of survey stations 4-5, 6-7, and 8-10. The largest group was observed near the mouth of Piltun Bay in the vicinity of stations 8-10 (41.7% of the animals), followed by the groups in the area of Points 6-7 (25.0%) and Points 4-5 (19.0% of the whales). As discussed above, it is possible that a group of transiting gray whales entered the central part of the Piltun Area during the early August survey time.

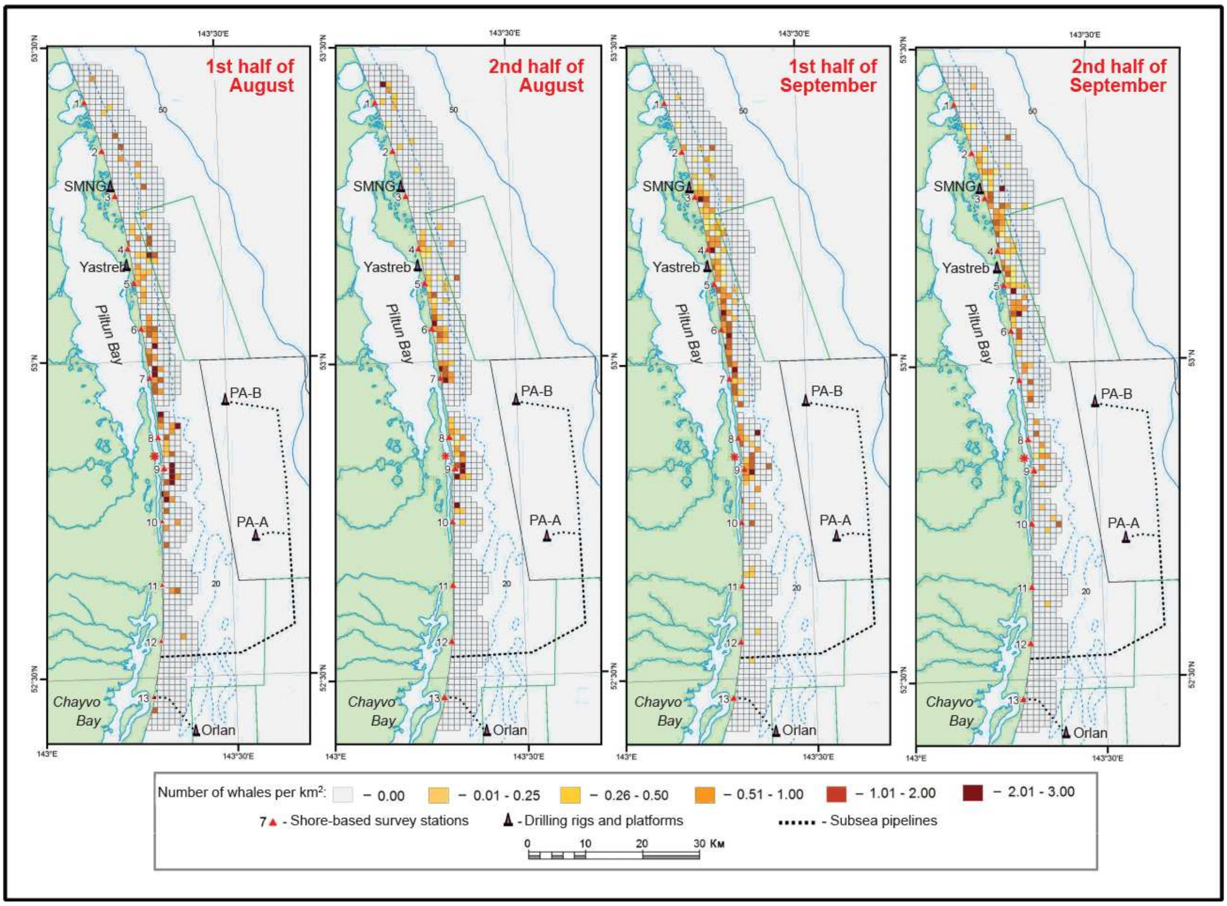


Figure 1. Seasonal variations in gray whale distribution in the nearshore (Piltun) area, August - September 2010 (based on data only from complete synchronized shore-based surveys)

In the northern portion of the survey area (opposite stations 1-3), a small number of whales (10.7%), were observed along the 20-m isobath and were absent in the coastal shallow waters (<20 m) normally preferred by gray whales. There were also a number of whales observed at >20 m depths approximately 10 km south, near the latitude of the Yastreb onshore rig (Figure 1). This could be attributed to the distribution of benthic-epibenthic forage, including the presence of schools of sand lance at depths of 20 meters or more (similar to 2004-2005 distribution (this report, Chapter 3)).

There were few gray whales in the southern part of the Piltun Area in the first half of 2010 (3.4% of the animals in the area) and they were for the most part dispersed.

The second half of August

The weather improved in the Piltun Area in the second half of August and during this time observers managed to conduct 6 complete synchronized surveys (between August 18 and 28). The average number of gray whales sighted during the 6 completed synchronized scans in the area was 36.3, and ranged from 14 to 51 animals (Table 4).

In the second half of August, the majority of the whales (89.9%) remained concentrated in the central part of the survey area (between station 4 and 10) in dispersed groups (Figure 1). No whales were sighted in the southern part of the area (south of station 10). The few animals in the northern area (10.1%) moved towards the northern parts of the feeding area (stations 1-2). They also moved into shallower waters, in contrast to the first half of the month. Further south (near stations 4 and 5), a number of whales continued to be sighted beyond the 20-m isobath, similar to the first half of the month.

The first half of September

Five complete synchronized surveys were conducted in the first half of September 2010 and showed that the average whale abundance in the Piltun feeding area had increased from 36.3 whales per survey in the second part of August to 58.0 whales per survey (ranging from 43 to 77 individuals).

In general the distribution of the whales in the area in the first half of September remained similar to that in August, but the main foraging aggregation, which included 93.5% of the whales in the area, increased in the north, keeping in the waters from stations 3 to 9. The densities of the whales in the vicinity of stations 3-5 increased (Figure 1). The distribution of the animals in the main foraging aggregation was quite even and the whales did not form distinct groups. Some whales were sighted north and south of this aggregation but their numbers were low. A small number of whales were also observed beyond the 20-m isobath near stations 2 and 3.

The second half of September

As in previous years, towards the end of September 2010 there was a decline in the abundance of whales in the waters of the Piltun Area. Based on five complete synchronized surveys made from September 17 to September 27, the average number of whales decreased to 49.0 (range 32 – 59). The maximum number of individuals sighted on September 17 and 19 decreased to 59 (by comparison to 77 in the first half of the month) and the smallest number (32) were sighted during the last survey on September 27 (Table 4). In earlier years the gray whales started to move away from the Piltun Area to the Offshore foraging group during mid- to late-September, where there was a corresponding increase in their abundance. In 2010, bad weather and poor visibility precluded the offshore surveys scheduled for 30 September, hence it can only be hypothesized that the same redistribution of whales occurred in late September 2010.

In addition to the decrease in whale abundance, there were other changes in gray whale distribution in the Piltun Area in the second half of September. This decrease in numbers was evident in the central part of the survey area in the vicinity of stations 7-9 (Figure 1). Whales continued to aggregate in the northern areas, with 79% of the whales observed between stations 2-6. There continued to be fewer whales in the southern part of the area (south of station 10) and on its northern periphery (in the vicinity of station 1). A small number of whales continued to stay beyond the 20-m isobath in the vicinity of stations 1-3 and some whales went further offshore (up to 7-8 km from shore) than they had in August and the first half of September.

To summarize the data from onshore surveys in August and September 2010, we observed a concentrated group of gray whales in the central Piltun feeding area, with a shift north starting at the beginning of September. In the first half of August, whales were concentrated near stations 4-10. In the second half of September, they were concentrated near stations 2-9. The temporal and spatial distribution shift is displayed in Figure 2. Few whales were observed in the most southern part of the survey area, i.e., between station 10 and 13.

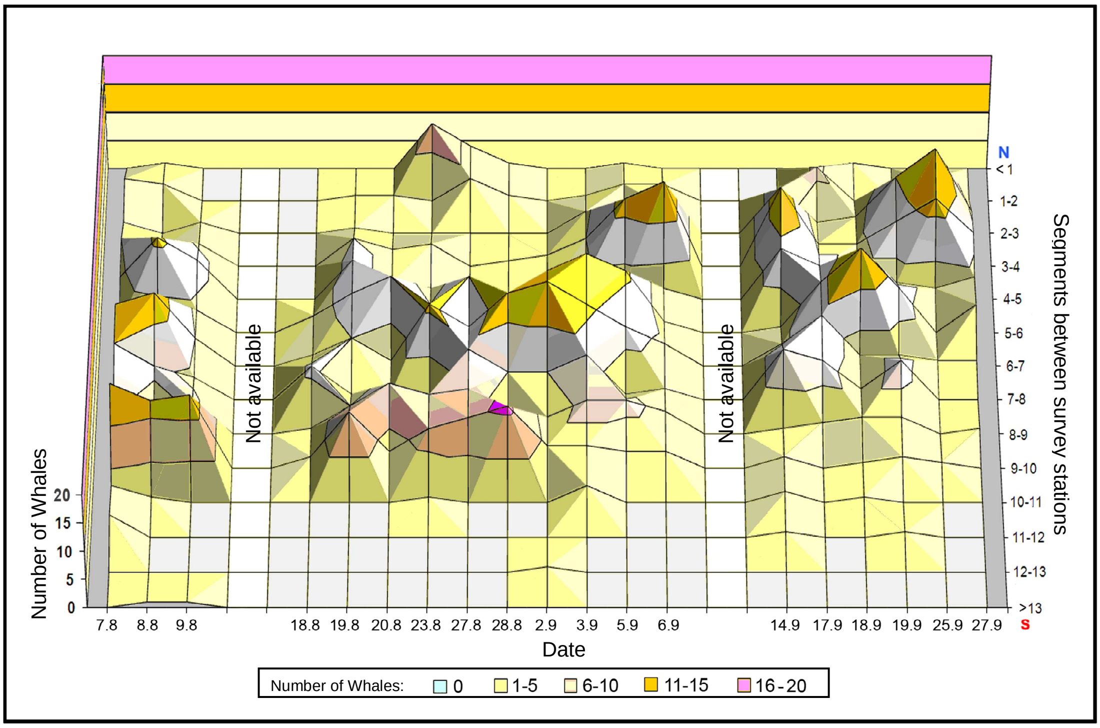


Figure 2. Spatial-temporal variation in gray whale distribution in the Piltun area, August - September 2010 (based on complete synchronized shore-based survey data). White indicates intervals between synchronized surveys.

Interannual Variability

A comparison of the August-September 2010 distribution data to August-September 2009 data indicates that there was a general northward shift in the concentration of whales in 2010, accompanied by a decline in the presence of whales on the southern periphery of the area (near stations 10-13). This may be attributed to corresponding changes in the distribution of biomass of their preferred benthic and/orepibenthic prey species (see Chapter 3 of this report).

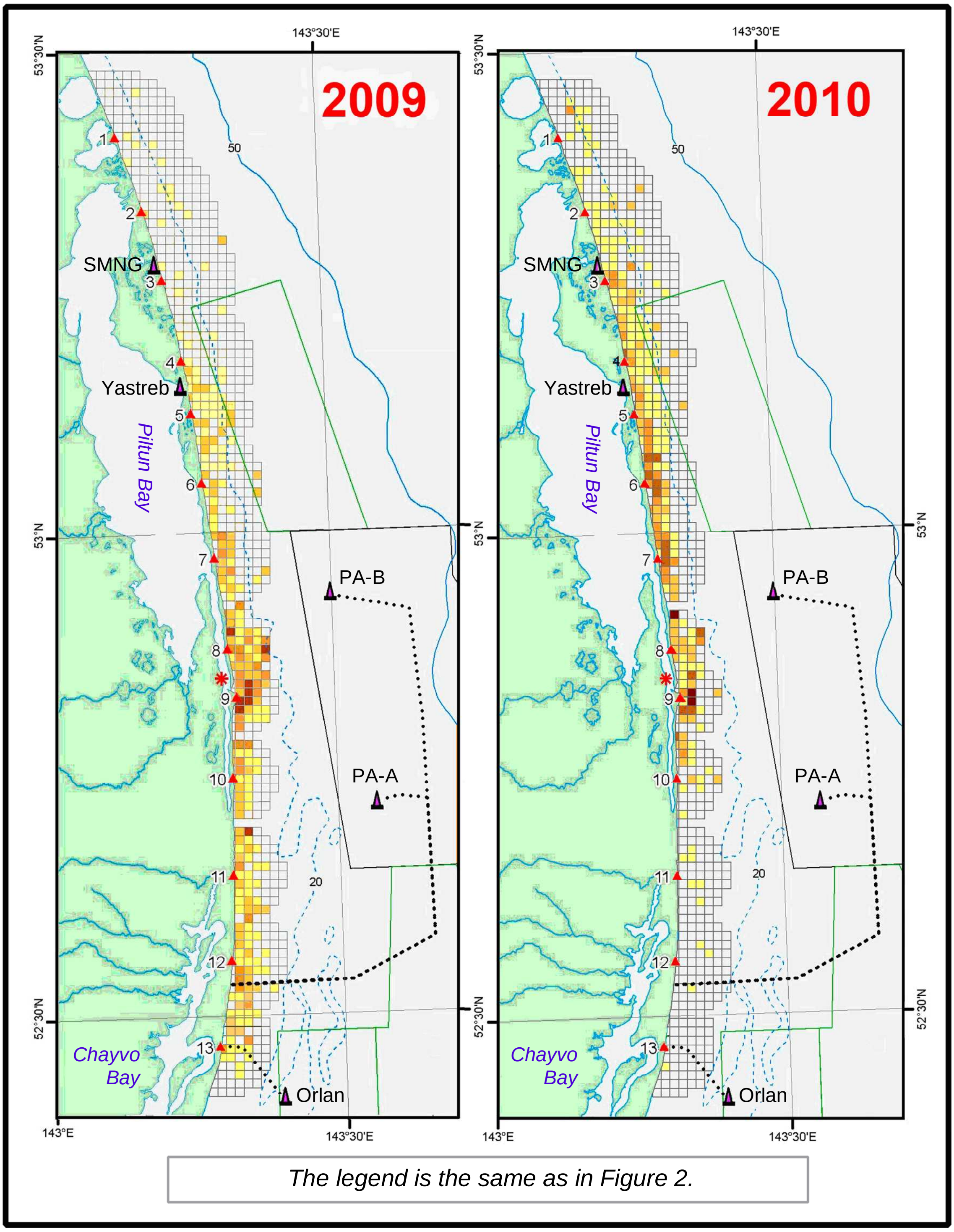
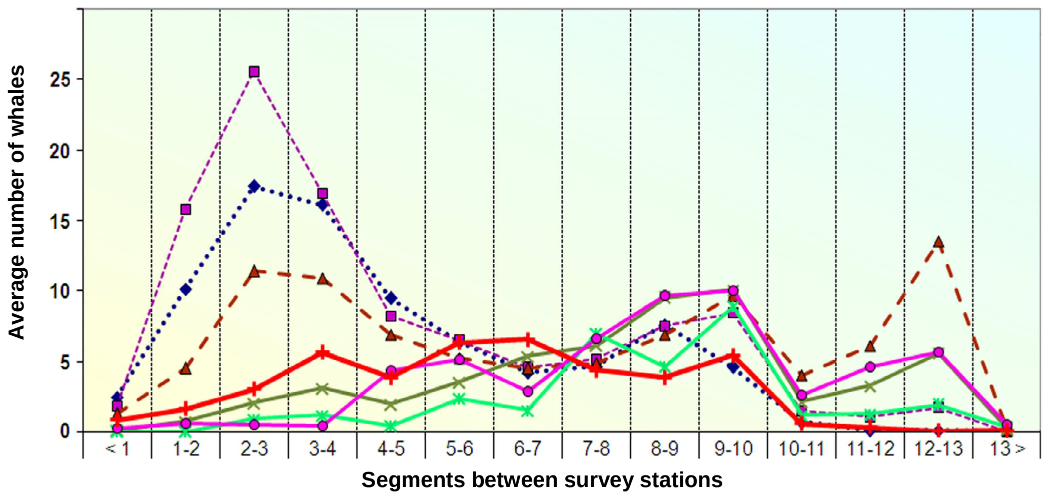


Figure 3. Distribution of gray whales in the Piltun feeding area, August–September 2009 and 2010 (data from complete synchronized shore-based surveys)

The distribution of whales in 2010 was fairly even across the Piltun feeding area. The main difference with previous years (2004-2009) was the absence of any substantial density 'peaks' near certain stations (Figure 4). Past years' distributions were characterized by localized peaks of abundance in the zone adjacent to the mouth of Piltun Bay, in the northern part of the feeding area or, as in 2006, along its southern periphery. In 2010 the average number of whales in the entire central part of the waters (from stations 3-4 to 9-10) varied little (from 3,84 to 6,53 individuals), while a gradual decrease in the number of whales was observed towards the north and south ends of the Feeding Area (especially near the southern stations, 11-13). Because whale distribution in the feeding season is primarily determined by the availability of prey, it is possible to assume that the distribution of benthos in the near shore waters in 2010 was also more evenly over the feeding ground. This subject is described in greater detail in this report).



Year	Average number of whales in segments													
2004	2,45	10,14	17,41	16,09	9,45	6,36	4,18	4,64	7,59	4,59	0,68	0,09	0,09	0,00
2005	1,80	15,80	25,56	16,92	8,20	6,52	4,56	5,16	7,52	8,44	1,48	1,04	1,72	0,00
2006	1,25	4,50	11,38	10,88	6,88	5,25	4,50	4,88	6,88	9,63	4,00	6,13	13,50	0,13
2007	0,10	0,75	2,05	3,10	1,95	3,55	5,35	6,10	9,50	10,10	2,15	3,25	5,60	0,20
2008	0,00	0,00	0,91	1,18	0,45	2,36	1,55	7,00	4,64	8,91	1,18	1,27	1,91	0,36
2009	0,23	0,62	0,54	0,38	4,31	5,15	2,85	6,62	9,69	10,00	2,62	4,62	5,62	0,54
2010	0,84	1,63	3,00	5,63	3,84	6,32	6,53	4,37	3,84	5,42	0,58	0,32	0,05	0,11

Figure 4. Year-to-year variations in spatial pattern of gray whale abundances in the Piltun area waters, August-September 2004–2010 (from comprehensive synchronized shore-based survey data)

From August 18th Rosneft conducted a dual phase seismic survey in the southern part of the Lebedinskoye Oil and Gas Field opposite Station 4. This survey was not completed by the end of the observations season. To date, no specific analyses have been conducted and no striking abnormalities in whale distribution , i.e. absence of whales, can be detected for the season as a whole.

Density Analysis

Density analysis provides a quantitative estimate of the gray whales' usage of the Piltun feeding area. Data from both onshore and offshore based surveys were used to calculate the habitat usage index (the number of 1 x 1 km square cells where the animals' presence was observed). This index amounted to 20.8% in 2010 (whales were observed in 244 out of 1174 1 x 1 km square cells scanned during the surveys - Figure 1) vs. 36.9% and 23.4% in 2009 and 2008, respectively. The average whale density in the area's waters was 0.07 whales per square km of the entire scanned area in August-September 2010 (range of 0.04 to 2.47 whales per square). The average whale density in the "inhabited" squares was 0.35 whales/km^2[1].

In the area of the whales' main feeding ground, which covered the area from stations 2 to 10 , the usage index was 1.7 times greater than for the entire area (station 1 - 13) and amounted to 34.5% (whales were sighted in 209 of the 605 scanned squares). With 0.13 whales/km^2 the average whale density in the area between station 2 and 10 was almost double compared to that in the entire area. The highest densities (> 2 whales/km^2) were observed opposite the mouth of Piltun Bay in the waters opposite Station 9.

On the northern periphery of the survey area, north of station 2, the whales' water area usage index was only 9.0% in August-September 2010 (whales were sighted in 24 of the 267 scanned squares), while the average density in this area was only 0.02 whales/km^2 and 0.25 whales/km^2 in the "inhabited" squares with variations of 0.05 to 1.1 whale/km^2. In the southern part of the Piltun area, south of Station 10, the whales' water area usage index in the main foraging season (August-September) of 2010 was almost three times lower - 3.6% (the whales were sighted in only 11 of the 302 scanned squares) and their average density in the waters was a negligible 0.004 whares/km^2.

[1] Because of shore line irregularities, certain squares next to the shoreline were truncated to varying degrees on the west and had an area of less than 1 km^2. In all of these squares, the estimated whale distribution density is somewhat higher than their actual density, especially if the squares are very small (see the "Density Analysis" section, Volume 1, Chapter 2). This bias will be corrected as the density analysis methodology is refined.

Average density in the "inhabited" squares of the southern part of the area was also the lowest - 0.12 whales/km^2, with variations of 0.09 to 0.22 km^2.

Thus, based on the number of kilometer squares where gray whales were sighted (which was nominally assumed as evidence that they utilized the area in one way or another in the foraging process), in August-September 2010 the animals used approximately 244 square kilometers of the Piltun Feeding Area for foraging. This indicator was somewhat lower than in 2009 (287 km^2) and apparently could partly be attributed to a reduction in the total number of whales in the nearshore area but was primarily the result of the whales' almost total disappearance from its southern part, which could not be offset even by an increase in the whales' usage of the northern area of their foraging waters. The average seasonal density of the whales in the "inhabited" squares in 2010 (0.35 individuals/km^2) was higher than in 2008-2009 (0.29 whales/km^2), which provides evidence that even though the whales' Feeding Area was somewhat smaller in 2010, the presence of forage per unit of Feeding Area used was apparently greater than in the two years before.

2.2 WHALE DISTRIBUTION BASED ON DISTANCE FROM SHORE AND WATER DEPTH

Gray whale distribution in the Piltun area throughout all the survey years has been characterized by the concentration of individuals within the first 5 km of the near-shore zone. The year 2010 was no exception, since 97.6% of the animals sighted from shore were observed within this zone.

A high percentage of whales were observed 1-2 km from shore (41.8%), 27.6% were observed 0.5 to 1 km from shore, and 11.1% and 10.2% stayed in the 2-3 and 3-5 km zones, respectively. In the 0-0.5 km zone, 6.9% of the whale sightings were made and 2.4% were observed 5-10 km offshore (Table 5, Figure 5). There was no difference in the near-shore whale distribution in terms of distance from shore between the Odoptu-Piltun and Astokh-Chayvo areas. In both areas the overwhelming majority of the whales (65.2-85.3%) remained 0.5-2.0 km offshore. However, in the Odoptu-Piltun area, whales were 6.5 times more likely to be present the distant zone (i.e. 3 km and beyond): 12.2% observed in the 3-5 km zone and 3.0% in the > 5 km zone, while in the Astokh-Chayvo area only 2.4% of the whales were sighted in the 3-5 km zone, while no whales were sighted beyond the 5 km line (Table 5). Due to lower elevations the effective sighting range at station 8 – 10 is limited to a maximum of 5 km. There were no distinct seasonal trends in whale distribution in terms of distance from shore in the Piltun Area in 2010.

Table 5. Distribution of gray whales in the Piltun area by distance from shore, August-September 2010 (based on all shore-based surveys)

Distance, *km*	Number of whales by month, %						
	1-15.08	16-31.08	1-15.09	16-30.09	August	September	Total
Odoptu-Piltun area							
0 - 0.5	2.7	9.6	8.4	8.9	6.8	8.6	7.8
0.5 - 1	11.8	31.4	31.5	20.8	23.3	26.7	25.3
1 - 2	42.7	34.0	40.4	42.9	37.6	41.5	39.9
2 - 3	10.9	9.6	10.8	15.5	10.1	12.9	11.8
3 - 5	27.3	12.8	8.4	6.5	18.8	7.6	12.2
> 5	4.6	2.6	0.5	5.4	3.4	2.7	3.0
Astokh-Chayvo area							
0 - 0.5	5.2	3.3	2.6	0.0	4.2	2.0	3.5
0.5 - 1	32.8	47.5	33.3	8.3	40.3	27.4	36.5
1 - 2	53.4	45.9	51.3	33.4	49.6	47.1	48.8
2 - 3	6.9	3.3	7.7	50.0	5.1	17.6	8.8
3 - 5	1.7	0.0	5.1	8.3	0.8	5.9	2.4
> 5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
The Piltun Area as a whole							
0 - 0.5	3.6	7.8	7.4	8.3	6.0	7.8	6.9
0.5 - 1	19.0	36.0	31.8	20.0	28.6	26.8	27.6
1 - 2	46.4	37.3	42.2	42.2	41.3	42.2	41.8
2 - 3	9.5	7.8	10.3	17.8	8.6	13.5	11.1
3 - 5	18.5	9.2	7.9	6.7	13.2	7.3	10.2
> 5	3.0	1.9	0.4	5.0	2.3	2.4	2.4

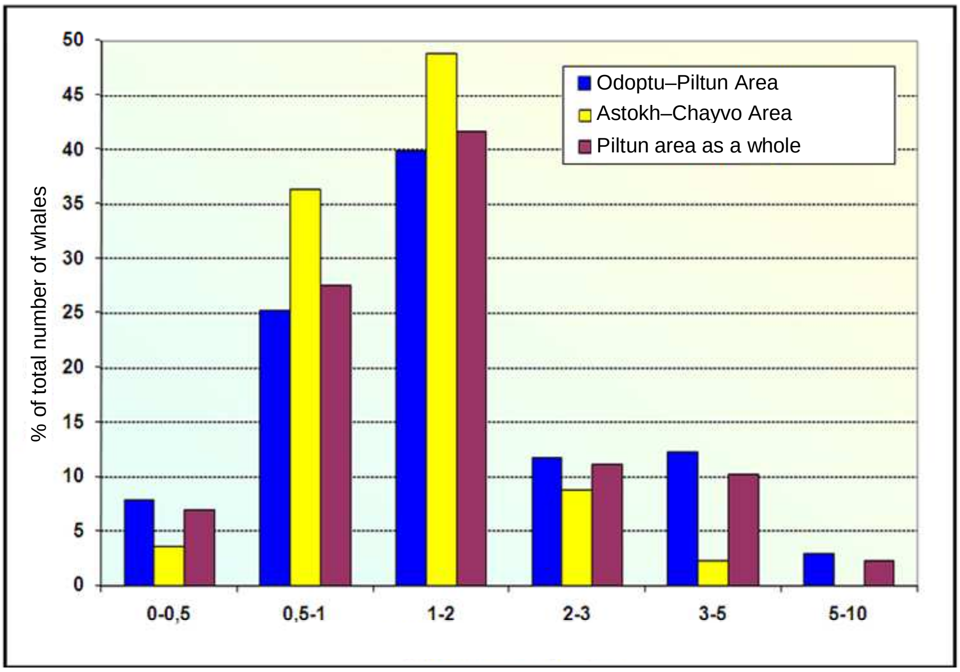


Figure 5. Gray whale distribution in the Piltun area by distance from shore, August - September 2010 (from all shore-based survey data; on x-axis distance from shore in km)

In 2010, the distribution of gray whales in the Piltun area as a function of water depth was generally similar to their distribution as a function of distance from shore. This similarity is expected since distance from shore correlates to water depth. .Most of the animals (91.0%) remained in waters less than 20 m depth during both months of observations (Table 6, Figure 6). The highest concentration (46.7%) was observed, as in past years, at depths of 6 to 10 m, while another 27.2% of the whales were observed in depths between 11 to 15 m.

When compared to August-September 2009 data, almost twice as many whales (up to 11.5%) were observed in the deep water (> 20 m) zone of the Odoptu-Piltun (Northern) Area in 2010. This increase was especially noticeable in the first half of August, when as many as 24.6% of the animals were observed in the Odoptu-Piltun area (Table 6, Figure 1). Whales were not observed at such depths in the Astokh-Chayvo area. As mentioned above, compared to the Astokh-Chayvo area the sighting range in the Odoptu Piltun area is larger due to higher elevations of the observation stations. In addition, the 20 meter isobath is located farther from shore in this area, and beyond the visual range of some of the observation stations, thus limiting observations of gray whales that may be present in deeper waters.

The only seasonal trend observed in the Piltun area was a twofold decrease in the number of whales in the shallow part of the water area (at depths of less than 10 m) and the proportional increase in their number in the deeper zone (11+m, Table 6) observed in the second half of September in both the Piltun area as a whole and in the northern (Odoptu-Piltun) and southern (Astokh-Chayvo) areas.

Table 6. Distribution of gray whales in the Piltun area by water depth, August-September 2010 (based on all shore-based surveys)

Depth, *m*	Number of whales by time of season, %						
	1-15.08	16-31.08	1-15.09	16-30.09	August	September	Total
Odoptu-Piltun Area							
0 - 5	2.7	23.1	8.4	3.6	14.7	6.2	9.7
6 - 10	33.6	47.4	50.2	30.9	41.7	41.5	41.6
11 - 15	28.2	16.0	27.6	46.4	21.1	36.1	29.8
16 - 20	10.9	2.6	7.4	9.5	6.0	8.4	7.4
21 - 25	22.8	9.0	3.9	4.8	14.6	4.3	8.7
> 25	1.8	1.9	2.5	4.8	1.9	3.5	2.8
Astokh-Chayvo Area							
0 - 5	20.7	6.6	12.8	8.3	13.5	11.8	12.9
6 - 10	69.0	77.0	56.4	25.0	73.1	49.0	65.9
11 - 15	8.6	16.4	20.5	50.0	12.6	27.4	17.1
16 - 20	1.7	0.0	10.3	16.7	0.8	11.8	4.1
21 - 25	0.0	0.0	0.0	0.0	0.0	0.0	0.0
> 25	0.0	0.0	0.0	0.0	0.0	0.0	0.0
The Piltun Area as a whole							
0 - 5	8.9	18.4	9.1	3.9	14.3	6.9	10.4
6 - 10	45.8	55.8	51.2	30.6	51.4	42.4	46.7
11 - 15	21.4	16.1	26.4	46.7	18.5	35.1	27.2
16 - 20	7.8	1.8	7.9	10.0	4.4	8.7	6.7
21 - 25	14.9	6.5	3.3	4.4	10.1	3.8	6.8
> 25	1.2	1.4	2.1	4.4	1.3	3.1	2.2

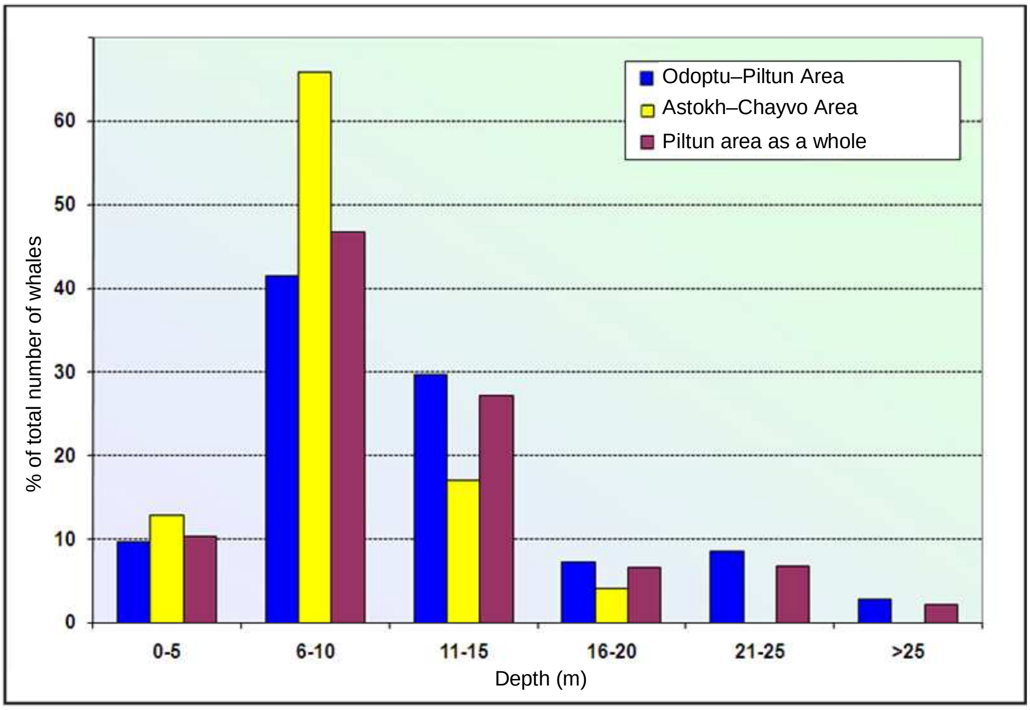


Figure 6. Gray whale distribution in the Piltun area by water depth, August - September 2010 (from all shore-based survey data)

The reasons for annual changes in the distribution of gray whales in the Piltun area as a function of water depth (and distance from shore) are not yet clear, but are most likely related to seasonal variations in the availability and biomass of benthic prey in the various shelf zones.

2.3 WHALE POPULATION DYNAMICS IN THE PILTUN AREA

In 2010 the first synchronized onshore surveys were made in the second week of August (Table 4). This time typically corresponds with the end of the migration of whales to the feeding areas from their wintering grounds and marks the beginning of the main phase of the feeding season which lasts from early August to late September (Vladimirov 2007; Vladimirov *et al.* 2005-2008). As noted above, the results of three complete surveys (August 7-9) showed that an average of 58.3 whales were observed during this time, with minimum 47 and maximum 69 whales. This was somewhat lower than the same figures for this period in 2009 (average of 60.2 whales, min.

57, max. 68) but is similar to 2007 figures (average of 57.0 individuals with a range between 47 to 67 animals) (Vladimirov *et al.* 2008, 2010)[2].

In the second half of August 2010, when the weather permitted making a series of synchronized surveys (August 18-28), an average of 36.3 whales were sighted in the Piltun Area, with minimum 14 and maximum 51 individuals (Table 4, Figure 7). Only one synchronized survey was made in this period in 2008 and 2009 and yielded figures of 37 and 73 whales respectively (Vladimirov *et al.* 2009, 2010). In 2007 the average number of whales surveyed in Piltun in the second half of August was 56.2 individuals with a minimum of 39 and maximum of 73 whales (Vladimirov *et al.* 2008)

In the first half of September 2010, the average number of gray whales in the Piltun Area (five synchronized surveys from September 2-14), increased to 58 individuals with a minimum of 43 and maximum of 77 (Table 4, Figure 7). This level of abundance is approximately equivalent to that for the same period in 2007 and 2009 (m - 53.7, min. - 43, max - 63 and m - 46, min - 40, max - 54, respectively) but is higher than in 2008 (m - 35.4, min – 28, max – 40).

In the second half of September 2010, the average number of gray whales in the Piltun Feeding Area decreased to 49 (min. - 32, max - 59). The same indicators for 2007-2009 were 48.2 individuals (min - 37, max - 55), 24 (min - 15, max - 31) and 28 (min - 21, max - 35), respectively. It appears that the 2010 gray whale abundance in the Piltun Area at the end of the main feeding season was within the normal range of variations for the past three years.

On the whole, seasonal gray whale abundance trends in the Piltun Feeding Area in August-September 2010 (Figure 7) were somewhat unusual. Maximum whale numbers were observed during the first survey (August 7). In past years (2003-2007 and 2009), the highest number of whales were sighted in late August to the first half of September. In only one case (2008) was peak abundance also observed in early August (August 9).

[2] The figures for 2008 (Vladimirov *et al.* 2009) are not used for comparative purposes, because in that year the poor weather in the Piltun Area in the first half of August made it possible to make only 1 complete count (during which 47 whales were sighted), and any estimates of the number of whales in the area based on this count are extremely unreliable.

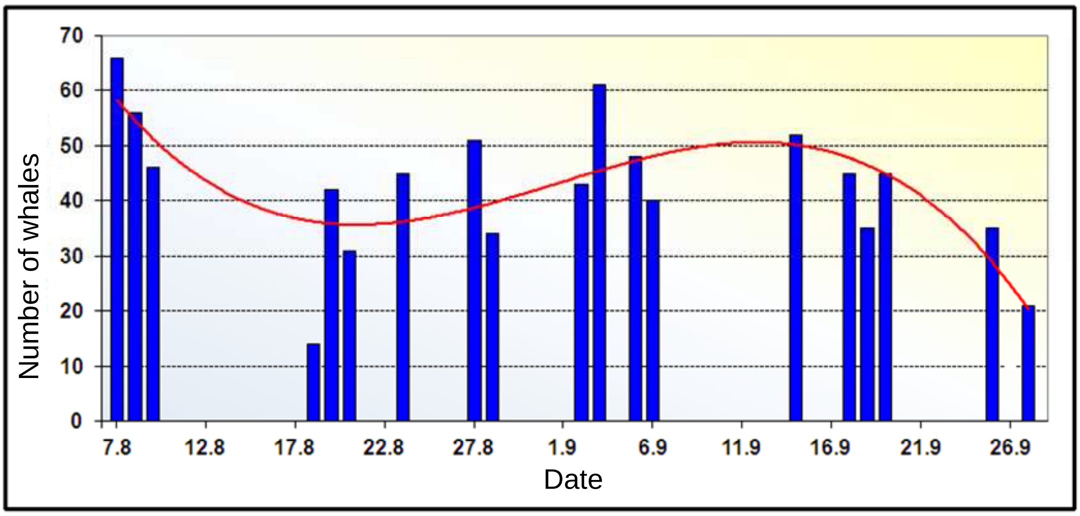


Figure 7. Seasonal dynamics of gray whale abundance in the Piltun area, August - September 2010 (based on complete synchronized shore-based surveys). Red line – polynomial trend.

If results from the initial surveys (August 7-8) are not included, abundance trends in August-September 2010 were similar to previous years. Until mid-September, the number of whales in the Piltun Area remained relatively stable at approximately 50 (with variations from 40 to 62 whales) and then, as in past years, numbers began to decline gradually to approximately 20 animals by the end of the month (Figure 7). The decline in the abundance of gray whales in the Piltun Area in the second half of September is a normal event associated with the start of the fall migration and the gradual withdrawal of the whales from their near shore feeding grounds. In previous years, the whales moved to the Offshore Feeding Area where seasonal warming of the water and the growth of benthos normally leads to an increase in food supply towards fall. Unfortunately, we were unable to document this trend in 2010 due to bad weather and poor weather which limited the surveys in the Offshore Feeding Area

Based on the number of whales sighted during the surveys, the largest observed group of whales present in the near shore waters of the Piltun Area from August-September 2010 was 77, which is comparable to the same figure for the previous year (73 whales). However, whales migrate between the Piltun feeding area and other areas, e.g. the offshore feeding ground (Yakovlev and Tyurneva, 2005, 2006, 2008; Yakovlev *et al.* 2007, 2009, 2010), In order to obtain an estimate of the total number of whales in the northeastern waters of Sakhalin, these other areas need to be incorporated in this analysis as well. This topic will be specifically examined in greater detail in Section 3 "Discussion of Results".

2.4 VESSEL-BASED SURVEYS

Results of the vessel-based surveys are provided in table 7.

Table 7. Number of whales sighted during vessel-based surveys in Northeast Sakhalin waters, August-September 2010

Survey area	Survey date	Number of individuals sighted	Comments
Offshore Feeding Area	August 3	1	-
Piltun-Astokh License Block	August 5	0	14 whales sighted in waters adjacent to the block's western boundary; 2 whales were resighted.
Piltun Feeding Area	August 18	31	-
Offshore Feeding Area	August 19	6	-
Arkutun-Dagi License Block	August 20	0	8 whales sighted in waters adjacent to the block's western boundary in its northern part
Piltun-Astokh License Block	September 1	4	Another 10 whales sighted in waters adjacent to the block's western and southern boundaries
Offshore Feeding Area	September 2	10	-
Arkutun-Dagi License Block	September 13	16	Another 3 whales sighted in waters adjacent to the block's western boundary (2 of which were actually in the northwest part of the Chayvo License Block)
Offshore Feeding Area	September 14	18	-
Piltun Feeding Area	September 15	30	-
Comment: The table does not include whales that were re-sighted from adjacent lines (or could have been) if the surveys were made on a grid of parallel transects (in the Offshore Area and in the waters of the Piltun-Astokh and Arkutun-Dagi License Blocks).			

2.4.1 Piltun Feeding Area

Additional information on gray whale distribution in the Piltun feeding area was acquired during vessel-based surveys conducted between mid August and mid September (Table 7).

The first systematic offshore Piltun survey was made on August 18, 2010. During this survey 16 gray whale sightings were recorded, comprising of 31 animals. Most of the sightings consisted of one or two whales. No gray whales were sighted in the southern part of the area (from Chayvo Bay to the mouth of Piltun Bay). Fifteen whales were observed in the central part of the area (from the mouth of Piltun Bay to station 6). Another 16 whales were sighted in the north Piltun Feeding Area, including a group of 10 whales at the latitude of Okha (Figure 8). Whales in the central part of the area stayed closer to shore (within 4 km of shore), while whales in the north stayed somewhat farther out to sea, in the area of the 20-m isobath.

On September 15, 2010 a second systematic survey in the Piltun Feeding Area was conducted, during which 22 gray whale sightings were recorded, consisting of 30 whales , i.e. nearly the same number of whales observed a month earlier. The distribution, however, changed. Although the whales were mostly seen again as singles or in pairs of two, they were more concentrated in the nearshore waters (<3 km from shore) between stations 2 to 10 and widely dispersed (Figure 8). No whales were seen at the latitude of Okha during this survey as was the case in the August survey.

In summary, the maximum number of gray whales sighted in 2010 during the vessel-based surveys in the Piltun Area was 31 (August 18), which is comparable to the 2009 data (33). These figures are higher than in 2008 (20 whales) but lower than in 2006-2007 (75 and 45 respectively). Thus, in the last two years the number of whales sighted in the Piltun Feeding Area has remained constant, even though their abundance is relatively low compared to the peak years.

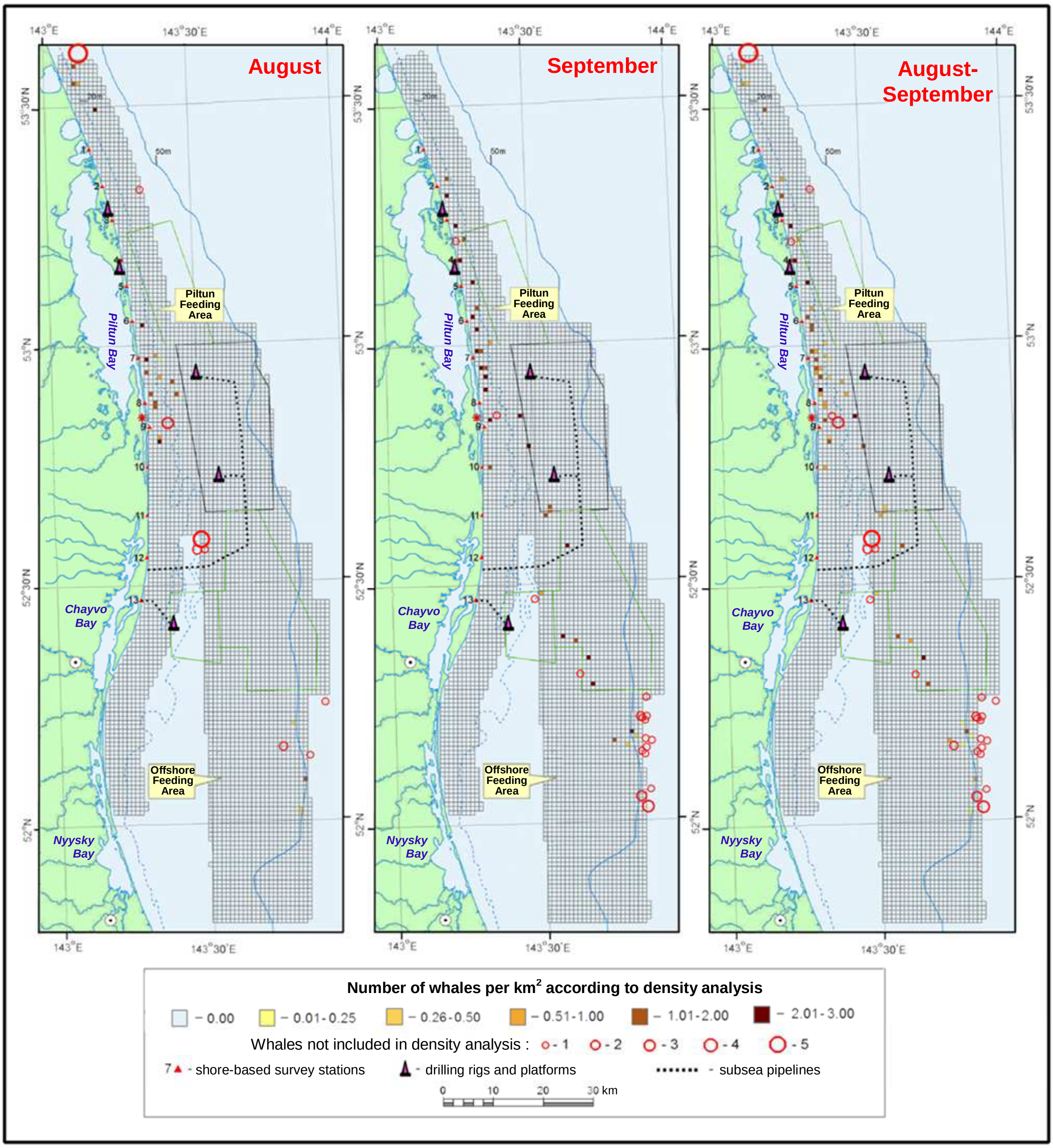


Figure 8. The distribution of gray whales in the waters of Northeast Sakhalinin August-September 2010. (according to vessel-based surveys)

2.4.2 *Offshore Feeding Area*

The first systematic survey in the Offshore Feeding Area on August 3 resulted in the sighting of just one whale in the east region.

A second systematic survey in the Offshore Feeding Area was performed on August 19. During 4 sightings, six whales were observed in the eastern and northeastern portions of the area. The whales were dispersed over a large area of water in the northeastern portion of the survey area (Figure 8).

A third survey in this area was made on September 2. Five sighting were made comprising of ten gray whales (Table 7). All ten whales were observed in a compact group in the northeastern portion of the area.

The last systematic survey in the Offshore Area was made on September 14. During this survey observers sighted 18 gray whales, i.e. almost twice the number sighted in the previous survey. The whales were located in the eastern part of the area, but were dispersed across the area's northeast and southeast portions..

As in previous years, the number of whales increased in the Offshore Feeding Area during the field season. The majority of whales were observed in the northeastern portion of the feeding area in deeper waters (up to 50-60 m). Compared to previous years, the maximum number of whales observed during one survey in the Offshore Area decreased by almost one third from 2009 - from 27 to 18, and by a factor of 4 from 2008 (82 whales). The planned September 30th survey in the Offshore Area was not conducted, so these results should be interpreted with caution.

There was seismic exploration underway over a large part of the Offshore Area from August 15 to September 7, 2010. Possible impact of this exploration on the number and distribution of gray whales will be considered below in Section 2.4 of this report.

2.4.3 *Arkutun-Dagi License Block*

Two systematic surveys were made in the area of the Arkutun-Dagi License Block, on August 20 and September 13 2010 (Table 7).

In the first survey observers sighted 8 gray whales. They were 3 sightings of 8 whales in close proximity to one another near the western boundary of the license block in its northern part 10-15 km off the coast of Sakhalin.

During the second survey observers noted an almost 2.5-fold increase in the number of gray whales in these waters (19) and found that they were more dispersed over the area. 16 gray whales were sighted within the license area and were mainly concentrated in the southwestern part at depths of 20-40 meters (Figure 8). Three more whales were sighted in waters adjacent to the Arkutun-Dagi Block on the west, of which 2 were actually within the adjacent Chayvo License area.

The number of gray whales in the waters of the Arkutun-Dagi block has increased noticeably over the past years. In 2006 only one whale was observed here, in 2007 a maximum of 2 whales were sighted, in 2008 7 whales were seen, no whales were sighted in 2009 and a maximum of 16 whales were sighted in 2010.

From mid August to September 7 the southeast part of the Arkutun-Dagi License Area was exposed to offshore seismic exploration noise (which also affected the waters of the Offshore Area). The effect of the exploration on gray whale distribution will be addressed in the relevant section of this report.

2.4.4 Piltun-Astokh License Area

In 2010 the first systematic survey in this license area was made on August 5 (Table 7). 16 gray whales were sighted west of the area, of which most whales were observed slightly north of the mouth of Piltun Bay (Figure 8).

A second systematic survey in the area was made on September 1. During this survey observers sighted 14 gray whales, which, as in August, mainly stayed near the western and southern boundaries. The whales seen near the southern boundary of the license area here approximately 14-16 km offshore.

2.4.5 Abundance and Distribution of Gray Whales in the Areas far from Shore

In comparison to previous years, 2010 was characterized by an unusual gray whale distribution in the offshore waters along the northeast coast of Sakhalin. The main differences with previous years concerned an increase in numbers of sighting in the Arkutun-Dagi License Area, and sightings over the two months of survey of a group of gray whales feeding 10-15 km offshore of Stations 11 and 12.

When estimating the gray whale abundance offshore Sakhalin in 2010, the numbers of animals in the Offshore area and the Arkutun-Dagi should be combined. In order to improve the accuracy of the estimation of the total number of whales, only the surveys conducted with brief time intervals (i.e. over the course of two consecutive days) should be used. In 2010 there were two occasions that met this requirement, i.e. surveys in the Offshore and Arkutun-Dagi Areas - August 19-20 and September 13-14 (Table 7). The September 13-14 survey yielded a higher total and was used for estimation purposes. We will recall that on September 13, 19 whales were sighted in the Arkutun-Dagi area and the adjacent waters on its west side, while 18 animals were sighted in the Offshore Area the following day (September 14). Thus, assuming there was no migration between the two areas on these consecutive days, the total number of gray whales in the Offshore foraging group was estimated to be 37 in 2010. This figure constitutes an increase of 42.3% compared to 2009, when a maximum of 26 whales were seen in the Offshore area

2.4.6 Abundance of Gray Whales Offshore North-east Sakhalin

In comparison to 2009, there was a slight decline in 2010 of the maximum number of gray whales sighted during shore-based surveys (from 73 to 66). As described in the previous paragraph, there was an increase of approximately 43% in the maximum number of whales observed in the whales offshore Sakhalin in 2010 compared to 2009. (Historical data indicates the maximum number of whales in the Offshore was usually observed end of September-early October, but due to bad weather conditions surveys could not be completed at this time in 2009 or 2010).

Similar to the estimation of the maximum number of whales in the offshore Sakhalin, when estimating the total number of whales in both feeding grounds (i.e. Piltun and the offshore area (including Arkuntun-Dagi) surveys can only be made then they were made on the same day or on two consecutive days. An increased duration between the surveys increases the likelihood of double counting whales that moved between the two areas.

In 2010 surveys of gray whales in the Piltun and Offshore groups were made on September 13-14.

During the onshore survey 52 whales were observed during the shore survey on September 14, while during the vessel-based survey 37 whales were observed on September 13-14 (Tables 4 and

7). Assuming there was no double counting of animals the total number of gray whales in the waters of northeast Sakhalin was 89 in 2010. In 2009 this value was 77 (Vladimirov *et al.* 2010). Thus, judging by the surveys, in 2010 there was a 15.6% increase in the overall abundance of gray whales in their feeding areas off the shores of northeast Sakhalin. Nevertheless, for the time being the total concurrent number of gray whales concentrated in the feeding season on these feeding grounds is lower than in 2007-2008, when synchronized surveys revealed totals of 98-101 whales.

The highest number of observed whales northeast of Sakhalin is no indication for the total population size. Photo-ID studies demonstrated the rather active movements of gray whales between East Sakhalin and East Kamchatka recent years (Tyurneva, 2010). This means that not all the whales that visit Sakhalin waters during a season are there at the same time and therefore are not included in the survey results. Hence a more accurate estimate of the total abundance of gray whales present during the main feeding season in 2010 in the waters of northeast Sakhalin can be made only after a comparative analysis of surveys and photo-ID data.

The annual trends of gray whale abundance in the East Sakhalin region will be examined in greater detail below, in Section 5 "Discussion of the Results".

2.5 THE SIZE OF GROUPS OF WHALES

2.5.1 Shore-based Piltun area surveys

During shore-based surveys (August-September 2010), the overwhelming majority of gray whales in the Piltun Area were observed alone (in 79.5% of the sighting, accounting for 63.3% of all the animals sighted (Table 8). 16.5% of the sightings consisted of groups of two was 16.5%, accounting for 26.3% of the observed whales. Groups of 3 were observed less often (2.9% of all sightings, including 6.9% of the whales), groups of 4 whales were less common (0.9% of the sightings, 3.0% of the whales), and groups of 5 whales were quite negligible (0.1% of sighting and 0.5% of the whales).

Table 8. The size of groups of gray whales sighted in the Piltun Feeding Area in 2010 (based on onshore surveys)

Month	Size of group (number of individuals)				
	1	2	3	4	5

	% of sightings	% of individuals	% of sightings	% of individuals	% of sightings	% of individuals	% of sightings	% of individuals	% of sightings	% of individuals
August	79.75	64.06	16.75	26.91	3.00	7.23	0.25	0.80	0.25	1.00
September	79.30	62.65	16.34	25.82	2.83	6.71	1.53	4.82	0.00	0.00
Total for season	79.51	63.30	16.53	26.32	2.91	6.95	0.93	2.97	0.12	0.46

From August to September there were no noteworthy changes in group size, apart from a slight increase in groups of 4 (from 0.25 to 1.47%).In general the percentages of single and groups of whales in 2010 were comparable to those as observed in 2004-2009.

2.5.2 Vessel-based Piltun area surveys

Systematic vessel-based surveys in the Piltun Feeding Area in 2010 recorded 38 gray whale sighting comprising of 61 individuals. The animals were alone or in groups of up to 10 whales (Table 9). The average number of whales in a group in August-September was 1.6. Single whales were sighted most often, in 60.5% of the cases on average for the whole survey period.., The percentage of single whales increased from 56.3% to 63.6% from August to September. Groups of two whales were encountered on average in 36.8% of the sightings and their number remained practically the same in August-September. A group of 10 whales was sighted only once in August. These figures indicate that most of the whales in the area stayed alone, which can probably be attributed to the fact that they were mostly feeding. The group size distribution observed in 2010 was also typical for 2007-2009.

2.5.3 Vessel-based Offshore area surveys

In the Offshore Feeding Area the average size of a group of gray whales sighted in vessel-based surveys in 2010 was 1.6, i.e. nearly identical to vessel-based Piltun surveys. As usual, single whales predominated, accounting for 54.2% of the sightings, while the largest group consisted of 5 whales (Table 9).

In the area of the Arkutun-Dagi License Area, the average size of gray whale groups in August-September 2010 was 2.3, which is greater than the same parameter for the Offshore and Piltun Feeding Areas and exceeds the figures for the area in 2007-2008 (no gray whales were sighted here in 2009). In 2010 both single whales and groups of 2-5 individuals were encountered in the Arkutun-Dagi Area (Table 9), but in contrast to the Piltun and Offshore Areas the single whales did not predominate (they only amounted to 30.77% of the sightings). But considering the small sample size (13 sightings), it is better to refrain from drawing any conclusions concerning the group proportions of whales in this area.

In the area of the Piltun-Astokh License Block, the average size of the encountered gray whale groups was 1.5 whales in 2010, and most of the sightings (55%) comprised of single whales, which is similar to the same figures for the Piltun and Offshore Feeding Areas. The largest groups encounteredhere consisted of 3 whales (Table 9).

In general, according to the systematic vessel-based surveys, in 2010 gray whales in the waters of Northeast Sakhalin (including the Piltun Area) were usually single whales with group sizes up to 10 individuals (Table 9). The average number of whales in a group from late July to early October 2010 was 1.63, which was considerably lower than in past years (1.81 in 2007 and 2008 and 1.87 in 2009).

Table 9. The size of gray whale groups sighted in the waters of Northeast Sakhalin in 2010 (according to systematic vessel-based surveys)

Month	Group size (number of individuals)											
	1		2		3		4		5		10	
	Number of groups	% of total number of groups	Number of groups	% of total number of groups	Number of groups	% of total number of groups	Number of groups	% of total number of groups	Number of groups	% of total number of groups	Number of groups	% of total number of groups
Piltun Feeding Area												
August	9	56.3	6	37.5	-	-	-	-	-	-	1	6.2
September	14	63.6	8	36.4	-	-	-	-	-	-	-	-
Total for season	23	60.5	14	36.9	-	-	-	-	-	-	1	2.6
Offshore Feeding Area												
August	4	66,7	2	33,3	-	-	-	-	-	-	-	-
September	7	43.8	7	43.8	1	6.2	-	-	1	6.2	-	-
Total for season	11	50,0	9	41,0	1	5,0	-	-	1	5,0	-	-
Arkutun-Dagi License Block												
August	1	33.4	1	33.3	-	-	-	-	1	33.3	-	-
September	3	30.0	3	30.0	3	30.0	1	10.0	-	-	-	-
Total for season	4	30.8	4	30.8	3	23.0	1	7.7	1	7.7	-	-
Piltun-Astokh License Block												
August	5	50.0	4	40.0	1	10,0	-	-	-	-	-	-
September	6	60.0	4	40.0	-	-	-	-	-	-	-	-
Total for season	11	55.0	8	40.0	1	5.0	-	-	-	-	-	-
In the waters of Northeast Sakhalin as a whole												
Total for season	n	%	n	%	n	%	n	%	n	%	n	%
- sightings	49	53.7	35	36.8	5	5.3	1	1.1	2	2.0	1	1.1
- individuals	49	31.0	70	44.3	15	9.5	4	2.6	10	6.3	10	6.3

2.6 THE DISTRIBUTION OF COWS AND CALVES

All gray whale cows feeding in the northeast of Sakhalin stay with their calves in the near-shore areas in the summer and the early fall until the calves have been weaned.

In 2010 only 1 "cow-calf" pair was sighted during the shore-based surveys in August-September. This pair was sighted on September 2 near the mouth of Piltun Bay opposite Station 9. Two single calves, i.e. without their mothers, were sighted on August 28 in the vicinity of Station 7 and on August 29 in the vicinity of Station 5 (Figure 9).

Because of the small number of cow-calf sightings in August-September, we also studied the data from a seismic monitoring program conducted in the Piltun Area in June and the first half of July 2010 on behalf of Sakhalin Energy. Surveys in this period showed that in early summer "mother-calf" pairs were encountered more frequently compared to later in the summer-early fall. A total of 7 pairs were encountered, with the first pair sighted on June 23, and the last one on July 11. The majority of these pairs (6 pairs) were observed in the northern part of the area (station 1-6), and not, as usual, near the mouth of the Piltun Bay - Figure 9). The highest number of cows with calves (2 pairs) were sighted twice during shore-based surveys - on June 23 in the area of Stations 1 and 4 and on July 1 in the area of Stations 1 and 6. This figure is similar to the maximum number of "mother-calf" pairs sighted in 2008-2009 but was lower compared to some previous years. In 2004 6 "mother-calf" pairs were observed during one synchronized survey, and 5 pairs were encountered each year of the period 2005-2007. It should be pointed out that the because of the small body length and blows it is difficult to observe calves during scans. The data obtained during photo-identification works is more accurate and therefore more reliable in making final conclusions on the number of cow-calves.. See Chapter 2 for more explanation based on Photo-ID data.

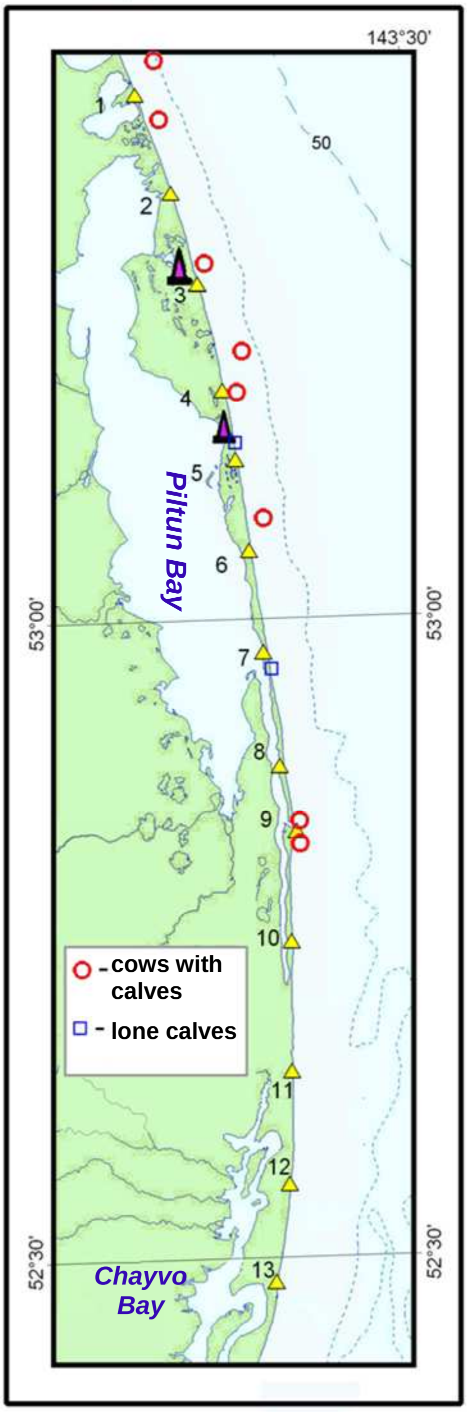


Figure 9. Distribution of cow-calf pairs and unassociated calves in Piltun area in June-September 2010 (based on shore-based surveys)

During observations as part of the SEIC 3D seismic survey monitoring and mitigation plan, observers also witnessed an attack by a killer whale on a gray whale calf, which is relatively rare in the waters of Sakhalin. This occurred on July 1 near Station 6 approximately 4 km off shore. A single adult male killer whale repeatedly attacked a calf traveling with his mother to the south for a period of 20-30 minutes, after which it stopped the attack The pair continued to move south although it was impossible to assess the severity of the calf's injuries as a result of this attack because of the distance between the scene of the attack and the observers. The further calf's fate is therefore unknown . This is the second recorded incident of a killer whale attack on gray whales in the Piltun Area. The first incident was observed on August 1, 2004 south of the mouth of Piltun Bay, when a mother-calf pair were attacked by a group of 9 killer whales but both managed to escape them in the shallow littoral and the calf stayed alive (Vladimirov, 2005).

2.7 The Impact of Anthropogenic Factors on Gray Whales

The following activities occurred during the 2010 feeding season and could have been potential factors of anthropogenic impact on the gray whales that foraged off the northeast coast of Sakhalin in the summer and fall of 2010:

- repeat 3D seismic survey in the Piltun-Ashtokh license area by SEIC from June 18 to July 2nd;
- seismic exploration in the area of the Lebedinskoye Offshore Oil and Gas Field by Rosneft from August 18 through October;
- offshore seismic exploration in the eastern part of the Offshore Feeding Area from August 15 to September 7; and
- the presence of various kinds of fishing boats in the Offshore Area fishing for walleye pollock.

More information on the Sakhalin Energy 3D seismic survey in the Piltun-Ashtokh license area and the monitoring and mitigation plan, which included distribution surveys, can be found in the IUCN WGWAP seismic task force reports (http://cmsdata.iucn.org/downloads/sstf_6_report_final.pdf).

The survey that Rosneft began on August 18, 2010 in the southern part of the Lebedinskoye field near Station 4 was conducted in the area often used by gray whales for feeding. Also, this survey was conducted during the main feeding season. More specific data on behavior, distribution of whales and acoustics are required to make any more conclusive statement on the impact of seismic exploration on gray whale.

Initial look at density maps of the overall distribution of gray whales in the Piltun Area over the season (Figure 1) did not reveal any adverse changes in the area of Station 4 once seismic exploration started there. Moreover, over the course of the season the whales steadily moved from the central part of the area to the north, despite the presence of ships there and periodically recurring seismic exploration noise. By comparison with 2009, the average number of whales that stayed in the seismic exploration zone in the waters between Stations 3 and 5 doubled - from 4.69 to 9.47 individuals (Figure 4).

In addition to seismic exploration at the Lebedinskoye Field, seismic exploration was also conducted in the Offshore Feeding Area from August 15 to September 7 on behalf of Gazprom; it covered a large part of the eastern half of the feeding area.

In addition to seismic exploration, the presence of fishing vessels harvesting walleye pollock could potentially have been another factor of anthropogenic impact on the gray whales, especially in the Offshore Feeding Area. But even though the number of vessels increased in September, the number of whales in the Offshore Area increased as well (Table 7). Given the relatively low intensity of this activity, there does not seem to be a visible adverse impact of fishing activities on the distribution of the whales; of which there was no evidence in past years.

The impact of anthropogenic activities on gray whales is in need of further detailed analysis using noise and animal behavior monitoring data, but at this time there is no clear indication of adverse (cumulative) impact of anthropogenic activity on whale distribution in 2010.

2.8 SURVEYS OF OTHER MARINE MAMMAL SPECIES

In 2010 vessel-based surveys (both systematic and opportunistic) in the waters of NE Sakhalin and in between Vladivostok and NE Sakhalin 380 sightings of other marine mammals species (i.e. non western gray whales) were made (Table 1, Figure 10, Appendix 1). The most common cetaceans encountered were the dolphin porpoise *(Phocoenoides dalli*) and harbor porpoise *(Phocoena phocoena*) (73 and 71 individuals respectively). The largest number of dolphin porpoises were sighted in July (32 individuals) and October (16 individuals) when the vessel was going back and forth between Vladivostok and NE-Sakhalin. 25 animals of harbor porpoise (13 in August and 12 in September) were sighted in the gray whale feeding area off the northeast coast of Sakhalin. The overwhelming majority of the harbor porpoises (62 individuals) were observed in the work area. Only 8 animals were sighted in July as the ship proceeded to the work area, while one animal was spotted in October on the ship's return trip. Common minke whales (*Balaenoptera acutorostrata)* (45 individuals) were encountered on a regular basis and were sighted in July as the ship proceeded to the work area (2) and during the work off the northeast coast of Sakhalin (17 in August and 26 in September). Killer whales (*Orcinus orca)* were ensurveyered frequently (28). They were mainly sighted in August (18) and September (9) in the gray whale feeding area. Another killer whale was sighted in October after the ship had left the work area. One sighting of a fin whale *(Balaenoptera physalus)* was made as the ship traveled to northeast Sakhalin. During the 2010 field season North Pacific right whales (*Eubalaena japonica)* (3 individuals) were observed off the coast of Sakhalin. They were sighted on October 1 when the ship had already left the work area and was positioned south of Nabil Bay (their coordinates are indicated in Appendix 1). Researchers also sighted three unknown baleen whales (one in July and two in August) and one cetacean of unknown species.

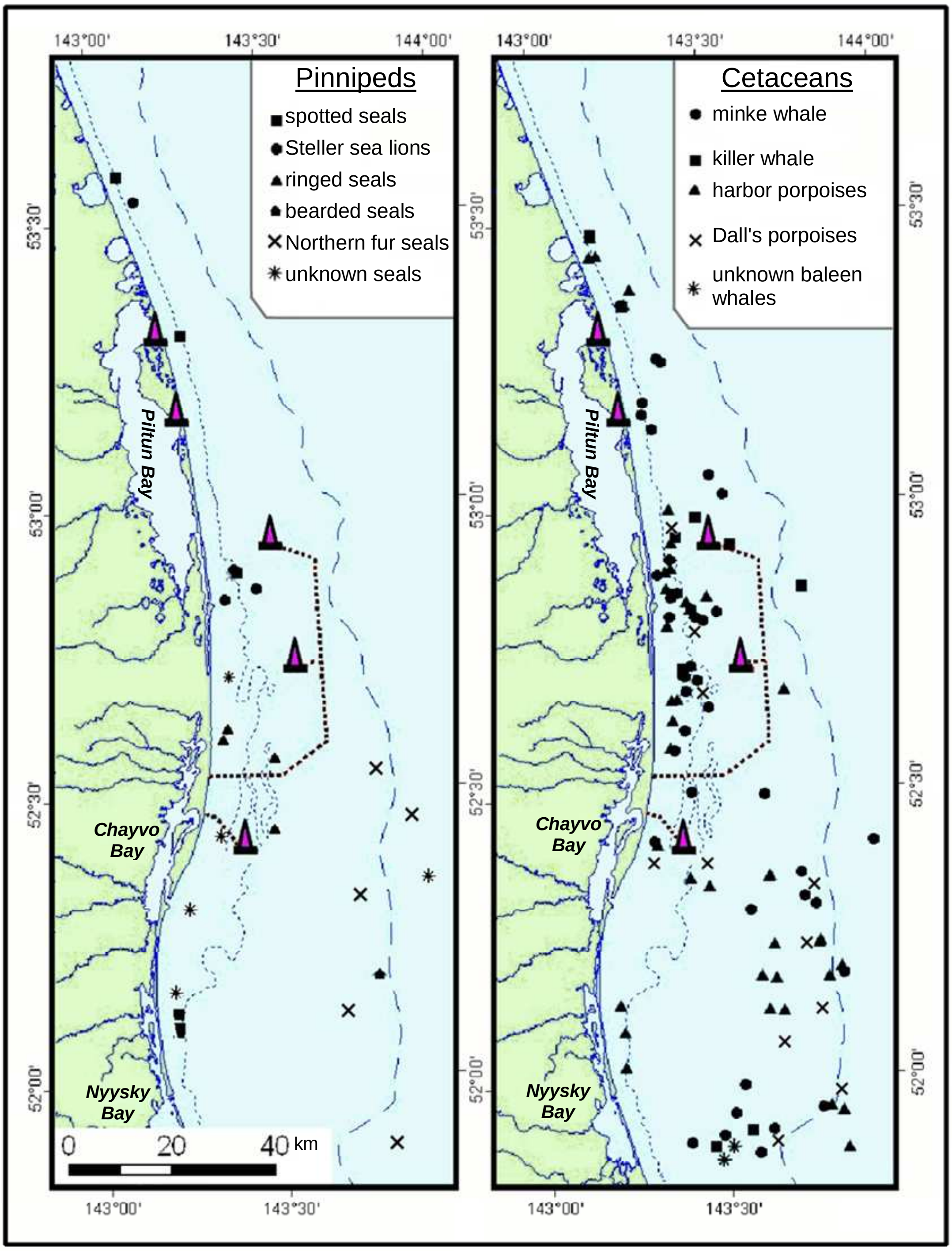


Figure 10. The locations of other marine mammal species (besides gray whales) in the littoral waters of Northeast Sakhalin in August-September 2010 (according to vessel-based surveys)

In addition to Cetaceans, during the 2010 vessel-based surveys different Pinniped species were also sighted. The most numerous were the Northern fur seals *(Callorhinus ursinus),* of which 132 individuals were sighted, the majority of which were sighted near Cape Terpeniye (111 in July and 11 in October). Another 10 fur seals were sighted in the gray whale feeding area (7 in August and 3 in September). Four ringed seals *(Pusa hispida,* 7 spotted seals *(Phoca largha)*, 5 Northern sea lions *(Eumetopias jubatus)*, 1 bearded seal *(Erignathus barbatus)*, and 5 unknown seals (Table 1) were also sighted in the waters of NE Sakhalin.

In addition to vessel-based survey results, onshore surveys conducted in August-September 2010 also resulted in the sightings of marine mammals other than gray whales. Minke whales (*B. acutorostrata)* were sighted 4 times (4 individuals), harbor porpoises *(P. phocoena*) were sighted 19 times (25 individuals), and killer whales (*Orcinus orca)* were sighted twice (2 individuals). These sightings were mostly made in the Northern part of the feeding area (station 1-6), except for two sightings of harbor porpoises near station 13 (Figure 11). The two minke whales were sighted in the northern part of the Piltun Area 1 to 4 km offshore. In the past season killer whales were sighted twice in the northern part of the area in early and mid September 3-6 km offshore and in both instances the animals were males. Harbor porpoises were observed up to 1 km offshore.

In the Piltun Area, the most common Pinnipeds were ringed seal and spotted seal, followed by bearded seals. Sightings of pinnipeds were not recorded during shore-based surveys, but they were seen regularly all throughout the survey areas well as en route to the work area. There is a regular mixed rookery of these seals which numbers approximately 800-100 individuals near the mouth of Piltun Bay.

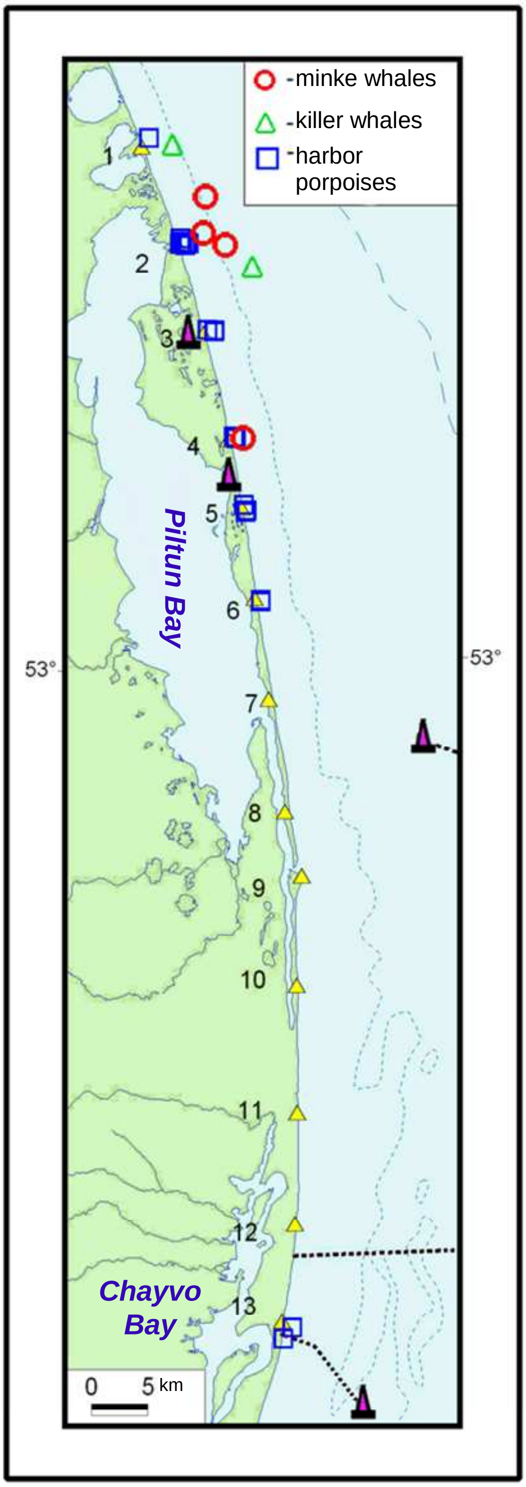


Figure 11. Places where other Cetacean species (besides gray whales) were sighted in the Piltun Area in August-September 2010 (according to shore-based surveys)

3. DISCUSSION

The annual distribution data obtained as part of the Gray Whale Monitoring Program in the waters of Northeast Sakhalin in the period 2001 to 2010 is a valuable source of information on longer-term gray whale distribution and abundance in their feeding areas. An analysis of the trends of these parameters makes it possible to identify the basic patterns of their annual and seasonal variations and arrive at tentative conclusions concerning the possible environmental factors that determine these relationships.

Results of shore-based surveys, that began as a pilot program in 2003 in the near-shore Piltun Area and have been continued as a full-scale program using the current methodology since 2004, demonstrate substantial variability of gray whale abundance in this feeding area. In 2003 the maximum number of whales sighted there was 70 (Melnikov and Starodymov, 2005). These data are not presented in this report.* In 2004 the maximum number of gray whales sighted there in shore surveys increased considerably (to 122) and remained practically the same in 2005 (119), but declined from year to year over the next three years (Figure 12) - to 99 in 2006, 73 in 2007, and 47 in 2008 (Vladimirov *et al.* 2005-2009). In 2009 the downward trend in gray whale abundance observed in the past 3 years in the Piltun Area was replaced by an increase - the maximum number of sighted whales increased by a factor of more than 1.5 (to 73 individuals), and in 2010 the number of gray whales in the coastal waters increased again (to 77). Thus, over the time of the surveys the total annual abundance of the nearshore feeding group varied by a factor of 2.5 (from 47 individuals in 2008 to 122 individuals in 2004).

* Vessel-based surveys were conducted in the Piltun Area in 2001-2003, but their results cannot be compared to shore-based survey data, because many whales in the 2-km nearshore zone go unnoticed from a vessel traveling 4-4.5 km offshore (which is evident on the maps - Figure 13), which means that the totals are lower than in shore counts.

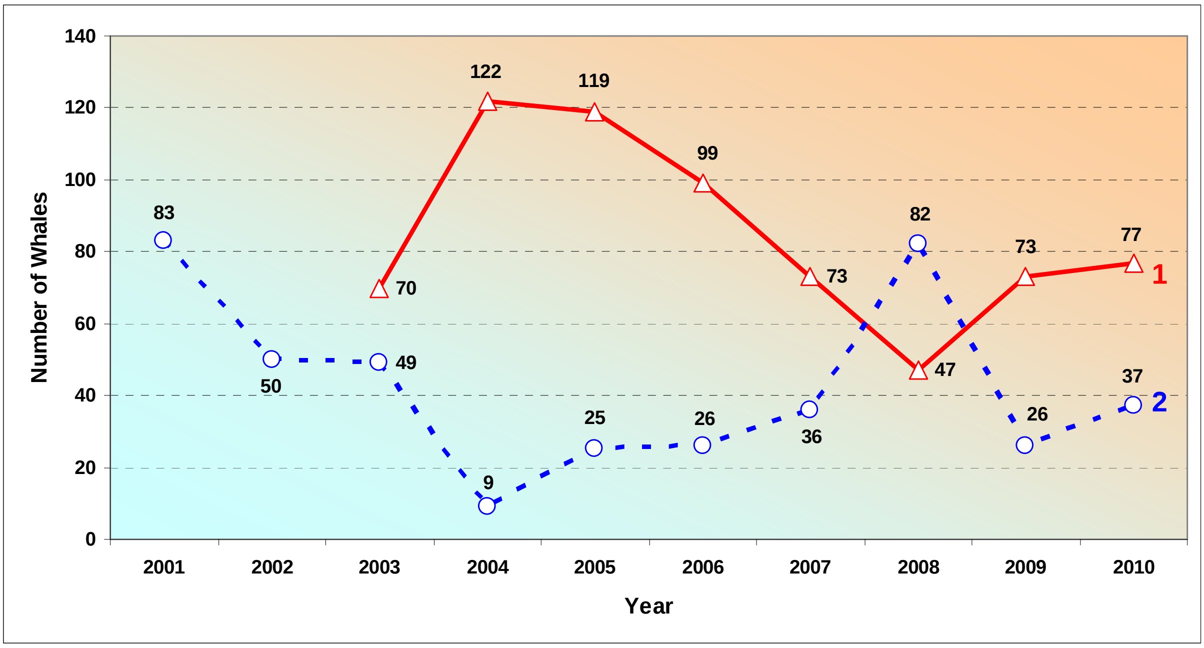


Figure 12. The maximum reported abundance of gray whales in the Littoral (Piltun) [1] and Offshore [2] Feeding Herds in 2001-2010 (according to shore- and vessel-based surveys)

As demonstrated by long-term monitoring results, abundance of whales feeding in the offshore area, is characterized by even greater annual (up to 9 times) variations of animal abundance (Figure 12). The data of the first vessel-based surveys made before the Monitoring Program that began in 2004 yielded one-day high sightings of 83, 50, and 49 individuals respectively for 2001-2003 (Vladimirov, 2004). The systematic vessel-based surveys made from 2004 to 2009 under the auspices of the Program indicated that in 2004 the maximum one-day observations of whales in the Offshore group decreased dramatically and unexpectedly to only 9 individuals, it increased somewhat in 2005 (25), and stayed approximately the same in 2006 (26). In 2007 it increased again slightly (to 36), while in 2008 it increased abruptly more than twofold (to 82 whales). But in 2008 the maximum number of whales in the Offshore group sighted in vessel-based surveys declined abruptly again (to 26), but in 2010 it increased slightly (to 37). However, there is a possibility that there could have been an underestimation in both years due to the bad weather, which made it necessary to cancel the surveys scheduled for late September, when the highest number of animals are usually observed in this area (Vladimirov *et al.* 2005 - 2010). In this regard it would be appropriate to note that this seasonal trend of the abundance of the gray whales of the Offshore group is a characteristic feature - it always increases from summer to fall and peaks in late

September - early October (the number of animals may continue to increase afterwards, but no surveys were made beyond beginning of October and therefore this is still unknown).

A comparison of the annual trends of gray whale abundance in the Piltun and Offshore Feeding Areas for 2003-2010 for which there are reliable survey figures for both areas indicates that over all 8 years the two areas showed opposite trends in whale numbers. An increase in the number of whales in one area invariably coincided with a decrease in the other area, and vice versa (Figure 12). These neighboring feeding areas can therefore be consider as "connected vessels", and the annual redistribution of whales between the areas indicates relative stability of the overall abundance of the gray whales in the East Sakhalin Feeding Range. The regular movement of whales from the Offshore Area to the Piltun Area and back has also been confirmed by photo-ID data (Tyurneva *et al.* 2009, 2010).

The monitoring data also demonstrates that in addition to variations in gray whale abundance in the Piltun Area, there are also significant variations in their geographical and temporal distribution. In 2001-2003, judging by the results of the first vessel-based surveys made, the whales were not observed in high densities in certain areas and were instead distributed relatively evenly across the Piltun Area. In 2002 more animals were concentrated in the northern part of the water area while in 2003 more were concentrated in the central part (Figure 13). In 2004-2005 the abundance of this feeding group increased and peaked (Figure 12), and the whales were mainly concentrated in the northern part of the Piltun Area (Figure 14), where up to 65-70% of the total number of whales in the area remained. This had not observed in the preceding 3 years. In 2006, when gray whale abundance in the Piltun Area started to decline, the density of animals in its northern part declined by almost by half in comparison to 2004-2005. At the same time there was a noticeable increase in the number of whales in the southern part of the near-shore feeding area. In the following 2 years, as the overall abundance of gray whales in the Piltun Area continued to decline, reaching its lowest level in 2008 (40% of the 2004-2005 level), their presence on the northern periphery continued to decline and they almost completely disappeared from there by 2008 (Figure 14). The main group of whales that year was observed in the central part of the area near the mouth of Piltun Bay, where approximately 60% of all animals present were concentrated (Vladimirov *et al.* 2009).

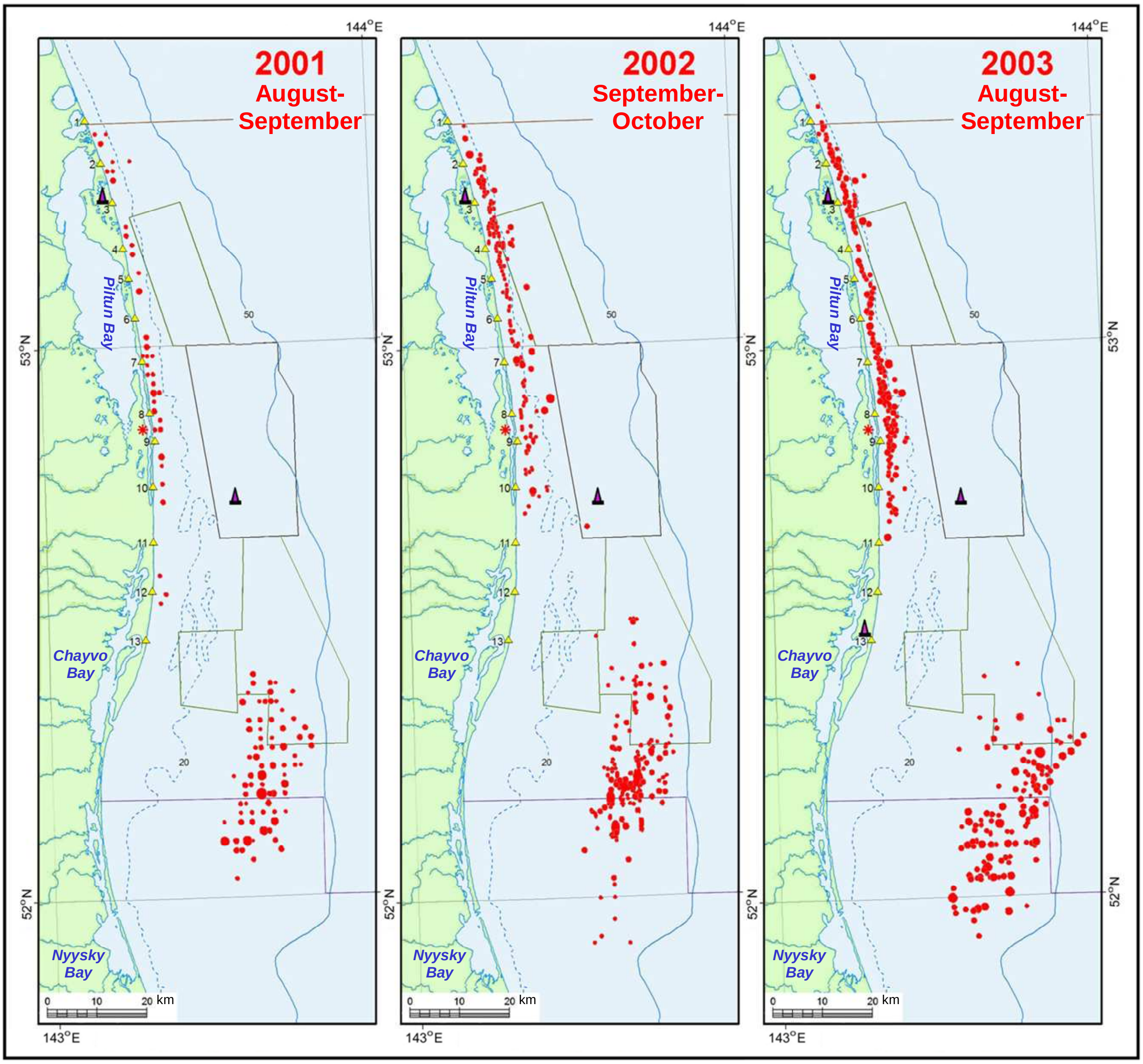


Figure 13. The distribution of gray whales in the waters of Northeast Sakhalin in the summer-fall in 2001-2003 (according to special and opportunistic vessel-based surveys) Locations of sighted whales - according to Vladimirov, 2004)

In 2009, the abundance of whales in the Piltun Area increased by more than 50% over the previous year, but their distribution remained quite similar, even though the density of the animals increased (Figure 14). In 2010, at a time when the number

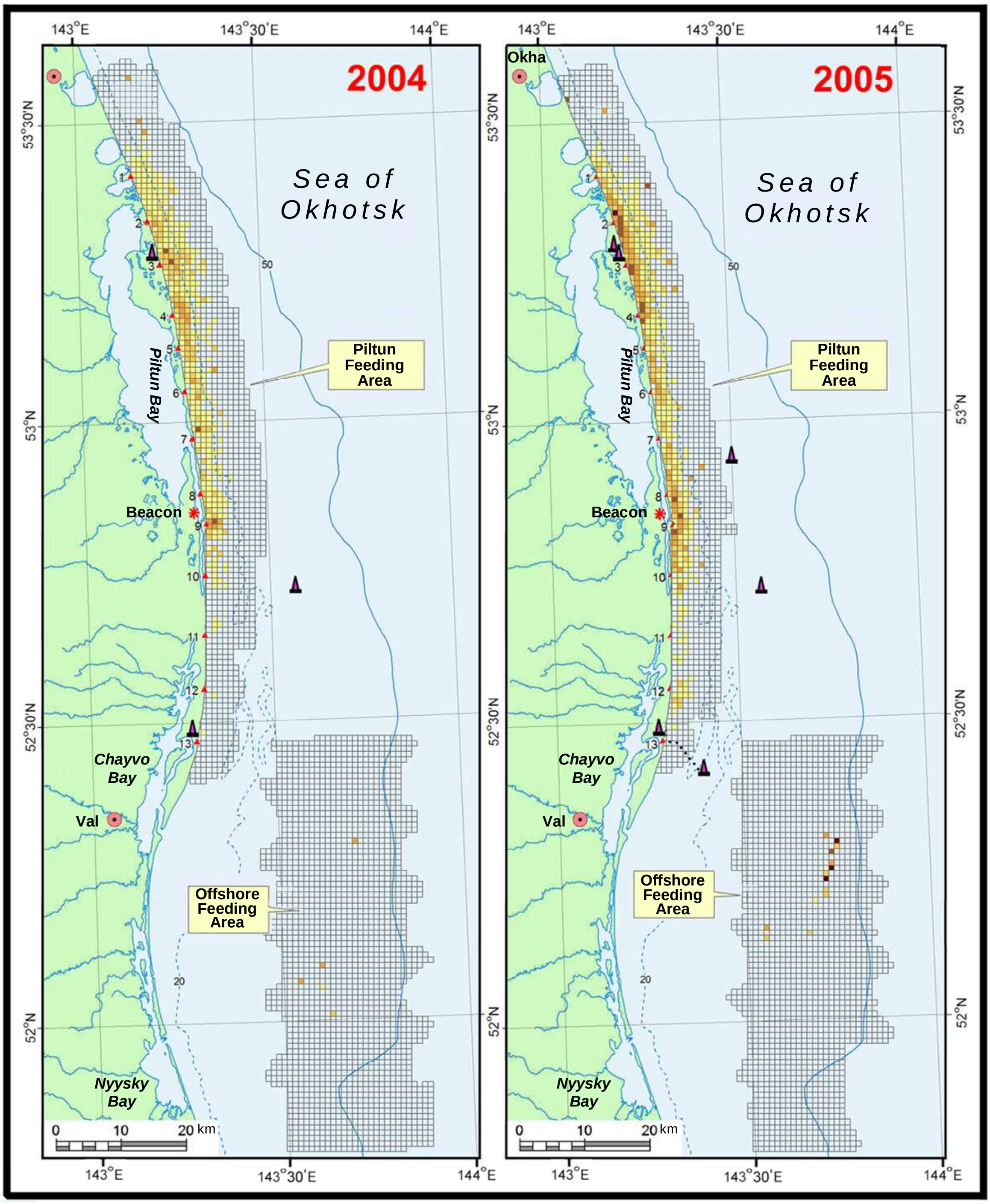
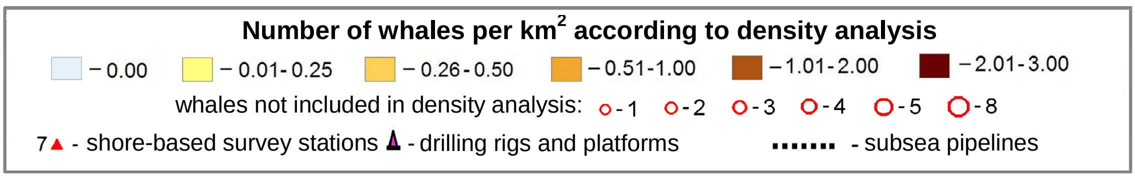


Figure 14. The distribution of gray whales in the waters of Northeast Sakhalin in August-September 2004-2010. (according to combined shore- and vessel-based surveys)



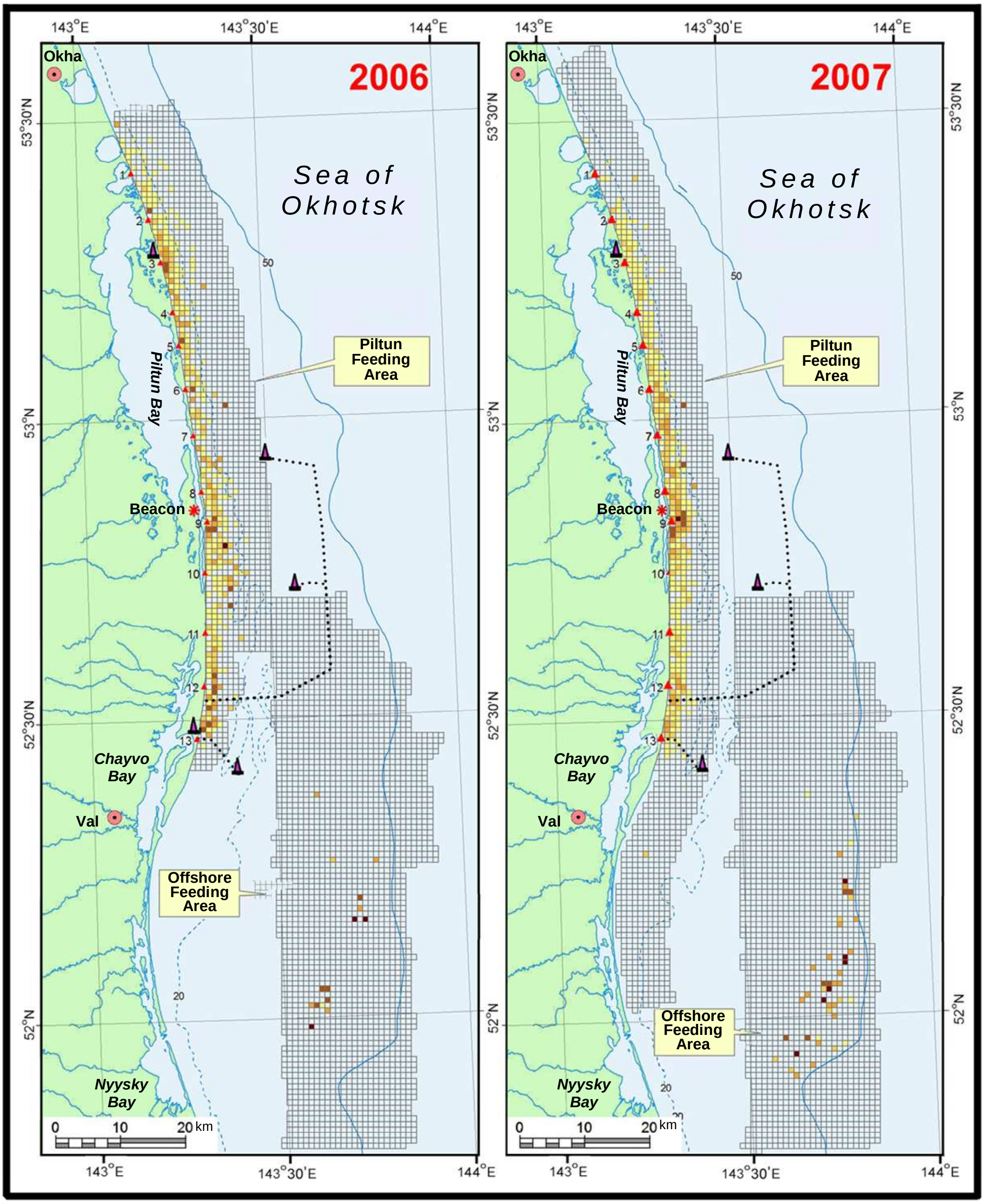
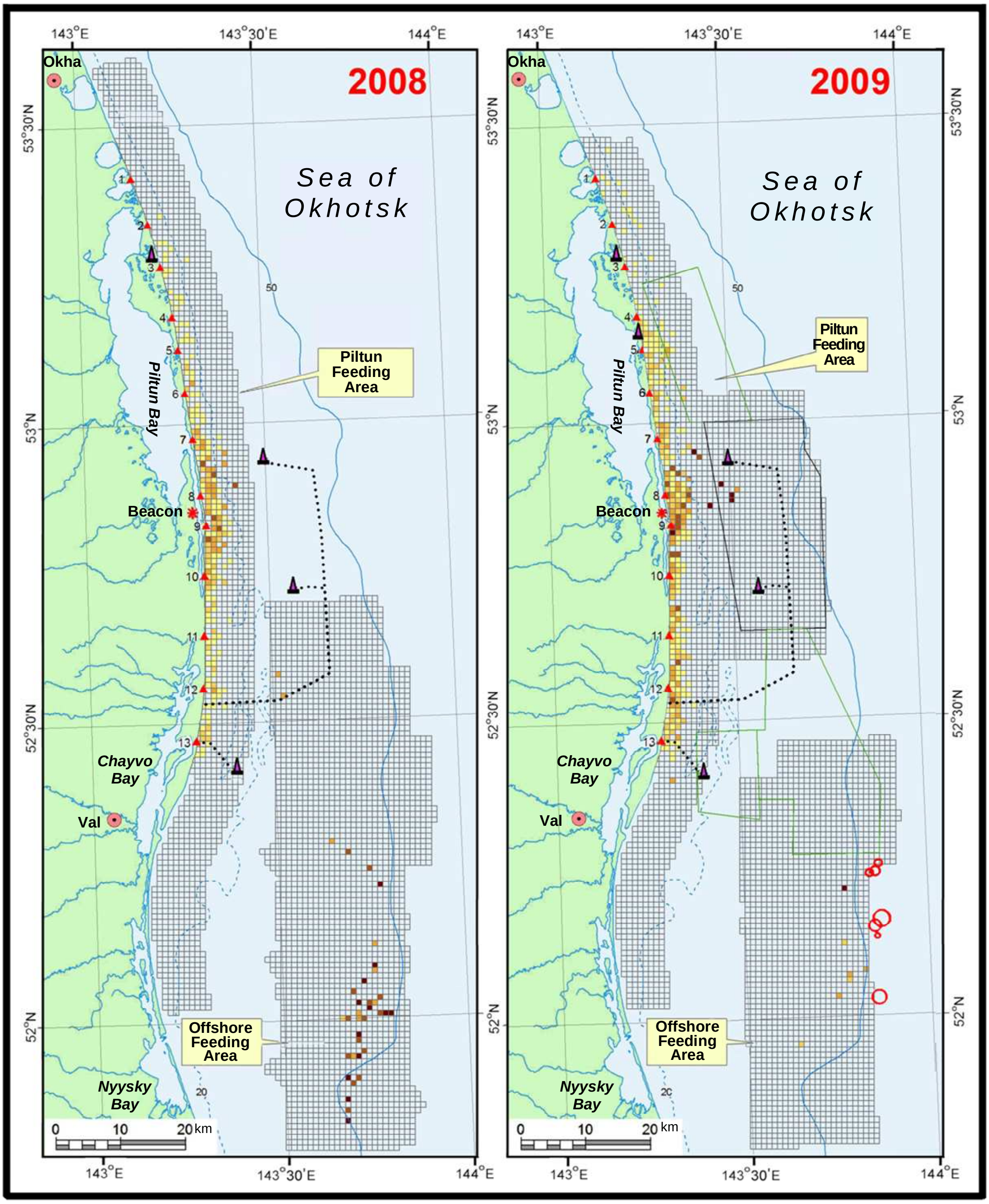


Figure 14. (*continued*) Same legend and key.



