

## Discovering a new feeding area for calf-cow pairs of endangered western gray whales *Eschrichtius robustus* on the south-east shelf of Kamchatka in 2009 and their utilizing different feeding regions within one season

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### Abstract

In 2009, photo-ID endangered western gray whale of *Eschrichtius robustus* studies were conducted principally at the two Sakhalin feeding areas and at the two Kamchatka areas (Olga and Vestnik Bay s). Photo-ID studies of gray whales have been performed annually in the Piltun and Offshore feeding areas off northeast Sakhalin during the period 2002-2009. Photo-ID studies conducted offshore southeast Kamchatka since 2006 revealed that some of Kamchatka whales belong to the western gray whale (WGW) population. Until 2008, cow-calf pairs had only been recorded in Piltun, and often near the mouth of Piltun Bay, where prey abundance is high and water is shallow. In 2008 a mother-calf pair was registered in Olga Bay for the first time. The earlier start of the survey season in Olga Bay in 2009 compared to previous years allowed more comprehensive data to be collected about mother-calf pairs; seven pairs were identified in 2009. Four of these mothers identified in Olga Bay had been observed on the Sakhalin shelf in previous years. Two of the seven calves were also observed later in the Piltun area during the 2009 season, one of them with its mother. Five mother-calf pairs and one calf without mother were identified only in the Piltun area on the Sakhalin shelf. Thus, a total of ten calves that have mothers in the Sakhalin catalogue were recorded in 2009. These results indicate that the Piltun area offshore Sakhalin is not the only feeding area for mother-calf pairs of the WGW, but that a second "nursery ground" exists in Olga Bay, Kamchatka.

**Keywords:** gray whale, calf, feeding, migration, Sea of Okhotsk, endangered species.

### 1. Introduction

Photo identification (photo-ID) is a valuable tool in gray whale studies (Calambokidis *et al.*, 1999), because individual gray whales bear uniquely distinguishable markings on their sides, backs and flukes. Individuals can be passively "tracked" over space and time by photographically "capturing" then subsequently "re capturing" the same whale while recording the location and time the photographs were taken. This technique is seen as a minimally intrusive method for monitoring because no physical device needs to be attached, nor biological samples taken from the animal. The main objective of the photo-ID study is to assess the status of the western gray whale (WGW) population, including its reproduction, survival rate and body condition. In addition, individually identified WGWs can inform us about habitat usage and possible presence of important habitat/areas on the Sakhalin shelf and in other regions, such as offshore southeast Kamchatka.

Photo-ID research for the purpose of studying population dynamics, behavior, and other aspects of marine mammal biology began being actively used in the 1970s. The use of digital cameras in the last decade has made it substantially easier to obtain high-quality photographs of cetaceans and manage related data on the location and conditions under which they were taken. Furthermore, digital photography allows researchers to check the quality of the pictures in real time.

Photo-ID has proven to be a useful and low-impact technique for monitoring wild populations of many species of marine mammals. Finally, photo-ID is an effective method of examining health indicators of individual whales as well as the overall health of groups or populations (Tyurneva *et al.*, 2007a).

One from main objectives of the photo-ID study of WGWs is to determine cow-calf pairs and their association during the season (timing of cow-calf separation i.e., weaning) and assess the number, status

and habitat use of cow/calf pairs (calf birth and survival rates)

## 1.1. Study area

### 1.1.1. Northeast Sakhalin shelf

The study area used for photo-ID covers the entire northeast coast of Sakhalin Island, including the nearshore Piltun feeding area and the Offshore feeding area further away from the coast (Figures 1 & 2). Photo-ID effort was concentrated in these two feeding areas, but whales were also photographed opportunistically if encountered elsewhere. For the purposes of the Photo-ID analysis on localized movements, the greater Piltun Area includes the entire nearshore feeding grounds except for one small sub-area off-shore of Chayvo Bay. This area is discussed separately when presenting data on whale movements.



Figure 1. Russian Far East, Sea of Okhotsk, Sakhalin Island and Kamchatka Peninsula regions.