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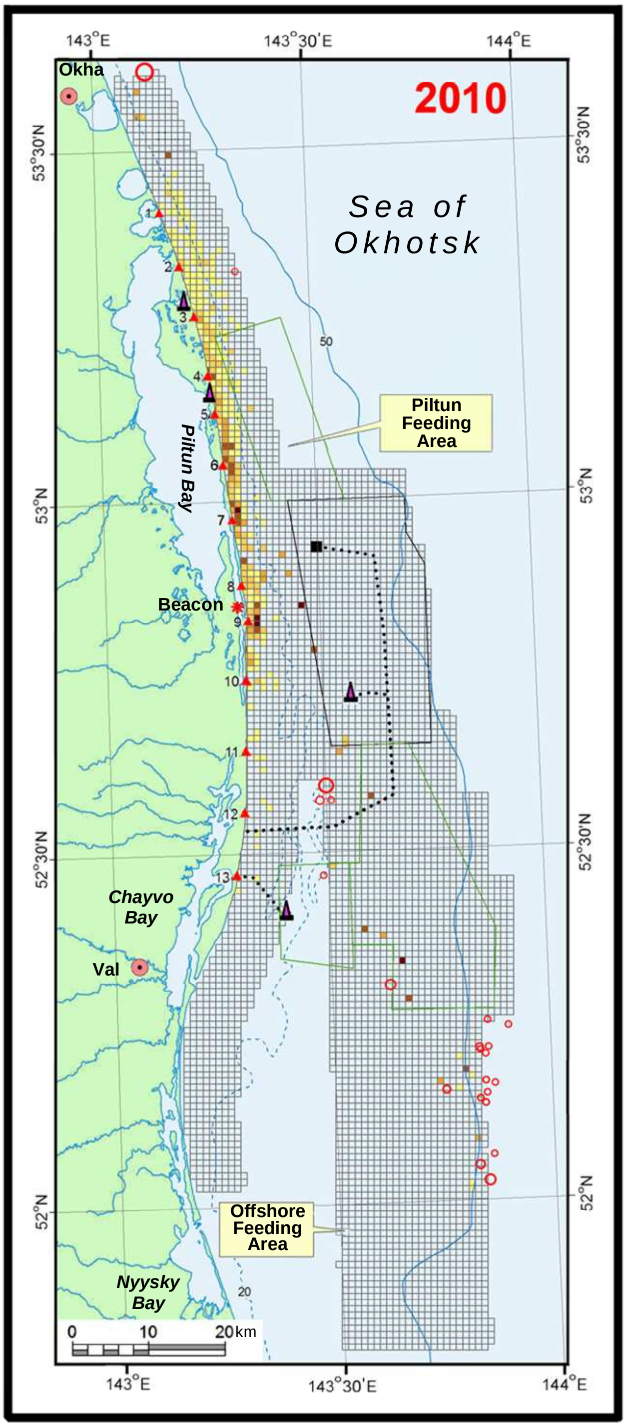

Figure 14. (*concluded*) Same legend and key.

of gray whales in the coastal waters remained almost the same (there was a decrease of 9.6%), their distribution changed - the animals moved in large numbers to the northern half of the feeding area and practically deserted its southern half, and the overall distribution of whales here came to resemble that in 2004 (Figure 14).

Over all the years of observations, despite the substantial (by a factor of 2.5) variations in overall whale abundance in the Piltun Area, a relatively stable concentration of whales was always observed in the central part of the area near the mouth of Piltun Bay (between Stations 7 and 10). This was even the case in 2004 and 2010, when more whales were seen in the northern part of the feeding area, resulting in somewhat smaller counts near the mouth (Figures 4 and 14). The two areas of the Piltun Area located north and south of the lagoon mouth are characterized by substantial variations in the number of whales, which may vary tenfold in the north and by a factor of up to 6.6 in the south (Figure 4).

As demonstrated by the 2004-2010 monitoring data and the results of earlier vessel-based surveys in 2001-2003 (Vladimirov, 2004), the gray whales of the Offshore feeding group used a rather large area of the Offshore Area and the Arkutun-Dagi License Area for feeding (from 51º50' to 52º40' N and from 143º30' to 143º55' E), but their distribution in this water area has also varied from year to year (Figures 13 and 14). In certain years the whales concentrated more in the southern part of this area, even moving in below the 52nd Parallel (for example, in 2003, 2007, and 2008), while in other years they moved primarily to its central and northern parts (in 2002, 2005, and especially in 2010).

At the same time, over the last few years, there has been a tendency for the main feeding area of the gray whales to shift gradually into the eastern, deeper water part of the Offshore Area (this phenomenon was first observed back in 2003, when the whales moved east to 143º55' E).

The distribution of the whales in the feeding waters was also quite variable from year to year - most often they were quite dispersed over a rather large area (such as in 2001, 2003, 2007-2010), but at times they formed more concentrated groupings (in 2002, 2005, and 2006).

With respect to the reasons for the observed considerable annual and seasonal differences in gray whale distribution and abundance, it should be mentioned that because they mainly come to the waters of North East Sakhalin to feed, most variations in their occurrences are thought to be primarily attributable to variations in the availability of food. Additional analyses are required to further quantify this correlation.

As an example, the periodic redistribution of whales between the coastal and offshore feeding areas which are interconnected in a manner reminiscent of "communicating vessels" is a plausible dynamic process which, it could be speculated, is possibly linked to variations in food biomass availability due to natural variations of climatic and geographical conditions. In particular, the increase in gray whale abundance in the Piltun Area in 2004-2005 is believed to be linked with the appearance of large spawning schools of the benthic Pacific sand lance (*Ammodytes hexapterus*). This fish species is known to serve as a food source for gray whales (Zimushko and Lenskaya, 1974) and also higher amphipod biomasses at shallower depths (Fadeev, 2005, 2006), which is thought to have attracted the vast majority of the whales that used to feed in the Offshore Area in the previous years. The disappearance of sand lance schools in the near-shore area in 2006, which at the same time coincided with a decline of amphipod biomass in the main whale feeding area (at depths of up to 15 m) resulted in a gradual decline in the animals' use of the northern part of the Piltun Area and the gradual departure of gray whales back to the Offshore Area, where forage benthos biomass remained the same and was higher than in the Piltun one (Fadeev, 2009, 2010). The reasons for the reverse redistribution of gray whales between these feeding areas in recent years are still not entirely clear and require further detailed analysis, currently scheduled to be conducted in 2011.

The increase in the presence of gray whales in the vicinity of the 20 meter isobath in the northern part of the near-shore area that was observed again in 2010 and the general movement of many whales to the northern location could have been caused by the reappearance of concentrations of sand lance (Fadeev, 2011, preliminary data).

It is hypothesized that the aforementioned typical seasonal trends in gray whale abundance in the Offshore group, namely the observed increase in the number of animals from summer to fall, can be attributed to relative food availability. Later in the feeding season prey biomass may decrease in the Piltun area due to consumption by the whales. This may encourage some whales to move to the Offshore Area, where later in the season prey biomass, even though it is more costly to obtain, may become more attractive to forage on vs. relatively depleted Piltun area (Fadeev 2011, pers. comm.).

In addition, there are quite significant movements of gray whales between the East Sakhalin and East Kamchatka Feeding Ranges observed in the last 2-3 years. Up to 30 whales that were previously sighted in Sakhalin waters have already been observed in East Kamchatka waters in the summer.

Critical topics of the relationships between variation in food availaibility and the coinciding variations in gray whale distribution and abundance in the East Sakhalin Feeding Region requires more detailed study. One important aspect of this study is to obtain more insight in all the feeding areas used western gray whales

4. CONCLUSIONS

Ship and shore-based surveys performed in August-September 2010 in the feeding habitat of gray whales off the northeastern coast of Sakhalin helped to obtain new information on distribution and abundance of these animals. The most noteworthy results of this work are as follows:

- The distribution of gray whales in the Piltun feeding area in August-September 2010 was characterized by an overall shift of the whales into the northern part of the feeding area and a sharp decrease in the number of whales in its southern part.

- Gray whales were also observed in the Arkutun-Dagi license area. The maximum number of gray whales recorded in the nearshore Piltun area in 2010 (66 individuals) decreased compared with 2009 (73 individuals) by 9.5%. Vessel-based surveys also showed a slight decrease in the number of animals observed in the Piltun area.

- The total number of gray whales concentrated in the northeast Sakhalin feeding grounds, based on the results of synchronized shore-based and vessel-based surveys increased in 2010 by 15.6% to 89 individuals (vs. 77 individuals in 2009).

- The number of cow/calf pairs observed in 2010 during shore-based surveys (2 pairs) remained at the level of 2008-2009. More accurate information on the number of cow/calf pairs is obtained by the photo-identification study.

- Survey data obtained in 2010 did not reveal clearly visible negative impacts of seismic surveys conducted in August and September in the coastal and Offshore gray whale feeding areas on the numbers and distribution of gray whales in the adjacent area. This conclusion requires further detailed analysis with the assistance of the results of acoustic monitoring.

- In general, the surveys conducted in 2010 showed that the gray whale population feeding along northeastern Sakhalin Island was in a relatively stable condition, although a precise estimate of the size of the population has been hampered in recent years by the active movement of animals between the northeast Sakhalin and Eastern Kamchatka feeding ranges.

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APPENDIX 1 RESULTS OF VESSEL-BASED SURVEYS OF MARINE MAMMALS OFFSHORE NE SAKHALIN IN 2010

Date (Дата)	Observer 1 (Наблюдатель 1)	Observer 2 (Наблюдатель 2)	Latitude DEGREES (Широта, градусы)	Latitude MINUTES (Широта, минуты)	Latitude hundredth MINUTES (Широта, сотые доли минуты)	Longitude DEGREES (Долгота, градусы)	Longitude MINUTES (Долгота, минуты)	Longitude hundredth MINUTES (Долгота, сотые доли минуты)	HEADING DEGREE (курс судна, градусы)	TIME, HOUR (Время, часы)	TIME, MINUTE (Время, минуты)	VISIBILITY, km (Видимость, км)	SEA STATE (Состояние моря)	LIGHT OR DARK (Светло или темно)	GLARE AMOUNT (Интенсивность отблеска)	GLARE POSITION (Местоположение отблеска)	Sighting ID (Номер группы)	SPECIES (Вид ММ)	NUMBER OF MM (Количество особей ММ)	MOVEMENT MM I.R.T. VESSEL (Передвижение ММ относительно	ACTIVITY 1 (Поведение 1)	ACTIVITY 2 (Поведение 2)	Direction FROM (Направление ММ, откуда)	Direction TO (Направление ММ, куда)	Distance, number of reticles (Расстояние: визирные метки)	HORIZON/SHORELINE (Референсная линия)	DISTANCE TO SHIP (Расстояние до судна)	AZIMUTH TO MM (Азимут ММ)	Binocs or naked eye? (Увидел в бинокль или нет?)	SIGHTING CUE (Характерная черта ММ)	MOVEMENT PACE (Интенсивность движения	COMMENTS (Примечания)
31.07.10	AK		46	52	29	144	5	80	19	06	07	8	01	L	NO			US	1	SP	SW		2	4			100	50	E	HE	SE	
31.07.10	AK		46	59	66	144	9	92	21	06	44	8	01	L	NO			HP	1	SA	FD	FD	11	1			300	10	E	FI	SE	
31.07.10	AK		47	1	23	144	10	62	19	06	50	8	01	L	NO			HP	1	SP	TH		2	4			400	80	E	FI	SE	
31.07.10	AK		47	2	49	144	11	32	20	07	00	8	01	L	NO			NF	1	NO	RE		2	4			100	80	E	FP		
31.07.10	AK		47	3	87	144	12	6	21	07	05	8	01	L	NO			HP	1	SP	FD		10	8			200	290	E	FI	SE	
31.07.10	AK		47	5	22	144	12	78	20	07	12	8	01	L	NO			HP	3	SP	FD		2	4			200	60	E	FI	SE	
31.07.10	AK		47	6	55	144	13	49	26	07	19	8	01	L	NO			NF	1	NO	RE		10	8	1.2	H	1500	10	B	FP		
31.07.10	EP		47	15	77	144	18	79	12	08	05	8	01	L	NO			NF	1	NO	FE		10	88			500	340	E	FP	SE	
31.07.10	EP		47	17	29	144	19	75	23	08	12	8	01	L	NO			NF	1	ST	SW	LO	10	8			500	320	E	HE	MO	
31.07.10	EP		47	18	17	144	20	33	23	08	13	8	01	L	NO			DP	2	SA	FD	TH	5	11			200		E			
31.07.10	EP		47	25	99	144	26	0	20	09	06	8	01	L	NO			NF	1	NO	RE		10	88			400	320	B	FP	SE	
31.07.10	EP		47	28	62	144	26	73	20	09	12	8	01	L	NO			HP	2	SA	FD		10	1			100	80	E	BO	MO	
31.07.10	EP		47	29	7	144	16	99	19	09	16	8	01	L	NO			DP	6	SA	FD	TH	10	2			70	90	E	FI	MO	
31.07.10	EP		47	31	2	144	28	67	21	09	30	8	01	L	NO			DP	1	SA	FD	TH	9	1			100	90	E	SP	MO	
31.07.10	EP		47	32	93	144	29	30	21	09	37	8	01	L	NO			DP	3	SA	FD		8	2			100	90	E	SP	MO	
31.07.10	EP		47	33	37	144	29	38	20	09	39	8	01	L	NO			DP	4	SA	FD		2	10			100	320	E	SP	VI	
31.07.10	EP		47	33	27	144	29	38	20	09	40	8	01	L	NO			DP	8	SA	FD		10	2			100	80	E	SP	VI	
31.07.10	EP		47	34	59	144	30	15	20	09	45	8	01	L	NO			NF	6	NO	RE		2	4			200	40	E	FP	SE	
31.07.10	EP		47	35	90	144	31	22	20	09	50	8	01	L	NO			MW	1	SA	FD		6	3			500	100	E	BO	MO	
31.07.10	EP		47	37	16	144	31	63	20	10	00	8	01	L	NO			NF	4	SA	RE		2	4			200	80		FP	SE	
31.07.10	EP		47	40	83	144	33	71	20	10	21	8	01	L	NO			FW	1	SA	FD						1500	60	E	BO	MO	
31.07.10	EP		47	42	43	144	34	63	21	10	30	8	01	L	NO			NF	3	NO	RE		10	88			500	340	E	FP	SE	
31.07.10	EP		47	43	85	144	35	47	21	10	35	8	01	L	NO			NF	1	ST	SW	LO	10	8			100	340	E	BO	MO	

31.07.10	OS		47	49	16	144	38	52	22	11	06	8	01	L	NO			DP	3	SA	FD		11	10			500	320	B	SP	VI	
31.07.10	OS		47	49	88	144	38	97	21	11	10	8	01	L	NO			NF	2	SA	LO		3	5			50	90	E	HE	VI	
31.07.10	OS		47	52	12	144	40	26	21	11	20	8	01	L	NO			NF	1	SA	LO		2	3			70	70	E	HE	VI	
31.07.10	OS		47	54	35	144	41	55	21	11	35	8	01	L	NO			NF	2	SA	LO		3	4			50	90	E	HE	MO	
31.07.10	OS		47	55	35	144	42	14	22	11	37	8	01	L	NO			DP	3	SA	TH		11	10			500	345	B	SP	MO	
31.07.10	OS		47	55	85	144	42	42	20	11	45	8	01	L	NO			NF	2	NO	RE		10				500	340	B	FP	SE	
31.07.10	AK		47	59	72	144	44	61	19	12	04	8	01	L	NO			NF	1	SP	SW		2	4			100	60	E	BO	SE	
31.07.10	OS		48	2	41	144	46	3	19	12	19	7	01	L	NO			NF	3	SA	SW		2	5			1000	70	E	FP	SE	
31.07.10	OS		48	5	37	144	47	55	20	12	34	8	01	L	NO			NF	1	SA	LO		12	3			100	30	E	HE	SE	
31.07.10	OS		48	6	77	144	48	31	20	12	43	8	01	L	NO			UB	1	SA	FD		2	6			500	40	E	BO	SE	
31.07.10	OS		48	6	78	144	48	40	20	12	45	8	01	L	NO			NF	1	NO	RE		1	2			50	30	E	FP	SE	
31.07.10	OS		48	9	28	144	49	64	20	12	50	8	01	L	NO			NF	1	SA	LO		8	9			150	290	E	HE	MO	
31.07.10	OS		48	9	92	144	49	50	21	13	00	8	01	L	NO			NF	2	SA	LO		11	9			100	10	E	HE	MO	
31.07.10	OS		48	10	34	144	50	25	21	13	03	8	01	L	NO			NF	2	SA	LO		10	9			150	10	E	FP	MO	
31.07.10	OS		48	12	7	144	51	22	21	13	15	8	01	L	NO			NF	2	NO	RE		11				50	0	E	FP	SE	
31.07.10	OS		48	12	83	144	51	67	21	13	17	8	01	L	NO			NF	1	NO	RE		11				50	0	E	FP	SE	
31.07.10	OS		48	13	30	144	51	94	21	13	19	8	01	L	NO			NF	1	SA	BR		2	3			200	60	E	BO	VI	
31.07.10	OS		48	13	50	144	52	5	20	13	20	8	01	L	NO			NF	2	NO	RE		11	10			150	330	E	HE	SE	
31.07.10	OS		48	13	98	144	52	33	20	13	24	8	01	L	NO			NF	1	NO	RE		3				200	100	E	FP	SE	
31.07.10	OS		48	14	46	144	52	59	19	13	27	8	01	L	NO			NF	1	NO	2		2				170	70	E	HE	SE	
31.07.10	OS		48	14	73	144	52	72	19	13	28	8	01	L	NO			NF	1	SA	BR		11	10			50	0	E	BO	VI	
31.07.10	OS		48	15	0	144	52	87	20	13	30	8	01	L	NO			NF	4	NO	TH		1				200	30	E	FP	SE	
31.07.10	OS		48	15	97	144	53	40	20	13	35	8	01	L	NO			NF	1	SA	BR		2	3			300	60	E	FP	MO	
31.07.10	OS		48	17	5	144	54	1	21	13	41	8	01	L	NO			NF	1	SA	SW		2	3			500	60	B	HE	VI	
31.07.10	OS		48	17	91	144	54	51	20	13	46	8	01	L	NO			NF	1	SA	SW		11	10			300	50	E	HE	MO	
31.07.10	OS		48	18	56	144	54	90	20	13	50	8	01	L	NO			NF	1	NO	LO		1				200	40	E	FL	SE	
31.07.10	OS		48	18	86	144	55	5	20	13	52	8	01	L	NO			NF	1	SA	SW		2				150	60	E	HE	MO	
31.07.10	OS		48	19	0	144	55	20	20	13	53	8	01	L	NO			NF	1	NO	RE		3				100	80	E	FP	SE	
31.07.10	OS		48	19	44	144	55	40	20	13	55	8	01	L	NO			NF	1	SA	SW		3				150	80	E	FP	MO	
31.07.10	OS		48	19	64	144	55	52	20	13	56	8	01	L	NO			NF	2	SA	SW		11				50	0	E	FP	MO	
31.07.10	AK		48	20	4	144	55	74	19	14	00	8	01	L	NO			NF	1	NO	RE		11				400	355	E	FP	SE	
31.07.10	AK		48	20	59	144	56	8	19	14	02	8	01	L	NO			NF	2	SA	SW		2				200	60	E	FP	SE	
31.07.10	AK		48	21	12	144	21	15	19	14	04	8	01	L	NO			NF	1	SP	TH		11				200	0	E	BO	MO	
31.07.10	AK		48	21	23	144	56	44	19	14	05	8	01	L	NO			NF	4	SA	SW		2	3			150	60	E	HE	SE	

31.07.10	AK		48	21	39	144	56	55	19	14	06	8	01	L	NO			NF	1	SA	SW		2	3			200	60	E	BO	SE	
31.07.10	AK		48	21	76	144	56	77	19	14	08	8	01	L	NO			NF	1	SP	SW		10	8			250	350	E	BO	SE	
31.07.10	AK		48	22	59	144	57	27	19	14	13	8	01	L	NO			NF	2	NO	RE		2				200	60	E	FP		
31.07.10	AK		48	22	82	144	57	39	19	14	14	8	01	L	NO			NF	1	SP	SW		2	4			150	60	E	BO	SE	
31.07.10	AK		48	23	15	144	57	57	19	14	16	8	01	L	NO			NF	1	NO	RE		10				300	330	E	FP		
31.07.10	AK		48	23	36	144	57	71	21	14	17	8	01	L	NO			NF	3	NO	RE		2				200	60	E	BO		
31.07.10	AK		48	23	72	144	57	92	20	14	19	8	01	L	NO			NF	1	SP	SW		2	4			150	70	E	BO	SE	
31.07.10	AK		48	23	93	144	58	5	20	14	20	8	01	L	NO			NF	1	NO	RE		10				200	350	E	FP		
31.07.10	AK		48	24	26	144	58	24	22	14	22	8	01	L	NO			NF	1	SP	SW		2	4			300	60	E	BO	SE	
31.07.10	AK		48	24	48	144	58	39	21	14	23	8	01	L	NO			NF	1	SP	SW		10	8			150	350	E	HE	SE	
31.07.10	AK		48	24	89	144	58	62	22	14	25	8	01	L	NO			NF	1	ST	SW		10	4			300	350	E	HE	SE	
31.07.10	AK		48	25	45	144	58	96	21	14	29	8	01	L	NO			NF	1	SP	SW		2	4			150	40	E	HE	SE	
31.07.10	AK		48	25	75	144	59	15	21	14	30	8	01	L	NO			NF	1	NO	RE		10				150	350	E	HE		
31.07.10	AK		48	26	56	144	59	64	22	14	35	8	01	L	NO			NF	2	SP	SW		1	4			200	40	E	BO	SE	
31.07.10	AK		48	26	76	144	59	76	23	14	36	8	01	L	NO			NF	1	SA	SW		1	2			150	40	E	HE	SE	
31.07.10	AK		48	27	27	145	0	1	20	14	39	8	01	L	NO			NF	2	SP	SW		2	4			200	40	E	BO	SE	
31.07.10	AK		48	27	51	145	0	21	20	14	40	8	01	L	NO			NF	1	SP	SW		2	4			100	40	E	HE	SE	
31.07.10	AK		48	28	12	145	0	56	20	14	44	8	01	L	NO			NF	1	SP	SW		1	4			100	40	E	HE	SE	
31.07.10	AK		48	28	49	145	0	76	20	14	46	8	01	L	NO			NF	3	NO	RE		10				200	350	E	FP		
31.07.10	AK		48	28	98	145	1	34	20	14	48	8	01	L	NO			NF	2	NO	RE		10				150	350	E	FP		
31.07.10	AK		48	29	52	145	1	35	20	14	51	8	01	L	NO			NF	2	NO	RE		1				100	30	E	FP		
31.07.10	AK		48	30	20	145	1	73	20	14	55	8	01	L	NO			NF	1	NO	RE		1				100	350	E	FP		
31.07.10	AK		48	31	0	145	2	19	20	15	00	8	01	L	NO			NF	2	SP	SW		1	3			150	30	E	HE	SE	
31.07.10	AK		48	31	66	145	2	56	20	15	03	8	01	L	NO			NF	1	NO	RE		10				250	330	E	FP		
31.07.10	AK		48	32	2	145	2	77	20	15	04	8	01	L	NO			NF	1	NO	RE		10				150	330	E	FP		
31.07.10	AK		48	32	49	145	3	4	20	15	08	8	01	L	NO			NF	1	NO	RE		2				200	40	E	FP		
31.07.10	AK		48	33	65	145	3	68	20	15	14	8	01	L	NO			NF	1	NO	RE		2				200	40	E	FP		
31.07.10	AK		48	37	47	145	4	8	357	15	34	8	01	L	LI	7/8		NF	1	SP	SW		10	8			200	300	E	HE	SE	
31.07.10	AK		48	38	85	145	3	88	355	15	42	8	01	L	LI	7/8		NF	1	NO	RE		2				300	80	E	FP		
31.07.10	AK		48	41	35	145	3	56	356	15	53	8	01	L	LI	7/8		NF	1	SP	SW		9				200	260	E	BO	SE	
31.07.10	AK		48	45	69	145	3	4	355	16	15	6	01	L	LI	9		NF	1	NO	RE		10				150	350	E	FP		
31.07.10	AK		48	46	15	145	2	98	355	16	18	6	01	L	LI	9		NF	1	NO	RE		1				150	15	E	FP		
31.07.10	AK		48	46	83	145	2	87	358	16	21	6	01	L	LI	9		NF	1	NO	RE		10				150	310	E	FP		
31.07.10	AK		48	47	89	145	2	71	352	16	27	6	01	L	LI	9		NF	1	NO	RE		10				200	310	E	FP		

31.07.10	EP		49	3	56	145	0	60	355	17	44	0.7	02	L	MO	9		DP	2	SA	SW		1	11			200	320	E	SP	VI	
01.08.10	AK		51	54	97	143	37	55	300	11	30	0.9	02	L	NO			MW	1	SA	FD		11	11			400	270	E	BO	MO	
02.08.10	EP		51	54	71	143	28	85	184	20	30	10	01	L	SE	3		MW	1	SP	SW		8	10			500	170	E	BO	VI	
03.08.10	AK	EP	51	52	82	143	49	99	0	07	51	10	01	L	MO	3		HP	1	SA	FD		11	10			400	330	E	FI	VI	
03.08.10	AK	OS	51	53	48	143	38	8	270	08	52	10	01	L	NO			DP	1	SA	TH		2	3			500	340	B	FI	MO	
03.08.10	EP	OS	51	53	49	143	30	89	268	09	05	10	01	L	SE	6		UB	1		FD	FE	11				600	225	E	BL	SE	Slowed down, do not quite understand the direction of the whale
03.08.10	EP	OS	51	53	72	143	22	98	1	09	16	10	01	L	SE	3		MW	1	SP	FD		3	2			500	100	E	FI	VI	
03.08.10	EP	AK	51	57	0	143	45	35	90	10	30	10	01	L	MO	1/2		MW	1	SP	FD		11	10			500	70	E	BO	SE	
03.08.10	EP	AK	51	56	99	143	46	59	92	10	33	10	01	L	MO	2		HP	1	SA	FD		4	11			1000	40	E	FI	MO	
03.08.10	EP	AK	51	57	0	143	48	86	91	10	42	10	01	L	MO	2		HP	2	SP	FD		1	4			300	120	E	FI	SE	
03.08.10	EP	AK	51	58	71	143	48	99	359	11	00	10	01	L	MO	4/5		DP	1	SP	FD		1	1			300	25	E	SP	SE	
03.08.10	EP	AK	52	0	0	143	50	2		11	13	10	01	L	MO	3		GW	1	SA	FD	FD	10	10	1.5	H	1000	300	B	BL	SE	
03.08.10	EP	AK	52	0	49	143	49	45		11	20	10	01	L	LI	7		GW	1	SP	FD	FD	1	1	1	H	1500	290	E	BL	SE	Slowed down, do not quite understand the direction of the whale
03.08.10	EP	AK	52	0	49	143	47	68	266	11	27	10	01	L	LI	7		GW	1	SP	FD	FD	4	4	0.5	H	2500	30	B	BO	SE	
03.08.10	OS	AK	52	4	0	143	39	48	90	13	30	10	01	L	LI	2/4		DP	2	SP	FD		2	2			300	120	E	SP	VI	
03.08.10	OS	EP	52	7	50	143	46	14	268	14	46	10	01	L	NO			DP	2	SA	FD		2	2			400	120	E	SP	VI	
03.08.10	EP	AK	52	7	50	143	40	11	267	15	06	10	01	L	NO			HP	2	SA	FD		2	10			400	235	E	FI	VI	
03.08.10	EP	AK	52	7	48	143	37	32	270	15	14	10	01	L	NO			HP	1	SA	FD		11	1			300	330	E	FI	VI	
03.08.10	EP	AK	52	11	0	143	36	35	89	16	25	10	01	L	NO			HP	3	SA	FD		1	11			300	330	E	FI	SE	
03.08.10	EP	AK	52	11	1	143	38	9	92	16	30	10	01	L	NO			HP	1	SA	FD		1	11			700	110	E	FI	SE	
03.08.10	AK	OS	52	11	0	143	46	46	85	16	58	10	01	L	NO			BS	1	SA	SW		10				50	40	E	HE	SE	
03.08.10	AK	OS	52	11	1	143	47	50	92	17	00	10	01	L	NO			HP	2	SP	SW		1	5			250	180	E	BO	SE	
03.08.10	EP	OS	52	11	69	143	49	98	3	17	20	10	01	L	NO			HP	1	SA	FD		11	9			450	330	E	FI	MO	
03.08.10	EP	OS	52	14	50	143	46	26	270	17	55	10	01	L	NO			HP	1	SP	FD		11	11			250	230	E	FI	MO	
03.08.10	EP	OS	52	14	50	143	38	96	270	18	19	10	01	L	NO			HP	1	SA	FD		11	2			700	250	E	FI	VI	
04.08.10	AK		52	51	37	143	26	33	262	12	30	10	00	L	LI	9/8		GW	1	UN	FE				0.2	SH	4000	250	B	BL		
04.08.10	AK		52	51	37	143	25	52	279	12	37	10	00	L	LI	9/8		GW	1	UN	FE				0.3	SH	3500	300	B	BL		
04.08.10	AK		52	51	37	143	25	52	265	12	44	10	00	L	LI	9/8		GW	1	UN	FE						3000	340	E	BL		
04.08.10	AK	EP	52	51	25	143	23	75	255	12	49	10	00	L	LI	8/9		GW	4	UN	FE						3000	238	E	BL		

04.08.10	AK	EP	52	51	20	143	23	16	312	12	56	10	00	L	LI	12/1		GW	1	UN	FE						3000	210	E	BL		
04.08.10	AK	EP	52	51	22	143	23	12	281	13	00	10	00	L	LI	1/2		GW	2	UN	FE				0.2	SH	4000	170	B	BL		
04.08.10	AK	EP	52	51	22	143	22	96	356	13	16	10	00	L	LI	5/6		GW	1	UN	FE						3000	325	E	BL		
04.08.10	AK	EP	52	50	99	143	22	89	181	13	30	10	01	L	LI	7/9		GW	1	UN	FE						3500	210	E	BL		
04.08.10	AK	EP	52	50	98	143	22	89	161	13	33	10	01	L	LI	9/10		GW	1	ST	FE						1500	270	E	BL		
04.08.10	AK	EP	52	50	96	143	22	91	142	13	38	10	01	L	LI	9/10		GW	1	ST	FE						1500	280	E	BL		
04.08.10	AK	EP	52	50	91	143	22	84	198	13	40	10	01	L	LI	12/1		GW	1	UN	FE						1000	200	E	BL		
04.08.10	AK	EP	52	50	48	143	23	17	290	14	43	10	02	L	LI	8/10		MW	1	SA	FD		11	11			600	290	E	BO	MO	
04.08.10	AK	EP	52	50	36	143	23	41	357	15	30	10	02	L	LI	7/8		GW	1	UN	FE				0.5	H	2500	345	B	BL		
04.08.10	AK	EP	52	50	90	143	23	42	359	15	39	10	02	L	LI	7/8		GW	1	UN	FE				0.2	H	4000	30	B	BL		
04.08.10	AK	OS	52	51	25	143	23	2	347	16	04	10	01	L	LI	10		GW	1	UN							1500	20	E	BL		
04.08.10	AK	OS	52	51	44	143	22	95	347	16	06	10	01	L	LI	10		GW	1	UN					0.1	H	4000	10	B	BL		
04.08.10		OS	52	53	71	143	23	60	11	17	30	10	01	L	NO			GW	2	UN			2		0.5	H	2500	30	B	BL		
04.08.10		OS	52	53	91	143	23	90	158	17	51	10	01	L	NO			GW	2	UN			11				1000	60	E	BL		
04.08.10		OS	52	53	32	143	23	89	284	18	05	10	01	L	NO			GW	1	UN			0				1000		E	BL		
04.08.10		OS	52	53	45	143	23	195	285	18	09	10	01	L	NO			GW	3	UN			11				2500	270	E	BL		
04.08.10		OS	52	54	44	143	21	69	30	18	53	10	01	L	NO			GW	1	UN			0		0.2	H	3000	10	B	BL		
04.08.10		EP	52	59	89	143	21	42	154	20	00	10	01	L	NO			GW	2	NO	FE		10				3000	30	B	BL		
04.08.10		EP	52	59	89	143	21	42	154	20	00	10	01	L	NO			GW	4	NO	FE		11				4000	330	B	BL		
05.08.10	AK	EP	52	56	53	143	28	12	270	09	41	8	02	L	NO		1	GW	2	UN					0.2	Sh	4000	240	B	BL		
05.08.10	AK	EP	52	56	51	143	23	64	270	09	56	8	02	L	NO		2	GW	1	UN							2000	240	E	BL		
05.08.10	AK	EP	52	56	51	143	22	39	271	10	00	8	02	L	NO		2	GW	1	UN					1	Sh	1500	200	B	BL		
05.08.10	AK	EP	52	56	33	143	22	5	172	10	10	8	02	L	NO		3	GW	1	UN							1500	215	E	BL		Possibly the whale with the number from previous transect
05.08.10	AK	EP	52	55	13	143	22	31	174	10	17	8	02	L	NO		4	GW	2	UN					0.2	H	####	85	B	BL		
05.08.10	AK	EP	52	54	4	143	22	47	174	10	23	8	02	L	NO		5	GW	2	UN	FD				0.3	Sh	3000	260	B	BL	SE	
05.08.10	AK	EP	52	53	91	143	22	49	174	10	24	8	02	L	NO		6	GW	1	UN					0.2	H	4000	90	B	BL		
05.08.10	AK	EP	52	53	32	143	22	60	174	10	27	8	01	L	NO		7	GW	1	UN					0.3	Sh	3500	195	B	BL		
05.08.10	AK	OS	52	53	4	143	23	0	98	10	37	8	01	L	NO		8	GW	2	UN							3000	65	B	BL		
05.08.10	AK	EP	52	51	52	143	45	8	183	12	05	10	01	L	NO		9	KW	2	SA	FD	FD	1	11			500	135	E	FI	SE	
05.08.10	OS	EP	52	49	52	143	25	84	269	13	23	15	01	L	NO		10	GW	3	UN	FE		1				2000	290	E	BL	SE	
06.08.10	EP		53	25	50	143	12	51	296	08	00	6	02	L	NO			GW	1	NO	BR		11				700	270	E	BO		

06.08.10	EP		53	24	28	143	12	93	191	09	15	3	02	L	NO			GW	1	SA	FD		2	10			600	130	E	BL	MO	Turned to the right from the whale
06.08.10	EP		53	21	15	143	15	2	157	09	34	1	02	L	NO			MW	1	SA	FD		3	9			500	85	E	BO	VI	
06.08.10	EP		52	58	44	143	22	45	168	17	16	3	03	L	NO			GW	1	UN			9				600	350	E	BL		
06.08.10	EP		52	54	48	143	24	59	138	18	27	8	02	L	NO			GW	1	SP	FD		2	4			2000	160	E	BL	SE	
06.08.10	AK		52	59	52	143	22	48	356	19	49	8	02	L	NO			GW	3	UN			10		0.2	Sh	4000	310	B	BL		
06.08.10	AK		53	0	12	143	22	39	356	19	53	8	02	L	NO			GW	1	UN			11		0.1	H	5000	350	B	BL		
06.08.10	OS		53	0	90	143	22	32	0	20	00	8	02	L	NO			GW	1	UN			10				2000	320	E	BL		
06.08.10	OS		53	3	55	143	22	4	198	20	20	8	02	L	NO			GW	1	UN			3		0.1	H	5000	30	B	BL		
07.08.10	EP		53	3	48	143	22	12	329	06	00	8	02	L	NO			GW	3	UN	FD	FE	11				3000	265	B	BL		
07.08.10	EP		53	3	49	143	22	12	339	06	08	10	02	L	NO			GW	1	UN	FD	FE	10				3500	345	B	BL		
07.08.10	EP		53	3	50	143	22	10	32	06	39	10	01	L	NO			GW	2	UN			2				5000	335	B	BL		
07.08.10	EP		53	3	51	143	22	8	19	07	00	10	01	L	NO			GW	1	UN			11				5000	180	B	BL		
07.08.10	OS	AK	53	3	99	143	18	69	12	09	43	10	01	L	MO	9/10		GW	5	UN	FD	FE	11		0.4	H	2000	150	B	BL		
07.08.10	OS	AK	53	3	99	143	18	69	12	09	43	10	01	L	MO	8		GW	2	UN	FD	FE	8		0.5	H	2500	120	B	BL		
07.08.10	OS		53	5	51	143	18	5	84	10	54	10	01	L	MO	2/3		GW	2	UN	FD		11				2000	30	E	BL		
07.08.10	OS		53	6	32	143	21	72	34	11	22	10	01	L	MO	3		GW	2	UN			10		0.1	H	6000	350	B	BL		
07.08.10	OS		53	8	8	143	21	97	332	11	43	10	01	L	MO	5		GW	2	UN			2		0.1	H	6000	0	B	BL		
07.08.10	AK		53	8	48	143	20	6	274	12	00	10	03	L	MO	7/8		GW	1	SA	FD	FD	9	8			2500	275	E	BL		
07.08.10	AK		53	10	19	143	17	83	109	13	28	10	03	L	MO	2/3		GW	3	SA	FD	FE	1	11	0.4	H	3000	80	B	BL	SE	Two whales go together, one slightly to the side, the whales are moving north.
07.08.10	OS		53	3	42	143	29	7	80	18	38	10	01	L	MO	6		MW	1	SA	FD		1	2			1000	100	E	BO	VI	
07.08.10	AK		53	0	99	143	31	57	240	19	47	10	01	L	SE	2		GW	2	UN			1		0.1	Sh	6000	220	B	BL		
07.08.10	AK		53	0	34	143	30	44	240	19	53	10	01	L	SE	2		GW	1	UN			12		0.1	Sh	6000	220	B	BL		
07.08.10	AK		52	55	16	143	23	59	227	20	35	10	01	L	NO			GW	1	UN			1		0.1	H	6000	230	B	BL		
07.08.10	AK		52	53	29	143	22	86	228	20	44	10	01	L	NO			GW	1	UN			2		0.2	H	4500	210	B	BL		
07.08.10	AK		52	53	0	143	20	1	17	21	05	10	01	L	SE	9		GW	1	SP	FD	FE	11	1	1	H	1500	18	E	BL	SE	
08.08.10	OS		52	52	80	143	23	69	6	06	17	10	00	L	MO	3		GW	2	UN	FD			2	0.1	H	6000	340	B	BL		
08.08.10	OS		52	52	82	143	23	69	147	06	48	10	00	L	MO	7		GW	3	UN	FD			1	0.2	H	4500	210	B	BL		
08.08.10	OS		52	52	82	143	23	69	192	06	56	10	00	L	MO	7		HP	5	SP	FD	FD	1	11	0.4	Sh	3000	220	B	BO		
08.08.10	OS		52	52	86	143	23	68	192	07	30	10	00	L	SE	9		GW	2	UN	FD			3			2500	230	E	BL		
08.08.10	OS		52	52	86	143	23	68	192	07	36	10	00	L	SE	9		SS	1	ST	SW			9	9		1000	60	E	BO		

08.08.10	AK	EP	52	52	43	143	21	67	124	09	07	10	00	L	SE	10		GW	1	UN			1		0.1	H	6000	30	B	BL		
08.08.10	AK	EP	52	52	57	143	21	69	22	09	16	10	00	L	SE	2		GW	1	UN			1		0.2	H	4500	40	B	BL		
08.08.10	AK	OS	52	51	30	143	23	38	181	10	46	10	00	L	MO	10		GW	3	UN			11		0.1	H	6000	150	B	BL		
08.08.10	EP		52	51	6	143	24	90	210	12	35	11	00	L	NO			GW	1	UN			11				2000	195	E	BL		
08.08.10	OS	EP	52	48	59	143	22	66	174	14	30	10	00	L	LI	1		GW	1	UN			3				2000	270	E	BL		
08.08.10	OS		52	46	275	143	22	74	18	16	30	10	00	L	NO			MW	1	SA	FD		8				500	240	E	FI	VI	
08.08.10	AK		52	46	49	143	22	7	175	18	42	10	00	L	SE	3		GW	1	UN					0.1	H	6000	125	B	BL		
08.08.10	AK		52	44	83	143	22	33	170	18	56	10	00	L	SE	3		GW	1	UN					0.1	H	6000	190	B	BL		
08.08.10	AK		52	41	85	143	22	69	174	19	30	10	00	L	LI	3		HP	1	SA	FD	FD			0.3	H	3500	190	B	BO	SE	
08.08.10	EP		52	40	34	143	23	17	146	20	17	10	00	L	SE	6		HP	2	SP	FD						400	175	E	BO	VI	
09.08.10	AK		52	49	40	143	27	47	295	05	47	10	00	L	NO			GW	2	ST	FD	FE	6	5	1	H	1500	95	E	BL	SE	
09.08.10	AK		52	49	40	143	27	49	246	06	00	10	00	L	LI	6		GW	2	ST	FD	FE	6	5	1	H	1500	100	E	BO	SE	
09.08.10	AK		52	49	43	143	27	47	195	07	00	10	00	L	MO	7		GW	1	UN	NO				0.1	Sh	6000	355	B	BL		
09.08.10	AK		52	49	43	143	27	47	177	07	30	10	00	L	SE	9		HP	1	SP	FD	FD	5	2	0.4	Sh	3000	30	B	FI	SE	
09.08.10	AK		52	49	48	143	27	45	179	07	51	10	00	L	MO	9		HP	1	SP	FD	FD	2	4	0.8	Sh	1900	265	B	FI	SE	
09.08.10	AK		52	49	49	143	27	45	179	08	00	10	00	L	MO	9		GW	2	SP	FD	FD	9	10	0.5	H	2500	105	E	BL	SE	
09.08.10	OS		52	49	14	143	30	12	226	11	10	10	00	L	LI	9		MW	1	SA	FD		10	11			500	130	E	FL	VI	
09.08.10	AK		52	50	11	143	30	79	267	12	00	10	00	L	LI	8		GW	1	ST	FD	FD	1	11	0.5	Sh	2500	350	E	BL	SE	
09.08.10	OS		52	50	50	143	24	97	60	13	21	10	00	L	LI	9		GW	3	UN	TH		3				2000	90	E	BL		
09.08.10	OS		52	50	68	143	25	25	46	13	24	10	00	L	LI	9		GW	2	UN	TH		1				2500	60	E	BL		
09.08.10	AK		52	51	48	143	27	61	24	14	39	10	00	L	NO			GW	1	UN	NO		7		0.3	Sh	3500	350	B	BL		
09.08.10	AK		52	51	41	143	27	45	324	15	00	10	00	L	NO			SL	1	SP	SW	SW	4	2			250	60	E	BO	SE	
09.08.10	AK		52	51	58	143	28	70	241	15	35	10	00	L	LI	12		GW	2	UN	NO		2		0.4	Sh	3000	340	E	BL		
09.08.10	AK		52	51	51	143	26	58	191	15	38	10	00	L	LI	1/2		GW	1	UN	NO		1		0.1	Sh	6000	350	B	BL		
09.08.10	AK		52	51	51	143	25	96	323	15	45	10	00	L	LI	10		GW	1	UN	NO		1		0.1	Sh	6000	310	B	BL		
10.08.10	EP		52	47	51	143	25	11	139	06	30	10	01	L	MO	9/10		GW	1	UN			10		0.2	H	4500	75	B	BL		
10.08.10	EP		52	47	51	143	25	11	143	06	40	10	01	L	SE	9/10		GW	3	UN	FD		5				3500	290	B	BL		
10.08.10	EP		52	47	52	143	25	11	146	07	30	10	01	L	MO	10		GW	2	UN			1		0.2	Sh	4500	220	B	BL		
10.08.10	AK		52	57	83	143	23	37	74	11	48	0.1	01	L	NO			DP	2	SP	FD	FD	4	2			100	95	E	SP	VI	
11.08.10	AK		53	19	92	143	15	88	172	08	41	5	02	L	NO			GW	1	SP	FD	FD	10	8			800	70	E	BL	SE	
11.08.10	AK		53	19	57	143	16	38	144	08	54	5	02	L	NO			GW	1	SP	FD	FD	5	3			1500	230	E	BL	SE	
11.08.10	AK		53	18	9	143	18	7	34	10	16	8	02	L	NO			GW	1	UN	NO		3		0.5	H	2500	160	E	BL		
11.08.10	EP		53	21	80	143	14	46	343	11	16	5	02	L	NO			GW	2	UN			2		1	Sh	1500	30	E	BL		
11.08.10	EP		53	22	15	143	14	29	343	11	18	5	02	L	NO			GW	2	UN			2				2000	30	B	BL		

11.08.10	EP		53	26	33	143	11	73	337	11	40	5	02	L	NO			GW	1	UN			12				1500	110	E	BL		
12.08.10	AK		53	34	71	143	5	66	146	06	30	8	03	L	NO			GW	1	SP	FD	FD	11	7	1	H	1500	85	E	BL	SE	
12.08.10	AK		53	34	71	143	5	67	158	07	37	8	03	L	NO			SS	1	ST	SW	LO	3	4	6		200	245	E	HE	SE	
12.08.10	EP		53	31	0	143	9	19	153	09	08	10	03	L	NO			GW	3	UN	FL		1				3500	170	B	BL		
12.08.10	EP		53	29	73	143	10	44	148	09	43	10	03	L	NO			GW	2	UN	FL		2				1000	190	E	BL		
12.08.10	AK		53	28	71	143	10	45	65	15	00	10	03	L	NO			HP	2	SP	FD	FD	2	4			300	165	E	FI	SE	
12.08.10	OS		53	28	61	143	10	53	12	20	38	10	03	L	NO			GW	2	UN	FE			3			1000	110	E	BL		
12.08.10	OS		53	28	61	143	10	53	17	20	43	10	03	L	NO			KW	4	SA	FD			11	3		100	350	E	FI	MO	
14.08.10	OS		51	54	80	143	33	22	79	16	55	10	02	L	MO	4		KW	5	SA	FD	FD	11	2			500	60	E	FI	VI	
15.08.10	AK		52	20	33	143	27	86	357	14	04	8	03	L	NO			HP	1	SA	FD		11				500	330	E	FI	SE	
15.08.10	AK		52	33	43	143	29	89	0	15	34	5	04	L	NO			RS	1	SP	SW	SW	1	5			100	15	E	BO	SE	
15.08.10	AK		52	49	15	143	25	46	350	16	55	5	04	L	NO			GW	2	UN	NO		1		0.5	H	2500	30	B	BL		
17.08.10	OS		53	1	61	143	32	31	167	16	46	10	03	L	LI	3		MW	1	SP	FD	FD	1	3			800	200	E	FI	VI	
17.08.10	AK		52	56	62	143	34	3	179	17	12	10	03	L	LI	3		KW	1	SP	FD	FD	1	5	1	H	1600	215	E	FI	SE	
17.08.10	AK		52	38	11	143	37	58	208	18	46	10	01	L	NO			GW	1	UN	NO		11		0.4	H	3000	175	B	BL		
17.08.10	EP		52	25	94	143	29	25	206	19	48	8	01	L	NO			RS	1	ST	SW	LO	10	8			200	180	E	HE		
17.08.10	EP		52	23	36	143	27	43	203	20	02	8	01	L	NO			DP	1	SA	SW		11		2.5	H	800	170	B	BO		
18.08.10	EP	AK	52	1	50	143	13	3	352	08	50	10	00	L	NO			HP	2	SP	FD	FD	11	8	0.7	SH	800	320	E	FI	SE	Dedicated survey started at Piltun area
18.08.10	EP	AK	52	5	19	143	12	45	355	09	12	10	00	L	MO	3		SS	1	SA	SW	SW	1	11	2.5	H	750	320	E	BO	SE	
18.08.10	EP	AK	52	5	19	143	12	45	355	09	12	10	00	L	MO	3		HP	2	SA	FD	FD	11	1	3	H	650	15	B	SP	MO	
18.08.10	EP	AK	52	5	83	143	12	35	355	09	16	10	00	L	MO	3		SS	1	SA	SW	SW	1	11	4	SH	400	320	B	BO	SE	
18.08.10	EP	AK	52	7	10	143	12	15	355	09	23	10	00	L	LI	3		SS	1	NO	LO	SI	11	11	4	H	500	355	B	HE		
18.08.10	EP	OS	52	8	6	143	11	97	9	09	30	10	00	L	LI	3		HP	1	SA	FD	FD	12	1			500	0	E	FI	SE	
18.08.10	EP	OS	52	9	72	143	12	24	4	09	39	10	00	L	LI	3		US	1	SA	SW		11				700	320	E	BO	MO	
18.08.10	EP	OS	52	18	28	143	14	64	25	10	30	10	01	L	MO	2/3		US	1	SA	SW		11				500	0	E	BO	MO	
18.08.10	OS	AK	52	23	3	143	18	36	21	11	00	10	01	L	LI	2/3		DP	2	SA	FD	FD	4	1			300	60	E	SP	VI	
18.08.10	OS	AK	52	24	69	143	19	33	9	11	11	10	01	L	LI	4		HP	1	SA	FD		11	10			500	330	E	FI	SE	
18.08.10	OS	AK	52	26	13	143	19	91	19	11	20	10	00	L	NO			US	1	ST	SW	SW	1	11	4	H	500	60	B	BO	SE	
18.08.10	OS	AK	52	34	99	143	21	33	348	12	13	10	01	L	LI	4		HP	2	SP	FD	FD	5	1	3	H	600	100	B	FI	MO	
18.08.10	OS	AK	52	35	54	143	21	20	0	12	16	10	01	L	LI	4		RS	1	NO	LO	SI	2				200	40	E	HE		
18.08.10	OS	AK	52	36	30	143	21	43	13	12	20	10	01	L	NO			RS	1	NO	LO	SI	2		3.5	H	500	80	B	HE		
18.08.10	OS	AK	52	37	80	143	22	3	13	12	30	10	01	L	NO			HP	2	SA	FD	FD	2	2			300	70	E	FI	SE	
18.08.10	AK	EP	52	42	49	143	22	54	0	13	00	10	01	L	NO			US	1	NO	LO	LO	10				250	350	B	HE		

18.08.10	AK	EP	52	46	51	143	22	83	2	13	22	10	01	L	NO			HP	1	SA	FD	FD	2	10	1	SH	2500	335	B	FI	MO	
18.08.10	AK	EP	52	47	92	143	22	86	1	13	30	10	01	L	NO			GW	1	SP	FD	FD	8	10	1	SH	1500	335	B	BL	SE	
18.08.10	AK	EP	52	47	92	143	22	86	1	13	30	10	01	L	NO			GW	2	ST	FD	FD	9	3			1000	280	E	BO	SE	
18.08.10	AK	EP	52	59	69	143	22	97	354	13	48	10	01	L	NO			HP	1	SA	FD	FD	4	10			500	330	E	FI	SE	
18.08.10	AK	EP	52	51	37	143	22	88	352	13	52	10	01	L	NO			GW	1	SP	FD	FD	8	10	0.5	SH	2000	320	B	BO	SE	
18.08.10	EP	OS	52	52	12	143	22	75	354	13	56	10	01	L	NO			GW	1	NO	FD						2000	310	E	BL	SE	
18.08.10	EP	OS	52	53	46	143	22	49	352	14	05	10	01	L	NO			HP	2	SP	FD		1	3	3	H	600	30	B	FI	SE	
18.08.10	EP	OS	52	53	46	143	22	49	352	14	05	10	01	L	NO			GW	1	UN	FE		10		0.5	SH	1800	300	B	BL	SE	
18.08.10	EP	OS	52	56	30	143	21	97	353	14	21	10	01	L	MO	3		GW	1	UN	FE		10		0.3	SH	1800	290	B	BL	SE	
18.08.10	EP	OS	52	57	45	143	21	78	354	14	30	10	01	L	MO	3		GW	1	UN	FE		2				1000	30	E	BL	SE	
18.08.10	EP	OS	52	58	1	143	21	68	352	14	32	10	01	L	MO	7		GW	2	UN	FE		10				1000	330	E	BL	SE	Worked shore-based photo-ID group, turned away from the course by 10 degrees to avoid interference.
18.08.10	EP	OS	52	59	27	143	21	80	352	14	39	10	01	L	MO	7		GW	2	UN	FE		10		0.3	SH	2000	230	B	BL	SE	
18.08.10	EP	OS	53	2	0	143	21	11	352	14	56	10	01	L	MO	7		SS	1	ST	SW	SI	2	3			200	20	E	HE	SE	
18.08.10	EP	OS	53	2	47	143	21	6	353	15	00	10	01	L	MO	7		GW	2	UN	FD		9				1800	270	E	BL		
18.08.10	OS	AK	53	10	17	143	19	1	359	15	50	10	01	L	MO	7		MW	1	ST	FD	FD	11	10	0.5	SH	1500	350	B	FI	SE	
18.08.10	OS	AK	53	17	87	143	16	21	346	16	35	10	01	L	MO	8		SS	1	SA	SW	LO	1	11			300	300	E	HE	SE	
18.08.10	OS	AK	53	18	73	143	15	84	346	16	42	10	01	L	MO	9		GW	1	UN	NO		3		0.2	H	4000	80	E	BL		
18.08.10	AK	EP	53	28	87	143	10	39	342	17	45	10	01	L	MO	9		GW	2	SP	FD	FD	4	2	1	H	1500	15	E	BL	SE	
18.08.10	AK	EP	53	31	30	143	8	83	337	18	00	10	01	L	SE	9		GW	1	UN	NO		11		0.2	H	4500	315	B	BL		
18.08.10	AK	EP	53	32	7	143	8	34	341	18	05	10	01	L	SE	9		GW	1	SA	FD	FD	11	10	0.5	H	2500	325	B	BL		Whales near the vessel "Iskatel' ("Searcher") with three lines of seismic equipment behind it.
18.08.10	AK	EP	53	34	0	143	7	15	341	18	18	10	01	L	SE	9		GW	2	UN	NO		1		0.5	H	2500	350	B	BL		
18.08.10	AK	EP	53	34	92	143	6	63	342	18	25	10	01	L	SE	10		GW	10	UN	NO		2		0.5	H	2500	30	B	BL		
19.08.10	EP	OS	52	0	45	143	34	31	273	12	16	10	01	L	LI	9		MW	1	SA	FD		11	10			2500	230	E	FI	MO	
19.08.10	AK	OS	52	4	1	143	46	89	90	13	57	10	02	L	MO	3		GW	2	UN	NO		10		0.3	H	3500	45	B	BL		
19.08.10	AK	OS	52	6	80	143	50	3	1	14	26	10	02	L	MO	8		GW	1	UN	NO		1		0.5	H	2500	20	B	BL		

19.08.10	AK	OS	52	7	64	143	50	14	70	14	30	10	02	L	MO	8		GW	2	UN	NO		11		0.1	H	6000	300	B	BL		
19.08.10	EP	OS	52	11	3	143	42	51	90	16	47	10	03	L	MO	4/5		GW	1	UN	NO		11		0.1	H	6000	70	B	BL		This whale was possibly counted at 14:30
19.08.10	EP	OS	52	10	80	143	50	9	331	17	17	10	03	L	MO	9		MW	1	SP	FD		2	3			500	0	E	FI	MO	
19.08.10	EP	OS	52	13	0	143	49	95	358	17	30	10	02	L	MO	9		GW	1	UN	NO		2		0.1	H	6000	60	B	BL		
20.08.10	OS		52	18	1	143	45	95	90	07	15	10	01	L	LI	11		MW	1	SP	FD	FD	11	10			500	330	E	BO	SE	
20.08.10	OS	EP	52	21	20	143	55	35	280	11	10	10	01	L	NO			US	1	SP	SW	LO	2	4			200	305	E	HE	MO	
20.08.10	OS	AK	52	32	63	143	30	7	349	16	40	10	01	L	NO			GW	1	UN	NO		1		0.4	H	3000	10	B	BL		
20.08.10	OS	AK	52	33	5	143	30	4	0	16	42	10	01	L	NO			GW	2	UN	NO		11		0.7	H	2000	339	E	BL		
20.08.10	OS	AK	52	33	88	143	29	99	0	16	45	10	01	L	NO			GW	5	UN	NO		0		0.5	H	2600	5	E	BL		16:52 begun to turn to the next transect, a group of feeding whales near the turning point.
22.08.10	EP		52	47	23	143	25	14	276	07	00	99	02	L	NO			GW	5	UN	NO	FD		1	0.1	SH	3500	325	B	Bl		
22.08.10	AK		52	56	69	143	23	37	329	13	23	10	03	L	LI	7/6		GW	3	UN	NO		10		0.1	SH	3500	300	B	BL		
22.08.10	AK		52	57	61	143	21	32	292	13	30	10	03	L	LI	9/8		GW	1	UN	NO		2		0.3	SH	1500	0	B	BL		
22.08.10	AK		52	57	86	143	20	25	128	13	47	10	02	L	LI	1/3		GW	2	UN	NO		8		0.5	H	2500	5	B	BL		
22.08.10	EP		53	0	66	143	20	75	322	15	45	10	03	L	LI	9		GW	1	UN	NO		12		0.1	SH	2500	320	B	BL		
22.08.10	OS		53	1	26	143	19	94	321	15	51	10	03	L	LI	9		GW	2	UN	NO		10				1000	270	E	BL		
22.08.10	OS		52	56	36	143	24	88	171	19	11	10	01	L	MO	3		GW	1	SP	FD	FD	11		0.4	H	3000	140	B	BL	MO	
22.08.10	OS		52	50	52	143	26	15	182	19	45	10	01	L	MO	3		HP	1	SA	SW		2				1000	240	E	FL	MO	
22.08.10	AK		52	47	41	143	25	20	2	20	30	10	01	L	LI	9		GW	1	UN	NO		10		0.2	SH	3500	300	B	BL		
22.08.10	AK		52	47	41	143	25	20	2	20	30	10	01	L	NO			GW	4	UN	NO		10		0.3	SH	2500	285	B	BL		
23.08.10	OS		52	47	41	143	25	22	323	06	24	10	01	L	NO			GW	1	UN	NO		11		0.3	SH	2000	300	B	BL		
23.08.10	OS		52	47	25	143	25	23	331	06	46	10	01	L	MO	3		GW	1	UN	NO		11		0.1	SH	2500	310	B	BL		
23.08.10	OS		52	47	41	143	25	23	323	07	00	10	01	L	MO	3/4		GW	1	UN	NO		1		0.3	SH	2000	330	B	BL		
23.08.10	OS		52	47	41	143	25	22	332	07	25	10	01	L	SE	3/4		GW	2	UN	NO		11		0.3	SH	2000	310	B	BL		
23.08.10	OS		52	47	41	143	25	23	326	07	30	10	01	L	SE	3/4		GW	2	UN	NO		1		0.1	SH	2500	350	B	BL		
23.08.10	AK		52	47	42	143	25	23	331	07	50	10	01	L	SE	4		GW	2	UN	NO		10		0.2	SH	2000	310	B	BL		
23.08.10	AK		52	47	42	143	25	26	297	08	00	10	01	L	SE	5		GW	1	SP	FD	FD	5	2	1	H	1500	90	E	BL	SE	
23.08.10	AK		52	50	42	143	23	35	286	10	13	10	01	L	SE	7		GW	2	UN	NO		11		0.4	H	3000	0	E	BL		
23.08.10	EP		52	55	22	143	22	21	200	11	30	10	02	L	LI	10		GW	2	UN	NO		10		0.5	SH	2500	255	B	BL		

23.08.10	OS		53	1	34	143	20	60	236	14	00	10	02	L	LI	9		GW	4	UN	NO		3		0.5	SH	2500	320	B	BL		
23.08.10	AK		52	48	18	143	29	76	80	17	45	10	02	L	MO	6		GW	1	UN	NO		3		0.7	H	2000	195	B	BL		
23.08.10	AK		52	48	41	143	35	37	95	18	17	10	02	L	SE	7		GW	1	UN	NO		3		1	H	1500	180	E	BL		
24.08.10	AK		52	48	19	143	27	35	290	06	24	10	01	L	NO			GW	2	ST	FD	FD	1	10	0.1	SH	5000	305	B	BO	SE	
24.08.10	EP		52	46	28	143	27	2	230	08	30	10	01	L	SE	8		GW	2	UN	NO		2				4000	280	B	BL		
24.08.10	OS		52	41	18	143	41	12	152	11	39	10	01	L	LI	11		HP	2	SA	FD	FD	11	2			700	140	E	FI	VI	
24.08.10	OS		52	33	8	143	47	17	153	12	30	10	01	L	LI	1		NF	3	SP	LO	SW	1	5	1	H	1600	170	B	HE	MO	
24.08.10	OS		52	28	47	143	50	84	154	13	00	10	01	L	LI	1/2		NF	1	UN	RE		11		0.4	H	3000	130	B	FP		
24.08.10	AK		52	21	85	143	42	93	140	15	47	10	01	L	LI	2		MW	1	SA	FD		11	10			800	120	E	BO	MO	
24.08.10	AK		52	20	50	143	45	32	210	16	57	10	02	L	NO			DP	2	SA	FD	FD	11	10			600	140	E	SP	VI	
25.08.10	EP		52	21	4	143	33	91	119	07	48	10	02	L	SE	11		GW	1	UN	NO		11				1000	85	E	BL		
25.08.10	OS		52	20	93	143	34	89	300	08	00	10	02	L	SE	3		GW	2	UN	FD	FD	11				1000	310	E	BL		
26.08.10	AK		51	51	69	143	27	46	83	07	44	10	02	L	MO	1		UB	1		UN		11				1500	70	E	BL		
26.08.10	EP		52	7	43	143	40	83	56	12	30	10	02	L	LI	3		NF	1	SP	RE		2	4			150	130	E	FP	SE	
26.08.10	EP		52	8	34	143	46	75	78	12	50	10	02	L	LI	3		GW	1	UN	NO		10				1500	30	E	BL		
26.08.10	OS		52	18	90	143	43	69	11	16	40	10	01	L	LI	5		NF	1	NO	RE		11	10			800	350	E	FP		
26.08.10	AK		52	19	3	143	43	90	316	18	27	10	00	L	MO	10		NF	1	NO	RE	RE	2	2			300	40	E	FP		Maybe it's the same fur seal that was registered previously.
26.08.10	AK		52	19	43	143	43	92	109	18	46	10	00	L	MO	6		MW	1	SA	FD	FD	3	3			500	180	E	FI	SE	
27.08.10	AK		52	47	59	143	25	21	327	06	14	10	01	L	NO			GW	1	UN	NO		11		0.3	SH	3500	300	B	BL		
27.08.10	AK		52	47	59	143	25	21	327	06	14	10	01	L	NO			GW	2	UN	NO		1		0.1	SH	6000	340	B	BL		
27.08.10	AK		52	47	59	143	25	21	327	06	14	10	01	L	NO			GW	2	UN	NO		1		0.2	SH	5000	345	B	BL		
27.08.10	AK		52	47	59	143	25	22	320	06	30	10	02	L	NO			GW	1	UN	NO		1		0.3	SH	3500	345	B	BL		
27.08.10	AK		52	47	59	143	25	24	311	07	22	10	02	L	SE	4		GW	2	UN	NO		12		0.3	SH	3000	310	B	BL		
27.08.10	AK		52	47	59	143	25	24	308	07	46	10	02	L	SE	5		GW	1	UN	NO		3		0.3	H	3500	60	E	BL		
27.08.10	EP		52	50	43	143	22	77	173	10	30	10	01	L	MO	11		SL	1	UN	SW		9				600	250	E	HE		
27.08.10	OS		52	52	43	143	22	48	295	13	00	10	01	L	MO	8		GW	1	SA	FD	FD	3	1			1000	20	E	BL	MO	
27.08.10	AK		52	55	23	143	23	87	2	13	56	10	01	L	MO	7/8		GW	2	UN	NO		10		0.1	SH	3600	300	B	BL		
27.08.10	AK		52	58	79	143	22	4	353	14	19	10	01	L	MO	7/8		GW	1	UN	NO		10		0.2	SH	3000	335	B	BL		
27.08.10	AK		53	1	8	143	22	15	0	14	30	10	01	L	MO	8		GW	1	UN	NO		11		0.1	SH	3600	320	B	BL		
27.08.10	AK		53	7	64	143	20	5	331	15	07	10	01	L	MO	8/9		GW	1	SP	FD	FD	10	8			1500	230	E	BL	SE	
27.08.10	EP		53	12	13	143	23	80	342	19	50	10	00	L	SE	9		GW	2	SP	FD	FD	8	9	0.4	H	2500	319	E	BL		
27.08.10	OS		53	15	91	143	20	51	325	20	12	6	00	L	LI	10/1		GW	2	UN	NO		10				1500	280	E	BL		

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27.08.10	OS		53	18	52	143	17	43	325	20	30	6	00	L	NO			GW	1	UN	NO		11				2000	320	E	BL		
28.08.10	EP		53	20	49	143	15	0	19	07	15	8	00	L	SE	2		KW	1	SP	SW		1	5			1500	45	B	FI	SE	
28.08.10	EP		53	20	49	143	15	0	19	07	15	8	00	L	SE	2		GW	2	NO	FD	FD	2				1500	40	B	BO		
28.08.10	OS		53	20	86	143	15	12	24	08	30	8	00	L	SE	3		HP	2	SA	TH	BR	1	2			1500	50	B	FI	MO	
28.08.10	AK		53	22	60	143	15	68	121	11	30	8	00	L	LI	1		HP	3	SA	TH	TH	12	11			1800	75	B	FI	MO	
28.08.10	AK		53	25	9	143	13	53	248	12	56	10	00	L	LI	9		GW	2	ST	FD	FD	4	6			1000	40	E	BL	SE	
28.08.10	AK		53	26	20	143	10	11	277	13	54	10	00	L	LI	9		HP	1	SP	FD	FD	2	4			400	30	E	FI	SE	
28.08.10	EP		53	29	59	143	7	89	316	15	00	10	00	L	LI	9		GW	8	UN	FD	FD	3		0.2	H	4500	40	B	BL		
28.08.10	OS		53	31	78	143	8	40	324	17	08	10	00	L	MO	9		SL	2	SA	LO	SW	1	3			500	0	E	HE	SE	
28.08.10	OS		53	35	21	143	5	87	6	17	30	8	00	L	MO	8		GW	4	UN	NO		1		0.2	H	4500	30	B	BL		
29.08.10	EP		53	14	60	143	31	34	146	11	20	8	01	L	NO			GW	2	UN	NO		2		0.4	H	3000	187	E	BL		
29.08.10	EP		53	13	98	143	22	3	141	11	25	10	01	L	NO			GW	1	UN	NO		10				700	110	E	BL		
29.08.10	OS		53	4	6	143	21	93	156	14	12	10	01	L	NO			GW	1	UN	FD	FD	2		0.3	H	3600	200	B	BL		
29.08.10	OS		52	53	12	143	20	85	249	15	24	10	01	L	NO			GW	2	UN	FD	FD	2				1000	300	E	BL		
29.08.10	AK		52	53	36	143	20	63	60	15	49	10	01	L	NO			GW	1	UN	NO		2		0.3	H	3500	100	B	BL		
29.08.10	AK		52	53	8	143	20	73	196	16	00	10	01	L	NO			GW	1	UN	NO		12		0.2	SH	2000	200	B	BL		
29.08.10	AK		52	57	6	143	22	60	208	18	00	10	01	L	NO			GW	1	UN	NO		1		0.1	SH	4000	215	B	BL		
29.08.10	AK		52	57	6	143	22	60	208	18	00	10	01	L	NO			GW	1	UN	NO		1		0.1	SH	4000	220	B	BL		
29.08.10	AK		52	57	43	143	22	75	238	18	23	10	01	L	NO			KW	1	SP	FD	FD	7	11			1500	130	E	FI	SE	
30.08.10	EP		52	55	48	143	22	11	129	09	00	3	03	L	NO			GW	1	UN	NO		3		0.3	SH	2000	215	E	BL		
30.08.10	EP		52	55	48	143	22	11	124	09	30	8	03	L	NO			GW	1	UN	NO		3		0.2	SH	2500	190	E	BL		
30.08.10	OS		52	53	55	143	23	84	117	11	30	8	03	L	NO			SL	1	SA	LO	SW	2	3			200	180	E	HE		
31.08.10	EP		52	59	28	143	21	34	350	07	37	10	03	L	NO			GW	1	UN	NO		10	99			1500	320	E	BL		
31.08.10	EP	OS	52	59	99	143	27	31	90	08	02	10	02	L	NO		1	KW	4	SA	FD	FD	3	2	0.8	H	2000	180	B	FI	MO	
31.08.10	AK		52	54	52	143	22	37	227	11	00	10	04	L	MO	9/10		GW	1	UN	NO		2	99	0.3	SH	2500	310	B	BL		
31.08.10	AK		52	54	44	143	22	34	317	19	52	8	04	L	NO			GW	1	UN	NO		11	99	0.4	SH	2500	290	B	BL		
31.08.10	AK		52	54	43	143	22	33	329	20	14	8	04	L	NO			GW	1	SA	FD	FD	1	11	1	SH	1000	330	B	BL	SE	
31.08.10	AK		52	54	43	143	22	33	329	20	14	8	04	L	NO			MW	1	SP	FD	FD	4	2			300	60	E	FI	MO	
01.09.10	OS		52	53	82	143	22	5	183	06	46	8	01	L	NO			GW	2	UN	NO		2	99			1000	210	E	BL		
01.09.10	OS		52	52	93	143	22	5	276	06	54	8	01	L	NO			GW	2	UN	NO		1	99			1500	290	E	BL		
01.09.10	OS		52	52	84	143	21	7	273	07	00	8	01	L	NO			MW	1	SA	FD	FD	1	2			700	290	E	FI	MO	
01.09.10	OS		52	52	92	143	20	57	304	07	02	8	01	L	NO			GW	2	UN	NO		9	99			800	220	E	BL		
01.09.10	OS		52	53	47	143	20	94	39	07	21	8	01	L	NO			HP	1	SA	SW	SW	2	3			900	100	E	FI	MO	

01.09.10	EP	OS	52	54	81	143	22	36	169	11	08	10	02	L	LI	1	1	GW	1	UN	NO		1	99			700	215	E	BL		
01.09.10	EP	OS	52	54	55	143	22	45	167	11	11	10	02	L	LI	1	2	GW	1	UN	NO		2	99			1000	220	E	BL		
01.09.10	EP	OS	52	54	55	143	22	45	167	11	11	10	02	L	LI	1	3	GW	1	SA	FD	FD	12	11			1500	180	E	BL		Slowed down, turned to the right by 10 degrees from the whale. For safety reasons to the whales, chose not to circle but simply turned to the next transect.
01.09.10	EP	OS	52	53	0	143	25	93	89	11	34	10	02	L	LI	2	4	GW	2	UN	NO		2	99	0.2	H	4500	155	B	BL		
01.09.10	AK	OS	52	49	49	143	26	67	270	14	08	10	02	L	LI	11	5	GW	1	UN	NO		2	99	0.1	SH	3500	305	B	BL		
01.09.10	AK	OS	52	46	0	143	26	90	90	14	50	10	02	L	LI	3/4	6	GW	2	UN	NO		10	99	0.3	H	3500	40	B	BL		
01.09.10	EP	AK	52	42	65	143	24	30	170	17	30	8	02	L	LI	3	7	KW	1	SP	FD	FD	10	8			1000		E	FI	SE	
01.09.10	EP	AK	52	41	99	143	24	31	180	17	34	8	02	L	LI	3	8	MW	1	SP	FD	FD	2	4			800		E	FI	SE	
01.09.10	EP	AK	52	38	98	143	29	33	85	18	15	8	02	L	NO		9	GW	2	SP	FL		4	2	0.4	H	3000	115	B	BL	SE	
01.09.10	EP	AK	52	38	99	143	31	15	85	18	21	8	02	L	NO		10	GW	2	UN	NO		11	99			2000	75	E	BL		
01.09.10	EP	AK	52	38	99	143	31	15	85	18	21	8	02	L	NO		11	GW	1	UN	FL		11	99			2000	70	E	BL		
01.09.10	EP	AK	52	38	99	143	32	29	85	18	24	8	02	L	NO		12	GW	1	SA	FD	FD	11	10			1000	30	E	BO	SE	
02.09.10	EP	AK	52	7	45	143	49	59	274	15	08	10	02	L	MO	9/10	1	GW	2	UN	NO		4	99	0.3	H	3500	25	B	BL		Pacific explorer is located about six miles east. Seismic vessel moves to the south.
02.09.10	EP	AK	52	7	45	143	49	59	274	15	08	10	02	L	MO	9/11	2	GW	1	UN	NO		4	99	0.5	H	2500	20	B	BL		
02.09.10	AK	OS	52	11	0	143	42	92	87	17	30	10	02	L	MO	6	3	GW	5	UN	NO		12	99	0.1	H	6000	90	B	BL		
02.09.10	AK	OS	52	11	1	143	48	43	87	17	49	10	02	L	SE	6	4	GW	1	UN	NO		5	99	0.3	H	3500	140	B	BL		
02.09.10	AK	OS	52	11	1	143	48	43	87	17	49	10	02	L	SE	6	5	GW	1	SA	FD	FD	1	2			1000	105	E	BL		
02.09.10	EP	OS	52	14	50	143	46	62	269	18	37	10	01	L	SE	12	6	HP	2	SA	FD	FD	2	3			500	310	E	FI	SE	
03.09.10	EP		52	34	92	143	28	29	240	07	17	10	02	L	SE	1		GW	3	UN	NO		7	99	0.5	H	2500	25	E	BL		
03.09.10	EP		52	35	25	143	27	91	320	07	22	10	02	L	SE	4		GW	1	UN	NO		3	99	0.3	H	3500	70	E	BL		
03.09.10	OS		52	41	8	143	23	32	17	08	20	10	01	L	SE	2		GW	2	UN	NO		2	99	0.1	H	6000	50	B	BL		
03.09.10	OS		52	45	80	143	27	40	256	10	48	10	01	L	SE	9		GW	3	UN	NO		9	99	0.5	H	2700	160	B	BL		
03.09.10	AK		52	45	83	143	27	19	57	11	00	10	01	L	SE	2/3		GW	1	SP	FD	FD	4	2	0.6	H	2300	55	E	BL	SE	

03.09.10	AK		52	47	71	143	26	75	340	11	21	10	01	L	SE	5		GW	1	UN	NO		11	99	0.1	SH	355	320	B	BL		
03.09.10	AK		52	47	71	143	26	75	340	11	21	10	01	L	SE	5		GW	1	UN	NO		10	99	0.1	SH	3500	290	B	BL		
03.09.10	AK		52	48	95	143	26	51	350	11	30	10	01	L	SE	5		MW	1	SA	FD	FD	10	10			800	320	B	FI	SE	
03.09.10	AK		52	49	62	143	26	39	351	11	36	10	01	L	SE	5		GW	1	UN	NO		10	99	0.1	SH	3500	285	B	BL		
03.09.10	AK		52	51	33	143	25	86	348	11	51	10	01	L	MO	5/6		GW	2	SP	FD	FD	4	2	0.5	H	2500	110	B	BL	SE	
03.09.10	AK		52	51	83	143	25	59	340	11	56	10	01	L	MO	5/6		GW	1	UN	NO		12	99	0.4	H	3000	340	B	BL		
03.09.10	AK		52	53	3	143	25	0	333	12	08	10	01	L	MO	6		GW	1	UN	NO		2	99	0.4	SH	3500	0	B	BL		
03.09.10	EP		52	52	98	143	23	67	337	14	55	10	02	L	MO	7/8		GW	2	NO	FD	FD	11	88	0.2	SH	2500	317	B	BL		
03.09.10	OS		52	56	21	143	92	10	121	15	54	10	02	L	MO	6		GW	1	UN	NO		2	99	0.3	H	3600	140	B	BL		
03.09.10	EP		52	58	4	143	22	86	342	16	43	8	02	L	SE	9		GW	1	UN	NO		11	99	0.1	SH	4000	300	B	BL		
03.09.10	OS		52	59	16	143	22	26	345	16	45	8	02	L	SE	9		GW	3	UN	NO		11	99	0.2	SH	3500	305	B	BL		
03.09.10	OS		52	59	87	143	21	66	97	17	12	8	02	L	SE	9		GW	1	UN	NO		11	99	0.2	SH	3000	315	E	BL		
03.09.10	OS		53	0	12	143	21	53	358	18	11	8	02	L	SE	9		GW	3	UN	NO		11	99	0.3	SH	2500	320	B	BL		
03.09.10	OS		53	0	97	143	21	51	359	18	17	8	02	L	SE	9		GW	4	UN	NO		11	99	0.1	SH	3500	330	B	BL		
03.09.10	OS		53	2	6	143	21	49	0	18	23	8	02	L	SE	9		GW	7	UN	NO		11	99	0.1	SH	3500	330	B	BL		
03.09.10	OS		53	3	51	143	21	50	359	18	33	8	02	L	SE	9		GW	5	UN	NO		10	99	0.2	SH	3000	300	B	BL		
03.09.10	AK		53	3	47	143	20	11	0	19	46	8	01	L	SE	9		GW	1	UN	NO		10	99			2500	320	B	BL		
03.09.10	AK		53	3	98	143	20	12	0	19	49	8	01	L	SE	9		GW	1	UN	NO		11	99			1500	300	E	BL		
03.09.10	AK		53	5	94	143	19	94	10	20	00	8	01	L	SE	9		GW	2	SA	FD	FD	1	1	1	H	1500	30	E	BO	SE	
04.09.10	OS		53	17	50	143	15	96	215	06	34	8	02	L	NO			GW	1	UN	NO		3	99	0.2	SH	3000	310	B	BL		
04.09.10	OS		53	17	50	143	15	96	215	06	34	8	02	L	NO			GW	1	UN	NO		4	99	0.1	SH	3500	330	B	BL		
04.09.10	OS		53	17	49	143	15	97	236	07	00	8	02	L	NO			GW	1	UN	NO		11	99	0.5	SH	1500	210	B	BL		
04.09.10	OS		53	17	49	143	15	97	236	07	00	8	02	L	NO			GW	1	UN	NO		1	99	0.5	SH	1500	260	B	BL		
04.09.10	OS		53	17	46	143	16	1	258	07	40	10	02	L	NO			GW	1	SA	FD	FD	11	10			1000	220	E	BL	SE	
04.09.10	AK		53	18	44	143	16	85	95	09	15	10	02	L	SE	12		GW	1	SA	FD	FD	1	1	1	H	1500	100	E	BL	SE	
04.09.10	AK		53	18	38	143	17	64	95	09	18	10	02	L	SE	12/1		GW	1	UN	NO		2	99	0.4	H	3000	170	E	BL		
04.09.10	AK		53	17	80	143	19	20	175	10	05	10	02	L	SE	10		GW	2	UN	NO		10	99	0.2	H	4500	140	E	BL		
04.09.10	EP		53	6	67	143	21	62	163	13	08	10	03	L	MO	12/1		GW	1	UN	NO		2	99	0.2	SH	3000	215	B	BL		
04.09.10	OS		52	59	75	143	21	63	233	14	36	10	03	L	MO	12		GW	1	NO	FD	FD	2	99			1500	270	E	BL		
04.09.10	OS		53	5	38	143	21	20	227	15	34	10	02	L	MO	12		GW	2	UN	NO		12	99	0.2	SH	3000	260	B	BL		
04.09.10	AK		53	4	51	143	20	32	245	15	42	10	02	L	MO	11/12		GW	3	SA	FD	FD	1	1			1500	275	E	BL	SE	
04.09.10	OS		53	3	74	143	18	47	97	16	06	10	02	L	MO	4		GW	1	UN	NO		7	99	0.1	SH	3500	340	B	BL		
04.09.10	OS		53	4	44	143	18	77	352	16	18	10	02	L	MO	9		GW	2	UN	NO		11	99	0.3	H	3500	332	B	BL		
04.09.10	OS		53	5	24	143	19	91	1	16	37	10	02	L	MO	7		GW	1	UN	NO		2	99	0.2	H	4500	41	B	BL		

04.09.10	OS		53	5	24	143	19	91	1	16	37	10	02	L	MO	7		GW	1	UN	NO		11	99	0.3	H	3500	330	B	BL		
04.09.10	OS		53	6	57	143	19	95	353	16	47	10	02	L	MO	9		GW	1	UN	NO		2	99	0.1	H	6000	40	B	BL		
05.09.10	AK		53	7	33	143	18	98	180	06	30	10	01	L	NO			GW	1	SP	FD	FD	4	2			1500	295	E	BL	SE	
05.09.10	AK		53	7	33	143	18	98	180	06	42	10	01	L	NO			GW	1	UN	UN		1	99	0.1	SH	4000	185	B	BL		
05.09.10	AK		53	7	33	143	18	98	176	06	48	10	01	L	NO			GW	1	UN	UN		1	99	0.2	H	4500	180	B	BL		
05.09.10	AK		53	7	33	143	18	98	176	06	48	10	01	L	NO			GW	1	UN	UN		1	99	0.1	SH	4000	190	B	BL		
05.09.10	AK		53	7	33	143	18	98	176	06	48	10	01	L	NO			GW	1	UN	UN		2	99	0.3	SH	2000	230	B	BL		
05.09.10	AK		53	7	37	143	18	98	179	07	18	10	01	L	SE	9		GW	1	UN	UN		4	99			3000	300	E	BL		
05.09.10	AK		53	7	37	143	18	98	177	07	36	10	01	L	SE	9		GW	2	UN	UN		4	99			3500	310	E	BL		Maybe a cow-calf pair
05.09.10	EP		53	8	43	143	18	15	347	08	08	10	01	L	SE	2		GW	1	SP	FD		1	11	1	H	1500	367	E	BL		
05.09.10	EP		53	5	43	143	19	25	171	10	10	10	01	L	MO	10		GW	2	UN	NO		11	99	0.2	H	4500	140	B	BL		
05.09.10	EP		53	4	66	143	16	67	184	10	55	10	01	L	LI	10		GW	2	UN	NO		1	99			1500	205	E	BL		
05.09.10	OS		53	4	36	143	19	56	144	11	07	10	01	L	LI	12		GW	3	UN	NO		10	99			1000	184	E	BL		
05.09.10	OS		53	4	36	143	19	56	144	11	07	10	01	L	LI	12		GW	2	UN	NO		2	99	0.2	H	4500	104	B	BL		
05.09.10	OS		53	4	36	143	19	56	144	11	07	10	01	L	LI	12		GW	2	UN	NO		2	99	0.1	H	6000	84	B	BL		
05.09.10	OS		53	3	62	143	20	59	148	11	30	10	01	L	LI	12		GW	2	UN	UN		1	99	0.3	H	3500	185	E	BL		
05.09.10	AK		53	2	39	143	20	38	172	11	47	10	01	L	LI	11/12		GW	2	UN	UN		1	99	0.2	SH	3500	193	E	BL		
05.09.10	OS		53	1	8	143	21	35	170	13	00	8	00	L	NO			GW	1	UN	NO		11	99	0.2	H	4500	146	B	BL		
05.09.10	OS		52	59	52	143	21	83	169	13	09	8	00	L	NO			GW	1	UN	NO		2	99	0.3	H	3500	220	B	BL		
05.09.10	OS		52	59	52	143	21	83	169	13	09	8	00	L	NO			GW	1	UN	NO		10	99	0.1	H	6000	130	B	BL		
05.09.10	OS		52	56	5	143	22	84	9	13	30	8	00	L	LI	1		HP	1	SA	FD	FD	11	10			600	0	E	FI	SE	
05.09.10	OS		52	54	81	143	23	17	172	13	41	8	00	L	LI	1		GW	1	UN	NO		2	99	0.2	SH	3500	222	B	BL		
05.09.10	AK		52	52	8	143	21	97	158	14	12	8	00	L	LI	2		GW	3	UN	UN		1	99	0.4	H	3000	180	E	BL		
05.09.10	AK		52	50	49	143	23	66	280	15	41	8	01	L	LI	10/11		GW	1	UN	UN		9	99	1	H	1500	160	B	BL		
05.09.10	EP		52	42	24	143	25	41	204	18	00	8	03	L	SE	2		DP	1	SA	TH	FD	10	2			100	235	E	SP		
06.09.10	OS		52	40	79	143	23	89	75	09	42	10	01	L	SE	2		MW	1	ST	FD	FD	1	11			1000	95	E	FI	MO	
06.09.10	OS		52	41	87	143	24	67	17	09	48	10	01	L	SE	3		MW	1	SA	FD	FD	11	11			700	7	E	FI	SE	
06.09.10	OS		52	42	96	143	25	25	19	09	53	10	01	L	SE	3		MW	1	SA	FD	FD	1	1			900	40	E	FI	SE	
06.09.10	OS		52	46	81	143	26	30	0	10	11	10	01	L	SE	4		DP	4	SA	FD	FD	2	3			800	60	E	FI	VI	
06.09.10	OS		52	47	98	143	26	36	0	10	16	10	01	L	SE	4		MW	2	SA	FD	FD	2	2			1000	30	E	FI	VI	
06.09.10	OS		52	50	31	143	26	0	348	10	27	10	01	L	SE	5		GW	3	UN	UN		3	99	0.1	H	6000	80	B	BL		
06.09.10	OS		52	50	88	143	27	57	85	10	34	10	01	L	SE	2		GW	1	SA	FD	FD	11	10	0.3	H	3600	55	B	BL		
06.09.10	AK		52	51	55	143	29	74	275	11	00	10	01	L	MO	7/8		GW	1	UN	UN		2	99	0.7	H	2100	345	E	BL		

06.09.10	AK		52	58	56	143	22	95	343	12	28	10	01	L	MO	6		GW	1	UN	UN		10	99	0.1	SH	3500	280	B	BL		
06.09.10	AK		52	59	94	143	22	0	323	12	36	10	01	L	MO	6/7		GW	2	UN	UN		11	99	0.2	SH	3000	295	B	BL		
06.09.10	AK		53	2	72	143	20	65	356	12	55	10	01	L	MO	6/7		GW	1	SP	FD	FD	9	8	0.2	SH	2000	230	B	BL	SE	
06.09.10	AK		53	1	62	143	19	29	231	13	43	10	01	L	MO	10/11		GW	4	NO	FD	FD	1	99			1500	258	E	BL	SE	
06.09.10	EP		53	2	69	143	19	9	282	15	00	10	02	L	MO	9		GW	1	UN	UN		2	99	0.1	SH	4000	345	B	BL		
06.09.10	EP		53	2	69	143	19	9	282	15	00	10	02	L	MO	10		GW	1	UN	UN		2	99	0.2	SH	3500	310	B	BL		
06.09.10	EP		53	1	98	143	21	9	146	16	10	10	02	L	MO	3		GW	1	UN	UN		11	99	0.8	H	2000	125	B	BL		
06.09.10	EP		52	54	62	143	24	20	165	16	49	10	02	L	SE	2/3		GW	3	UN	UN		11	99	0.2	H	4500	135	B	BL		Maybe the same group as one seen at 10:27
08.09.10	EP		52	25	10	143	18	56	11	09	00	10	03	L	SE	3		MW	1	SA	FD		11	1			150	40	B	BO	VI	
08.09.10	AK		52	25	49	143	33	8	140	15	34	10	02	L	MO	2		GW	1	UN	FL		11	99	0.2	H	4500	120	B	BL		
08.09.10	AK		52	24	87	143	34	9	100	15	44	10	02	L	MO	2		GW	1	UN	UN		10	99	0.3	H	3500	40	E	BL		
08.09.10	AK		52	24	87	143	34	28	103	15	52	10	02	L	SE	4		GW	1	SA	FD	FD	11	10			500	110	E	BO	SE	
08.09.10	AK		52	23	29	143	36	24	144	16	12	10	02	L	SE	3		GW	1	SA	FD	FD	11	99	0.8	H	2000	110	E	BO	SE	Photo-ID
08.09.10	AK		52	23	29	143	36	24	144	16	12	10	02	L	SE	3		GW	3	UN	UN		2	99	1	H	1600	180	E	BL		
08.09.10	AK		52	22	76	143	37	71	140	16	17	10	02	L	SE	3		GW	3	UN	UN		1	99	0.4	H	3000	160	E			
08.09.10	EP		52	27	79	143	34	50	312	19	09	10	01	L	SE	10		GW	1	UN	UN		2	99	0.3	H	3600	370	B	BL		
09.09.10	EP		51	53	6	143	27	11	2	07	00	8	02	L	LI	3		KW	3	SP	FD	FD	1	3			500	25	E	BO	SE	
09.09.10	AK		52	14	14	143	43	96	87	13	06	10	03	L	MO	3		GW	1	SP	FD	FD	10	10	1.2	H	1500	30	E	BL	SE	
09.09.10	AK		52	13	12	143	49	11	112	13	41	10	03	L	MO	2/3		GW	1	UN	UN		10	99	0.8	H	2000	35	E	BL		
09.09.10	AK		52	12	73	143	50	10	164	13	51	10	03	L	NO			GW	1	SA	FD		1	1	1.8	H	1000	155	E	BL		
09.09.10	AK		52	12	73	143	50	10	164	13	51	10	03	L	NO			GW	1	SA	FD	FD	1	1			500	150	E	BL	SE	Started drifting.
09.09.10	AK		52	12	73	143	50	10	164	13	51	10	03	L	NO			GW	1	NO	FD	FD	9	88			500	80	E	BO	SE	
09.09.10	AK		52	12	73	143	50	10	164	13	51	10	03	L	NO			GW	1	UN	UN		3	99			1500	220	E	BL		
09.09.10	EP		52	14	86	143	51	0	338	14	40	10	03	L	MO	7/8		GW	2	UN	UN		2	99	0.2	H	4500	40	B	BL		
09.09.10	OS		52	37	25	143	31	21	341	18	08	10	03	L	SE	9		MW	1	ST	FD	FD	11	10	0.2	H	4500	320	B	FI	MO	
09.09.10	OS		52	40	62	143	29	25	340	18	30	10	03	L	SE	10		MW	1	SA	FD	FD	10	10	0.3	H	3600	310	B	FI	MO	
09.09.10	AK		52	52	66	143	24	89	348	19	41	10	03	L	MO	9		GW	1	UN	UN		11	99			2500	310	E	BL		
09.09.10	AK		52	54	32	143	24	21	350	19	52	10	03	L	MO	9		GW	1	UN	UN		10	99			3000	280	E	BL		
10.09.10	AK		52	56	39	143	21	77	248	07	50	10	02	L	SE	7		GW	1	SA	FD	FD	11	1			1500	250	B	BL		
10.09.10	AK		52	53	13	143	23	91	180	09	47	10	02	L	SE	10		GW	1	UN	FD	FD	2	99			2500	220	B	BL		
11.09.10	EP		52	53	48	143	23	79	10	07	55	10	02	L	SE	3		GW	1	UN	UN		10	99			2500	300	E	BL		
11.09.10	EP		52	52	82	143	24	30	170	08	03	10	02	L	SE	9/10		GW	2	UN	UN		10	99	0.6	H	2400	110	B	BL		

11.09.10	OS		52	48	89	143	26	32	320	11	00	10	03	L	MO	5		GW	1	UN	UN		11	99			2500	285	E	BL		
11.09.10	EP		52	53	42	143	23	63	235	18	30	10	03	L	SE	1		GW	1	UN	UN		2	99	0.2	SH	3000	245	B	BL		
11.09.10	AK		52	52	47	143	24	37	170	19	13	10	03	L	SE	3		GW	1	UN	UN		1	99			1000	185	E	BL		
11.09.10	AK		52	51	62	143	24	51	155	19	28	10	03	L	SE	4		GW	1	UN	UN		2	99			3500	220	B	BL		
12.09.10	EP		52	34	18	143	34	74	341	07	18	10	02	L	SE	3		GW	2	UN	UN		2	99	0.5	H	2600	25	E	BL		
12.09.10	OS		52	44	83	143	28	64	28	09	00	10	02	L	SE	3		GW	1	UN	UN		2	99	0.4	H	3000	88	B	BL		
12.09.10	AK		52	51	25	143	23	94	120	11	38	10	02	L	SE	2		MW	1	SA	FD	FD	1	1			500	210	E	FI	MO	
12.09.10	AK		52	49	76	143	27	23	82	12	17	10	02	L	SE	2		GW	1	SP	FD	FD	10	8	1	H	1500	350	E	BL	SE	
12.09.10	AK		52	48	27	143	27	69	120	13	17	10	01	L	MO	2		GW	1	UN	UN		5	99			2000	270	B	BL		
12.09.10	AK		52	48	5	143	27	71	115	13	25	10	01	L	MO	2		MW	1	SP	FD	FD	11	9			400	65	E	BO	SE	
13.09.10	AK	EP	52	35	51	143	37	39	274	09	12	10	02	L	SE	6/7	1	GW	3	SP	FD	FD	9	10	0.7	H	2000	220	E	BL	SE	
13.09.10	AK	EP	52	31	99	143	32	74	99	10	22	10	02	L	SE	2	2	GW	3	UN	UN		11		0.1	H	5000	65	B	BL		Perhaps these are the same whales that were seen earlier today.
13.09.10	EP	OS	52	28	52	143	31	54	270	13	05	10	01	L	NO		3	GW	1	UN	UN		1	99			1000	280	E	BL		
13.09.10	EP	OS	52	28	52	143	31	54	270	13	05	10	01	L	NO		4	GW	1	UN	UN		11	99	0.5	SH	3500	250	B	BL		
13.09.10	EP	AK	52	24	97	143	32	23	87	13	48	10	01	L	MO	3	5	GW	2	UN	FD		1	99	0.2	SH	4500	135	B	BL		
13.09.10	AK	OS	52	25	0	143	55	21	60	15	06	10	01	L	LI	5	6	MW	1	SP	FD	FD	4	3			1000	120	E	BO	SE	
13.09.10	AK	OS	52	21	48	143	42	65	269	16	14	10	01	L	LI	11	7	GW	2	UN	UN		11	99	0.3	H	3500	245	B	BL		
13.09.10	AK	OS	52	21	48	143	42	65	269	16	14	10	01	L	LI	11	8	GW	4	UN	UN		11	99	0.3	H	3500	247	B	BL		
13.09.10	AK	OS	52	21	48	143	40	26	269	16	20	10	00	L	LI	11	9	GW	1	UN	UN		10	99	0.1	H	6000	203	B	BL		
13.09.10	EP	OS	52	21	49	143	38	31	271	16	30	10	00	L	NO		10	GW	2	SP	FD	FD	2	4	0.5	H	2500	340	E	BL	SE	
13.09.10	EP	OS	52	21	49	143	38	31	271	16	30	10	00	L	NO		11	HP	1	SA	FD		12	1			300	280	E	BO	MO	
13.09.10	EP	OS	52	21	49	143	38	31	271	16	30	10	00	L	NO		12	HP	1	ST	FD		11	11			500	250	E	BO	SE	
13.09.10	EP	OS	52	21	50	143	24	96	270	16	39	10	00	L	LI	11	13	HP	3	SA	FD		1	1			500	260	E	BO	SE	
13.09.10	EP	OS	52	17	98	143	34	1	82	17	40	10	00	L	SE	6	14	MW	1	SA	FD		1	1			700	110	E	BO	SE	
13.09.10	EP	AK	52	17	96	143	39	37	88	18	00	10	00	L	SE	6	15	GW	3	NO	UN		2	88	1	H	1600	140	E	BO		
13.09.10	AK		52	18	4	143	41	57	340	20	08	10	00	L	NO			GW	1	UN	FD		11	99	0.5	H	2500	245	E	BL		
14.09.10	AK	OS	52	14	50	143	43	77	90	07	46	10	02	L	SE	12	1	DP	1	SA	TH	TH	1	2			600	140	E	SP	MO	
14.09.10	AK	OS	52	14	50	143	46	0	90	07	53	10	02	L	SE	12	2	GW	2	UN	UN		2	99	0.1	H	6000	118	E	BL		
14.09.10	AK	OS	52	14	49	143	46	70	89	07	55	10	02	L	SE	12	3	GW	1	UN	UN		11	99	0.1	H	6000	74	E	BL		
14.09.10	AK	OS	52	13	71	143	50	0	180	08	17	10	02	L	SE	3	4	GW	1	UN	UN		10	99	0.7	H	2000	124	E	BL		Probably this is one of the two whales from sighting 2

14.09.10	AK	OS	52	13	22	143	50	0	180	08	20	10	02	L	SE	3	5	GW	2	SA	FD	FD	9	10	1	H	1500	120	E	BL	SE	
14.09.10	AK	OS	52	11	83	143	50	3	180	08	28	10	02	L	SE	3	6	GW	2	UN	UN		11	99	0.3	H	3500	160	E	BL		
14.09.10	AK	OS	52	11	83	143	50	3	180	08	28	10	02	L	SE	3	7	GW	2	SA	FD	FD	12	1	0.3	H	3500	182	E	BL		Turned without circulation, because whales near the site of the turn.
14.09.10	AK	OS	52	11	5	143	49	3	262	08	34	10	02	L	SE	9	8	GW	1	SA	FD	FD	11	11	0.3	H	3500	223	E	BL		
14.09.10	AK	OS	52	10	98	143	47	40	268	08	39	10	02	L	SE	6	9	GW	2	UN	UN		11	99	0.3	H	3500	240	E	BL		
14.09.10	EP	AK	52	4	28	143	49	99	180	11	43	10	03	L	SE	10	10	GW	2	UN	UN		1	99	0.6	H	2400	182	E	BL		
14.09.10	EP	AK	52	3	99	143	49	61	270	11	54	10	03	L	MO	7/8	11	GW	1	UN	UN		7	99	0.5	H	2600	90	E	BL		
14.09.10	OS	EP	52	0	48	143	48	91	93	14	30	10	01	L	MO	3	12	GW	3	UN	UN		11	99	0.3	H	3500	47	B	BL		
14.09.10	AK	EP	51	57	0	143	31	67	271	16	00	10	01	L	MO	10	13	MW	1	SA	FD	FD	11	10			1000	240	E	FI	SE	
14.09.10	AK	OS	51	53	47	143	32	20	90	16	44	10	00	L	LI	5/6	14	MW	1	SA	FD	FD	1	2	0.3	H	3500	120	E	FI	SE	
14.09.10	AK	OS	51	53	50	143	48	34	90	17	40	10	00	L	SE	6	15	NF	1	NO	RE	RE	1	1			500	150	E	FP		
15.09.10	OS	EP	52	34	63	143	22	14	2	10	50	10	02	L	SE	4	1	MW	1	SP	FD		2	4			500	85	E	BO	MO	
15.09.10	AK	EP	52	44	1	143	22	63	0	11	49	10	02	L	SE	4	2	GW	1	NO	BR		10	99			2500	295	E	BO		
15.09.10	AK	EP	52	49	52	143	22	94	2	12	22	10	02	L	SE	6	3	GW	2	UN	UN		10	99			3000	314	E	BL		
15.09.10	AK	EP	52	52	53	143	22	71	353	12	41	10	02	L	SE	5/6	4	GW	2	UN	UN		11	99	0.2	H	4500	319	B	BL		
15.09.10	AK	EP	52	55	17	143	22	23	353	12	57	10	02	L	SE	6	5	GW	2	UN	FD		10	99			2500	299	E	BL		Probably this is sighting 4
15.09.10	AK	EP	52	56	20	143	22	5	353	13	03	10	02	L	SE	6	6	GW	2	UN	UN		11	99	0.2	SH	3000	306	B	BL		The shortest distance to shore about 3,7 km
15.09.10	AK	EP	52	57	33	143	21	86	354	13	10	10	02	L	SE	6	7	GW	1	SP	FD	FD	2	7			1500	270	E	BL	SE	
15.09.10	AK	EP	52	58	12	143	21	73	353	13	15	10	02	L	MO	6	8	GW	2	UN	UN		1	99	0.2	H	4500	2	B	BL		
15.09.10	AK	EP	52	58	89	143	21	58	353	13	21	10	02	L	MO	6	9	GW	1	UN	UN		10	99			2500	286	E	BL		
15.09.10	AK	EP	52	59	50	143	21	46	354	13	23	10	02	L	MO	6	10	GW	1	UN	UN		9	99			1500	270	E	BL		
15.09.10	AK	OS	53	0	86	143	21	22	354	13	32	10	02	L	MO	6	11	GW	1	UN	UN		10	99			3000	311	B	BL		
15.09.10	AK	OS	53	0	86	143	21	22	354	13	32	10	02	L	MO	7	12	GW	1	UN	UN		10	99			3000	306	B	BL		
15.09.10	AK	OS	53	3	24	143	20	83	355	13	46	10	02	L	MO	6	13	GW	1	UN	UN		11	99			3000	290	E	BL		
15.09.10	AK	OS	53	3	24	143	20	83	355	13	46	10	02	L	MO	6	14	GW	1	UN	UN		11	99			3500	330	E	BL		
15.09.10	AK	OS	53	6	60	143	20	31	353	14	05	10	02	L	NO		15	GW	1	UN	UN		11	99			3000	318	E	BL		
15.09.10	AK	OS	53	6	60	143	20	31	353	14	05	10	02	L	NO		16	GW	2	UN	UN		10	99			3000	314	E	BL		
15.09.10	AK	OS	53	10	19	143	19	19	348	14	27	10	02	L	NO		17	GW	1	UN	UN		10	99			3500	280	E	BL		
15.09.10	AK	OS	53	12	60	143	18	29	348	14	41	10	02	L	NO		18	GW	1	UN	UN		9	99			3000	283	E	BL		

15.09.10	AK	OS	53	12	92	143	18	17	348	14	43	10	02	L	NO		19	GW	2	UN	UN		11	99			1500	318	E	BL		
15.09.10	AK	OS	53	13	72	143	17	86	348	14	48	10	01	L	NO		20	GW	2	UN	UN		11	99			4000	305	E	BL		
15.09.10	EP	OS	53	15	75	143	17	10	346	15	00	10	01	L	MO	7	21	GW	1	UN	UN		10	99			5000	280	B	BL		
15.09.10	EP	OS	53	16	98	143	16	58	346	15	07	10	01	L	MO	7	22	GW	1	UN	UN		11	99			4500	315	B	BL		
15.09.10	EP	OS	53	18	34	143	16	5	347	15	15	10	02	L	MO	8	23	GW	1	UN	UN		11	99	0.1	H	5000	337	B	BL		
17.09.10	EP		52	50	82	143	22	68	311	10	24	10	01	L	SE	6		GW	1	UN	UN		10	99			3000	280	B	BL		
17.09.10	OS		52	50	46	143	23	48	161	11	00	10	01	L	SE	11		GW	1	UN	UN		9	99	0.2	H	4500	70	B	BL		
17.09.10	AK		52	40	81	143	27	97	154	11	52	10	01	L	SE	12		DP	1	SA	TH	TH	2	3			500	230	E	SP	VI	
17.09.10	OS		52	31	48	143	34	66	153	12	45	10	01	L	SE	12		GW	2	SA	FD	FD	11	10			1600	133	E	BL	MO	
17.09.10	OS		52	30	38	143	35	53	152	12	47	10	01	L	SE	12		MW	1	SA	FD	FD	11	10			2500	112	E	BO	MO	
17.09.10	OS		52	24	1	143	40	47	154	13	27	10	01	L	LI	1/2		GW	1	UN	UN		1	99	0.2	H	4500	184	B	BL		
17.09.10	OS		52	24	1	143	40	47	154	13	27	10	01	L	LI	1/2		GW	2	UN	UN		2	99	0.5	H	2500	204	B	BL		
17.09.10	OS		52	24	1	143	40	47	154	13	27	10	01	L	LI	1/2		GW	1	UN	UN		3	99	0.5	H	2500	220	B	BL		
17.09.10	AK		52	21	36	143	43	19	340	15	15	10	01	L	LI	7/8		GW	2	UN	UN		9	99	0.3	H	3600	255	B	BL		
17.09.10	AK		52	21	36	143	43	19	340	15	15	10	01	L	LI	7/8		GW	1	UN	UN		10	99	0.2	H	4500	280	B	BL		
17.09.10	AK		52	22	18	143	42	93	350	15	20	10	01	L	LI	8		GW	1	UN	UN		9	99	0.1	H	6000	240	B	BL		It is possible that this and the other three whales were already reported in today at 13.27
17.09.10	AK		52	23	11	143	42	59	345	15	26	10	01	L	LI	8		GW	2	UN	UN		10	99	0.2	H	4500	260	B	BL		
17.09.10	AK		52	23	33	143	43	44	248	15	30	10	01	L	MO	12		GW	3	UN	UN	FL	2	99	0.2	H	4500	282	B	BL		
17.09.10	AK		52	23	33	143	43	44	248	15	30	10	01	L	MO	12		GW	1	UN	UN	FL	2	99	0.2	H	4500	280	B	BL		
17.09.10	AK		52	27	44	143	40	92	352	16	04	10	01	L	MO	8		GW	2	SA	FD	FL	11	9	1	H	1500	313	E	BL	SE	
17.09.10	AK		52	27	52	143	40	84	33	16	58	10	01	L	NO			GW	1	UN	FL	FL	9	99	0.3	H	3600	278	B	BL		
18.09.10	OS		52	31	80	143	39	23	194	17	08	10	02	L	SE	3		GW	1	UN	UN		2	99	0.1	H	6000	201	B	BL		
18.09.10	OS		52	31	70	143	39	27	254	17	15	10	02	L	SE	10		GW	1	UN	UN		11	99	0.2	H	4500	220	E	BL		
19.09.10	OS		52	19	49	143	33	15	344	06	57	10	01	L	NO			GW	1	UN	UN		2	99	0.3	H	3600	45	B	BL		
19.09.10	OS		52	19	52	143	33	14	317	07	00	10	01	L	NO			GW	3	UN	UN		2	99	0.4	H	3000	74	B	BL		
19.09.10	AK		52	19	66	143	39	10	332	08	53	10	01	L	NO			GW	2	UN	UN		3	99	0.1	H	6000	10	E	BL		
19.09.10	AK		52	19	74	143	39	56	280	09	30	10	01	L	NO			GW	1	UN	UN		3	99	0.1	H	6000	170	E	BL		
19.09.10	AK		52	20	16	143	39	57	305	09	58	10	01	L	SE	6		GW	1	UN	FD		2	99	0.5	H	2500	350	E	BL		
19.09.10	AK		52	20	15	143	39	89	297	10	13	10	01	L	SE	6		GW	1	UN	UN		10	99	0.7	H	2100	245	E	BL		
19.09.10	OS		52	20	14	143	38	50	325	11	45	10	01	L	MO	6		GW	1	UN	UN		4	99	0.5	H	2500	105	E	BL		

19.09.10	OS		52	20	18	143	38	52	143	12	00	10	01	L	MO	12		GW	1	UN	UN		10	99			3000	190	E	BL		
19.09.10	EP		52	11	2	143	45	79	152	13	00	10	01	L	MO	12/1		GW	2	UN	UN		12	99	0.2	H	4500	147	E	BL		
19.09.10	EP		52	11	2	143	45	79	152	13	00	10	01	L	MO	12/1		GW	2	UN	UN		12	99	0.2	H	4500	153	E	BL		
19.09.10	EP		52	11	2	143	45	79	152	13	00	10	01	L	MO	12/1		GW	2	UN	UN		1	99	0.1	H	6000	160	B	BL		
19.09.10	OS		52	10	14	143	47	38	48	15	00	10	00	L	LI	4		GW	1	MI	FE	FL	5	88	0.5	H	2500	200	E	BL		
19.09.10	AK		52	8	0	143	49	51	163	18	30	10	01	L	SE	3		GW	4	UN	UN		2	99	0.1	H	6000	208	E	BL		
19.09.10	AK		52	6	61	143	50	20	162	18	40	10	01	L	SE	3		GW	1	UN	UN		1	99	0.1	H	6000	190	E	BL		
19.09.10	AK		52	6	7	143	50	47	163	18	43	10	01	L	SE	3		GW	2	UN	UN		10	99	0.2	H	4500	83	E	BL		
19.09.10	AK		52	4	98	143	51	6	161	18	50	10	01	L	SE	3		GW	2	UN	UN		11	99	0.3	H	3600	133	E	BL		
19.09.10	AK		52	4	98	143	51	6	161	18	50	10	01	L	SE	3		GW	1	UN	UN		11	99	0.3	H	3600	130	E	BL		
19.09.10	AK		52	4	29	143	51	46	160	18	54	10	01	L	SE	3		GW	1	UN	UN		12	99	0.1	H	6000	140	B	BL		
19.09.10	AK		52	4	29	143	51	46	160	18	54	10	01	L	SE	3		GW	2	UN	FL		3	99	0.2	H	4600	235	E	BL		
19.09.10	AK		52	3	48	143	51	91	161	19	00	10	01	L	SE	3		GW	6	UN	FL	FD	3	99	1	H	1600	92	E	BL	SE	
19.09.10	AK		52	2	99	143	52	16	194	19	06	10	01	L	SE	3		GW	1	UN	UN		10	99	0.3	H	3600	142	E	BL		
20.09.10	OS		51	56	50	143	36	6	351	11	11	10	01	L	MO	4/5		GW	1	UN	UN		2	99	0.4	H	3000	26	B	BL		
20.09.10	AK		52	5	31	143	44	98	154	15	37	10	02	L	MO	2		GW	1	UN	UN		9	99	0.3	H	3600	35	E	BL		
20.09.10	EP		52	5	58	143	44	58	39	15	55	10	02	L	MO	6		GW	1	UN	UN		2	99	0.3	H	3600	70	E	BL		
20.09.10	EP		52	1	23	143	52	45	56	19	16	10	02	L	NO			GW	2	UN	UN		10	99	0.1	H	6000	15	B	BL		
20.09.10	EP		52	1	23	143	52	45	56	19	16	10	02	L	NO			GW	1	UN	UN		11	99	0.2	H	4500	30	B	BL		
20.09.10	EP		52	3	24	143	53	23	20	19	30	8	02	L	NO			GW	2	UN	UN		11	99	0.2	H	4500	0	B	BL		
23.09.10	OS		54	26	18	142	37	23	66	11	18	10	03	L	SE	3		DP	5	SA	FD	TH	1	1	E		500	90	E	SP	VI	
23.09.10	OS		54	7	96	143	6	70	150	13	40	10	02	L	MO	1		KW	5	SP	FD	FD	11	10	0.5	H	2600	130	E	FI	SE	
23.09.10	AK		53	44	10	143	9	8	178	15	40	10	02	L	MO	2		GW	1	UN	UN		10	99	0.5	H	2600	140	E	BL		
24.09.10	OS		53	20	58	143	15	23	155	09	06	10	02	L	NO			GW	1	UN	UN		2	99	0.5	SH	1800	235	B	BL		
24.09.10	OS		53	18	71	143	16	53	160	09	16	10	02	L	NO			GW	4	UN	UN		2	99	0.3	SH	2400	220	B	BL		
24.09.10	OS		53	17	29	143	17	31	170	09	24	10	02	L	NO			GW	2	UN	UN		2	99	0.4	SH	2005	230	B	BL		
24.09.10	OS		53	15	57	143	17	76	172	09	30	10	02	L	NO			GW	2	UN	UN		2	99	0.5	SH	1800	232	B	BL		
24.09.10	AK		53	3	71	143	19	23	150	12	19	10	02	L	NO			GW	1	SA	FD	FD	11	10	E		600	130	E	BL		
24.09.10	OS		52	53	2	143	23	83	342	19	00	8	03	L	NO			NF	1	SP	SW	SW	8	10	E		400	232	E	HE	MO	
25.09.10	EP		52	51	15	143	22	76	145	13	38	10	01	L	NO			MW	1	SA	FD		11	2	E		450	180	E	BO	MO	
25.09.10	AK		52	36	65	143	24	74	162	17	11	10	01	L	NO			MW	1	SP	FD	FD	4	2	E		500	270	E	FI	SE	
25.09.10	AK		52	30	47	143	27	47	167	17	47	10	01	L	LI	3		GW	1	UN	UN		2	99	0.2	SH	4500	230	B	BL		Distance to shore about 11.5 km. This whale seen at Chayvo

25.09.10	AK		52	30	47	143	27	47	167	17	47	10	01	L	NO			MW	1	SP	FD		2	4	0.5	SH	2600	260	B	BO	MO	
25.09.10	AK		52	25	15	143	30	86	145	18	17	10	01	L	NO			GW	3	UN	UN		1	99	0.3	H	3600	160	E	BL		
26.09.10	AK		52	21	72	143	34	81	112	07	19	10	02	L	NO			GW	1	UN	UN		3	99	1	H	1600	210	E	BL		
26.09.10	AK		52	21	2	143	37	32	110	07	29	10	02	L	LI	11		GW	1	UN	UN		2	99	0.3	H	3600	140	E	BL		
26.09.10	AK		52	20	93	143	37	65	110	07	30	10	02	L	LI	11		GW	3	UN	UN		10	99	0.5	H	2600	75	E	BL		
26.09.10	EP		52	18	63	143	43	99	266	08	49	10	02	L	SE	7		GW	3	UN	UN		2	99	0.2	H	4500	325	B	BL		
26.09.10	EP		52	21	38	143	42	16	332	10	05	10	02	L	SE	5		GW	2	UN	UN		3	99	0.3	H	3600	75	B	BL		
26.09.10	AK		52	57	87	143	21	60	8	14	10	10	03	L	SE	6		GW	1	UN	UN		11	99	0.6	SH	2500	340	B	BL		
27.09.10	OS		53	1	36	143	20	85	344	09	30	10	02	L	MO	5		GW	1	UN	UN		11	99	0.3	SH	2500	334	B	BL		
27.09.10	OS		53	2	58	143	20	25	343	09	39	10	02	L	MO	5		GW	2	UN	UN		1	99	0.4	H	3000	350	B	BL		
27.09.10	OS		53	3	65	143	20	3	82	09	49	10	02	L	MO	2		GW	2	UN	UN		11	99	0.2	H	4500	50	B	BL		
27.09.10	AK		53	3	88	143	20	54	345	11	16	10	02	L	MO	6		GW	2	UN	UN		11	99	0.1	SH	3600	340	B	BL		
27.09.10	AK		53	6	8	143	19	48	346	11	30	10	02	L	LI	6		GW	1	SP	FD	FL	4	2	0.2	H	4500	40	B	BL	SE	
27.09.10	AK		53	7	72	143	18	72	344	11	41	10	02	L	LI	6		GW	2	UN	UN		1	99	0.2	H	4500	10	E	BL		
27.09.10	AK		53	7	72	143	18	72	344	11	41	10	02	L	LI	6		GW	1	UN	FD		10	99	0.4	SH	1600	290	E	BL		
27.09.10	AK		53	9	1	143	18	7	340	11	52	10	02	L	LI	6		MW	1	SP	FD		2	1	E		1500	20	E	BO	SE	
27.09.10	AK		53	9	36	143	19	75	49	12	07	10	01	L	LI	4		GW	1	UN	UN		1	99	0.3	H	3600	60	E	BL		
27.09.10	AK		53	11	71	143	22	79	21	12	30	10	01	L	LI	6		GW	1	UN	UN		9	99	0.1	SH	3400	275	E	BL		
27.09.10	AK		53	14	41	143	21	69	336	12	50	10	01	L	NO			MW	1	SP	FD	FD	10	8	E		1500	20	E	BO		
27.09.10	AK		53	18	28	143	14	55	283	13	30	10	01	L	LI	9		GW	1	UN	FD		9	99	E		600	200	E	BO		
27.09.10	AK		53	18	28	143	14	55	283	13	30	10	01	L	LI	9		GW	1	ST	FD		11	9	E		1000	270	E	BO		
27.09.10	AK		53	18	38	143	14	5	15	13	34	10	01	L	LI	6		GW	1	SP	FD		9	99	0.1	SH	1600	290	E	BO		
28.09.10	AK		53	8	1	143	19	82	60	08	00	10	01	L	NO			MW	1	SA	FD		11	1	E		600	65	E	FI	SE	
28.09.10	AK		53	15	15	143	21	30	350	09	10	10	02	L	SE	3		MW	1	SA	FD		11	1	E		800	10	E	FI	SE	
28.09.10	AK		53	19	78	143	15	82	334	09	43	10	02	L	NO			GW	1	UN	UN		9	99	E		1500	235	E	BL		
28.09.10	AK		53	26	25	143	11	64	341	10	22	10	02	L	NO			HP	1	SA	FD		11	1	E		500	350	E	BL		
30.09.10	OS		54	20	87	142	16	6	65	18	10	6	05	L	NO			NF	1	SA	SW	LO	2	3	E		500	155	E	HE		
01.10.10	AK		52	4	65	143	53	5	173	10	30	10	04	L	NO			GW	1	SP	FD	FD	2	4	E		600	260	E	BL	SE	
01.10.10	AK		52	4	65	143	53	5	173	10	30	10	04	L	NO			GW	1	UN	UN		1	99	1	H	1600	190	E	BL		
01.10.10	AK		52	4	65	143	53	5	173	10	30	10	04	L	NO			GW	1	UN	UN		1	99	0.8	H	1900	200	E	BL		
01.10.10	AK		52	2	66	143	53	51	171	10	41	10	04	L	MO	10		GW	2	SP	FD		2	3	0.6	H	230	220	E	BL	SE	
01.10.10	AK		52	1	87	143	53	70	171	10	45	10	04	L	MO	10		GW	2	UN	UN		2	99	0.7	H	2100	225	E	BL		
01.10.10	OS		51	16	7	144	3	37	171	14	47	10	03	L	NO			RW	2	SP	FD	FD	11	9	E		600	151	E	BL	SE	
01.10.10	OS		51	1	65	144	6	68	162	16	00	10	03	L	SE	2		RW	1	SA	FD	FD	11	9	1	H	1600	142	B	FL	SE	

02.10.10	EP		47	17	52	144	15	71	201	12	11	10	03	L	MO	10		NF	1	SA	BR	SW	10	1	E		300	255	E	BO	VI	
02.10.10	OS		46	44	22	143	55	97	202	15	19	10	01	L	SE	1		NF	1	UN	RE		3	99	E		600	292	E	BO		
02.10.10	AK		46	40	83	143	54	3	201	15	37	10	01	L	SE	1		NF	2	UN	RE		11	99	E		500	190	E	BO		
02.10.10	AK		46	39	27	143	53	17	202	15	45	10	01	L	SE	1		KW	1	UN	FD		11	99	0.2	H	4500	160	B	FI	SE	
02.10.10	OS		46	30	95	143	49	13	202	16	30	10	01	L	SE	2		NF	5	UN	RE		11	99	1	H	1600	170	B	BO		
02.10.10	OS		46	29	64	143	48	36	201	16	36	10	01	L	SE	2		NF	1	UN	RE		3	99	E		600	290	E	BO		
02.10.10	OS		46	29	16	143	48	9	201	16	39	10	01	L	SE	2		NF	1	UN	RE		11	99	E		700	170	E	BO		
02.10.10	AK		46	21	63	143	43	65	203	17	20	10	02	L	SE	2		DP	2	SA	TH	TH	2	2	E		600	300	E	SP	VI	
02.10.10	AK		46	14	3	143	38	66	208	18	00	10	02	L	SE	2		DP	8	SA	TH	TH	2	9	E		500	170	E	SP	VI	
02.10.10	AK		46	9	93	143	36	17	203	18	24	10	02	L	SE	2		DP	2	SP	TH	TH	7	11	E		500	160	E	SP	VI	
02.10.10	AK		46	9	62	143	35	97	203	18	26	10	02	L	SE	2		HP	1	SP	FD	FD	7	11	E		500	170	E	BO	VI	
03.10.10	AK		45	49	10	139	11	75	272	11	33	10	01	L	NO			DP	4	SA	TH	TH	1	1	E		500	320	E	SP	VI	
03.10.10	AK		45	48	82	138	14	71	268	15	08	10	02	L	LI	9/10		UW	1	SP	FD		10	8	E		1000	210	E	BL	SE	

APPENDIX 2 RESULTS OF SHORE-BASED SURVEYS OF MARINE MAMMALS IN THE PILTUN FEEDING AREA IN 2010

1 – Date **2** – Monitoring station number **3** – Species of cetacean (GW – gray whale, MW – Minke whale, HP – harbor porpoise, KW – killer whale) **4 –** Number of individuals **5** – Latitude (N) **6** – Longitude (E)

Odoptu-Piltun section

1	2	3	4	5	6
7.VIII	8	GW	1	52,81897	143,35209
7.VIII	8	GW	2	52,81932	143,35386
7.VIII	8	GW	1	52,86553	143,34332
7.VIII	8	GW	1	52,89945	143,33328
7.VIII	8	GW	2	52,90097	143,36885
7.VIII	8	GW	2	52,90603	143,32821
7.VIII	8	GW	1	52,91624	143,32737
7.VIII	7	GW	2	52,94487	143,32452
7.VIII	7	GW	1	52,95549	143,32621
7.VIII	7	GW	1	52,96883	143,34053
7.VIII	7	GW	1	52,97644	143,32263
7.VIII	7	GW	1	52,98038	143,32395
7.VIII	7	GW	2	52,98644	143,31532
7.VIII	7	GW	1	53,01309	143,31857
7.VIII	7	GW	1	53,01409	143,30946
7.VIII	6	GW	1	53,02366	143,31769
7.VIII	6	GW	2	53,04495	143,31647
7.VIII	6	GW	2	53,04908	143,31519
7.VIII	5	GW	1	53,11104	143,28933
7.VIII	4	GW	1	53,13307	143,29818
7.VIII	5	GW	1	53,16337	143,33725
7.VIII	4	GW	1	53,16585	143,32487
7.VIII	5	GW	1	53,17035	143,32380
7.VIII	4	GW	1	53,18910	143,25899
7.VIII	4	GW	1	53,18838	143,31624
7.VIII	4	GW	2	53,19708	143,32248
7.VIII	3	GW	1	53,21279	143,32332
7.VIII	3	GW	2	53,27332	143,30737
7.VIII	3	GW	3	53,32848	143,25302
7.VIII	2	HP	2	53,33560	143,19949
7.VIII	2	GW	2	53,33985	143,25451
7.VIII	2	GW	1	53,34107	143,25420
7.VIII	1	GW	1	53,40413	143,22264
8.VIII	8	GW	1	52,88449	143,33644
8.VIII	8	GW	2	52,91809	143,32556
8.VIII	7	GW	1	52,95108	143,32681
8.VIII	7	GW	1	52,95253	143,31868
8.VIII	7	GW	1	52,96875	143,34114
8.VIII	7	GW	1	52,97977	143,32483
8.VIII	7	GW	1	52,98162	143,32335
8.VIII	7	GW	1	52,98801	143,32006
8.VIII	7	GW	1	52,99616	143,33077
8.VIII	6	GW	1	52,99897	143,32169
8.VIII	7	GW	2	53,00681	143,31098
8.VIII	7	GW	3	53,01483	143,30605
8.VIII	6	GW	1	53,01490	143,32159

1	2	3	4	5	6
8.VIII	6	GW	1	53,02589	143,32387
8.VIII	6	GW	1	53,03727	143,32018
8.VIII	6	GW	3	53,04858	143,33431
8.VIII	6	GW	1	53,05476	143,29086
8.VIII	6	GW	1	53,07459	143,30797
8.VIII	6	GW	1	53,11034	143,28860
8.VIII	5	GW	1	53,13066	143,30642
8.VIII	5	GW	1	53,13216	143,30567
8.VIII	5	GW	1	53,14774	143,28892
8.VIII	4	GW	1	53,15329	143,28843
8.VIII	4	GW	1	53,16468	143,28724
8.VIII	4	GW	1	53,16667	143,29413
8.VIII	5	GW	1	53,17041	143,32588
8.VIII	5	GW	2	53,17210	143,32184
8.VIII	5	GW	1	53,17508	143,31335
8.VIII	5	GW	1	53,17553	143,31189
8.VIII	4	GW	1	53,18392	143,31784
8.VIII	3	GW	1	53,20262	143,27378
8.VIII	3	GW	1	53,23156	143,31125
8.VIII	2	GW	1	53,36034	143,23721
8.VIII	2	GW	1	53,36077	143,23647
8.VIII	1	GW	1	53,39206	143,20294
8.VIII	1	HP	1	53,42163	143,16408
8.VIII	1	GW	1	53,45144	143,18103
9.VIII	8	GW	1	52,84761	143,35325
9.VIII	8	GW	1	52,88042	143,33847
9.VIII	8	GW	1	52,87885	143,43287
9.VIII	8	GW	1	52,89436	143,36012
9.VIII	8	GW	1	52,89521	143,35930
9.VIII	7	GW	1	52,96071	143,32521
9.VIII	7	GW	1	52,96923	143,32763
9.VIII	7	GW	1	52,98895	143,31867
9.VIII	6	GW	2	53,01139	143,31169
9.VIII	6	GW	2	53,01484	143,32314
9.VIII	6	GW	1	53,06506	143,30182
9.VIII	5	GW	1	53,09232	143,28951
9.VIII	5	GW	2	53,12140	143,28803
9.VIII	5	GW	1	53,13425	143,27495
9.VIII	4	GW	1	53,14288	143,32065
9.VIII	4	GW	1	53,14487	143,27995
9.VIII	5	GW	1	53,14703	143,29165
9.VIII	4	GW	1	53,15936	143,32102
9.VIII	4	GW	2	53,16284	143,32371
9.VIII	3	GW	2	53,19378	143,28056
9.VIII	3	GW	1	53,19494	143,28459
9.VIII	4	GW	1	53,21683	143,26494

1	2	3	4	5	6
9.VIII	3	GW	1	53,29911	143,29425
9.VIII	2	GW	1	53,30826	143,29100
9.VIII	2	GW	1	53,31126	143,29322
10.VIII	1	GW	1	53,38460	143,17626
10.VIII	1	GW	1	53,51986	143,15398
10.VIII	1	GW	3	53,51984	143,15712
18.VIII	8	GW	1	52,89438	143,32690
18.VIII	7	GW	2	52,96526	143,32256
18.VIII	7	GW	1	52,97007	143,33188
18.VIII	7	GW	1	52,97107	143,32490
18.VIII	7	GW	1	52,97227	143,31377
18.VIII	7	GW	1	52,98376	143,30852
18.VIII	7	GW	1	52,99321	143,31563
18.VIII	5	GW	1	53,07192	143,29318
18.VIII	5	GW	1	53,07302	143,29929
18.VIII	5	GW	1	53,09780	143,28277
18.VIII	5	HP	1	53,12179	143,27552
18.VIII	2	MW	1	53,34337	143,23246
19.VIII	8	GW	1	52,85145	143,35418
19.VIII	8	GW	1	52,90632	143,32600
19.VIII	7	GW	1	52,98322	143,31462
19.VIII	7	GW	1	53,00088	143,33222
19.VIII	7	GW	1	53,00629	143,30801
19.VIII	6	GW	2	53,03815	143,30430
19.VIII	6	GW	1	53,05500	143,29882
19.VIII	6	GW	3	53,07286	143,28305
19.VIII	6	GW	1	53,07286	143,28602
19.VIII	6	GW	1	53,10203	143,33104
19.VIII	5	GW	1	53,11607	143,33775
19.VIII	4	GW	1	53,12499	143,32604
19.VIII	5	GW	1	53,12670	143,28415
19.VIII	5	GW	1	53,12700	143,28404
19.VIII	4	GW	1	53,13056	143,28824
19.VIII	5	GW	1	53,13219	143,31619
19.VIII	5	GW	1	53,13612	143,36046
19.VIII	4	GW	1	53,17769	143,26539
19.VIII	4	HP	4	53,18088	143,26615
19.VIII	4	GW	1	53,18258	143,27995
19.VIII	4	GW	2	53,19222	143,26864
19.VIII	3	GW	1	53,20889	143,31720
19.VIII	4	GW	1	53,21395	143,32261
19.VIII	3	HP	1	53,26560	143,24198
19.VIII	3	HP	1	53,26676	143,24270
19.VIII	2	GW	1	53,30789	143,25578
19.VIII	2	GW	1	53,37446	143,18833
20.VIII	8	GW	1	52,85047	143,35279

1	2	3	4	5	6
20.VIII	8	GW	1	52,87600	143,35360
20.VIII	8	GW	2	52,87619	143,36285
20.VIII	8	GW	1	52,89662	143,33070
20.VIII	6	GW	1	53,04945	143,31848
20.VIII	6	GW	1	53,07402	143,30825
20.VIII	6	GW	1	53,07531	143,28685
20.VIII	6	GW	2	53,08121	143,29687
20.VIII	5	GW	1	53,09357	143,29192
20.VIII	6	GW	1	53,09492	143,29627
20.VIII	5	GW	1	53,09969	143,29311
20.VIII	5	GW	1	53,10412	143,29322
20.VIII	5	GW	1	53,10447	143,30383
20.VIII	5	GW	1	53,11238	143,28460
20.VIII	4	GW	1	53,15785	143,27244
20.VIII	4	GW	1	53,16403	143,26998
20.VIII	4	GW	1	53,17218	143,28744
20.VIII	4	GW	1	53,18847	143,34311
20.VIII	4	GW	2	53,19335	143,26525
20.VIII	1	GW	1	53,40960	143,17327
23.VIII	8	GW	2	52,86211	143,34073
23.VIII	8	GW	1	52,86997	143,34519
23.VIII	7	GW	2	52,97515	143,33145
23.VIII	7	GW	4	52,98929	143,31782
23.VIII	7	GW	1	52,99939	143,32362
23.VIII	6	GW	1	53,01327	143,31729
23.VIII	6	GW	1	53,02917	143,33015
23.VIII	6	GW	1	53,04239	143,31560
23.VIII	6	GW	1	53,04311	143,32057
23.VIII	6	GW	1	53,05302	143,30538
23.VIII	6	GW	1	53,08223	143,29548
23.VIII	6	GW	1	53,09651	143,28765
23.VIII	5	GW	1	53,09825	143,29052
23.VIII	5	GW	1	53,10137	143,28650
23.VIII	5	GW	1	53,10676	143,28532
23.VIII	5	GW	1	53,13330	143,27527
23.VIII	4	GW	1	53,13739	143,27683
23.VIII	4	MW	1	53,18019	143,27740
23.VIII	4	HP	1	53,18258	143,26301
23.VIII	4	GW	1	53,19182	143,25917
23.VIII	4	GW	2	53,19038	143,34326
23.VIII	4	GW	1	53,20280	143,26718
23.VIII	1	GW	3	53,44360	143,18217
23.VIII	1	GW	5	53,44999	143,18399
24.VIII	3	GW	3	53,25576	143,23860
24.VIII	2	GW	1	53,27666	143,23091
24.VIII	2	GW	3	53,34105	143,26947

1	2	3	4	5	6
24.VIII	2	GW	3	53,35162	143,27772
24.VIII	2	GW	2	53,36220	143,25470
24.VIII	2	GW	1	53,36840	143,21338
24.VIII	1	GW	1	53,36857	143,23648
24.VIII	2	GW	1	53,37582	143,22539
24.VIII	2	GW	1	53,41212	143,23384
24.VIII	2	GW	2	53,41250	143,23158
24.VIII	1	GW	1	53,46112	143,17677
24.VIII	1	GW	1	53,51784	143,18198
25.VIII	4	GW	1	53,11836	143,30928
25.VIII	4	GW	1	53,13080	143,28973
25.VIII	4	GW	1	53,13948	143,31324
25.VIII	4	GW	1	53,16019	143,26547
25.VIII	4	GW	1	53,24397	143,29784
25.VIII	3	GW	1	53,27394	143,23266
25.VIII	3	GW	1	53,28275	143,22794
25.VIII	2	GW	1	53,28680	143,22485
25.VIII	2	GW	1	53,28743	143,22766
25.VIII	2	GW	1	53,29010	143,23717
25.VIII	2	GW	1	53,29506	143,22676
25.VIII	2	GW	1	53,31077	143,27163
25.VIII	3	GW	1	53,31177	143,23477
25.VIII	2	GW	2	53,31480	143,27491
25.VIII	3	GW	1	53,33324	143,27760
25.VIII	2	GW	1	53,33695	143,26089
25.VIII	2	GW	1	53,33950	143,26951
25.VIII	1	GW	1	53,37485	143,18176
25.VIII	1	GW	1	53,47259	143,19848
26.VIII	5	GW	1	53,07120	143,29183
26.VIII	5	GW	1	53,08561	143,29222
26.VIII	5	GW	2	53,08636	143,29562
26.VIII	5	GW	1	53,09975	143,30746
26.VIII	5	GW	2	53,11096	143,31160
26.VIII	5	GW	1	53,13571	143,27748
26.VIII	5	GW	1	53,18003	143,26107
26.VIII	4	GW	1	53,20191	143,26817
26.VIII	3	GW	1	53,27314	143,28141
26.VIII	2	GW	1	53,27700	143,22880
26.VIII	2	GW	1	53,33548	143,24357
26.VIII	2	GW	1	53,33723	143,22566
26.VIII	2	GW	1	53,33796	143,24334
26.VIII	2	GW	1	53,34006	143,23580
26.VIII	2	GW	1	53,35359	143,25248
26.VIII	1	GW	1	53,35547	143,20721
26.VIII	1	GW	1	53,36745	143,23280
26.VIII	2	GW	1	53,39108	143,23840

1	2	3	4	5	6
26.VIII	1	GW	1	53,41152	143,22149
26.VIII	1	GW	1	53,41438	143,22144
26.VIII	1	GW	2	53,41496	143,20381
26.VIII	1	GW	1	53,42558	143,21791
27.VIII	8	GW	2	52,85719	143,34348
27.VIII	8	GW	1	52,88625	143,33164
27.VIII	8	GW	1	52,89564	143,33624
27.VIII	8	GW	1	52,90784	143,31841
27.VIII	7	GW	1	52,96861	143,32915
27.VIII	7	GW	2	52,96933	143,31749
27.VIII	7	GW	1	52,96961	143,32716
27.VIII	7	GW	2	52,96973	143,32164
27.VIII	7	GW	1	52,97587	143,31445
27.VIII	7	GW	2	52,97613	143,31435
27.VIII	7	GW	1	52,98525	143,31270
27.VIII	7	GW	1	53,00593	143,31553
27.VIII	6	GW	1	53,03806	143,30443
27.VIII	6	GW	1	53,05061	143,29749
27.VIII	6	GW	2	53,05566	143,30662
27.VIII	6	GW	1	53,06593	143,29384
27.VIII	6	GW	2	53,06626	143,29702
27.VIII	6	GW	3	53,06734	143,29284
27.VIII	6	GW	1	53,06743	143,29241
27.VIII	6	GW	1	53,07091	143,28750
27.VIII	2	HP	1	53,33456	143,20683
27.VIII	2	GW	1	53,35459	143,24308
27.VIII	1	GW	2	53,40518	143,21991
27.VIII	1	GW	1	53,41167	143,21093
27.VIII	1	GW	1	53,43641	143,19489
27.VIII	1	GW	1	53,43727	143,19347
27.VIII	1	GW	1	53,44606	143,19132
27.VIII	1	GW	1	53,44793	143,18626
28.VIII	8	GW	1	52,81956	143,36386
28.VIII	8	GW	1	52,82004	143,36562
28.VIII	8	GW	1	52,88413	143,33227
28.VIII	7	GW	1	52,96044	143,30810
28.VIII	7	GW	1	52,96929	143,31827
28.VIII	7	GW	2	52,97351	143,31678
28.VIII	7	GW	1	52,99770	143,30779
28.VIII	7	GW	3	52,99776	143,30711
28.VIII	7	GW	2	52,99781	143,30643
28.VIII	7	GW	1	52,99795	143,30302
28.VIII	7	GW	1	53,00057	143,31406
28.VIII	6	GW	1	53,02985	143,30346
28.VIII	6	GW	1	53,03026	143,30476
28.VIII	6	GW	1	53,03297	143,31144

1	2	3	4	5	6
28.VIII	6	GW	2	53,03929	143,32052
28.VIII	6	GW	1	53,07203	143,29236
28.VIII	5	GW	1	53,13624	143,28914
28.VIII	4	GW	1	53,20616	143,27139
28.VIII	3	HP	1	53,26750	143,23216
28.VIII	2	GW	1	53,34188	143,21655
28.VIII	1	GW	1	53,41861	143,22033
29.VIII	8	GW	1	52,86460	143,35545
29.VIII	8	GW	1	52,90645	143,33072
29.VIII	8	GW	3	52,91736	143,32545
29.VIII	7	GW	1	52,97001	143,31657
29.VIII	7	GW	1	52,97111	143,31734
29.VIII	7	GW	2	52,98781	143,31467
29.VIII	7	GW	2	52,98947	143,31454
29.VIII	7	GW	1	52,99610	143,32870
29.VIII	7	GW	2	53,00633	143,30150
29.VIII	7	GW	1	53,01385	143,30251
29.VIII	6	GW	1	53,02924	143,30150
29.VIII	6	GW	1	53,05658	143,30192
29.VIII	6	GW	1	53,08025	143,29908
29.VIII	6	GW	1	53,09395	143,29850
29.VIII	6	GW	1	53,09409	143,29729
29.VIII	6	GW	1	53,09471	143,28876
29.VIII	6	GW	1	53,10595	143,31417
29.VIII	5	GW	1	53,13472	143,27713
29.VIII	4	GW	1	53,13803	143,27007
1.IX	7	GW	1	52,92762	143,33929
1.IX	7	GW	2	53,00953	143,32856
1.IX	6	GW	1	53,03441	143,30533
1.IX	6	GW	1	53,05666	143,31351
1.IX	6	GW	1	53,06066	143,28862
1.IX	6	GW	2	53,08027	143,29477
1.IX	6	GW	1	53,08081	143,28905
1.IX	5	GW	1	53,11918	143,28476
1.IX	5	GW	1	53,12166	143,27501
1.IX	4	GW	1	53,13011	143,27890
1.IX	5	GW	1	53,13874	143,28303
1.IX	4	GW	1	53,14011	143,28060
1.IX	4	GW	1	53,15279	143,28335
1.IX	4	GW	1	53,19181	143,25808
1.IX	3	GW	1	53,27466	143,23566
1.IX	3	GW	2	53,29157	143,31331
1.IX	2	GW	1	53,32166	143,27825
1.IX	2	GW	1	53,39339	143,23026
2.IX	8	GW	1	52,88437	143,32394
2.IX	7	GW	1	52,93778	143,32254
2.IX	7	GW	1	52,95409	143,31968
2.IX	7	GW	2	52,96212	143,32432
2.IX	7	GW	1	52,98491	143,31987
2.IX	7	GW	1	52,98668	143,32013
2.IX	7	GW	1	52,98803	143,32678
2.IX	7	GW	1	52,99853	143,31944
2.IX	7	GW	1	52,99905	143,31732
2.IX	7	GW	1	53,00547	143,30603
2.IX	7	GW	1	53,01291	143,30362
2.IX	6	GW	1	53,02037	143,30260
2.IX	6	GW	2	53,02499	143,29825
2.IX	7	GW	1	53,02601	143,29815
2.IX	7	GW	1	53,02604	143,29964
2.IX	6	GW	1	53,02640	143,30448
2.IX	6	GW	2	53,03964	143,30565
2.IX	6	GW	2	53,04032	143,30673
2.IX	6	GW	1	53,04368	143,30304
2.IX	6	GW	1	53,04531	143,31210
2.IX	6	GW	2	53,05387	143,30014
2.IX	6	GW	1	53,05983	143,30113
2.IX	6	GW	2	53,06570	143,29280
2.IX	6	GW	1	53,06995	143,32238
2.IX	6	GW	2	53,08624	143,28793
2.IX	5	GW	1	53,08626	143,28815
2.IX	5	GW	1	53,09391	143,28656
2.IX	5	GW	2	53,11370	143,29219
2.IX	5	GW	1	53,11425	143,28155
2.IX	4	GW	1	53,13072	143,28329
2.IX	5	GW	1	53,14618	143,27406
2.IX	4	GW	1	53,15343	143,27311
2.IX	4	GW	1	53,17989	143,26341
2.IX	4	GW	1	53,18950	143,27313
3.IX	8	GW	1	52,86556	143,33210
3.IX	8	GW	1	52,87281	143,33316
3.IX	8	GW	4	52,88515	143,37742
3.IX	8	GW	2	52,89245	143,33276
3.IX	7	GW	1	52,94628	143,32544
3.IX	7	GW	1	52,95043	143,32112
3.IX	7	GW	4	52,99577	143,31601
3.IX	7	GW	1	53,00540	143,30967
3.IX	7	GW	1	53,01287	143,30923
3.IX	7	GW	1	53,01294	143,30811
3.IX	6	GW	1	53,02203	143,30998
3.IX	6	GW	2	53,02379	143,31513
3.IX	6	GW	1	53,02993	143,31454
3.IX	6	GW	2	53,03664	143,31056

1	2	3	4	5	6
3.IX	6	GW	1	53,06896	143,29705
3.IX	6	GW	2	53,07744	143,28779
3.IX	6	GW	1	53,08071	143,29407
3.IX	6	GW	2	53,08097	143,29159
3.IX	6	GW	4	53,08110	143,28993
3.IX	5	GW	1	53,08623	143,29062
3.IX	6	GW	1	53,09387	143,29475
3.IX	6	GW	1	53,09430	143,28628
3.IX	5	GW	2	53,09430	143,29037
3.IX	5	GW	4	53,09547	143,29475
3.IX	5	GW	1	53,09782	143,30135
3.IX	5	GW	1	53,11112	143,27880
3.IX	5	GW	2	53,11571	143,28703
3.IX	5	GW	1	53,13568	143,28187
3.IX	4	GW	2	53,15442	143,27779
3.IX	5	GW	1	53,15548	143,29104
3.IX	5	GW	1	53,17910	143,27543
3.IX	4	GW	1	53,18763	143,25495
3.IX	4	GW	2	53,21013	143,30564
3.IX	4	GW	1	53,21137	143,25058
3.IX	3	GW	1	53,23425	143,24955
3.IX	3	GW	2	53,26618	143,24936
3.IX	3	GW	1	53,28382	143,23848
3.IX	3	GW	3	53,30044	143,27976
3.IX	2	GW	3	53,32094	143,25687
3.IX	1	GW	1	53,33346	143,27484
3.IX	1	GW	1	53,36896	143,19778
4.IX	1	GW	1	53,37931	143,19730
4.IX	1	GW	1	53,38414	143,17665
5.IX	8	GW	1	52,85244	143,35819
5.IX	8	GW	1	52,86961	143,35948
5.IX	8	GW	1	52,88305	143,33392
5.IX	6	GW	1	53,00386	143,33439
5.IX	7	GW	2	53,01388	143,31175
5.IX	7	GW	1	53,02773	143,30421
5.IX	6	GW	2	53,03347	143,31368
5.IX	6	GW	1	53,04502	143,30569
5.IX	6	HP	1	53,05085	143,29261
5.IX	6	GW	1	53,05169	143,30597
5.IX	6	GW	2	53,05200	143,31568
5.IX	6	HP	2	53,05258	143,29230
5.IX	6	GW	1	53,05356	143,30735
5.IX	6	GW	1	53,05822	143,30374
5.IX	6	GW	2	53,06208	143,30085
5.IX	6	GW	1	53,06689	143,30895
5.IX	6	GW	1	53,07828	143,30880

1	2	3	4	5	6
5.IX	6	GW	2	53,08726	143,29006
5.IX	6	GW	1	53,10168	143,33261
5.IX	5	GW	2	53,10298	143,31320
5.IX	5	GW	1	53,10653	143,29055
5.IX	5	GW	1	53,10743	143,29264
5.IX	5	GW	2	53,11447	143,28359
5.IX	4	GW	1	53,14755	143,28746
5.IX	5	GW	1	53,15890	143,26851
5.IX	4	GW	2	53,17911	143,26954
5.IX	4	GW	4	53,18069	143,26945
5.IX	4	GW	1	53,18347	143,28465
5.IX	4	GW	1	53,19437	143,25855
5.IX	4	GW	3	53,19587	143,26753
5.IX	4	GW	1	53,20857	143,25950
5.IX	4	GW	1	53,21600	143,29581
5.IX	3	GW	1	53,25379	143,31541
5.IX	3	GW	1	53,32290	143,22782
5.IX	2	MW	1	53,33285	143,26179
5.IX	2	HP	1	53,33677	143,20903
5.IX	2	HP	1	53,33722	143,20314
5.IX	2	HP	2	53,34013	143,19991
5.IX	2	GW	2	53,34026	143,20273
5.IX	2	GW	1	53,34005	143,24411
5.IX	2	MW	1	53,37253	143,23719
5.IX	1	KW	1	53,41428	143,20006
5.IX	1	GW	1	53,42521	143,20154
6.IX	7	GW	1	52,96069	143,31497
6.IX	7	GW	1	52,97001	143,32504
6.IX	7	GW	1	52,99074	143,32444
6.IX	7	GW	2	52,99183	143,31463
6.IX	7	GW	1	53,01459	143,30018
6.IX	5	GW	1	53,07520	143,31169
6.IX	5	GW	1	53,10895	143,33498
6.IX	5	GW	1	53,13586	143,27409
6.IX	5	GW	1	53,15863	143,28038
6.IX	5	GW	1	53,18096	143,26746
6.IX	4	GW	1	53,18873	143,28618
6.IX	4	GW	1	53,18972	143,26570
6.IX	4	GW	1	53,19981	143,27718
6.IX	4	GW	1	53,20046	143,28239
6.IX	4	GW	1	53,20346	143,25885
6.IX	4	GW	2	53,20534	143,30087
6.IX	4	GW	1	53,22314	143,26136
6.IX	4	GW	1	53,23258	143,25020
6.IX	3	GW	2	53,24810	143,26333
6.IX	4	GW	1	53,24876	143,24647

1	2	3	4	5	6
6.IX	3	GW	2	53,25725	143,24178
6.IX	3	GW	1	53,25785	143,24449
6.IX	3	GW	1	53,26027	143,25935
6.IX	3	GW	1	53,26338	143,24417
6.IX	3	GW	1	53,26648	143,23249
6.IX	3	GW	1	53,26867	143,23076
6.IX	3	GW	1	53,27281	143,25839
6.IX	3	GW	1	53,27581	143,23928
6.IX	3	GW	1	53,28057	143,23504
6.IX	2	GW	3	53,34033	143,27042
8.IX	2	GW	1	53,36894	143,24406
8.IX	1	GW	1	53,43963	143,20586
12.IX	2	GW	1	53,26220	143,24690
12.IX	2	GW	1	53,26513	143,25736
12.IX	3	GW	1	53,27044	143,23457
12.IX	3	GW	2	53,27301	143,24516
12.IX	2	GW	1	53,29441	143,22166
12.IX	2	GW	1	53,29449	143,24661
12.IX	2	GW	1	53,30292	143,23054
13.IX	3	GW	2	53,23628	143,27200
13.IX	3	GW	1	53,24848	143,26515
13.IX	3	GW	1	53,25389	143,25142
13.IX	3	GW	1	53,25755	143,25115
13.IX	3	GW	2	53,26454	143,23470
13.IX	3	GW	2	53,26486	143,24750
13.IX	3	GW	1	53,27125	143,24409
13.IX	3	GW	1	53,27993	143,23632
13.IX	3	GW	1	53,28528	143,23859
13.IX	3	GW	1	53,29698	143,23146
13.IX	3	GW	1	53,30026	143,24409
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14.IX	8	GW	1	52,88309	143,33745
14.IX	8	GW	2	52,90530	143,32575
14.IX	7	GW	1	52,92622	143,33216
14.IX	7	GW	1	52,92654	143,33355
14.IX	7	GW	1	52,94319	143,33915
14.IX	7	GW	2	52,94639	143,32434
14.IX	7	GW	1	52,96638	143,33768
14.IX	7	GW	3	52,98438	143,32371
14.IX	7	GW	1	53,00538	143,30784
14.IX	6	GW	2	53,07679	143,29202
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14.IX	5	GW	1	53,12788	143,29371
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14.IX	4	GW	1	53,14209	143,28718
14.IX	5	GW	1	53,14291	143,28834

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14.IX	5	GW	1	53,15733	143,27140
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14.IX	4	GW	1	53,20574	143,28453
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14.IX	4	GW	2	53,21355	143,27572
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14.IX	3	GW	2	53,21834	143,28961
14.IX	4	GW	1	53,23042	143,26829
14.IX	3	GW	2	53,23484	143,26968
14.IX	3	GW	2	53,23866	143,27592
14.IX	4	GW	1	53,24679	143,24870
14.IX	4	GW	1	53,24692	143,25457
14.IX	3	GW	3	53,25761	143,24382
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14.IX	3	GW	2	53,26806	143,23753
14.IX	3	GW	1	53,27563	143,24448
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14.IX	3	GW	1	53,30414	143,25658
14.IX	3	GW	1	53,30501	143,25297
14.IX	3	GW	1	53,32139	143,27949
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15.IX	8	GW	1	52,89323	143,35537
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15.IX	7	GW	1	52,96592	143,32251
15.IX	7	GW	1	52,97353	143,32487
15.IX	7	GW	2	52,97545	143,32483
15.IX	7	GW	1	52,99368	143,32166
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15.IX	7	GW	1	53,00038	143,30539
15.IX	7	GW	1	53,00041	143,30463
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15.IX	6	GW	1	53,02216	143,30878
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15.IX	3	GW	1	53,28118	143,23702
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17.IX	7	GW	1	52,94388	143,34250
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17.IX	6	GW	1	52,97167	143,36104
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17.IX	5	GW	1	53,08874	143,30171
17.IX	5	GW	1	53,08908	143,30275
17.IX	6	GW	1	53,09356	143,29962
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17.IX	5	GW	1	53,12666	143,28516
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17.IX	4	GW	1	53,13876	143,27877
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17.IX	5	GW	1	53,14162	143,28703
17.IX	5	GW	1	53,14268	143,29107
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17.IX	4	GW	1	53,20825	143,25444
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17.IX	3	GW	1	53,35235	143,19388
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18.IX	5	GW	2	53,14671	143,27609
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18.IX	1	GW	1	53,44782	143,21718
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19.IX	8	GW	1	52,87318	143,35233
19.IX	8	GW	4	52,88924	143,35134
19.IX	8	GW	2	52,91505	143,33984
19.IX	7	GW	1	52,94781	143,33250
19.IX	6	GW	1	53,04532	143,31343
19.IX	6	GW	1	53,05236	143,30748
19.IX	6	GW	2	53,05404	143,30732
19.IX	6	GW	1	53,08036	143,30186
19.IX	6	GW	1	53,08759	143,28397
19.IX	6	GW	1	53,08756	143,28703
19.IX	4	GW	1	53,08827	143,36103
19.IX	5	GW	1	53,09420	143,41594
19.IX	5	HP	1	53,12312	143,27725
19.IX	5	GW	1	53,12445	143,29085
19.IX	5	HP	1	53,12865	143,27342
19.IX	4	GW	1	53,14453	143,27666
19.IX	4	GW	1	53,15263	143,27364
19.IX	5	GW	2	53,15904	143,26751

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19.IX	4	GW	1	53,20590	143,25685
19.IX	5	GW	1	53,21135	143,32645
19.IX	4	GW	2	53,21702	143,25512
19.IX	4	GW	2	53,22337	143,25245
19.IX	4	GW	4	53,22340	143,25755
19.IX	3	GW	1	53,24604	143,24652
19.IX	3	GW	1	53,25163	143,27767
19.IX	3	GW	1	53,27761	143,24218
19.IX	3	GW	2	53,28046	143,27334
19.IX	3	GW	1	53,28864	143,25185
19.IX	2	GW	3	53,28904	143,39335
19.IX	2	GW	1	53,30276	143,26452
19.IX	2	GW	2	53,30378	143,24970
19.IX	3	GW	1	53,30849	143,22240
19.IX	3	GW	1	53,30838	143,23424
19.IX	3	GW	1	53,31244	143,22342
19.IX	2	GW	1	53,31121	143,29345
20.IX	2	GW	1	53,22195	143,29102
20.IX	3	GW	2	53,23372	143,27623
20.IX	3	GW	1	53,27406	143,22947
20.IX	3	GW	1	53,27844	143,22909
20.IX	2	GW	1	53,28675	143,22811
20.IX	3	GW	2	53,28848	143,26152
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20.IX	3	GW	1	53,32943	143,20846
20.IX	2	GW	1	53,33356	143,21070
20.IX	2	GW	2	53,33585	143,20583
23.IX	6	GW	2	53,05262	143,31076
23.IX	6	GW	1	53,05931	143,29617
23.IX	6	GW	2	53,07246	143,32078
23.IX	5	GW	1	53,08488	143,28754
23.IX	5	GW	1	53,09393	143,29167
23.IX	6	GW	1	53,10818	143,30495
23.IX	6	GW	2	53,10903	143,29679
23.IX	5	GW	1	53,12992	143,28521
23.IX	5	GW	1	53,15324	143,27537
23.IX	4	GW	1	53,16484	143,27846
23.IX	4	GW	2	53,17000	143,28013
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23.IX	4	GW	1	53,17309	143,26387
23.IX	4	GW	1	53,17616	143,29474

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23.IX	4	GW	2	53,20055	143,27390
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23.IX	4	GW	1	53,20594	143,27480
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23.IX	4	GW	1	53,20965	143,29140
23.IX	3	GW	1	53,28434	143,23945
23.IX	3	GW	1	53,32225	143,22438
23.IX	2	HP	1	53,33593	143,21174
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23.IX	2	GW	1	53,34567	143,22690
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25.IX	4	GW	1	53,20133	143,27792
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25.IX	4	GW	1	53,21383	143,27588
25.IX	4	GW	3	53,21571	143,24987
25.IX	3	GW	1	53,21649	143,28553
25.IX	4	GW	2	53,23056	143,27137
25.IX	4	GW	1	53,23107	143,24583
25.IX	4	GW	1	53,23124	143,24883
25.IX	3	GW	4	53,23401	143,26792
25.IX	3	GW	1	53,24829	143,28583
25.IX	3	GW	1	53,24964	143,24195
25.IX	3	GW	1	53,25800	143,23752
25.IX	3	GW	3	53,26625	143,24283
25.IX	3	GW	1	53,26684	143,23291
25.IX	3	GW	3	53,26756	143,25018
25.IX	3	GW	1	53,29520	143,22474
25.IX	3	GW	1	53,31104	143,21510
25.IX	3	GW	1	53,31157	143,22489
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25.IX	2	GW	2	53,32527	143,21123
25.IX	3	GW	1	53,32905	143,21830
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25.IX	3	GW	1	53,34290	143,29594
25.IX	2	GW	3	53,35472	143,29309
25.IX	3	GW	1	53,36240	143,31653
26.IX	3	GW	1	53,23534	143,27691
26.IX	3	GW	1	53,24034	143,28365
26.IX	3	GW	1	53,25189	143,27654

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26.IX	2	GW	1	53,33771	143,20169
26.IX	2	GW	2	53,34502	143,19637
27.IX	7	GW	1	52,97459	143,34010
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27.IX	5	GW	1	53,12261	143,33669
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27.IX	6	GW	1	53,14241	143,31745
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27.IX	3	GW	1	53,22490	143,27507
27.IX	4	GW	1	53,24643	143,27023
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27.IX	3	GW	1	53,25087	143,27582
27.IX	3	GW	1	53,26353	143,23166
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27.IX	2	GW	2	53,27184	143,27481
27.IX	3	GW	2	53,27579	143,27016
27.IX	3	GW	1	53,28725	143,23886

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5.VIII	9	GW	1	52,81591	143,33696
5.VIII	9	GW	2	52,82315	143,34518
5.VIII	9	GW	1	52,82927	143,35679
5.VIII	9	GW	1	52,82982	143,35387
5.VIII	9	GW	1	52,83373	143,35301
5.VIII	9	GW	1	52,83453	143,34064
5.VIII	9	GW	1	52,83835	143,34884
5.VIII	9	GW	1	52,84254	143,35172
5.VIII	9	GW	2	52,84303	143,34357
5.VIII	9	GW	2	52,84292	143,35099
5.VIII	9	GW	1	52,84640	143,33988
7.VIII	12	GW	1	52,56394	143,36080
7.VIII	11	GW	1	52,63599	143,34408
7.VIII	11	GW	1	52,63735	143,35093
7.VIII	11	GW	1	52,64094	143,35301
7.VIII	10	GW	2	52,71114	143,33384
7.VIII	10	GW	1	52,74324	143,35650
7.VIII	10	GW	1	52,77946	143,34744
7.VIII	9	GW	1	52,81057	143,33963
7.VIII	10	GW	1	52,81104	143,33287
7.VIII	9	GW	1	52,81390	143,35221
7.VIII	9	GW	1	52,81431	143,35313
7.VIII	9	GW	1	52,81542	143,34570
7.VIII	9	GW	1	52,81600	143,34737
7.VIII	9	GW	1	52,81719	143,35813
7.VIII	9	GW	1	52,81772	143,35121
7.VIII	9	GW	2	52,82448	143,35457
7.VIII	9	GW	1	52,82651	143,34680
7.VIII	9	GW	1	52,82665	143,34690
7.VIII	9	GW	1	52,83149	143,34787
7.VIII	9	GW	2	52,83663	143,34553
7.VIII	9	GW	1	52,83674	143,34770
7.VIII	9	GW	1	52,84815	143,34712
8.VIII	13	GW	1	52,45087	143,29201
8.VIII	10	GW	1	52,74086	143,33726
8.VIII	10	GW	2	52,75864	143,32946
8.VIII	10	GW	1	52,77417	143,33368
8.VIII	10	GW	2	52,77428	143,33288
8.VIII	10	GW	1	52,77438	143,33208
8.VIII	9	GW	1	52,79358	143,32728
8.VIII	9	GW	2	52,80941	143,33940
8.VIII	9	GW	1	52,81187	143,34946
8.VIII	9	GW	1	52,81414	143,34399
8.VIII	9	GW	1	52,81775	143,34658
8.VIII	9	GW	1	52,83098	143,34739
8.VIII	9	GW	1	52,84728	143,35240
9.VIII	13	GW	1	52,45074	143,29091
9.VIII	10	GW	3	52,78418	143,34228
9.VIII	10	GW	1	52,78457	143,34010
9.VIII	9	GW	1	52,81151	143,35121
9.VIII	9	GW	2	52,81348	143,34445
9.VIII	9	GW	1	52,81415	143,34680
9.VIII	9	GW	2	52,81461	143,34817
9.VIII	9	GW	1	52,81529	143,34992
9.VIII	9	GW	1	52,81708	143,34679
9.VIII	9	GW	1	52,82221	143,34545
9.VIII	9	GW	1	52,83647	143,35004
9.VIII	9	GW	1	52,85107	143,34186
9.VIII	9	GW	1	52,85624	143,34567
18.VIII	10	GW	1	52,75733	143,34504
18.VIII	9	GW	1	52,82686	143,35022
18.VIII	9	GW	1	52,83568	143,34853
19.VIII	13	HP	1	52,47680	143,30170
19.VIII	10	GW	2	52,77167	143,33823
19.VIII	10	GW	1	52,77183	143,33751
19.VIII	9	GW	1	52,81766	143,33320
19.VIII	9	GW	2	52,82229	143,35264
19.VIII	9	GW	3	52,82470	143,35475
19.VIII	9	GW	1	52,82978	143,35651
19.VIII	9	GW	1	52,83069	143,35358
19.VIII	9	GW	1	52,83468	143,34431
19.VIII	9	GW	1	52,83559	143,35471
19.VIII	9	GW	1	52,83961	143,35004
20.VIII	9	GW	1	52,81599	143,33778
20.VIII	9	GW	2	52,81698	143,35035
20.VIII	9	GW	1	52,83136	143,35379
20.VIII	9	GW	1	52,83198	143,34796
20.VIII	9	GW	1	52,83763	143,34647
20.VIII	9	GW	1	52,85402	143,34611
20.VIII	9	GW	1	52,85416	143,34542
23.VIII	10	GW	1	52,74531	143,34189
23.VIII	9	GW	1	52,81466	143,33414
23.VIII	9	GW	2	52,82072	143,34218
23.VIII	9	GW	1	52,82124	143,34350
23.VIII	9	GW	1	52,82815	143,35076
23.VIII	9	GW	2	52,82867	143,34927
23.VIII	9	GW	1	52,83075	143,34942
23.VIII	9	GW	1	52,83288	143,35047
23.VIII	9	GW	2	52,83584	143,34192
27.VIII	10	GW	2	52,77307	143,33570
27.VIII	10	GW	2	52,77345	143,33339
27.VIII	9	GW	1	52,81523	143,33671
27.VIII	9	GW	1	52,81802	143,34173
27.VIII	9	GW	2	52,82625	143,34934
27.VIII	9	GW	1	52,82766	143,35007
27.VIII	9	GW	1	52,83050	143,34656
27.VIII	9	GW	1	52,83135	143,35043
27.VIII	9	GW	1	52,83390	143,35392
27.VIII	9	GW	1	52,83591	143,35598
27.VIII	9	GW	1	52,84460	143,34937

1	2	3	4	5	6
27.VIII	9	GW	1	52,85053	143,34163
28.VIII	10	GW	1	52,75818	143,32811
28.VIII	10	GW	1	52,81002	143,35563
28.VIII	9	GW	2	52,81966	143,34127
28.VIII	9	GW	1	52,82056	143,36353
28.VIII	9	GW	1	52,82240	143,35033
28.VIII	9	GW	1	52,82258	143,35055
28.VIII	9	GW	1	52,82292	143,34802
28.VIII	9	GW	1	52,82645	143,35365
29.VIII	10	GW	1	52,73373	143,38009
29.VIII	9	GW	3	52,81765	143,35999
29.VIII	9	GW	1	52,81794	143,36035
29.VIII	9	GW	1	52,82072	143,35659
29.VIII	9	GW	1	52,83647	143,35145
29.VIII	9	GW	1	52,84802	143,34965
29.VIII	9	GW	1	52,85044	143,35961
29.VIII	9	GW	1	52,86310	143,35656
29.VIII	9	GW	1	52,86604	143,33232
1.IX	13	GW	2	52,50823	143,33124
1.IX	12	GW	2	52,52912	143,32956
2.IX	12	GW	1	52,52873	143,32981
2.IX	9	GW	1	52,81791	143,34355
2.IX	9	GW	1	52,81956	143,33625
2.IX	9	GW	2	52,82260	143,33790
2.IX	9	GW	2	52,83582	143,38860
2.IX	9	GW	1	52,83997	143,34893
3.IX	11	GW	1	52,66722	143,33088
3.IX	10	GW	1	52,74362	143,34357
3.IX	10	GW	1	52,74395	143,34674
3.IX	10	GW	1	52,74830	143,34698
3.IX	10	GW	1	52,76985	143,34189
3.IX	9	GW	1	52,81983	143,34811
3.IX	9	GW	1	52,82704	143,34423
3.IX	9	GW	2	52,83494	143,34371
3.IX	9	GW	1	52,84378	143,33590
3.IX	9	GW	1	52,84894	143,34038
5.IX	9	GW	1	52,82214	143,34648
5.IX	9	GW	1	52,82228	143,34670
5.IX	9	GW	1	52,82423	143,35181
5.IX	9	GW	1	52,83791	143,35760
5.IX	9	GW	1	52,83917	143,35638
5.IX	9	GW	1	52,85140	143,35617
5.IX	9	GW	1	52,85854	143,36762
6.IX	9	GW	1	52,80025	143,36710
6.IX	9	GW	2	52,82384	143,35487
6.IX	9	GW	1	52,83377	143,35090
6.IX	9	GW	1	52,83396	143,35080
6.IX	9	GW	1	52,83848	143,34910
6.IX	9	GW	1	52,83907	143,35703
12.IX	13	GW	1	52,46985	143,32551

1	2	3	4	5	6
14.IX	12	GW	1	52,57520	143,35426
14.IX	11	GW	1	52,66620	143,34592
14.IX	11	GW	1	52,67466	143,34437
14.IX	10	GW	1	52,78216	143,32734
14.IX	9	GW	1	52,80592	143,33481
14.IX	9	GW	1	52,83477	143,34902
15.IX	9	GW	2	52,82063	143,34902
17.IX	13	HP	1	52,46833	143,28990
17.IX	9	GW	1	52,86199	143,35362
18.IX	10	GW	1	52,73674	143,36448
18.IX	9	GW	1	52,80909	143,35612
18.IX	9	GW	1	52,83176	143,35637
18.IX	9	GW	1	52,84878	143,36114
18.IX	9	GW	1	52,84907	143,36060
19.IX	11	GW	1	52,62084	143,35684
19.IX	10	GW	1	52,75546	143,36628
19.IX	10	GW	1	52,77145	143,34321
19.IX	9	GW	1	52,84975	143,34130
25.IX	10	GW	1	52,74700	143,38402
27.IX	9	GW	1	52,83641	143,35374

PHOTOGRAPHIC IDENTIFICATION OF THE WESTERN GRAY WHALE (*ESCHRICHTIUS ROBUSTUS*) OFFSHORE NORTHEASTERN SAKHALIN ISLAND AND SOUTHEASTERN SHORE OF KAMCHATKA PENINSULA, 2010

VOLUME II

RESULTS AND DISCUSSION[1]

Photo by Yuri Yakovlev

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REPORT
ON THE RESEARCH PROJECT

PHOTOGRAPHIC IDENTIFICATION OF THE WESTERN GRAY WHALE (Eschrichtius robustus) OFFSHORE NORTHEASTERN SAKHALIN ISLAND AND SOUTHEASTERN SHORE OF KAMCHATKA PENINSULA, 2010

Yu.M. Yakovlev, O. Yu.Tyurneva, V.V. Vertyankin

VLADIVOSTOK
2011

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3.1 PHOTOGRAPHIC IDENTIFICATION OF GRAY WHALES OFFSHORE NORTHEAST SAKHALIN ISLAND

3.1.1 Field Effort Results

The results of the photographic identification (photo-ID) field effort are presented in this section. These results are based on unprocessed data as described in the field notes recorded during photo-ID missions.

Photos and video footage from gray whales were taken from August 4 to September 27, 2010. The effectiveness of the photo-ID team largely depended on weather conditions. Photo-ID effort in 2010 was often interrupted because of extended periods of fog. Photo-ID work could also not be performed while the vessel was in transit, taking shelter against storms, or when other survey work was being conducted (e.g. benthic, disitrbution and acoustics studies).

Table 1 contains a summary of the photo-ID effort conducted during expeditions from 2002 to 2010. A day was counted as a survey day if a whale (or a group of whales) was photographed from either the Zodiac, while conducting dedicated photo-ID surveys, or opportunistically from the deck of the *Akademik Oparin* research vessel, when a gray whale was seen while the vessel was anchored or performing other research tasks. In 2010, the entire period of photo-ID activities was 20 days (including both work from the Zodiac and from the deck of the *Akademik Oparin)*. A total of 17 days were spent photographing whales from the Zodiac. The number and duration of missions[1], the number of whale sightings during a mission, the number of observed whales per sighting, the duration of each sighting, etc. were recorded in the respective field (Table 2 and Tables A1 and A2 in the Appendix).

[1] A mission is an interval of Photo ID work from the base vessel's deck or from the Zodiac (starting once the Zodiac is launched and ending when it returns to the base vessel)

Table 1. Photo-ID Effort (Counted by Days) in Expeditions Offshore Sakhalin Island, 2002-2010

Year	Dates	Expedition Duration (Days)	Total Number of Survey Days	Time in Transit (Days) (including Stormy Days and Port Calls)	Ship inactive due to Storm (days)	Photo-ID Days from Zodiac/ from Ship's Deck and Zodiac	Number of Missions (from Zodiac/ from Ship's Deck and Zodiac)	Number of Sightings from Zodiac	Number of Whales Seen from Zodiac/ from Ship's Deck	Total Number of Photos
2002	30.08 25.10	57	29	17	11	13/-	24	72	93/-	2602
2003	21.07 27.09	69	40	16	13	17/22	35	86	146/37	7482
2004	30.07 07.10	70	56	9	5	16/24	27	113	209/57	9647
2005	12.07 07.10	88	77	6	5	32/34	56	186	384/58	17600
2006	03.08 14.10	73	60	7	6	19/33	26/52	109	238/150	16703
2007	03.07 10.10	100	74	13	13	31/62	55/86	229	503/198	24230
2008	25.06 - 23.07 24.08 - 10.10	77	60	14	3	20/29	30/49	79	174/128	7713
2009	01.07 03.10	95	72	13	10	18/25	31/41	119	267/18	11146
2010	27.07. 05.10	71	52	12	7	17/20	27/33	133	253/11	13441

Table 2. Photo-ID Effort (Missions) and Number of Photographs Taken Offshore Sakhalin from the Zodiac in 2010

	Date	Mission No.	Area	Number of Photographs	Duration of Mission (hr: min)
	04.08.10	1	Piltun	381	3:15
	07.08.10	1	Piltun	180	1:54
	08.08.10	1	Piltun	278	3:16
	08.08.10	2	Piltun	1547	5:30
	09.08.10	1	Piltun	1171	3:22
	09.08.10	2	Piltun	518	2:02
	18.08.10	1	Okha	245	1:10
	20.08.10	1	Offshore	287	0:56
	23.08.10	1	Piltun	39	0:57
	23.08.10	2	Piltun	627	3:37
	25.08.10	1	Offshore	262	1:21
	26.08.10	1	Offshore	43	0:28
	27.08.10	1	Piltun	1451	5:06
	27.08.10	2	Piltun	239	2:05
	28.08.10	1	Piltun	100	0:54
	28.08.10	2	Piltun	394	1:07
	28.08.10	3	Piltun	528	1:37
	28.08.10	4	Okha	1421	1:15
	04.09.10	1	Piltun	251	1:52
	05.09.10	1	Piltun	691	4:11
	05.09.10	2	Piltun	161	2:28
	06.09.10	1	Piltun	471	1:10
	06.09.10	2	Piltun	407	2:05
	12.09.10	1	Piltun	12	4:45
	19.09.10	1	Offshore	675	2:08
	19.09.10	2	Offshore	557	2:56
	27.09.10	1	Piltun	326	1:21
Total		27		13262	62:48

In 2010, whales were photographed from the Zodiac over a total of 17 days, of which 12 days in the Piltun area, 4 days in the Offshore area, and 2 days in the Okha area. Note that on August 28 photo-ID surveys were performed in the Piltun and Okha areas on the same day, see Table 3. The Okha area, where whales have not been encountered in great abundance since 2002, abuts the northernmost part of the Piltun area. For detailed descriptions of the study area see Volume I, Chapter 1 and 3..

Over the 2010 season, a total of 13,441 photographs were taken (Table 1) from the vessel and the zodiac. The total number of encountered gray whales was 264 (field data), including repeat sightings of the same whale during different missions. A total of 9772 whale photos were taken from the Zodiac only in the Piltun area, 1666 photos in the Okha area during two missions on August 18 and 28, and 1824 photos in the Offshore area. Six missions were conducted from the vessel deck in two of the areas (Piltun and Offshore) during the entire expedition period (3 of which were carried out on the same days as the Zodiac operations, and 3 on different days when the zodiac was not deployed), and 179 photos were taken of 11 encountered whales (including repeat sightings) over a period of 1 h 48 min in total. The average number of whale sightings per day of photo-ID effort was 14.88 from the Zodiac and 1.83 sightings from the deck of the main vessel.

Table 3. Descriptive Statistics of Photo-ID Work Carried out from the Zodiac during the 2010 Expedition to Sakhalin Island

Zodiac Operating Parameters	Piltun Area	Offshore Area	Okha Area	Total
Number of whale photo days*	12	4	2	17
Number of missions	20	5	2	27
Number of sightings	109	19	5	133
Total number of encountered whales	211	22	10	253
Average number of whales encountered per day	17.6	5.5	5.0	14.9
Average number of whales encountered per sighting	1.9	1.2	2.0	1.9
Total duration of missions (hr:min)	54:06	8:15	2:25	64:46
Total duration of sightings (hr:min)	32:39.	4:52	:37	38:08
Average duration of sighting (minutes)	18.0	15.4	7.4	17.2
Total number of whale photos	9772	1824	1666	13262
Average number of whale photos per day	814.3	456.0	833.0	780.1
Average number of whale photos per mission	488.6	364.8	833.0	491.2
Average number of photos per sighting	89.7	96.0	333.2	99.7
Average number of photos per single whale (field data)	46.3	57.0	166.6	52.4

** On August 28, photo ID work was conducted both in the Piltun and Okha areas.*

Summary data on photographic and effort parameters and other survey characteristics are given in Tables A1 and A2 in the Appendix. Water depth measurements were taken at the places where whales were sighted in the Piltun, Offshore, and Okha areas (Table A3). The average water depth at whale sightings was 15.6 m in the Piltun area, 40.4 m in the Offshore area, and 36.2 m in the Okha area.

3.1.2 Photo-ID data analysis

Whale counts and numbers in the following results section is based on post-processed and photo-identified (matched) data. These numbers vary from the field observations, as these don't include repeat sightings.

3.1.3 Identification and the Numbers of Individual Animals

Of particular interest is not only the information gathered relating to new whales, but also data pertaining to whales that have been identified in previous years,, since combining these data provide more extensive and detailed information about individual animals. Data regarding the number of whales identified offshore the northeast coast of Sakhalin over the study years of 2002-2010 are given in Table 4.

Table 4. Numbers of Whales Identified during 2002-2010 Offshore Northeast Sakhalin Island

Year	Number of Whales (total for year)[1]	2002***	2003	2004	2005	2006	2007	2008	2009	Number of New Whales Per Year	Number of Whales from Previous years not Sighted in Current Year[1]	Number of Whales in Catalogue
A	B=C+D+E+F+ G+H+I+J+**K**	C	D	E	F	G	H	I	J	K	L	**M=B+L**
2002	47									47*		47
2003	82	35								47	10	92
2004	96*	39	33*							24	22	118
2005	117**	41	40*	18						18	19	136
2006	121(5)	42	37	15	14					13(5)	27	148(5)*
2007	125(3)	40	39	16	10	7				13(3)	35(5)	160(8)*
2008	98	33	33	17	5	3	2			5	67(8)	165(8)*
2009	117	35	36	17	8	5	3	1		12	60(8)	177(8)*
2010	105 (2)	29	30	15	7	4	3	2	5	10(2)	82(8)	187 (10)

**Indicates that a better quality photograph was obtained and a temporary whale was matched during this field & laboratory season. The matched whale is added to the annual catalogue for the year in which the whale was first recorded as a temporary. The temporary whale sighting history was added to the annual catalog for the year in which the matched individual was first recorded*

The temporary whale sighting history (Temp000) is in the catalogue.

TempGW1 was first encountered in 2002 and was determined to be KOGW139 in 2008

TempGW2 was first encountered in 2003 and was determined to be KOGW135 in 2006

TempGW3 was first encountered in 2002 and was determined to be KOGW108 in 2008

TempGW4 remains in the catalogue

TempGW5 remains in the catalogue

TempGW6 remains in the catalogue

TempGW7 remains in the catalogue

TempGW8 remains in the catalogue

TempGW9 was first encountered in 2005 and was determined to be KOGW129 in 2008

TempGW10 was first encountered in 2004 and was determined to be KOGW116 в 2008 г.

TempGW11 remains in the catalogue

TempGW12 remains in the catalogue

[1]The bracketed values are counts of individual animals with a temporary identification number assigned (Table A7)

TempGW13 remains in the catalogue

TempGW14 was first encountered in 2007 and was determined to be KOGW158 in 2008.

TempGW15 was added to the temporary whale catalogue in 2010 due to the poor quality of the image of the right side

TempGW16 was added to the temporary whale catalogue in 2010 due to the poor quality of the image of the right side

***In 2009, six whales sighted by the shore-based behavioral team (BT) were added to the number of whales sighted by the vessel team (VT)*
**** First observed in year provided in column.*

Not every whale in the catalogue contains images of all four aspects (i.e. the right side, the left side, the dorsal fluke and the ventral fluke). The likelihood of obtaining complete coverage of all four aspects of each whale increases each year as more photographs are added to the catalogue. Table 5 (and Table A4 of the Appendix) present data related to the total number of aspects photographed per whale over all years of observations.

Table 5. Assessment of Photographic Coverage of Four Standard Aspects of Gray Whale Sightings Identified from 2002-2010 Offshore Sakhalin Island

Year		Aspects				Total
		4	3	2	1	
2002	Number	17	3	9	18	47[a]
	%	36.17%	6.38%	19.15%	38.30%	
2003	Number	42	11	21	8	82
	%	51.22%	13.41%	25.61%	9.76%	
2004	Number	52	12	26	6	96[b]
	%	54.17%	12.50%	27.08%	6.25%	
2005	Number	53	13	47	4	117[c]
	%	45.30%	11.11%	40.17%	3.42%	
2006	Number	59	16	40	11	126[d]
	%	46.83%	12.70%	31.75%	8.73%	
2007	Number	75	16	34	3	128[e]
	%	58.59%	12.50%	26.56%	2.34%	
2008	Number	41	15	31	11	98[f]
	%	41.84%	15.31%	31.63%	11.22%	
2009	Number	55	7	42	13	117[g]
	%	47.01	5.98	35.90	11.11	
2010	Number	41	17	36	13	107[h]
	%	38.32%	15.89%	33.64%	12.15%	
2002-2010	Number	123	16	46	12	197[i]
	%	62.44%	8.12%	23.35	6.09%	

[a] *Two whales photographed in 2002 were temporary whales that were issued catalogue ID #'s in 2009 increasing the total from 45 to 47 individuals included in the catalogue.*

[b] *One whale photographed in 2004 was a temporary whale that was issued a catalogue ID # in 2009 increasing the total from 95 to 96 individuals included in the catalogue.*

[c] *One whale photographed in 2005 was a temporary whale that was matched to a current catalogue whale decreasing the total from 118 to 117 individuals included in the catalogue.*

[d] *Five whales photographed in 2006 were temporary whales for a total of 126 whales sighted with 121 individuals included in the catalogue*

e Three whales photographed in 2007 were temporary whales for a total of 128 whales sighted with 125 individuals included in the catalogue.

f In 2008 there were no temporary whales were photographed for a total of 98 whales, with 98 individuals included in the catalogue.

g In 2009, no temporary whales were photographed, so there are a total of 117 whales in catalogues including whales photographed only by the behavior team.

h In 2010, two temporary whales were photographed for a total of 107 whales, with 105 animals included in the catalogue

i In 2002-2010, ten temporary whales were photographed for a total of 197 whales, with 187 animals included in the main catalogue.

** Of these 10 temporary whales that have only one photographed aspect, 5 individuals had their right side photo included in the annual catalogue. The other five animals were catalogued with only their left side photographs. All of them were assigned temporary numbers because of the lack of a high-quality right- side photo.*

Calves rarely show their flukes, hence generally only their sides were photographed (Yakovlev and Tyurneva 2003). Over all the years of observations, no cow/calf pair has been sighted in the Offshore feeding area. Whales feeding in deeper waters of the offshore area showed their flukes more frequently than whales in the shallow Piltun area and were therefore easier to completely photograph all four aspects.

As a result of photo-ID effort in 2002-2010, the current catalogue of western gray whales of the Marine Biology Institute of the Far Eastern branch of the Russian Academy of Sciences (IBM FEB RAS) contains 185 identified whales that are either fully (with all four aspects) or otherwise well described (two or three aspects), and two whales only photographed on the right side, plus 10 temporary whales (Table A4).

3.1.4 Whale Group Size and Age Distribution

Table 6 and Figure 1 display information on gray whale group sizes of all previous years. It shows that in 2010, the observed group sizes of whales changed compared to previous years. The percentage of solitary individuals increased compared to 2008 and 2009, but is still lower than pre-2008 values., Especially noteworthy was the drop in the number of groups of three in comparison with 2009, specifically, as well as compared to previous years. The largest group sighted during photo-ID efforts in 2009 consisted of six whales, and was recorded once in the Piltun area. In 2007 and 2009, large groups consisting of 12 and 11 whales, respectively, were recorded.