### 1.1.2. East Kamchatka shelf

Photo-ID studies were also conducted along the eastern coast of Kamchatka Peninsula in 2004 at Khalaktyrsky Beach south of Cape Nalycheva ( $53^{\circ}11' N$ ,  $159^{\circ}42' E$ ), and from 2006-2009, in two locations that included Olga Bay ( $54^{\circ}34' N$ ,  $160^{\circ}57' E$ ), and Vestnik Bay ( $51^{\circ}28' N$ ,  $157^{\circ}34' E$ ) ( Figures 1 & 2). From Olga Bay in the north to Vestnik Bay in the south, these three locations are located over a distance of 600 km of rocky shores.



Figure 2. Locations of photo-identified gray whales off SE Sakhalin and Kamchatka, 2009.

Their shorelines resemble the Sakhalin Island coast adjacent to Piltun Bay, with slightly curving sandy beaches ~23 km long (Vestnik Bay), ~25 km long (Khalaktyrsky Beach) and ~50 km long (Olga Bay) and have small rivers flowing into them. The depths of these areas range from 5 to 20 meters. In all three locations described above, the northern part of each bay has a cape extending into the sea (cape Olga, cape Nalycheva, cape Zholyty).

## 1.2. History of western gray whale Photo-ID

### 1.2.1. Sakhalin Island shelf

Photo-ID studies of WGWs in this area are currently carried out by two teams of researchers. The Russian-US photo-ID team has been active in the nearshore Piltun feeding area since 1997, with a pilot program conducted in 1994 (Weller *et al.*, 2002). Specialists from the Institute of Marine Biology (IMB) of the Far East Branch of the Russian Academy of Science (DVO RAN) (henceforth "IBM team") have been working in both (Piltun and Offshore) feeding areas every year since 2002 (Yakovlev *et al.*, 2009; 2010).

### 1.2.2. East Kamchatka shelf

Over the past few decades, researchers have become increasingly aware of a wide distribution of gray whales in the coastal waters off southeast Kamchatka during the summer, autumn and early winter months (Tyurneva *et al.*, 2006, 2007a). No WGWs were sighted along the coast of western Kamchatka over many years of both systematic and

pilot observations. According to vessel-based surveys conducted on an annual basis by the Kamchatka Regional Fisheries Management Agency (Kamchatrybvod), gray whales have been sighted in the coastal waters to the southeast of the tip of the peninsula since 1979. Since the mid-eighties, solitary whales began to be observed during the summer months near the southeast coast of Kamchatka (Tyurneva *et al.*, 2006; 2007b).

In 2004, three gray whales were sighted and photographed during 2 days of systematic surveys at Khalaktyrsky Beach offshore of the eastern part of the Kamchatka Peninsula in July and August (Yakovlev *et al.*, 2010). During the first comparison of these photographs with the available 2002-2005 WGW catalogue of photo-identified whales offshore northeast Sakhalin no matches were found. However, in the following years, two of these individuals were identified offshore Sakhalin (Tyurneva *et al.*, 2006, Yakovlev *et al.*, 2010).

In 2006, three days were dedicated to this activity. At the beginning of July 2006, photographs of one gray whale were taken in the Vestnik Bay from the deck of the ship in the course of a scheduled survey of marine mammals. During two days in August 2006 (devoted exclusively to Photo-ID work in the Olga Bay), the photographs of 12 gray whales were taken. In 2007, photographs of 7 gray whales were taken in the Vestnik Bay, and of 30 whales in the Olga Bay. In 2008, photographic work offshore south-east Kamchatka was only done in Olga Bay using Zodiacs that were launched from the shore. Over the period from August 19 to 29, 50 identified individuals were recorded.

In 2006, the IBM photo ID laboratory was also asked to examine the gray whale photographs gathered in the north of the Sea of Okhotsk in Kekumy Bay dated July 13, 2006, and in Babushkin Bay dated July 28, 2006. As a result three whales were identified, which were assigned catalog ID numbers NOGW# (Yakovlev *et al.*, 2010). In 2007, one of these whales was also sighted in both the Piltun feeding area and Olga Bay and was given additional ID numbers for these catalogues.

According to the 2004 and 2006-2009 photo-ID data, 78 gray whales were identified in the surveyed areas offshore southeast Kamchatka, 41 of which are also registered in the WGW catalogues of northeast Sakhalin maintained at the IBM DVO RAN.

Available data suggest significant spatial movements linked to the resource usage of one or several feeding areas (Tyurneva *et al.*, 2006; Yakovlev *et al.*, 2009). Such movements can be divided into inter- and intra-annual movements.