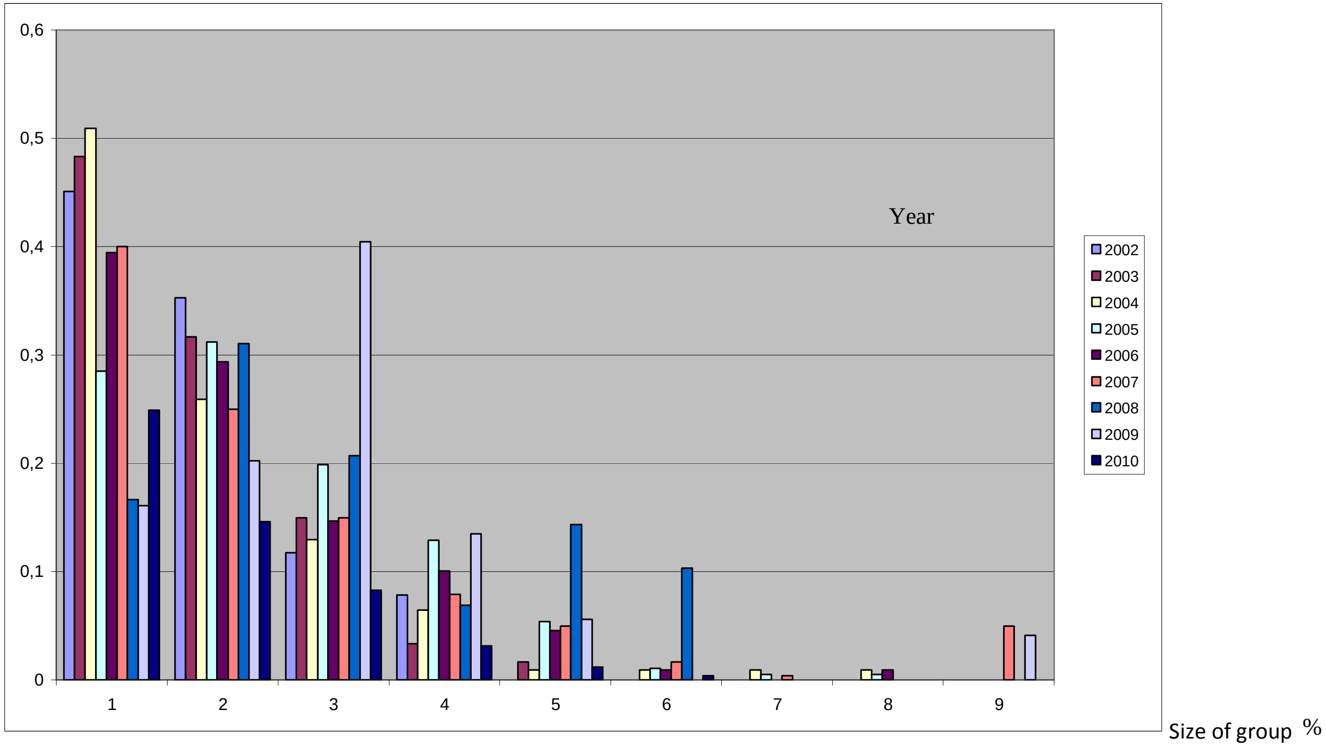


Figure 1. Percentage of Animals in Groups Relative to the Total Number of Whales Sighted Offshore Sakhalin, 2002-2010 (Field Data)

Table 6. Gray Whale Group Size and Sighting Rates in Known Feeding Areas, Based on Photographs Taken Only from the Zodiac Offshore Sakhalin in 2003-2010 (Field Data)

	Number of Groups in 2003	% Sighted in 2003	Number of Groups in 2004	% Sighted in 2004	Number of Groups in 2005	% Sighted in 2005	Number of Groups in 2006	% Sighted in 2006	Number of Groups in 2007	% Sighted in 2007	Number of Groups in 2008	% Sighted in 2008	Number of Groups in 2009	% Sighted in 2009	Number of Groups in 2010	% Sighted in 2010
All areas																
1	58	48.33	55	50.93	52	28.11	43	39.45	96	40.00	28	16.20	43	16.10	63	24.90
2	38	31.66	28	25.93	57	30.81	32	29.36	60	25.00	27	31.20	27	20.22	37	29.25
3	18	15.00	14	12.96	37	20.00	16	14.68	36	15.00	12	20.80	36	40.45	21	24.90
4	4	3.33	7	6.48	25	13.51	11	10.09	19	7.91	3	6.90	9	13.48	8	12.65
5	2	1.66	1	0.93	10	5.41	5	4.59	12	5.00	5	14.50	3	5.62	3	5.93
6			1	0.93	2	1.08	1	0.92	4	1.66	3	10.40			1	2.37
7			1	0.93	1	0.54			1	0.41						
8			1	0.93	1	0.54	1	0.92								
11									1	5.00						
12													1	4.12		
Total:	120		108		185		109		229		173		119		133	
Offshore area																
1	33	56.89	4	100.00	1	50.00	8	50.00	16	38.10	11	6.40	4	3.36	11	34.38
2	13	22.41			1	50.00	2	12.50	6	14.29	11	12.70	4	3.36	4	25.00
3	10	17.24					3	18.75	9	21.43	3	5.20	10	8.40	3	28.13
4	2	3.44					1	6.25	5	11.90	4	4.60	3	2.52	1	12.50
5							1	6.25	1	2.38						
6							1	6.25	3	7.14						
7									1	2.38						
11									1	2.38						
12													1			
Total:	58		4		2		16		42		50		22		19	
Piltun area																
1	25	40.32	51	50.00	51	28.02	33	37.93	78	43.10	16	9.20	39	32.77	50	23.70
2	25	40.32	28	26.42	56	30.77	30	34.48	52	28.73	16	18.50	21	17.65	32	30.33
3	8	12.90	14	13.21	37	20.33	13	14.94	26	14.36	9	15.60	25	21.01	16	22.75
4	2	3.22	7	6.73	24	13.19	8	9.20	13	7.18	1	2.30	4	3.36	7	13.27
5	2	3.22	1	0.94	10	5.49	2	2.30	11	6.08	5	14.50	2	1.68	3	7.11

	Number of Groups in 2003	% Sighted in 2003	Number of Groups in 2004	% Sighted in 2004	Number of Groups in 2005	% Sighted in 2005	Number of Groups in 2006	% Sighted in 2006	Number of Groups in 2007	% Sighted in 2007	Number of Groups in 2008	% Sighted in 2008	Number of Groups in 2009	% Sighted in 2009	Number of Groups in 2010	% Sighted in 2010
6			1	0.94	2	1.10			1	0.55	3	10.40			1	2.84
7			1	0.94	1	0.55										
8			1	0.94	1	0.55	1	1.15								
Total:	62		104		182		87		181		122		91		109	
Cape Elizabeth																
1					1	50.00										
2					1	50.00										
Total:					2											
Northern																
4					4	100.00										
Total:					4											
Chayvo area																
1							2	33.33	2	33.33	1	0.60				
2									2	33.33			2	1.68		
3									1	16.66			1	0.84		
4							2	33.33	1	16.66			2	1.68		
5							2	33.33					1	0.84		
Total:							6		6		1		6			
Okha																
1															2	20.00
2															1	20.00
3															2	60.00
Total:															5	

3.1.5 Repeat Sightings of Whales Offshore Northeast Sakhalin

In total, 208 whales were photographed offshore Sakhalin Island in 2010, taking into account repeat encounters (Table 7). The average number of sightings (sighting frequency) per whale for the 2010 season was 1.94. This was lower than in most years, but higher than in 2002 and 2003. The lower sighting frequency was likely due to the shorter field season and reduced number of workdays in comparison with recent years (Table 8).

Table 7. **Frequency** of Repeat Sightings of Identified Gray Whales (IDW) Near Sakhalin Island in 2010

Number of sightings per whale (A)	Number of whales with this number of sightings (B)*	Total number of whale sightings (A×B)
1	**50**	**50**
2	**28**	**56**
3	**19**	**57**
4	**5**	**20**
5	**5**	**25**
Total	**107**	**208**

** The number of whale sightings include TEMP whales.*

Repeat sightings of whales provide more information about whale movements, supply additional data for better matching of photographs, and allow researchers to track changes in the body condition of whales throughout the feeding season.

Analysis of the inter- and intra-year frequency of sightings of identified whales in 2002-2010 is of particular interest as patterns of habitat use can only be established by repeat encounters with the same individual over time. A higher sighting frequency results in a larger, more reliable data set, which in turn allows for better spatial and temporal data analyses. For example, repeat sightings of whales over the course of a day and over the course of a season, provide important data on whale movement within feeding areas and the frequency of their visits to those areas. More detailed sighting data is provided in Tables A5 and A6 of the Appendix.

Table 8. Frequency of Repeat Sightings of Identified Gray Whales (IDW) Offshore Sakhalin, 2002-2010

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010
Number of whale sightings*	66	154	228	384	390	678	275	297	208
Number of IDW per year *	47	82	96	117	126	128	98	111	107
Average frequency of IDW sightings per season*	1.40	1.88	2.38	3.28	3.10	5.30	2.81	2.67	1.94

** includes temporary whales*

A detailed sighting history of whales during the 2002-2010 period is summarized in Tables A6 and A11 of the Appendix.

Repeat sightings of whales and photographing of whales over the course of a day, as well as sightings of the same whales over the course of a season, also provide important data on whale movements within their feeding areas and the dynamics of their visits to these areas.

3.1.6 Frequency of Sightings and Movement of Identified Whales between Known Feeding Areas Offshore Sakhalin Island

Whale movement patterns between the coastal Piltun and Offshore feeding areas have been studied based on repeat sightings of identified animals in both areas over the entire survey period (Figure 2, A2; and Table 9, A5).

In the Offshore area, a smaller number of whales were identified in 2010 compared to previous years (excluding 2004 and 2005), but this can be attributed to the reduction of working hours designated for photo-ID due to limited vessel time for photo-ID combined with bad weather conditions that were encountered throughout the entire field season. For example, offshore observers and the photo-ID group noted large conglomerations of gray whales in the Offshore area but were unable to photograph them. Nonetheless, the number of identified whales in that area is comparable with results obtained in 2002, 2003 and 2006, and 2009 (Table 9). A major increase in whale abundance in this area was observed in 2007 and 2008.

During the entire 2010 Photo ID period, there were six working days in the Offshore area, which involved photos taken both from the Zodiac (4 days) and from the base ship (5 days). Twenty five sightings of 21 individual whales were recorded in this area, including repeat encounters (Table 3 and Table A5). Nine whales were seen in the Offshore area only (i.e. they were not recorded in the Piltun or Okha areas) (Tables 3, 9, A5, and Figures 2, A2).

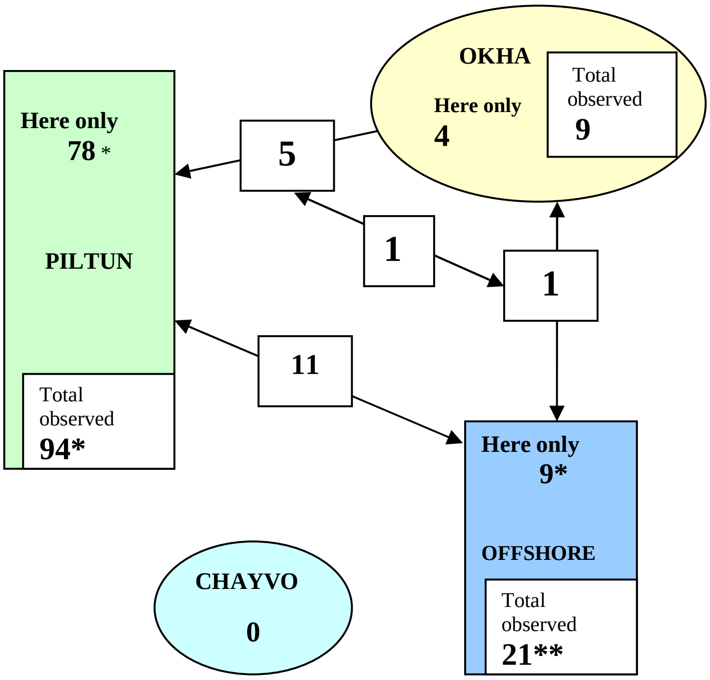
The research team spent 12 days in the Piltun area, during which photo identification was conducted for 12 days from the Zodiac and only one day from the base ship. In total, 174 sightings of 94 individual whales were recorded including repeat encounters. Seventy-eight individuals were only seen in the Piltun area.

A redistribution of photographed whales within known feeding areas (Piltun and Offshore) was observed in 2010. For example, Offshore Sakhalin 5 whales were recorded at the Arkutun-Dagi site (3 of which were only encountered here), although in previous years no whales had been observed in this region.

In the Piltun feeding area, whales were observed in the north (North Piltun) beyond the 20-meter isobath (Tables 3, 9, and Figure 2; Tables A5, A6, and A2). A similar distribution was observed in 2004 and 2005, but at that time there was a sharp drop in the number of whales in the Offshore area (Tables 3 and 9).

In August 2010, gray whales were observed in the area located adjacent to the town of Okha (Figures 2 and A2). Two photo-ID surveys were conducted in this area, which resulted in 9 individual whales being photographed, 4 of which were not sighted in other areas during the rest of the field season (Table 7, Figures 2 and A2). The researchers did not observe any feeding whales in this area. These were possibly transient whales coming from the north.

In the shallow-water area adjacent to Chayvo Bay, not a single whale was recorded in 2010, despite the fact that in 2006, 2007, and 2009 a large number of them were sighted there (Tables 9, and Figure 2, Tables A5, A6, and Figures A2).



* The number of whales observed in the Piltun area included whales observed in North Piltun. A total of 11 whales were sighted in North Piltun, including 3 that were only observed there.
** The number of whales observed in the Offshore area included the Arkutun-Dagi sightings. A total of 5 whales were sighted in Arkutun-Dagi, including 3 that were only observed there.

Figure 2. Whale Movement within the Known Feeding Areas Offshore Northeast Sakhalin Island in the Summer/Autumn Season of 2010

Table 9. Whale Movement among the Feeding Areas Offshore Northeast Sakhalin in 2002-2010*

Year	Number of Whales Identified in the Piltun Area	Number of Whales Identified in the Offshore Area	Number of Whales Identified in the Offshore and Piltun Areas	Number of Whales Identified in the Chayvo Area	Number of Whales Identified in the Chayvo/Piltun and Chayvo/Offshore	Number of Whales Identified in Northern areas	Number of Whales Identified in the Chayvo/Piltun/Offshore	Number of Whales Identified Near Okha
2002	13(12)	35(34)	1					
2003	51(47)	35(31)	4					
2004	95(89)	7(1)	6					
2005	115(105)	7(1)	6			5 (1)		
2006	105(67)	33(14)	17	28(7)	19/0		2	
2007	103(45)	71(25)	38	20	12/0		8	
2008	61(35)	62(36)	25	1(1)				
2009	79(60) 6(6)**	39(24)	13	14(6)	6/2			
2010	94(78)	21(9)	11	-	-	-		9(4)

** Numbers include TEMP whales. Values in parenthesis indicate the number of animals reported only in the specified area and not sighted in other surveyed areas. Numbers in table can change annually to reflect updates to the catalogue, for example due to matched temporary whales.*

***Bottom row indicates whales encountered by the behavior team only.*

During the nine years of this photo-ID study, use of the Offshore feeding area by gray whales varied in intensity. In 2004 and 2005, smaller numbers were observed in the Offshore feeding area compared to other years (Table 9).

In 2005, whales were sighted in two new areas along northern Sakhalin when the research vessel was traveling northwards to take shelter from a predicted storm (Yakovlev and Tyurneva 2006). In the first area north of the town of Okha, four whales were identified, of which one was new to the catalogue and had been seen earlier in the season in the Piltun area. Two whales from this group were observed in the Piltun area both earlier and later in the same season. These whales also had been sighted in the Piltun and Offshore feeding areas in previous years and were sighted again in these areas in subsequent years. One animal from the group was sighted once in 2005 in the new (northern) area after which it was encountered annually. In the second area, west of Cape Elizabeth in Severny Bay, two whales were sighted, but only one could be photographed and identified. This animal was new to the catalogue and was not sighted again in later years (Tables A5, A6 and A7 of Appendix).

In the following years, no encounters of gray whales were recorded offshore northern Sakhalin north of Okha and west of the Cape Elizabeth (Table 9).

In 2006, a total of five gray whales were photo-identified in the Offshore area in August. By mid-September of the same year, the number of sightings increased, so that we were able to photograph and identify 33 animals. In 2007, the number of photo-identified whales in the Offshore area reached 71, which was the highest number of photo-identified whales in that area over all the survey years (Table 7). In 2008, 62 animals were photo-identified in the Offshore area. It is possible that more whales were feeding here, but they were not captured on photographs because of unfavorable weather conditions and the necessity to perform other tasks as part of the integrated program.

Thirty-three sightings of 28 individual gray whales were recorded in the shallow waters adjacent to the Chayvo Bay in 2006 (Chayvo area). Seven of the identified animals that year were sighted only in that area (Table 9). In 2007, a smaller number of whales were recorded in the Chayvo area compared to 2006, with only 20 animals observed (Table 9). In 2008 only one whale was photographed in the Chayvo area

(Table 9). Vessel- and shore-based marine mammal surveys also indicated that whales were not present in Chayvo area in 2008.

Over all the years of this study (2002-2010), 97 whales were sighted in both the Piltun and Offshore feeding areas (Table 9). A total of 94 whales were recorded only in the Piltun area during the period 2002 to 2010, and 5 whales only in the Offshore area (not including temporary whales).

3.1.7 Cow/Calf Pairs

In addition to monitoring the size of the western gray whale population, it is very important to determine the number of cows with calves and determine their health status through external physical indicators, such as body weight and skin condition.

In 2010, four cow/calf pairs and four calves without mothers were recorded. All cows and calves were assigned reliability grades as discussed in Volume I, Chapter 3. Table 10 summarizes the results of this classification.

Table 10. Occurrence of Cow/Calf Pairs and Calves Encountered without Mothers near Sakhalin Island in 2010, with the Assigned Reliability Grades

Calf Catalogue ID (KOGW)	Number of observation days	Reliability Grade and Criteria Used	Total Grade	Cow Catalogue ID (KOGW)	Number of observation days	Reliability Grade and Criteria Used	Total Grade
178	1	A1,2,4+D3	A	93	1	**I** (2,3,4,5)	**I**
179	1	B1,2,4	B	63	1	**II** (2,3,4)	**II**
180	2	A1,2,3	A	7	2	**I** (1,3)	**I**
181*	1	C1,2,4,5	C	N/A	N/A	N/A	N/A
182*	3	C1,2,4,5	C	N/A	N/A	N/A	N/A
183	1	C1,2,4,5	C	N/A	N/A	N/A	N/A
184	2	A1,2,3	A	44	2	**I** (1,2,3)	**I**
187*	1	C1,2,4,5	C	N/A	N/A	N/A	N/A

** Evaluation of whales KOGW181, KOGW182, and KOGW187 will be revised in the Kamchatka section.*

During the 2010 field season cow-calf pairs were first recorded on August 8. Due to the relatively short field season and the low number of work days in 2010, the researchers were unable to determine the time that calfs separated from the mothers(Tables A5, A7 in the Appendix). One of the photo-identified mothers (KOGW063) had been recorded previously with calves in 2003 and 2007 (Table A7). Two females (KOGW093 and KOGW007) were identified as mothers for the first time in 2010. The IBM photo-ID team had not previously recorded KOGW044 with calves, but in previous years this female whale was repeatedly observed in the feeding area with a poor body condition (class 3 and 4).

One of the calves, whose mother could not be determined, was observed very close to an emaciated whale, but unfortunately this whale showed just its head and only later we were able to identify it as KOGW064 later (detailed information will be provided in the Kamchatka chapter). We know that this whale was recorded as a cow with calves in 2004 and 2007 (Table A7). Three calves unaccompanied by cows were encountered in calf groups.

The body conditions of all recorded calves were normal and did not exhibit signs of being underweight.

3.1.8 Body Condition

Body Weight

Starting in 2003, whales were assigned body condition (BC) classes based upon their physical condition using visual assessment. Since 2005, we have been able to observe individual whales with body weight deviations over an extended period of time. The body condition of most of the underweight whales was observed to improve over the course of the season (Yakovlev and Tyurneva, 2006; Yakovlev *et al.* 2007).

If an animal was observed with a higher BC class during the first sightings and the parameters improved during the subsequent sightings, we used the most recent data in calculating the total number of underweight whales.

Table 11 a. Body Condition of Sakhalin Island Gray Whales in 2010

BC Class	Number of Whales in Each BC Class in 2010	Percentage of Whales in Each BC Class in 2010
0	83	77.6
1	12	11.2
2	7	6.5
3	4	3.7
4	1	0.9

Classes II, III, and IV, i.e., whales with an poor body condition, are highlighted in green.

In 2010, a total of 12 whales were identified with a poor body condition, including 5 nursing cows (Table 11a). This is 11.1% of the total number of recorded whales for that year (Table 11). During the entire 2010 season (from August 4 to September 27), a total of 25 whales showed improvements in their BC class (Table A7 of Appendix). Figure 3 shows the overall improvement in body condition over the course of the 2010 season. A summary of body condition data collected from 2003 to 2010 is given in Table 11. All calves observed over all survey years were in normal physical condition and assigned Class 0 (Table A7 in the Appendix).

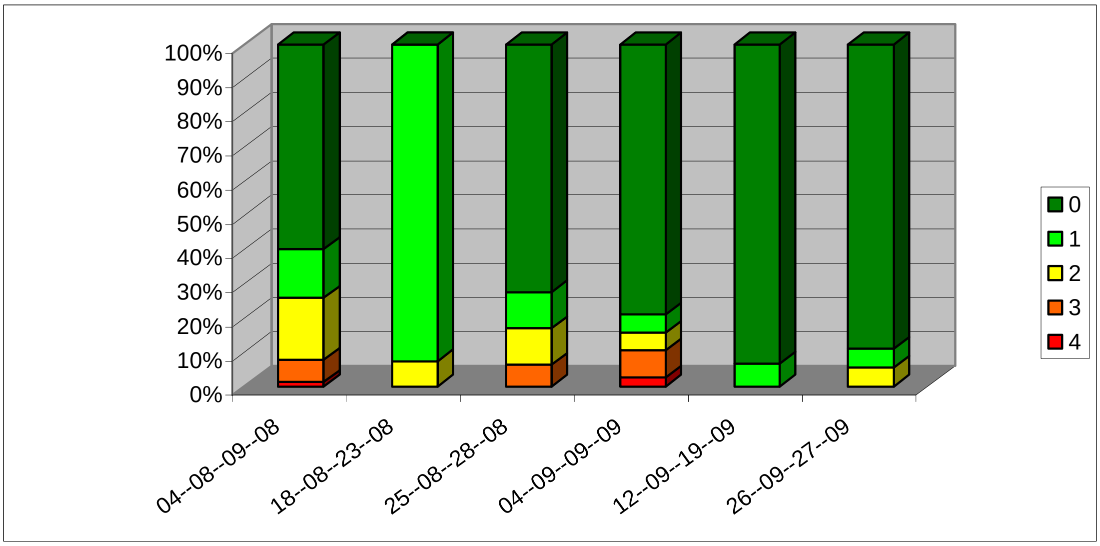


Figure 3. Percentage of Photo-identified Gray Whales within Each Body Condition (BC) Class Relative to the Total Number of Whales Sighted Offshore Sakhalin Island Averaged over 7-day Periods during the 2010 Field Season Offshore Sakhalin Island

Table 11. **Number of Whales with a Poor Body Condition (BC) Sighted off Sakhalin Island in 2003 - 2010**

Year	Total Identified Whales	Total Whales with Low BC Class	Percentage of Total Recorded Whales with Low BC Class	Number of Nursing Cows Recorded in Given Year
2003	82	15	18.3 %	9
2004	96	11	11.5 %	3

2005	117	10	8.6 %	3
2006	126	20	15.9 %	3
2007	129	13	10.1 %	6
2008	98	20	20.4 %	3
2009	111	19	17.1 %	3
2010	107	12	11.1 %	5

Note: Whales with temporary ID numbers in the catalogue were included in the number of whales for each BC class.

In 2010, we were able to track the body condition of animals that were identified in 2009 as cows with calves. The comparative data are presented in Table 12.

All cows with poor BC in 2009 that were sighted in 2010 showed improvement in their body condition from 2009 to 20010 (Table A7 of Appendix).

Of all eight calves that were observed in cow/calf pairs in 2009, five (62.5%) were sighted in good physical condition offshore Sakhalin in 2010 (Table A7 of Appendix).

Table 12. Inter-year Comparison of the Body Condition of Cows and Calves Offshore Northeastern Sakhalin, 2009-2010

	Number of Cows/calves in 2009	**Number of Underweight Cow/calves in 2009**	**Number of 2009 Cows/calves in 2010**	**Changes in BC from 2009 to 2010**	
				Improvement in BC	**Deterioration in BC**
Cows	6	6	5	5	0
Calves	8	8	5	5	0

Skin Sloughing

Skin sloughing of WGWs was observed for the first time in 2003 (Table A7 of Appendix). Whales that have been photographed with skin sloughing were monitored for other obvious changes in external appearance or physical condition. To date, annual visual assessments of the photographs of these whales did not find any atypical physical condition. In 2010, gray whale KOGW114 was observed with stage 2 skin sloughing. The whale was first recorded on August 23 without any signs of skin problems, but when sighted again on August 27 there were large areas with sloughed skin (Table A7). However, our visual assessments have shown that these areas do not appear to have any effect on health (Table A7).

Other Skin Condition Impairments

In 2006, whale KOGW028 (which was first identified in 2003) with the most marked skin sloughing, also showed irregular white spots on its body. The origin and nature of these spots is unknown. In 2007, this same whale was recorded with skin sloughing and with spots of the same shape as in 2006, but less distinct. This whale was photographed again in 2008 and the spots looked the same as in 2007. In 2010, KOGW028 was observed both off Kamchatka and off Sakhalin Island. No traces of the spots were seen, but the whale was in a very poor body condition (BC Class 4). In 2007, another 3 whales were observed with white spots for the first time that did not show this skin impairment. Two of them were also observed in 2010 offshore Sakhalin, and their white spots did not appear to have changed from three years ago. These large white spots can increase in size in a short amount of time, but they may also remain stable (Yakovlev *et al.* 2009).

3.2 Photo Identification of Gray Whales Offshore Eastern Kamchatka Peninsula

3.2.1 Field Effort Results

In 2010, Photo-ID studies were conducted in Olga Bay off the southeastern shore of the Kamchatka Peninsula. The first photographic surveys were conducted on June 22, and the last ones on August 10. During this period, 13 Photo-ID missions were made over a period of 13 days. Of these, 4 days were spent in June, 7 in July, and 2 in August. A total of 206 sightings (encounters) with 317 gray whales were recorded (field data) in 2010, and 16,862 photographs were taken.

Whales were observed at depths from 5 to 16 meters (average depth—10.7 m). The water temperature near the surface was 12-15 °C.

During the Photo-ID research on the shelf of the Kamchatka Peninsula in 2004 and 2006 to 2008, no repeat encounters of gray whales were recorded among the three surveyed areas. For example, whales encountered in the Khalaktyrskyi Beach area were not encountered in Olga Bay or in Vestnik Bay, and vice versa either during the same or during different years. However, in 2009, Photo-ID data showed for the first time that whales visited both Olga and Vestnik bays in different years. Whale KamGW016 was initially sighted in an inlet near Khalaktyrskyi Beach in 2004 was sighted in Olga bay (Table A10) in 2010.

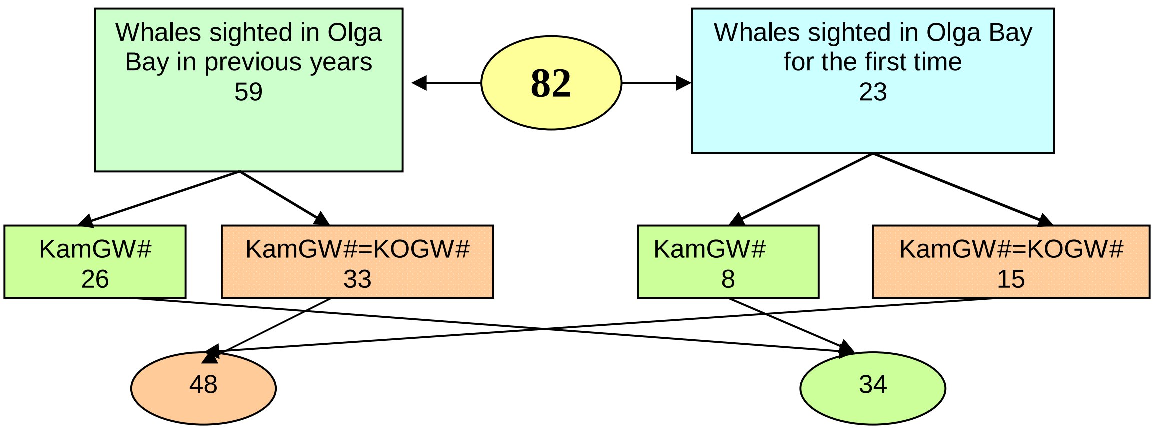
This same whale had been sighted offshore Sakhalin in previous years.

3.2.2 Identification and the Number of Individual Animals

During 13 days of work in 2010, a total of 117 sightings of gray whales were recorded in Olga Bay, out of which 267 whales were photographed, including repeat sightings of animals. The total number of individual whales identified excluding repeat sightings was 82 (Table A8 of Appendix).

Of these 82 whales, a total of 59 individuals had been previously encountered in Olga Bay (including TEMP02) and 23 animals were new for this area ~~(TEMP02 from 2009)~~. Forty-eight of these 82 whales were already included in the Sakhalin gray whale catalogue. Of these 48 whales with dual identification numbers (KamGW000/KOGW000), 33 whales had already been encountered off the Kamchatka Peninsula in previous years, while 15 were sighted here for the first time.

Thirty-four of the 82 whales recorded in Olga Bay in 2010 were seen only there, while 8 were encountered for the first time, i.e., they had not been recorded in Kamchatka or Sakhalin before (Figure 4).

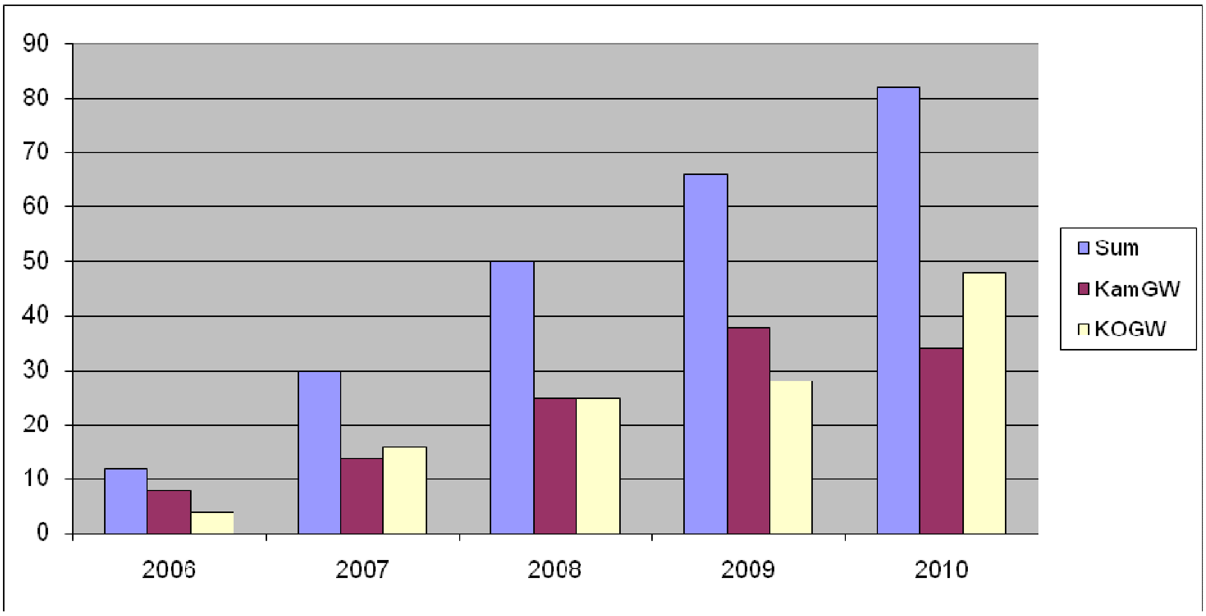


Whales encountered near the coast of Kamchatka have designations of the form KamGW000, while whales, observed on the continental shelf off Sakhalin have designations of the form KOGW000.

Figure 4. Gray Whales Recorded in Olga Bay in 2010.

KamGW000 are the whales observed off the Kamchatka coast, and KOGW000 is the indication of the whales seen offshore Sakhalin.

Figure 4 shows the number of whales photographed in the Olga Bay that were also recorded offshore Sakhalin in various years of studies (KOGW/KamGW) compared to the number of whales not sighted anywhere but offshore Kamchatka (KamGW).



**Whales marked as KamGW were recorded only offshore Kamchatka, whales marked as KOGW were also recorded offshore Sakhalin Island*

Figure 5. Annual Number of Identified Gray Whales in Olga Bay (Kamchatka)

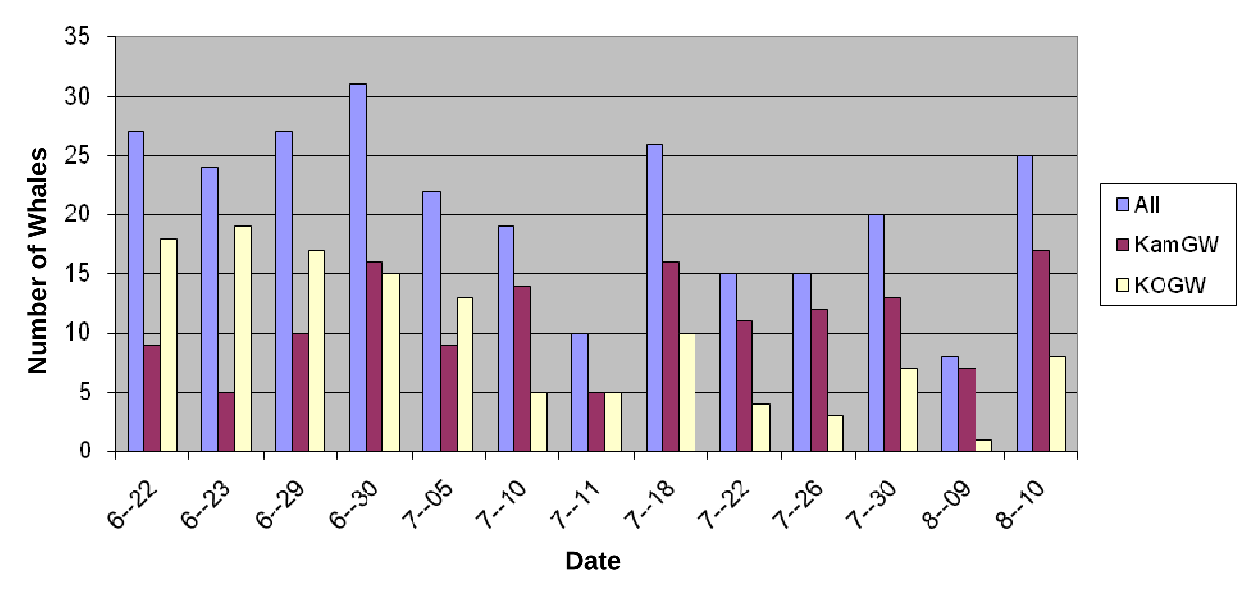
As can be seen from Figure 5, the number of whales identified in the Olga Bay has been observed to increase each year, which corresponded to the amount of field work, which has also increased each year and has also been linked to survey timing (Table 13).

Table 13. Number of Identified Gray Whales and Survey Period for Olga Bay Area, Kamchatka

Survey Period	No. of photo ID days	Number of Identified Whales
21-08 / 22-08 2006	2	12
02-08 / 05-08 2007	2	30
19-08 / 28-08 2008	5	50
11-07 / 02-09 2009	8	65 +2 (TEMP)
22-06 / 10-08 2010	13	82

In 2009, a simple data analyses demonstrated that the number of identified whales in Olga Bay is strongly linked to the season (Tyurneva *et al.* 2010). A gradual increase in the number of whales occurs prior to July 21 with a decline in numbers from that date onwards to September 2 (no surveys have been conducted after this date).

In 2010, fieldwork in Olga Bay began around the end of June and ended mid August (Figure 6, Table 13). This allowed us to track the trend in number of whales identified in the Sakhalin and Kamchatka area. Figure 6 shows that, even though the total number of whales dropped slightly by the end of the survey season, the percentage of whales identified from the two catalogues dropped significantly (Figure 7).



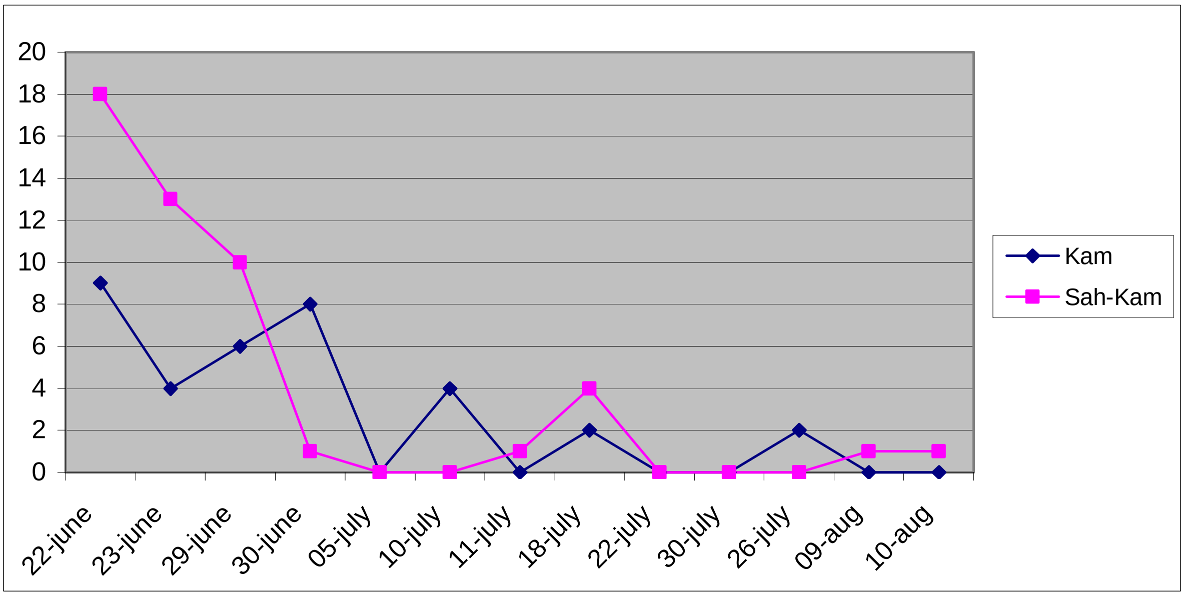
"KamGW" - whales only identified in the Kamchatka catalogue, "KOGW" - whales identified in both the Sakhalin and Kamchatka catalogues, and 'All" – all whales identified in Olga Bay

Figure 6. Number of Identified Whales in Olga Bay (Kamchatka) per Day* of Research in the 2010 Field Season.

The 2009 and 2010 surveys give a better picture of the seasonal variation in number of identified whales in Olga Bay. Understanding when whales are most abundant in the bay as well as the rate with which new individuals arrive or leave the bay helps to put the numbers of whales identified in previous seasons in perspective. It's very likely that shorter field seasons as well as later survey start dates are at least part of the reason for the lower numbers of identified gray whales in Olga Bay in the first couple years of the study.

Figure 7 shows that new whale sightings in Olga Bay in 2010 was highly dependent on the date of observations, with fewer new whales being photographed as the season progressed. This trend was similar in 2009. In 2010 82% of all observed whales in Olga Bay were seen before the end of June.

At present, the affiliation of each gray whale individual in Olga Bay is unknown. Although quite a large percent of whales are included in the IBM western gray whale catalogue, it is likely that some of them also belong to the eastern population.



"Kam" means whales only identified in the Kamchatka catalogue, "Sak-Kam" means whales identified in both the Sakhalin and Kamchatka catalogues.

Figure 7. Dates of first observation of whales in Olga Bay (Kamchatka) in 2010*.

3.2.3 Kamchatka Catalogue Assessment: Photographic Coverage of Four Standard Body Aspects

Each year of field work allows us to obtain a more detailed description of each individual as well as a more complete catalogue of the Kamchatka gray whale population. This annual updating of the catalogue allows us to improve the process of matching gray whales with earlier identified individuals from the Kamchatka and Sakhalin catalogues. The number of whales in the Kamchatka catalogue increases with every year of research. The photo-ID effort conducted in the period 2004, 2006-2010 resulted in a total of 140 whales being included in the Kamchatka catalogue. Of these 140 animals, 13 were described only by one (left or right) side of the body. If the Sakhalin catalogue contained the full description of an animal, then, even in the absence of the right side image, it was assigned an identification number in the Kamchatka catalogue. For example, 5 whales in the catalogue for 2004, and 2006-2010 were represented only by the left side, but they have well-described duplicates in the Sakhalin catalogue. If a whale was new for both catalogues and lacked high-quality image of the right side, it was assigned a temporary number (TEMP ##). The sole exception is individual TEMP01=KOGW015 that was defined by the head and front region based on the data obtained by researchers on the shelf of Sakhalin Island in 2009 and had no images of the aspects required for placement in the Kamchatka catalogue. The data on the completeness of documenting four standard photographed aspects of identified gray whales are given in Table A9.

3.2.4 Cow/Calf Pairs

During the 2004, 2006 and 2007 surveys, no cow/calf pairs were sighted offshore Kamchatka. In 2008, a cow and a calf were recorded in Olga Bay. The pair stayed in shallow waters (4.5-8.0 meters) while the Photo-ID work was being conducted. The mother had been recorded offshore Sakhalin in 2002-2006, and in the Olga Bay in 2007. She had already been reported as a mother with a calf in 2003. The calf was in body condition (BC) Class 1.

In 2009, the early start date of the research allowed more comprehensive data on the cow/calf pairs in Olga Bay to be collected. After processing the photographs, seven pairs were identified which are in agreement with the observations that were made by the field team (Tyurneva *et al.* 2010).

Table 14. Occurrence of Cow/Calf Pairs Offshore Southeastern Kamchatka Peninsula in 2010, with the Assigned Reliability Grades.

Calf Kam/KoGW	Sighting date	Reliability grade and criteria used	Total grade	Cow Kam/KoGW	Sighting date	Reliability grade and criteria used	Total grade
124/182	2010_06_22	A1.2,3	A	68/45	2010_06_22	**I**(1,3)	**I**
	2010_06_23			68/45	2010_06_23		
	2010_06_29			68/45	2010_06_29		
	2010_06_30			68/45	2010_06_30		
133/187	2010_06_23	A1.2,3	A	39/019	2010_06_23	**I**(1,3)	**I**
	2010_06_30			39/019	2010_06_30		
135/181	2010_06_29	A1,2,3	A	60/064	2010_06_29	**I**(1,2,3)	**I**
	2010_07_05			60/064	2010_07_05		

In 2010, three cow/calf pairs were recorded with a high reliability grade in Olga Bay. All three of the recorded mothers were encountered offshore Sakhalin Island and Kamchatka Peninsula in previous years (Tables A8, A10, A11). One female was photographed as mother with calves in the Piltun area in 2004 and 2007 (Table A7). The two other females had never been recorded as mothers.

The three cow/calf pairs in Olga Bay were observed at the start of the 2010 field season. The first observation was on June 22 and the last on July 5. Later in the season all three calves were recorded in the Piltun area (Sakhalin Island), at which time only one of them was encountered together with the mother. All three calves were first recorded there on August 8 (Table 10). These resightings of

Kamchatka calves in the Piltun area increased the identification reliability score of the cow/calf pairs sighted offshore Sakhalin (Table 15).

Table 15. Recording of Cow/Calf Pairs in 2010 in Olga Bay Offshore Southeastern Kamchatka and in Piltun Area Offshore Northeastern Sakhalin, and Identification Reliability Grades for the Pairs.

No. of calf in main catalogue KOGW000/KamGW000	Number of survey days: Sakhalin/Kamchatka	Reliability grade and criteria used	Reliability index	No. of cow in main catalogue KOGW000/KamGW000	Number of survey days: Sakhalin/Kamchatka	Reliability grade and criteria used	Reliability grade
178	1/0	A1,2,4+D3	A	93	1/0	**I** (2,3,4,5)	**I**
179	1/0	B1,2,4	B	63	1/0	**II** (2,3,4)	**II**
180	2/0	A1,2,3	A	7	2/0	**I** (1,3)	**I**
181/135	1/2	A1,2,3+D3	A	64/60	1/2	**I** (1,2,3)	**I**
182/124	3/4	A1,2,3+D3	A	45/68	0/4	**I** (1,3)	**I**
183	1/0	C1,2,4,5	C	n/a	n/a	n/a	n/a
184	2/0	A1,2,3	A	44	2/0	**I** (1,2,3)	**I**
187/133	1/2	A1,2,3+D3	A	19/39	0/2	**I** (1,3)	**I**

3.2.5 Body Condition

A total of 41 underweight gray whales (including 3 nursing mothers) were photographed in Olga Bay, totaling 35.4% of the total number of identified whales for that area. It should be noted that the BC classes in Table 16 are based on the last day the whales were sighted. Through the entire field season, there were 21 whales identified whose body condition improved. All the calves sighted during 2010 had normal body condition and were assigned to BC class 0.

The relatively high proportion of gray whales recorded on the Kamchatka Peninsula with poor physical body condition can, at least, partially be explained by the fact that they were first identified early in the field season (see Figure 8 and Table A8, Appendix).

Table 16 summarizes the body condition (BC) data for gray whales identified offshore Kamchatka in 2010.

Table 16. Body Condition (BC) Classes for the Whales Sighted in Olga Bay Offshore Kamchatka, 2010

BC Class	Number of whales of indicated BC class	Percentage of whales of indicated BC class
0	41	50.0
1	12	14.6
2	23	28.0
3	3	3.7
4	3	3.7

Classes 2, 3, and 4, highlighted in yellow, correspond to underweight animals.

3.2.6 Total Number of Whales Identified in 2010 Offshore Sakhalin Island and Kamchatka Peninsula

In 2010, out of the 187 individuals contained in the Sakhalin western gray whale catalogue of the MBI FEB RAS, 128 + 2 TEMP individuals were sighted offshore Sakhalin Island and Kamchatka Peninsula. The total number of gray whales from Kamchatka and Sakhalin catalogues identified in 2010 was 162+2 TEMP individuals, among which 80 + 2 TEMP whales were recorded in 2010 only offshore Sakhalin, and 57 whales only offshore Kamchatka Peninsula (out of which, 23 whales were recorded in the Sakhalin catalogue in previous years), and 25 whales were recorded in both areas.

3.2.7 Movement of Gray Whales between the Southeast Coast of Kamchatka and the Offshore Waters of Northeastern Sakhalin

Sighting data of whales identified both offshore Kamchatka and northeast Sakhalin Island are useful in that they provide informaton about an individual’s movement between summer feeding areas.

Five whales identified previously in feeding areas offshore northeast Sakhalin Island were observed offshore Kamchatka Peninsula during the survey periods in 2004 and 2006. Four of the whales were sighted in Kronotsky Gulf in Olga Bay. The fifth whale was photographed in Vestnik Bay in the SE part of Kamchatka Peninsula from a vessel performing tasks unrelated to the survey.

One more (a sixth) whale, which was identified in 2004 near Khalaktyrskyi Beach on Kamchatka Peninsula, in 2006 was identified offshore Sakhalin near Chayvo Bay. Two whales encountered in 2006 offshore Kamchatka were later recorded offshore Sakhalin during the same season (Tables A4 and A6, Appendix). One of these whales was first seen in Vestnik Bay in July of 2006, and then 50 days later was photographed in the Piltun area of Sakhalin Island. The second whale was recorded in August in Olga

Bay at Kamchatka, and then 39 days later was sighted in the Piltun area of Sakhalin Island. Data on all Kamchatka gray whale sightings are presented in Table A10 of the Appendix.

In 2007 in Olga Bay, 30 whales were photographed, and 14 of these were known Sakhalin whales. Seven of these 30 whales were sighted offshore Sakhalin later that same season (2007) (Tables A8 and A10, Appendix).

In 2007 in Vestnik Bay, 7 whales were recorded, and 6 of these were known Sakhalin whales. They were all sighted later offshore Sakhalin that same season (Tables A8 and A10, Appendix).

In 2008 in Olga Bay, 50 whales were recorded, including one whale that was also recorded in 2008 in both the Kamchatka and Sakhalin offshore areas. Of these 50 whales, 25 were known Sakhalin whales and were sighted in Kamchatka waters either in 2008 (1 whale) or in previous years.

Ten whales with double ID numbers (KOGW/KamGW) that had been recorded offshore Kamchatka in 2007 were later sighted offshore Sakhalin in 2008 (Tables A8 and A10, Appendix).

In 2009, in Olga Bay, 64 + 2 TEMP whales were identified, eight of these were also seen off Sakhalin in the same season, including one that was photographed after being stranded ashore on Sakhalin (Tables A4, A6, A8, and A10, Appendix) (Tyurneva *et al.* 2009). A whale that was first recorded in 2004 at Khalaktyrskyi Beach on Cape Nalychev (Kamchatka) and had not been sighted anywhere since that time, was photographed off Sakhalin in 2009. Of the seven calves recorded in Olga Bay in 2009, two were seen in the Piltun area in the same season, including one of them with its mother (Table A10). XXX of these calves were seen in the Piltun area in 2010.

Out of 11 whales identified in the Vestnik Bay in 2009, 10 were encountered offshore Sakhalin Island in the same year, with only one remaining off Kamchatka (Table A10).

In 2010, 25 whales were recorded that had moved from Olga Bay (Kamchatka) to Sakhalin Island in the same feeding season (Table A10, figure XX). Among these, there were three calves that were first identified in Olga Bay during the 2010 season. As described above, they were sighted in the Piltun area (Sakhalin) on August 8, 2010, and only one of them was with its mother.

Two whales (KamGW012 and KamGW020) that since 2006 were only seen in Olga Bay (Kamchatka), were identified for the first time off Sakhalin in 2010 and included in that catalogue.They were assigned numbers from the Sakhalin catalogue (Table A11).

Other interesting observations of all the whales that have been identified both offshore Kamchatka and Sakhalin are as follows:

- KamGW008 (KOGW095) was recorded as a yearling in 2004 in the Piltun area and has not been sighted offshore Sakhalin in subsequent years (Tables A8, A10, A11),
- KamGW010 (KOGW077) and KamGW026 (KOGW075) were recorded as calves in the Piltun area in 2003, and have since only been encountered in Olga Bay until 2010 when they were seen off Sakhalin (Tables A8, A10, A11),
- KamGW035 (KOGW124) was recorded as a calf in 2005 and then was sighted off Sakhalin in 2006, 2007, and 2010 (Tables A8, A10, A11),
- Eight whales that had been recorded offshore Sakhalin as calves in 2007 were sighted in 2008 offshore Kamchatka in Olga Bay,
- Of five calves recorded offshore Sakhalin Island in 2008, three were encountered in Olga Bay in 2009, and
- Of eight whales known as calves in 2009 and recorded off both Sakhalin and Kamchatka, five were sighted off Sakhalin and only one off Kamchatka in Olga Bay in 2010(Tables A8, A10, A11).

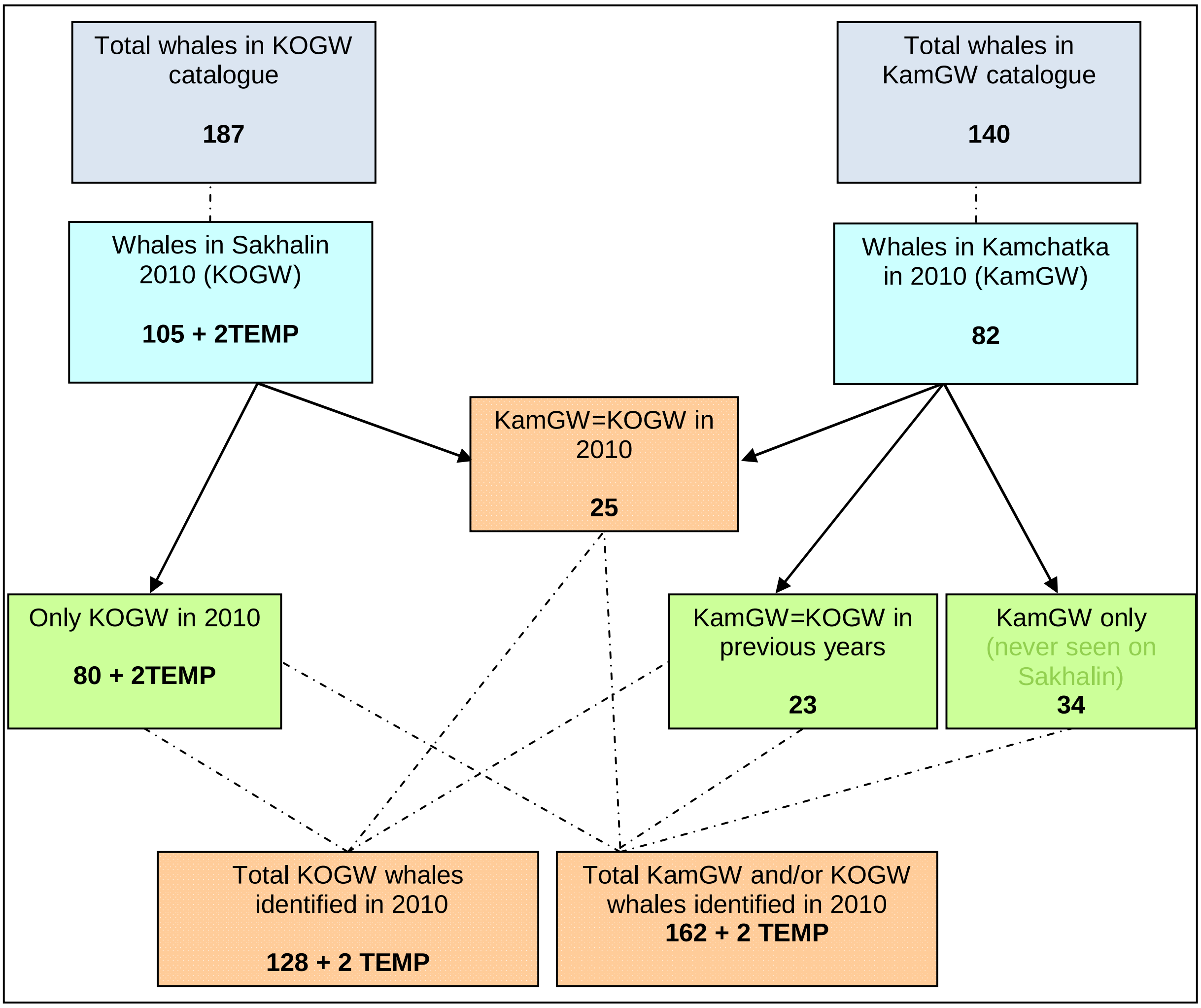


Figure 8. Population migration between the feeding grounds in 2010

3.3 DISCUSSION

3.3.1 General Whales Movement Among Feeding Areas

Photo-ID methods of whale populations are often used to determine habitat utilization by individuals. Tracking movements of gray whales during their feeding period can broaden the understanding of their feeding ecology. As the whales move between regions they target specific prey species in each area. Photo-ID sighting data can follow these whales through the seasons, and establish patterns of habitat use that can be useful for management and planning decisions.

The analyses of the 2002-2010 Photo-ID data collected offshore Sakhalin indicate that inter- and intra-year movements of gray whales occur both within the Piltun and Offshore areas and between these areas. Over all the years of this study (2002-2010), 97 whales were sighted in both the Piltun and Offshore feeding areas (Table 9). A total of 94 whales were recorded only in the Piltun area during the period 2002 to 2010, and 5 whales only in the Offshore area. We have also discovered movement to areas to the north and to the south off the Piltun region as well as to offshore Kamchatka (Yakovlev and Tyurneva 2008, Tyurneva *et al.* 2010, Tyurneva *et al.* 2010). Continuous long-term monitoring of whales and their movement is needed to be able to identify these spatial patterns (Meier *et al.* 2007; Vladimirov 2005, 2006, 2007, 2008a, b). As shown above, information about the whales' movement between areas over the course of a single season can only be provided by repeat sightings with individually recognized whales in that season. Similarly, individual gray whale sightings in one area during a season with re-sightings of the same animal in other areas in subsequent years provide information about inter-year movements.

The frequency of sightings over the entire survey period is an important factor in studying whale movement among different areas. In general, sample sizes for observational studies of cetaceans tend to be small due the challenging, costly, and time-consuming nature of this type of science. The benefit of a long-term monitoring program is that with increasing duration of the study, photographic re-capture of the same individuals increases over time, resulting in more sighting data allowing more robust analyses of patterns regarding whale movement and feeding area utilization.

By incorporating spatial data in the sighting histories of known whales and whale groups, habitat use patterns can be established over long-term studies. These baseline datasets are useful for continued monitoring of the whales and for recording any potential deviations in spatial or temporal use patterns that may arise in the future.

3.3.2 Whale Movement between Southeastern Kamchatka and Sakhalin

Of all whales identified in the surveyed areas offshore SE Kamchatka in 2004 and 2006 to 2010, about 56% (79 out of 140 +1 TEMP) were also photographed in different areas offshore Sakhalin. It is therefore likely that these whales are part of the western gray whale population. The question as to population affiliation of the other 44% (62 animals) sighted only offshore Kamchatka remains uncertain.

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The sightings described in paragraph « Movement of Gray Whales between the Southeast Coast of Kamchatka and the Offshore Waters of Northeastern Sakhalin»indicate that the visitation of known Sakhalin gray whales to the Kamchatka Peninsula, and their movement between these regions, both during the same season and among seasons, is common. It is likely that some of the gray whales enter Olga Bay to feed early in the feeding season and then later move to Sakhalin, and possibly to other feeding areas as well.

3.3.3 Whale Movement between Other Areas and Sakhalin

In 2006 in the Kekurny Bay and Babushkin Bay in the north of the Sea of Okhotsk, three whales were identified and were assigned catalogue ID numbers NOGW (Vladimirov *et al.* 2007). Later, in 2007, one of these, whale NOGW003 was sighted in Piltun (five sightings) and was given catalogue ID number KOGW160 (Tables A5, A6, A8 of Appendix).

In 2008, in the Zakatny Bay offshore Shiashkotan Island (Kurile chain) a joint survey from TIBOX and MBI FED RAS identified one whale that had been recorded previously in Olga Bay off Kamchatka in 2007. This whale was also later sighted in Olga Bay during the same season (Figure A4 of Appendix). Off Medny Island (Commander Islands) one whale was identified that had previously been recorded in Olga Bay and offshore Sakhalin in 2007. This whale was also later sighted in the Olga Bay in August 2008. Offshore of Karaginsky Island four new whales were identified and have not been sighted in any other location. (Figure A4 of Appendix).

Every year, whales are recorded as visiting both the Sakhalin and Kamchatka areas during the same season and/or during previous years. In 2006, for example, two whales were observed both offshore

Sakhalin Island and Kamchatka during the same feeding season. In 2008, 10 whales previously recorded offshore the Kamchatka Peninsula in 2007 were later photographed recorded in the area of Sakhalin Island. In 2010, 25 of the 82 whales identified in Olga Bay (Kamchatka) were later seen off Sakhalin Island. Over all the survey years, 78 gray whales have been identified (41% of all known Sakhalin whales and 55.7% of all known Kamchatka whales) that have visited both the Sakhalin and Kamchatka offshore areas, both in different years and in the same season. This proves that whales relocate between NE Sakhalin and Kamchatka both within one feeding season and between the summer and autumn seasons.

The reasons that induce some animals from the small western stock of gray whales to leave the known feeding grounds and, crossing the Sea of Okhotsk, to move northward toward the areas in the immediate vicinity of the northwestern feeding borders of the eastern (California-Chukotka) gray whale population are still unclear. Seasonal variability in the distribution of cetaceans has been extensively reported and is believed to be a response to seasonal habitat fluctuations and to the distribution constituting whales' prey (Payne *et al.* 1986, Calambokidis *et al.* 1989, Calambokidis *et al.* 1990, Calambokidis and Quan 1997, Weinrich *et al.* 1997, Wilson *et al.* 1997, Forney and Barlow 1998, Karczmarski *et al.* 1999). For example, eastern gray whales feeding along the west coast of Vancouver Island, Canada, rotate feeding grounds and prey types both within and between the summer feeding seasons as a function of the distribution and abundance of their prey (Bass 2000; Dunham and Duffus 2001, 2002; Meier 2003, Nelson *et al.* 2008). The distribution of eastern gray whales along the west coast of North America is variable both within and between years with whales using areas from northern California to southeastern Alaska from spring to autumn, involving significant interchange of animals between areas within and between years (Calambokidis *et al.* 2002). Over recent years, gray whales have also been more frequently seen in the Beaufort Sea, where they were rarely sighted about two decades ago (Stafford *et al.* 2007).

Some researchers believe that climate warming, causing earlier ice melting, has led to changes in the food chain in the historic whale foraging areas, such as the Bering Sea. These changes are likely to cause early phytoplankton bloom and to introduce fish species into the area that compete with the whales for food. As a result, the whales migrate further north, where temperatures are still lower and food is more abundant. It is possible that similar considerations apply to the western gray whale population, which would in turn affect the timing of the western gray whales' presence in their historic feeding areas and their potential expansion to the new feeding areas. In this context, the western gray whale population may serve as a good indicator of the changing environmental conditions in the region (Moore 2008).

Northeastern Sakhalin and Kamchatka are two parts of the historical feeding range of the western gray whale population. According to historical records, the range of the western population in the Sea of Okhotsk included Sakhalin Bay (at the west side of the north-west tip of the island), the Akademiya and Tugursk Bays south of the Shantar Islands (at the far west side of the Sea of Okhotsk, west of the north-west edge of Sakhalin Island), offshore Northeast Sakhalin, the Shelikhov Bay, Gizhiga Gulf and Penzhina Gulf in the farthest northeast corner of the sea, as well as waters offshore western Kamchatka (Sleptsov 1955; Krupnik 1984; Yablokov and Bogoslovskaya 1984; Reeves *et al.* 2008).

Sokolov and Arseniev (1994) and Jones and Swartz (2002) present a map showing the gray whale range encompassing the entire Far Eastern basin where the western population inhabits waters along eastern shores of Asia from the Korean Peninsula all the way to the Sea of Okhotsk and marking paths of migration of the species toward the southeastern shores of Kamchatka. The current state of both gray whale populations and ranges of their distribution are covered in an exhaustive review (Swartz *et al.* 2006).

The affiliation of whales sighted along Kamchatka shores with one or the other population has almost never been discussed. It was always believed that the vast spaces of the northwestern part of the Pacific Ocean separating the Chukchi and Bering seas from the Seas of Okhotsk and the Sea of Japan were sufficient to consider these whale populations as totally separate entities (Vladimirov 1994). Our data indicate that this common perception may need to be revised, although the degree to which the two populations may mix remains to be investigated.

3.3.4 Cow/Calf Pairs

Our observations support the hypothesis put forward by Weller *et al.* (2000) that calves are weaned in the period from July to September. According to the data obtained by Bogoslovskaya (1966) for gray whales in the offshore waters of the Chukotka Peninsula, demographic grouping starts in July and August, when calves leave their mothers and gather in groups in the shallowest waters that are rich in prey. Shore-based distribution surveys conducted in 2005 (Vladimirov *et al.* 2006) indicated that separation of mother and calf pairs had been completed by early September, with the last cow/calf pair observed from the shore on 11 September. In 2009, data provided by the vessel-based and shore-based photo identification teams indicate that the last pair recorded on the shelf of Sakhalin Island was encountered on 19 September.

Before 2008, the shallow-water Piltun area on the shelf of Sakhalin Island was considered to be the only feeding ground for the cow/calf pairs. But in 2008 the first cow/calf pair was found in Olga Bay of the southeastern shelf of Kamchatka Peninsula. This mother was recorded with calves on the northeastern shelf of Sakhalin Island in previous years (Tyurneva *et al.* 2010). Research conducted offshore Kamchatka Peninsula in 2009 and 2010 earlier in the season compared to previous years demonstrated that mothers with calves also used Olga Bay for feeding. These identified females included both individuals known from the Sakhalin catalogue and those not encountered on the shelf of Sakhalin Island. Calves and Cow/calf pairs were observed to relocate from Olga Bay to the Piltun area on the shelf of Sakhalin Island during the same season.

3.3.5 Body Condition

The presence of abnormally emaciated whales remains unexplained. The causes of emaciation in both Pacific gray whale populations are not clear, but a rather extensive body of evidence suggests that over-exploitation of the available food supply and/or possible large-scale climatic/oceanographic shifts affecting the productivity in the North Pacific region have been at least partially responsible for emaciation observed in eastern gray whales (LeBoeuf *et al.* 2000; Moore *et al.* 2001, 2003, Brownell and Weller 2001).

As the population of eastern gray whales increases to levels estimated to exceed the levels prior to the period of commercial whaling, intraspecific competition pressures in the subarctic feeding grounds may be increasing (LeBoeuf *et al.* 2000; Moore *et al.* 2001, 2003).

Other authors believe that changes in the extent and consolidation of sea ice in the Arctic Ocean, triggered by the climate change of the past 10 or 15 years, may affect the seasonal distribution and geographic boundaries of habitats, migration routes, the body condition or the reproductive status of whales (Tynan and DeMaster 1997; Perryman *et al.* 2002, Burek *et al.* 2008), which has potentially led to more intensive use of sub-Arctic zones.

Grebmeier and Barry (Grebmeier and Barry 1991) state that due to global warming, primary production in surface waters may be depressed resulting in a reduced availability of benthic prey. LeBoeuf *et al.* (2000) suggested that reduced availability of prey caused by a decline in productivity in North Pacific regions may be a limiting factor of gray whale feeding in subarctic areas. It is conceivable that these large-scale climatic and/or oceanographic events may have affected the entire North Pacific region and thus may have had simultaneous and similar impacts on both the western and the eastern gray whale populations (Brownell and Weller 2001).

Western gray whale prey studies have identified the Piltun area and particularly the offshore feeding area to be rich in prey sources (Fadeev 2002 – 2009) . Benthic data acquired as part of this program also indicate that year-to-year variations in food biomass exist; however, this topic requires further study. It as also possible that some other factor(s), such as diseases or anthropogenic impacts, during winter migration and/or the summer feeding period may have simultaneously and similarly affected both gray whale populations.

Some whales that had shown signs of emaciation in the previous years did not show such signs in the subsequent years. The ability of 'skinny' whales to recover to good body condition within one feeding season has been observed (Yakovlev and Tyurneva 2003, 2004, 2005b, 2006, 2007, 2008, 2009; Yakovlev *et al.* 2007; Weller *et al.* 2004). The feeding energy patterns of gray whales, in combination with the starvation and feeding cycles related to migration, feeding and reproduction is a dynamic process. At this point, recovery and deterioration of the body condition of both nursing and non-nursing whales still elude full explanation based on available data.

In addition to the unexplained appearance of thin animals, skin sloughing was observed in some animals in 2003 for the first time. Upon repeated observations of these whales in 2004–2009, it appears that, according to the results of studying photographs, skin sloughing recorded in 2003 did not have any permanent noticeable influence on the external body condition of the whales' skin. So far, the phenomenon of skin sloughing remains unexplained, but it may be a result of several factors including suppressed immunity, diseases caused by bacteria, viruses, fungi (Gaydos *et al.* 2004), internal or external parasites (Dailey *et al.* 2000), pollution, or excessive exposure to fresh water. The examples of skin sloughing recorded by us showed that the skin recovers relatively quickly after sloughing, and no subsequent pathological consequences are observed on the whale's skin (Tyurneva and Yakovlev *2*005c, Tombach Wright *et al.* 2007).

Organic pollutants have been shown to be responsible for the high incidence of tumors and skin ulcers in marine mammals by causing the hormonal balance in the body to change (Béland *et al.* 1992). Similar skin peeling has been reported in blue whales (Sears *et al.* 2000) and the Arctic whales (Pettis *et al.* 2004), but has been previously unreported in the eastern or western gray whale populations.

Further study is required to understand the duration and meaning of the skin sloughing phenomena before any conclusions can be drawn about the factors that cause it. It is especially important to document whale skin sloughing among those whales that were found to have skin sloughing in previous years, in order to continue observations of such a whale group with the aim of tracing changes or creating a long-term model. Further photography of the whales' skin, as well as biological skin samples from the affected areas could be collected for histological study and analysis to determine the presence of pathogenic viruses, microbes or fungi.

The appearance of white patches, observed on some gray whales since 2005, has yet to be explained. Continued photo-id monitoring of these individuals has not resulted in any obvious conclusions about the affect of white skin patches on gray whales. To date no obvious short-term health effects have been photographed but as this phenomenon is not well understood, it is essential to continue observation of all known afflicted individuals.

3.4 CONCLUSIONS

During the feeding season in 2010, photo-identification of gray whales took place on the northeastern shelf of Sakhalin and in Olga and Vestnik Bays in southeastern Kamchatka.

3.4.1 Catalogue Overview

The Sakhalin WGW Catalogue now contains 187 fully identified individual gray whales. Some of these whales were registered repeatedly over several years, whereas others are new to the catalogue or were not sighted again for a long time.

The catalogue of gray whales photo-identified on the Kamchatka shelf consists of photographs of animals observed in three areas: (Khalaktyrskyi Beach, Vestnik and Olga Bays) during 2004 and 2006-2010. At present, this catalogue contains 140 fully identified animals. A total of 78 of these whales were also observed in different areas of the Sakhalin shelf during various years, and it is possible that most of them are western gray whales. It is yet unclear to which population the other 62 animals belong to that were photographed near Kamchatka Peninsula, but are not identified in the Sakhalin catalogue.

3.4.2 Whales Identified in 2010 on Both the Sakhalin and Kamchatka Shelves

In 2010, , between August 4 and September 27, 105 whales were observed off the shore of Sakhalin (not including temporary whales). This number is higher than in 2008 (98 whales), but lower than in 2009

(117) and 2007 (125). This might have been due to shorter observation periods during the last three years and because of unfavorable weather conditions.

In 2010 we identified 10 new gray whales + 2 TEMP, including 8 calves. Two of the adult animals were first sighted in 2006 in Olga Bay (Kamchatka), and had only been recorded there until 2010 when they were also seen near Sakhalin.

Between June 22 and August 10, 2010, 82 whales were sighted in Olga Bay. Of these, 58 were already known, having been observed previously in Olga Bay. The other 24 were new to Olga Bay?, and xxx were seen in SE Kamchatka previously. Forty eight of these 82 whales were registered in the Sakhalin WGW catalogue.

Since 2006, the number of identified whales in Olga Bay has grown every year. However, this could be attributed to the earlier start date and increased duration of the field seasons, which increases from year to year. In 2009 and 2010, the number of new whales (i.e. those that were identified for the first time) in Olga Bay also strongly depended on the observation dates. While the abundance of whales identified in both catalogues and in the Kamchatka catalogue only had decreased to 10 individuals by the end of the field season in September 2009, the total abundance dropped only slightly (from 27 to 25 whales) by the end of the 2010 field season on the 10th of August , . It's worth mentioning that the number of whales with dual numbers (KOGW000/KamGW000) included in this figure, dropped significantly, from 11 to 2 animals.

Every year since the start of the surveys in Olga Bay in 2006, researchers have identified some whales in this area that had been registered as calves in Piltun area in the previous year. Three of the five calves registered in the Sakhalin shelf in 2008 were identified in Olga Bay in 2009. In 2009, out of eight calves observed in Olga Bay (of which only one was sighted in Olga Bay in 2010), five were recorded off Sakhalin.

In 2010, a total of 128 out of 187 animals contained in the A.V. Zhirmunsky IBM DVO RAN Sakhalin catalogue of gray whales were recorded, which includes sightings off both Sakhalin and Kamchatka. The total number of identified gray whales included in the Kamchatka and/or Sakhalin catalogues in 2010 alone was 162 +2 TEMP whales/ 80 + 2 TEMP of these were registered only on Sakhalin shelf and 57 only off the shore of Kamchatka (23 of which have been registered in the Sakhalin catalogue in the previous years) and 25 were seen in both locations (figure ?? the one I added). At present, it is unknown whether all of the animals observed in Olga Bay, Kamchatka belong to the western stock, or whether some of them belong to the eastern gray whale population.

3.4.3 Migration of Gray Whales between Sakhalin Feeding Areas in 2010

A total of 21 individuals were identified in the Offshore feeding area off the northeastern shore of Sakhalin island in 2010. Nine of these whales were observed in that area only. A total of 94 whales were identified in the Piltun feeding area, 78 of which were observed only in that region. Not a single whale was observed during this season in Chayvo Bay. A group of 9 whales, 4 of which were not observed anywhere else during this season, was sighted in the offshore area next to Okha.During the length of the study, (2002-2010), 97 whales were identified in both the Piltun and Offshore feeding areas both during one year and over several years. In addition, 94 individual whales were sighted only in the Piltun area and 5 used only the Offshore area (all of these numbers include temporary whales). A change in gray whale distribution was noted in 2010. In the Piltun area, some whales were sighted farther north than in previous years, beyond the 20-meter isobath. A similar distribution was also observed in 2004 and 2005. Whales were sighted in the Offshore area near or within the Arkutun-Dagi Lisense Area. We believe that the use of available feeding grounds offshore Sakhalin by gray whales is a normal behavior aimed at exploiting ever-changing forage habitat. During all these years, cow-calf pairs were registered only in the Piltun area.

Of the 82 whales identified in Olga Bay (Kamchatka) in 2010, 25 whales were spotted near Sakhalin later in the season. Additional 23 whales had been seen in Sakhalin in previous years but not in 2010.

3.4.4 Body Condition

Since 2005, we collected data to monitor the improvement of gray whales' body condition (BC) within a feeding season. In 2010, such improvement of BC was also recorded. In 2010, 12 whales with poor BC were identified, including 4 nursing females. This constitutes 11.4% of the total number of identified animals (105 individuals). All calves observed during these years were physically normal (BC 0).

If the BC of a particular whale improved upon subsequent observation, then the data used in calculations of the number of malnourished animals was based on the latest observation. According to our observations, 25 whales improved their BC during the period of August 4 to September 27.

In Olga Bay, 41 of the 82 whales (50%) showed low BC. Three of these were nursing females.

The high percentage of gray whales with poor body conditions recorded near Kamchatka versus the Sakhalin can be explained by the early photo-identification survey period, as whales have just arrived to the feeding grounds from their winter-long fast and have not had time to accumulate body fat stores.

3.4.5 Cow/Calf Pairs

In 2010, 5 cow/calf pairs and 3 calves without mothers were recorded off Sakhalin. ow/calf pairs were first sighted on August 8 during the 2010 field season. One of the photo-identified mothers (KOGW063) had been recorded previously with calves in 2003 and 2007. Two females (KOGW093 and KOGW007) were identified as mothers for the first time in 2010. Our group had not previously recorded KOGW044 with calves, but she came to the feeding area repeatedly with a body condition class of 3 and 4. One of the calves, whose mother could not be determined, was observed together with an emaciated whale (in a masked position). Unfortunately this whale showed just its head and later we were able to identify it as KOGW064 based on data from the Kamchatka team. Three calves unaccompanied by cows were encountered in calf groups.

Three cow/calf pairs were recorded in Olga Bay (Kamchatka) in 2010. Three of the recorded mothers had been encountered offshore Sakhalin Island and Kamchatka Peninsula in previous years, and one of them was also photographed in the Piltun area in 2004 and 2007 with calves. The two other females had never been recorded as mothers.

Three cow/calf pairs were seen in Olga Bay only at the start of the field season. Later, all three calves were recorded in the Piltun area (Sakhalin Island), at which time one of them was encountered together with the mother. All three calves were first recorded there on August 8, 2010. Thus, the mothers of the two calves sighted without mothers off Sakhalin were identified later off Kamchatka Peninsula.

Separation of the pairs started in the end of August and lasted until the middle of September, which is consistent with the long-term observations. One of the photo- identified mothers was registered with calves in 2004 and 2006. Two other females identified as mothers in 2009 were registered in 2007. Three females were observed with calves for the first time. Two calves were observed without mothers, but identified in calf groups. All registered calves were well nourished without any signs of malnutrition.

Three of the mother/calf pairs were registered near the Kamchatka shore in June only. However, one of the pairs was later observed near Sakhalin and was seen there many times after that.

We cannot ignore the fact that the earlier survey times helped us in identifying cow/calf pairs in Olga Bay in 2009 and 2010. It is quite possible that the pairs were present in this area before 2008, but they were not identified as such because the calves had already separated from their mothers. The obtained data suggests that the Piltun area of the Sakhalin shelf is not the only feeding area for mother-calf pairs and that at least a second “nursery ground” for foraging whales is located in Olga

3.5 ACKNOWLEDGMENTS

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Field Photography and Videography Offshore Kamchatka Peninsula		
Photographer, Team Leader	Vladimir Vasilyevich Vertyakin	Sevvostokrybvod Federal State Administration, Petropavlovsk-Kamchatsky
Data recorded by	Vladimir Romanovich Kuznetsov	Far Eastern State University
Zodiac Driver	Yury Vladimirovich Vertyankin	Sevvostokrybvod Federal State Administration, Petropavlovsk-Kamchatsky

3.8 APPENDIX

FIGURES

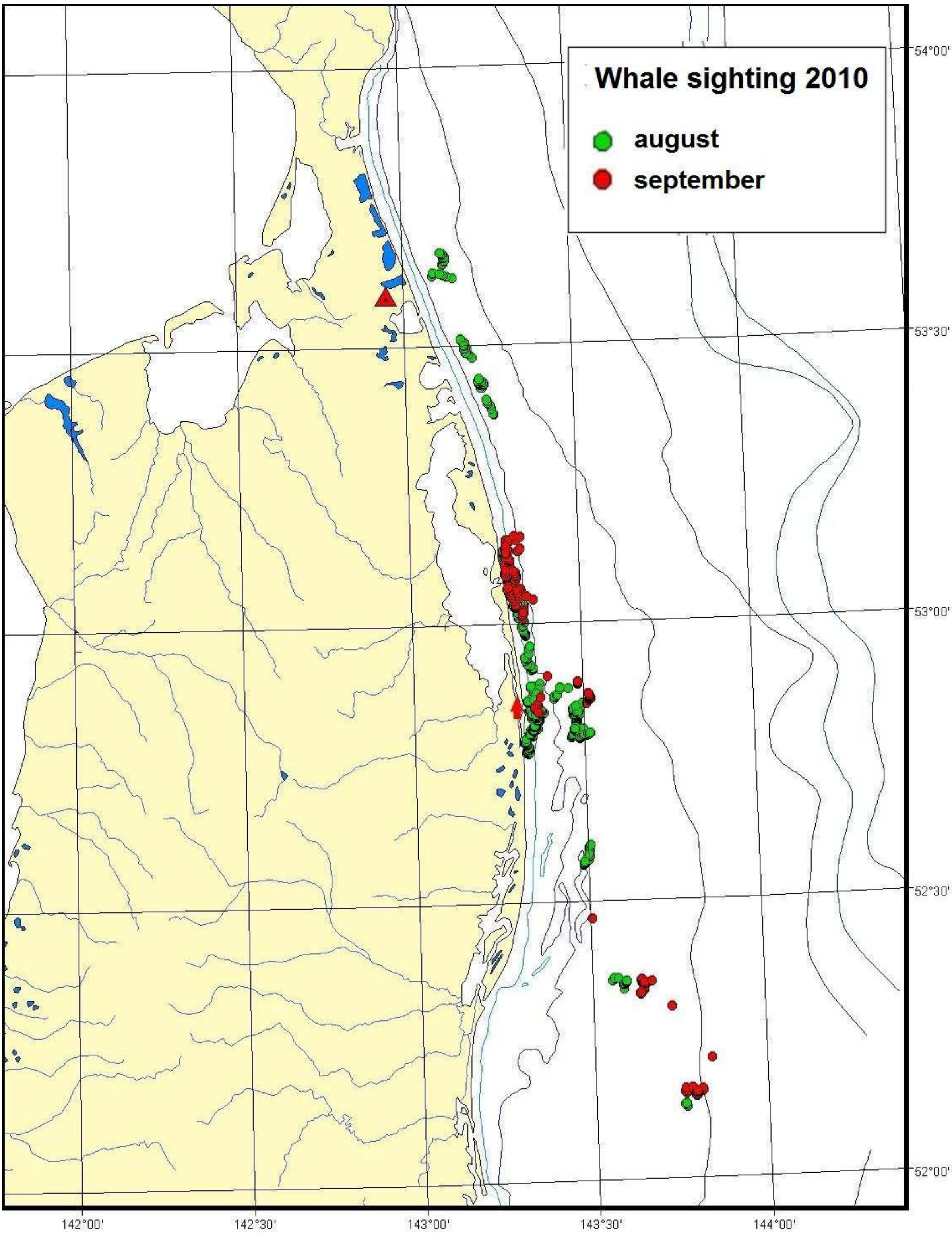

Figure A1. Gray whale photo-ID sites along the NE coast of Sakhalin Island, 2010.

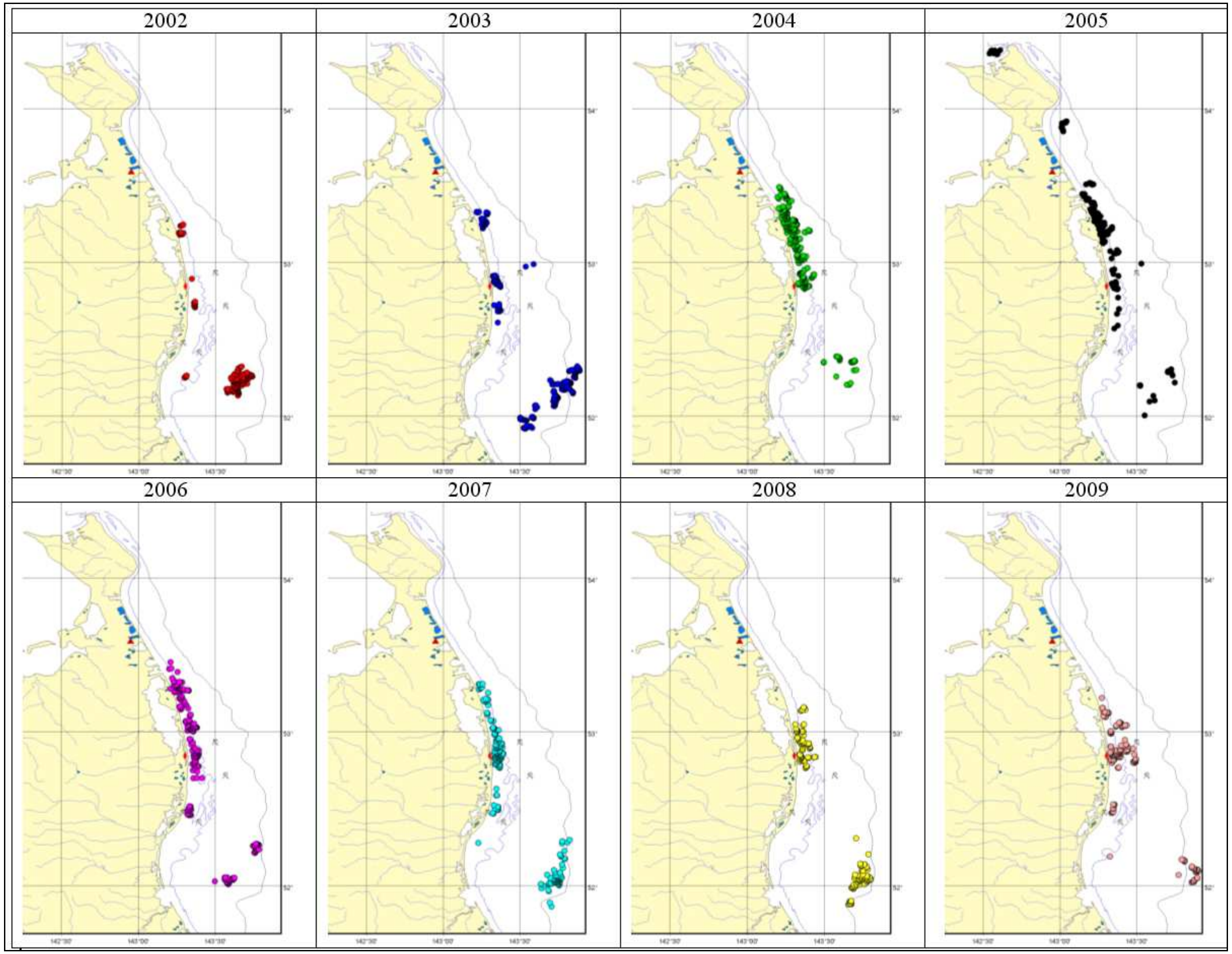

Figure A2. Gray whale photo-ID locations along the NE coast of Sakhalin Island in September throughout the study years, 2002 to 2009.

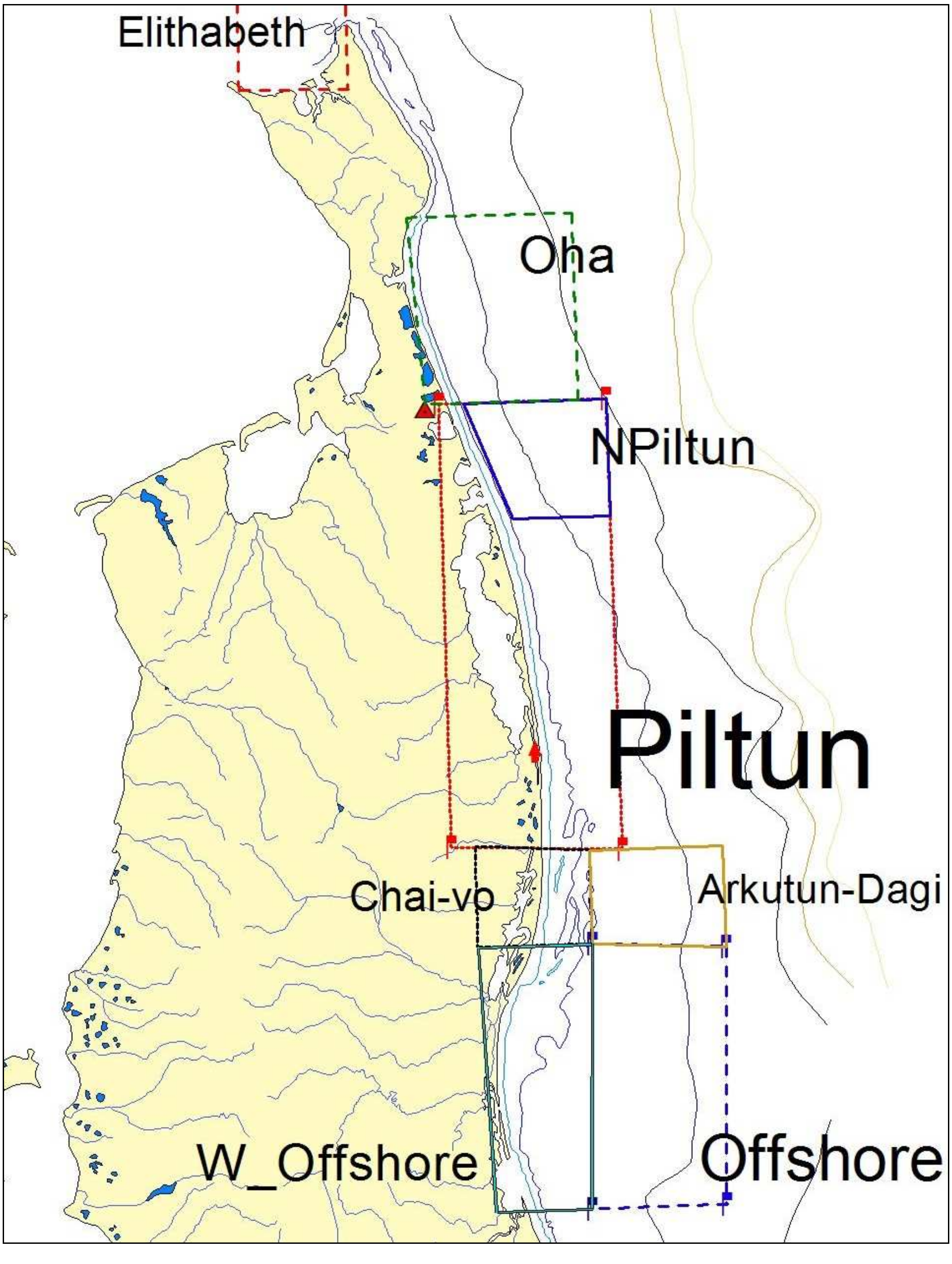

Figure A2. Boundaries of zones described in Appendix Table A6.

TABLES

Table A1. Time spent at each gray whale sighting from the Zodiac, Sakhalin 2010

N	Date	Area	Number of missions per day	Duration of each sighting in minutes																						
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	Total
1	10.08.04	Piltun	1	12	06	04	13	11	09	14	10	05	12	07	08											1:51
2	10.08.07	Piltun	1	25	16	02																				0:43
3	10.08.08	Piltun	2	21	13	26	28	15	10	19	03	07	21	05	08	32	20	17	17	24	12	24	07	24	06	5:59
4	10.08.09	Piltun	2	19	43	35	12	19	34	13	13	06	21	12	0	02										3:53
5	10.08.18	Okha	1	08	03	05	21																			0:37
6	10.08.20	Offshore	2	01	14	17	06																			0:38
7	10.08.23	Piltun	2	26	11	12	08	27	09	20																2:53
8	10.08.25	Offshore	2	02	35	27																				1:04
9	10.08.26	Offshore	1	08																						0:08
10	10.08.27	Piltun	2	08	07	21	16	14	56	05	06	26	15	06	12	11	16	18								4:57
11	10.08.28	Piltun and Okha*	4	35	25	23	31	16	18	04																3:32
12	10.09.04	Piltun	1	10	13	07	22	07	02																	1:01
13	10.09.05	Piltun	2	11	05	15	07	17	23	19	08	07	14	22	08	29	11	06								3:22
14	10.09.06	Piltun	2	36	08	13	17	29	16																	1:59
15	10.09.09	Offshore	1	10																						0:10
16	10.09.12	Piltun	1	02																						0:02
17	10.09.13	Offshore	1	02																						0:02
18	10.09.19	Offshore	2	07	19	23	02	17	21	04	29	14	04	14	04	09										2:47
19	10.09.26	Offshore	1	03																						0:03
20	10.09.27	Piltun	2	30	36	10	11																			2:27
Total			**33**																							**14:08**

Table A2. Gray whale group size at each sighting in the course of photo-ID efforts from the Zodiac, Sakhalin 2010

N	Date	Area	Number of whales registered from Zodiac at each sighting																						Number of whales in Piltun Area	Number of whales in Offshore Area	Number of whales in Okha Area
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22			
1	04.08.10	Piltun	2	2	1	2	1	1	1	1	2	1	1	1											16		
2	07.08.10	Piltun	2	1	1																				4		
3	08.08.10	Piltun	1	1	2	1	1	2	3	2	2	6	2	3	3	3	3	1	3	2	4	2	2	2	51		
4	09.08.10	Piltun	1	5	3	2	3	2	3	4	4	1	3	1	1										33		
5	18.08.10	Okha	1	1	2	3																					7
6	20.08.10	Offshore	4	3	3																					10	
7	23.08.10	Piltun	1	4	2	1	4	1	3																16		
8	25.08.10	Offshore	2	1																						3	
9	26.08.10	Offshore	1																							1	
10	27.08.10	Piltun	1	4	2	2	1	3	1	1	2	2	1	3	1	1	1								26		
11	28.08.10	Piltun and Okha	2	2	2	4	1	2	3																13		3
12	04.09.10	Piltun	2	1	1	1	1	1																	7		
13	05.09.10	Piltun	2	1	1	1	1	2	2	1	2	2	1	1	1	2	1								21		
14	06.09.10	Piltun	3	1	1	3	1	1																	10		
15	12.09.10	Piltun	1																						1		
16	19.09.10	Offshore	2	1	3	1	1	1	1	2	1	1	2	1	1											18	
17	27.09.10	Piltun	5	3	3																				17		
	Total																								**211**	**32**	**10**

Table A3. Depths recorded in the course of photo-ID efforts from the Zodiac, Sakhalin 2010

N	Date	Area	Depth at each sighting. m																						Mean depth in Piltun Area	Mean depth in Offshore Area	Mean depth in Okha Area
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22			
1	04.08.10	Piltun	14	12	8	4	5	14	14	14	13	13	20	21											12.67		
2	07.08.10	Piltun	9	16	15																				13.33		
3	08.08.10	Piltun	15	15	6	13	10	8	7	6	6	7	9	8	7	6	4	8	4	9	7	8	10	9	8.27		
4	09.08.10	Piltun	29	28	27	28	27	29	26	27	28	28	23	24	26										26.92		
5	18.08.10	Okha	31	38	37	39																					36.25
6	20.08.10	Offshore	28	29	29																					28.67	
7	23.08.10	Piltun	5	15	14	15	12	11	17																12.71		
8	25.08.10	Offshore	33	32																						32.50	
9	26.08.10	Offshore	53																							53.00	
10	27.08.10	Piltun	7	8	13	15	15	17	13	10	7	8	13	10	7	7	7								10.47		
11	28.08.10	Piltun & Okha	30	31	32	30	32	32	36																31.16		36
12	04.09.10	Piltun	7	12	10	6	8	9																	8.67		
13	05.09.10	Piltun	21	12	10	9	10	13	16	14	17	16	17	17	13	12	14								14.07		
14	06.09.10	Piltun	26	24	10	7	6	4																	12.83		
15	12.09.10	Piltun	23																						23.00		
16	19.09.10	Offshore	39	39	39	39	38	52	51	54	53	52	54	53	54											47.46	
17	27.09.10	Piltun	9	10	20																				13.00		
	Total																								**15.6**	**40.4**	**36.2**

Table A4. Recorded aspects of individual gray whales photographed off the NE coast of Sakhalin Island and Kamchatka in 2002-2010.

№ KOGW	2002					2003					2004					2005					2006					2007					2008					2009					2010					Qas for
	RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		02-10
KOGW001	Y	Y	Y	Y	Y						Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y		Y						4
KOGW002	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						Y	Y	Y	Y	Y	4
KOGW003	Y	Y	Y	Y	Y																																									4
KOGW004	Y	Y			Y	Y	Y	Y	Y	Y																																				4
KOGW005	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	4
KOGW006	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						4
KOGW007	Y	Y	Y	Y	Y			Y	Y	Y		Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y											Y	Y			Y	4
KOGW008	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	4
KOGW009	Y	Y	Y	Y	Y					Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	4
KOGW010	Y	Y			Y						Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y							Y			Y	Y	Y	Y	Y	Y	4
KOGW011	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y			Y	4
KOGW012	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y				Y	Y	Y	Y	Y	Y	Y	Y			Y	4
KOGW013	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y				Y	N				Y	Y						4
KOGW014	Y	Y	Y	Y	Y						Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y		Y	Y	Y	Y	Y	Y	Y		Y	Y	Y											4
KOGW015	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y		Y	4
KOGW016	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y			Y	Y	Y			Y	Y	Y			Y	Y	Y			Y						4
KOGW017		Y			N											Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						Y	Y	Y	Y	Y	Y	Y	Y		Y	4
KOGW018	Y	Y	Y	Y	Y		Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y																Y	Y	Y	Y	Y	4
KOGW019	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						Y		Y	Y	Y						4
KOGW020	Y				N	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	4
KOGW021	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	4
KOGW022	Y	Y	Y	Y	Y						Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	4
KOGW023	Y	Y			Y						Y	Y	Y	Y	Y						Y	Y	Y	Y	Y											Y	Y	Y		Y	Y		Y	Y	Y	4
KOGW024	Y				N											Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y				Y	Y	Y	Y	Y	Y						4
KOGW025	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y				Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y		Y						Y		Y		Y	Y	Y			Y	4
KOGW026	Y	Y			Y	Y	Y			Y						Y	Y			Y	Y	Y			Y						Y	Y	Y		Y	Y	Y			Y	Y	Y			Y	3
KOGW027		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y			Y	Y			Y	Y	Y	Y	Y	Y							Y		Y	Y	4
KOGW028	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y						Y	Y			Y	Y				Y	4
KOGW029	Y	Y			Y	Y	Y			Y	Y	Y			Y	Y	Y				Y	Y			Y	Y	Y			Y	Y	Y	Y		Y	Y	Y			Y						3
KOGW030	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						4
KOGW031	Y				N		Y	Y	Y	Y	Y		Y		Y						Y		Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	4
KOGW032	Y	Y		Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y											4
KOGW033	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y		Y	Y	Y		Y			Y	Y	Y			Y	Y				Y	4
KOGW034	Y	Y			Y							Y			Y	Y	Y			Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y			Y						4
KOGW035	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y		Y			Y	Y	Y			Y	4

- continued next page -

№ KOGW	2002					2003					2004					2005					2006					2007					2008					2009					2010					Qas for
	RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		02-10
KOGW036	Y				N	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y			Y						Y	Y	Y	Y	Y	4
KOGW037	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y						4
KOGW038	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y				Y	Y				Y	Y	Y			Y	4
KOGW039	Y				N	Y	Y		Y	Y						Y	Y			Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	4
KOGW040	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y			Y								Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y		Y	4
KOGW041	Y	Y			Y						Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y			Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y						4
KOGW042	Y	Y	Y	Y	Y						Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	4
KOGW043		Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y						Y	Y	Y	Y	Y	4
KOGW044	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y		Y	Y	Y			Y	Y	Y	Y		Y	Y	Y			Y		Y		Y	Y	Y	Y			Y	4
KOGW045	Y	Y	Y		Y		Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y						Y	Y			Y						4
KOGW046						Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						4
KOGW047						Y	Y	Y	Y	Y											Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y			Y	Y	Y			Y	Y	Y		Y	Y	4
KOGW048						Y	Y			Y	Y	Y		Y	Y	Y	Y			Y	Y	Y			Y	Y	Y	Y	Y	Y						Y	Y			Y	Y	Y			Y	4
KOGW049						Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y			Y	Y	Y	Y	Y	Y						4
KOGW050						Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y				Y						4
KOGW051						Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y			Y						4
KOGW052						Y	Y			Y																																				2
KOGW053						Y	Y	Y	Y	Y						Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y						Y	Y		Y	Y	Y	Y			Y	4
KOGW054						Y	Y	Y	Y	Y			Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	4
KOGW055						Y	Y	Y	Y	Y						Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y			Y	Y				Y	4
KOGW056						Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	4
KOGW057						Y	Y	Y	Y	Y											Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	4
KOGW058						Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y			Y	Y	Y	Y	Y	Y						Y	Y	Y	Y	Y	4
KOGW059						Y	Y			Y						Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y						Y	Y			Y	Y				Y	4
KOGW060						Y	Y	Y	Y	Y	Y	Y			Y	Y	Y			Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	4
KOGW061						Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	4
KOGW062						Y	Y			Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						4
KOGW063						Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y						Y	Y	Y	Y	Y	4
KOGW064						Y	Y	Y		Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y			Y						Y	Y	Y	Y	Y	Y	Y			Y	4
KOGW065						Y	Y			Y																																				2
KOGW066						Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y		Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	4
KOGW067						Y	Y			Y		Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y																4
KOGW068						Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y			Y	Y	Y	Y	Y	Y	4
KOGW069						Y	Y			Y	Y	Y			Y	Y	Y			Y	Y	Y			Y	Y	Y			Y	Y	Y			Y	Y	Y			Y						2
KOGW070						Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	4

- continued next page -

№ KOGW	2002					2003					2004					2005					2006					2007					2008					2009					2010					Qas for
	RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		02-10
KOGW071						Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y			Y		Y	Y	Y	Y	4
KOGW072						Y	Y			Y	Y	Y			Y	Y	Y			Y		Y			N	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y			Y		Y			Y	4
KOGW073						Y	Y			Y																Y	Y	Y	Y	Y						Y	Y			Y	Y	Y			Y	4
KOGW074						Y	Y	Y	Y	Y			Y		N			Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	4
KOGW075						Y	Y			Y																										Y	Y			Y	Y	Y	Y		Y	3
KOGW076						Y	Y			Y	Y	Y			Y	Y	Y			Y	Y	Y	Y	Y	Y						Y	Y			Y	Y	Y	Y	Y	Y	Y				Y	4
KOGW077						Y	Y			Y																															Y	Y	Y	Y	Y	4
KOGW078						Y	Y			Y	Y	Y	Y		Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y			Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	4
KOGW079						Y	Y			Y						Y	Y	Y		Y																										3
KOGW080						Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						Y	Y	Y		Y	Y	Y	Y	Y	Y	Y				Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	4
KOGW081						Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	4
KOGW082						Y	Y			Y	Y	Y			Y	Y	Y			Y	Y	Y			Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	4
KOGW083						Y	Y			Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y			Y																					4
KOGW084						Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						Y	Y	Y	Y	Y	Y	Y	Y		Y	Y		Y	Y	Y	Y	Y	Y	Y	Y						4
KOGW085						Y				N	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y			Y	Y	Y			Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y			Y	4
KOGW086						Y	Y			Y	Y	Y	Y		Y	Y	Y	Y	Y	Y						Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	4
KOGW087							Y			N	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y				Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	4
KOGW088						Y	Y	Y	Y	Y																																				4
KOGW089							Y			N											Y	Y			Y	Y	Y	Y		Y	Y				Y	Y	Y			Y						3
KOGW090							Y			N							Y	Y	Y	N	Y	Y			Y																					3
KOGW091						Y				N											Y	Y			Y	Y	Y	Y		Y	Y	Y			Y											3
KOGW092							Y			N	Y	Y			Y		Y	Y		Y	Y	Y			Y	Y	Y			Y	Y	Y			Y	Y	Y			Y	Y	Y			Y	2
KOGW093											Y	Y			Y	Y	Y	Y		Y	Y	Y			Y	Y	Y	Y		Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y			Y	4
KOGW094											Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	4
KOGW095											Y	Y	Y	Y	Y						Y	Y			Y																					4
KOGW096											Y	Y			Y	Y	Y			Y	Y				Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	4
KOGW097											Y		Y	Y	Y											Y	Y			Y	Y	Y	Y	Y	Y	Y				Y	Y	Y	Y	Y	Y	4
KOGW098											Y	Y			Y																															2
KOGW099											Y	Y			Y	Y	Y	Y		Y	Y	Y				Y	Y			Y	Y	Y	Y		Y	Y	Y	Y	Y	Y						3
KOGW100											Y	Y			Y																															2
KOGW101											Y	Y			Y																															2
KOGW102											Y	Y			Y	Y	Y			Y	Y	Y					Y		Y		Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	3
KOGW103											Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						Y	Y	Y	Y	Y	4
KOGW104											Y	Y	Y	Y	Y	Y	Y			Y																Y		Y	Y	Y						4
KOGW105											Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y		Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	4

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№ KOGW	2002					2003					2004					2005				
	RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF	
KOGW106											Y	Y			Y	Y	Y			Y
KOGW107											Y				N	Y	Y			Y
KOGW108											Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
KOGW109											Y	Y			Y					
KOGW110											Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
KOGW111											Y	Y	Y	Y	Y	Y	Y			Y
KOGW112											Y	Y			Y	Y				Y
KOGW113											Y	Y			Y	Y	Y	Y	Y	Y
KOGW114											Y	Y			Y	Y	Y	Y	Y	Y
KOGW115												Y		Y	N	Y	Y			Y
KOGW116												Y		Y	N	Y	Y	Y		Y
KOGW117																Y	Y	Y	Y	Y
KOGW118																Y	Y	Y	Y	Y
KOGW119																Y	Y			Y
KOGW120																Y	Y			Y
KOGW121																Y	Y	Y	Y	Y
KOGW122																Y	Y	Y	Y	Y
KOGW123																Y	Y	Y	Y	Y
KOGW124																Y	Y			Y
KOGW125																Y	Y			Y
KOGW126																Y	Y			Y
KOGW127																Y	Y			Y
KOGW128																Y	Y			Y
KOGW129																Y	Y			Y
KOGW130																Y	Y			Y
KOGW131																Y	Y			Y
KOGW132																Y	Y			Y
KOGW133																Y	Y			Y
KOGW134																Y	Y	Y	Y	Y
KOGW135																				
KOGW136											Y	Y	Y	Y	Y					
KOGW137																				
KOGW138																				
KOGW139																				
KOGW140																				

№ KOGW	2006					2007					2008					2009					2010					Qas for
	RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		02-10
KOGW106	Y	Y			Y																					2
KOGW107	Y	Y			Y	Y	Y	Y	Y	Y											Y	Y	Y	Y	Y	4
KOGW108	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	4
KOGW109	Y	Y	Y	Y	Y																					4
KOGW110	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y				Y	Y		Y	Y	Y	4
KOGW111											Y	Y	Y		Y	Y				Y						4
KOGW112	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	4
KOGW113	Y	Y				Y	Y	Y	Y	Y		Y			N	Y	Y	Y	Y	Y						4
KOGW114	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y				Y		Y			Y	4
KOGW115	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						Y	Y	Y	Y	Y						4
KOGW116	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y			Y	4
KOGW117	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y				Y	Y	Y	Y	Y	Y	Y	Y			Y	4
KOGW118	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	4
KOGW119	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y				Y						Y	Y			Y	4
KOGW120																										2
KOGW121	Y	Y			Y																					4
KOGW122																										4
KOGW123	Y				Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y						4
KOGW124	Y				Y	Y	Y			Y						Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	4
KOGW125	Y	Y	Y		Y	Y	Y	Y		Y						Y	Y			Y	Y	Y	Y	Y	Y	3
KOGW126																DEAD										
KOGW127	Y	Y			Y	Y	Y			Y						Y	Y			Y						2
KOGW128																										2
KOGW129	Y	Y			Y	Y	Y	Y	Y	Y						Y	Y	Y	Y	Y						4
KOGW130																										2
KOGW131																Y		Y	Y	Y	Y	Y	Y	Y	Y	4
KOGW132	Y	Y				Y	Y			Y											Y	Y			Y	2
KOGW133	Y	Y	Y																			Y	Y	Y	Y	3
KOGW134																										4
KOGW135	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	4
KOGW136	Y	Y	Y	Y	Y	Y	Y	Y		Y																4
KOGW137	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	4
KOGW138	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y																4
KOGW139	Y	Y	N	N	Y						Y			Y	Y	Y	Y			Y		Y			Y	3
KOGW140	Y	Y	N	Y	Y																					3

- continued next page -

№ KOGW	2002					2003					2004					2005					2006					2007					2008					2009					2010					Qas for
	RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		02-10
KOGW141																					Y	Y	N	N	Y																					2
KOGW142																					Y	Y	N	N	Y																					2
KOGW143																					Y	Y	N	N	Y																					2
KOGW144																					Y	Y	Y	N	Y	Y	Y			Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	4
KOGW145																					Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y		Y	Y	Y	Y	Y	Y						4
KOGW146																					Y	N	N	N	N	Y	Y			Y						Y				Y	Y	Y			Y	2
KOGW147																					Y	Y	N	N	Y	Y	Y	Y	Y	Y																4
KOGW148																										Y	Y	Y	Y	Y																4
KOGW149																										Y	Y			Y																2
KOGW150																										Y	Y			Y																2
KOGW151																										Y	Y			Y																2
KOGW152																										Y	Y			Y																2
KOGW153																										Y	Y	Y	Y	Y																4
KOGW154																										Y	Y			Y																2
KOGW155																										Y	Y			Y																2
KOGW156																										Y	Y			Y																2
KOGW157																										Y	Y			Y																2
KOGW158																										Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	4
KOGW159																										Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	4
KOGW160																										Y	Y	Y	Y	Y						Y	Y			Y	Y	Y			Y	4
KOGW161																															Y	Y			Y											2
KOGW162																															Y	Y			Y		Y			Y	Y	Y			Y	2
KOGW163																															Y	Y			Y											2
KOGW164																															Y	Y		Y	Y											3
KOGW165																															Y	Y			Y											2
KOGW166																																				Y	Y			Y						2
KOGW167																																				Y	Y			Y	Y	Y			Y	2
KOGW168																																				Y	Y			Y		Y			Y	2
KOGW169																																				Y	Y			Y						2
KOGW170																																				Y	Y			Y						2
KOGW171																																				Y	Y			Y						2
KOGW172																																				Y	Y	Y	Y	Y						4
KOGW173																																				Y	Y			Y	Y	Y			Y	2
KOGW174																																				Y	Y			Y						2
KOGW175																																				Y	Y			Y	Y	Y			Y	2

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№ KOGW	2002					2003					2004					2005					2006					2007					2008					2009					2010					Qas for
	RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		RS	LS	DF	VF		02-10
KOGW176																																				Y	Y			Y						2
KOGW177																																				Y	Y			Y	Y	Y			Y	2
KOGW178																																									Y	Y			Y	2
KOGW179																																									Y	Y			Y	2
KOGW180																																									Y	Y	Y		Y	3
KOGW181																																									Y				Y	1
KOGW182																																									Y	Y			Y	2
KOGW183																																									Y	Y			Y	2
KOGW184																																									Y	Y			Y	2
KOGW185																																									Y	Y	Y	Y	Y	4
KOGW186																																									Y	Y		Y	Y	3
KOGW187																																									Y				Y	1
TEMP01	Y				N							Y			N																															done
TEMP02							Y			N		Y			N		Y			N																										done
TEMP03																						Y			N																					done
TEMP04																					Y				N																					1
TEMP05																					Y				N																					1
TEMP06																					Y				N																					1
TEMP07																					Y				N																					1
TEMP08																						Y			Y																					1
TEMP09																											Y			N																done
TEMP10																										Y				N																done
TEMP11																											Y			N																1
TEMP12																											Y			N																1
TEMP13																											Y			N																1
TEMP14																					Y				N																					done
TEMP15																																									Y				N	1
TEMP16																																									Y				N	1

Table A5. Locations of encounters with identified gray whales off NE Sakhalin Island based on all surveys, 2002-2010.

	2002			2003			2004			2005					2006				2007			2008			2009			2010		
ID	P	O	C	P	O	C	P	O	C	P	O	C	Oha	El	P	O	C	Oha	P	O	C	P	O	C	P	O	C	P	O	Oha
001		Y						Y		Y					Y				Y	Y		Y	Y			Y				
002		Y			Y		Y			Y					Y	Y			Y	Y	Y		Y					Y		
003		Y																												
004		Y		Y																										
005		Y		Y			Y																		Y			Y		
006		Y								Y	Y						Y		Y	Y		Y			Y					
007	Y			Y			Y			Y					Y		Y		Y	Y								Y		
008		Y		Y			Y			Y			Y		Y	Y				Y			Y			Y		Y	Y	Y
009		Y					Y			Y					Y				Y	Y			Y			Y		Y		
010		Y					Y			Y					Y				Y	Y	Y				Y			Y		
011		Y			Y		Y			Y		Y			Y				Y	Y			Y			Y		Y		
012		Y		Y	Y		Y			Y		Y			Y	Y			Y	Y			Y	Y		Y		Y		
013		Y			Y		Y			Y					Y	Y				Y			Y		Y					
014		Y								Y					Y	Y				Y			Y							
015		Y			Y					Y					Y				Y	Y		Y	Y					Y		
016		Y			Y		Y			Y						Y			Y			Y			Y					
017		Y			Y		Y			Y					Y	Y			Y	Y						Y		Y	Y	
018	Y			Y			Y			Y					Y													Y		
019		Y			Y			Y		Y	Y					Y				Y						Y				
020		Y			Y		Y			Y		Y			Y	Y	Y		Y	Y		Y	Y					Y		
021		Y			Y		Y			Y					Y					Y		Y	Y			Y		Y	Y	
022	Y			Y			Y			Y					Y		Y		Y			Y					Y	Y		
023	Y						Y								Y		Y									Y		Y		
024	Y									Y					Y		Y		Y	Y			Y		Y					
025	Y	Y		Y	Y		Y			Y	Y					Y			Y	Y						Y				Y

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	2002			2003			2004			2005					2006				2007			2008			2009			2010		
ID	P	O	C	P	O	C	P	O	C	P	O	C	Oha	El	P	O	C	Oha	P	O	C	P	O	C	P	O	C	P	O	Oha
026	Y			Y						Y		Y			Y							Y			Y			Y		
027	Y			Y			Y										Y		Y			Y						Y		
028		Y					Y			Y					Y				Y						Y			Y		
029	Y			Y			Y			Y					Y				Y	Y		Y	Y		Y					
030	Y			Y			Y			Y					Y				Y	Y		Y	Y		Y	Y				
031	Y				Y		Y								Y				Y				Y		Y				Y	
032		Y					Y			Y					Y				Y	Y			Y							
033		Y			Y		Y			Y					Y				Y							Y			Y	
034		Y					Y			Y									Y			Y			Y					
035		Y		Y	Y		Y			Y					Y				Y	Y		Y	Y		Y				Y	
036		Y			Y		Y			Y					Y	Y			Y	Y			Y						Y	
037		Y		Y			Y			Y	Y				Y				Y	Y		Y	Y		Y					
038		Y		Y			Y			Y		Y			Y			Y	Y			Y			Y			Y		
039		Y		Y						Y					Y		Y		Y	Y		Y			Y	Y		Y		
040		Y		Y						Y										Y			Y			Y		Y		
041		Y					Y			Y						Y			Y	Y		Y			Y		Y			
042	Y		Y				Y			Y						Y			Y	Y		Y				Y			Y	
043		Y		Y	Y		Y			Y		Y				Y			Y				Y					Y		
044		Y		Y		Y				Y					Y		Y		Y			Y			Y		Y	Y		
045		Y			Y			Y		Y							Y			Y						Y				
046					Y		Y			Y					Y	Y			Y				Y			Y				
047				Y						Y					Y				Y		Y	Y			Y			Y		
048							Y			Y					Y				Y	Y					Y			Y		
049				Y			Y			Y		Y	Y		Y	Y			Y	Y		Y			Y					
050				Y			Y			Y					Y				Y			Y			Y					
051					Y		Y			Y									Y	Y			Y				Y			
052					Y																						Y			
053				Y						Y					Y				Y						Y			Y		
054					Y		Y			Y						Y			Y	Y		Y	Y		Y			Y		
055				Y						Y	Y				Y				Y	Y		Y			Y	Y		Y		

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ID	2002			2003			2004			2005					2006				2007			2008			2009			2010		
	P	O	C	P	O	C	P	O	C	P	O	C	Oha	El	P	O	C	Oha	P	O	C	P	O	C	P	O	C	P	O	Oha
056				Y			Y			Y					Y				Y			Y			Y	Y		Y		
057				Y											Y	Y			Y	Y			Y						Y	
058				Y			Y			Y		Y					Y		Y		Y		Y					Y	Y	
059				Y	Y					Y		Y			Y	Y			Y	Y					Y			Y		
060				Y			Y			Y					Y					Y		Y	Y		Y			Y	Y	
061				Y			Y			Y							Y		Y		Y	Y		Y	Y			Y	Y	
062				Y				Y		Y					Y	Y			Y	Y		Y	Y			Y	Y			
063				Y			Y			Y		Y			Y				Y			Y	Y					Y		
064				Y			Y			Y		Y			Y				Y		Y				Y		Y	Y		
065				Y																										
066					Y		Y			Y					Y		Y		Y				Y		Y			Y		
067				Y			Y			Y					Y	Y			Y											
068				Y			Y			Y					Y				Y			Y			Y			Y		
069				Y	Y		Y			Y					Y	Y	Y		Y		Y	Y	Y		Y	Y				
070					Y		Y			Y					Y		Y			Y			Y		Y	Y		Y		
071				Y			Y			Y					Y				Y		Y	Y			Y			Y		
072				Y			Y			Y					Y						Y	Y	Y		Y			Y	Y	
073				Y											Y				Y						Y			Y		Y
074				Y			Y			Y					Y		Y		Y			Y			Y			Y	Y	
075				Y						Y															Y			Y		
076				Y			Y			Y					Y	Y				Y			Y		Y	Y		Y		
077				Y																								Y		
078				Y			Y			Y					Y				Y	Y	Y		Y		Y					Y
079				Y						Y																Y	Y			
080				Y			Y								Y		Y		Y	Y	Y		Y		Y			Y		
081				Y			Y			Y					Y		Y		Y		Y	Y						Y		
082				Y											Y		Y		Y			Y			Y			Y	Y	
083				Y			Y			Y					Y															
084					Y		Y				Y					Y				Y			Y			Y				
085					Y		Y			Y						Y			Y	Y						Y			Y	

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ID	2002			2003			2004			2005					2006				2007			2008			2009			2010		
	P	O	C	P	O	C	P	O	C	P	O	C	Oha	El	P	O	C	Oha	P	O	C	P	O	C	P	O	C	P	O	Oha
086					Y		Y			Y										Y			Y		Y	Y		Y		
087				Y			Y			Y					Y					Y			Y			Y				Y
088					Y																									
089				Y			Y			Y					Y		Y		Y		Y		Y				Y			
090				Y			Y			Y																				
091				Y			Y			Y					Y				Y			Y								
092				Y			Y			Y					Y				Y		Y	Y			Y			Y		
093		Y					Y			Y					Y		Y		Y	Y	Y	Y			Y			Y		
094							Y			Y					Y				Y			Y			Y			Y		
095							Y																							
096							Y			Y					Y				Y		Y	Y	Y			Y		Y	Y	
097							Y	Y											Y			Y	Y		Y			Y		
098							Y																							
099							Y			Y					Y				Y			Y			Y		Y			
100							Y																							
101							Y																							
102							Y			Y					Y				Y			Y	Y			Y		Y		
103							Y			Y					Y				Y	Y			Y			Y		Y		
104								Y		Y													Y			Y				
105							Y			Y		Y			Y		Y		Y			Y			Y			Y	Y	
106							Y			Y					Y															
107							Y			Y					Y				Y									Y		
108	Y						Y			Y					Y		Y		Y	Y			Y			Y			Y	
109							Y								Y															
110							Y			Y	Y					Y				Y		Y							Y	
111							Y			Y												Y			Y					
112										Y					Y				Y		Y	Y			Y				Y	Y
113							Y			Y					Y				Y			Y			Y					
114							Y			Y						Y				Y		Y	Y		Y	Y		Y		
115							Y			Y					Y		Y			Y					Y	Y				

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ID	2002			2003			2004			2005					2006				2007			2008			2009			2010		
	P	O	C	P	O	C	P	O	C	P	O	C	Oha	El	P	O	C	Oha	P	O	C	P	O	C	P	O	C	P	O	Oha
116							Y			Y					Y				Y	Y		Y	Y		Y			Y		
117										Y					Y		Y		Y		Y		Y		Y	Y		Y		
118										Y					Y					Y		Y		Y		Y		Y		
119										Y					Y	Y				Y			Y					Y		
120										Y																				
121										Y					Y															
122														Y																
123										Y			Y			Y				Y			Y		Y					
124										Y					Y				Y	Y					Y	Y		Y		Y
125										Y					Y				Y						Y			Y		
126										Y																				
127										Y					Y				Y								Y			
128										Y																				
129										Y					Y				Y	Y					Y					
130										Y																				
131										Y															Y			Y		
132										Y					Y				Y		Y							Y		
133										Y					Y		Y												Y	
134										Y																				
135							Y			Y					Y				Y	Y		Y	Y		Y			Y		
136															Y		Y		Y		Y									
137															Y	Y			Y		Y	Y	Y		Y					Y
138															Y				Y											
139	Y														Y								Y		Y				Y	
140															Y															
141															Y															
142															Y															
143															Y															
144															Y				Y			Y					Y	Y		
145															Y				Y	Y			Y		Y					

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ID	2002			2003			2004			2005					2006				2007			2008			2009			2010		
	P	O	C	P	O	C	P	O	C	P	O	C	Oha	El	P	O	C	Oha	P	O	C	P	O	C	P	O	C	P	O	Oha
146															Y				Y									Y		
147															Y				Y											
148																			Y											
149																			Y											
150																			Y											
151																			Y											
152																			Y											
153																			Y											
154																			Y											
155																			Y											
156																			Y											
157																				Y										
158															Y		Y		Y	Y			Y					Y		
159																			Y			Y			Y			Y	Y	
160																			Y									Y		
161																						Y								
162																						Y						Y		
163																						Y								
164																						Y								
165																						Y								
166																									Y					
167																									Y			Y		
168																									Y			Y		
169																									Y					
170																									Y					
171																									Y					
172																									Y		Y			
173																									Y			Y		
174																									Y					
175																									Y			Y		

- continued next page -

	2002			2003			2004			2005					2006				2007			2008			2009			2010		
ID	P	O	C	P	O	C	P	O	C	P	O	C	Oha	El	P	O	C	Oha	P	O	C	P	O	C	P	O	C	P	O	Oha
176																														
177																												Y		
178																												Y		
179																												Y		
180																												Y		
181																												Y		
182																												Y		
183																												Y		
184																												Y		
185																												Y		
186																												Y		Y
187																												Y		

P – Piltun
O – Offshore
C – Chaivo
Oha – Okha
El – cape Elizabeth

Table A5. Number of encounters with identified gray whales by area off NE Sakhalin Island, 2010.

KOGW	Piltun	N. Piltun	Offshore	Okha	Arkutun-Dagi	Total
KOGW002	3	0	0	0	0	1
KOGW005	1	0	0	0	0	1
KOGW007	5	0	0	0	0	1
KOGW008	0	2	2	1	0	1
KOGW009	2	0	0	0	0	1
KOGW010	9	1	0	0	0	1
KOGW011	3	0	0	0	0	1
KOGW012	1	0	0	0	0	1
KOGW015	1	0	0	0	0	1
KOGW017	1	0	2	0	0	1
KOGW018	2	0	0	0	0	1
KOGW020	2	0	0	0	0	1
KOGW021	2	0	1	0	0	1
KOGW022	6	0	0	0	0	1
KOGW023	0	1	0	0	0	1
KOGW025	0	0	0	2	0	1
KOGW026	3	0	0	0	0	1
KOGW027	1	0	0	0	0	1
KOGW028	1	0	0	0	0	1
KOGW031	0	0	1	0	0	1
KOGW033	1	0	0	0	0	1
KOGW035	1	0	0	0	0	1
KOGW036	0	0	1	0	0	1
KOGW038	2	0	0	0	0	1
KOGW039	4	1	0	0	0	1
KOGW040	1	0	0	0	0	1
KOGW042	0	0	2	0	0	1
KOGW043	6	0	0	0	0	1
KOGW044	4	0	0	0	0	1
KOGW047	1	0	0	0	0	1
KOGW048	4	0	0	0	0	1
KOGW053	1	0	0	0	0	1
KOGW054	3	0	0	0	0	1
KOGW055	1	0	0	0	0	1
KOGW056	3	0	0	0	0	1
KOGW057	0	0	2	0	0	1
KOGW058	2	0	3	0	0	1
KOGW059	2	0	0	0	0	1
KOGW060	4	0	1	0	0	1
KOGW061	3	0	2	0	1	1
KOGW063	9	0	0	0	0	1
KOGW064	4	0	0	0	0	1
KOGW066	1	0	0	0	0	1
KOGW068	2	0	0	0	0	1
KOGW070	4	0	0	0	0	1

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KOGW	Piltun	N. Piltun	Offshore	Okha	Arkutun-Dagi	Total
KOGW071	3	0	0	0	0	1
KOGW072	1	0	0	0	1	1
KOGW073	1	0	0	2	0	1
KOGW074	2	0	1	0	0	1
KOGW075	2	1	0	0	0	1
KOGW076	1	0	0	0	0	1
KOGW077	3	0	0	0	0	1
KOGW078	0	0	0	1	0	1
KOGW080	2	0	0	0	0	1
KOGW081	5	0	0	0	0	1
KOGW082	1	0	1	0	0	1
KOGW085	0	0	0	0	2	1
KOGW086	1	0	0	0	0	1
KOGW087	0	0	0	2	0	1
KOGW092	5	0	0	0	0	1
KOGW093	3	0	0	0	0	1
KOGW094	1	1	0	0	0	1
KOGW096	2	0	1	0	0	1
KOGW097	2	0	0	0	0	1
KOGW102	0	3	0	0	0	1
KOGW103	0	1	0	0	0	1
KOGW105	1	0	2	0	0	1
KOGW107	1	0	0	0	0	1
KOGW108	0	0	3	0	2	1
KOGW110	0	0	1	0	0	1
KOGW112	1	0	0	1	0	1
KOGW114	3	0	0	0	0	1
KOGW116	3	0	0	0	0	1
KOGW117	1	0	0	0	0	1
KOGW118	1	0	0	0	0	1
KOGW119	1	0	0	0	0	1
KOGW124	0	3	0	1	0	1
KOGW125	3	0	0	0	0	1
KOGW131	2	2	0	0	0	1
KOGW132	3	0	0	0	0	1
KOGW133	0	0	0	0	1	1
KOGW135	2	0	0	0	0	1
KOGW137	0	0	0	1	0	1
KOGW139	0	0	0	0	1	1
KOGW144	8	0	0	0	0	1
KOGW146	4	0	0	0	0	1
KOGW158	2	0	0	0	0	1
KOGW159	1	0	0	0	1	1
KOGW160	2	0	0	0	0	1

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KOGW	Piltun	N. Piltun	Offshore	Okha	Arkutun-Dagi	Total
KOGW162	2	0	0	0	0	1
KOGW167	5	0	0	0	0	1
KOGW168	1	0	0	0	0	1
KOGW173	6	0	0	0	0	1
KOGW175	1	0	0	0	0	1
KOGW177	1	0	0	0	0	1
KOGW178	2	0	0	0	0	1
KOGW179	6	0	0	0	0	1
KOGW180	4	0	0	0	0	1
KOGW181	2	0	0	0	0	1
KOGW182	5	0	0	0	0	1
KOGW183	3	0	0	0	0	1
KOGW184	3	0	0	0	0	1
KOGW185	1	0	0	0	0	1
KOGW186	1	2	0	1	0	1
KOGW187	1	0	0	0	0	1

Table A7. Recorded sightings of cows with calves, body condition (BC) class and skin condition, 2002-2010

KOGW	Year 2002	Year 2003	cow/calf	BC	skin condition	Year 2004	cow/calf	BC	skin condition	Year 2005	cow/calf	BC	skin condition	Year 2006	cow/calf	BC	skin condition	Year 2007	cow/calf	BC	skin condition	Year 2008	cow/calf	BC	skin condition	Year 2009	cow/calf	BC	skin condition	Year 2010	cow/calf	BC
1	x			0	0	x		0	0	x		0	0	x		1		õ		1-0		x		1		x						
2	x	x		1	0	x		1	0	x		0	0	x		2		õ		2-1		x								x		1-0
3	x																															
4	x	x		0	0																											
5	x	x	cow	2-3	0	x		0	0	x	cow	4	0	x				õ				x		3-2-1		x		3		x		
6	x	x		0	0	x		2	0	x		0	0	x		1		õ				x		1		x						
7	x	x		0	0	x		0	0	x		0	0	x		1-4		õ		1-0										x	cow	3-2
8	x	x		3	0	x		0	0	x		0	0	x		2		õ		1-0		x				x		1		x		
9	x					x		0	0	x		0	0	x				õ		2	1	x				x				x		
10	x					x		1	0	x		1	1	x				õ		1-0						x				x		2-0
11	x	x		1	0	x		0	0	x		0	0	x				õ		1-0		x				x		2		x		2-0
12	x	x		1	0	x		1	0	x		1	0	x				õ		1-0		x				x		2		x		
13	x	x		2	0	x		0	0	x		2	0	x				õ								x						
14	x					x		1	0	x		0	0	x				õ				x										
15	x	x		0	0					x		0	0	x				õ	cow	4-3		x		1		x	cow	4		x		
16	x	x		0	0	x		0	0	x		0	0	x				õ		2-0	?	x		2		x						
17	x	x		0	0	x		1	0	x		0	0	x		2-1-0		õ		1-0						x				x		2-0
18	x	x	cow	2	0	x		0	0	x		0	0	x		2-1							cow							x		
19	x	x		2	0	x		0	0	x		3	0	x		3-2		õ		1						x		2-1			cow	
20	x	x		0	0	x		0	0	x		0	0	x		1-0		õ		1-0		x				x	cow	4		x		
21	x	x		0	0	x		2	0	x		0	0	x	cow	2-3		õ				x	cow	4-3		x		1		x		
22	x	x			0	x		0	0	x		0	0	x				õ		2		x		4-2=1		x				x		2-0
23	x					x		0	0				0	x		2-0										x				x		
24	x									x		0	0	x				õ				x				x						
25	x	x		1	0	x		0	0	x		0	0	x				õ		2-0						x		1		x		
26	x	x	cow	2	2					x		0	0	x		2						x				x		1		x		
27	x	x	cow	4	2	x		2	0	x	cow	3-4	0	x		2		õ	cow	4-3		x		2						x		
28	x	x		0	от 1 до 3	x		0	0	x		0	0	x		2		õ		2	1-2					x				x		4
29	x	x		0	0	x		1	0	x		0	0	x		1-0		õ		1-0	1	x				x		1				
30	x	x		0	0	x		0	0	x		0	0	x				õ				x				x		2-0				
31	x	x		0	0	x		0	0					x				õ		2-0	1	x				x	cow	3		x		
32	x	x		0	1	x		1	0	x		0	0	x				õ		2-0		x				x						
33	x	x		0	0	x		0	0	x		0	0	x		2		õ				x				x				x		
34	x					x		0	0	x		0	2	x		2-0		õ		2-0	1	x		2		x		2-1				
35	x	x		0	0	x		0	0	x		0	0	x		1		õ		2-1-0		x				x				x		3

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KOGW	Year 2002	Year 2003	cow/calf	BC	skin condition	Year 2004	cow/calf	BC	skin condition	Year 2005	cow/calf	BC	skin condition	Year 2006	cow/calf	BC	skin condition	Year 2007	cow/calf	BC	skin condition	Year 2008	cow/calf	BC	skin condition	Year 2009	cow/calf	BC	skin condition	Year 2010	cow/calf	BC
36	x	x		0	0	x		0	0	x		1	0	x		2		õ				x								x		
37	x	x	cow	2	0	x		0	0	x	cow	3	0	x		1		õ				x		3		x		3-0				
38	x	x		0	0	x		0	0	x				x				õ		2-0		x				x				x		2-0
39	x	x	cow	3	0					x		0	0	x		3-0		õ		2-1-0	1	x				x		1-0		x		
40	x	x		2	0	x		0	0	x		0	0					õ				x				x		2		x		1
41	x					x		0	0	x		0	0	x				õ		2-0		x		2		x		2				
42	x					x		0	1	x		0	1	x		1-0		õ		1-0		x				x		1		x		
43	x	x		1	0	x		0	0	x		1	0	x		1-0		õ		2		x								x		2
44	x	x		2	0	x		3	0	x		4	0	x				õ		4-3		x		4-2		x		1		x	cow	4-3
45	x	x		0	0	x		0	0	x		0	0	x				õ								x					cow	
46		x		0	0	x		2	0	x		0	0	x		2-1-0		õ		1	1	x				x						
47		x		0	1	x		0	0	x		0	0	x				õ				x		3		x				x		
48		x		0	0	x		0	0	x		0	0	x		4-1		õ		1-0						x				x		
49		x		2	2	x		0	0	x		0	0	x		2		õ		2-0		x				x						
50		x		0	2	x	cow	3	1	x		0	0	x	cow	2		õ		2-1-0		x		2-0		x	cow	1				
51		x		0	0	x		2	0	x		0	0	x		2		õ				x		1		x						
52		x	calf	0	0																											
53		x		0	0					x		0	0	x		1		õ		2-1-0						x		1		x		
54		x		0	0	x		0	0	x		0	0	x		1-0		õ		2-0		x		1		x		1		x		2-0
55		x		0	0					x		0	0	x				õ		1-0	1	x				x				x		
56		x		0	от1 до 3	x		1	0	x		0-1	0	x		2-0		õ		2-1	1	x		2		x				x		2-0
57		x		0	0									x		1		õ		2-0		x				x		3-0		x		
58		x		0	0	x		0	0	x		1	0	x				õ		2-1-0		x		2						x		2-0
59		x		0	0					x		0	0	x		1		õ		3-0	1					x		2-0		x		3
60		x		0	0	x		0	0	x		0	0	x		2-0		õ		1-0		x				x		2		x		2-0
61		x		0	0	x		0	0	x		0	0	x		2-0		õ		1-0	2	x				x				x		2-1
62		x		0	0	x		0	0	x	cow	2	0	x		1-0		õ	cow	4-3		x		2		x						
63		x	cow	2	0	x		1	0	x		0	0	x				õ	cow	2-0		x								x	cow	3-1
64		x		0	0	x	cow	2	0	x		2	0	x				õ	cow	3						x				x	cow	3-1
65		x		0	0																											
66		x		0	0	x		0	0	x		0	0	x		1-0		õ				x				x		2		x		
67		x		0	0					x		0	0	x		2-1		õ		2-1												
68		x		2	1	x		0	0	x		0	0	x		2		õ		1-0	1-2-3	x		1		x		2		x		
69		x	calf	0	0	x		1	0	x		0	0	x		1-0		õ				x				x		2-0				
70		x		2	0	x		1	0	x		0	0	x		1-0		õ				x				x		2-0		x		1-0
71		x		0	0	x		0	0	x		1	0	x				õ		2	1	x		2-1		x		2-0		x		
72		x		0	0	x		0	0	x		0	0	x				õ		1		x		1		x		2-0		x		3-0
73		x	calf	0	0													õ	?	2-1						x				x		
74		x		0	0	x		0	0	x		0	0	x				õ		1-0	1	x				x				x		3-0
75		x	calf	0	0																					x		1		x		

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KOGW	Year 2002	2003	cow/calf	BC	skin condition	Year 2004	cow/calf	BC	skin condition	Year 2005	cow/calf	BC	skin condition	Year 2006	cow/calf	BC	skin condition	Year 2007	cow/calf	BC	skin condition	Year 2008	cow/calf	BC	skin condition	Year 2009	cow/calf	BC	skin condition	Year 2010	cow/calf	BC
76		x	calf	0	0	x		0	0	x		0	0	x				õ				x				x				x		
77		x	calf	0	0																									x		2-0
78		x	calf	0	0	x		0	0	x		0	0	x				õ		1-0		x				x		1		x		2
79		x	calf	0	0					x		0	0																			
80		x	calf?	0	0	x		1	0					x		1-0		õ		1-0		x				x		1		x		
81		x	calf	0	0	x		0	0	x		0	0	x		2-0		õ		2-1-0		x				x		2		x		1-0
82		x	calf	0	0	x		0	0			0	0	x				õ		2		x				x				x		
83		x	calf?	0	0	x		0	0	x		0	0	x																		
84		x		1	0	x		0	0	x				x		2		õ				x				x						
85		x		0	0	x		1	0	x		0	0	x				õ		2-1		x				x				x		
86		x		0	0	x		0	0	x		0	0					õ				x				x		2-0		x		
87		x		0	0	x		0	0	x		0	0	x				õ				x				x		2-0		x		
88		x		0	0			0	0																							
89		x	calf?	0	0	x		0	0	x		0	0	x		2-1-0		õ		2-1-0		x				x		1				
90		x		0	0	x		0	0	x		0															cow					
91		x		0	0	x		0	0	x				x		1-0		õ		1		x										
92		x		0	0	x		2	0	x			0	x		2		õ		2-1		x		3-1		x	cow	4		x		3-0
93						x		0	0	x		0	0	x		2-0		õ		1-0		x	cow	3-1		x				x	cow	2
94						x		0	0	x		0	0	x		1-0		õ		1-0		x		2		x				x		2-0
95-female						x	calf	0	0																							
96						x		1	0	x		0	0	x				õ		1		x				x		1		x		
97						x		0	0									õ	cow	4-2		x		3-2		x	cow	2		x		1
98						x		0	0																							
99						x		0	0	x		0	0	x				õ		2-1-0		x		1		x		2-0				
100						x		3	0																							
101						x	calf	0	0																							
102						x		0	0	x		0	0	x				õ				x				x				x		
103						x		0	0	x		0	0	x				õ		2		x					cow			x		
104						x		0	0	x		1	0									x				x						
105						x		0	0	x		0	0	x		1-0		õ		2-1-0		x		2		x						1-0
106						x		0	0	x		0	0	x		1-0						x								x		
107						x		0	0	x		0	0	x		1		õ												x		
108						x		1	0	x		0	0	x		2-1		õ		2-0		x				x				x		1
109						x		0	0	x				x																		
110						x		2	0	x		0	0	x		1-0		õ				x				x	cow			x		
111						x		0	0	x		0	0									x		2		x						
112						x		0	0	x		0	0	x		2-1-0		õ		2-1-0		x				x		2-0		x		
113						x		0	0	x		0	0	x				õ		2		x				x						
114						x		0	0	x		0	0	x				õ		1-0		x				x	x			x		
115						x		0	0	x		0	0	x				õ		1						x		2-0				

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KOGW	Year 2002	2003	cow/calf	BC	skin condition	Year 2004	cow/calf	BC	skin condition	Year 2005	cow/calf	BC	skin condition	Year 2006	cow/calf	BC	skin condition	Year 2007	cow/calf	BC	skin condition	Year 2008	cow/calf	BC	skin condition	Year 2009	cow/calf	BC	skin condition	Year 2010	cow/calf	BC
116						x		0	0	x		0	0	x				õ		2-0	1	x				x		1-0		x		
117										x		0	0	x				õ		1-0		x				x				x		
118										x		0	0	x		1		õ				x				x				x		1
119										x		1	0	x		2-0		õ				x								x		1
120										x		2	0																			
121										x		0	0	x		1-2																
122										x		1	0																			
123										x		0	0	x				õ				x				x		2				
124										x	calf	0	0	x				õ		1						x		1		x		1
125										x	calf	0	0	x		1		õ		2-1-0						x		2		x		2-0
126										x	calf	0	0																			
127										x	calf	0	0	x		2		õ			2					x						
128										x		0	0																			
129										x		0	0	x		1		õ		2-0						x		1-0				
130										x		0	0																			
131										x		0	0													x		1		x		1-0
132										x		2	0	x				õ		1										x		
133-male										x		0	0	x																x		
134										x		0	0																			
135										x		0	0	x				õ				x				x		2-0		x		
136														x		1-0		õ		1												
137														x		1-0		õ		1-0		x				x				x		
138														x		2-0		õ		1-0												
139														x		2		õ								x		2		x		
140														x		1-0																
141														x	calf																	
142														x	calf																	
143														x	calf																	
144														x	calf?			õ				x		1		x		2		x		
145														x				õ				x				x						
146														x	calf?			õ		1-0	2-1					x				x		1
147														x		1-2		õ		1												
148																		õ	calf													
149																		õ	calf													
150																		õ	calf													
151																		õ	calf													
152																		õ	calf													
153																		õ	calf													
154-female																		õ	calf													

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KOGW	Year 2002	2003	cow/calf	BC	skin condition	Year 2004	cow/calf	BC	skin condition	Year 2005	cow/calf	BC	skin condition	Year 2006	cow/calf	BC	skin condition	Year 2007	cow/calf	BC	skin condition	Year 2008	cow/calf	BC	skin condition	Year 2009	cow/calf	BC	skin condition	Year 2010	cow/calf	BC
155																			x	calf?												
156																			x		1											
157																			x		1											
158																			x		1		x		2		x		2		x	
159																			x		2-1-0		x		2		x		1-0		x	
160																			x								x		1		x	
161																							x	calf								
162																							x	calf			x		2		x	
163																							x	calf								
164																							x	calf?								
165																							x	calf?								
166																											x		2-0			
167																											x	calf			x	
168																											x	calf			x	
169																											x	calf				
170																											x					
171																											x					
172																											x		2			
173																											x	calf			x	
174																											x	calf				
175																											x	calf			x	
176																											x	calf				
177																											x	calf			x	
178																															x	calf
179																															x	calf
180																															x	calf
181																															x	calf
182																															x	calf
183																															x	calf
184																															x	calf
185																															x	
186																															x	
187																															x	calf
TEMP1	x																															
TEMP2						x		0	0	x		0	0	matched to KOGW135																		
TEMP3	x	matched to KOGW108																														
TEMP4														x																		
TEMP5														x																		
TEMP6														x																		

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KOGW	Year 2002	Year 2003	cow/calf	BC	skin condition	Year 2004	cow/calf	BC	skin condition	Year 2005	cow/calf	BC	skin condition	Year 2006	cow/calf	BC	skin condition	Year 2007	cow/calf	BC	skin condition	Year 2008	cow/calf	BC	skin condition	Year 2009	cow/calf	BC	skin condition	Year 2010	cow/calf	BC
TEMP7														x																		
TEMP8														x																		
TEMP9																			matched to KOGW129													
TEMP10																			x	matched to KOGW116												
TEMP11																			x													
TEMP12																			x													
TEMP13																			x													
TEMP14																			matched to KOGW158													
TEMP15																															x	
TEMP16																															x	

Yellow	Sighted by behaviour team only
Orange	Sighted on Kamchatka only

Table A8. Number of encounters with gray whales off Kamchatka Peninsula during the 2004, 2006-2010.

ID (KamGW000)	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	KOGW000
KamGW001 cow			2006_08_21	1			2008_08_22	1	2009_07_11	1	2010_07_18	1	KOGW090
							2008_08_28	1	2009_07_21	1	2010_07_30	1	
							2008_08_29	1	2009_08_04	1	2010_08_10	1	
									2009_08_14	1			
KamGW002			2006_08_21	1	2007_08_02	1	2008_08_29	1	2009_07_16	1			KOGW132
									2009_07_21	1			
KamGW003			2006_08_22	1	2007_08_05	1	2008_08_19	1	2009_07_11	1	2010_06_30	1	
									2009_07_27	1	2010_07_05	1	
									2009_08_14	1	2010_07_11	1	
									2009_09_02	1	2010_07_18	1	
											2010_07_26	1	
											2010_08_10	1	
KamGW004			2006_08_22	2	2007_08_02	1	2008_08_22	1	2009_07_21	1	2010_06_30	1	
											2010_07_05	1	
											2010_07_10	1	
											2010_08_10	1	
KamGW005			2006_08_22	1			2008_08_19	1	2009_07_27	1	2010_06_30	1	
							2008_08_28	1	2009_08_04	1	2010_07_10	1	
							2008_08_29	1	2009_08_20	1	2010_07_11	1	
									2009_09_02	1	2010_07_18	1	
											2010_07_22	1	
											2010_07_26	1	
											2010_08_10	1	
KamGW006			2006_08_22	1							2010_06_30	1	
KamGW007			2006_08_22	1	2007_08_02	2	2008_08_22	1	2009_07_16	1	2010_07_18	1	
					2007_08_05	1	2008_08_23	1			2010_07_22	1	
											2010_07_26	1	
											2010_07_30	1	
											2010_08_09	1	

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ID (KamGW000)	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	KOGW000
KamGW008			2006_08_22	1	2007_08_02	1	2008_08_29	1			2010_06_23	1	KOGW095
											2010_06_29	1	
											2010_07_22	1	
											2010_07_30	1	
											2010_08_10	1	
KamGW009			2006_08_22	1	2007_08_02	1			2009_08_14		2010_06_29	1	
KamGW010			2006_08_22	1	2007_08_02	1	2008_08_28	1	2009_07_21	1	2010_06_22	1	KOGW077
					2007_08_05	1							
KamGW011			2006_08_22	1	2007_08_02	1			2009_08_14	1	2010_06_30	1	
											2010_07_05	1	
											2010_07_10	1	
											2010_07_26	1	
											2010_07_30	1	
KamGW012			2006_08_22	1	2007_08_02	1			2009_08_14	1			KOGW185
					2007_08_05	1							
KamGW013			2006_07_05	1									KOGW047
KamGW014	2004_07_22	1											
	2004_08_11	1											
KamGW015	2004_07_22	1											KOGW166
KamGW016	2004_08_11	1									2010_06_23	1	KOGW136
KamGW017					2007_08_02	1							
					2007_08_05	1							
KamGW018					2007_08_02	1	2008_08_22	1	2009_07_11	1	2010_06_29	1	KOGW160
									2009_07_16	1	2010_06_30	1	
									2009_07_21	1			
									2009_07_27	1			
KamGW019					2007_08_02	1			2009_06_05	1			KOGW022
KamGW020					2007_08_02	1	2008_08_22	1	2009_07_11	1	2010_06_30	1	KOGW186
					2007_08_05	1	2008_08_29	1	2009_07_27	1			
									2009_08_14	1			

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ID (KamGW000)	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	KOGW000
KamGW021					2007_08_02	1							
KamGW022					2007_08_02	1							
					2007_08_05	1							
KamGW023					2007_08_02	1							
KamGW024					2007_08_02	1	2008_08_22	1	2009_07_16	1	2010_06_22	1	NOGW001
					2007_08_05	1							
KamGW025					2007_08_02	1	2008_08_23	1	2009_08_04	1	2010_07_10	1	
							2008_08_28	1	2009_08_14	1	2010_07_18	1	
							2008_08_29	1			2010_07_22	1	
											2010_07_26	1	
											2010_08_09	1	
											2010_08_10	1	
KamGW026					2007_08_02	1							KOGW075
KamGW027					2007_08_02	1							
KamGW028					2007_08_02	1					2010_06_22	1	KOGW142
					2007_08_05	1					2010_06_23	1	
											2010_07_10	1	
											2010_07_11	1	
											2010_07_26	1	
											2010_07_30	1	
KamGW029					2007_08_02	1			2009_08_04	1	2010_06_29	1	
					2007_08_05	1					2010_06_30	1	
											2010_07_10	1	
											2010_07_18	1	
											2010_07_22	1	
											2010_07_30	1	
											2010_08_09	1	
											2010_08_10	1	

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ID (KamGW000)	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	KOGW000
KamGW030					2007_08_02	1	2008_08_28	1	2009_07_21	1	2010_06_22	1	
							2008_08_29	1	2009_08_04	1	2010_06_29	1	
											2010_06_30	1	
											2010_07_10	1	
											2010_07_22	1	
											2010_07_30	1	
											2010_08_10	1	
KamGW031					2007_08_02	1	2008_08_23	1	2009_07_16	1	2010_06_22	1	KOGW018
					2007_08_05	1					2010_06_30	1	
											2010_07_05	1	
KamGW032					2007_08_02	1			2009_07_16	1	2010_06_23	1	KOGW140
					2007_08_05	1			2009_07_21	1	2010_06_30	1	
KamGW033					2007_08_02	1							KOGW066
KamGW034													KOGW159 NOGW03
					2007_08_02	1							
KamGW035					2007_08_05	1	2008_08_19	1					KOGW124
KamGW036					2007_08_05	1							
KamGW037					2007_08_05	1	2008_08_22	1	2009_07_21	1	2010_06_29	1	KOGW133
							2008_08_29	1	2009_08_04	1	2010_07_05	1	
											2010_07_10	1	
											2010_07_11	1	
											2010_07_22	1	
											2010_08_10	1	
KamGW038					2007_06_05	1							KOGW092
KamGW039 cow					2007_06_05	1					2010_06_23	1	KOGW019
											2010_06_30	1	
KamGW040					2007_06_05	1							
					2007_06_08	1							
KamGW041					2007_06_08	1							KOGW105
					2007_06_11	1							

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ID (KamGW000)	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	KOGW000
KamGW042					2007_06_11	1			2009_06_11	1			KOGW137
KamGW043					2007_06_11	1							KOGW039
KamGW044					2007_06_11	1							KOGW033
KamGW045							2008_08_19	1			2010_08_09	1	KOGW028
							2008_08_29	1			2010_08_10	1	
KamGW046							2008_08_19	1					
KamGW047							2008_08_19	1					
							2008_08_23	1					
							2008_08_28	1					
KamGW048							2008_08_19	1	2009_07_11	1	2010_06_29	1	KOGW149
							2008_08_28	1	2009_07_27	1	2010_07_05	1	
							2008_08_29	1	2009_08_04	1	2010_07_18	1	
									2009_08_14	1	2010_07_22	1	
									2009_09_02	1	2010_07_30	1	
											2010_08_10	1	
KamGW049							2008_08_19	1	2009_07_11	1			
									2009_07_27	1			
KamGW050							2008_08_19	1			2010_06_29	1	KOGW152
							2008_08_28	1			2010_06_30	1	
											2010_07_05	1	
											2010_07_11	1	
											2010_07_18_	1	
											2010_07_30	1	
											2010_08_10	1	
KamGW051							2008_08_19	1					
							2008_08_23	1					
							2008_08_28	1					
KamGW052							2008_08_19	1	2009_07_11	1	2010_06_22	1	KOGW154
							2008_08_28	1	2009_07_21	1	2010_06_29	1	
									2009_07_27	1	2010_07_10	1	
									2009_08_14	1	2010_07_11	1	
									2009_08_20	1	2010_07_18	1	
									2009_09_02	1	2010_08_10	1	

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ID (KamGW000)	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	KOGW000
KamGW053							2008_08_19	1	2009_07_11	1	2010_07_05	1	KOGW148
							2008_08_22	1	2009_07_16	1	2010_07_10	1	
									2009_07_21	1	2010_07_18	1	
											2010_07_30	1	
KamGW054							2008_08_19	1	2009_07_16	1	2010_06_23	1	KOGW153
							2008_08_22	1	2009_07_21	1	2010_06_29	1	
							2008_08_23	1	2009_07_27	1	2010_06_30	1	
							2008_08_29	1					
KamGW055							2008_08_22	1	2009_07_11	1	2010_06_22	1	
							2008_08_23	1	2009_07_21	1	2010_06_29	1	
									2009_07_27	1	2010_07_05	1	
									2009_08_14	1	2010_07_18	1	
											2010_07_26	1	
											2010_07_30	1	
											2010_08_09	1	
											2010_08_10	1	
KamGW056							2008_08_22	1	2009_07_11	1	2010_06_29	1	KOGW151
							2008_08_29	1	2009_07_16	1	2010_06_30	1	
											2010_07_05	1	
											2010_07_10	1	
KamGW057 cow							2008_08_22	1	2009_07_16	1	2010_06_29	1	
							2008_08_29	1	2009_07_21	1	2010_07_10	1	
									2009_07_27	1	2010_07_11	1	
									2009_08_14	1	2010_07_18	1	
											2010_07_26	1	
											2010_07_30	1	
											2010_08_10	1	
KamGW058							2008_08_22	1					
							2008_08_29	1					

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ID (KamGW000)	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	KOGW000
KamGW059							2008_08_22	1			2010_06_23	1	
											2010_06_30	1	
											2010_07_18	1	
											2010_07_22	1	
											2010_07_26	1	
											2010_07_30	1	
											2010_08_09	1	
KamGW060 cow							2008_08_22	1			2010_06_29	1	KOGW064
											2010_07_05	1	
KamGW061							2008_08_22	1			2010_06_29	1	
											2010_07_05	1	
											2010_07_10	1	
											2010_07_18	1	
											2010_07_22	1	
											2010_07_30	1	
KamGW062							2008_08_22	1			2010_06_23	1	KOGW053
KamGW063							2008_08_22	1	2009_07_11	1	2010_06_23	1	KOGW107
							2008_08_29	1					
KamGW064							2008_08_22	1					KOGW127
							2008_08_29	1					
KamGW065							2008_08_22	1					KOGW131
							2008_08_29	1					
KamGW066							2008_08_22	1	2009_07_11	1	2010_07_11	1	
							2008_08_23	1	2009_07_27	1	2010_07_18	1	
											2010_07_30	1	
											2010_08_09	1	
											2010_08_30	1	
KamGW067							2008_08_28	1					
KamGW068 cow							2008_08_22	1	2009_06_14	1	2010_06_22	1	KOGW045
											2010_06_23	1	
											2010_06_29	1	
											2010_06_30	1	
											2010_07_05	1	

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ID (KamGW000)	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	KOGW000
KamGW069							2008_08_22	1			2010_06_29	1	KOGW067
							2008_08_29	1					
KamGW070							2008_08_22	1					KOGW084
							2008_08_28	1					
KamGW071							2008_08_22	1			2010_07_22	1	KOGW048
							2008_08_28	1			2010_06_23	1	
							2008_08_29	1			2010_06_30	1	
KamGW072							2008_08_22	1					
							2008_08_28	1					
KamGW073							2008_08_22	1	2009_07_16	1	2010_07_26	1	
							2008_08_29	1	2009_07_21	1	2010_07_30	1	
									2009_07_27	1	2010_08_10	1	
KamGW074							2008_08_22	1	2009_07_16	1	2010_06_23	1	KOGW150
									2009_08_20	1	2010_06_29	1	
									2009_09_02	1	2010_06_30	1	
											2010_07_11	1	
											2010_07_18	1	
											2010_07_22	1	
											2010_08_22	1	
KamGW075							2008_08_23	1					
KamGW076							2008_08_23	1	2009_07_11	1	2010_06_22	1	
							2008_08_28	1	2009_07_27	1	2010_06_29	1	
							2008_08_29	1	2009_08_14	1	2010_07_18	1	
											2010_08_10	1	
KamGW077							2008_08_29	1					KOGW073
KamGW078	**Found dead in 2009**						2008_08_29	1	2009_07_16	1			KOGW126
KamGW079									2009_07_11	1			
KamGW080									2009_07_11	1	2010_07_18	1	KOGW164
									2009_07_27	1	2010_07_26	1	
									2009_08_14	1	2010_07_30	1	
									2009_08_20	1	2010_08_10	1	
									2009_09_02	1			

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ID (KamGW000)	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	KOGW000
KamGW081									2009_08_04	1			
KamGW082									2009_07_11	1	2010_06_22	1	
KamGW083									2009_07_11	1	2010_07_18	1	KOGW163
									2009_07_27	1	2010_07_26	1	
KamGW084 cow									2009_07_11	1	2010_06_22	1	KOGW110
									2009_07_21	1			
KamGW085 calf									2009_07_11	1			
									2009_07_21	1			
									2009_08_20	1			
									2009_09_02	1			
KamGW086 calf									2009_07_11	1			
									2009_07_21	1			
									2009_08_04	1			
									2009_08_14	1			
									2009_08_20	1			
									2009_09_02	1			
KamGW087 cow									2009_07_11	1	2010_06_23	1	KOGW103
											2010_06_30	1	
KamGW088 calf									2009_07_11	1	2010_06_29	1	KOGW174
											2010_06_30	1	
											2010_07_05	1	
											2010_07_18	1	
											2010_07_26	1	
KamGW089									2009_05_30	1	2010_06_22	1	KOGW061
KamGW090									2009_06_06	1			KOGW091
KamGW091									2009_06_11	1	2010_06_22	1	KOGW145
KamGW092									2009_06_13	1			KOGW111
									2009_06_14	1			
KamGW093									2009_06_13	1			KOGW016
KamGW094									2009_06_14	1			KOGW089
KamGW095									2009_06_14	1			KOGW038

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ID (KamGW000)	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	KOGW000
KamGW096									2009_06_14	1			KOGW139
KamGW097									2009_07_16	1			KOGW157
									2009_07_21	1			
									2009_07_27	1			
KamGW098									2009_07_16	1	2010_06_22	1	KOGW121
									2009_08_04	1			
KamGW099									2009_07_16	1	2010_06_29	1	KOGW058
											2010_07_05	1	
KamGW100 calf									2009_07_16	1			
									2009_07_21	1			
									2009_07_27	1			
									2009_08_14	1			
									2009_08_20	1			
KamGW101 cow									2009_07_21	1			
									2009_07_27	1			
KamGW102 calf									2009_07_21	1			
									2009_07_27	1			
KamGW103									2009_07_21	1			KOGW125
KamGW104 calf									2009_07_21	1			KOGW177
KamGW105 calf									2009_07_21	1			
									2009_07_27	1			
									2009_08_14	1			
									2009_08_20	1			
									2009_09_02	1			
KamGW106 cow									2009_07_21	1	2010_06_30	1	
											2010_07_05	1	
											2010_07_30	1	
											2010_08_09	1	
											2010_08_10	1	
KamGW107									2009_07_21	1	2010_06_23	1	
											2010_06_30	1	
											2010_07_10	1	

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ID (KamGW000)	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	KOGW000
KamGW108									2009_07_21	1			
KamGW109									2009_07_11	1	2010_06_22	1	
									2009_07_16	1	2010_07_05	1	
									2009_07_21	1	2010_07_18	1	
									2009_07_27	1	2010_07_26	1	
											2010_07_30	1	
											2010_08_10	1	
KamGW110									2009_07_21	1			
									2009_07_27	1			
									2009_08_14	1			
KamGW111									2009_07_27	1			KOGW161
									2009_08_14	1			
KamGW112									2009_08_14	1	2010_06_30	1	
									2009_09_02	1	2010_07_22	1	
											2010_07_26	1	
KamGW113									2009_08_14	1			KOGW040
KamGW114									2009_08_20	1			
KamGW115									2009_07_11	1			
KamGW116									2009_07_16	1	2010_07_10	1	
											2010_07_18	1	
											2010_07_22	1	
											2010_07_30	1	
											2010_08_10	1	
KamGW117											2010_06_22	1	
KamGW118											2010_06_22	1	KOGW043
											2010_06_29	1	
											2010_07_05	1	
KamGW119											2010_06_22	1	
											2010_06_29	1	
											2010_07_05	1	
											2010_07_11	1	

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ID (KamGW000)	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	KOGW000
KamGW120											2010_06_22	1	
											2010_06_23	1	
											2010_06_30	1	
											2010_07_10	1	
											2010_07_18	1	
											2010_07_22	1	
											2010_08_10	1	
KamGW121											2010_06_22	1	KOGW013
KamGW122											2010_06_22	1	KOGW059
KamGW123											2010_06_22	1	KOGW036
											2010_06_23	1	
KamGW124 calf											2010_06_22	1	KOGW182 calf
											2010_06_23	1	
											2010_06_29	1	
											2010_06_30	1	
											2010_07_05	1	
KamGW125											2010_06_22	1	KOGW060
											2010_06_23	1	
KamGW126											2010_06_22	1	KOGW126
KamGW127											2010_06_22	1	KOGW147
KamGW128											2010_06_23	1	KOGW104
KamGW129											2010_06_23	1	KOGW144
											2010_06_30	1	
KamGW130											2010_06_23	1	KOGW056
KamGW131											2010_06_23	1	
KamGW132											2010_06_23	1	KOGW025
KamGW133 calf											2010_06_23	1	KOGW187
											2010_06_30	1	
KamGW134											2010_06_29	1	
											2010_06_30	1	
											2010_07_05	1	

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ID (KamGW000)	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	Date	Number of encounters	KOGW000
KamGW135 calf											2010_06_29	1	KOGW181
											2010_07_05	1	
KamGW136											2010_06_29	1	
											2010_06_30	1	
											2010_07_10	1	
KamGW137											2010_06_30	1	KOGW158
KamGW138											2010_07_10	1	
KamGW139											2010_07_10	1	
											2010_07_18	1	
KamGTW140											2010_07_18	1	KamGW140
											2010_07_22	1	

Table A9. Recoded aspects of individual gray whales photographed off Kamchatka, 2004, 2006-2010.

ID	ASPECT				Total
	RS	LS	DF	VF	
KamGW001	yes	yes	yes	yes	4
KamGW002	yes	yes	yes	yes	4
KamGW003	yes	yes	yes	yes	4
KamGW004	yes	yes	no	no	2
KamGW005	yes	yes	yes	no	3
KamGW006	yes	yes	no	no	2
KamGW007	yes	yes	no	no	2
KamGW008	yes	yes	yes	yes	4
KamGW009	yes	yes	yes	yes	4
KamGW010	yes	yes	yes	yes	4
KamGW011	yes	yes	no	no	2
KamGW012	yes	yes	yes	yes	4
KamGW013	yes	yes	yes	yes	4
KamGW014	yes	yes	yes	yes	4
KamGW015	yes	yes	yes	yes	4
KamGW016	yes	yes	yes	yes	4
KamGW017	yes	yes	no	no	2
KamGW018	yes	yes	no	no	2
KamGW019	yes	no	yes	yes	3
KamGW020	yes	yes	no	no	2
KamGW021	yes	yes	no	no	2
KamGW022	yes	yes	yes	no	3
KamGW023	yes	yes	no	no	2
KamGW024	yes	yes	yes	yes	4
KamGW025	yes	yes	yes	yes	4
KamGW026	yes	no	no	no	1
KamGW027	yes	no	no	no	1
KamGW028	yes	yes	no	no	2
KamGW029	yes	yes	yes	yes	4
KamGW030	yes	yes	yes	yes	4
KamGW031	yes	yes	yes	no	3
KamGW032	yes	yes	no	no	2
KamGW033	yes	no	no	yes	2
KamGW034	yes	no	no	no	1
KamGW035	yes	no	no	no	1
KamGW036	yes	yes	yes	yes	4
KamGW037	yes	yes	yes	yes	4
KamGW038	yes	yes	yes	yes	4
KamGW039	yes	yes	yes	yes	4
KamGW040	yes	yes	no	no	2
KamGW041	yes	yes	no	no	2
KamGW042	yes	yes	no	no	2
KamGW043	no	yes	no	yes	2
KamGW044	yes	yes	no	no	2
KamGW045	yes	yes	no	no	2

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ID	ASPECT				Total
	RS	LS	DF	VF	
KamGW046	yes	yes	yes	no	3
KamGW047	yes	yes	no	no	2
KamGW048	yes	yes	yes	yes	4
KamGW049	yes	yes	no	no	2
KamGW050	yes	yes	no	no	2
KamGW051	yes	yes	no	no	2
KamGW052	yes	yes	no	no	2
KamGW053	yes	yes	no	no	2
KamGW054	yes	yes	no	no	2
KamGW055	yes	yes	no	no	2
KamGW056	yes	yes	no	no	2
KamGW057	yes	yes	yes	yes	4
KamGW058	yes	yes	no	no	2
KamGW059	yes	yes	yes	yes	4
KamGW060	yes	yes	no	no	2
KamGW061	yes	yes	no	no	2
KamGW062	yes	yes	yes	yes	4
KamGW063	yes	yes	yes	yes	4
KamGW064	yes	yes	no	no	2
KamGW065	yes	yes	no	no	2
KamGW066	yes	yes	yes	yes	4
KamGW067	yes	no	no	no	1
KamGW068	yes	yes	no	no	2
KamGW069	yes	yes	no	no	2
KamGW070	yes	yes	no	no	2
KamGW071	yes	yes	no	no	2
KamGW072	yes	yes	no	no	2
KamGW073	yes	yes	yes	yes	4
KamGW074	yes	yes	yes	no	3
KamGW075	yes	yes	no	no	2
KamGW076	yes	yes	no	no	2
KamGW077	yes	no	no	no	1
KamGW078	yes	yes	no	yes	3
KamGW079	yes	yes	no	no	2
KamGW080	yes	yes	no	no	2
KamGW081	yes	yes	no	no	2
KamGW082	yes	yes	yes	no	3
KamGW083	yes	yes	no	no	2
KamGW084	yes	yes	yes	yes	4
KamGW085	yes	yes	no	no	2
KamGW086	yes	yes	no	no	2
KamGW087	yes	yes	no	no	2
KamGW088	yes	yes	no	no	2
KamGW089	yes	yes	yes	yes	4
KamGW090	yes	yes	no	no	2
KamGW091	yes	yes	no	no	2
KamGW092	yes	yes	no	no	2
KamGW093	no	yes	no	no	1
KamGW094	yes	yes	no	no	2
KamGW095	yes	yes	no	no	2

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ID	ASPECT				Total
	RS	LS	DF	VF	
KamGW096	yes	yes	no	no	2
KamGW097	yes	yes	no	no	2
KamGW098	yes	yes	yes	yes	4
KamGW099	yes	yes	no	no	2
KamGW100	yes	yes	yes	yes	4
KamGW101	yes	yes	yes	no	3
KamGW102	yes	yes	yes	no	3
KamGW103	yes	yes	no	no	2
KamGW104	yes	yes	no	no	2
KamGW105	yes	yes	no	no	2
KamGW106	yes	yes	no	no	2
KamGW107	yes	yes	yes	yes	4
KamGW108	yes	yes	yes	yes	4
KamGW109	yes	yes	no	no	2
KamGW110	yes	yes	no	no	2
KamGW111	yes	yes	no	no	2
KamGW112	yes	yes	no	no	2
KamGW113	no	yes	yes	no	2
KamGW114	yes	yes	no	no	2
KamGW115	yes	yes	no	no	2
KamGW116	yes	yes	no	no	2
KamGW117	yes	yes	yes	yes	4
KamGW118	yes	yes	no	no	2
KamGW119	yes	yes	yes	yes	4
KamGW120	yes	yes	yes	yes	4
KamGW121	no	yes	yes	yes	3
KamGW122	yes	no	no	no	1
KamGW123	yes	yes	no	no	2
KamGW124	yes	yes	no	no	2
KamGW125	yes	yes	no	no	2
KamGW126	yes	no	no	no	1
KamGW127	no	yes	no	no	1
KamGW128	yes	yes	no	no	2
KamGW129	yes	yes	no	no	2
KamGW130	yes	yes	no	yes	3
KamGW131	yes	no	no	no	1
KamGW132	yes	yes	no	no	2
KamGW133	yes	no	no	no	1
KamGW134	yes	yes	no	no	2
KamGW135	yes	yes	yes	no	3
KamGW136	yes	yes	yes	yes	4
KamGW137	yes	yes	yes	no	3
KamGW138	yes	yes	yes	no	3
KamGW139	yes	yes	no	yes	3
KamGW140	yes	no	no	no	1

Table A10. Number of encounters with identified gray whales off Kamchatka Peninsula (2004, 2006-2010) and off Sakhalin Island (2002-2010)

Kamchatka whale ID	Year encountered	Area	Sakhalin whale ID	Year encountered	Area
KamGW001	2006	**Olga Bay**	**KOGW090**	2003	**pil**
	2008			2004	**pil**
	2009			2005	**pil**
	2010				
KamGW002	2006		**KOGW132**	2005	**pil**
	2007			2006	**pil**
	2008			2007	**pil/chay**
	2009			2010	**pil**
KamGW008	2006		**KOGW095**	2004	**pil**
	2007				
	2008				
	2010				
KamGW010	2006		**KOGW077**	2003	**pil**
	2007			2010	**pil**
	2008				
	2009				
	2010				
KamGW013	2006	**Vestnik Bay**	**KOGW047**	2003	**off**
	2008			2004	**off**
				2005	**pil/off**
				2006	**pil**
				2007	**pil/chay**
				2008	**pil**
				2009	**pil**
				2010	**pil**
KamGW016	2004_08_11	Khalaktyrsky beach	**KOGW136**	2006	**Chay/pil**
	2010	Olga Bay		2007	**pil/chay**
KamGW015	2004_08_11	Khalaktyrsky beach	**KOGW166**	2009	**pil**
KamGW018	2007	**Olga Bay**	**KOGW160**	2007	**pil**
	2008			2010	**pil**
	2009				
	2010				
KamGW019	2007_08_02		**KOGW022**	2007	**pil**
				2008	**pil**
				2009	**Chay**
				2010	**pil**
KamGW026	2007		**KOGW075**	2003	**pil**
				2009	**pil**
				2010	**pil**
KamGW028	2007		**KOGW142**	2006	**pil**
	2010				
KamGW031	2007		**KOGW018**	2002-2006	**pil**
	2008			2010	**pil**
	2009				
	2010				
KamGW032	2007		**KOGW140**	2006	**pil**

	2009				
	2010				
KamGW033	2007		**KOGW066**	2003.2005-2009 2010	**pil/off/chay** **pil**
KamGW034	2007		**KOGW159**	2007	**pil**
				2008	**pil**
				2009	**pil**
				2010	**pil**
KamGW035	2007 2008		**KOGW124**	2005 2006 2007 2009 2010	**pil** **pil** **pil/off** **pil/off** **pil/oha**
KamGW037	2007		**KOGW133**	2005	**pil**
	2008			2006	**pil/chay**
	2009			2010	**oha**
	2010				
KamGW038	2007	**Vestnik Bay**	**KOGW092**	2003-2009 2010	**pil/chay** **pil**
KamGW039	2007_06_05 2010 б.Ольга		**KOGW019**	2002-2007 2009	**pil/off**
KamGW041	2007		**KOGW105**	2005-2009 2010	**pil/chay** **pil/off**
KamGW042	2007 2009		**KOGW137**	2006-2009 2010	**pil/off/chay** **oha**
KamGW043	2007		**KOGW039**	2002-2009 2010	**pil/off/chay** **pil**
KamGW044	2007		**KOGW033**	2002-2009 2010	**pil/off/chay** **off**
KamGW045	2008 2010	**Olga Bay**	**KOGW028**	2002-2009 **2010**	**pil/off** **pil**
KamGW048	2008 2009 2010		**KOGW149**	**2007**	**pil**
KamGW050	2008 2010		**KOGW152**	2007	**pil**
KamGW052	2008		**KOGW154**	2007	**pil**
	2009				
	2010				
KamGW053	2008		**KOGW148**	2007	**pil**
	2009				
	2010				
KamGW054	2008		**KOGW153**	2007	**pil**
	2009				
	2010				
KamGW056	2008		**KOGW151**	2007	**pil**
	2009				

	2010				
KamGW060	2008 2010		**KOGW064**	2005-2007 2009 2010	**pil/chay** **pil/chay** **pil**
KamGW062	2008 2010		**KOGW053**	2003-2007 2009 2010	**pil** **pil** **pil**
KamGW063	2008 2009 2010		**KOGW107**	2005-2007 2010	**pil** **pil**
KamGW064	2008		**KOGW127**	2005-2007 2009	**pil**
KamGW065	2008		**KOGW131**	2005 2009 2010	**pil** **pil** **pil**
KamGW068	2008 2009 2010		**KOGW045**	2002-2007 2009	**pil/off** **off**
KamGW069	2008 2010		**KOGW067**	2003-2007	**pil/off**
KamGW070	2008		**KOGW084**	2003-2008 2009	**off** **off**
KamGW071	2008 2010		**KOGW048**	2003-2007 2009 2010	**pil/off** **pil** **pil**
KamGW074	2008 2009 2010		**KOGW150**	2007	**pil**
KamGW077	2008		**KOGW073**	2003.2006.2007 2009 2010	**pil** **pil** **pil/oha**
KamGW078	2008 2009		**KOGW126**	2005 Кит найден мертвым в 2009	**pil**
KamGW080	2009 2010		**KOGW164**	2008	**pil**
KamGW083	2009 2010		**KOGW163**	2008	**pil**
KamGW084	2009 2010		**KOGW110**	2004-2008 2010	**pil** **off**
KamGW087	2009 2010		**KOGW103**	2004-2009 2010	**pil** **pil**
KamGW088	2009 2010		**KOGW174**	2009	**pil**
KamGW089	2009 2010 б.Ольга	**Vestnik Bay**	**KOGW061**	2003-2009 2010	**pil/chay** **pil/off**
KamGW090	2009		**KOGW091**	2003.2006-2008	**pil**
KamGW091	2009		**KOGW145**	2006-2009	**pil/off**
KamGW092	2009		**KOGW111**	2004.2006.2008. 2009	**pil** **pil**
KamGW093	2009		**KOGW016**	2002-2009	**pil/off**

KamGW094	2009		**KOGW089**	2003.2006-2009	**pil/chay**
KamGW095	2009		**KOGW038**	2002-2010	**pil/chay/oha**
KamGW096	2009		**KOGW139**	2006.2008-2010	**pil/off**
KamGW097	2009	**Olga Bay**	**KOGW157**	2007	**off**
KamGW098	2009		**KOGW121**	2005-2006	**pil**
	2010				
KamGW099	2009		**KOGW058**	2003-2008	**pil/off/chay**
	2010			2010	**pil/off**
KamGW103	2009		**KOGW125**	2005-2007.2009	**pil**
				2010	**pil**
KamGW104	2009		**KOGW177**	2009	**pil**
KamGW111	2009		**KOGW161**	2008	**pil**
KamGW113	2009		**KOGW040**	2002-2010	**pil/off**
KamGW118	2010		**KOGW043**	2002-2010	**pil/chay**
KamGW121	2010		**KOGW013**	2002-2009	**pil/off**
KamGW122	2010		**KOGW059**	2002-2010	**pil/off**
KamGW123	2010		**KOGW036**	2002-2008.2010	**pil/off**
KamGW124	2010		**KOGW182**	2010	**pil**
KamGW125	2010		**KOGW060**	2003-2010	**pil/off**
KamGW126	2010		**KOGW010**	2002-2010	**pil/off/chay**
KamGW127	2010		**KOGW147**	2006.2007	**pil**
KamGW128	2010		**KOGW104**	2004.2005.2008	**pil.off**
				2009	**off**
KamGW129	2010		**KOGW144**	2006-2010	**pil/chay**
KamGW130	2010		**KOGW056**	2003-2010	**pil/off**
KamGW132	2010		**KOGW025**	2002-2010	**pil/off/oha**
KamGW133	2010		**KOGW187**	2010	**pil**
KamGW135	2010		**KOGW181**	2010	**pil**
KamGW137	2010		**KOGW158**	2006-2008.2010	**pil/off/chay**

pil – Piltun
off - Offshore
chay - Chaivo
oha - Okha

Table A11 Years of encounters for the gray whales identified in both (Sakhalin and Kamchatka) catalogues in 2002-2010.

KOGW###	2002	2003	2004	2005	2006	2007	2008	2009	2010	KamGW###
1	Y		Y	Y	Y	Y	Y	Y		
2	Y	Y	Y	Y	Y	Y	Y	Y	Y	
3	Y									
4	Y	Y								
5	Y	Y	Y	Y	Y	Y	Y	Y	Y	
6	Y	Y	Y	Y	Y	Y	Y	Y		
7	Y	Y	Y	Y	Y	Y			Y	
8	Y	Y	Y	Y	Y	Y	Y	Y	Y	
9	Y		Y	Y	Y	Y	Y	Y	Y	
10	Y		Y	Y	Y	Y		Y	YY	126
11	Y	Y	Y	Y	Y	Y	Y	Y	Y	
12	Y	Y	Y	Y	Y	Y	Y	Y	Y	
13	Y	Y	Y	Y	Y	Y	Y	Y	Y	121
14	Y		Y	Y	Y	Y	Y			
15	Y	Y		Y	Y	Y	Y	YY	Y	Temp1
16	Y	Y	Y	Y	Y	Y	Y	YY		93
17	Y			Y	Y	Y		Y	Y	
18	Y	Y	Y	Y	Y	Y	Y	Y	YY	31
19	Y	Y	Y	Y	Y	YY		Y	Y	39
20	Y	Y	Y	Y	Y	Y	Y	Y	Y	
21	Y	Y	Y	Y	Y	Y	Y	Y	Y	
22	Y		Y	Y	Y	YY	Y	YY	Y	19
23	Y		Y		Y			Y	Y	
24	Y			Y	Y			Y		
25	Y	Y	Y	Y	Y	Y		Y	YY	132
26	Y	Y		Y	Y	Y		Y	Y	
27	Y	Y	Y	Y	Y	Y	Y		Y	
28	Y	Y	Y	Y	Y	Y	Y	Y	YY	45
29	Y	Y	Y	Y	Y	Y	Y	Y		
30	Y	Y	Y	Y	Y	Y	Y	Y		
31	Y	Y	Y		Y	Y	Y	Y	Y	
32	Y	Y	Y	Y	Y	Y	Y			
33	Y	Y	Y	Y	Y	YY	Y	Y	Y	44
34	Y		Y	Y	Y	Y	Y	Y		
35	Y	Y	Y	Y	Y	Y	Y	Y		
36	Y	Y	Y	Y	Y	Y	Y		YY	123
37	Y	Y	Y	Y	Y	Y	Y	Y		
38	Y	Y	Y		Y	Y	Y	YY	Y	95
39	Y	Y		Y	Y	YY	Y	Y	Y	43
40	Y	Y	Y	Y		Y	Y	YY	Y	113
41	Y		Y	Y	Y	Y	Y	Y		
42	Y		Y	Y	Y	Y	Y	Y	Y	
43	Y	Y	Y	Y	Y	Y	Y		YY	118
44	Y	Y	Y	Y	Y	Y	Y	Y	Y	
45	Y	Y	Y	Y	Y	Y	Y	YY	Y	68
46		Y	Y	Y	Y	Y	Y	Y		
47		Y			YY	Y	Y	YY	Y	13
48		Y	Y	Y	Y	Y	Y	Y	YY	71
49		Y	Y	Y	Y	Y	Y	Y		
50		Y	Y	Y	Y	Y	Y	Y		
51		Y	Y	Y		Y	Y	Y		
52		Y								
53		Y		Y	Y	Y	Y	Y	YY	62
54		Y	Y	Y	Y	Y	Y	Y	Y	
55		Y		Y	Y	Y	Y	Y	Y	

- continued next page –

KOGW###	2002	2003	2004	2005	2006	2007	2008	2009	2010	KamGW###

56		Y	Y	Y	Y	Y	Y	Y	YY	130
57		Y			Y	Y	Y	Y	Y	
58		Y	Y	Y	Y	Y	Y	Y	YY	99
59		Y		Y	Y	Y		Y	YY	122
60		Y	Y	Y	Y	Y	Y	Y	YY	125
61		Y	Y	Y	Y	Y	Y	YY	YY	89
62		Y	Y	Y	Y	Y	Y	Y		
63		Y	Y	Y	Y	Y	Y		Y	
64		Y	Y	Y	Y	Y	Y	Y	YY	60
65		Y								
66		Y	Y	Y	Y	YY	Y	Y	Y	33
67		Y	Y	Y	Y	Y	Y		Y	69
68		Y	Y	Y	Y	Y	Y	Y	Y	
69		Y	Y	Y	Y	Y	Y	Y		
70		Y	Y	Y	Y	Y	Y	Y	Y	
71		Y	Y	Y	Y	Y	Y	Y	Y	
72		Y	Y	Y	Y	Y	Y	Y	Y	
73		Y				Y	Y	Y	Y	77
74		Y	Y	Y	Y	Y	Y	Y	Y	
75		Y				Y		Y	Y	26
76		Y	Y	Y	Y		Y	Y	Y	
77		Y			Y	Y	Y	Y	YY	10
78		Y	Y	Y	Y	Y	Y	Y	Y	
79		Y		Y						
80		Y	Y		Y	Y	Y	Y	Y	
81		Y	Y	Y	Y	Y	Y	Y	Y	
82		Y	Y	Y	Y	Y	Y	Y	Y	
83		Y	Y	Y	Y					
84		Y	Y		Y	Y	YY	Y		70
85		Y	Y	Y	Y	Y	Y	Y	Y	
86		Y	Y	Y		Y	Y	Y	Y	
87		Y	Y	Y	Y	Y	Y	Y	Y	
88		Y								
89		Y			Y	Y	Y	YY		94
90		Y		Y	YY		Y	Y	Y	1
91		Y			Y	Y	Y	Y		90
92		Y	Y	Y	Y	YY	Y	Y	Y	38
93			Y	Y	Y	Y	Y	Y	Y	
94			Y	Y	Y	Y	Y	Y	Y	
95			Y		Y	Y	Y		Y	8
96			Y	Y	Y	Y	Y	Y	Y	
97			Y			Y	Y	Y	Y	
98			Y							
99			Y	Y	Y	Y	Y	Y		
100			Y							
101			Y							
102			Y	Y	Y	Y	Y	Y	Y	
103			Y	Y	Y	Y	Y	Y	YY	87
104			Y	Y				Y	Y	128
105			Y	Y	Y	YY	Y	Y	Y	41
106			Y							
107			Y	Y	Y	Y	Y	Y	YY	63
108			Y	Y	Y	Y	Y	Y	Y	
109			Y		Y					
110			Y	Y	Y	Y	Y	Y	YY	84
111			Y	Y			Y	YY		92
112			Y	Y	Y	Y	Y	Y	Y	
113			Y	Y	Y	Y	Y	Y		
114			Y	Y	Y	Y	Y	Y	Y	
115			Y	Y	Y	Y		Y		

- continued next page -

KOGW###	2002	2003	2004	2005	2006	2007	2008	2009	2010	KamGW###
116			Y	Y	Y	Y	Y	Y	Y	
117				Y	Y	Y	Y	Y	Y	
118				Y	Y	Y	Y	Y	Y	
119				Y	Y	Y	Y		Y	
120				Y						
121				Y	Y			Y	Y	98
122				Y						
123				Y	Y	Y	Y	Y		
124				Y	Y	YY	Y	Y	Y	35
125				Y	Y	Y		YY	Y	103
126	Found dead in 2009			Y			Y	Y		78
127				Y	Y	Y	Y	Y		64
128				Y						
129				Y	Y	Y		Y		
130				Y						
131				Y			Y	Y	Y	65
132				Y	YY	Y	Y	Y	Y	2
133				Y	Y	Y	Y	Y	YY	37
134				Y						
135		Y	Y		Y	Y	Y	Y	Y	
136			Y		Y	Y			Y	16
137					Y	YY	Y	YY	Y	42
138					Y	Y				
139					Y		Y	YY	Y	96
140					Y	Y		Y	Y	32
141					Y					
142					Y	Y			Y	28
143					Y					
144					Y	Y	Y	Y	YY	129
145					Y	Y	Y	YY	Y	91
146					Y	Y			Y	
147					Y	Y			Y	127
148					Y		Y	Y	Y	53
149						Y	Y	Y	Y	48
150						Y	Y	Y	Y	74
151						Y	Y	Y	Y	56
152						Y	Y		Y	50
153						Y	Y	Y	Y	54
154						Y	Y	Y	Y	52
155						Y				
156						Y				
157						Y		Y		97
158						Y	Y	Y	YY	137
159						YY	Y	Y	Y	34
160						YY	Y	YY	YY	18
161							Y	Y		111
162							Y	Y	Y	
163							Y	Y	Y	83
164							Y	Y	Y	80
165							Y			
166			Y					Y		
167								Y	Y	
168								Y	Y	
169								Y		
170								Y		
171								Y		
172								Y		
173								Y	Y	
174								YY	Y	88
175								Y	Y	

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KOGW###	2002	2003	2004	2005	2006	2007	2008	2009	2010	KamGW###
176								Y		
177								YY	Y	104
178									Y	
179									Y	
180									Y	
181									YY	135
182									YY	124
183									Y	
184									Y	
185									Y	12
186									Y	20
187									YY	133

Y	seen off Sakhalin
Y	seen off Kamchatka
YY	seen off both Sakhalin and Kamchatka in the same season

CHAPTER 3

BENTHOS STUDIES IN FEEDING GROUNDS OF THE WESTERN POPULATION OF GRAY WHALES, 2010

RESULTS AND DISCUSSION[1]

Photo by Yuri Yakovlev

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REPORT
ON THE RESEARCH PROJECT

BENTHOS STUDIES IN FEEDING GROUNDS OF THE OKHOTSK-KOREAN GRAY WHALE POPULATION IN 2010

RESULTS AND DISCUSSION

Research Supervisor,
V.I.Fadeev
Laboratory Director, Candidate of Biological Sciences

VLADIVOSTOK
2011

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CHAPTER 3: BENTHOS STUDIES

3.1 CHARACTERISTICS OF WATER COLUMN AND BOTTOM SEDIMENTS

3.1.1 Water Temperature

Surface and bottom water temperature and salinities were measured at benthos stations during the period from August 1 to September 27, 2010. However, the most complete multi-annual time series of observations is available for the month of September; thus, it is these data that are presented below.

Water temperature. In September 2010, the surface water temperature in the Piltun Area ranged from 9.9 to 14.1°C, and the bottom water temperature ranged from 5.9 to 12.1°C. Bottom water temperature averaged 8.7±0.4°C (m±SE) in the Piltun Area, which was higher than temperatures in the Offshore Area (7.8±0.2°C). Bottom water temperatures in the Piltun area were consistent between 2007-2010 (Table 1.). In 2010 bottom temperature was higher than in 2009 both in the Piltun and Offshore Areas, but lower than in 2008 and 2007 (in the offshore area 2010 bottom temperatures were very similar to those of 2008).

Table 1. Bottom Water Temperatures (°C) in September 2007-2010 in the Piltun and Offshore feeding areas.

Characteristic	Piltun area				Offshore area			
	2010	2009	2008	2007	2010	2009	2008	2007
Average	8.7	6.4	11	11.1	7.8	5.3	7.9	11.2
Std error	0.4	0.5	0.4	0.3	0.2	0.2	0.3	0.3
Minimum	5.9	1.5	6.7	5.8	4.8	3.2	4.5	5.6
Maximum	12.1	10.7	13.5	13.7	10.2	6.6	10.6	13.5
Observations	22	29	42	44	27	19	37	38

The occurrence of colder surface water observed in the northern part of the Piltun Area (Odoptu region) in 2001–2006 may be due to upwelling of deeper water in the area (Krasavtsev *et al.* 2000; Rutenko 2006). Colder sea surface temperatures were also recorded in this area in 2006-2010. It is thought that upwelling plays a significant role in primary productivity of phytoplankton in some parts of the Sea of Okhotsk (Shuntov 2001).

During the summer, upwelling has been observed on the northeastern shelf when winds are from the south (Borisov *et al.* 2008) and/or southeast. Hydrological observations indicate that durational upwelling can occur over large areas of the northeast Sakhalin shelf, and for prolonged periods in some parts (Krasavtsev *et al.* 2000).

3.1.2 Particle Size Distribution of Bottom Sediments

Particle size distribution of bottom sediments in 2010 was based on analyses of 158 samples taken at benthos stations and whale feeding sites. The bottom sediments at most stations throughout the area are characterized by predominance of sandy (psammite) fractions. Of the 158 stations, 88% are predominately sands, while 12% have gravel–pebble soils containing some sands of various grain sizes. The proportion of the fine sand fraction exceeds >70% at most stations.

Piltun Area

Data for 2002–2010 showed that fine, sandy soils predominate at depths up to 10–15 m throughout the area. With increasing depth, these are replaced by medium- and coarse-grained sands and areas with gravel–pebble soils containing some sands of varying grain size.

The 2010 data reconfirmed this spatial distribution. Fine sands predominated at >70% of the entire set of the stations taken in the Piltun area, with medium sands predominating at >20% of the stations. Gravel–pebble bottoms, often containing some sands of various grain sizes, occur in patches at depths greater than 15–20 m. The highet proportion (>15%) of silt–clay fraction in the sediment was observed in a local area at depths <20 m in the channel area of Piltun Lagoon. The active hydrodynamics of the area probably promotes the transfer of fine soil fractions to greater depths. Areas with elevated silt-clay content are found both north and south of the lagoon outlet. This is consistent with hydrology data indicating that during low tides and upwelling, the current direction along the shoreline in the coastal zone of the Piltun Area can change from south to north.

Offshore Area

The depths in the Offshore area increase gradually from 18 to 68 m. The proportion of silt-clay in the soil increases with water depth. Overall, fine sands predominate at >85% of the stations in the Offshore area. Gravel soils and coarse-grained sands occur in patches.

3.1.3 *Classification of Stations According to Similarity of Particle Size Distribution*

Data on the 10-fraction compositions of bottom sediments at stations in the Piltun and Offshore areas and at whale feeding sites have been grouped by cluster analysis procedures (Fadeev 2010). It follows from the dendrograms analysis that three groups of stations (A, B, C) can be distinguished according to particle size distribution. Table 2 provides average characteristics for each sediment group for the Piltun and Offshore areas based on data from 2006–2010.