## 2. Materials and Methods

The field procedure for the photo-ID work used by the IBM team offshore Sakhalin Island since 2002 is

based on recommendations for photo-ID work with marine mammals, set forth in the International Whaling Commission Special Issue No. 12 (Hammond *et al.*, 1990). The research vessel *Akademik Oparin* was the base ship for the photo-ID effort, with the actual work conducted from a 3.8 m long Zodiac when weather and sea conditions allowed. On specified photo-ID days, when conditions permitted, the Zodiac was deployed from the mother vessel whenever gray whales were sighted. The whales' position (determined by the GPS), the time, whale behavior, number of whales in the group, direction of their movement, the presence of other groups of gray whales, killer whales and passing vessels, and airplanes or helicopters in the observation area were also noted. The presence of mud plumes, both at whale feeding sites and when no whales were visible was recorded near the locations where the Zodiac was launched.

A Nikon D2X digital camera with a fixed 300 mm f/4 telephoto lens or a Nikkor 80-400 mm zoom lens with image stabilizer (IS) was used for photography. The photographs were recorded at a high resolution setting in large RGB JPEG and RAW format. An attempt was made to photograph all aspects (head, back flanks and flukes) of each whale. A whale was photographed in sequence, from head to fluke on both the right and left sides, and the dorsal and ventral fluke surfaces. Priority was given to photographing the flanks of the whale, as fluking frequency varies with individual behavior and foraging depth. Preference was given to photographing the right side (flanks) of the subject animal as right sides have been arbitrarily chosen among western gray whale researchers as a baseline identifier. Matchable right side photographs are required for an individual whale to be included in the photographic identification catalogues. A matchable quality photograph for photo-identification of gray whales is any photograph of the appropriate region of the body (aspect) that can be readily identified as belonging to a particular individual whale when compared to other photos of the same target region of that same whale.

The photo-ID effort was conducted in Olga Bay and Vestnik Bay, Kamchatka Peninsula (Figure 1) using vessel-based field procedures similar to those used in the Offshore feeding area along Sakhalin Island. A Canon 40D digital camera equipped with Canon 75-300 mm zoom lens with image stabilizer was used for photography. All photos were taken at the highest possible resolution and saved in JPEG format.

Shore-based photography has been a part of behavioral monitoring research on western gray whales in Sakhalin, since 2004. This research was conducted in the nearshore Piltun Feeding Area, one of the primary known feeding habitats of the western gray

<sup>1</sup> Group size estimates were based on a consensus of the observers aboard the Zodiac and were later confirmed in the laboratory via photo-matching.

whale. Observations covered 66 km of coastal region in the northern portion of the nearshore feeding area. Behavioral observations are described in more detail in Yakovlev *et al.* (2010). The shore-based photo ID effort supplements the vessel-based, Sakhalin, photo ID program by sampling near shore waters where gray whale mothers and calves are typically found. Vessel based photo-ID efforts were conducted over a larger area and therefore do not sample the nearshore feeding area as frequently. In addition, the shore-based approach may conduct photo ID during inclement weather conditions (for example when Beaufort > 3) when it is not possible to conduct photo-ID work from the Zodiac.

To recognize whales by their distinguishing marks on their sides and flukes, standard photo-recognition methods specified by the International Whaling Commission were applied (Hammond *et al.*, 1990). Confident left-to-right side matches were established based on the following criteria: (1) the whale was photographed as a solitary individual; (2) sequences of the left and right side were compared with flukes in common for a single sighting; and (3) as a final check to compare matches and assist with right to left matches, whale knuckle height, spacing and ratios were considered. Whale body color served as the basic feature for whale identification; scars and barnacle spots were used as additional features for comparison. Whales identified offshore of the Kamchatka Peninsula were assigned catalogue numbers, KamGW# in the Kamchatka catalogue, and whales identified offshore Sakhalin Island were assigned catalogue numbers, KOGW# in the Sakhalin catalogue. Whales identified in both regions carry two (KamGW# and KOGW#) catalogue numbers and appear in both the Kamchatka and Sakhalin catalogues. Whales which had matchable quality photographs of other aspects, but were missing a quality right side image in the catalogue, were given a Temporary number (TEMP#) until a matchable right side photograph could be obtained and added to the sighting history for that individual. The whale is then issued the appropriate sequential catalogue number, retaining its TEMP# for historical reference.