Group A consists of stations where the 0.1–0.25 mm fraction (fine sand) predominates. According to 2002–2010 data, the proportion of this fraction varies from 60 to 96% of dry sediment weight in sediments of the Piltun area. The normalized entropic index of sediment sorting averages 0.35 and varies from 0.17 to 0.47 (an ideally sorted sediment has a value of 0). The depth range at which this sediment group occurs in the Piltun area is 9–23 m, with the average depth at 15 m. ***Group B*** includes stations where the soil is predominately medium and fine-grained sand with < 20% coarse sand and minor amount of gravel. The normalized entropic index of sorting averages 0.61 and varies from 0.44 to 0.73. The average depth of the sediments of this group in the Piltun area is 22 m (depth range 14–26 m). ***Group C*** comprises stations without clear dominance2 of any one fraction. The soil is medium and fine-grained sand fractions mixed with (>40%) coarse sand and gravel fractions. The major fractions are 0.5–1.0 mm (coarse sand) and 1.0–2.0 mm (small gravel). The defining feature of Group C is a substantial (usually >10%) presence of coarse fraction (gravel and pebble). The normalized entropic index of sorting average 0.84 and varies from 0.79 to 0.88 (absolutely ungraded sediment has a value of 1). The average depth of this group of stations in the Piltun area is 25 m (depth range 20–37 m).

Group A is well-sorted fine-grained sands, ***Group B*** comprises medium-sorted sands of varying grain size (a mixture of fine and medium sands), and ***Group C*** includes poorly sorted sands, characterized by a gravel mixture of varying grain size, pebbles, and shell detritus. The characteristics of the different sediment groups in the Piltun area from 2010 data are in good agreement with the sediment analysis based on the 2006–2009 data (Table 2), and data from 2002-2005 (Fadeev 2006).

[2] Dominance is defined as comprising > 50% of the total weight of the sample.

Table 2. Characteristics of Sediment Groups in Piltun and Offshore Areas.

Sediment group	Sediment fractions (% Total)						H_s	H_s/H_{max}	Code
	Peb	Grav	Sand coarse	Sand med	Sand fine	Aleu+Pel			
Piltun area, 2010 data									
A	0	0.65	1.25	7.8	**86.72**	3.58	0.58	0.36	Sf
B	0	6.14	8.03	46.73	37.05	2.05	1.11	0.67	Smf
C	3.1	35.6	23.22	19.93	16.05	2.1	1.44	0.81	Gr+Sfmc
Piltun area, 2009 data									
A	0.39	1.21	0.77	11.41	**84.52**	1.7	0.57	0.32	Sf
B	0.26	8.11	9.64	47.81	32.64	1.54	1.23	0.68	Smf
C	1.05	37.28	14.81	17.49	25.96	3.41	1.47	0.82	Gr+Sfmc
Piltun area, 2008 data									
A	0	0.75	0.75	7.9	**83.3**	7.3	0.63	0.39	Sf
B	0	3.8	5	32.68	**52.77**	5.75	1.01	0.63	Sf
C	4.42	36.1	17.5	16.88	21.7	3.4	1.58	0.88	Gr+Sc
Piltun area, 2007 data									
A	0	0.74	0.49	5.40	**83.92**	9.45	0.61	0.35	Sf
B	0	4.71	7.51	45.95	39.54	2.29	1.2	0.7	Sfm
C	3.52	41.1	23.23	15.66	14	2.49	1.42	0.81	Gr+Sc
Piltun area, 2006 data									
A	0	0.7	0.71	3.84	**90.36**	4.39	0.42	0.26	Sf
B	0	6.73	9.17	34.97	47.84	1.29	1.18	0.73	Sfm
C	1.88	38.83	24.98	18.13	15.5	0.68	1.42	0.79	Gr+Sc
Offshore area, 2010 data									
A	0	0.3	0.94	15.34	**79.1**	4.32	0.65	0.34	Sf
B	0	2.67	2.9	48.41	34.1	11.92	0.93	0.53	Smf
C	1.55	31.63	12.42	25.5	21.5	7.4	1.51	0.83	Gr+Smf
Offshore area. 2009 data									
A	0.71	2.74	2.4	15.65	**75.4**	3.1	0.83	0.47	Sf
B	0.31	3.49	5.41	**52.03**	37.55	1.21	1.05	0.59	Smf
C	0.44	18.49	21.83	36.69	20.66	1.89	1.44	0.8	Gr+Scmf
Offshore area. 2008 data									
A	0	0.64	1.16	5.43	**85.88**	6.93	0.53	0.32	Sf
B	0	1.42	4.94	44.76	42.34	6.61	0.88	0.5	Smf
C	4.85	31.1	19.78	23.6	12.43	8.55	1.59	0.87	Gr+Scm
Offshore area. 2007 data									
A	0	0.62	1.00	7.18	**83.61**	7.65	0.55	0.33	Sf
B	0	2.55	8.81	**68.1**	13.46	7.19	0.95	0.5	Sm
C	2.3	34.13	20.48	27.43	13.71	2.54	1.52	0.82	Gr+Scm
Offshore area. 2006 data									
A	0	0.39	0.5	1.96	**94.39**	2.76	0.27	0.17	Sf
B	0	0.71	1.14	2.84	**76.56**	18.75	0.71	0.44	Sf+Al
C	3.28	22.72	14.34	28.8	29.96	0.9	1.49	0.83	Sfc+Gr

Notes for Tables 2 and 3: H_s is the entropic index of sediment sorting, and H_s/H_{max} is the normalized entropic index of sorting. ***Boldface*** *indicates the dominant sediment fractions (dominance is defined as comprising > 50% of the total weight of the sample).*

3.1.4 Particle Size of Bottom Sediments at Gray Whale Feeding Sites

The sediment composition at gray whale feeding sites in the Piltun and Offshore areas was studied using data obtained in 2001–2010 (Fadeev 2002-2009, present study).

Table 3 presents data on the characteristics of sediments at whale feeding sites in 2006-2010. In 2006-2010, medium sands and mixed fine–medium sands predominated at 35% of the whale-feeding sites, while 10% of the sites were dominated by fine and coarse sands.

Well-sorted fine sands (sediment group A) were prevalent at all gray whale feeding sites in both the Piltun and Offshore feeding areas in 2010. Only about 20% of the whale feeding sites had medium-sorted mixed sandy soils (Group B - medium and fine sands).

Table 3. Characteristics of Sediment Groups at Whale Feeding Sites.

Sediment group	Sediment fractions						H_s	H_s/H_{max}	Code
	Peb	Grav	Sand coarse	Sand med	Sand fine	Aleu+Pel			
Whale feeding sites **(2010 stations)**									
A	0	0	2.19	10.9	**80.2**	6.71	0.53	0.31	Sf
B	0	1.1	9.85	**55.3**	28.5	5.25	1.01	0.55	Sf+Sm
C	0	9.8	15.5	43.0	28.9	2.8	1.4	0.81	Sm+Scf
Whale feeding sites (2009 stations)									
A	0.85	1.07	1.48	4.62	**85.02**	6.96	0.87	0.38	Sf
B	0.34	1.28	3.37	22.91	**66.61**	5.49	1.37	0.59	Sf+Sm
C	0	11.82	22.52	44.58	18.89	2.19	1.47	0.68	Sm+Scf
Whale feeding sites (2008 stations)									
A	0	0.64	1.31	7.25	**84.57**	6.23	0.74	0.37	Sf
B	0	2.39	5.05	48.52	39.23	4.81	1.21	0.57	Smf
C	0	10.04	18.82	48.98	19.27	2.89	1.47	0.68	Smcf
Whale feeding sites (2007 stations)									
A	0	0.23	0.77	5.28	**87.55**	6.16	0.43	0.31	Sf
B	0	1.69	8.85	**71.66**	10.4	7.4	0.74	0.46	Sm
C	0	7.37	12.13	44.81	26.67	9.01	1.42	0.85	Smfc
Whale feeding sites (2006 stations)									
A	0	0.44	0.35	1.32	**90.48**	7.41	0.37	0.23	Sf
B	0	0	0.59	**87.7**	11.45	0.3	0.41	0.3	Sm
C	0	11.45	9.1	48.05	31.3	0.1	1.19	0.74	Smf+Gr

3.1.5 Concentrations of Key Pollutants in Sediments

The first studies of key pollutants in the Piltun Area were conducted in 2001, when sediment samples were collected in the vicinity of locations where whales were observed to feed intensely (i.e., feeding points). Concentrations of petroleum hydrocarbons and 10 heavy metals (copper, aluminium, arsenic, barium, cadmium, chromium, iron, mercury, lead and zinc) were found to be low, and no significant effect of pollutants on benthos was observed (Fadeev 2002).

More detailed assessments of key pollutants were carried out in 2004, 2005 and 2008-2010[3], of which the results are summarized below.

Organochlorine pesticides

It is thought that organochlorine pesticides in the waters of the northeastern Sakhalin shelf have two possible sources: 1) the Amur River flow and 2) the waters flowing out of coastal lagoons.

Table 4. Organochlorine pesticide concentrations (ng/g) in bottom sediments at 4 stations in the Piltun area in 2005 and 2008-2010.

Station	Depth	DDT	DDE	DDD	∑DDT	∑HCH
2-2N	15	1.0 (0.8/0.6/0.5)*	0.3 (0.2/0.2/0.2)	0.4 (0.4/0.2/01)	1.7 (1.4/1.7/1.1)	0.3 (0.2/0.2/0.2)
2-3M	16	0.6 (0.9/0.7/0.6)	0.2 (0.2/0.2/0.1)	0.2 (0.2/0.2/0.1)	1.0 (1.3/1.4)	0.2 (0.4/0.4/0.2)
2-4M	15	1.3 (1.4/1.5/1.5)	0.2 (0.2/0.2/0.1)	0.2 (0.2/0.2/0.2)	1.7 (1.8/1/8/1.6)	0.4 (0.4/0.4/0.3)
4-1S	16	1.1 (1.1/1.0/1.0)	0.2 (0.2/0.2/0.2)	0.3 (0.2/0.1/0.2)	1.6 (1.6/1.5/1.5)	0.2 (0.3/0.3/0.3)

*Note: *data correspond to values in 2005 (2008/2009/2010).*

Table 4 indicates that the concentration of DDT as well as the total concentration of DDT and its metabolites, vary only slightly and do not exceed background values for the northeastern Sakhalin region (Status of the Environment 1996, 1997).

Heavy metals

Concentrations of heavy metals in marine sediments depend on a number of factors. In some situations, the mineralogical composition and particle size distribution of sediments influence heavy metal concentrations. Sandy bottoms, due to their lower sorption capacity, typically have lower concentrations of heavy metals than silt-clay deposits. Hydrodynamic conditions, physical and chemical processes, and

[3] 60 bottom sediment samples were collected each year: 42 samples in the Piltun area and 18 in the Offshore feeding area. Samples were taken at 2001 sampling points on three transects to assess possible year-to-year changes in the pollutant distribution. In the Piltun Area in 2005 and 2008-2009, 4 samples were taken at depths of 10-15 m to study the concentration of organochlorine pesticides in the bottom sediments. Samples were taken in the same depth range in 2001and also 2010.

biological activity all affect the accumulation and distribution of microelements. Concentrations of heavy metals in NE Sakhalin shelf sediments are presented in Table 5.

Concentration values of heavy metals in the deposits in the study area in 2010 did not exceed the background values registered for the deposits of northeast Sakhalin shelf prior to the beginning of active industrial activities (Status of the Environment 1996, 1997; Multidisciplinary studies 1997; Kot 1998); they were substantially below the values of the Probable Active Concentration of toxic metals (PAC) at which negative influence on benthic organisms is expected.

Table 5. Heavy metal concentrations in the area of the Piltun – Astokh field and NE Sakhalin shelf based on published data and the data collected in the study area.

Elements	Concentration, µg/g					
	Published[1]	Published[2]	PAC[3]	2005[4]	2009[4]	2010[4]
As(µg/g)	2.5 - 14.8	–	8.2 – 70.0	0 – 2.2	0.2 – 3.9	–
Ba (µg/g)	268 - 763	–	–	0.9 – 20.42	–	–
Cd (µg/g)	<0.01 – 0.13	0.12	4.2 – 9.6	0 – 0.027	0	0 – 0.05
Cr (µg/g)	0.6 – 121	42	160 – 370	1.6 – 33.2	7.9 – 41.0	5.1 – 29.0
Cu (µg/g)	0.6 – 6.7	32	108 – 270	0.79 – 6.6	0 – 2.5	0 – 3.3
Hg (µg/g)	0.001 – 0.047	0.19	0.15 – 71.0	0.002 – 0.023	0 – 0.01	0 – 0.01
Pb (µg/g)	5.1 – 19.5	30.5	112 – 218	0 – 1.9	0	0
Zn (µg/g)	3.1 – 29.1	21.1	271 – 410	1.98 – 15.10	2.5 – 14.0	3.2 – 16.0

Note:
[1] Published data for Piltun – Astokh field (Status of the Environment 1996, 1997).
[2] Published data for NE Sakhalin shelf (Kot 1998).
[3] PAC is Probable Active Concentration of toxic metals (Long at al. 1995).
[4] Study area grid grab samples and at whale feeding points collected in the Piltun and Offshore feeding areas.

Petroleum hydrocarbons

In 2010, concentrations of petroleum hydrocarbons in the sediments of the Piltun feeding area ranged from <0.5 to 4.8 µg/g dry sediment and averaged 2.21±0.17 (m±SE) µg/g dry sediment. In the sediments of the Offshore feeding area, petroleum hydrocarbons averaged 2.93±0.26 µg/g dry sediment. All of these values are lower than the natural background concentrations of petroleum hydrocarbons in Sakhalin shelf sediments (Status of the Environment, 1996, 1997; Multidisciplinary Studies… 1997). Similar patterns are noticeable for 2005 and 2008-2010 data; lower petroleum hydrocarbon concentrations in the sediments were measured closer to shore.

Analysis of the concentrations and distribution of the main pollutants – petroleum hydrocarbons, heavy metals and organochlorine pesticides – in the bottom sediments of the Piltun and Offshore feeding areas makes it possible to conclude that pollutants levels would not have any significant effect on benthos observed during the study period. These low pollutant levels in Sakhalin waters might have been promoted by the active hydrodynamic conditions of the waters in question and the movement of waters of the eastern Sakhalin Current along the coast, which prevent the accumulation of pollutants in sandy sediment. This conclusion is further confirmed by the results of an analysis of heavy metals in the bodies of benthic animals - polychaetes - from the Piltun feeding area, discussed below.

3.1.6 The content of heavy metals in the tissue of abundant polychaetes species in the Piltun Area

In aquatic ecosystems, heavy metal compounds are among the important pollutants that can adversely impact benthos. Polychaetes are a major component of benthos communities in the Piltun and Offshore feeding areas. We know that heavy metal concentrations in the tissues of certain polychaetes species are proportional to the content of these elements in the soil, which makes it possible to use them as markers of the pollution of bottom sediments (Dean 2008).

Heavy metal concentrations measured in bottom sediments off the NE coast of Sakhalin (Piltun Area) (Table 6) are much lower than the corresponding Probable Active Concentrations (PAC) (Long et al., 1995) that can cause a decline in benthos abundance and diversity. They are much lower than pollutant concentrations in Sea of Japan sediments (Amur Bay and Zolotoy Rog Bay).

Table 6. Heavy metal concentrations (µg/g dry sediment) in bottom sediments in the Piltun area, Amur Bay and Zolotoy Rog Bay (Sea of Japan).

Elements	PAC[1]	Piltun Area					Amur Bay	Zolotoy Rog Bay
		2001	2005	2007			2004	2000-2003
				Sm	Sf	Pel	Pel	Pel
Fe	nd	824-4160	1390-7580	1005-1060	4857-7032	17667	23732-24982	15000-20250
Zn	271-410	0.3-12.9	1.98-15.10	1.5-1.75	10.5-14.25	37	397-443	182-837
Cu	108-270	0.11-1.53	0.79-6.60	0.2-0.62	1.23-1.8	9.37	39.7-49.3	235-423
Mn	nd	nd	nd	31-37	114-193	363	755-1013	112-150
Cd	4.2-9.6	0.002-0.029	0.00-0.027	0.02	0.02-0.06	0.07	0.22-0.24	4.0-9.5
Co	nd	nd	nd	0.5-0.71	3.12-5.63	8.72	18.4-21.9	6.3-7.5
Ni	43-52	nd	nd	0.29-1.73	4.31-47.71	33.21	15.3-17.6	235-925
Pb	112-218	0.76-3.48	0.00-1.9	2.3-4.2	3.8-11	9.4	280-303	235-925
According to :	Long *et al.* 1995	Lishavskaya, Moshenko 2008	Fadeev 2006	Proprietary unpublished data L.T. Kovekovdovoi (TINRO)				Davidkova *et al.* 2005

Note: nd – no data; Deposits: Sm - Sand med, Sf – Sand fine, Pel – mud. PAC1 – Probable Active Concentration of toxic metals.

Heavy metal content was analyzed in the tissues of abundant polychaetes species in the benthos of the Piltun Area and coastal waters of the Sea of Japan (Table 7).

Table 7. Heavy metal concentrations (μg/g dry biomass) in tissues of dominant polychaete species in the Piltun area, Amur Bay and Zolotoy Rog Bay (Sea of Japan).

Species	Area	Deposit	Iron (Fe)	Zinc (Zn)	Copper (Cu)	Manganese (Mn)	Cadmium (Cd)
Nephtys caeca	Piltun Area (2008)	Smc	211±54	261± 59	6.64±0.16	0.65±0.15	1.43±0.63
N. longosetosa		Sf	213	116	3.22	2.4	1.97
Nephtys sp.		Sf	259±25	203±19	4.50±1.27	2.25±0.05	1.97±0.75
Nereis vexillosa	Piltun Area (2008)	Pel	965	95.7	3.19	3.1	0.64
	Zolotoy Rog Bay	Pel	1351±94	312±93	10.4±2	nd	2.31±0.21
Hediste japonica	Amur Bay	Sm+Pel	626±36	137±43	6.18±0.82	1.53±0.19	0.26±0.01
Capitella capitata	Piltun Area (2008)	Pel	669	43.1	10.28	2.3	0.97
	Zolotoy Rog Bay	Pel	3708	212	11.2	nd	2.1

Note: The values are either the arithmetic mean (n=3) ± standard error or a unit estimate. Heavy metal content in polychaetes from Zolotoy Rog Bay is given according to Davidkova et al. 2005.

Iron (Fe) and Zinc (Zn) were the predominant elements in polychaete tissues. The concentrations of these elements in the tissues of polychaetes of the genus Nephtys from the Piltun area were similar. The highest Fe concentrations were observed in tissues of the detritophage C. capitata, while the highest Zn concentrations were observed in the tissues of the omnivorous polychaete Nereis vexillosa, which inhabits the silty soils of Zolotoy Rog Bay in the Sea of Japan.

The highest iron (Fe) content in the Piltun Area was observed in the species Nereis vexillosa on silty soils. We should point out that Fe concentrations in silty sediments reached their highest level (17667 μg/g dry weight) by comparison with sandy soils (Table 6). The somewhat lower Zn content in the tissues of Nereis vexillosa by comparison with polychaetes of the genus Nephtys can probably be attributed to the regulation of its content in the animals' bodies irrespective of the element's concentration in sediments. The results are consistent with the conclusions of other authors (Bryan, Gibbs, 1980) that iron (Fe), copper (Cu) and lead (Pb) accumulate in nereid tissues in proportion to the elements' concentrations in bottom sediments, while zinc (Zn) and manganese (Mn) concentrations are regulated by the animals. Cu, Mn, and cadmium (Cd) concentrations in the tissues of the Sakhalin Nereis vexillosa were similar to those in polychaetes of the genus Nephtys.

Cu concentrations in polychaete tissues were third highest, after Fe and Zn. Depending on the animals' habitat, Cu contents in tissues varied from 3.19 to 6.64 μg/g dry weight in the Piltun Area and 6.18 to 24.5 μg/g dry weight in the more polluted littoral waters of the Sea of Japan.

Mn and Cd concentrations were similar in tissues of all polychaetes. Manganese concentrations in polychaete tissues varied from 0.65 to 3.1, cadmium - from 0.12 to 3.43 μg/g dry weight. The highest Cd concentration was detected in the tissues of Capitella capitata (2.1 μg/g dry weight) from Zolotoy Rog Bay.

In comparing element contents in the tissues of polychaetes from different habitats we find that the contents of almost all heavy metals were higher in the tissues of animals from Zolotoy Rog Bay (Table 7). This is consistent with the high anthropogenic heavy metal pollutant levels in the bay as indicated in published treatises (Tkalin 1993).

According to the literature (Rainbow et al. 2006), Fe, Zn, and Cu in the tissues of the nereid Hediste diversicolor from the relatively clean littoral waters of Southeast England are up to 518, 114, and 9.42 μg/g dry weight respectively. Concentrations of the same metals in the tissues of H. diversicolor from heavily polluted areas of the English littoral were up to 1521, 510 and 1430 μg/g dry weight respectively (Rainbow et al. 2006).

The data in Table 7 show that heavy metal contents in the tissues of polychaetes from the Piltun Area do not exceed the levels typical of polychaetes from relatively clean areas. In general this is consistent with the conditions of low anthropogenic impact levels in the waters off the NE coast of Sakhalin.

In addition to sampling concentrations of pollutants in invertebrate tissues, the presence/absence of certain species can be used as indicators of polluted versus less impacted areas. The presence of the polychaete Capitella capitata and certain species of the genus Neries is a positive indicator of marine sediment pollution. The presence of the polychaete Nephtys longosetosa in the Piltun Area is a negative pollution indicator since this is considered a pollution-sensitive species (Gray et al. 1990).

Thus, an analysis of heavy metal contents in bottom sediments and polychaete tissues from different habitats makes it possible to conclude that heavy metal pollution was not observed in the littoral waters of the Piltun Area during the study period.

3.2 BENTHOS ABUNDANCE AND DISTRIBUTION IN THE PILTUN AREA

Benthos studies were conducted in the Piltun and Offshore feeding areas in 2002–2010, in the Intermediate area in 2002 and in 2007-2010, and in the Chayvo subarea in 2001 and in 2006-2010. The section below describes the composition and quantitative distribution for the Piltun Area. Section 3.3 to 3.5 summarizes the results for the Offshore feeding area, the Intermediate area, and gray whale feeding sites.

The Piltun area station locations in 2010 consisted of 76 bottom grab stations (228 samples), as indicated in Figure 1. The locations of stations in previous years have been reported in previous annual reports (Fadeev 2002-2010).

3.2.1 Total Benthos Biomass

The 2001 and 2002 data showed an increase in total benthos biomass with depth throughout the Piltun area (from 507.4 g/m^2 at a depth of 11 m to 1153 g/m^2 at 30 m in 2001, and from 274 g/m^2 in the range 11 – 15 m to 755 g/m^2 at 30 m in 2002 (Fadeev 2003), mainly due to increasing biomass of the sand dollar Echinarachnius parma, which comprised 61-70% of the total biomass of the study area, and increased to 85–95 % at depths of 25–30 m. The proportion of other groups in the total biomass was significantly lower: crustaceans, 9–17%; bivalve mollusks, 8–13%; isopods, 4–5%; and amphipods, 4-9% (Fadeev 2003). The proportion of key WGW forage benthos (amphipods and isopods) to the total biomass decreased with depth: from 40–59% at 5–15 m to 1–4% at 20–30 m.

In 2003 and 2004, the average benthos biomass in the Piltun area at depths of 8–30 m was more than 500 g/m^2, with a colony density of more than 6000 ind/m^2. Once again, the sand dollar *E. parma* comprised the largest proportion (70%) of the benthos biomass; the proportion of sand dollars in the total benthos biomass increased with depth, from 20% at 15 m to 95% at 25–30 m. The biomass of amphipods decreased from 146 g/m^2 (74% of total benthos biomass) at depths of 8–11 m to 9 g/m^2 (1.2% of total benthos biomass) at >26 m. The sharpest changes in the quantitative abundance of benthos were observed between 15 and 20 m.

In 2005, average benthos biomass in the Piltun feeding ground was 392.4±63.3 g/m^2, which was not significantly (t-test, p>0.05) different from the 2004 data (501.2±93.8) (Fadeev 2005 2006). In 2006, the average benthos biomass in the Piltun area was 434.3± 64.5 g/m^2, which was not significantly different from 2004 and 2005. The average total benthos biomass in the Piltun Area in 2008 was 415.6±148.2 g/m^2 and showed no statistically significant (t-test, p>0.05) differences from 2007 data (448.5±87.1 g/m^2).

In 2008-2010, as in previous years, sand dollars accounted for most of total biomass (on average, >75% in of each sample), and the proportion was as high as >95% at depths greater that 20 m. The quantitative abundance of the principal WGW forage benthos (amphipods and isopods) decreased from 75 g/m^2 (69% of total benthos biomass) in samples taken at 11-15 m, to 28 g/m^2 (<4%) at depths of 26-30 m (Figure 2).

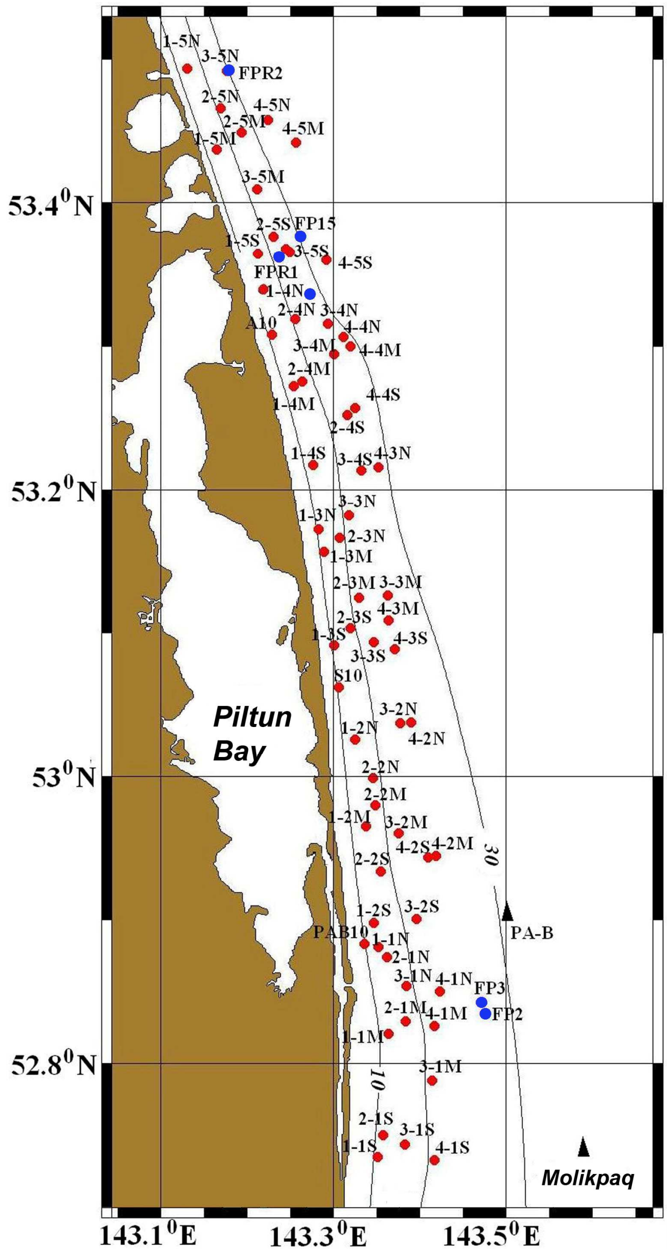

Figure 1. Locations of stations in the Piltun area in 2010.

3.2.2 Biomass of Crustaceans (Crustacea)

Crustaceans (amphipods and isopods) are believed to be the most important food resource for WGWs. The main crustacean groups had high frequencies of occurrence in 2008-2010, with amphipods occurring in >90% of the samples and isopods in >60%; these frequencies were not substantially different from those in 2006-2007. Despite the frequent occurrence of crustaceans in the Piltun area, the percentage of these animals in total benthos biomass varied considerably, mainly with depth. Based on data from 2002–2010, the overall proportion of crustaceans in the macrobenthos biomass in Piltun feeding area was 40–75% at depths of 5–10 m and only 3–10% at 26–30 m (Figure 2).

Various orders within the crustacean group were distributed differently with respect to depth; three patterns were noticed: (1) amphipods and isopods had a maximum biomass at depths of 5–15 m, decreasing sharply at depths >20 m; (2) cumacean biomass reflected the opposite pattern: lower biomass in shallower depths, and increasing in biomass in depths >20 m; and (3) decapod biomass was low at all depths and varied only slightly.

In 2010, as in 2008-2009, the proportion of crustaceans in the overall biomass was >65% at depths of 11–15 m, decreasing to <5% at 26–30 m. Spots of high biomass at depths greater than 20 m consist of cumaceans and large Saduria entomon isopods, an important WGW food source. Amphipods had the strongest proportional decreasing trend with depth (Table 8; Figure 2). Some patchy areas of high crustacean biomass were observed in the coastal zone at depths not greater then 15-20 m. These shallow-water accumulations consist mainly of amphipods and isopods.

Table 8. Macrobenthos Biomass (g/m^2) in the Piltun Area 2008-2010.

Depth	Depth[1]								Entire area		
	10–15 m		16–20 m		21–25 m		26–30 m				
	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2008
Amphipoda	77.8	79.2	31.1	24.1	19.6	11.2	12.3	13.7	35.2±7.7	32.1±5.2	36.1±9.2
Isopoda	26.7	30.6	12.5	9.6	16.3	19.5	18.3	23.2	18.5±3.6	20.7±4.3	12.9±3.7
Bivalvia	39.3	26.5	62.4	68.7	36.2	49.2	19.2	45.8	39.3.1±4.1	47.6±13.1	28.8±4.2
Cumacea	1.1	1.7	1.1	1.2	2.1	1.1	8.5	12.6	3.2±2.4	4.2±3.3	6.9±2.3
Echinoidea	14.5	18.9	161.3	367.8	489.1	518.7	540.9	496.8	302±105	351±118	319±146
Polychaeta	3.3	2.2	2.3	6.1	12.2	14.4	19.2	33.4	9.3±3.9	14.1±3.4	7.5±0.7
Rest	3.6	5.6	7.1	13.2	12.1	23.3	9.1	17.1	7.9±5.8	8.8±6.7	12.9±5.4
Totals	166.2	164.7	277.8	490.7	587.6	637.4	627.5	642.6	414.8±124	483.9±118	415.6±148

Notes: [1] Biomass values represent averages calculated from different sample sets. For simplicity of presentation, mean±SE are included only for overall (entire area) calculations.

3.2.3 Biomass of Isopods

The small isopod *Synidotea cinerea* (average body weight 0.02 g) was the most significant component of benthos biomass in the Piltun area. In 2002-2010 it had the highest frequency of occurrence (>80%) of all macrobenthos species. Maximum biomass values for this species were observed in depths less than 15 m; only a few individuals of *S. cinerea* were encountered in deeper waters. Results of diving works show that the largest colony of *S. cinerea* (up to 5000 ind/m^2) was associated with tube mats of the sea worm *Onuphis shirikishinaiensis* (Fadeev 2007).

A larger isopod, *Saduria entomon* (body weight up to 5 g, average weight 2.1 g), was encountered much less frequently in the Piltun area. However, this species can form large local accumulations that, together with other crustaceans, can provide potential prey for gray whales. In contrast to *S. cinerea*, the biomass of *S. entomon* increases with depth.

The spatial distribution of isopods was distinctly patchy in all years of the study, with variable distribution patterns. For example, distinct accumulation of isopod biomass was observed near the mouth of the Piltun lagoon in 2009-2010 (Figure 3). In 2008 larger accumulations were recorded in the northern portion of the area.

Both isopods species do not seem to provide a substantial, constant food resource for WGW in the Piltun Area. The average isopod biomass in 2007 (6.8±3.8 g/m^2) was lower than in 2002 and in 2006 (11.6±1.6 and 18.9±4.6 g/m^2, respectively). The average biomass of isopods in the Piltun Area in 2010 was 18.5±3.6 g/m^2 and showed no statistically significant (t-test, $p>0.05$) differences from 2009 data (20.7±4.3 g/m^2) and 2008 data (12.9±3.7 g/m^2). During 2002-2010, the highest biomass of *Saduria entomon* was observed within local accumulations at depths > 20 m. In 2002-2010, maximum biomass of this species reached levels >75 g/m^2 at some sampling stations.

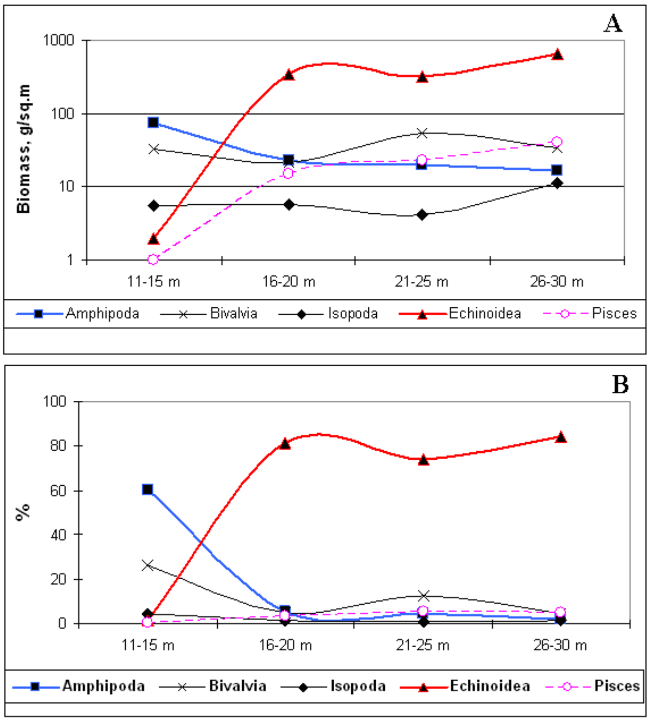

Figure 2. Variation in biomass (A, g/m^2) and variation in the proportions (B, %) of 5 benthos groups by depth in the Piltun area in 2002-2010.

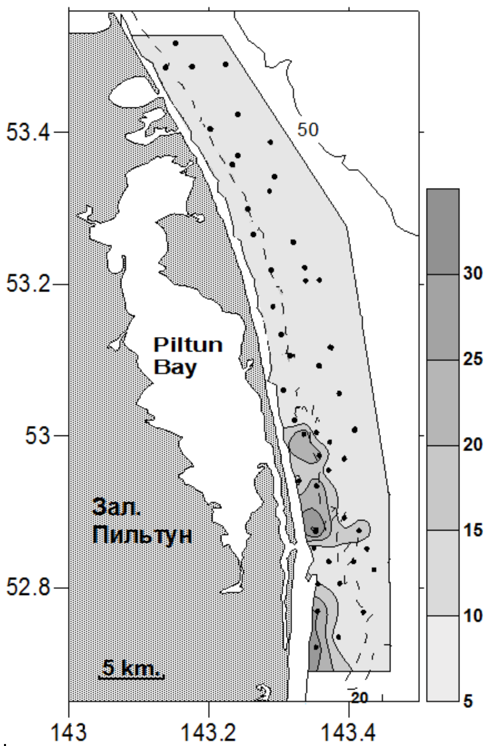

Figure 3. Isopod biomass distribution (g/m^2) in the Piltun area in 2010 (corrected for sampling effort).

3.2.4 Biomass of Amphipods

In 2002-2003, 37 amphipod species were recorded. Of these, six species had frequencies of occurrence (P) 50%: *Eohaustorius eous eous (100%), Monoporeia affinis* (98%), *Grandifoxus longirostris* (86%), *Eogammarus schmidti* (81%), *Anisogammarus pugettensis* (78%), *and Westwoodilla sp*. (65%). The average amphipod biomass levels for the entire area were similar in 2002 and 2003 (42.7±9.6 g/m^2 and 54.6±8.7 g/m^2, respectively – compared to 35.9 g/m^2 observed in 2001).

The average amphipod biomass in the Piltun area in 2005 was 38.8±7.2 g/m^2, which was lower than 2004 values of 47.4±7.7 g/m^2. In 2006, average amphipod biomass in the overall Piltun area decreased compared with 2005 to 28.5±3.8 g/m^2, due to a decrease in amphipod biomass at depths greater than 25 m (18.1 g/m^2 in 2005 and 9.4 g/m^2 in 2006); however, WGW do not commonly feed at depths >25 m because amphipods comprise on average less than 2% of benthos biomass at these depths and do not form significant accumulations.

In September 2006, the average amphipod biomass in 11-15 m depth in the southern Piltun area was 33.5±11.8 g/m^2. In July 2005, in the same area in similar depths, the average amphipod biomass reached 69.4±18.3 g/m^2. The 2006 decline may have been due to various factors. For instance, in 2005 sampling in the southern Piltun area was performed in July, *i.e.*, at the beginning of the feeding season, while in 2006 samples were collected in September, *i.e.*, at the end of the feeding season. Notwithstanding the different months of sample collection, the average size of mature *M. affinis* individuals, the dominant WGW food species, was 11.62±0.14 mm (max = 15.9 mm) in 2005 and 12.66±0.18 mm (max = 15.8 mm) in 2006. Another possible causal factor for the 2006 decline in biomass may have been temperature. Benthic water temperatures in the southern part of the Piltun area were lower in 2006 than in 2004 and 2005. In addition, satellite data indicated that coastal sea ice cover remained later in 2006 than in 2004 and 2005 (Figure 17). Thus, lower bottom temperatures and longer sea ice cover might have limited amphipod production during 2006 in the Piltun area.

In 2007, the average amphipod biomass was 32.1±4.8 g/m^2, which is higher than that in 2006. As in 2005-2006, the average amphipod biomass in 2007 was about 9% of the total benthos biomass. More than 95% of amphipod biomass was due to two species: *Monoporeia affinis* (>60% of the total amphipod biomass) and *Eogammarus schmidti* (more than 30%). In 2007, amphipods accounted for 58% of benthos biomass at depths < 15 m, and the proportion decreased to 1.5% at depths greater than 20

m. In 2008, 2009 and 2010 the average amphipod biomass for the entire Piltun area was 36.1±4.8 g/m^2, 41.4±5.2 g/m^2 and 35.2±7.7 g/m^2 respectively.

A comparison of amphipod biomass spatial distribution among years is presented in Figure 4. Although data for 2005 are not included in Figure 4, amphipod biomass was more evenly distributed in 2006 than in 2005 (Fadeev 2006). In 2006, local spots of elevated biomass (about 120 g/m^2) were recorded in the northern parts of the area; these northern concentrations were of *Eogammarus schmidti*, which is usually the second-most predominant amphipod species in the overall Piltun feeding area. Another notable change in the spatial distribution of amphipods was the re-emergence of elevated amphipod biomass near the mouth of the Piltun lagoon in 2007 and in 2008 after a decline in 2006. In most years of this study, concentrations of amphipod biomass have typically been highest in the southern Piltun area adjacent to the mouth of Piltun lagoon. In 2009 amphipods were primarily encountered in the middle and southern parts of the Piltun Area, while in 2010 they were encountered all over the Piltun Area from the north to the south.

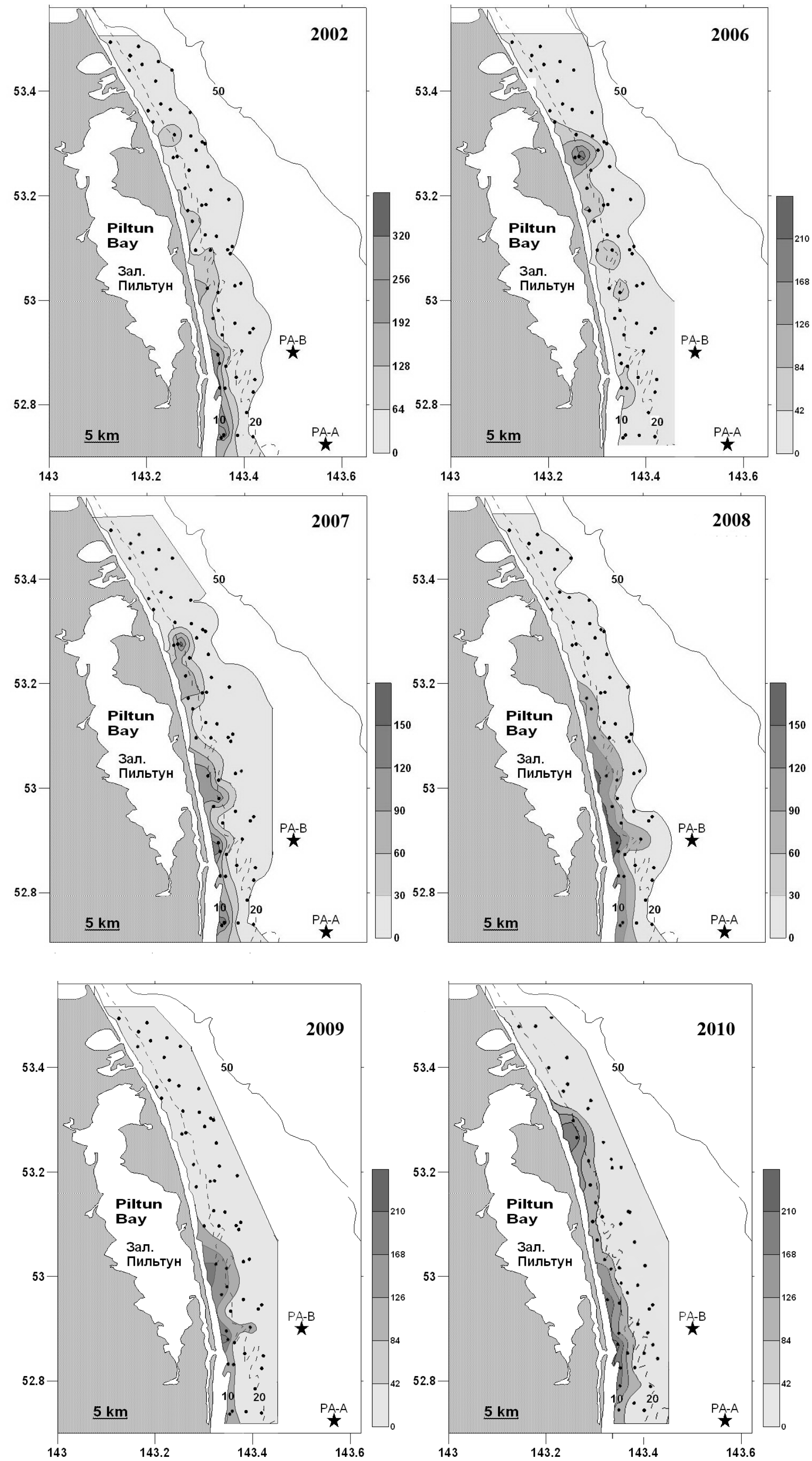

Figure 4. Amphipod biomass spatial distribution (g/m^2) in the Piltun feeding area. Characteristics of the dominant amphipod species (corrected for sampling effort).

This section describes some characteristics of the amphipod *Monoporeia affinis* (= *Pontoporeia affinis*), as it is one of the dominant amphipod species in the Piltun area and an important WGW prey resource. M. affinis is a brackish-water, Pan-Arctic, circumpolar species represented by relict populations in the boreal zone. It inhabits the northern Arctic seas and lakes of Northern Europe and North America. It has been recorded in the northern Pacific along the littoral of the Komandorskiye Islands, in freshened areas and relict lakes of the western part of the Bering Sea (the mouth of the Kamchatka River, the Anadyr liman, and lakes near the mouth of the Kamchatka River) and in the Amur liman and the Sea of Okhotsk.

In the Baltic Sea, it lives at depths of 0.5-300 m with salinity of 1.5-18‰ and temperatures up to 12.8ºC (Yarvekyulg 1979). Females are benthic forms and are submerged in the sediment throughout their life cycle. Males are pelagic forms during the mating season. In cold waters, the species reaches sexual maturity in the second year of life, while in warmer waters, it has a one-year life cycle (Segerstrale 1967). Mating occurs in October-December, and young appear in March or April. The males die soon after mating, and the females die after the young emerge from the incubating sac.

They are burrowing deposit feeders that turnover significant amounts of sediment during feeding, and thus affect bivalve mollusk juveniles (Segestrale 1973), meiobenthic animals (Olafsson and Elmgren 1991) and even zooplankton (Albertsson and Leonardsson 2001). In the Baltic Sea, *M. affinis* is among the most highly productive benthic species (Andersin *et al.* 1984).

Some ecological and biological aspects of the dominant amphipod *M.affinis* in the Piltun area were investigated during 2007 and 2008. Correlation analysis (Spearman correlation coefficient) between abundance *M. affinis* and some parameters (depth, salinity, temperature) revealed that the depth has an influence on distribution of Monoporeia affinis in the Piltun Area:

Variable	Depth	Salinity	Temperature
Abundance	**-0.52**	0.07	-0.11

The size structure of Monoporeia's settlement was slightly different in July 2007 compared to July 2008. In July 2008 three distinct size groups could be identified, whereas it was very difficult to identify separate size (age) groups in July 2007 (Figure 5, Table 9).

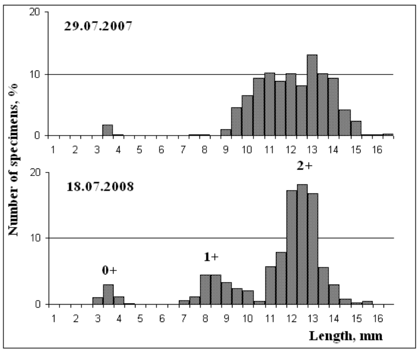

Figure 5. The size-age population structure of the *Monoporeia affinis* in July 2007 and 2008.

Table 9. Average size for each age group of *Monoporeia affinis in 2007 and 2008.*

Cohort	29.07.2007	18.07.2008
0+	3.6±0.2	3.7±0.3
1+	10.7±0.8	8.8±0.7
2+	13.2±1.0	12.6±0.8

Note: 0+ age group – generation of this year, 1+ age group – generation of last year, 2+ age group – generation of before last year.

There is no statistically significant difference between body lengths of females and males (*t*-test; p>0.05). Male and female *M. affinis* have the same mean and mode length (Table 10).

Table 10. Variations of length and weight of the *Monoporeia affinis.*

Characteristic	Females		Males		Juveniles	
	Length, mm	Weight, g	Length, mm	Weight, g	Length, mm	Weight, g
Mean	12.2	0.043	12.2	0.041	5.7	0.006
StdDv	0.1	0.002	0.1	0.001	0.5	0.001
Mode	**13**	0.052	**13**	0.044	3.6	0.001
Min	8	0.011	9	0.017	3.5	0.001
Max	15.2	0.108	14.7	0.074	8.8	0.016
N	112		127		20	

The maximal length of females length (15.2 mm) is slightly longer than that of males (14.7 mm). According to our observation, the specimens of *Monoporeia affinis* become mature in age of one year when they reach the length of 8 mm.

Year-to-year Changes in Amphipod Biomass

The data used for analysis of year-to-year changes in amphipod biomass consisted of data collected in 2002-2010 from 192 grid and feeding point stations located in the Piltun feeding area. These stations represent a subset of the entire set of grid stations and are located in the Piltun coastal area at depths of up to 15 m, *i.e.,* depths of maximum amphipod concentration.

All these stations are classified as high-calorie Crustacea – amphipods and isopods, and located in summer-autumn feeding areas for gray whales. Over 50-65% of the total benthic biomass is comprised of five species: *Monoporeia affinis*, *Eogammarus schmidti*, *Anisogammarus pugettensis, Anonyx nugax,* and *Eohaustorius eous.* These species have large body size (more than 5-6 mm) and high frequency of occurrence (60-90%) in summer. Results of single-factor dispersion analysis allow us to reject a hypothesis on homogeneity of groups, *i.e.,* they show the presence of statistically significant differences in mean total amphipod biomass throughout years (one-way ANOVA: df=8; F=3.6; p=0.001). Figure 6 shows differences in mean total amphipod biomass. As follows from the picture, the amphipod biomass decreased from the maximum values in 2002 (115.5 ±19.6 g/m^2; mean±SE) and in 2003 (113.8 ±14.2 g/m^2) to minimum values in 2006 (52.6±7.4 g/m^2).

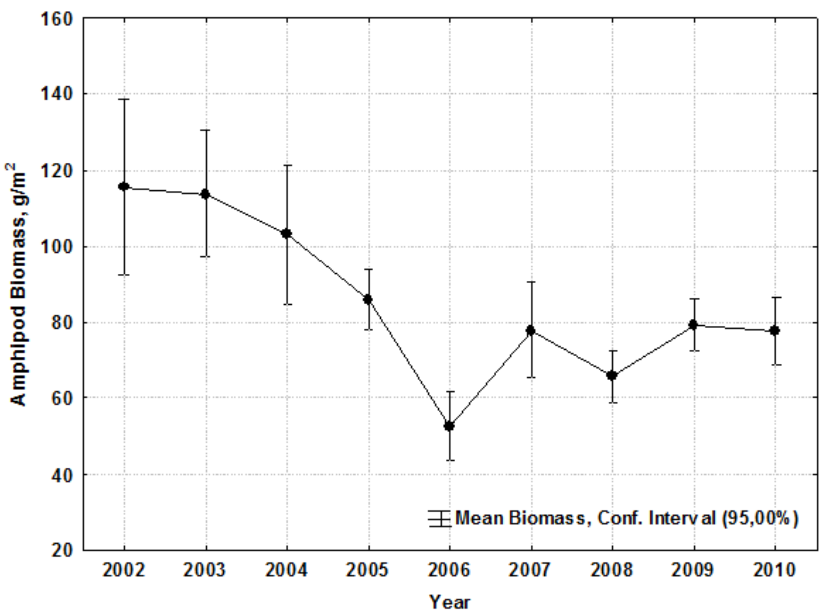

Figure 6. 2002–2010 changes in mean total amphipod biomass in Piltun area at depths < 15m.

Fisher LSD Test and Mann-Whitney U-test were used to confirm yearly differences in mean biomass (Borovikov 2001). Calculations in both tests show nearly identical results; principal deviations refer to assessment of difference significance levels (Table 11). The key results of the statistical analysis are as follows:

1. There was not a statisitically significant difference in mean amphipod biomass between years 2002 to 2005 (LSD multiple comparison, P>0.05).
2. Mean amphipod biomass in 2006 was significantly lower compared to 2002-2005, 2007, and 2009-2010 and was not statistically significantly different from the 2008 values.
3. Mean amphipod biomass in 2007-2010 was significantly lower compared to 2002-2003; amphipod biomass in 2008 was significantly lower compared to 2002-2005.

There is only one difference in the results of the Fisher LSD Test and Mann-Whitney U-test: The Mann-Whitney U-test shows 2009 and 2010 mean amphipod biomass to be higher than in 2008 (p=0.016), whereas Fisher LSD Test suggests there is no statistically significant difference between 2008 and 2009-2010 (p>0.05). However, if we correct the Mann-U alpha level for the number of analyses conducted on a single dataset (*i.e.*, Bonferonni correction to alpha = 0.05/8 = 0.006; a standard procedure to guard against committing a Type I error in multiple comparisons), we conclude the Mann-U comparison between 2008 and 2009-2010 is not statistically significant. Note, the Fisher LSD test does not need an alpha correction factor because it essentially acts as a single test (*i.e*, alpha = 0.05). Other year-to-year comparisons that the Mann-U test found to be marginally significant (*i.e.*, 0.05 > P > 0.006) will also become non-significant if we correct alpha (despite the LSD test continuing to show them as significant), a result that is symptomatic of non-parametric tests like Mann-U being less powerful than parametric tests like ANOVA and Fisher LSD (Zar 1984). In short, statistical inference should be based on the Fisher LSD results shown in Table 11; significant Mann-U results that align with significant Fisher LSD results gives confidence that these results indicate a true effect.

Thus, based on the results of the analyses, multi-year changes in amphipod biomass in the shallow waters of Piltun area represent a statistically significant biomass decrease in 2006 compared to 2002-2005. The rise in amphipod biomass observed in 2007-2010 has not yet reached the maximum biomass values of 2002-2003 (statistically significant differences still remain). In 2009-2010 amphipod biomass, which constitutes the main feeding component for gray whales in the Piltun area, reached the level of 2004-2005 (no statistically significant differences in biomass values).

Possible causes of the statistically significant drop of amphipod biomass in 2006 in the Piltun feeding area are described below in Section 3.6 «Comments for assessing year-to-year changes in forage benthos in the Piltun and Offshore feeding areas».

Table 11. Fisher LSD Test and Mann-Whitney U-test results showing mean total amphipod biomass broken down by years.

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010
2002		**ns**	**ns**	**ns**	***	*	*	*	*
2003	**ns**		**ns**	**ns**	***	**	***	**	**
2004	**ns**	**ns**		**ns**	***	**ns**	**	**ns**	**ns**
2005	**ns**	**ns**	**ns**		**	**ns**	**	**ns**	**ns**
2006	***	***	***	***		*	**ns**	***	**
2007	*	*	**ns**	**ns**	**		**ns**	**ns**	**ns**
2008	***	***	*	*	**ns**	**ns**		*	*
2009	*	*	**ns**	**ns**	**	**ns**	**ns**		**ns**
2010	*	*	**ns**	**ns**	*	**ns**	**ns**	**ns**	

Legend: Top triangle – Mann-Whitney U-test results (alpha=0.007), bottom triangle – LSD test (alpha=0.05; one-way ANOVA: df=8; F=3.6; p=0.001).
*Significance levels: ns = p>0.05, * = p<0.05, **= p<0.01, *** = p<0.001.*

3.2.5 Biomass of Fish

Sand lance (*Ammodytes hexapterus*) have been identified as a food resource for gray whales (Zimushko and Lenskaya 1970). The sand lance is a temporary component of biota at depths of ≤40 m, where it breeds. The densest accumulations of *A. hexapterus* in the Piltun area were associated with areas with sandy bottoms and mixed gravel, at depths greater than 20 m.

In 2002-2003, the frequency of occurrence of sand lance *A. hexapterus* (percentage of samples containing sand lance) in samples from the Piltun area was 5-8%, with an average biomass of 4.6-6.2 g/m^2. The frequency of occurrence of sand lance in 2004 was higher (15%), with an average biomass of 14.8±4.8 g/m^2. Within local accumulations, the sand lance biomass varied from 68 to 166 g/m^2, which amounted to 25 to 48% of the total macrobenthos biomass in the samples.

Sand lance was encountered in small numbers throughout the Piltun area in 2004-2005, with the densest accumulations recorded in the northern and middle parts of the area. In 2005, when frequency of occurrence was 15% throughout the area, the frequency in the northern part was as high as 40-60%.

Average biomass in 2005 was 16.3±4.4 g/m^2 for the Piltun area and reached 150 – 236 g/m^2 within local accumulations.

The average sand lance biomass in the Piltun area was lower in 2009 and 2008 (8.8±3.7 g/m^2 and 12.9±5.4 g/m^2) than in 2007 (27.7±12.1 g/m^2). In the northern part of the Piltun area, a substantial decrease in sand lance frequency of occurrence was observed, from 40-60% in 2005 to 20-25% in 2006-2007, and 8-12% in 2008-2009. The causes for this decline are unknown, but are possibly related to a natural decline in numbers. In 2010 the frequency of occurrence of sand lance in the northern part of the area increased to 20%. In 2010 two gray whale feeding points with sand lance biomass levels of 66 and 78 g/m^2 were observed.

Changes in the spatial distribution of sand lance biomass during the period 2004-2005 and 2007-2010 are illustrated in Figure 7.

The most distinct increase in frequency of occurrence and biomass of sand lance in the northern Piltun area was observed during 2004-2005. The high numbers of sand lance in the northern Piltun area (in 2004-2005) was concurrent with a decrease in the number of whales feeding in the Offshore area, and increase in the number of gray whales feeding at depths greater than 20 m in the northern Piltun area (Vladimirov *et al.* 2006; Yakovlev and Tyurneva 2006). Simultaneously, the number of whales feeding at depths greater than 20 m in the northern Piltun area was higher in 2004-2005 than in 2007-2009, and the number of individual whales observed in the Offshore feeding area, based on the photo-ID data, was lower in 2004-2005 (7 and 7 whales, resp.) than in 2007-2009 (about 30-70 whales each year) (Vladimirov *et al.* 2006; Yakovlev and Tyurneva 2006; Yakovlev *et al.* 2010). Thus, the appearance of an additional, accessible food resources may have attracted feeding whales to the northern Piltun area, away from other feeding areas.

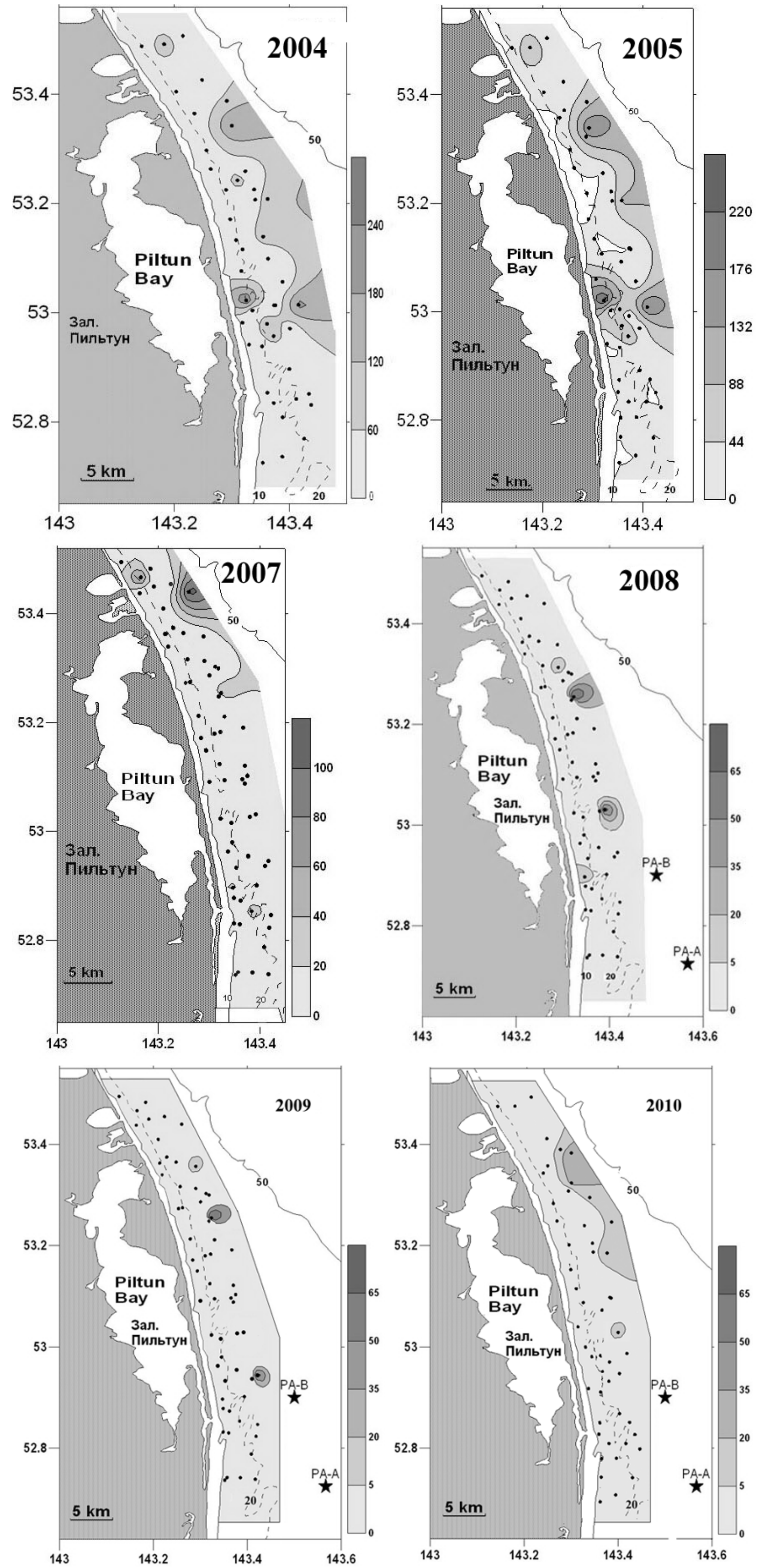

Figure 7. Sand lance biomass distribution in the Piltun area in 2004-2005, 2007-2010(corrected for sampling effort). Note annual difference in biomass scale.

3.2.6 Composition and Distribution of Benthos Complexes

There were three benthos compexes identified in the Piltun area. Figure 8 shows the locations within the Piltun area where each benthos complex occurred. The benthos complexes differ both in the composition and the quantitative abundance of the taxonomic groups (Table 12).

Table 12. Composition of benthos complexes of the Piltun area.

Taxonomic Group	Amphipoda complex		Bivalvia complex		Sand dollar complex	
	A, spec./m^2	B, g/m^2	A, spec./m^2	B, g/m^2	A, spec./m^2	B, g/m^2
Amphipoda	4200	**77.6**	127	10.7	147	5.9
Bivalvia	50	16.3	394	**89.5**	63	30.1
Cumacea	62	0.9	152	1.5	573	3
Decapoda	0	0	1	0.6	2	1.1
Echinoidea	0	0	1	3.4	36	**710.9**
Isopoda	208	20	111	12.9	14	3.3
Pisces*	0	0	2	3.1	3	18.1
Polychaeta	13	2.9	22	9.7	19	6.1
Totals	4533	117.7	810	131.4	857	778.5

*Note: * - temporary community component.*

The Amphipoda complex occurred at 105 stations at depths ranging from 5 to 23 m (average depth 14 m) in the fine- and medium-grained sand zone. The complex is distributed in a belt-like pattern along the coast in the Piltun area (Figure 8). The average biomass of the complex (122 g/m^2) is made up primarily of amphipods – 66%; isopods – 17%; and bivalve mollusks – 14%. The complex includes 45 amphipod species with a total biomass of 77.6 ±12.2 g/m^2 and a colony density of 4,200±750 ind/m^2. The most abundant species were *Monoporeia affinis, Eogammarus schmidti, Eohaustorius eous eous* and *Anisogammarus pugettensis*; they accounted > 90% of the average biomass and colony density.

The Amphipoda complex is dominated by the amphipod *Monoporeia affinis*, which makes up 60% of biomass and 75% of colony density. Isopods *Synidotea cinerea* and *Saduria entomon* are the next most significant components of the Amphipoda complex; the dominant species*, S. cinerea,* has a frequency of occurrence in the complex of >90%, and it accounts for 95% of the total isopod biomass. The Amphipoda complex also includes 10 species of mollusks, of which five species have a frequency of occurrence greater than 50%: *Tellina lutea, Siliqua alta, Tridonta borealis, Liocyma fluctuosum* and *Macoma lama.* These species account for more than 95% of the biomass of bivalve mollusks (16.3 g/m^2) within the amphipod complex.

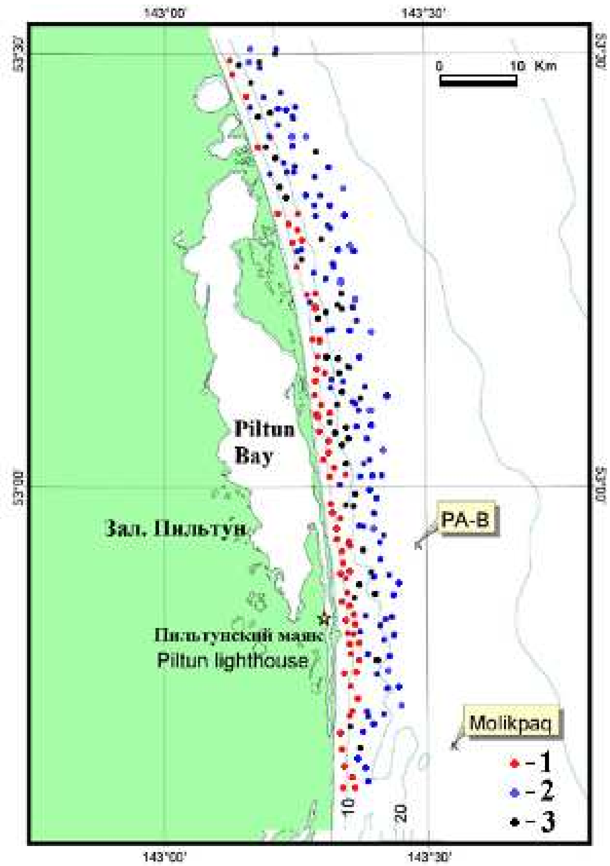

Figure 8. Distribution of complexes in the Piltun area. Complex designations: 1 – amphipods; 2 – sand dollars; 3 – bivalve mollusks.

<u>The Bivalvia complex</u> occurred at 72 stations at depths ranging from 12 to 28 m (21 m on average) in fine sands and mixed gravel and sand bottoms. In contrast to the amphipod complex, it has a distinctly patchy distribution across the Piltun area (Figure 8). The composition of the complex includes 21 bivalve mollusk species, with a biomass of 89.5±22.3 g/m^2 of an average total biomass of the complex (sum of an average biomass of all benthic groups) of 131.4 g/m^2. Seven mollusk species have the highest frequency of occurrence: *Tellina lutea, Astarte arctica, Macoma lama, Tridonta borealis, Siliqua alta, Mysella kurilensis, Liocyma fluctuosum* and *Mactromeris polynyma*. They account for more than 95% of the total biomass of the complex. The bivalve mollusk complex is not homogeneous: *Tellina lutea* is dominant in the shallow areas, while *Astarte arctica* is dominant in deeper waters (deeper than 20-25 m). In some patches within the complex, the total biomass of amphipods and isopods (primarily *Saduria entomon*) can reach 50% of the biomass of mollusks. These are the patches where gray whales tend to feed.

The sand dollar complex has been described in detail based on materials from 2001-2004 (Fadeev 2007) and, considering the low significance of *Echinarachnius parma* as a food resource of WGW, a detailed description is not included in this report. Figure 8 shows where this complex was found within the Piltun feeding area.

Summarizing the analysis of the distribution of macrobenthos complexes, we note that there are two complexes that cover most area offshore the Piltun Bay, i.e., a shallow-water, coastal amphipod complex with a high proportion of prey organisms by biomass, and a deeper-water sand dollar complex with a low proportion of prey organisms by biomass. The provisional boundary between the complexes lies at depths of about 20 m.

3.3 BENTHOS ABUNDANCE AND DISTRIBUTION IN THE OFFSHORE AREA

3.3.1 Total Benthos Biomass

In 2010, 48 stations were sampled (144 bottom grab samples) in the Offshore area at depths from 18 to 68 m. The average depth in 2010 was 42.9±1.8 m (n=48). Station locations in the Offshore area are shown in Figure 9.

Most of the Offshore area has sandy sediments: well-graded fine sand was recorded at 40 stations and differently-grained sand with mixtures of gravel and pebbles at eight stations. The proportion of the silt-clay fraction is more than 20-26% of the dry sediment weight at a number of stations. Seventeen taxonomic groups were identified for benthos of the Offshore area in 2008-2010. The frequency of occurrence between these groups (in percentage of total biomass) differed substantially (Table 13).

Table 13. Frequency of occurence of taxonomic groups in the Offshore area.

Frequency of Occurrence (P, %) of Taxonomic Groups, n=48							
P>50%		P = 25-50%		P = 10-25%		P<10%	
Group	P,%	Group	P,%	Group	P,%	Group	P,%
Amphipoda	95	Gastropoda	40	Echinoidea	17	Bryozoa	3
Polychaeta	90	Holoturoidea	35	Isopoda	12	Pisces	5
Bivalvia	70	Decapoda	25	Caprellida	10	Ophiuroidea	5
Cumacea	65	Nemertinea	25	Hydroidea	10		
Actinia	77						
Sipunculida	67						

As in 2002-2009, the groups with a biomass contribution occurrence greater than 50% in 2010 were amphipods, cumaceans, bivalve mollusks, marine worms and sea anemones. Groups with lower biomass contributions, such as sand dollars *E. parma* (P = 17%), nevertheless formed localized concentrations of biomass. For the Offshore area as a whole, these 17 taxonomic groups accounted for more than 95% of the average total benthos biomass during 2010. The biomass of benthos in the Offshore area in 2009-2010 is presented in Table 14.

The average total benthos biomass in the Offshore area was 578.6±123.3 g/m^2 in 2010, and 598.6±134.7 g/m^2 in 2009; these values were not statistically significant (*t*-test, p>0.05).

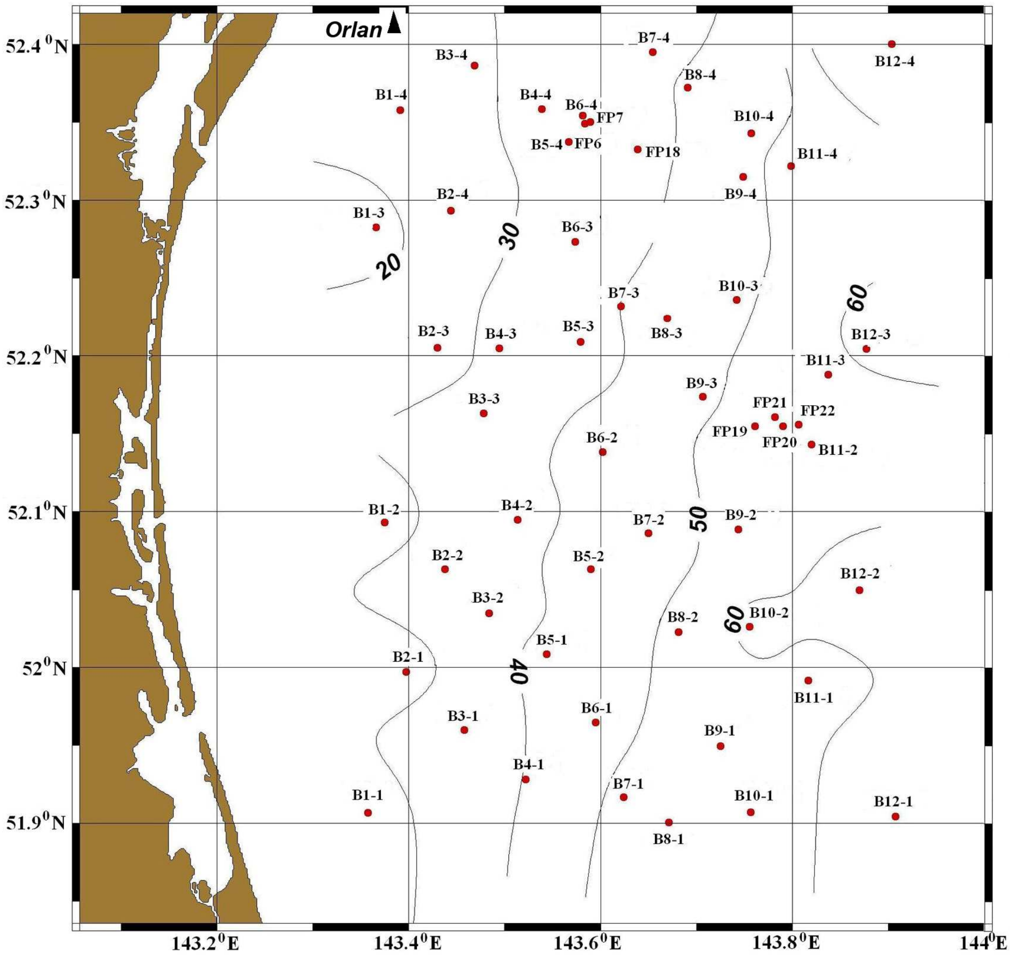

Figure 9. Diagram of station locations in the Offshore area in 2010.

Table 14. Macrobenthos biomass (g/m^2) in the Offshore area, 2009-2010.

Indicator	Taxonomic Group								Entire Area (Bsumm)	
	Amphipoda		Actinia		Bivalvia		Echinoidea			
	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009
Average	206.2	183.9	162.1	139.5	88.1	102.5	61.6	72.2	578.2	598.6
Std Er	53.7	66.2	45.5	52.3	18.7	28.2	13.8	25.2	123.3	134.7
Proportion, % of Bsumm	39	31	31	23	18	17	12	12		

Notes: Average of 48 stations. ***Bsumm*** *is the average total benthos biomass, g/m^2*

The biomass of the main groups (amphipods, bivalve mollusks, sea anemones and cumaceans) in 2010 was comparable to the 2007-2009 data. The biomass of amphipods – the most important component in the diet of whales in the Offshore area – was 206.2±53.7 g/m^2 and 183.9±66.2 g/m^2 in 2010 and 2009, respectively. The year-to-year variations in the average amphipod biomass are statistically insignificant (*t*-test; $p>0.05$). Analysis of data from the central part of the Offshore area (20 stations), where benthic samples were taken in 2002-2004 and in 2006-2010, shows that the differences between the years in the total biomass of benthos and the total biomass of the main prey item - *Ampelisca eschrichti* - were statistically not significant (*t*-test; $p>0.05$).

The spatial distribution of benthos biomass in 2010 was similar to that in 2007-2009. The biomass of amphipods of the Offshore area increases eastwards, this is from shore toward deeper water (Figure 11), with a maximum of 975 g/m^2. A similar trend was observed in 2002-2006. There was also a gradual increase in the proportion of silt-clay fractions in the seabed deposits.

The other groups (sea anemones, bivalve mollusks, cumaceans and sand dollars) that make up most of the remainder of the biomass had a patchy distribution in the Offshore area. Higher-biomass patches of these groups were located on the edge of the area of abundant amphipods.

3.3.2 Composition and Distribution of Benthos Complexes

During 2002-2010 (290 stations), four macrobenthos complexes were distinguished in the Offshore area: the sand dollar complex (Complex I), the cumacean and amphipod complex (Complex II), the ampeliscid amphipod complex with bivalve mollusks, and sea anemones (Complex III), and the ampeliscid amphipod complex (Complex IV). The last (Complex IV) occupied the largest part of the study area and is considered of greater importance to the feeding of gray whales (Figure 10, Table 15).

Offshore Benthos Complex I

A complex dominated by sand dollars *Echinarachnius parma* was present mostly in the northern Offshore area (Figure 10). The average depth was 32.8±5.8 m (49 stations at depths of 18-43 m). Sand dollars are dominant at all stations, with an average biomass greater than 600 g/m^2 (68% of the total biomass of the complex).

A similar complex was described in the Piltun area at depths greater than 20 m (Fadeev 2007). According to Averintsev *et al.* (1979), there is a substantial subarctic-latitude occurrence of the sand dollar *E. parma* in the area of northeastern Sakhalin Island at depths of 15-120 m. This area comprises about 13,000 km^2, *i.e.*, about 40% of the shelf area off eastern Sakhalin. The *E. parma* population is associated with shallow sandy bottoms and silted sands, where bottom currents with sufficiently high speeds are present (Koblikov 1983 a, b). As the current speed decreases southward along the eastern Sakhalin shelf and bottom silting increases, the sand dollars are replaced by other species, such as mobile seston-feeders. Sand dollars settle primarily on sands and coarse silts, with an organic matter content of 0.5-1.0% and a concentration of suspended matter in the seabed water of about 20 mg/l (Kuznetsov 1964). Significant bottom areas occupied by the *E. parma* community have been discovered on the western Kamchatka shelf (Neyman 1988), and, as researchers note, the northern boundary of the *E. parma* area has advanced more than 20 miles to the north. They connect the cause of such changes with an indirect human impact – over-harvesting of the Kamchatka crab and flounder (which feed on the sand dollars), which has resulted in a disruption of the balance in the “predator-prey” system.

Offshore Benthos Complex II

A complex dominated by cumacean *Diastylis bidentata* and amphipod *Ampelisca eschrichti*. The average depth for this complex was 25.7±3.8 m (56 stations at depths of 20-38 m). The average total biomass of the complex was 465.6±53.4 g/m^2 (mean±SE), and the dominant species accounted for more than 85% of the biomass (cumaceans – 54%; and amphipods – 33%). The complex occurred in patches at depths of

20 to 38 m in the western part of the area, on fine-grained and mixed sands. Amphipod *A. eschrichti* was a subdominant species with a biomass of 115.5±32.2 g/m^2.

Data collected in 2002 were used to examine relationships between the colony density of cumacean *D. bidentata* and amphipod *A. eschrichti* in the Offshore area. The amphipod colony density decreased, and the cumacean colony density increased, as depth increased (Fadeev 2003). Ampeliscid amphipods and cumaceans are seston-feeders and filter-feeders; *i.e.*, both species obtain nutrition by filtering seabed water. In areas of greatest abundance, their densities become very large: for cumaceans, up to 87,000 ind/m^2; and for amphipods, more than 31,000 ind/m^2. Consequently, it could be expected that competition for food supplies might result in a spatial separation between accumulations of amphipod *A. eschrichti* and cumacean.

Analysis of benthos at gray whale feeding sites in the Offshore area indicated that the whales fed in areas where the cumacean complex was dominant on a number of occasions (Fadeev 2007). Nevertheless, the significance of cumaceans in WGW diet remains uncertain. It is known that there is a threshold amphipod body size (6-8 mm, according to Rice and Wolman 1973; Nerini 1984) below which WGW cannot access them as a food source. If this value is valid for other crustaceans as well, it is worth noting that the cumaceans in the Offshore area are significantly smaller. Gray whales may prefer the high ampeliscid biomass content of this complex, selectively feeding the areas of this complex with ampeliscid pockets.

Table 15. Quantitative characteristics (Biomass, g/m^2) of macrobenthos complexes in the Offshore area.

Parameter	Taxonomic Group					Average total biomass (Bsumm)
	Amphipoda	Actinia	Bivalvia	Echinoidea	Cumacea	
Complex I. *Echinarachnius parma*						
Average biomass	53.4	105.9	54.2	**611.8**	49.6	895.2
Standard Error	20.4	49.1	27.2	119.2	23.2	98.7
Proportion in Bsumm. %	6	12	6	68	5	100%
Complex II. *Diastylis bidentata* + Amphipoda						
Average biomass	145.8	17.3	19.6	22.3	**241.9**	446.6
Standard Error	48.8	11.3	9	14.3	53.2	53.4
Proportion in Bsumm. %	33	4	4	5	54	100%
Complex III. *Ampelisca eschrichti* + Bivalvia + *Actinia*						
Average biomass	**323.7**	**229.8**	**209.9**	**0**	31.2	794.6
Standard Error	48.1	54.6	51.7	0	8.3	78.5
Proportion in Bsumm. %	41	29	26	0	4	100%
Complex IV. *Ampelisca eschrichti*						
Average biomass	**593.1**	82.4	49.3	**0**	28.9	758.4
Standard Error	47.9	35.4	30	0	5.9	45.5
Proportion in Bsumm. %	78	11	7	0	4	100%

Note: Abbreviated names of complexes used in Figure 10 are given in parentheses.

Offshore Benthos Complex III

A complex dominated by amphipod *A. eschrichti*, bivalve mollusks, and sea anemones. The average depth of the occurrence of this complex was 41.1±4.4 m (80 stations in a range of 25-52 m). This complex occurred in patches on the edge of the ampeliscid complex, and had an average biomass of 794.6±78.5 g/m^2. Ampeliscids, bivalve mollusks, and sea anemones accounted for over 95% of the biomass of the complex. The complex included 19 recorded species of bivalve mollusks. Two species had the highest frequency of occurrence: *Serripes groenlandicus* (P>50%) and *Liocyma fluctuosum* (P>20%).

The dominant species in this complex – amphipod *Ampelisca eschrichti* and bivalve mollusks *S. groenlandicus* and *L. fluctuosum* – are seston-feeders and filter-feeders, and are associated with hydrodynamically active sections of the shelf. A high seston concentration near the seabed and steady bottom currents to facilitate seston transfer promote their development. Actinians, which are classed as predators, also depend on currents to promote the transfer of larvae from existing sestonophage colonies to new areas, which lead to a patchy distribution.

Offshore Benthos Complex IV

A complex dominated by amphipod *Ampelisca eschrichti* was indentified at 105 stations with an average depth of 52.8±4.6 m (range 36-72 m). The complex occurred in the eastern part of the Offshore area. The average biomass was 758.4±45.5 g/m^2, and the biomass of the dominant group – amphipods – was more than 590 g/m^2 (>75% of total biomass). The complex comprised 36 amphipod species, of which 14 species were found only in the Offshore area. *A. eschrichti* was distinctly dominant with regard to frequency of occurrence, colony density and biomass. Its biomass made up 95-100% of the total amphipod biomass at some stations. The maximum ampeliscid biomass had similar values in 2002 – 1,352, 2003 – 1,237, 2004 –1094, 2005 – 1,334, 2009 – 1,077 and 2010 – 975 g/m^2, at 100% frequency of occurrence.

The ampeliscid colony density and biomass in the area are comparable to, and in some cases exceed, the benthic values of other highly productive areas of the North Pacific (Kuznetsov 1964; Koblikov 1983 a, b, 1986; Makarov 1937) and eastern gray whale feeding grounds (Stoker 1981; Nerini and Oliver 1983; Oliver *et al.* 1983; Dunham and Duffus 2001, 2002; Moore 2000; Moore *et al.* 2007). In contrast to the dominant species in the amphipod complex of the Piltun area, the ampeliscids live in tubes attached to the substrate in areas with significant bottom currents (Mills 1967; Wildish and Kristmans 1997).

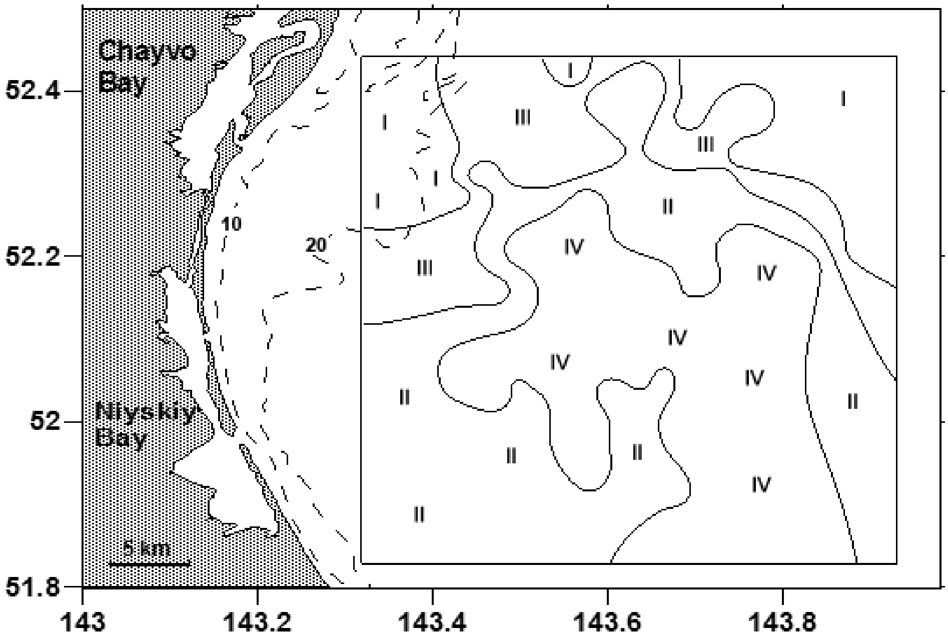

Figure 10. Distribution of benthic complexes in the Offshore area. The numbers of the complexes are given in Table 15.

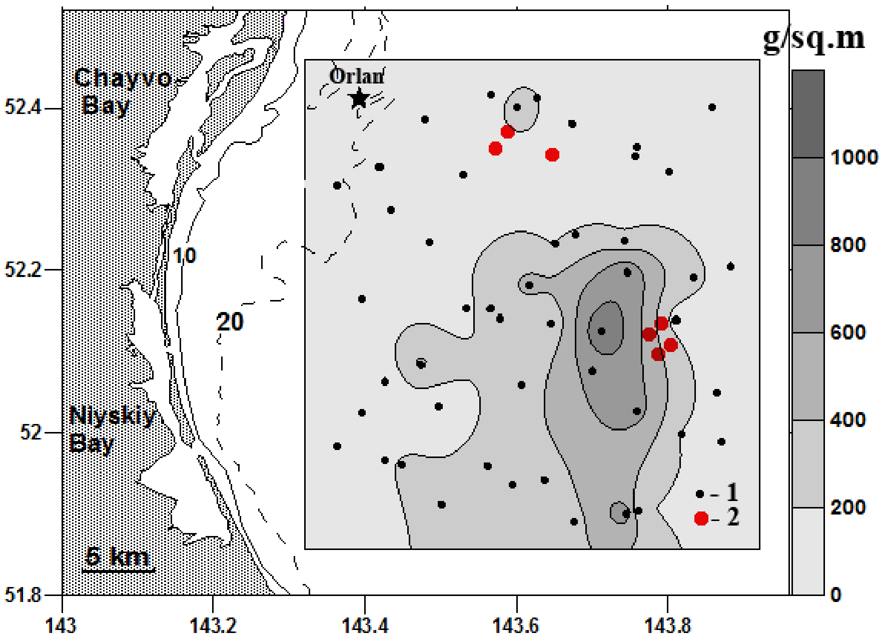

Figure 11. Ampeliscid amphipod biomass distribution in the Offshore area in 2010. 1 – Benthic stations, 2 – WGW Feeding Points (corrected for sampling effort).

3.4 BENTHOS ABUNDANCE AND DISTRIBUTION IN THE INTERMEDIATE AREA

Stations of the Intermediate area are located south of the Piltun area and cover waters from Chayvo Bay to the western boundary of the Offshore area. Bottom grab samples were collected at 15 stations (45 samples) in 2007-2008, at 13 stations (39 samples) in 2002 and at 12 stations (36 samples) in 2009-2010 at depths from 8 to 25 m, with an average collection depth of 16.1±3.1 m. Figure 12 shows a chart of the stations sampled in 2010.

3.4.1 Total Benthos Biomass

In 2007-2010, the average benthos biomass for the Intermediate area was 414.9±173.5 g/m^2 (mean±SE). Similar to the pattern in the Piltun area, substantial variations in benthos biomass were recorded with depth in the Intermediate area (Table 16). The biomass of amphipods decreased sharply from 74.1±33.2 g/m^2 at depths of ≤15 m to 2.1±1.2 g/m^2 at 25 m. Sand dollar biomass increased with the depth and reached maximum values (as much as 367.2±234.2 g/m^2) at depths greater than 20 m.

3.4.2 Composition and Distribution of Benthos Complexes

Analysis of the benthos composition indicates significant variations between the stations. Classification of the Intermediate stations according to benthos composition and biomass of individual groups resulted in three benthos complexes:

Intermediate Benthos Complex I

A shallow-water complex (34 stations, average depth 13.2±2.9 m) with dominance of amphipods at an average biomass of 71.5±18.6 g/m^2. This complex is similar to the amphipod complex of the Piltun area and includes the same amphipod species as in the Piltun area at depths of ≤15 m, isopods *Synidotea cinerea* with biomass up to 35 g/m^2, and bivalve mollusks. Hence, 2002 and 2008-2010 data indicate that forage benthos also has a relatively high biomass south of Piltun Bay, as far as Chayvo Bay.

Intermediate Benthos Complex II

A complex dominated by ascidian *Pareugyrioides dalli* (17 stations, average depth 24±4.2 m). The complex occupied sections in the southern part of the Intermediate area, and is a boundary complex with the Offshore area. The biomass of the dominant species averaged 134.2±54.5 g/m^2, while cumaceans and polychaetes were found in small numbers.

Intermediate Benthos Complex III

A complex was similar to the sand dollar complex offshore of the Piltun feeding area and was dominated by sand dollars *E. parma* was identified at 36 stations, at an average depth of 22.9±3.7 m. Sand dollar biomass averaged 267.8±145.4 g/m^2.

The latter two complexes are found in patches in areas with a complex bottom macrorelief and active hydrodynamics. Based on depth finder profiling data, the ascidian complex was associated with terrain elevations comprised of sand of varying grain size mixed with shell debris. The *E. parma* complex was more prevalent on flatter relief.

Sharp changes in the abundance of benthos were recorded in the coastal zone south of the Intermediate area (from Chayvo Bay to Niyskiy Bay). The average total benthos biomass to the south of the Intermediate area, according to 2002 data (three stations), was 90.9 g/m^2, and amphipod biomass decreases to 3.7 g/m^2, while isopod biomass decreased to 5.9 g/m^2. This reflects similar results obtained in 2001 (Fadeev 2002).

Table 16. Distribution of macrobenthos biomass (g/m^2) in the Intermediate area (2007-2010 data).

Group	Frequency of occurrence,%	Depth (m)			Average biomass	Standard Error
		<15	16-20	21-25		
Amphipoda	100	**74.1**	14.3	2.1	38.7	11.9
Bivalvia	95	32.6	43.5	16.7	24.9	7.1
Polychaeta	90	2.8	8.6	18.7	15.5	5.9
Cumacea	84	10.5	3.8	8	8.8	4
Echinoidea	60	0	**111.8**	**367.2**	224.3	97.6
Isopoda	50	17.7	4.2	4.9	8.1	3.2
Ascidia	45	0	72.3	98.4	94.6	43.8
Total		137.7	258.5	516	414.9	173.5

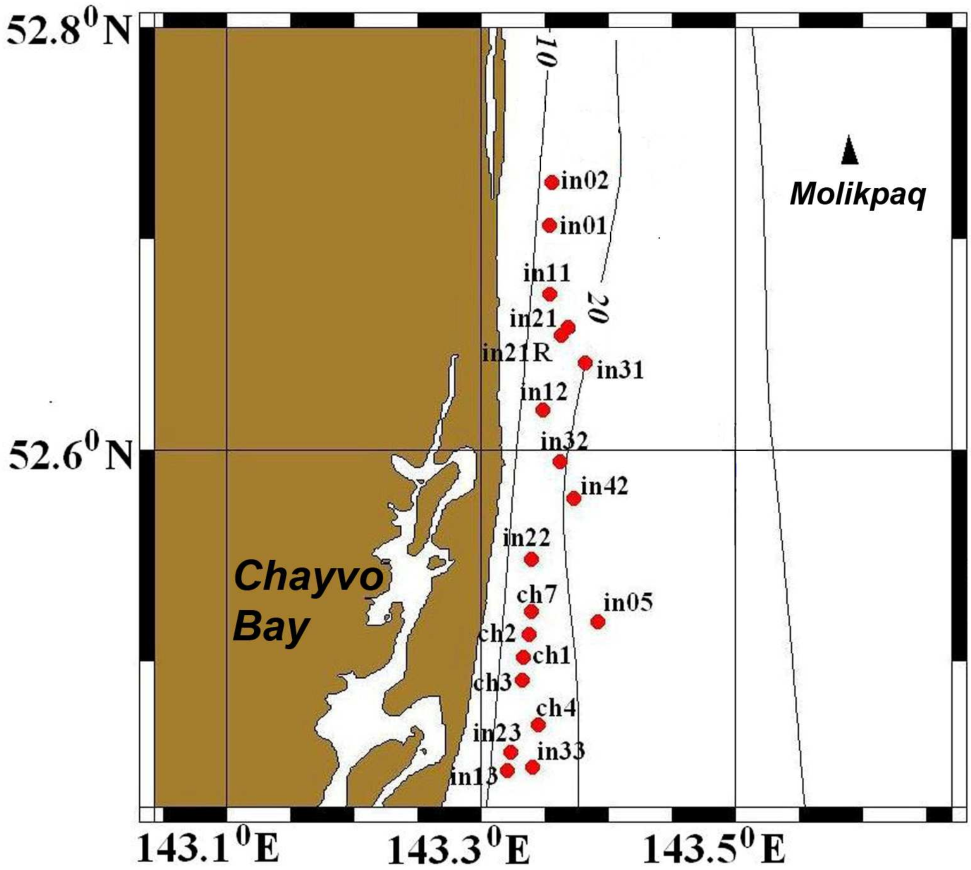

Figure 12. Locations of stations in the Intermediate (In) and Chayvo (Ch) areas in 2010.

3.5 BENTHOS ABUNDANCE AND DISTRIBUTION AT GRAY WHALE FEEDING SITES

During the 2010 field season, 15 benthos stations (45 samples) at gray whale feeding sites were sampled by grab: 7 in the Offshore area, 6 in the Piltun area and 2 in the Chayvo area.

3.5.1 Whale Feeding Sites in the Piltun Area

Diving samples were first collected at 21 whale feeding sites (average depth of the stations 19.5±1.5 m) in the Piltun area in 2002. The average benthos biomass was 234.4 g/m^2. Forage benthos – amphipods and isopods – made up more than 50% of the total biomass.

Twelve sites (average depth 18.6±1,6 m) were studied in 2003. The average biomass of benthos at the feeding sites was 164.2 g/m^2, and amphipods and isopods made up 79% of the biomass. Most of the whales fed at depths of 20 m or less within the shallow-water amphipod complex in 2003 (Fadeev 2007).

In 2004, 50 whale feeding sites were studied in a depth range of 14-35 m (average depth 23.5±0.9 m was greater than previous years). The increase in the average feeding depth was due to the whales' foraging within the sand dollar complex at depths greater than 20 m in the northern part of the Piltun area.

In 2005, there were 74 whale feeding sites (average depth 18.5±1.1 m). Most of the whales fed at depths of 20 m or less within the coastal amphipod complex. In the northern Piltun area, however, whales were once again observed feeding in deeper waters. The number of "deeper-water" whales in 2005 was sometimes as high as 40% of the total number of whales in the northern Piltun area. Analysis of 2004-2005 samples showed that the sand lance *Ammodytes hexapterus*, the amphipod *Eogammarus schmidti* and the isopod *Saduria entomon* had the highest frequency of occurrence and biomass at deeper-water feeding sites (>20m) in the northern area.

The sand lance accumulations in the northern Piltun area (depth greater than 20 m) were located 5-7 km from the shallow-water areas of the coastal amphipod complex (depth less than 15-20 m); however, gray whales can cover this distance in 1-1.5 hours, and so coastal areas with amphipod dominance and the deeper-water areas with sand lance dominance could easily be foraged by the same whales within short periods of time.

The average sand lance biomass in the Piltun area at the whale feeding locations was lower in 2009 and 2008 (8.8±3.7 g/m^2 and 12.9±5.4 g/m^2, respectively) than in 2007 (27.7±12.1 g/m^2). In the northern part of the Piltun area, the contribution of sand lance to the total biomass decreased from 40-60% in 2005 to 20-25% in 2006-2007, and 8-12% in 2008-2009. In 2010 the sand lance biomass contribution in the northern part of the Piltun Area increased to 20%. Duirng field observations two gray whale feeding sites were identified. Sand lancelance biomass at these feeding sites was 66 and 78 g/m^2. Considering the higher biomass numbers, and relative contribution of sand lance to the overall biomass, we may assume that in 2010 sand lance schools recovered in the northern part of the area to levels similar to 2006-2007 (Figure 7).

In 2008 the amphipod biomass at whale feeding sites in the Piltun area was 35.2±3.2 g/m^2. In 2009 the examined whale feeding sites were located mainly in southern and central part of the Piltun Area (Figure 13). All feeding sites were less than 20 m deep and were located in the area with amphipod biomass ranging from 50 to 120 g/m^2. In 2010, areas of high amphipod biomass increased, extending from the northern to the southern parts of the Piltun Area (Figure 4). In 2010 amphipod biomass in the Piltun WGW feeding area at depths of 10-12 m increased to 100 g/m^2 compared to 20 g/m^2 in 2009 and reached levels of 180-205 g/m^2 in certain places.

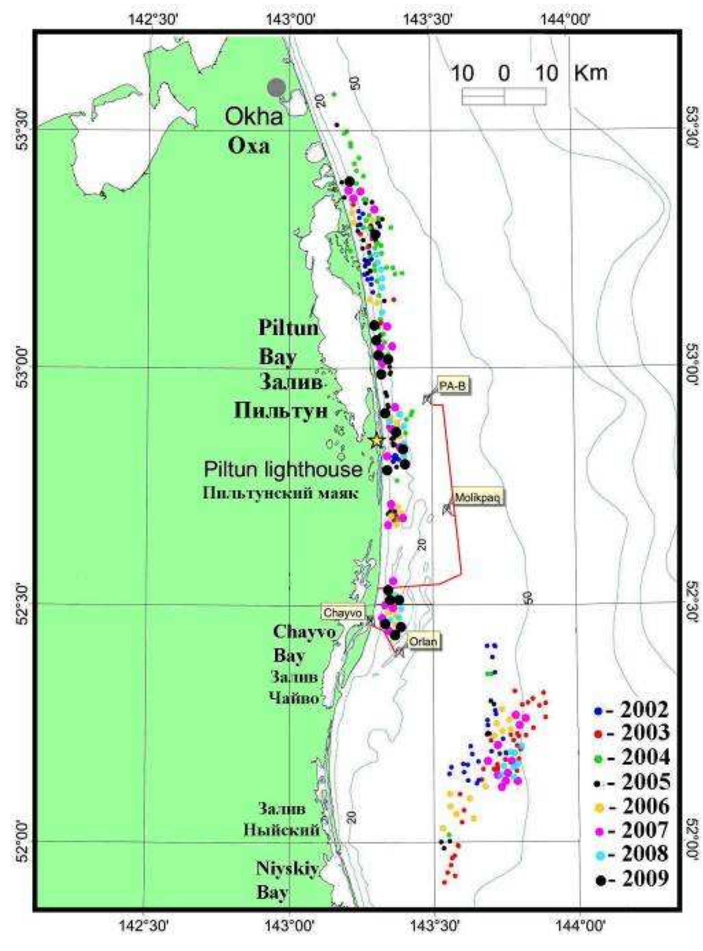

Figure 13. Chart of gray whale feeding sites studied in 2002-2009. See Figures 1 and 11 for 2010 WGW Feeding Points.

3.5.2 *Whale Feeding Sites in the Chayvo Subarea*

During 2006-2010, 44 benthos stations at gray whale feeding sites were sampled by grab in the Chayvo subarea. Stations at whale feeding sites were located in depths of 10 to 15 m (average depth – 13.5 m) on well-graded fine and medium sand. Video records did not reveal any accumulation of planktonic animals in the water column. Copepods, euphausiids, cumaceans and planktonic amphipod-hyperiids were found in insignificant numbers in samples of plankton and epibenthos (epibenthos net).

Benthos at the whale feeding sites belonged to coastal amphipod complex, which is common at depths ≤20 m in the Piltun area; the species composition of this complex in the Intermediate area was the same as that in the Piltun area.

The occurrence of the amphipod complex to the south of Piltun Bay, as far as Chayvo Bay, has been known since 2001 (Fadeev 2002), when it was also noted that the biomass of amphipods is significantly lower there than in the Piltun area. In 2001, the average amphipod biomass at whale feeding sites in the 10-15 m range was 35.7±9.8 g/m^2, in 2006[1] this was 41.1±7.9 g/m^2, in 2007 51.3±8.6 g/m^2, in 2008 the average amphipod biomass was 47.6±9.6 g/m^2 and in 2009 this was 61.4±13.6 g/m^2, respectively. Amphipod biomass at feeding locations in the Chayvo Subarea did not change significantly in 2010 (57.8±9.4 g/m^2) compared to previous years (Figure 14).

Vessel-based observation and photo-ID data recorded no more than 5-7 gray whales feeding in the Chayvo area at any one time. This may indicate that this small area with relatively low prey biomass may be of secondary importance as feeding habitat compared to the Piltun and Offshore feeding areas.

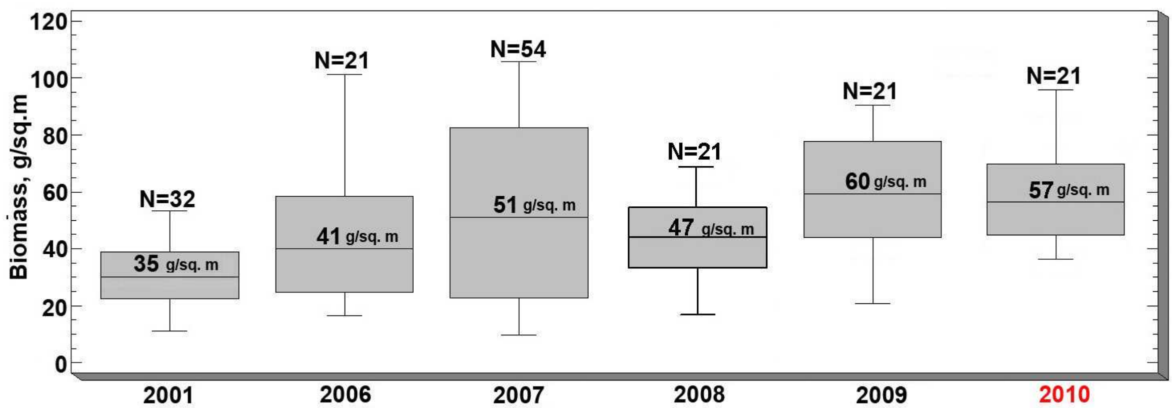

Figure 14. Amphipod biomass (g/m^2) in the Chayvo subarea in 2001, 2006-2010.

[1] 2006-2010 samples were collected from the area between two transects, over 5-30 m depth, that were sampled in 2001.

3.5.3 Whale Feeding Sites in the Offshore Area

In 2002-2003, 64 whale feeding sites were studied in the Offshore area; three sites were studied in 2004, eight sites in 2005, 14 sites in 2006, 30 sites in 2007, 9 sites in 2008 and 13 in sites 2009. In 2010 a total of 7 whale feeding sites were sampled. During all these years, the whales fed in a depth range, from 41 to 61 m, *i.e.*, in a zone of high abundance of the amphipod *Ampelisca eschrichti* (Figure 15).

The ampeliscid biomass at whale feeding sites averaged 366.3±168.3 g/m^2 in 2005, 329.4±143.8 g/m^2 in 2006, 516±140.1 g/m^2 in 2007 and 523±148.5 g/m^2 in 2008. The average ampeliscid biomass at whale feeding sites in 2009 and 2010 was 507.7±59.3 g/m^2 and 423.4±103.5 g/m^2 respectively, indicating that gray whales forage in the Offshore area primarily at sites with ampeliscid biomass of more than 400-500 g/m^2. In 2007-2010 whales fed at depths greater than those recorded previously (51-53 m). It is possible that whales foraged at greater depths in 2007-2010 due to increased abundance (and therefore resource pressure or competition) of whales (up to 70 individuals) in the Offshore feeding area (Figure 15).

In 2009-2010, as in previous years, benthos at the feeding sites had composition and structure consistent with the *Ampelisca eschrichti* complex and the *A. eschrichti* + Bivalvia + Actinia complex.

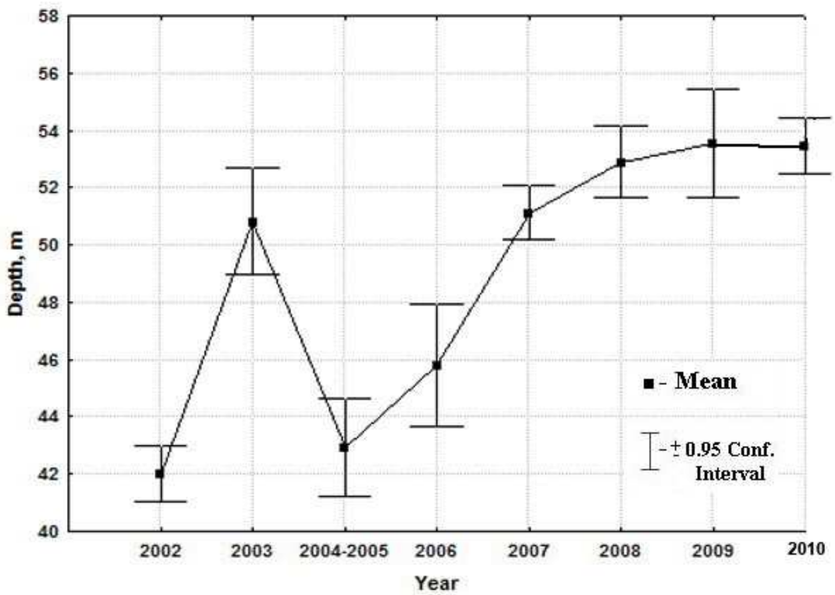

Figure 15. Distribution of average depths of whale feeding sites in the Offshore area by years.

3.5.4 Study of the benthos in Olga Bay (Eastern Kamchatka)

In July of 2009 and 2010 at 16 feeding points of gray whales in Olga Bay along the south-eastern coast of Kamchatka (Figure 16) 48 grab benthic samples were taken. In addition, two stations (6 samples) were collected outside of whale feeding points. Gray whales feed in Olga Bay at depths ranging from 6 to 13 m, with the average depth of 8.5 ± 0.7 m. Sediments at feeding points are represented by fine and medium-sized sand mixed with up to 20% gravel.

Six taxonomic groups of animals were collected in the benthic samples, four groups having the highest frequency of occurrence (P, %): amphipods (P = 100%), cumaceans (P = 100%), polychaetes (P = 75%) and bivalves (P = 38%). Average total biomass of benthos in the feeding points of whales in 2009 and 2010 had similar values: 71.8 ± 9.0 g/m2 in 2009 (n = 21) and 71.2 ± 8,7 g/m2 in 2010 (n = 27). More than 95% of the biomass in the whale feeding points was comprised by amphipods (61%) and cumaceans (36%). Benthic biomass at the two stations outside of whale feeding points was significantly lower than at the feeding points: in 2009 - 24.0 ± 7.6 g/m2 (n = 3) and in 2010 - 22.0 ± 5.6 g/m2 (n = 3).

The biomass of amphipods and cumaceans at the feeding points of gray whales in Olga Bay in 2009 and 2010 is shown in Table 17. Overall, 16 species of amphipods were identified. More than 90% of the average total biomass of amphipods was accounted for by three species: Monoporeia sp. (37.0 ± 9.3 g/m2), Psammonyx kurilicus (4.9 ± 1.8 g/m2) and Eohaustorius sp. (4.1 ± 2.0 g/m2). Amphipod Monoporeia sp. that dominated the biomass of amphipods in Olga Bay has a certain resemblance to Monoporeia affinis from the Piltun feeding area on Sakhalin. Body length of mature individuals of Monoporeia sp. in Olga Bay in August 2010 ranged from 8.7 mm to 12.2 mm (mean 10.38 ± 0.11 mm), which corresponds to the age class of 1+ of Monoporeia affinis from Piltun feeding area (see Table 9)..

In terms of the total biomass of amphipods (Table 17) and the size of gray whale feeding area Olga Bay is similar to Chayvo feeding subarea on Sakhalin. No more than 5-7 whales were seen simultaneously feeding in the Chayvo subarea, whereas in Olga Bay in 2010 the photo-identification work identified more than 40 gray whales. Therefore there must be other feeding areas of gray whales that can be found along the coast of Kamchatka.

Table 17. Biomass (g/m2) of abundant groups of benthos in Olga Bay (Kamchatka) and in the Chayvo Bay subarea (Sakhalin) in 2009-2010.

Parameters	Chayvo Bay (Sakhalin)		Olga Bay (Kamchatka)	
	Feeding Point		Feeding Point	
	2009	2010	2009	2010
Amphipoda	61.4±13.6	57.8±9.4	43.8±7.2	50.3±7.9
Cumacea	<0.1	0.16±0.15	25.6±6.7	14.8±3.6
Isopoda	18.1±4.9	15.8±5.0	<0.1	<0.1
No,of samples	21	21	21	27

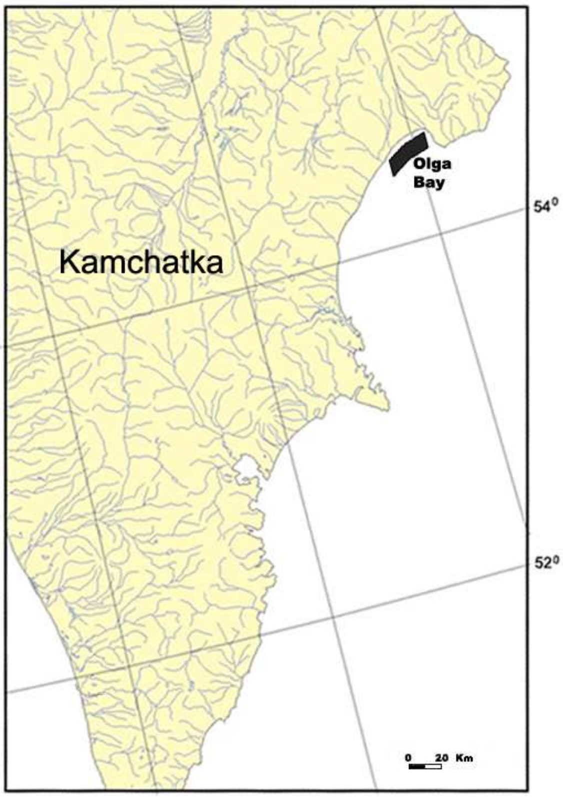

Figure **16**. Site locations of benthic samples in the feeding area of gray whales off the southeastern coast of Kamchatka

3.6 Comments for Assessing Year-to-Year Changes in Forage Benthos in the Piltun and Offshore feeding areas

The purpose of this section is to compare the most notable trends in year-to-year changes in the distribution of foraging whales and forage benthos. This section is not intended to provide a detailed, cross-spectrum analysis of the relationships between benthos and foraging whales. That exercise would require special analysis within the framework of a unified GIS.

3.6.1 Principal Trends in the Distribution of Whales in 2002-2010

1. 2002-2003 – whales fed in both (Piltun and Offshore) feeding areas; most of the whales in the Piltun area fed in the shallow-water zone at depths ≤ 20 m in the northern and southern parts of the area.

2. 2004-2005 – whales fed primarily in the Piltun area; the number of photo-identified whales in the Offshore area was low– 8 (2004) and 7 (2005) individuals; whales fed in the Piltun area generally in the shallows at depths of ≤ 20 m, while in the northern part of the area, some whales (up to 40%) fed at depths greater than 20 m.

3. 2006 – whales fed in both the Piltun and Offshore areas; the number of photo-identified whales in the Offshore area increased to 33 individuals; whales in the Piltun area fed along the entire coastline; the number of foraging whales declined sharply in the southern part of the area, as did the proportion of whales feeding at depths >20 m in the north. A small number of foraging whales appeared in the Chayvo Bay area.

4. 2007-2009 – whales fed in both areas; the number of photo-identified whales in the Offshore area increased to 70; the number of foraging whales in the southern Piltun area increased relative to 2006, while the number of whales feeding at depths > 20 m in the northern part of the area was very low. The Chayvo subarea had a small number of foraging whales.

5. 2010 – whales fed in both the Piltun and Offshore areas. In the shallow littoral areas of the Piltun Area the whales forage along the entire coast from north to south. A small number of foraging whales were observed in the northern part at depths > 20 m.

3.6.2 *Principal Trends in Variation of Forage Benthos Abundance in 2002-2010*

Offshore Area

Biomass of forage benthos was stable, and no major year-to-year variations were observed; whales fed in a depth range of 41-61m every year in a zone of high abundance of major prey: amphipods *Ampelisca eschrichti.*

Piltun Area

1. 2004-2005 – areas with elevated amphipod biomass occur in the shallower-water part of the southern and northern Piltun area; Monoporeia affinis is dominant in biomass; there is an increase in the frequency of occurrence (to 40-60%) and biomass of the sand lance Ammodytes hexapterus in the northern part of the area.

2. The appearance of the sand lance in waters >20 m in the northern part of the Piltun area coincided with a decrease in the number of whales in the Offshore area, and the appearance of foraging whales in the northern Piltun area at depths greater than 20 m.

3. 2006 – the proportion of the amphipod M. affinis in the total biomass of forage benthos in the shallow-water zone decreased, and the biomass of this species at shallow-water stations in the southern part of the Piltun Feeding area declined by 50% from the 2005 level; in the northern part of the Piltun Feeding area, the frequency of occurrence of the sand lance decreased from 40-60% to 20-25%.

4. The decrease in abundance of amphipods and sand lance in 2006 coincided with the appearance of foraging whales in the Chayvo subarea and an increase in the number of whales in the Offshore area. It is notable that whales began feeding in the Chayvo subarea at sites with biomass of about 40 g/m2 when the biomass of amphipods in the southern Piltun area dropped to approximately this level.

5. 2007-2009 – amphipod biomass increased in the shallow-water zone of the Piltun area. In 2008-2009 amphipod M. affinis was dominant in the southern and central part of the area Piltun area; its biomass there in 2007-2009 was higher than in 2006 but did not reach the maximum levels of previous years (see Figures 4 and 6).

6. In 2007-2009, sand lance abundance at deeper-water sites in the northern part of the area remained at the low level of 2006. In 2009, the frequency of occurrence, biomass and the spatial distribution of sand lance in the Piltun area were similar to those of 2008. There have been sporadic finds while the concentrations in the northern part of the area is absent (see Figure 7).

7. In 2010, areas with high amphipod biomass increased in size, extending from the northern to the southern parts of the Piltun Area (see Figure 4). At depths of 10-12 m amphipod biomass in

the WGW foraging area increased 20-100 g/m^2 over 2009 and in certain places reached 180-205 g/m^2.

An increase in the abundance of the amphipod *M. affinis* in the south Piltun area coincided with shore- and vessel-based observations of increases in the number of foraging whales in the southern section of the area; lone foraging whales were observed in deeper waters of the northern section.

3.6.3 Changes in Hydrology and Sea Ice Cover in the Piltun Area

An analysis of the year-to-year dynamics of the hydrological regime in the Piltun area showed that the lowest bottom temperatures for the period 2004-2010 occurred in 2010. Temperature is expected to affect amphipod breeding, growth, and feeding, resulting in changes to their life cycle duration. For example, the dominant species in the Piltun area, *Monoporeia affinis*, has a two-year life cycle in cold waters and a one-year life cycle in warmer waters (Segestrale 1967). The amphipod *Ampelisca macrocephala,* which inhabits the Offshore area, lives for 5-6 years in the cold waters of the Bering Sea, but for only 2-3 years in the temperate waters of Denmark (Kannewoff 1969; Highsmith and Coyle 1991). Whether the few degrees centigrade of temperature differences in the Piltun area has affected amphipod life cycle is not known. The effect of hydrological features on the life cycle of mass amphipod species on the Sakhalin north-east shelf will be further assessed once current morphometric analysis of the 2007-2010 amphipod collections is completed.

Important climate parameters such as sea ice dynamics can also impact coastal biota. Ice conditions varied substantially in the Piltun area during 2004-2010. Figure 17 indicates the position of the ice edge during the first ten days of June each year. According to these satellite monitoring data, the northeastern Sakhalin coastal zone was free of ice in June 2004 and 2005. However, the area was covered in 10-point ice almost to the mouth of the Piltun lagoon in early June 2006. In June 2007-2010, ice remained near the Chayvo lagoon, but there was open coastal water from the Piltun lagoon northward.

Ice cover could affect the abundance of *Monoporeia affinis* through influence on hydrological processes and on primary production (*i.e.*, food for benthos). Settled phytoplankton and detritus of phytoplanktonic origin have been reported to play an important role in the diet of this species (Sarvala 1991; Van de Bund at al. 2001). In an environment with an ice regime, such as the northeast Sakhalin shelf and associated coastal bays and lagoons, the intensity and duration of spring bloom of phytoplankton may, as in similar environments, be influenced in part by light conditions when the water surface is free of ice (Schell *et al.* 1982); persistence of ice conditions could delay the spring bloom of phytoplankton, and this in turn could affect zooplankton productivity and fish that feed on plankton (Boytsov and Orlova 2004), as well as benthos (Fleeger *et al.* 1989). A sharp increase in growth rates of *M. affinis* has been shown to follow the spring bloom of phytoplankton in the Baltic Sea, where nutrients availability affected growth to a greater degree than temperature (Lehtonen 1996; Lehtonen and Andersin 1998).

The lowest abundance of *M. affinis,* the most likely principal component of WGW diet, occurred in 2006. The distinguishing features of the hydrological and climatic conditions in 2006 were: (a) a decrease in the summer temperature of bottom waters, and (b) an anomalous ice cover duration (Figure 17).

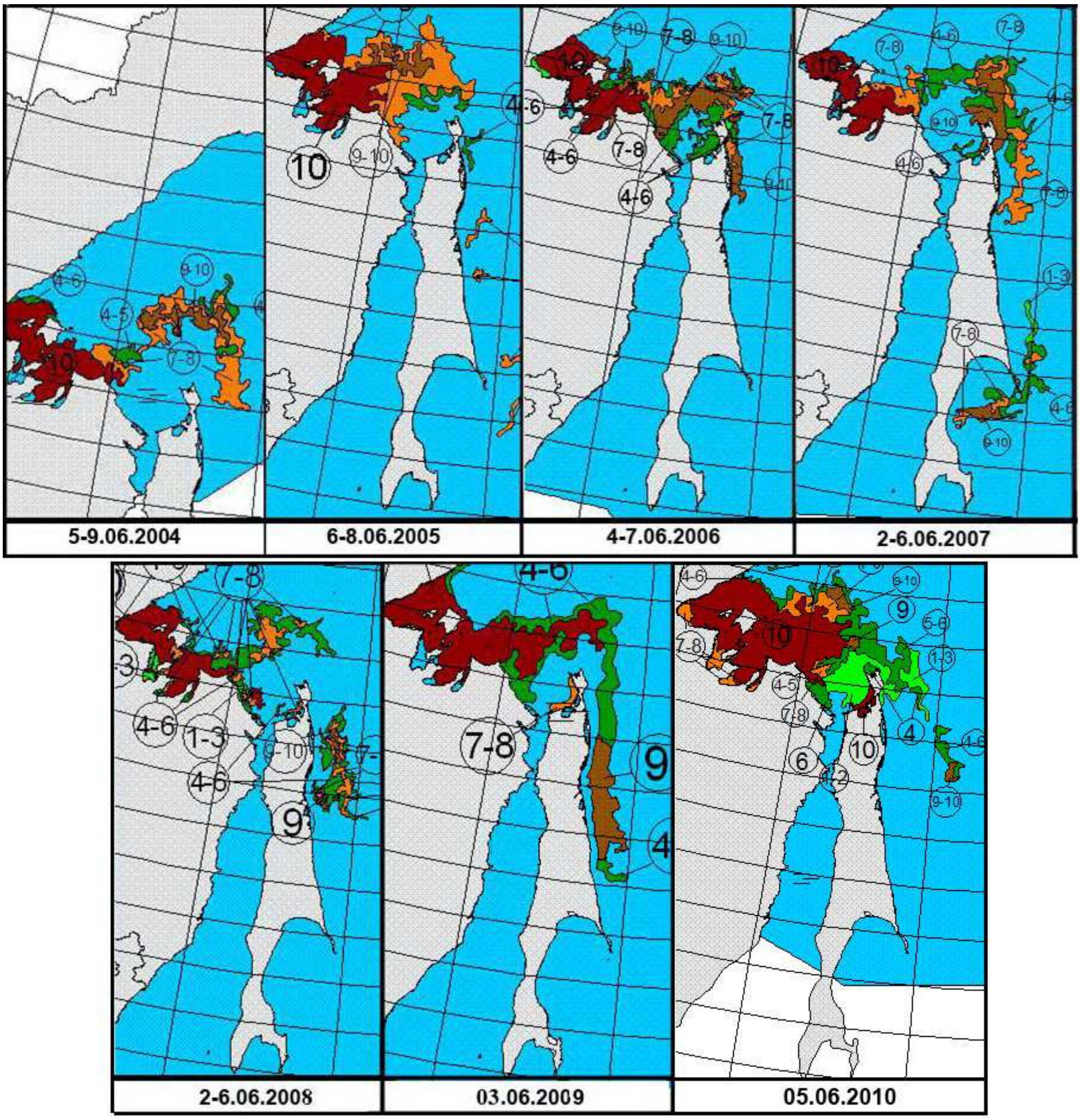

Figure 17. Locations of ice fields according to satellite monitoring data during the first ten days of June 2004-2010 of northeastern Sakhalin (http://www.aari.nw.ru).

We note that the two phemonena may be related. There are available data on the observed cooling of the climate of the Sea of Okhotsk (Volvenko 2004). Unfortunately, no data are available for phytoplankton productivity.

3.7 CONCLUSION

1. In 2010, the average total biomass of benthos in the Piltun feeding area was 414.8±124.3 g/m^2. As in previous years, sand dollars constituted the largest proportion of the total biomass (>70% of total biomass on average, and up to 95% at depths greater than 20 m).

2. For the entire depth range studied in 2010, the average biomass of amphipods was 35.2±7.7 g/m^2. More than 90% of the abundance of amphipods was due to two species: *Monoporeia affinis* (> 60% of total amphipod biomass) and *Eogammarus schmidti* (> 30%). The distribution of amphipod biomass along the coast of the Piltun feeding area showed similar trends in 2002-2009; zones of maximum biomass were associated with the coastal waters, and the amphipod distribution has a distinctly aggregated nature.

3. Multi-year changes in amphipod biomass in the shallow waters of Piltun area represent a statistically significant biomass decrease in 2006 compared to 2002-2005. Amphipod biomass rise observed in 2007-2010 has not yet reached the maximum biomass values of 2002-2003 (statistically significant differences still remain). In 2009-2010, amphipod biomass, the main feeding component for gray whales in the Piltun area, reached the level of 2004-2005 (no statistically significant differences in biomass values).

4. In 2010, areas of high amphipod biomas biomass increased in size, extending from the northern to the southern parts of the Piltun Area.

5. In the northern part of the Piltun area (depth > 20 m), a substantial decrease in sand lance frequency of occurrence was observed, from 40-60% in 2005 to 20-25% in 2006-2007, and 8-12% in 2008-2009. In 2010, sand lance biomass contribution in the northern part of the Piltun Area increased to 20%. Sand lance biomass at gray whale foraging spots was 66 and 78 g/m^2. Considering the higher biomass numbers, and relative contribution of sand lance to the overall biomass, we may assume that in 2010 sand lance schools recovered in the northern part of the area to levels similar to 2006-2007. This is evidenced by both the increase in the frequency of sand lance encounters and the increase in the area of their schools.

6. <u>Offshore feeding area</u>. The average benthos biomass in 2010 was 578.6±123.3 g/m^2. The biomass of amphipods was 206.2±53.7 g/m^2 in 2010 compared to 183.9±66.2 g/m^2 in 2009. Year-to-year differences in average amphipod biomass were not statistically significant. The

spatial distribution of benthos biomass was similar in 2010 and 2006-2009. The proportion of amphipod biomass in total benthos biomass of the Offshore feeding area increased with distance from shore toward deeper waters. As in previous years in the Offshore feeding area, in 2010 the whales fed in the areas with amphipod biomass greater than 300 g/m^2.

7. Year-to-year variations in forage benthos in the Piltun and Offshore areas. Forage benthos biomass in the Offshore feeding area was stable during 2002-2010, and no major year-to-year variations were observed; whales fed in a depth range of 41- 61 m during all those years in a zone of high abundance of amphipods *Ampelisca eschrichti.* In the Piltun feeding area, the most notable changes in the abundance and spatial distribution of the dominant amphipod species, *Monoporeia affinis*, occurred in 2006 when the lowest biomass levels were observed. Hydrological and climatic conditions in summer 2006 were characterized by lower bottom temperatures compared to 2004-2005, and the anomalous duration of the ice cover.

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CHAPTER 4

PATTERNS OF WESTERN GRAY WHALE BEHAVIOR, MOVEMENT, AND OCCURRENCE OFF SAKHALIN ISLAND, 2010

VOLUME II

RESULTS AND DISCUSSION[1]

Photo taken from shore, O. Sychenko.

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March 2011

[1] Chapter 4 *In:* Western gray whale research and monitoring program in 2010, Sakhalin Island, Russia. Volume II Results and Discussion

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CHAPTER 4: BEHAVIOUR

4.1 EFFORT

Behavioral research started on 1 August and ended on 31 September 2010. There were a total of 36 observation days (281 hrs) of effort at six shore-based stations (see Chapter 5, Appendix 1) for the entire field season. Due to weather conditions, the first day of data collection was on 7 August at South Station. The last observation day of effort was on 28 September at North Station. Almost half the effort was conducted during August (36% of the observation time) than during September (64%) (Table 1).

Table 1. Total amount of effort during 7 August to 28 September 2010.

Station	August		September		Total		
	Days	Hours	Days	Hours	Days	Hours	Avg. hrs/day
(1) North Station	2	21.99	5	31.40	7	53.38	7.63
(2) Odoptu Station	2	20.73	3	18.73	5	39.46	7.89
(3) Station 07	3	23.08	3	29.19	6	52.27	8.71
(4) 2nd Station	2	16.74	5	33.88	7	50.63	7.23
(5) 1st Station	2	16.59	3	25.8	5	42.39	8.48
(6) South Station	2	16.61	4	26.02	6	42.63	7.10
Total	13	115.74	23	165.01	36	280.75	7.80

4.2 SCAN DATA

4.2.1 General

For each observation day, scan surveys were conducted to collect information on relative abundance and distribution patterns of western gray whales in the study area. A total of 169 scans were conducted for the entire field season, which yielded 864 sightings of 1134 gray whales (Table 2). The average number of scans per day of effort was 4.8 scans with a range of 1 to 10 scans per day. Distribution patterns of gray whales observed at the six stations are shown in Figure 1 to 3. Figure 2Figure 3 represent the kernel density of the sightings for both the whales observed for the entire field season and those whales observed during the different months (August & September) within the feeding season.

From the shore-based stations, whales could potentially be sighted up to about 10 km distance from the station depending on the observation height (distance-to-horizon ranges from ~ 9 to 16 km). However, whales were usually less than < 5 km from shore (Figure 5; Table 3). Northern regions (North and

Odoptu Stations) represented some of the highest elevations (approximately twice the observation height compared to other stations) and therefore observers could see whales at farther distances. As illustrated in previous years, despite the increased observation range, these regions had lower overall number of whales compared to other stations. In contrast, the most southern station (South Station) in the study area, which had the lowest observation height, had the highest density of whales throughout the field season. In 2010, there was a marked shift in this distribution pattern later in the field , season with more whales observed in the northern region later in the field season compared to the southern stations (see below).

For a given scan, the mean number of gray whales sighted was 5.6 $\pm$ 4.37 SD (Median = 5, Range: 0-16, N = 169) whales. The mean number of pods detected during the scan was 4.2 $\pm$ 3.14 (Median = 3, Range: 0-12, N = 169) pods. Pod sizes ranged from 1 to 4 gray whales per pod for all sightings. The vast majority of the sightings were of single whales with an overall mean of 1.3 $\pm$ 0.62 whales per pod (Figure 4).

Table 2. Summary of scans conducted in 2010 at six shore-based stations off northeastern Sakhalin Island.

Station	Days	# Scans	Mean Scans/Day	# Sightings	# Individuals
North Station	6	34	5.7	163	218
Odoptu Station	5	20	4.0	101	123
Station 07	6	26	4.3	114	144
2nd Station	7	38	5.4	139	268
1st Station	5	20	4.0	206	199
South Station	6	31	5.2	141	182
All Stations	35	169	4.8	864	1134

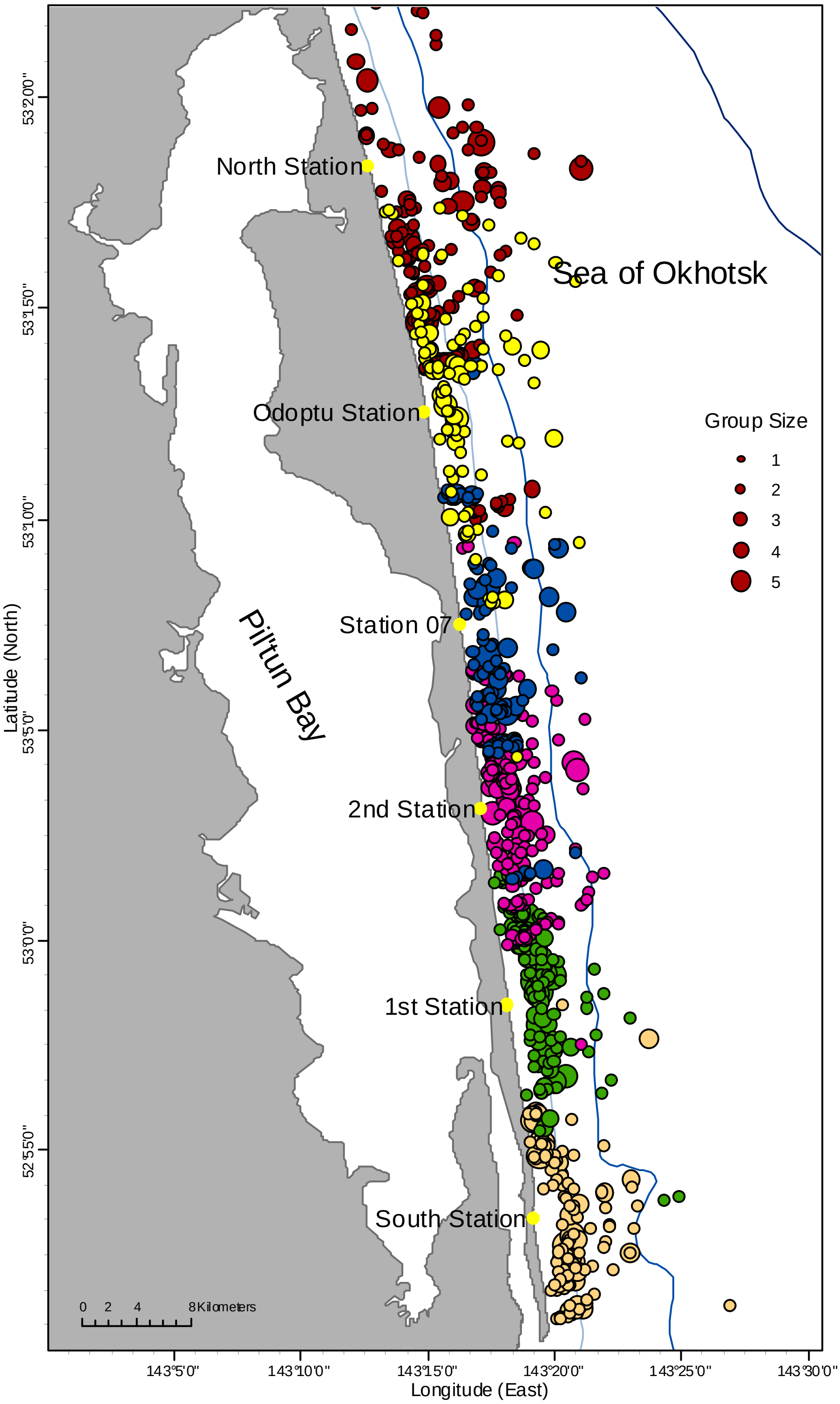


Figure 1. Geographic positions of sightings of western gray whales at six shore-based stations off Sakhalin Island, summer 2010.

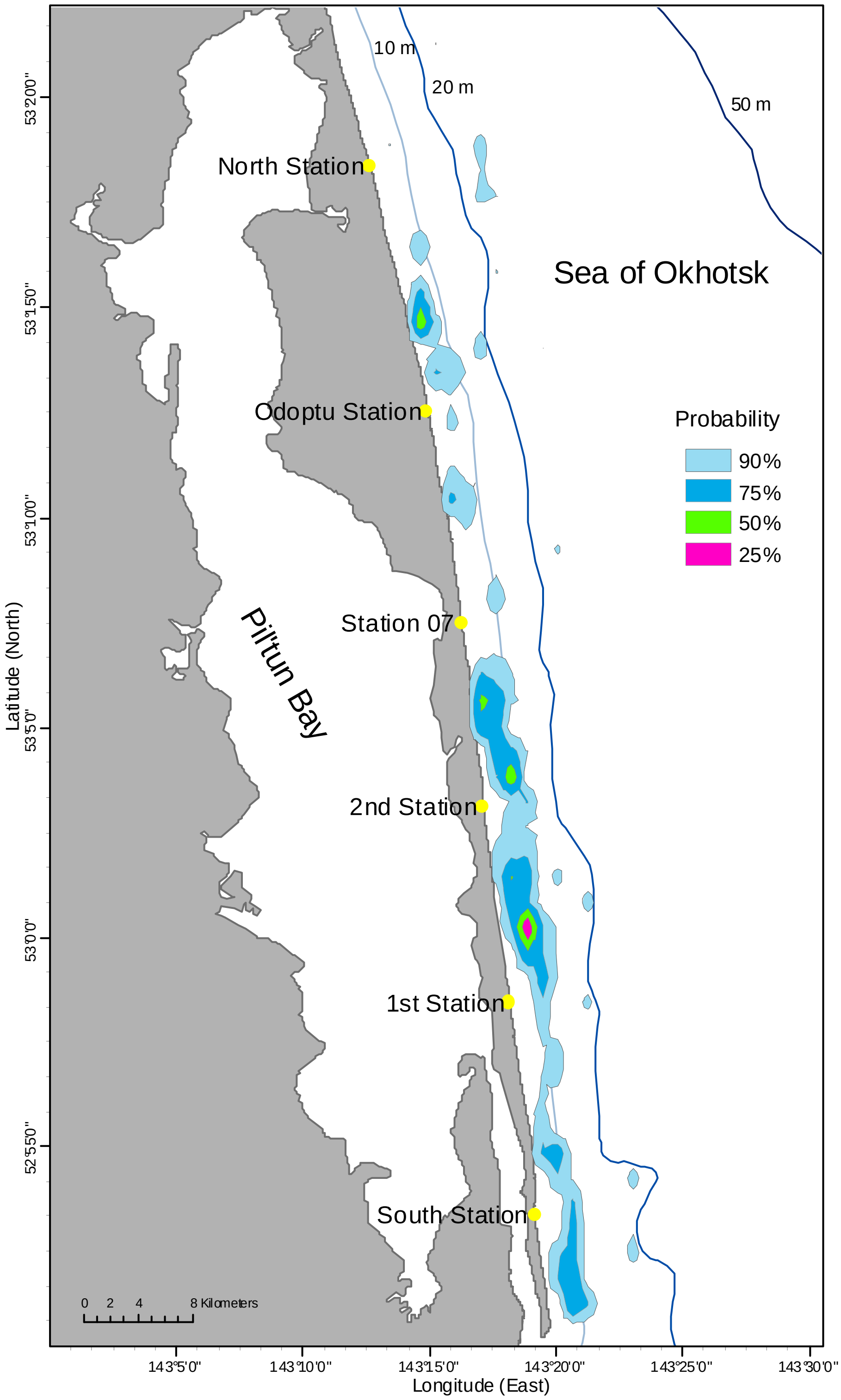
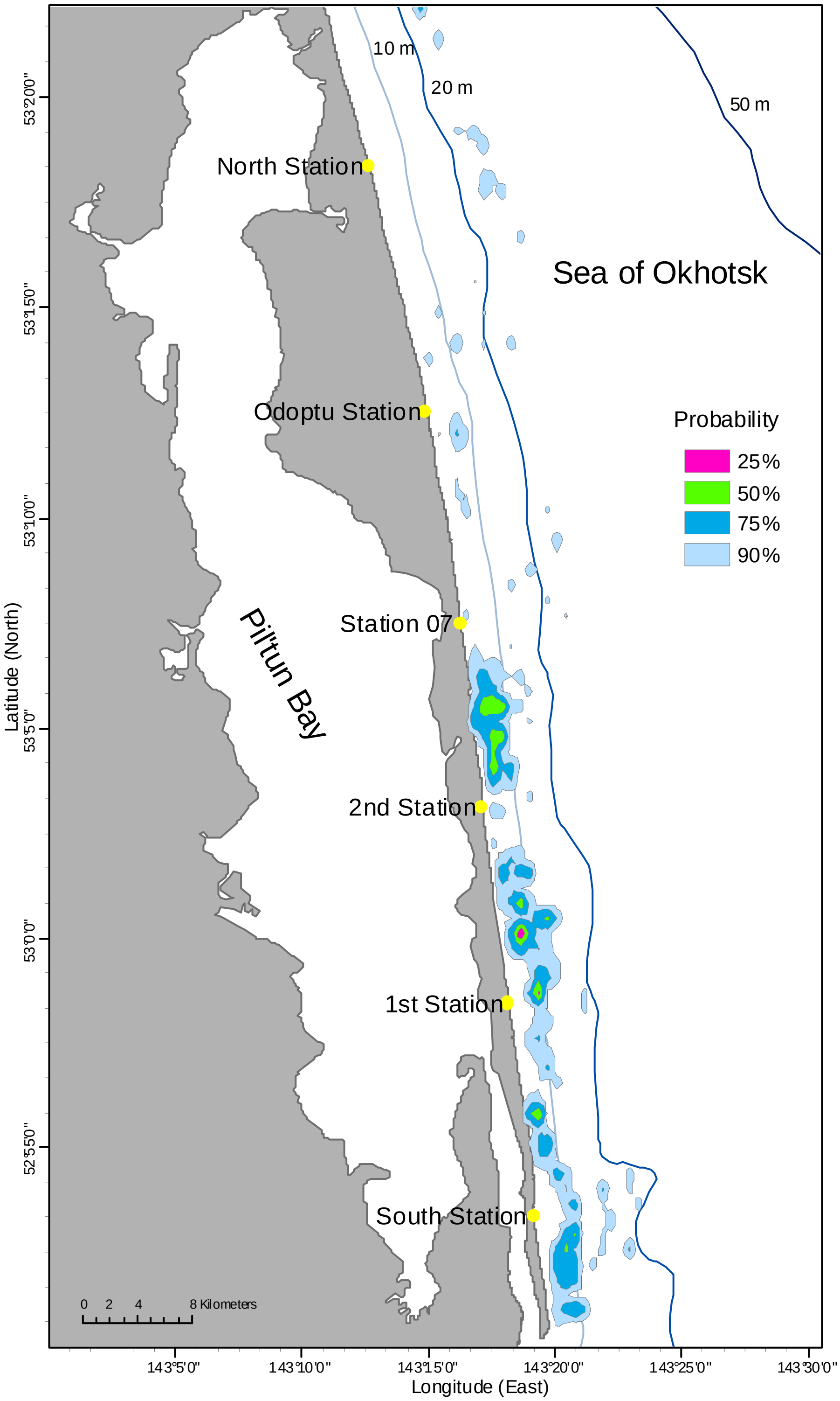


Figure 2. Distribution of western gray whales from six shore-based stations during the summer of 2010. Blue – pink represents the kernel density probability contours.

A. August



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B. September

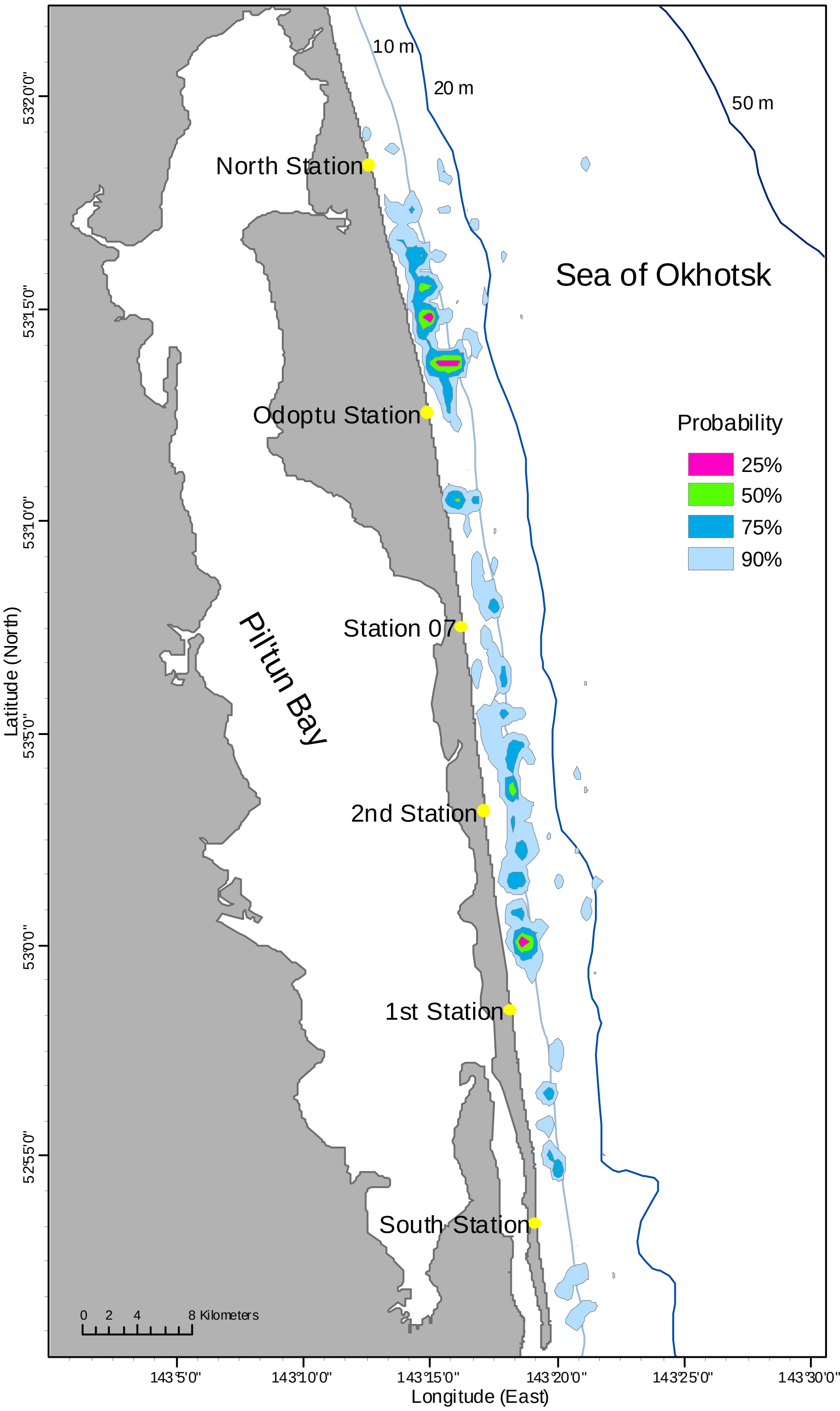
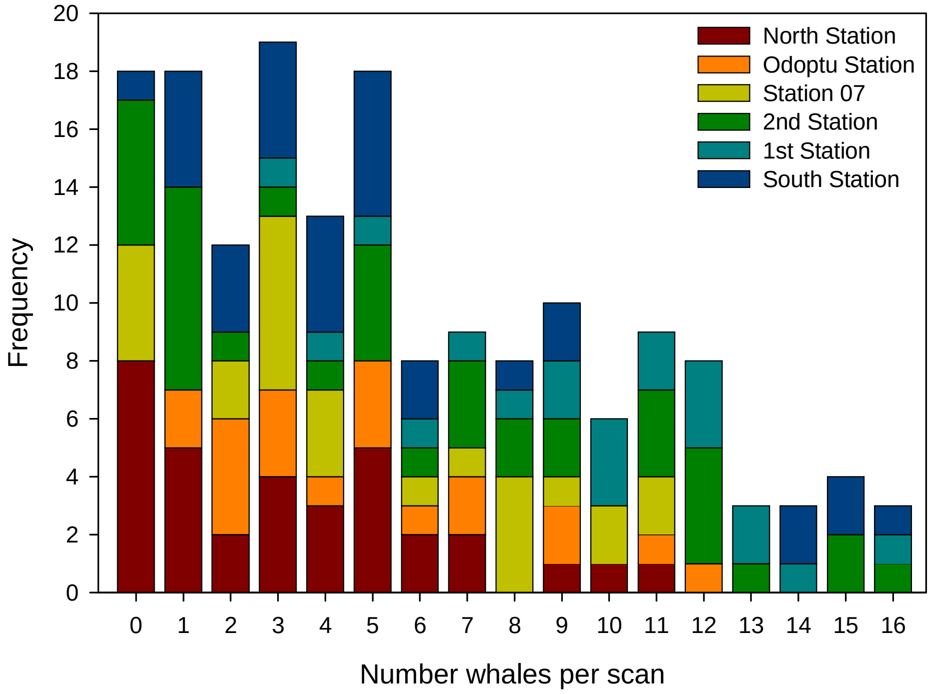


Figure 3. Seasonal distribution of western gray whales from six shore-based stations from (A) August and (B) September of 2010. Blue – pink represents the kernel density probability contours.

A.



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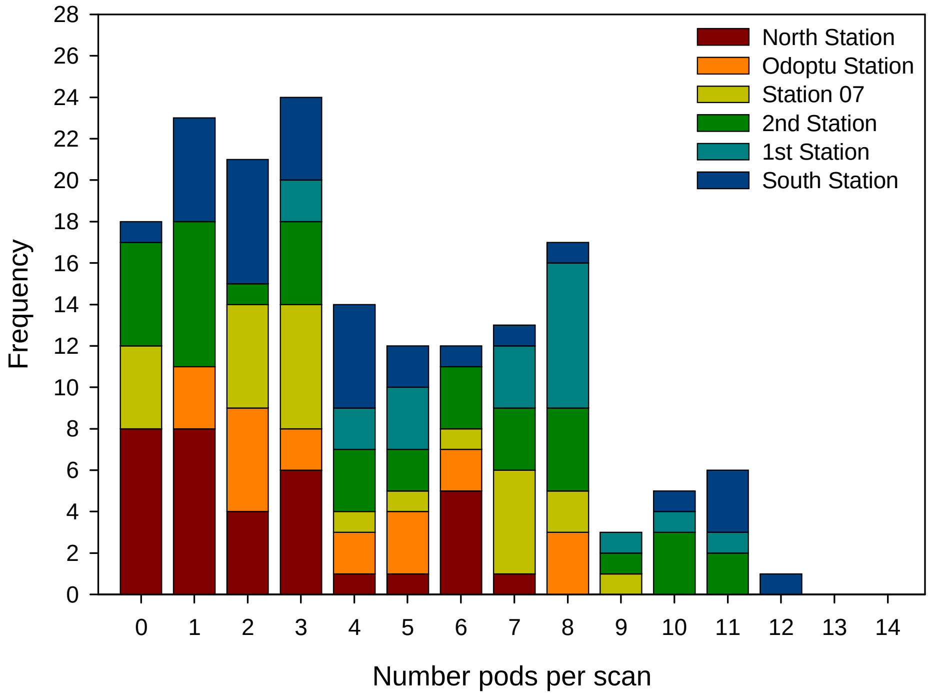

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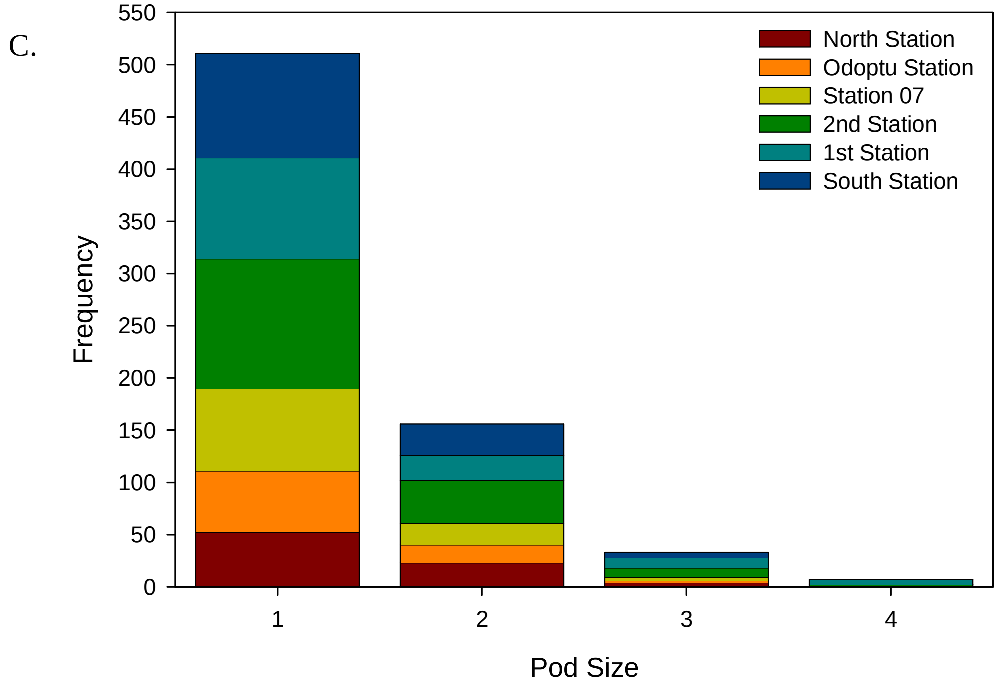

Figure 4. Frequency histograms of numbers of whales (A) and pods (B) detected per scan throughout the study period, and pod size (C).

4.2.2 Distance from Shore

Western gray whales observed in the study area were on average 1.6 ± 1.25 km from shore (Table 3 and Figure 5). Gray whales observed at North Stations were significantly farther from shore (F = 3.93, df = 5, P = 0.002) than whales sighted at Station 07, 2nd and South stations.

There were temporal (intra-seasonal) differences in western gray whale's distance from shore. For the entire feeding season, whales were farther from shore in August compared to September (F = 5.49, df = 1, P = 0.019). In August, whales observed at the most northern locations (North and Odoptu) were significantly farther from shore compared to whales observed in other parts of the study area. Among the northern stations, whales observed in August at North Station where significantly farther than at Odoptu, but these two stations had similar distances in September. At a given station, there were also significant differences in whale distances from shore in August and September. North and Odoptu stations had whales farther from shore in August compared to September, while 2nd station had whales further from shore in September compared to August. The remaining stations were not observed to significantly vary for the different months of observation.

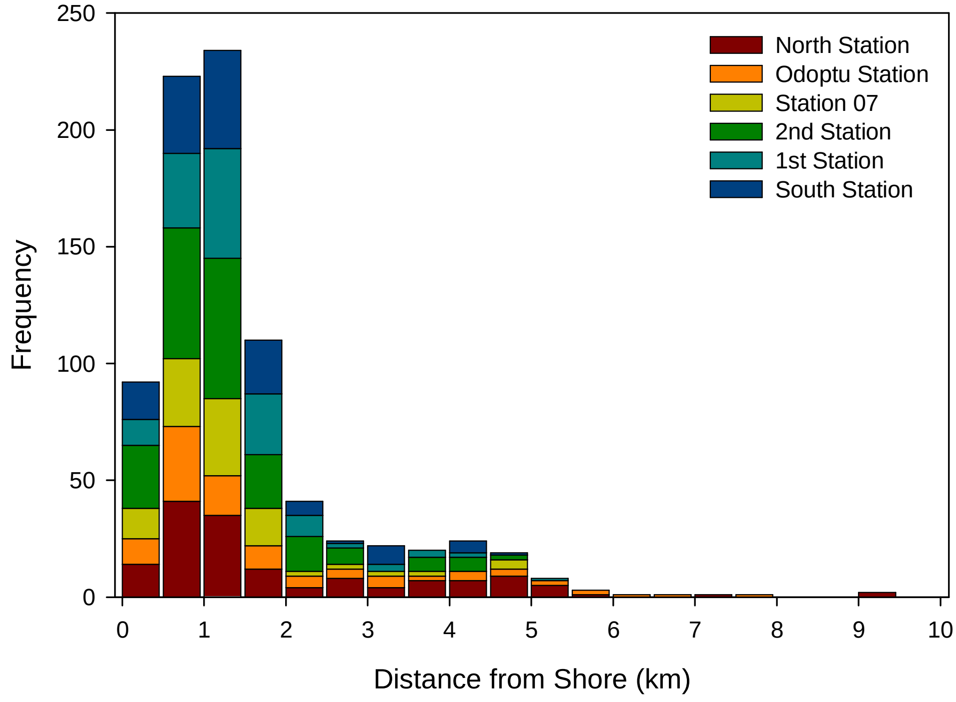

Figure 5. Frequency distribution of distance of western gray whale sightings from shore off Sakhalin Island, summer 2010.

Table 3. Distance of western gray whale sightings from shore at six shore-based stations. Sample size represents number of sightings of gray whales in 2010.

Station	Mean, km	Median, km	SD, km	N	Min, km	Max, km
North Station	2.00	1.27	1.736	149	0.24	9.11
Odoptu Station	1.86	1.14	1.658	100	0.21	7.65
Station 07	1.36	1.14	0.987	103	0.22	4.95
2nd Station	1.36	1.12	0.980	202	0.14	4.95
1st Station	1.41	1.21	0.834	136	0.12	5.26
South Station	1.39	1.15	0.945	135	0.08	4.60
Total	1.55	1.17	1.247	825	0.08	9.11

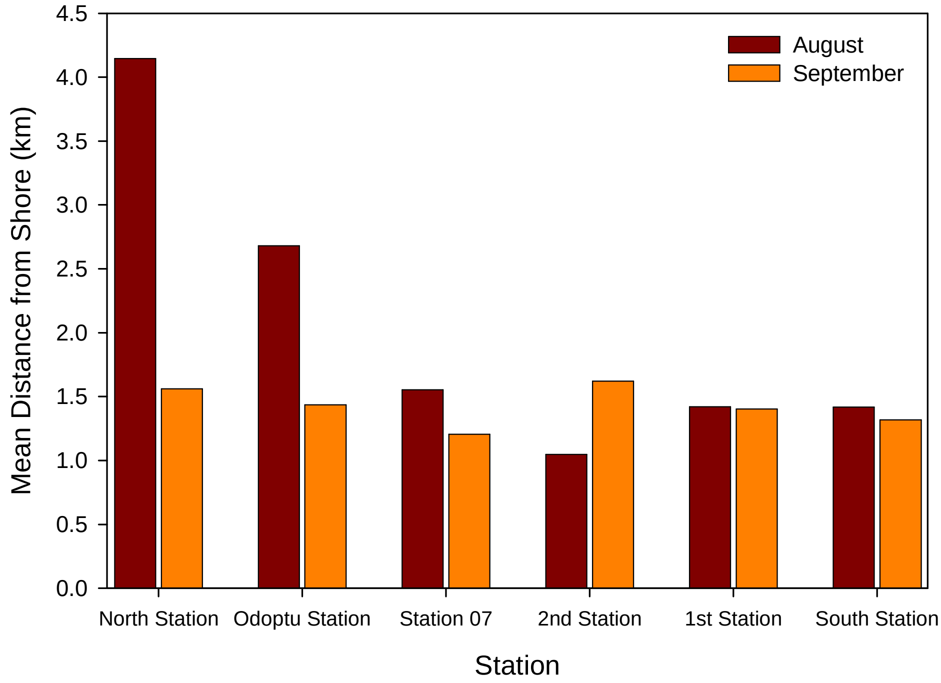

Figure 6. Western gray whale distance from shore at six geographic locations during August- September of 2010.

4.2.3 Morning vs. Afternoon

To evaluate daily variation in whale abundance, the number of whales sighted during a scan were categorized into morning and afternoon periods for each station. We found no significant daily patterns in the number of whales (F = 0.20, df = 1, P = 0.657) during the morning compared to the afternoon portions of each day (Figure **7**). In the morning, the mean number of whales was 5.5 ± 4.52 SD (Median = 5, Range: 0-16, N = 91); and in the afternoon, mean number of whales was 5.8 ± 4.22 (5, 0-16, 78).

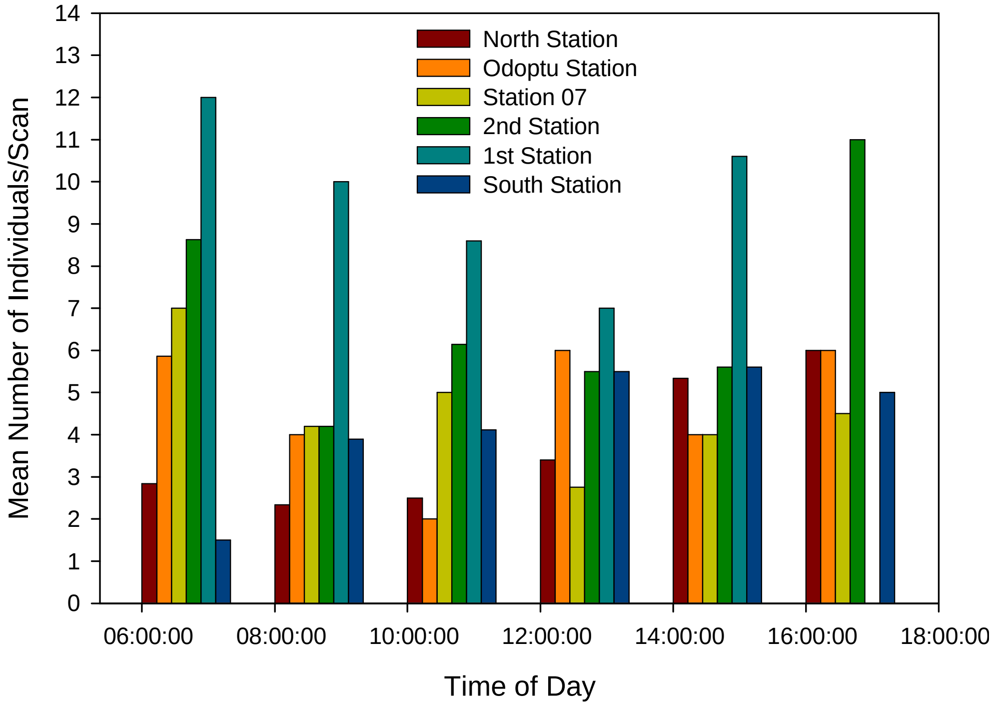

Figure 7. Mean number of whales per time of day at six shore-based stations 2010.

4.2.4 Stations

As seen in the distributional maps, western gray whales were not uniformly distributed when they were utilizing the nearshore feeding habitat. The mean numbers of whales for each station were significantly different ($F = 7.34$, $df = 5$, $P < 0.001$) with more whales at 1st Station compared to all other stations (Table 4). The post-hoc comparison resulted in marginal value of $P = 0.05$ with fewer whales at North Station compared to South Station. No significant differences ($F = 0.09$, $df = 1$, $P = 0.765$) were found in whale abundance for the different months throughout the study area. However, for a given station, the utilization of the area varied ($F = 11.33$, $df = 5$, $P < 0.001$) for the different periods of the whales' feeding season. In August, 1st Station had significantly higher number of whales than Station 07, North and Odoptu Stations; South and 2nd stations were more abundant in whales than North Station. Post-hoc comparison found a marginal value of $P = 0.05$ between South Station and Station 07, with South Station tending to have more whales. South Station had, also significantly more whales than Odoptu Station during the month of August. In September, a significant difference in number of whales was found only between 1st and South stations, with the fewer whales at the latter. Two stations (North and South) were significantly different in abundance in August compared to September with more whales in

September than in August at North Station, and more whales in August than September at South Station (Table 5, Figure 8).

Table 4. Relative abundance of whales (A) and pods (B) detected per scan at six shore-based stations. Sample size is represented by the number of scans per station.

A.

Station	Mean	Median	SD	Range	N
North Station	3.4	3	3.07	0 - 11	34
Odoptu Station	5.0	4.5	3.30	1 - 12	20
Station 07	5.0	4	3.60	0 - 11	26
2nd Station	6.2	5.5	5.05	0 - 16	38
1st Station	9.8	10	3.43	3 - 16	20
South Station	5.6	4	4.65	0 - 16	31
Total	5.6	5	4.37	0 - 16	169

B.

Station	Mean	Median	SD	Range	N
North Station	2.4	2	2.20	0 - 7	34
Odoptu Station	3.9	3.5	2.38	1 - 8	20
Station 07	4.0	3	2.81	0 - 9	26
2nd Station	4.6	4	3.58	0 - 11	38
1st Station	6.8	7.5	2.26	3 - 11	20
South Station	4.4	3	3.48	0 - 12	31
Total	4.2	3	3.14	0 - 12	169

Table 5. Relative abundance of western gray whales per scan for August and September 2010. Numbers in parentheses indicate sample size.

Station	August	Days	September	Days
North Station	1.4 ± 1.80 (15)	2	4.9 ± 3.02 (19)	4
Odoptu Station	3.0 ± 1.86 (12)	2	7.9 ± 2.80 (8)	3
Station 07	4.5 ± 3.64 (13)	3	5.5 ± 3.62 (13)	3
2nd Station	7.9 ± 4.29 (14)	2	5.3 ± 5.58 (24)	5
1st Station	12.1 ± 2.03 (9)	2	7.8 ± 3.16 (11)	3
South Station	9.3 ± 4.79 (13)	2	3.0 ± 2.09 (18)	4
Total	6.0 ± 4.76 (76)	13	5.3 ± 4.02 (93)	22

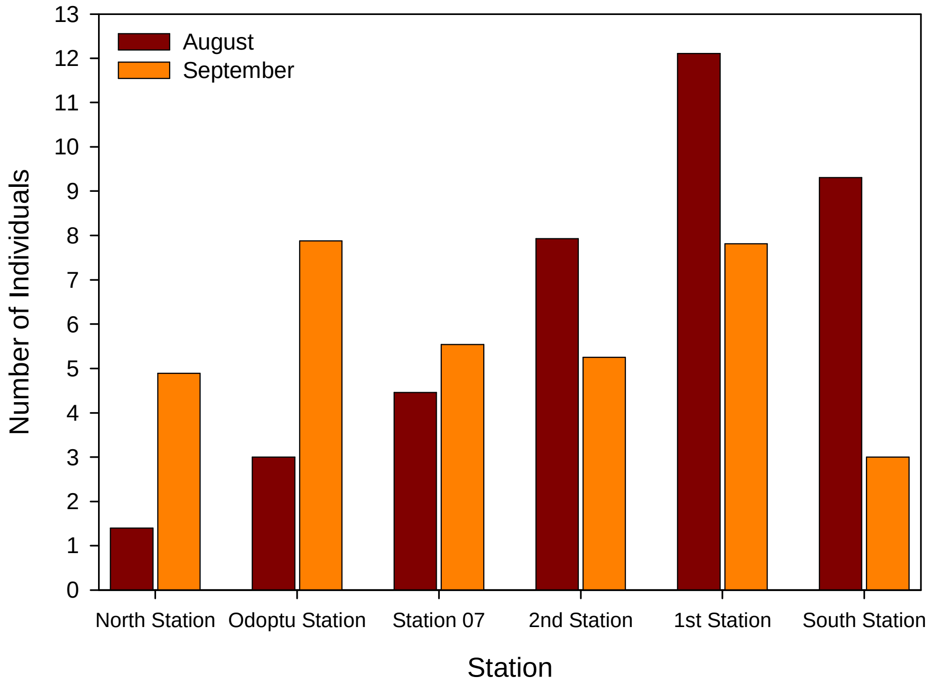

Figure 8. Mean number of western gray whales observed for two months of observations at six shore-based locations in 2010.

The mean and maximum relative abundance of western gray whales for each day of effort are plotted in Figure 9 and Figure 10, respectively. These figures illustrate the relative abundance through the observation period and indicate where whales shift in their habitat use. For example, in the beginning of the field season, whales were generally more abundant at the southern part of the study area (South, 1st, 2nd stations). As the season progressed, fewer whales were observed in the southern part of the study area with a corresponding increase in numbers of whales in the middle and northern stations (Station 07, North, and Odoptu stations).

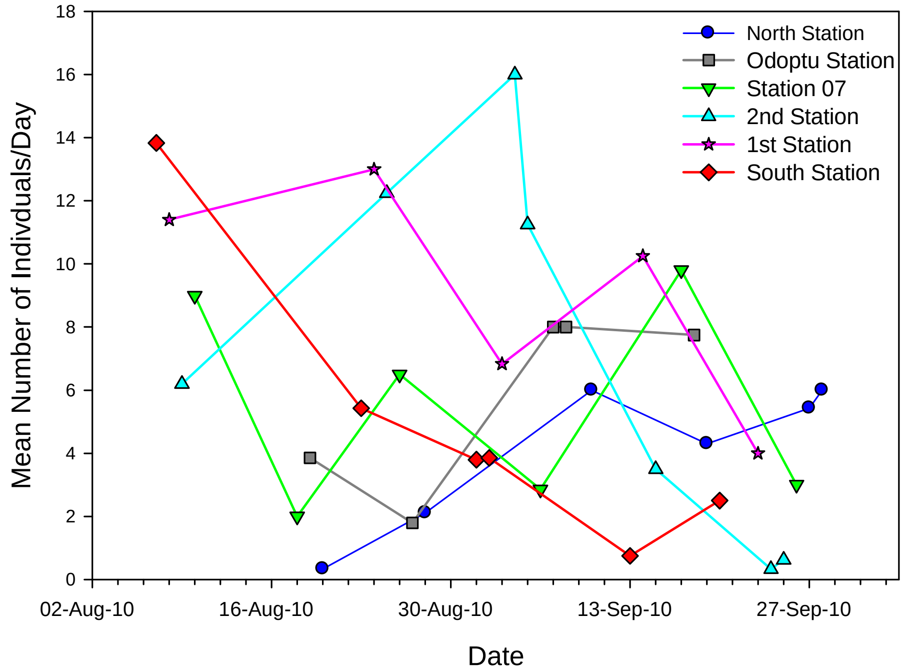

Figure 9. Mean number of whales per scan day at six shore-based stations in 2010.

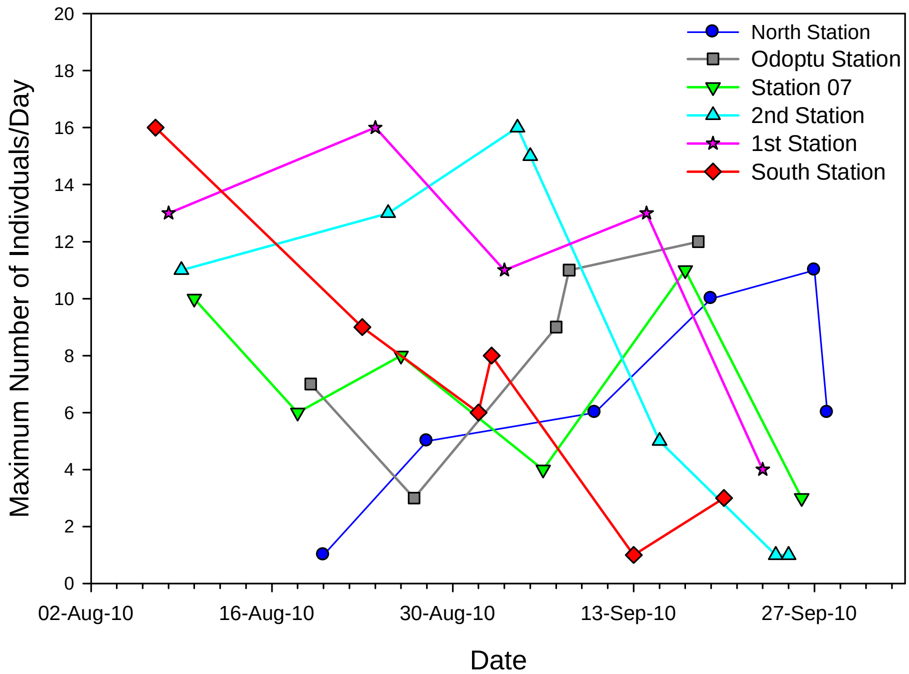

Figure 10. Maximum number of whales per scan day at six shore-based stations in 2010.

4.3 THEODOLITE TRACKLINES

4.3.1 Effort

Western gray whales in the study area were tracked using theodolite survey techniques. The movements of gray whales were monitored for a total of 170 hours with an average track duration lasting for approximately 1.07 hrs (range from 5 min to 4.5 hrs) (Table 6). A total of 158 tracklines with over 8,638 geographic positions of movement were recorded (Figure 11). The majority of individuals were tracked in September (63%) compared to August (37%) primarily due to more observational effort in September compared to August (Table 7).

Table 6. Summary of trackline data gathered in 2010 at six shore-based stations**.**

Station	# Tracks	Mean Duration, hr	Range, hr
North Station	29	1.09	0.1 - 4.5
Odoptu Station	24	1.14	0.2 - 3.5
Station 07	27	1.26	0.1 - 4.4
2nd Station	32	0.86	0.2 - 3.2
1st Station	28	1.27	0.1 - 4.2
South Station	18	0.74	0.1 - 1.8
Total	158	1.07	0.1 - 4.5

Table 7. Summary of trackline data gathered during August – September, 2010.

Month	# Tracks	Mean Duration, hr	Range, hr
August	59	1.02	0.1 - 4.2
September	99	1.1	0.1 - 4.5
Total	158	1.07	0.1 - 4.5

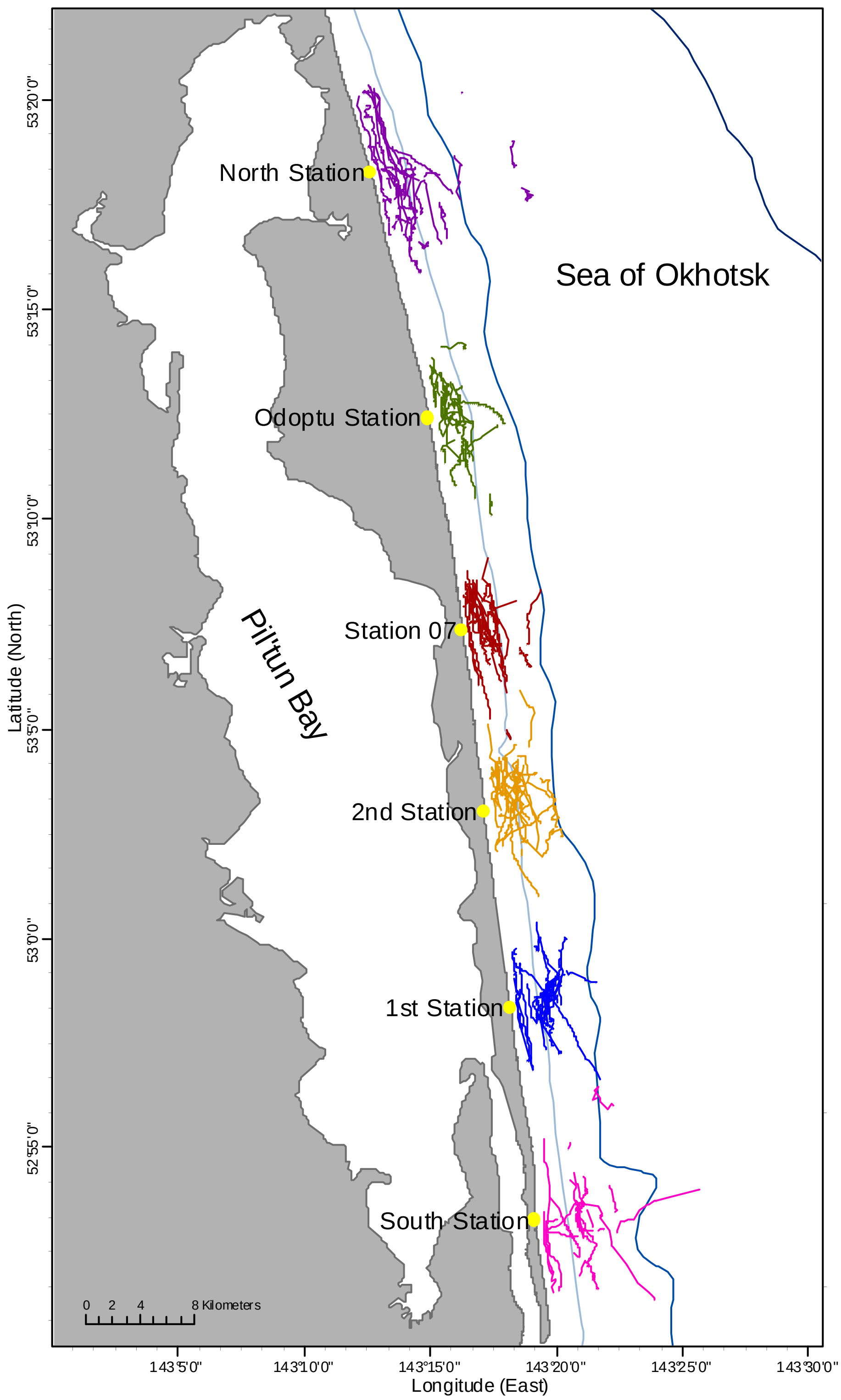

Figure 11. Tracklines of western gray whales at six shore-based positions on Sakhalin Island during summer 2010 (N = 158).

The analytical data set, consisting of only recognizable or single individuals, yielded 98 tracklines that were suitable for movement analyses (Table 8). In 2010, gray whales were observed to be moving 2.5 ± 1.82 SD km/h (Figure 12), accelerating 0.00 ± 0.274 km/h^2 (Figure 13), reorienting 15.8 ± 13.26 °/min (Figure 14), and ranging 38.8 ± 30.16 m/min (Figure 17). Directional indices (mean vector length and linearity index) were 0.84 ± 0.193 (Figure 15) and 0.85 ± 0.193 (Figure 16), respectively. Taken together, these movement parameters suggest a more straight-line path movement (traveling) as opposed to a non-directional feeding type behavior. As all behaviors were pooled together for these general assessments, the more straight-line results are likely a factor of having more representative traveling type tracklines in the dataset (see sample size in the Behavior section below).

Table 8. Summary data for movement parameters of western gray whales during summer 2010.

N = 98	Mean	Median	Min	Max	SD
Leg Speed (km/h)	2.51	2.12	0.27	8.60	1.820
Reorientation Rate (°/min)	15.77	11.40	1.22	72.54	13.264
Acceleration (km/h^2)	0.00	0.01	-1.16	0.89	0.274
Linearity Index	0.85	0.94	0.06	1.00	0.193
Mean Vector Length	0.84	0.92	0.24	1.00	0.193
Ranging Index (m/min)	38.77	31.88	2.98	139.35	30.156
Distance from Shore (km)	1.11	1.00	0.02	3.61	0.677

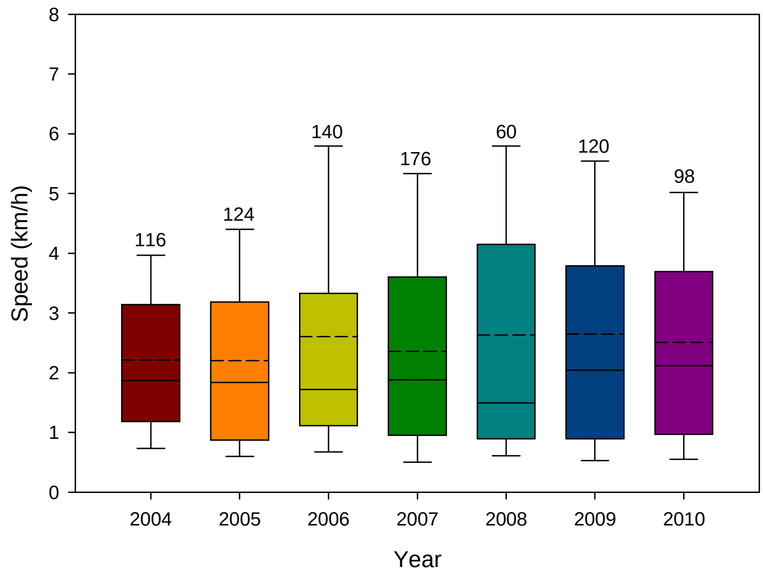

Figure 12. Leg Speed for all single or recognizable individual gray whales observed at six (2004-2005 and 2007-2010) to nine (2006) shore-based stations. For each box-plot the whiskers represent the 10th and 90th percentile, the box represents the 25th and 75th percentile, the solid bar represents the 50th percentile, and dashed bars represent mean values. The number above the 90th percentile whisker is the sample size.

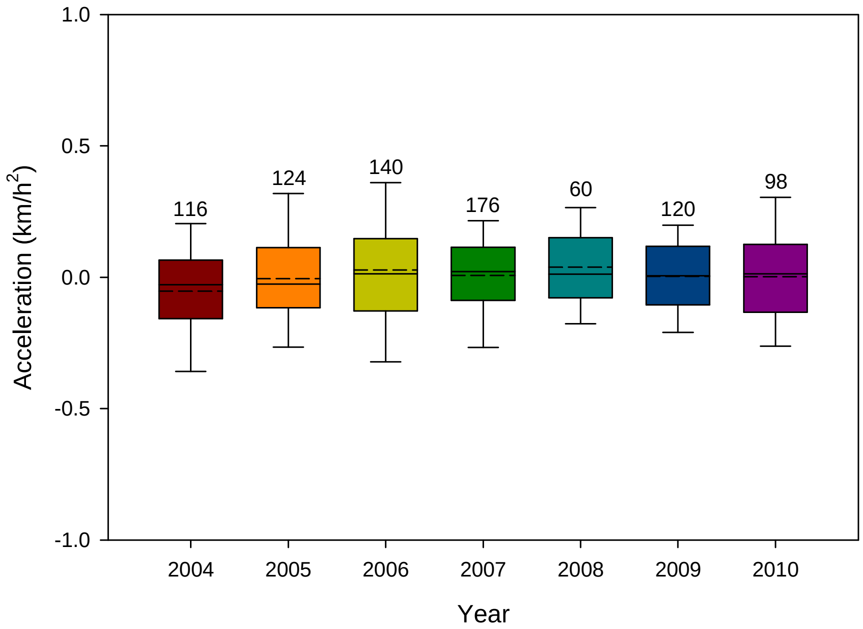

Figure 13. Acceleration for all single or recognizable individual gray whales observed at six (2004-2005 and 2007-2010) to nine (2006) shore-based stations. Negative values represent deceleration. Display as in Figure 12.

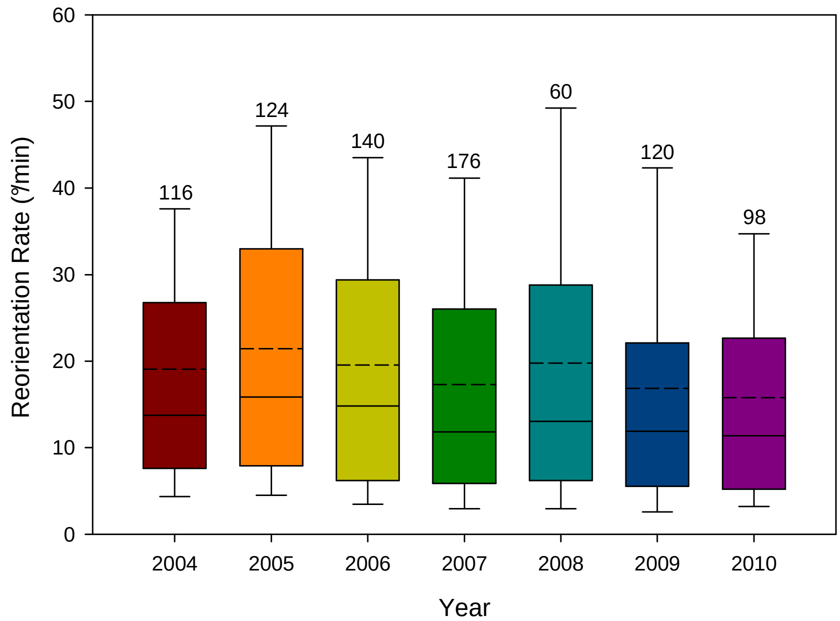

Figure 14. Reorientation rate for all single or recognizable individual gray whales observed at six (2004-2005 and 2007-2010) to nine (2006) shore-based stations. Display as in Figure 12.

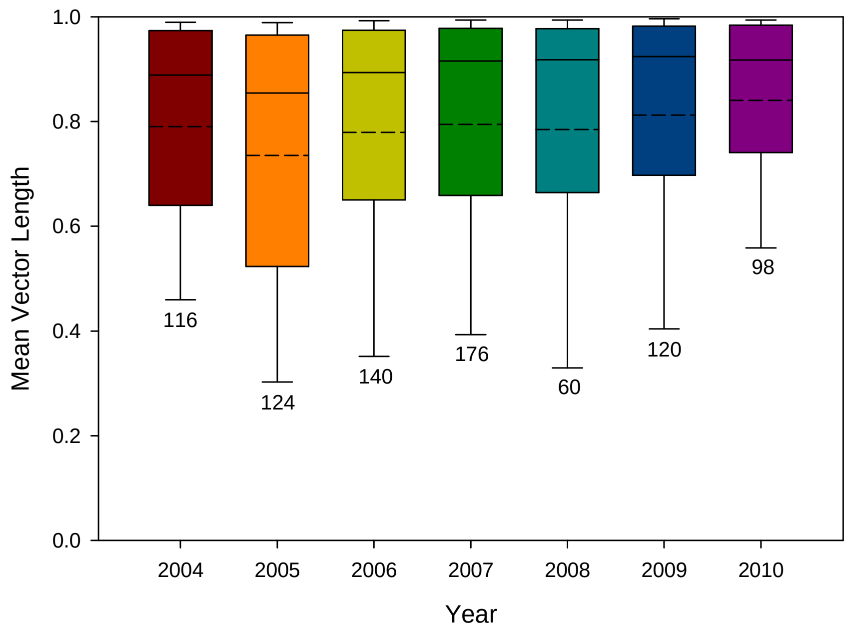

Figure 15. Mean vector length for all single or recognizable individual gray whales observed at six (2004-2005 and 2007-2010) to nine (2006) shore-based stations. Display as in Figure 12.

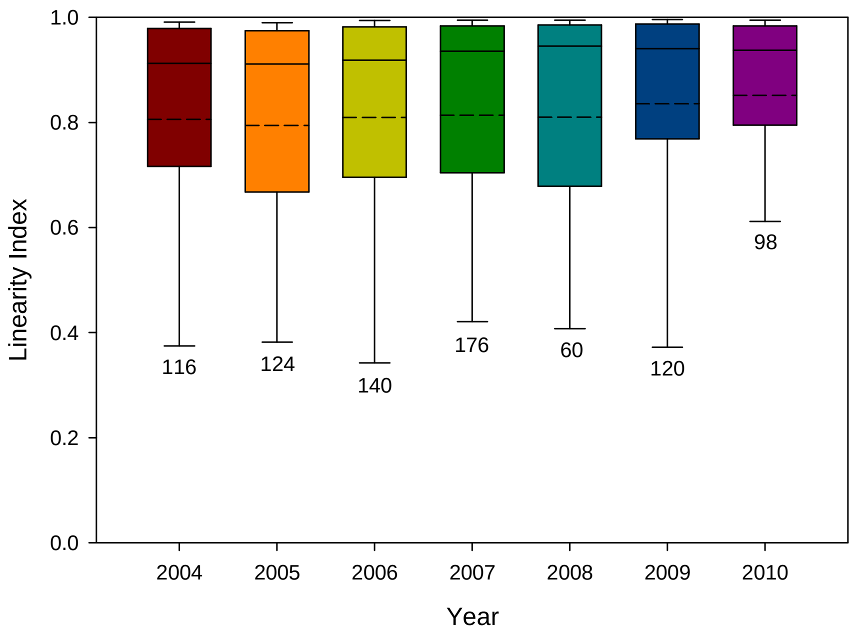

Figure 16. Linearity index for all single or recognizable individual gray whales observed at six (2004-2005 and 2007-2010) to nine (2006) shore-based stations. Display as in Figure 12.

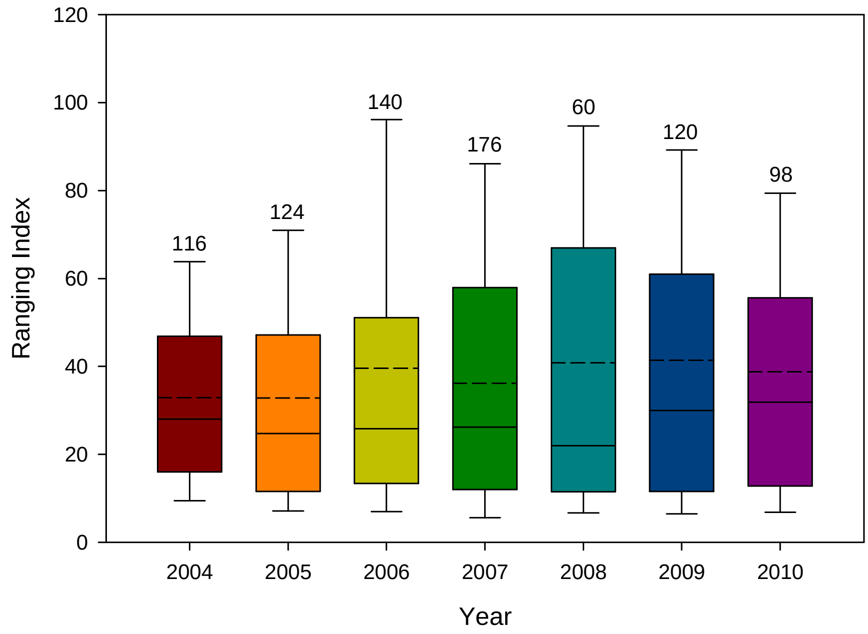

Figure 17. Ranging index for all single or recognizable individual gray whales observed at six (2004-2005 and 2007-2010) to nine (2006) shore-based stations. Display as in Figure 12.

4.4 FOCAL BEHAVIOR OBSERVATIONS

Focal follow observations were conducted to monitor behavioral events and respiration patterns of individual gray whales. A total of 67 focal sessions were conducted with 77 hrs of observation time from 7 August to 28 September 2010 (Table 9). The mean duration of a focal session lasted approximately 1.14 hours (range 0.2 – 5.8 hrs), with over 6,832 behavioral events being recorded. Approximately twice the focal follow sessions were collected in September (64%) compared to August (36%) (Table 10).

Table 9. Summary of focal behavior data gathered at six shore-based stations.

Station	# Focals	Mean Duration (hr)	Range (hr)
North Station	10	1.42	0.5 - 3.1
Odoptu Station	11	1.25	0.4 - 3.5
Station 07	11	1.58	0.3 - 5.8
2nd Station	12	0.68	0.3 - 1.1
1st Station	14	1.10	0.2 - 4.0
South Station	9	0.85	0.4 - 1.1
Total	67	1.14	0.2 - 5.8

Table 10. Summary of focal behavior data gathered during the months of August-September, 2010.

Month	# Focals	Mean Duration (hr)	Range (hr)
August	24	1.21	0.3 - 4.0
September	43	1.11	0.2 - 5.8
Total	67	1.14	0.2 - 5.8

While individuals were at the surface, the mean duration between subsequent respirations was 23 ± 10.3 SD seconds (Figure 18), with a mean of 4.3 ± 2.16 blows per surfacing (Figure 19). The individuals monitored remained at the surface for 1.3 ± 1.30 minutes and dove for a mean of 2.5 ± 1.04 minutes (Figure 18). The dive surface blow rate and surface blow rate were 1.1 ± 0.28 and 4.4 ± 1.80 blows per minute, respectively (Table 11 and Figure 19). The general surface-respiration-dive patterns observed in 2010 were similar to those observed in previous years.

Table 11. Summary statistics for surface-respiration-dive parameters of individual western gray whales.

N = 67	Mean	Median	Min	Max	SD
Blow Interval (min)	0.38	0.33	0.18	0.88	0.171
Blows/Surfacing	4.32	4.00	1.50	12.00	2.159
Surface Time (min)	1.33	1.00	0.18	7.12	1.297
Dive Time (min)	2.45	2.14	1.10	5.13	1.035
Surface Blow Rate	4.42	4.23	1.82	10.35	1.795
Dive-Surface Blow Rate	1.10	1.06	0.46	1.82	0.283

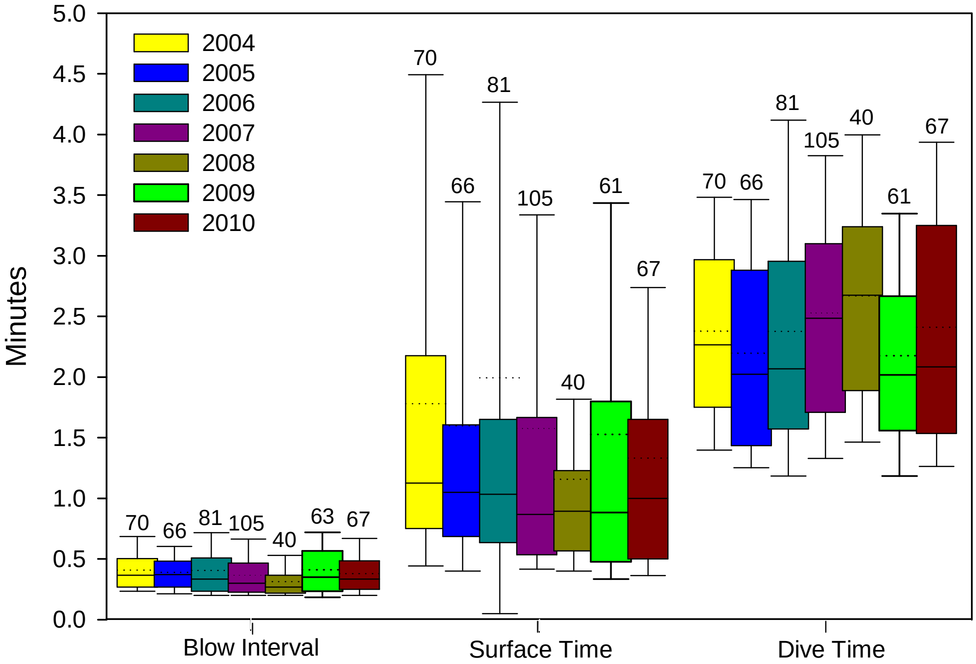

Figure 18. Blow interval, surface time, and dive time parameters of western gray whales. Display as in Figure 12.

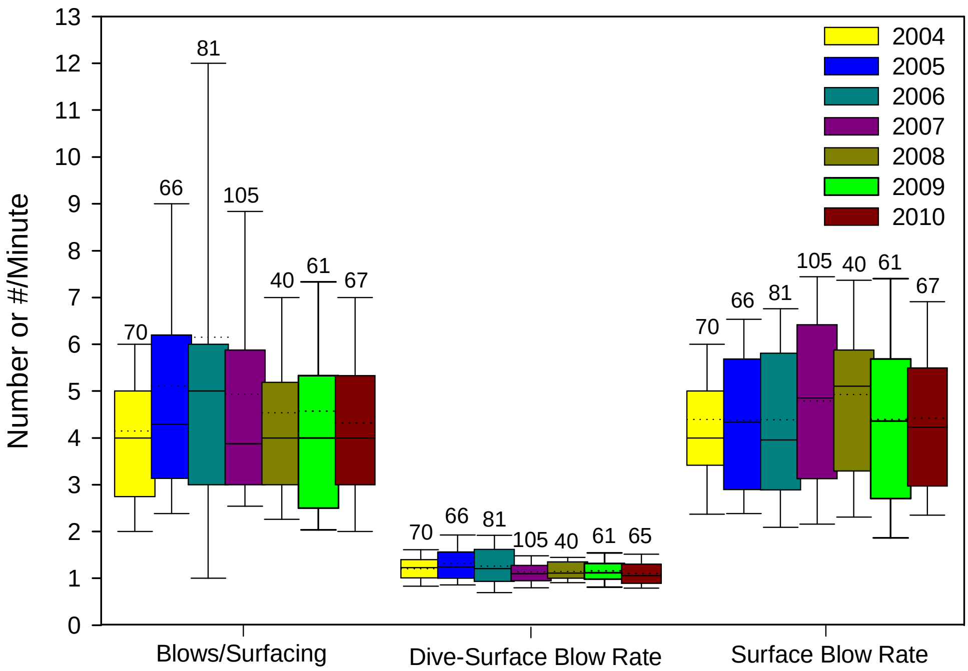

Figure 19. Number of blows per surfacing, dive-surface blow rate, and surface blow rate of western gray whales. Display as in Figure 12.

4.5 BEHAVIORAL STATES

Movement and respiration patterns depend on the activity of the animal. For example, traveling animals would likely have more directional movement and decreased dive time compared to a whale feeding in one localized area with non-directional movement and longer foraging dives. For each track or focal follow session, the general behavioral state of the whale was recorded. In 2010, there were three primary behavioral states observed: 1) Feeding – whale(s) generally remain in one localized area with non-directional movement and consistent periods of diving; 2) Feeding/Traveling – whale(s) swim in one general direction at relatively slow speeds with consistent periods of diving; and 3) Traveling – whale(s) swim in one general direction and often remain at the surface without consistent dives. Other behavioral states were observed, such as socializing, resting, and milling, however, there were too few occurrences to provide detailed analyses.

For the three primary behavioral states, western gray whales' ranging index ($F = 86.35$, $df = 2$, $P < 0.001$), linearity (39.78, 2, <0.001) and mean vector length (24.14, 2, <0.001) were found to be significantly different when comparing movement parameters among the behavioral states. Speed (107.23, 2, <0.001) and reorientation rates (141.02, 2, <0.001) significantly varied only between feeding and traveling, and feeding/traveling and traveling activities. When gray whales were traveling, they tend to have higher speeds, reorient directions less, with more directionality, and covering larger geographic ranges, compared to concentrated feeding and feeding/traveling activities.

Gray whales' respiration patterns were also found to be different among behavioral states. While gray whales were feeding, they had significantly longer dive durations (5.04, 2, 0.009) compared to traveling behavior. Surface-blow rates (7.73, 2, <0.001) and respiration interval (10.74, 2, <0.001) were also significantly different among the feeding states and that of traveling. However, there were no differences in respiration patterns between the two different "modes" of feeding (i.e. concentrated feeding in a localized area compared to directional persistence in feeding/traveling activity). Acceleration, distance from shore, surface time, number of blows per surfacing, and dive-surface blow rate were all non-significant among the three behavioral states (Table 12, - Figure 32).

Table 12. Movement and respiration variables of western gray whales during feeding, feeding/traveling, and traveling behavioral states. Post-hoc significance is denoted by F (Feeding), FT (Feeding/Traveling), and T (Traveling).

Variable	Feeding	Feeding/Traveling	Traveling	F (df = 2)	P	Post-hoc Significance
Speed (km/h)	0.9 ± 0.44 (27)	1.4 ± 0.83 (41)	3.6 ± 1.75 (69)	75.33	< 0.001	F-T, FT-T
Reorientation rate (/min)	27.5 ± 16.53 (27)	16.4 ± 8.73 (41)	9.4 ± 7.99 (69)	22.68	< 0.001	F-T, FT-T
Linearity Index	0.7 ± 0.22 (27)	0.9 ± 0.12 (41)	1.0 ± 0.10 (69)	39.78	< 0.001	F-T, FT-T, FT-F
Mean vector length	0.7 ± 0.25 (27)	0.8 ± 0.15 (41)	0.9 ± 0.13 (69)	24.14	< 0.001	F-T, FT-T, FT-F
Ranging index (m/min)	11.1 ± 6.28 (27)	20.1 ± 13.61 (41)	57.5 ± 29.27 (69)	86.35	< 0.001	F-T, FT-T, FT-F
Distance to shore	1.0 ± 0.64 (27)	1.1 ± 0.64 (41)	1.1 ± 0.70 (69)	0.35	0.700	
Acceleration (km/h)	0.0 ± 0.13 (27)	0.0 ± 0.19 (41)	0.0 ± 0.31 (69)	0.11	0.891	
Respiration Interval (min)	0.3 ± 0.11 (16)	0.3 ± 0.15 (26)	0.4 ± 0.17 (44)	10.74	< 0.001	F-T, FT-T
Surface Time (min)	1.4 ± 1.64 (16)	1.2 ± 1.47 (26)	1.3 ± 1.07 (44)	0.44	0.643	
Dive Time (min)	2.9 ± 0.92 (15)	2.5 ± 0.85 (26)	2.1 ± 0.96 (44)	5.04	0.009	F-T
Blows/Surfacing	4.8 ± 2.22 (16)	4.4 ± 2.19 (26)	4.1 ± 2.02 (44)	1.00	0.372	
Surface blow rate	5.2 ± 1.87 (16)	5.2 ± 1.91 (26)	3.8 ± 1.30 (44)	7.73	< 0.001	F-T, FT-T
Dive-surface blow rate	1.1 ± 0.21 (15)	1.2 ± 0.37 (26)	1.1 ± 0.28 (43)	0.02	0.757	

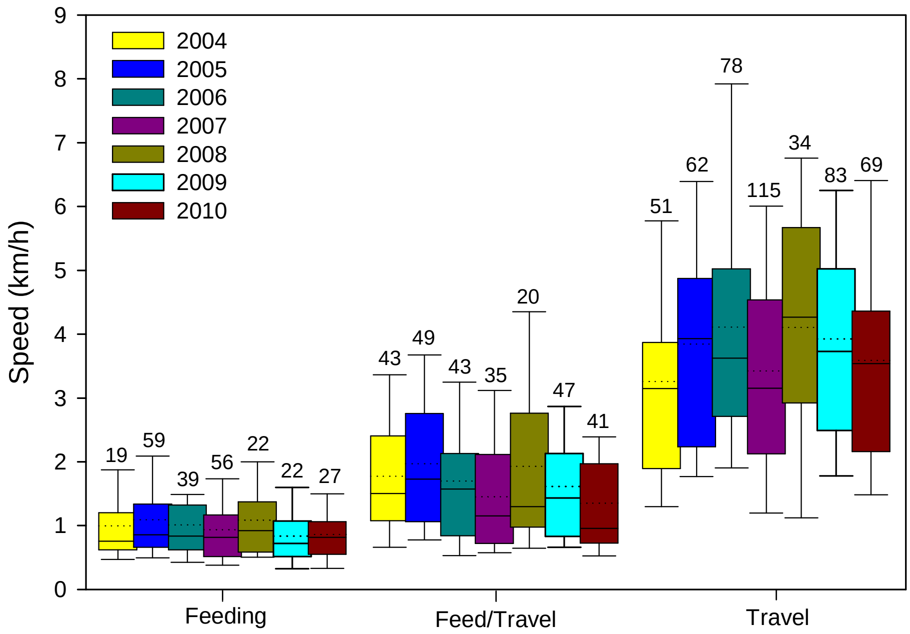

Figure 20. Speed of western gray whales during three behavioral states. Display as in Figure 12.

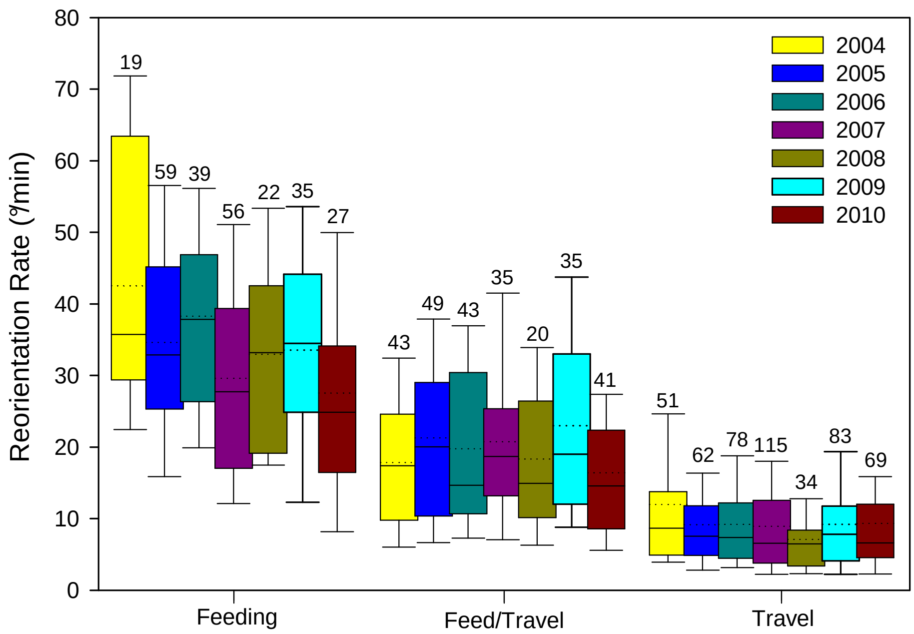

Figure 21. Reorientation rate of western gray whales during three behavioral states. Display as in Figure 12.

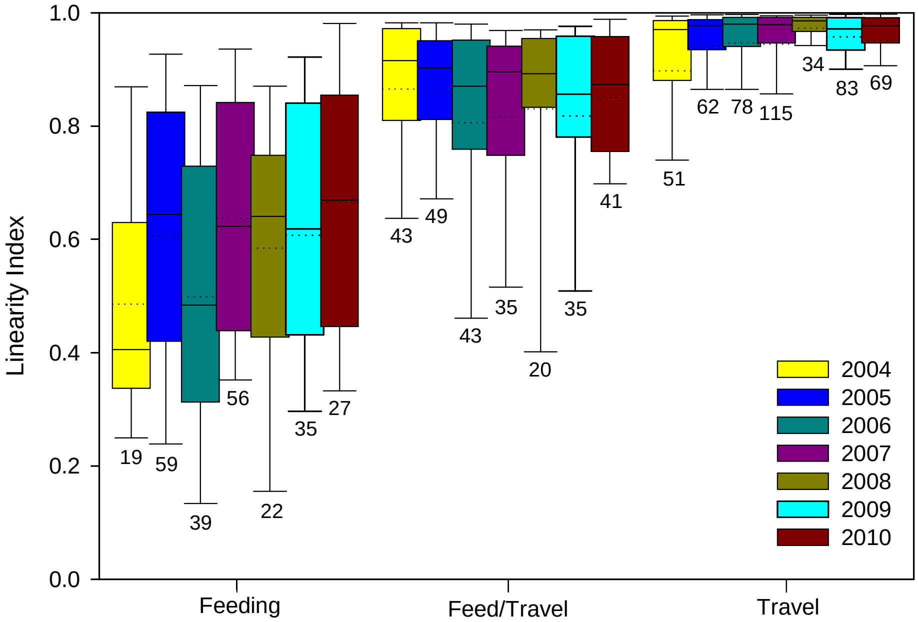

Figure 22. Linearity index of western gray whales during three behavioral states. Display as in Figure 12.

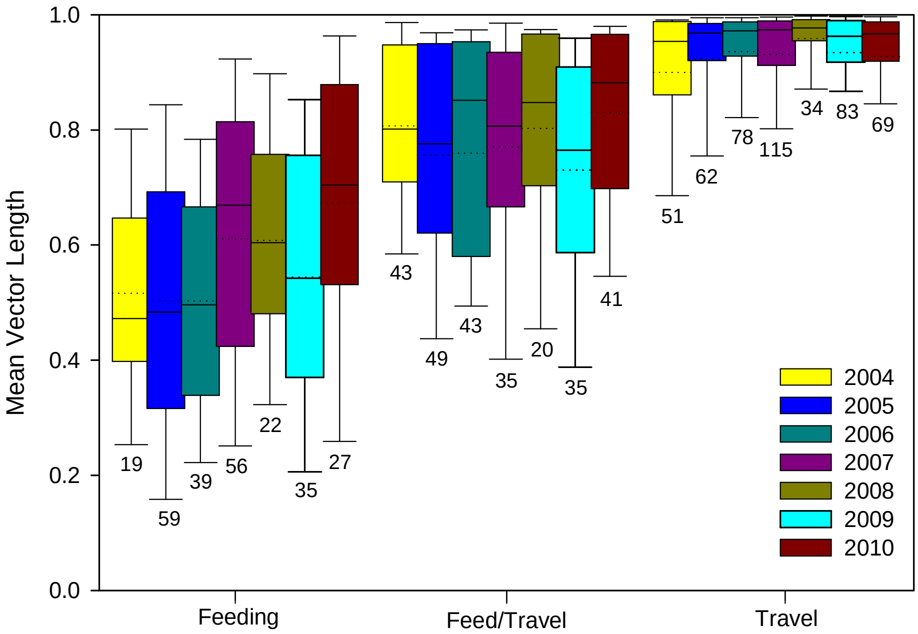

Figure 23. Mean vector length of western gray whales during three behavioral states. Display as in Figure 12.

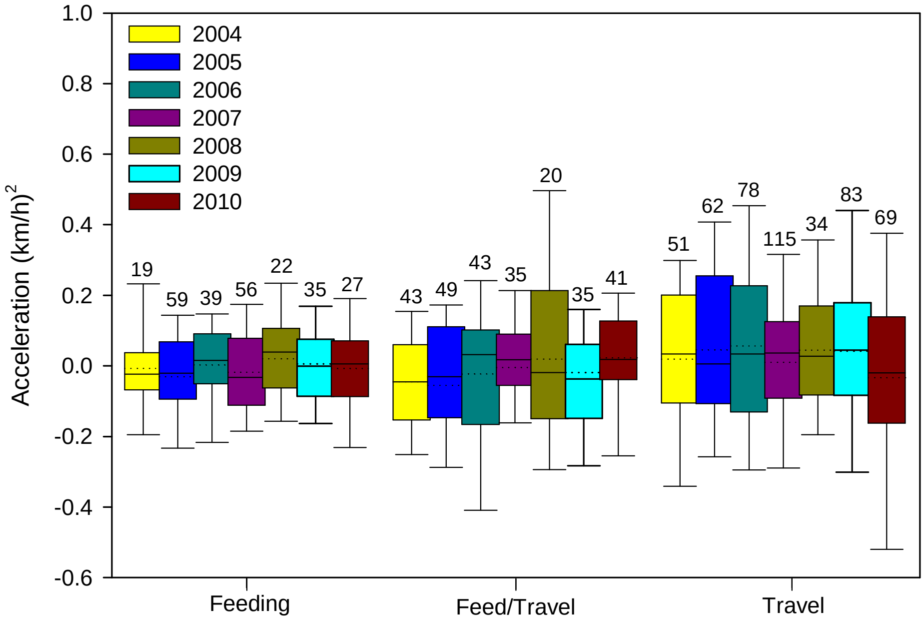

Figure 24. Acceleration of western gray whales during three behavioral states. Display as in Figure 12.

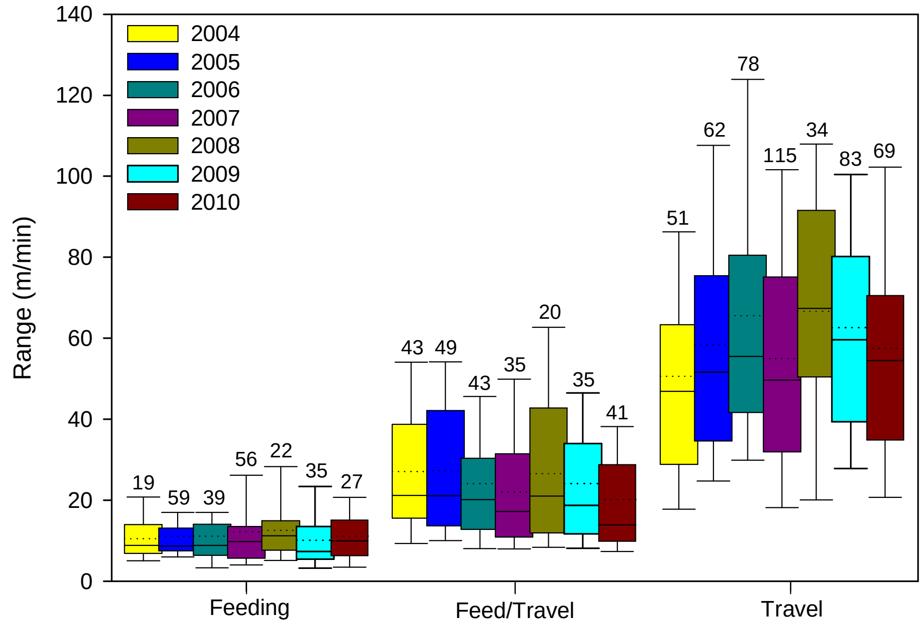

Figure 25. Ranging index of western gray whales during three behavioral states. Display as in Figure 12.

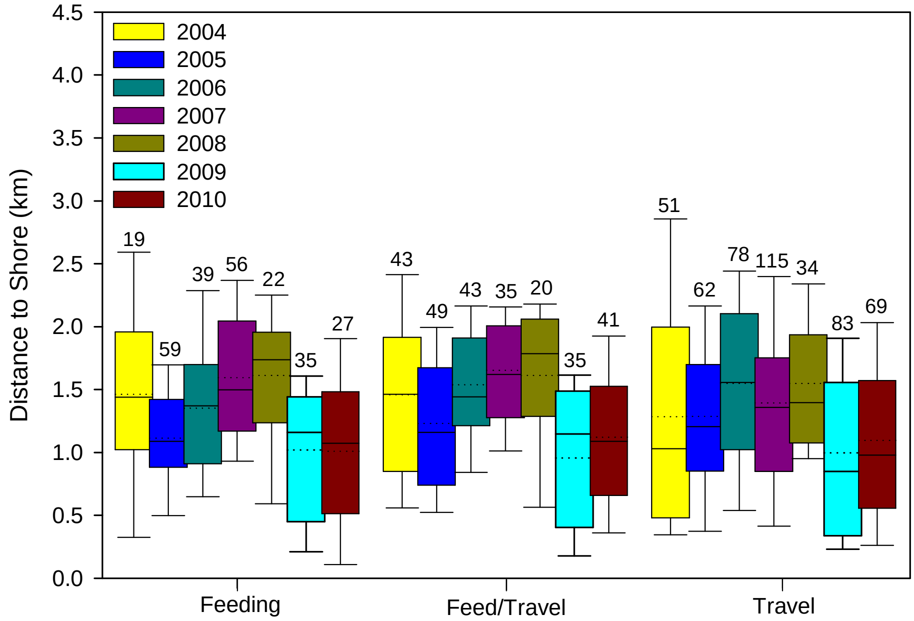

Figure 26. Distance to shore of western gray whales during three behavioral states. Display as in Figure 12.

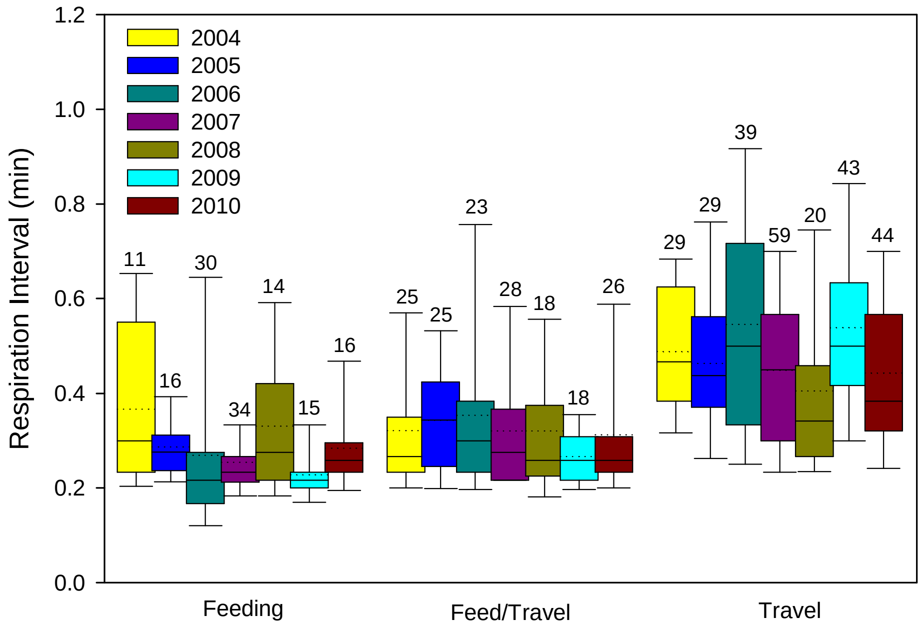

Figure 27. Respiration interval of western gray whales during three behavioral states. Display as in Figure 12.

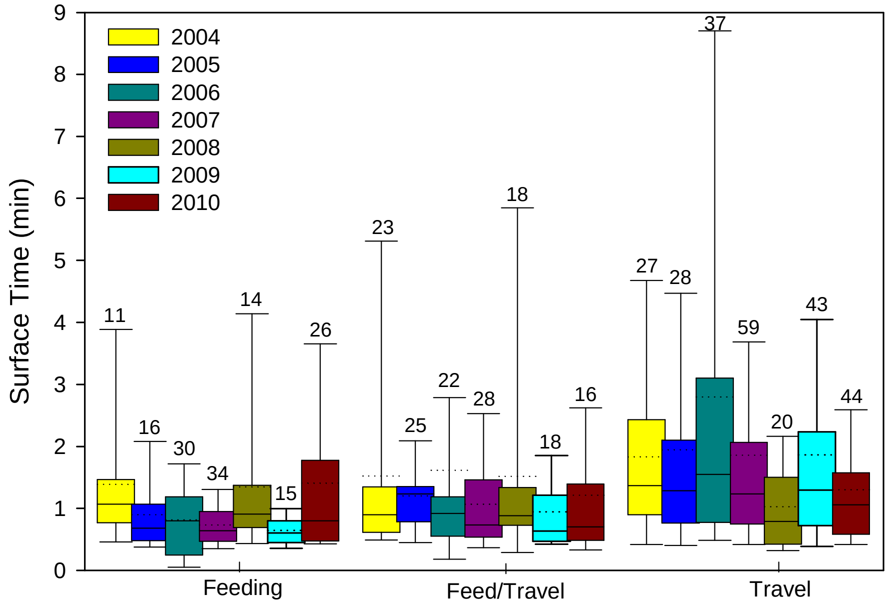

Figure 28. Surface time of western gray whales during three behavioral states. Display as in Figure 12.

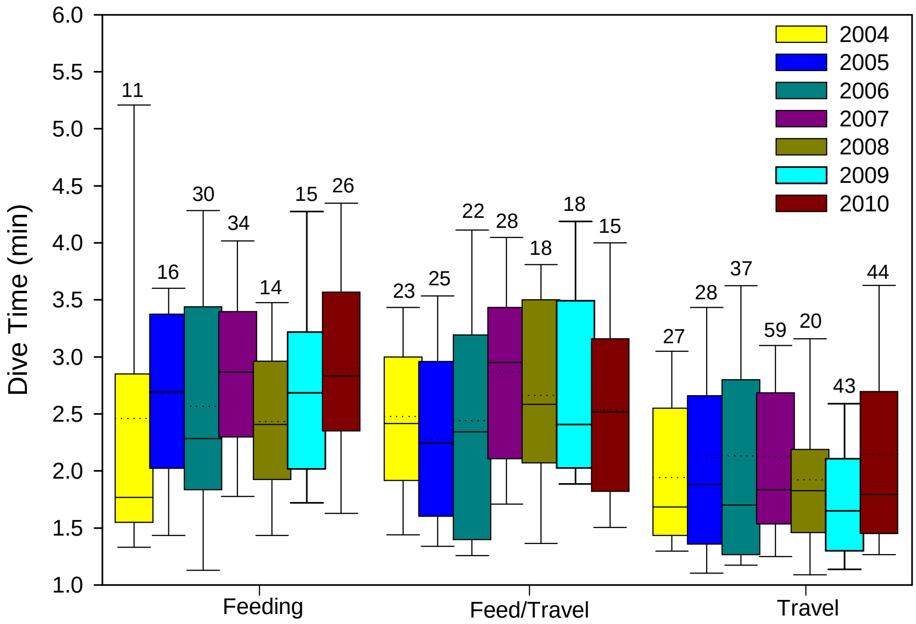

Figure 29. Dive time of western gray whales during three behavioral states. Display as in Figure 12.

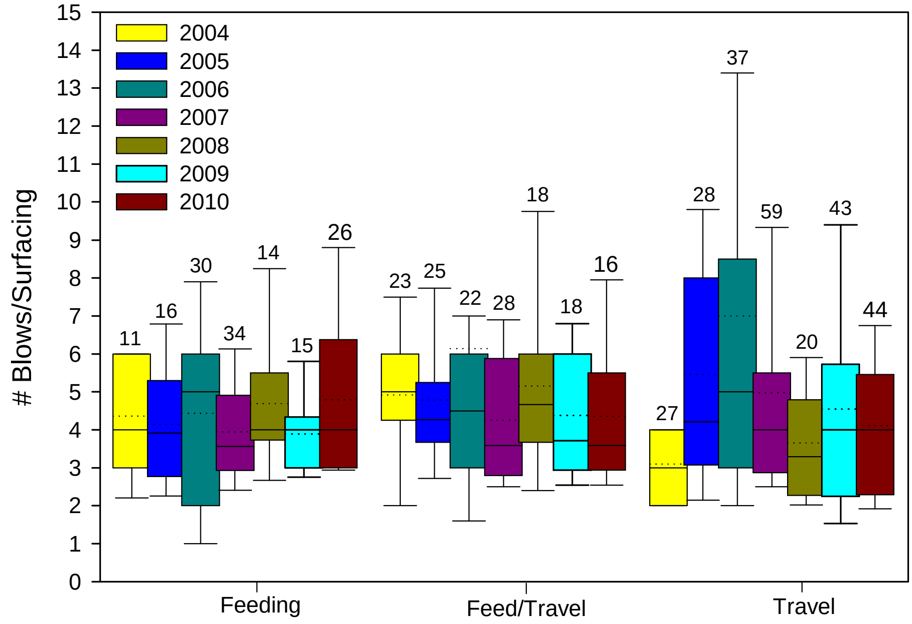

Figure 30. Number of blows per surfacing of western gray whales during three behavioral states. Display as in Figure 12.

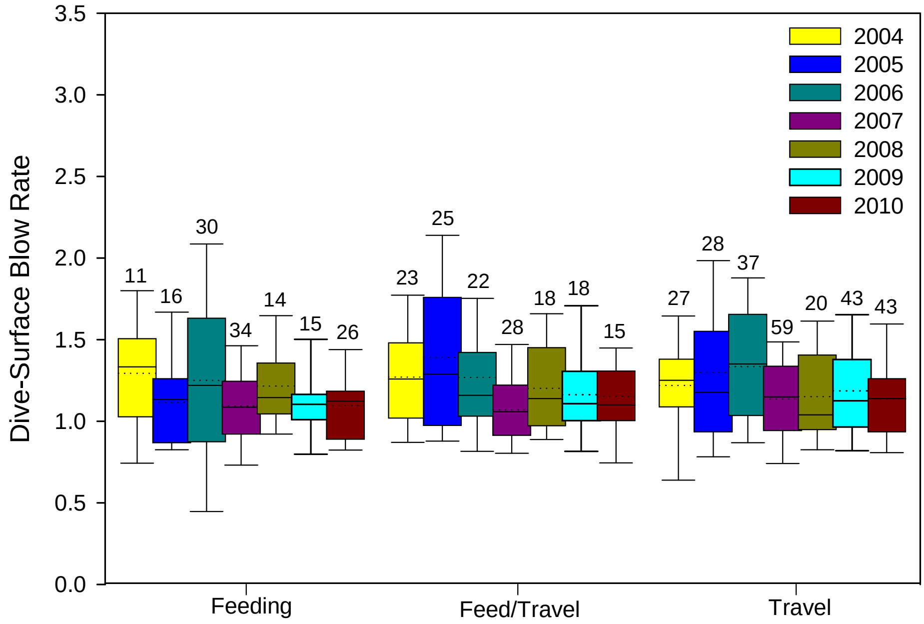

Figure 31. Dive-surface blow rate of western gray whales during three behavioral states. Display as in Figure 12.

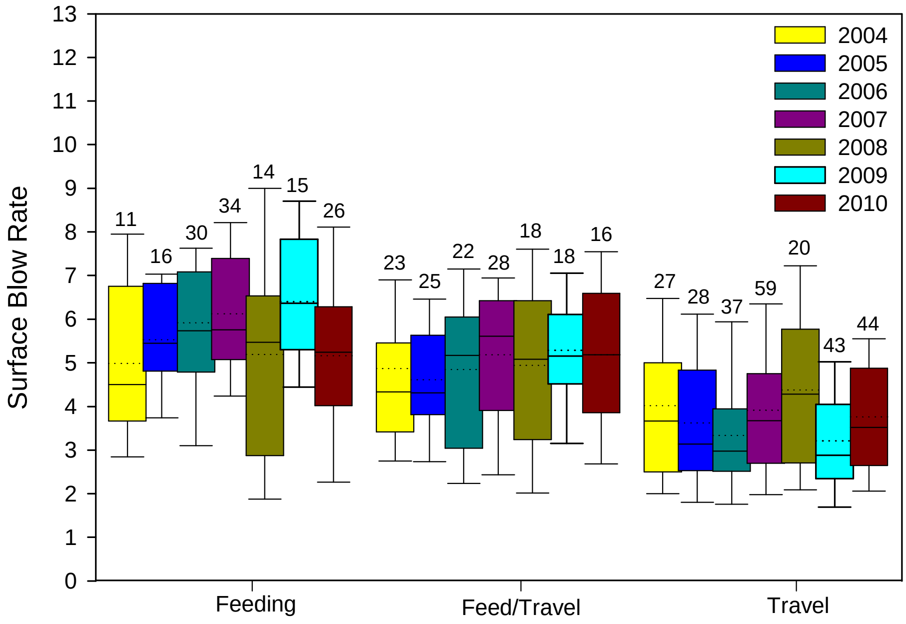

Figure 32. Surface blow rate of western gray whales during three behavioral states. Display as in Figure 12.

The “displacement” (i.e. geographic movement from an initial observation) analysis indicated significant differences in movement for the three behavioral states. After 20 "steps" of movement (i.e. 30 minutes in duration), individuals displaced 0.03 km^2 (95% confidence interval: 0.02 – 0.04 km^2), 0.38 km^2 (0.22 – 0.54 km^2), and 2.55 km^2 (2.04 – 3.12 km^2) while they were feeding, feeding/traveling, and traveling, respectively (Figure 33). In 2010, the displacement values for whales feeding and feeding/traveling were within the same confidence intervals observed in 2002-2009. Displacement values while traveling were comparable to those observed in 2006-2009, but significantly higher compared to earlier observations (2002-2005).

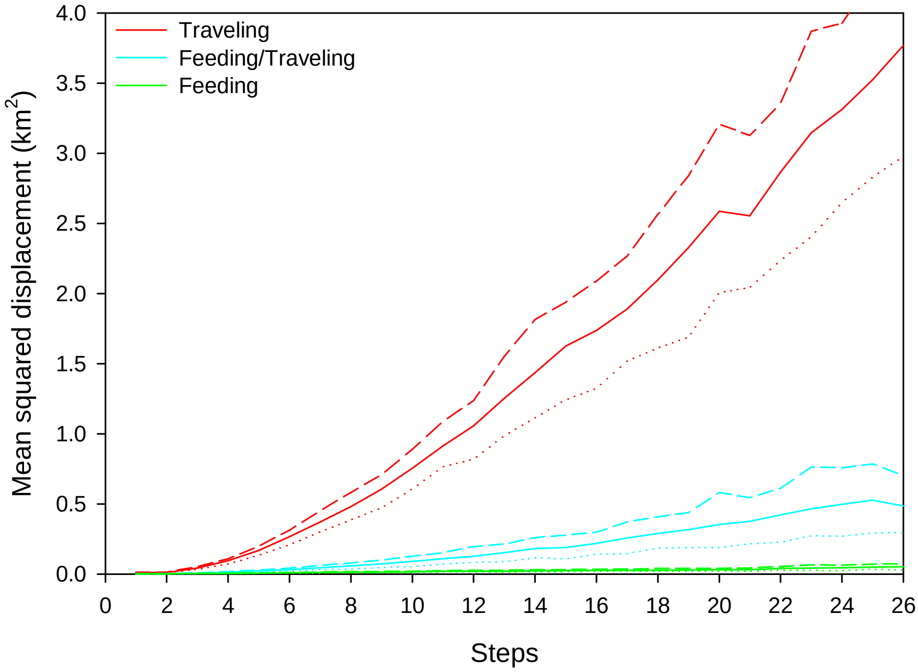

Figure 33. Mean squared displacement of western gray whales in 2010 during three behavioral states. The upper and lower 95% confidence intervals are represented by dashed and dotted lines, respectively.

4.5.1 Distribution of Behavioral Activity

Figure 34 illustrates areas of feeding, feeding/traveling, and traveling activities observed in the study area. Feeding behavior varied within the study area ranging from little feeding to concentrated feeding in a "patchy" distribution. Gray whales were observed to be primarily feeding in the regions near 1st, 2nd and North stations. Less concentrated feeding occurred near Odoptu Station and Station 07, and the least feeding was observed at South Station. Some of the areas of feeding activity were observed to be continually utilized throughout the feeding season, while other feeding areas appeared to be utilized on a shorter temporal basis (Figure 35). For example, the feeding "patches" observed off North, 07, and 2nd stations were utilized more in September than in August. In fact, the “patches” off North and 07 stations increased at least twice in size in September compared to earlier in the feeding season (August). There were more feeding regions off 1st Station with more scattered “patches” in September compared to one large “patch” in August. It should be noted that the distributional behavioral activity presented here are not likely to represent continuous coverage for the entire coastal observation range and therefore there may be gaps of information, especially for areas between stations as sampling and identifying behavior is more difficult with increasing distances from the observation platform.

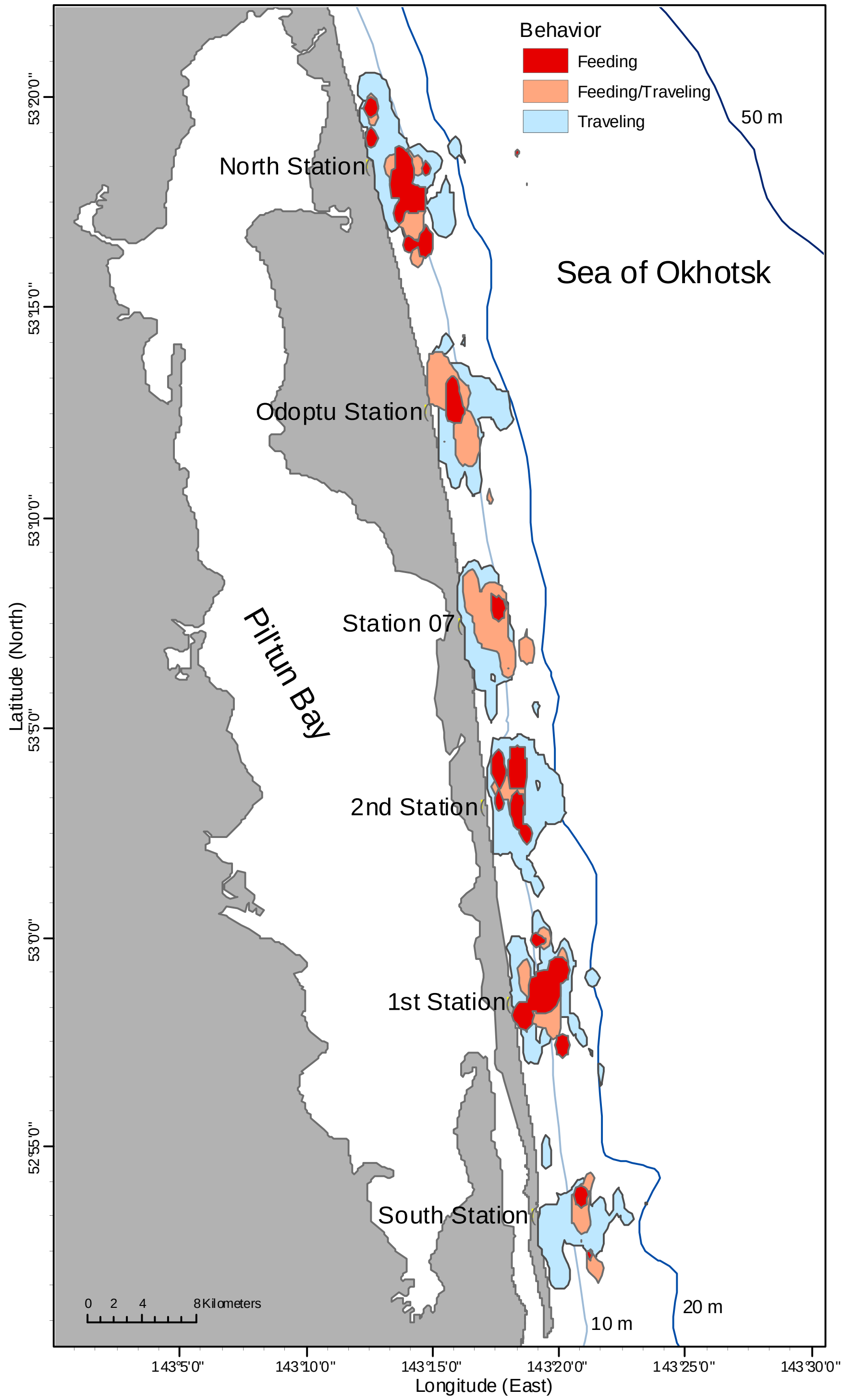

Figure 34. Feeding, Feeding/Traveling and Traveling tracklines of western gray whales in the Piltun feeding area from August - September 2010. Contours represent the 95% kernel density probability.

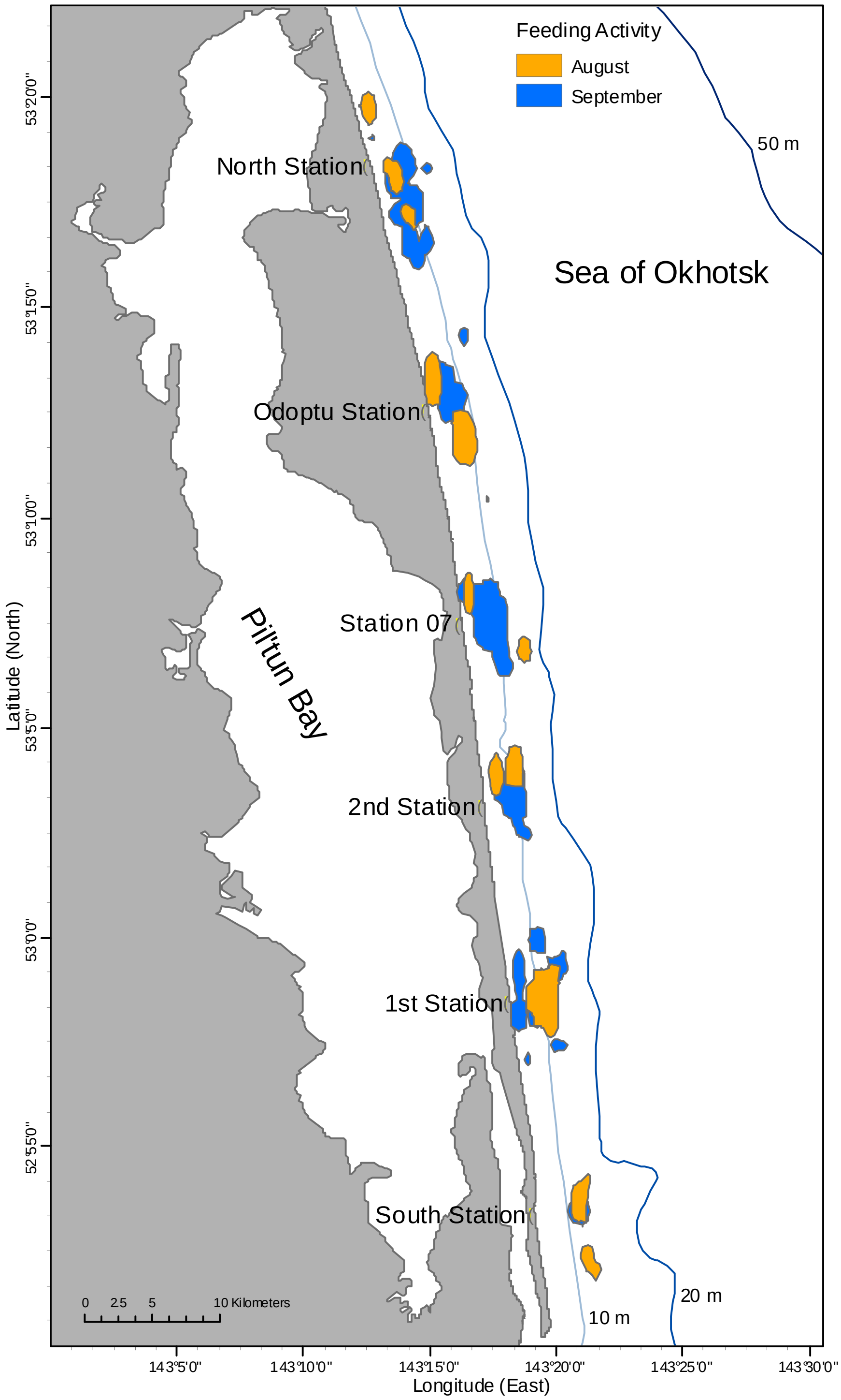

Figure 35. Feeding activity (feeding + feeding/traveling behavioral states) observed for western gray whales in the nearshore Piltun feeding area during August and September 2010. Contours represent the 95% kernel density probability.

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4.5.2 Social Activity

Western gray whales have been observed to engage in social bouts each feeding season. Socializing behavior has been more frequently observed during the latter part of their feeding season (late-August through September). This may be indicative of successful feeding as animals engage in more energetic activities. During each of these occasions, the animals' behavior and movements were similar. There were periods of surface-activity with flukes, pectorals, heads, and other parts of an animal's body above the surface of the water, and periods of apparent "chasing", when one animal rapidly moved away from the group, and the rest of the social group then "chased" this animal. Once the other individuals "caught up" with the individual that moved away, the surface activity continued and similar active events were repeated.

A total of four occasions of social activity were observed in 2010. The first social activity was sighted on 8 September at Odoptu Station. A group of three gray whales was tracked for 40 minutes. They were initially observed traveling, then socializing, and proceeded to traveling again at 1.3 – 1.7 km from shore. On 14 September, two groups of gray whales were observed engaged in social activity at 1st Station. The first group consisted of four individuals socializing and partially feeding for 20 minutes at 1.5 km from shore, after which they continued traveling for another 20 minutes of observation. Three hours later, a second group (4-5 individuals) was observed displaying social behavior. Some of these individuals may have been from the first socializing group observed earlier that day. The second group was tracked for approximately two hours primarily feeding and feeding/traveling, and observed socializing for 20 minutes at 2.7 km from shore towards the end of the observation period. The last sighting of social activity occurred on 15 September at 2nd Station. Three to four individuals were feeding, which turned into social behavior lasting for 50 minutes at 2 – 3 km from shore, after which whales switched back to feeding. During two of the four socializing behavior occasions, sexual-social activity was observed with a penis at the surface. These two occasions were on 8 and 15 September.

4.6 KILLER WHALES

Five groups of killer whales (two in August and three in September) were sighted in the study area during the 2010 field season. The first group consisted of two killer whales that were sighted during a scan on 9 August at 2nd Station. The group was approximately 1.8 km from shore. The minimal distance of this group to gray whales observed in the area was 1.2 km. This gray whale group had three gray whales (including mother/calf pair) that was observed traveling and feeding/traveling north. The second killer whale sighting occurred on 26 August at Station 07. A single killer whale was sighted during a scan at 4 km from shore with the closest approach of 1.8 km to a gray whale from the same scan. On 12 September at North Station, a group of four to five killer whales were sighted during a scan. This killer whale group was tracked for 10 minutes and observed traveling north within 0.2 km from shore. The minimal distance between these killer whales and a gray whale tracked during the same time was 1.6 km. However, it is highly probable that the distance could be much less before the track, as killer whales were first observed in front of the station, while the gray whale was south of the station. On 13 September at South Station, a single killer whale was observed during a scan at 0.7 km from shore. No gray whales were recorded during this scan; however, theodolite tracking was conducted on an individual gray whale that was within 3.1 km from the killer whale. The final killer whale sighting occurred on 19 September at North Station. A single adult male was observed during a scan at approximately 4.4 km from shore with the closest approach to a gray whale was 3.7 km. For each of the above observations, gray whales were not noted to change their behavior due to the presence of killer whales

4.7 DISCUSSION

The 2010 western gray whale feeding season had a significant amount of anthropogenic activity both near and within their feeding grounds. From early June through early July, Sakhalin Energy Investment Company conducted a 4-D Seismic survey in the Piltun-Astokh (PA-A) exploration field. This survey area was slightly offshore of the nearshore (Piltun) feeding grounds. The seismic activity from this survey produced sound levels above 163 dB re 1 µPa within the known nearshore feeding habitat for a portion of the survey. At these relatively high sound exposure levels, gray whales have been previously noted to behaviorally respond (Gailey *et al.* 2007c, Malme 1986, 1988). As such, mitigation and monitoring plans were developed to minimize potential impacts on western gray whale distribution and behavior (see Seismic Task Force-6 2010 for review). These data have currently not been analyzed but apparent behavioral reactions to the survey were recorded (Seismic Task Force-6 2010).

A more concerning activity occurred later in the feeding season. During August-November 2010. Rosneft-Shelf-Far East conducted another seismic exploration survey of their Lebedinskoye oil and gas field that is located within the northern portion of the study (feeding) area presented. The seismic activity consisted of both onshore and nearshore marine activities (generally less than 20 m water depth). Several vessels of various types and sizes were utilized during these seismic exploration operations. At least two vessels were constantly present in the area and were observed within close proximity to the shore (within 1 km). The vessels moved mainly within the area off this study's Odoptu Station. The seismic vessel initially arrived to the feeding area on 11 August and seismic exploration was planned until 20 November. Further details on sound exposure levels, mitigation/monitoring measures employed, and overall operational activities are currently unknown.

A third seismic survey reportedly occurred near the western gray whale offshore feeding area. This survey was observed to occur from 15 August to 7 September. Again, details on sound exposure levels, mitigation/monitoring measures employed, and overall operational activities are currently unknown.

The three seismic exploration activities that occurred during the 2010 western gray whale feeding season could have had different impacts to western gray whales regardless of the level of sound exposure. Nearshore feeding gray whales may be more habituated or at least more familiar to sound exposure from an offshore source, but a sound source within the feeding grounds could have an entirely different effect. Seismic activity in the feeding grounds is rather uncommon and may inhibit whales movement and access to other parts of the feeding grounds. Western gray whales typically travel parallel to the coast and a sound source directly in the feeding area would likely have increasing exposure as the whale approaches the source. The location of the seismic sound source could be an important aspect for gray whales. In fact, Tyack and Clark (1998) found that migrating eastern gray whales avoided a low frequency acoustic sound source when it was located directly in their migratory path, but no avoidance behavior when the exact same sound source was placed offshore of the migration corridor. In addition, the cumulative effects of all seismic survey activities could have the potential to lead to population level consequences.

To date, little is known about the impacts sound and other anthropogenic activities may have on western gray whales. Behavioral studies conducted along the NE Sakhalin coast since 2001 have produced more insight into potential impacts oil and gas operations and other activities may have had on gray whales. For example, vessel activity has been noted to significantly alter gray whales movement patterns while vessels were in close proximity, usually less than 500 m (Gailey *et al.* 2007a). Seismic exploration, characterized by pulsed sounds, has been recorded to have had elicited several behavioral responses monitored during an Exxon-Neftgas seismic survey in 2001. However, construction activities with more continuous sounds, such as the installation of a Concrete Gravity Based Structure in 2005 and dredging and pipeline construction activity in 2006 demonstrated to have elicited relatively minor behavioral changes compared to pulsed (seismic/pile-driving) activity (Gailey *et al.* 2007b, 2010).

This report does not encapsulate the anthropogenic activity that occurred in 2010 neither prior to the onset of the study nor during. The 2010 results presented here provide mean values based on the entire field season and do not intend to identify specific activities that could have had an affect on individuals or the population. We present this summary as a fundamental overview of the field season and compare the general mean values collected in 2010 to those collected in previous feeding seasons with the caveat that industrial activity and other natural factors have not been taken into account.

The 2010 behavioral studies on western gray whales were conducted with reduced overall research effort compared to previous field seasons since only one behavioral team was in the field conducting research per good weather day. Since 2004, two behavioral teams were deployed to provide adequate sample sizes and longer tracks on individual gray whales while covering a larger geographic area. However, despite the team reduction, the 2010 behavioral program was highly successful in the amount of data collected during the field season. In fact, the sample sizes obtained were comparable to previous years when two teams conducted research. This was likely due to a combination of better weather conditions, abundance of whales, and increased observation duration per good weather day. However, sampling frequency per station decreased in 2010 compared to previous years as one team could only traverse the six observation stations in six good weather days as opposed the previous three good weather days with two teams. The decreased sampling frequency could have affected detection of smaller shifts in abundance and/or responses to certain activities that occurred in the study area.

As noted in Photo-ID studies (Chapter X), it appears that the majority of the known population of western gray whales returned to the nearshore feeding grounds off the northeastern portion of Sakhalin Island, Russia in 2010. One exceptional year was 2008, when there was a notable decline (~1/3 reduction) in the number of individual gray whales returning to the feeding grounds off of the northeastern coast of Sakhalin Island (Gailey *et al.* 2009, Vladimirov *et al.* 2009, Yakovlev and Tyurneva 2009). Since 2004, an increasing amount of research effort has been conducted to identify gray whales off the southern coast of the Kamchatka peninsula. In 2008, there was a corresponding increase (25 individuals) in the number of gray whales sighted off of Kamchatka that have also been sighted off the Sakhalin coast in previous years (Yakovlev and Tyurneva 2009). The Kamchatka region is approximately 1000 km to the east of Sakhalin Island and may represent an alternative summer feeding ground for western gray whales. The population may have historically used the Kamchatka Peninsula and other unknown feeding habitats in the past or some individuals may preferentially forage there on some temporal basis every year.

It remains unclear why a decreased percentage of the western gray whale population did not inhabit the feeding grounds off Northeastern Sakhalin Island in 2008 compared to the number of individuals that were identified in 1997-2007 and those observed in 2009-2010. Amphipod biomass, one of the prey items of gray whales, in the nearshore coastal waters off of Sakhalin has changed significantly in recent years with higher concentrations in 2002-2004 and notable decreases in 2005 and, especially, 2006 (Chapter 4). Amphipod biomass increased in 2007-2009 compared to 2006, but concentrations were generally lower than those observed in 2002-2004 (Chapter 4). These changes in benthic food resources could be one explanation for the decreased number of whales observed in 2008. Prey abundance may have been particularly high or comparable off of other areas, such as Kamchatka, and therefore certain individuals remained there for that feeding season or whales could have been searching other regions for an alternative feeding source. Another plausible explanation for the lower number of whales in Sakhalin waters could be related to potential avoidance of the area as a result of continual anthropogenic activity. From 2005-2007, there have been a number of human-related activities in relation to oil and gas development, such as CGBS installation (late July-Sept 2005), pipeline construction (mid-June - Sept 2006), topside installation (late-June - mid-July 2007), and seismic operations (Aug - Sept 2007). The continual and cumulative impacts of such activity is one plausible explanation for the lower number of whales observed off of Sakhalin in 2008. Such relationships have been noted in the past for the eastern gray whale population where gray whales abandoned preferential breeding lagoons as a result of increasing levels of anthropogenic activity (Gard 1974, Bryant *et al.* 1984). However, the overall number of western gray whales returning to the Sakhalin feeding grounds increased in 2009 and 2010 compared to that of 2008, but were similar in numbers to previous years (Chapters 2, 3, and 5). Therefore, there does not appear to be a continual decreasing use of the feeding grounds off Sakhalin.

With the exception of the lower number of whales observed in 2008, there has been a relatively constant annual use of the nearshore feeding area. The rationale for such site fidelity to a small geographic area could be for historic reasons, exceptional high concentrations of prey (Chapter 4), and/or stability or consistency in prey abundance compared to other potential feeding areas. Similar site fidelity to preferential feeding areas (albeit larger geographic areas) has been reported for gray whales of the eastern population (for example, Pike 1962, Hatler and Darling 1974, Würsig *et al.* 1986, Dunham and Duffus 2002, Jones and Swartz 2009).

It is currently unknown where western gray whales occur beyond their summer-fall feeding season. However, a satellite tagging study was initiated in 2010 to provide essential information on migration routes and potential breeding grounds of this population. The 2010 tagging study tagged one male western gray whale that was noted as a calf in 1997 and typically sighted each year in the nearshore feeding grounds off Sakhalin Island. This individual, dubbed 'Flex', was tracked over 7500 kilometers from the Sakhalin feeding grounds east to Kamchatka, across the Pacific Ocean, and on to the Oregon coast (Mate *et al.* 2010). The satellite tag stopped transmitting off the Oregon coast, but it is presumed that this individual continued south, potentially to the eastern gray whale breeding grounds in/near the lagoons of Baja California. This new information suggests there is some degree of mixing between the eastern and western gray whale populations. Recent photographic matching between the eastern and western population provided additional sightings of 'Flex'. He was observed in April 2008 off Vancouver Island, British Columbia. The same individual was sighted in the summer of that same year off Sakhalin Island (Weller 2011). Recent genetic analyses also support the theory that at least some mixing occurs between the two populations (Lang 2010), but the extent of this mixing is currently unknown. It is also unknown how representative the current information is in regards to the overall migration routes and breeding grounds of the western gray whale population, particularly those of reproductive females. For example, five female western gray whales were incidentally fatally entangled in set nets off Japan, while the tracked individual was not observed to migrate near that region (Weller *et al.* 2008).

The western gray whales are an important component of the ecological community in the northeast Sakhalin feeding grounds. Their unique method of bottom feeding disrupts benthic communities and suspends sediments. Benthic communities can be dominated by dense mats of amphipod species, a predominate prey item for gray whales. Other scavenger species, such as lysianassid amphipods, have been observed in higher abundances in recent feeding “pits” of gray whales than surrounding (non-feeding pit) areas (Oliver and Slattery 1985). Increased organic material is usually left in a feeding pit weeks to months after the feeding, which stimulates recolonization. It is also known that grazers, such as gray whales, may prevent domination by a single species, such as amphipods or sand lance, and thus increase the biodiversity in the region (Botkin and Keller 2003). In addition, surface feeding and diving sea birds have been associated with feeding gray whale activity and may annually depend on gray whale feeding (Grebmeier and Harrison 1992). As a result of their feeding, gray whales affect the ecology in a dynamic way upon which many other species depend.

Western gray whales have demonstrated a considerable amount of intra and inter-year variability in their utilization of feeding habitat. Early observations of abundance and distribution indicated extensive use of the feeding area near the mouth of the lagoon as well as higher abundance of whales in the offshore feeding area (Weller *et al.* 1999, Johnson *et al.* 2007), although some of these early observations may have been influenced by a seismic survey (Yazvenko 2007). In 2002-2004, more gray whales were observed in the northern part of the study area compared to those regions at the mouth of the lagoon. This northerly-occurring trend continued for three years. Since 2005, there has been a notable decline in whale abundance in the northern region with a corresponding increase in abundance at the mouth of the lagoon. In 2009, this pattern of few whales in the northern portion and higher abundance in the southern portion of the study area continued. However, the central part of the study area typically has had less drastic fluctuations in abundance compared to the northern and southern parts of the nearshore feeding habitat studied here (Table 13).

In 2010, this pattern of higher southern (lower northern) abundance of whales was initially observed to continue, but, as the field season progressed, fewer whales were observed in the southern regions. The northern regions had particularly high abundance of whales in September. There was an apparent intra-seasonal shift in habitat use during the 2010 feeding season. This could have been a result of over-utilization of the southern habitat in the past few years, while the northern habitat was less extensively utilized and prey biomass could have increased due to a lack of utilization. Such intra-seasonal shifts in habitat use are not uncommon for western gray whales. For example, in 2006, observations were conducted south of our usual (and present) study area to monitor pipeline dredging activity close to shore. Western gray whale abundance in this region was suspected to be low based on previous surveys (Vladimirov *et al.* 2005, 2006). However, later in the feeding season, in August and September, the abundance of whales to the south increased significantly compared to earlier observations (Gailey *et al.* 2007a, Vladimirov *et al.* 2007). In 2007, the initial distribution of gray whales was more uniform in the Piltun feeding area in August. In September, there was an abandonment of the northern region, and concentrated in the southern portion of the study area. Lastly, in 2009, there was a noticeable decrease in whale abundance during the month of August in the central portion of the study area compared to the number of animals observed in July. In September, the abundance increased to even higher levels than observed earlier in the season.

In 2004-2005, the northern regions (North and Odoptu stations) had substantially higher number of whales than other regions. From 2004-2006, whales were sighted every observation day in this region with a minimum of 2 whales per scan and a maximum of 17 whales per scan. In 2007, 36% of the observation days found zero whales in this northern region. Interestingly, the majority (80%) of the zero whale days in 2007 were observed during the latter part of the season (September) where whales were no longer utilizing the area. In 2008 and 2009, the low abundance in these regions continued. At the most northern location, North Station, in 2009, the majority of the sightings (83%) were observed in July and August, while only 5 gray whales were sighted in September. The majority (82%) of the whales observed in these regions were observed to be traveling south.

Despite the fluctuations in whale distribution and abundance, there are some consistent patterns. For example, over the study years, the central part and the mouth of the lagoon have been consistently utilized by western gray whales. These areas may represent more stable/consistent prey sources among feeding seasons. It has been suggested that changes in prey types and concentrations may be the reasons for annual shifts in gray whale abundance and distribution (Fadeev 2009). However, few analyses have considered intra-seasonal variability in whale abundance in relation to prey availability. As gray whales feed during the season, they decrease the biomass of their prey and, presumably, may move to a new location with higher biomass. For example, in 2010, initial observations found concentrated feeding near the mouth of the lagoon, but as the feeding season progressed, this feeding area or "patch" appeared to be utilized less. The concentrated feeding earlier in the season likely decreased the biomass and the biomass values may not accurately reflect the concentrations at the time the animals were feeding.

We hypothesize that the observed variation in whale abundance and distribution is related to alternating use of feeding habitat from regions that are extensively utilized for a period of time (i.e., lowered prey biomass) to less-used habitats where prey biomass has had a chance to recover due to lack of exploitation.. In most naturally occurring habitats, food resources are commonly distributed in a mosaic of patches of variable size and shape with fluctuating quantity and quality of food (WallisDeVries 1994). As one patch decreases over time due to predation, another patch may increase due to less predator exploitation. The region near the lagoon mouth may represent a higher quality patch with higher biomass or more rapid recovery due to nutrient flow or primary productivity near the mouth of the lagoon. However, extensive use of the area may lead whales to select alternative areas in the nearshore feeding grounds. Gray whale predation on amphipods has been noted to depress the larger size amphipods while increasing the density of the smaller sized amphipod species (Coyle and Highsmith 1994). Thus the size and age-class structure of the amphipod distribution could play a key component to intra-seasonal variability in gray whale distribution.

Table 13. Summary of number of whales and pods per scan for 2001-2010. Stations proceed from highest latitude (North Station) to lowest latitude (South Station). Sightings between 0-20 and 160-180 where removed from 2004 - 2010 data sets to properly compare relative abundance of gray whales to the methods of 2001-2003 (see methods). Sightings from 2006-2007 were summarized from mid-July to September since this period was more typical of past field seasons.

Number Whales										
Station	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
North Station	-	-	-	5.7 ± 3.49 (23)	9.1 ± 4.70 (10)	7.2 ± 2.99 (19)	2.3 ± 2.00 (38)	1.3 ± 1.25 (7)	0.8 ± 1.44 (22)	2.5 ± 1.86 (23)
Odoptu Station	-	8.4 ± 4.59 (16)	5.6 ± 4.31 (29)	12.2 ± 5.77 (24)	5.6 ± 4.52 (11)	4.2 ± 2.63 (20)	2.1 ± 1.92 (46)	1.3 ± 1.22 (9)	0.9 ± 1.75 (19)	3.5 ± 2.84 (19)
Muritai	2.3 ± 1.49 (34)	-	-	-	-	-	-	-	-	-
Station 07	1.8 ± 1.35 (41)	3.3 ± 2.74 (29)	2.3 ± 3.32 (55)	5.9 ± 4.13 (31)	3.6 ± 1.96 (21)	1.9 ± 1.67 (32)	1.5 ± 1.52 (33)	1.7 ± 0.75 (18)	3.0 ± 2.06 (63)	3.9 ± 3.03 (16)
Midway	2.7 ± 1.87 (40)	-	-	-	-	-	-	-	-	-
2nd Station	2.3 ± 1.88 (34)	2.0 ± 1.83 (37)	1.8 ± 1.75 (37)	3.7 ± 2.95 (28)	3.94 ± 2.18 (18)	2.8 ± 2.02 (46)	2.7 ± 2.24 (36)	3.1 ± 1.53 (36)	3.9 ± 3.81 (38)	5.03 ± 3.74 (31)
Mt. Kiwi	4.0 ± 2.7 (42)	-	-	-	-	-	-	-	-	-
1st Station	-	1.9 ± 1.98 (35)	1.2 ± 1.84 (46)	3.1 ± 3.00 (45)	2.8 ± 1.83 (16)	2.6 ± 2.09 (58)	3.7 ± 2.75 (45)	2.0 ± 1.09 (27)	4.0 ± 3.53 (35)	7.2 ± 3.33 (20)
South Station	-	-	-	2.3 ± 2.35 (37)	5.5 ± 3.77 (16)	4.8 ± 3.00 (44)	6.8 ± 3.93 (38)	5.4 ± 2.42 (33)	7.1 ± 3.9 (35)	3.9 ± 3.14 (28)
Number Pods										
Station	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
North Station	-	-	-	3.8 ± 2.10 (23)	6.1 ± 3.44 (10)	4.7 ± 2.23 (19)	1.4 ± 1.18 (38)	0.9 ± 0.69 (7)	0.5 ± 0.96 (22)	1.7 ± 1.21 (23)
Odoptu Station	-	5.7 ± 2.85 (16)	4.4 ± 3.01 (29)	8.4 ± 3.83 (24)	3.9 ± 2.55 (11)	2.9 ± 1.94 (20)	1.5 ± 1.38 (46)	0.9 ± 0.78 (9)	0.5 ± 0.9 (19)	2.7 ± 1.86 (19)
Muritai	1.6 ± 1.05 (34)	-	-	-	-	-	-	-	-	-
Station 07	1.3 ± 0.94 (41)	2.2 ± 1.75 (29)	1.7 ± 2.22 (55)	4.1 ± 2.35 (31)	2.4 ± 1.47 (21)	1.6 ± 1.36 (32)	1.1 ± 1.06 (33)	1.4 ± 0.70 (18)	2.1 ± 1.41 (63)	2.8 ± 2.14 (16)
Midway	2.0 ± 1.25 (40)	-	-	-	-	-	-	-	-	-
2nd Station	1.7 ± 1.29 (34)	1.5 ± 1.37 (37)	1.3 ± 1.22 (37)	2.4 ± 1.47 (28)	2.9 ± 1.67 (18)	2.3 ± 1.66 (46)	1.8 ± 1.64 (36)	2.2 ± 1.03 (36)	2.5 ± 2.7 (38)	3.5 ± 2.41 (31)
Mt. Kiwi	2.6 ± 1.43 (42)	-	-	-	-	-	-	-	-	-
1st Station	-	1.5 ± 1.40 (35)	1.0 ± 1.50 (46)	2.2 ± 1.89 (45)	2.5 ± 1.75 (16)	2.0 ± 1.57 (58)	2.5 ± 1.78 (45)	1.6 ± 0.84 (27)	2.7 ± 2.3 (35)	4.8 ± 2.09 (20)
South Station	-	-	-	1.7 ± 1.61 (37)	2.6 ± 2.68 (16)	3.9 ± 2.21 (44)	5.0 ± 3.37 (38)	4.1 ± 2.03 (33)	4.9 ± 2.64 (35)	3.0 ± 2.28 (28)

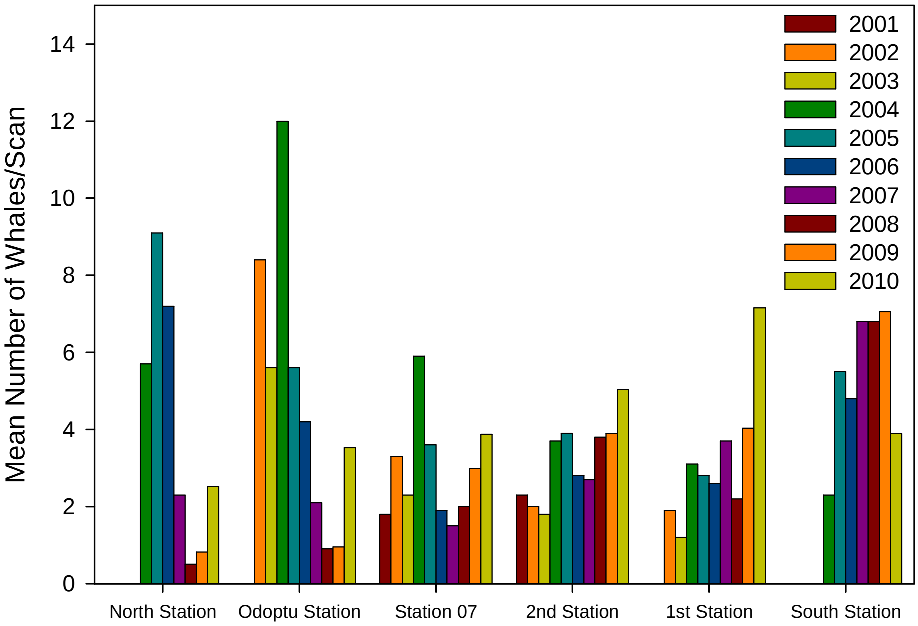

Figure 36. Annual relative abundance of western gray whales at six shore based stations from 2001-2010. Sightings between 0-20 and 160-180 where removed from 2004 - 2010 data sets to properly compare relative abundance of gray whales to the methods of 2001-2003 (see methods). Sightings from 2006-2007 were summarized from mid-July to September since this period was more typical of past field seasons.

There may be other food sources that whales feed preferentially upon, if they are available. In 2003 and 2004, the mean distances of whales from shore were slightly higher (2.3 and 2.1 km, respectively) than 2005-2010 mean distances (between 1.5 to 1.8 km); distributional patterns in 2003 and 2004 illustrated a consistent feeding area in waters greater than 5 km from shore and greater than 20 m water depths during those feeding seasons. This slightly further offshore feeding area had high concentrations of sand lance (Fadeev 2004, 2005). Although sand lance has not been previously shown to be the primary prey source for gray whales, gray whales are known to be highly adaptable and exploit seasonal abundance of different prey items and it is likely the whales were exploiting the abundance of sand lance or some other epibenthic food sources during those years. From 2007 - 2009, the more distant from shore feeding area was not extensively utilized, which corresponded with lower abundance of sand lance (Fadeev 2008, 2009, 2010). In general, western gray whales are typically within water depths less than 20 m (~4-5 km from shore). Regions greater than 20 m water depth are dominated by sand dollars (Echinoidea) that have little nutritional value to gray whales. The primary prey items (amphipods, bivalves, isopods) have been shown to be in great abundance in water depths < 20 m for the Piltun feeding area (Chapter 4). The 2010 field season did have higher abundance of whales in the northern region similar to that of 2004-2005, with some offshore patchy feeding regions. In fact, the northern stations distribution from shore was, on average, further from shore than that of the southern regions in 2010.

Although there are apparent annual and intra-seasonal shifts in habitat use of western gray whales on their northeast Sakhalin feeding grounds, to-date there has been no significant daily pattern in abundance. Daily variation have been noted for the eastern gray whale population. For migrating eastern gray whales, Perryman *et al.* (1999) found significant diel variation with larger pod sizes and increased distance from shore during the day, but no changes in the gray whales overall respiration parameters. Stelle (2008) and Guerrero (1989) have suggested increasing resting periods at night for feeding eastern gray whales with whales primarily observed feeding during daylight hours. Gailey *et al.* (2010) found significant daily changes in respiration parameters, which supports Stelle (2008) and Guerrero (1989) hypothesis of increased feeding during daylight hours. With increased lighting during the day, gray whales could potentially identify prey species more efficiently and therefore, feed more throughout the day and less during low lighting and night time periods. The univariate analyses presented in this study indicate that there were no significant diel patterns, but sample sizes are likely insufficient to detect these patterns (if they existed). There are also other contributing factors which could affect daily changes in behavior, abundance, and distribution. Multi-year analyses of these data while taking into account natural factors, such as tide, weather conditions, temporal factors, and prey availability data, would likely yield further insights and understanding of how western gray whales are utilizing their feeding habitat.

The general movement and respiration patterns in 2010 are similar to those observed in previous years with the exception of 2002 (Table 14). In 2002 (a non-construction year), gray whales were observed to be traveling more throughout the study area. We hypothesized that increased traveling activity could be representative of a different foraging strategy, such as feeding more on prey in the water column as opposed to benthic foraging. Gray whales could be feeding more on “clouds” of water column prey, which tend to distributed in a somewhat “rare and random” poisson fashion. Similar greater travel between locations was evident for eastern gray whales feeding on mysids, rather than feeding on bottom-dwelling ampeliscid amphipods, off Vancouver Island, Canada (Guerrero 1989). In 2010, western gray whale speed of movement was 2.5 km/h and range index of 38.8 m/min, and was comparable to the 1.9 - 2.7 km/h speeds and 31.1 - 41.4 m/min range indices observed in 2001-2009.

Again, this may be representative of increased traveling behavior compared to that of feeding and feeding/traveling representative tracklines in the dataset. In the past four years, there have been small increases in speed and range as well as decreased values in reorientation rates (Table 14).

Behavioral activity in 2010 indicated that gray whales were feeding in a patchy distribution (Figure 34 – Figure 35). The patchy distribution of prey could be one explanation for the observed behavior. The 2009 movement variables were slightly higher than previous years, which could potentially be related to industrial activity (seismic/pile-driving). Further analyses are required to examine the potential impact of the industrial activities that occurred in 2009.

The general blow interval and dive time in 2010 were similar to those of 2003-2009, which are comparable to those of bottom-feeding eastern gray whales in the northern Bering Sea (Würsig *et al.* 1986) and off Vancouver Island, Canada (Guerrero 1989). In 2002, blow interval and dive time were higher and lower, respectively, than observed in other years, which could be indicative of the greater amount of travel in that year (Gailey *et al.* 2005, Table 14). Dive times were generally lower than those reported for eastern gray whales, which could be related to the shallow water depth of the nearshore Piltun feeding region. Previous studies on eastern gray whales have found a general increase in dive time for whales observed in deeper water depths (Würsig *et al.* 1986). In addition, Gailey *et al.* (2007c, 2010) found that water depth was significantly associated with dive time, indicating that whales had longer durations of dives in deeper waters. However, Gailey *et al.* (2007) reported the overall blow interval in 2006 was similar to previous observations, but when further analyses examined sound exposure levels to the whales respiration patterns, it was found that gray whales significantly decreased their blow interval with higher sound energy exposure suggesting a increased breathing rate which could be a stress response or at least a higher energetic state in relation to the dredging, pipeline construction, and/or vessel activity that occurred (Gailey *et al.* 2010).

Three behavioral states were predominately observed on the feeding grounds: 1) feeding, 2) feeding/traveling, and 3) traveling. For these behavioral states, movement and respiration patterns were significantly different when whales engaged in these different modes of activity. Gray whales moved faster, more directional, and covered a larger geographic range while traveling compared to feeding/traveling and feeding. Movement patterns were also different between the two different modes of feeding behavior (feeding/traveling and feeding). Differences in movement patterns during feeding and feeding/traveling behavior could be representative of the different foraging strategies, such as feeding in one area with high prey concentrations while feeding/traveling in areas of lower prey density or on different prey types (water column compared to benthic feeding). Feeding/traveling behavior could be also related to a “search” mode where whales are investigating or "plowing" the bottom in lower prey density areas in search for higher concentrations. Observations of whales feeding in one localized area for several hours suggest that prey concentrations at that location was particularly high compared to surrounding areas.

While whales were engaged in feeding or feeding/traveling activities, there were no differences in how the whales cycled through their surface-respiration-dive cycles. While feeding, their respiration patterns were optimized to spend less time at the surface in order to return to their benthic prey resources. While traveling, the whales dive time decreased and their duration between blows at the surface were longer compared to that of their feeding states. The combination of these two parameters resulted in a significantly lower surface blow rate. Taken together, western gray whales spent more time at the surface while traveling, which may be related to the increased speeds (i.e. increased energetic activity) of movement during traveling.

“Displacement” analyses in the past five years (2006-2010) have had significantly different traveling patterns for gray whales from those found in previous years (2002-2005). Feeding and feeding/traveling patterns, however, were not significantly different between all years. Displacement values combine variables of directionality, reorientation, and speed. It is unknown why whales were observed to be traveling at a higher rate in 2006-2010 compared to those observations in 2002 through 2005. As previously suggested, these patterns could be related to a more patchy distribution of prey where animals travel more directionally between known patches. Alternatively, there could be more whales in the datasets that were disturbed by anthropogenic activity; for example close vessel approaches or responses to “noisy” activity. Since 2005, there has been considerable amount of industrial activity compared to that of 2002-2004. Western gray whales have been noted to behaviorally respond to both sound levels and close vessel approaches (Gailey *et al.* 2007 b, c, 2010).

Other behavioral states, such as resting, milling, socializing, playing, etc., were less frequently observed compared to the three predominately observed behavioral states. This leads to low statistical power for proper analyses of these states, which limits quantitative interpretation. In addition, behavioral states such as socializing consist of more than one individual, which increases the difficulty in reliably tracking or conducting focal follow observations unless one distinctive individual could be recognized within the group. Since the onset of behavioral observations in 2001, socializing behavior has been observed during a similar time period (end of August through September). The increase in social bouts in the latter part of the summer-fall feeding season has similarly been described for eastern gray whales off St. Lawrence Island (Würsig *et al.* 1986). It is unknown why gray whales engage in these social/sexual activities more in the latter part of the feeding season. One hypothesis is that increased social activity could be associated with successful feeding as the whales' energy requirements are met and they can thus engage in more energetic activities. The descriptions of social behavior observed for the western population are similar to those described for the eastern population on their feeding grounds and are akin to descriptions of courting and mating behavior (Sauer 1963, Fay 1963, Jones and Swartz 2009). In fact, the majority of the social behavior observations during 2001-2010 included observations of apparent sexual activity, as indicated by general social behavior and – at times -- an exposed penis. Although sexual-related activity continues to be observed on the feeding grounds, it likely serves some unknown social purpose that is ultimately non-reproductive (Jones and Swartz 2009).

Table 14. Summary statistics for movement and respiration data collected during 2001 - 2010. Dashes (-) separate numbers that indicate ranges; plus/minus (±) separate means and standard deviations, and numbers in parentheses are sample sizes.

Variable	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Leg Speed (km/h)	1.9 ± 1.49 (510)	3.2 ± 2.06 (74)	2.3 ± 1.04 (47)	2.2 ± 1.30 (116)	2.2 ± 1.84 (124)	2.6 ± 2.12 (140)	2.4 ± 1.76 (176)	2.6 ± 2.02 (59)	2.7 ± 2.03 (120)	2.5 ± 1.82 (98)
Acceleration (km/h^2)	0.0 ± 0.71 (506)	0.1 ± 0.50 (74)	0.0 ± 0.23 (47)	0.0 ± 0.22 (116)	0.0 ± -0.03 (124)	0.0 ± 0.27 (140)	0.0 ± 0.23 (176)	0.0 ± 0.17 (59)	0.0 ± 0.21 (120)	0.0 ± 0.27 (98)
Reorientation Rate (°/min.)	17.4 ± 13.72 (506)	21.0 ± 19.32 (74)	26.0 ± 18.76 (47)	19.1 ± 15.17 (116)	21.4 ± 15.85 (124)	19.5 ± 15.92 (140)	17.3 ± 14.52 (176)	19.8 ± 18.48 (59)	16.8 ± 14.98 (120)	15.8 ± 13.26 (98)
Linearity	0.8 ± 0.23 (482)	0.8 ± 0.24 (74)	0.8 ± 0.29 (47)	0.8 ± 0.23 (116)	0.8 ± 0.91 (124)	0.8 ± 0.24 (140)	0.8 ± 0.23 (176)	0.8 ± 0.24 (59)	0.8 ± 0.22 (120)	0.9 ± 0.19 (98)
Mean Vector Length	0.8 ± 0.26 (482)	0.8 ± 0.27 (74)	0.7 ± 0.29 (47)	0.8 ± 0.22 (116)	0.7 ± 0.85 (124)	0.8 ± 0.25 (140)	0.8 ± 0.24 (176)	0.8 ± 0.26 (59)	0.8 ± 0.24 (120)	0.8 ± 0.19 (98)
Ranging Index	-	-	31.1 ± 18.06 (47)	32.9 ± 22.31 (116)	32.8 ± 24.71 (124)	39.6 ± 35.91 (140)	36.2 ± 29.87 (176)	40.8 ± 34.47 (59)	41.4 ± 34.27 (120)	38.8 ± 30.16 (98)
Distance to Shore (km)	1.1 ± 0.66 (510)	-	2.3 ± 1.23 (283)	2.1 ± 1.45 (984)	1.5 ± 1.19 (502)	1.5 ± 0.66 (140)	1.4 ± 0.72 (176)	1.6 ± 0.60 (59)	1.0 ± 0.65 (120)	1.1 ± 0.68 (98)
Blow Interval (blows/min.)	0.4 ± 0.14 (271)	0.5 ± 0.19 (46)	0.4 ± 0.13 (34)	0.4 ± 0.17 (64)	0.4 ± 0.15 (66)	0.4 ± 0.21 (81)	0.4 ± 0.18 (105)	0.3 ± 0.13 (40)	0.41 ± 0.207 (63)	0.4 ± 0.17 (67)
Blows per Surfacing	5.2 ± 3.93 (234)	4.9 ± 4.45 (42)	4.2 ± 1.38 (34)	4.2 ± 1.63 (64)	5.1 ± 2.86 (66)	6.2 ± 6.73 (81)	4.9 ± 3.22 (105)	4.5 ± 2.15 (40)	4.6 ± 3.15 (61)	4.3 ± 2.16 (67)
Surface Time (min.)	1.6 ± 1.84 (241)	1.7 ± 1.50 (42)	1.7 ± 1.78 (34)	1.8 ± 1.73 (64)	1.6 ± 1.73 (66)	2.0 ± 3.13 (81)	1.6 ± 1.97 (105)	1.2 ± 1.16 (40)	1.5 ± 1.85 (61)	1.3 ± 1.30 (67)
Dive Time (min.)	2.5 ± 0.92 (239)	1.8 ± 0.80 (44)	2.2 ± 0.77 (34)	2.4 ± 0.80 (64)	2.2 ± 0.84 (66)	2.4 ± 1.13 (81)	2.5 ± 0.94 (105)	2.7 ± 0.94 (40)	2.2 ± 0.87 (61)	2.5 ± 1.04 (67)
Dive-Surface Blow Rate	1.2 ± 0.34 (236)	1.3 ± 0.32 (42)	1.3 ± 0.42 (34)	1.2 ± 0.32 (64)	1.3 ± 0.42 (66)	1.3 ± 0.48 (81)	1.1 ± 0.33 (105)	1.2 ± 0.24 (40)	1.2 ± 0.28 (61)	1.1 ± 0.28 (67)

Killer whales are one of the few known predators of gray whales. Predation on gray whales has been documented for the eastern population (Baldridge 1972, Goley and Straley 1994, George and Suydam 1998) and it is likely to occur to some degree on the smaller population of western gray whales. Indirect evidence of killer whale interactions with western gray whales are apparent from tooth rake marks on the bodies of some individuals. In fact, Weller *et al.* (2009) found approximately 44% of the 169 western gray whales identified had evidence of at least one killer whale encounter, which is considerably higher than those reported for other baleen whales (Mehta *et. al.* 2007, Steiger *et al.* 2008). Interactions of killer whales and western gray whales may at times result in successful predation, especially on calves or recently weaned calves. Transient killer whales have been sighted infrequently (~2-9 times per field season) on the western gray whale feeding ground during each feeding season. Western gray whales have generally not been noted to respond to the presence of killer whales. In 2010, five groups of killer whales were observed, which is less than the nine groups observed in 2007, but higher than the one sighting of killer whales in 2008. In 2009, six killer whale sightings were observed. As observed in previous years, western gray whales in 2010 did not illustrate any form of a response in the presence of killer whales. For the past decade of observations, there has only been one observation of obvious harassment by killer whales. This observation occurred in 2006, when a group of 4-6 killer whales was observed to be harassing two adult gray whales. The killer whales were seen at the surface near and round the gray whales and the gray whales responded by increasing their speed of movement and moving inshore (Gailey *et al.* 2007a). However, the relatively high incidence of killer whale scarring on western gray whales may suggest that killer whale predation attempts are rather frequent and could potentially be a limiting factor towards the recovery of the population (Weller *et al.* 2009). Such encounters may be more prevalent during their annual migrations and/or on their breeding grounds.

With some understanding of the amount of natural variability that can exist, behavioral studies continue to examine indicators of response that could affect foraging by gray whales. Since a successful feeding season is essential to their annual survival, it is critically important to monitor their feeding activity. The summary presented here is, however, biased to some unknown degree to those general (i.e. "normal") movement and respiration patterns and are not examined in relation to sound levels and/or exposure to other anthropogenic activity that occurred in 2010. For example, if gray whales were impacted due to the seismic activity at only the near-by observation platform (Odoptu Station), while other whales at the five other observation locations were not impacted due to the distance, then pooling these data together would skew the results towards the non-disturbed (i.e. "normal") values.

Since 2005, there has been an increasing amount of anthropogenic activity. In 2005, construction activities related to placement of a Concrete Gravity Based Structure occurred with behavioral associations related to near-shore vessel activity and sound levels related to construction. In 2006 and 2007, construction activity related to pipeline placement and top-sides installation at the PA-B site occurred in the vicinity of the Piltun feeding area. Multivariate analyses of these activities indicated relatively minor behavioral changes in relation to the more continuous sounds produced by the construction (Gailey *et al.* 2007c, 2010). These results suggest that if these types of construction activities are monitored and mitigated properly, there would be little to no effect on individual western gray whales and therefore on the population.

During the 2008 feeding season, there was less direct industry activity, albeit some seismic and onshore pile driving operations occurred. The seismic exploration occurred in the northern part of the study area during early to mid September while onshore pile driving occurred near our Station 07 until July 4 and recommenced on September 10. In 2009, both onshore pile driving and seismic activity continued, but for a much longer duration of exposure during the feeding season. On-shore pile driving at the same location (near Station 07) continued for the majority of the gray whale feeding season. Another seismic operation occurred in 2009 in the northern part of the study area during late-August through September. During the 2010 feeding season, there was a significant amount of seismic activity with Sakhalin Energy Investment Company conducted seismic operations early in the feeding season (June-early July), while Rosneft-Shelf Far-East conducted seismic operations within the feeding habitat in the height of the feeding season (August-November). These activities produced pulsed sounds compared to continuous sounds generated by construction activities analyzed in Gailey *et al.* (2007 b, 2010). These pulsed sounds have a higher probability of impacting whales compared to the continuous sounds, and analyses using some of the seismic data are currently being conducted. In fact, seismic operations conducted by Exxon-Neftgas had several behavioral responses in relation to sounds generated from their seismic survey (Gailey *et al.* 2007b).

We conclude that this report presents preliminary evaluations of abundance and behavioral patterns of western gray whales observed in August and September of 2010. We acknowledge that industrial operations may have affected some of the variables analyzed here. We also acknowledge that the data analyzed here considers a subsample of the entire data-set and do not fully consider entire tracks and focal follow observations due to analytical concerns of over-representation/ pseudoreplication and auto-correlation. More complex analyses are required to account for these analytical issues. As well, natural factors that have been shown to influence movement and respiration were not taken into account (see Gailey *et al.* 2007b,c, 2010). Whales dive time, for example, is not likely to be representative since water depth has been shown to be an important consideration while interpreting this variable. Results presented here do, however, suggest considerable variability. This variability could partially be explained by natural factors. Anthropogenic activity could also be another plausible factor. Additional analyses of western gray whale abundance, distribution, movement, and behavior are required to properly analyze these data.

In summary, this report provides initial results of western gray whale behaviors that were observed in 2010 and compares these results to similar studies and previous years' work. The results may have been confounded by anthropogenic activity (i.e. pile driving, seismic activity, etc) and it is presently unknown how these activities may have affected the distribution, abundance, and behavior of western gray whales. There has been a considerable amount of annual and intra-seasonal variation in how western gray whales utilize their feeding habitat. One of the major influences of abundance and distribution of gray whales on their feeding grounds is the amount and types of prey available. More sophisticated analyses are needed to link this important information to the prey availability and gray whale presence, distribution, behavior, and movement. In 2010, the apparent distribution shifts in whale abundance may be related to changes in food availability or alternatively to human activity. Behavioral patterns were found to be similar to previous year, although more work needs to be conducted to understand impacts of sound exposure and vessel activity in 2010, to which western gray whales have been noted to respond (Gailey *et al.* 2007 b, c, 2010).

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APPENDIX 1. DAILY SUMMARY OF THEODOLITE, FOCAL BEHAVIOR, AND SCAN DATA COLLECTED DURING THE SUMMER OF 2010.

Station	Date	Start Day	End Day	Effort(hrs)	# Tracklines	# Focal Follows	# Scans
South Station	7-Aug-10	10:17:15	17:21:51	7.08	5	1	6
1st Station	8-Aug-10	7:41:26	17:31:00	9.83	10	1	5
2nd Station	9-Aug-10	8:13:22	18:25:15	10.20	3	1	10
Station 07	10-Aug-10	7:01:10	10:00:47	2.99	2	1	2
Station 07	18-Aug-10	9:01:49	18:21:37	9.33	3	0	7
Odoptu Station	19-Aug-10	7:47:33	17:15:22	9.46	4	2	7
North Station	20-Aug-10	7:42:15	18:52:22	11.17	3	2	6
South Station	23-Aug-10	8:30:47	18:02:38	9.53	6	4	7
1st Station	24-Aug-10	7:54:26	14:40:26	6.77	3	1	4
2nd Station	25-Aug-10	7:28:03	14:00:49	6.55	8	4	4
Station 07	26-Aug-10	7:16:28	18:01:37	10.75	5	3	4
Odoptu Station	27-Aug-10	7:26:51	18:42:45	11.27	4	3	5
North Station	28-Aug-10	7:45:50	18:35:02	10.82	3	1	9
South Station	1-Sep-10	8:23:01	15:16:06	6.89	1	1	5
South Station	2-Sep-10	9:06:35	17:39:40	8.55	3	1	7
1st Station	3-Sep-10	8:01:27	18:16:44	10.26	4	3	6
2nd Station	4-Sep-10	7:25:40	11:56:02	4.51	4	3	1
2nd Station	5-Sep-10	7:16:56	17:42:57	10.43	11	3	8
Station 07	6-Sep-10	7:06:45	18:39:50	11.55	6	2	7
Odoptu Station	7-Sep-10	7:32:31	9:56:22	2.40	2	1	2
Odoptu Station	8-Sep-10	7:13:20	13:53:19	6.67	6	2	2
North Station	10-Sep-10	8:01:56	11:31:50	3.50	4	1	1
North Station	12-Sep-10	13:30:26	18:44:44	5.24	2	2	0
South Station	13-Sep-10	8:35:17	14:54:54	6.33	1	1	4
1st Station	14-Sep-10	8:23:03	17:31:22	9.14	7	5	4
2nd Station	15-Sep-10	8:01:30	16:26:42	8.42	6	1	4
Station 07	17-Sep-10	7:55:37	18:14:56	10.32	10	4	5
Odoptu Station	18-Sep-10	8:12:12	17:51:58	9.66	8	3	4
North Station	19-Sep-10	8:05:59	18:02:38	9.94	6	2	10
South Station	20-Sep-10	9:18:05	13:33:23	4.26	2	1	2
1st Station	23-Sep-10	9:04:07	15:28:20	6.40	4	4	1
2nd Station	24-Sep-10	9:24:23	11:50:00	2.43	0	0	3
2nd Station	25-Sep-10	8:39:28	16:45:10	8.10	0	0	8
Station 07	26-Sep-10	7:56:29	15:15:34	7.32	1	1	1
North Station	27-Sep-10	8:27:21	18:16:06	9.81	7	2	7
North Station	28-Sep-10	9:05:21	11:59:31	2.90	4	0	1
TOTAL				280.75	158	67	169