Analysis of photo-ID data also incorporated the identification of whales with deviations from the "physiological norm". Such deviations included: (1) emaciation ("skinny" whales); and (2) obvious sloughing of skin or other anomalous skin conditions.

### 2.1. Cow and calf identification

A "calf" was defined as an individual up to one year old (current year's offspring) as established by a set of criteria, such as their small body size (about one-third a mature adult) and demonstrating a close association with a particular adult whale.

In 2009, we began developing a systematic process to rank the significance of cow-calf pair identification criteria and grade the reliability of the identification of existing pairs and unaccompanied calves. This system

is still being refined, and at present is only applied to calf identification. The cows are identified by their close behavior and proximity to the calf; as a rule, these feeding females also have significant body condition deficiency.

The calf identification process was based on a set of morphological and behavioral criteria that were evaluated by photographs, video footage and photo-ID field notes. To date, it consists of the following elements: reliability grades (A – complete certainty, B – certainty, C – possible certainty) and calf identification criteria (numbered). Calf identification reliability grades are assigned based on sets of different criteria. For example, grade A with criteria 1, 2, 4 indicates that the new whale was seen in shallow waters (1), it looked like a calf (2) and the whale was observed once in close association with a mother and without other adults nearby, but after that was seen in groups with other known calves (4).

**Grade A was assigned if any 3 of the following conditions were met:**

1. the whale is not in the catalogue and was observed only in shallow waters.
2. the whale looks like a calf (has a short round rostrum, is smaller than an adult, has no "donut" -shaped barnacle spots).
3. the whale was observed two or more times in close association with a full size adult whale that was presumed to be a cow.
4. the whale was observed once in close association with a full size adult whale presumed to be a cow and without other adults nearby, but after that was seen in groups with other known calves, and possibly some adults.

**Grade B was assigned if any 3 of the following conditions were met:**

1. the whale is not in the catalogue and was observed only in shallow waters.
2. the whale looks like a calf (has a short round rostrum, is smaller than an adult, has no "donut" -shaped barnacle spots).
3. the whale was observed once in close association with a full size adult whale presumed to be a cow and with other adults nearby, but after that was seen in groups with other known calves, and possibly some adults.
4. the whale was observed once in close association with a full size adult whale presumed to be a cow and was not encountered after that.

**Grade C was assigned if any 3 of the following conditions were met:**

1. the whale was not in the catalogue and was observed only in the shallow waters.
2. the whale looks like a calf (has a short round rostrum, is smaller than an adult, has no "donut"-shaped barnacle spots).
3. the whale was observed once near a full size adult whale presumed to be a cow and without

other adults nearby, but didn't show close association.

4. the whale was observed without a mother, but was seen near other cow-calf pairs.
5. the whale was observed without a mother, but was seen in groups with other known calves, and possibly some adults.

**Grade D Additional criteria:**

1. smaller blow compared with that of adult whales.
2. playful behavior.
3. calf or cow/calf identification is confirmed by the behavior studies team.

**Notes:**

\* *Criteria D1 and D2 are used to improve the certainty of the identification, but do not affect the assigned grade.*

\*\* *If a calf identification that received grade B or C also had criterion D3, then the grade is raised to an A. If the behavior team thinks that the whale is a calf, but can't define its mother, then a C grade is raised to B.*

Not all of the above criteria are present at all times, and the weight given to the different criteria is subjective, therefore the degree of certainty in the conclusion regarding the calf identification varied from case to case. Calves that displayed some criteria, but did not satisfy sufficient conditions to be assigned a grade A or B, were retained as possible, i.e. assigned grade C.

During late August-September, calves are weaned from their mothers, and towards the end of the season solitary, unassociated small-size gray whales may be recorded. These may include recently weaned calves or yearlings. Distinguishing between the two is difficult. The only definitive criterion in identifying a yearling is a record of it as a calf in the previous year, although factors such as the presence of vibrissae, size, blow height, rostrum shape, behavior, and absence of barnacle spots can all be used to support the classification.

### 3. Results

#### 3.1. Identified whales in the Sakhalin and Kamchatka gray whale catalogues

The 2002-2009 catalogue of photo-identified western gray whales offshore Sakhalin Island currently includes 177 fully identified, individual whales. Some of these individuals have been recorded repeatedly in separate years, while others are new to the catalogue or have not been recorded for some time. The catalogue of gray whales photo-identified on the Kamchatka shelf consists of photographs of 116 fully identified animals observed in three areas: (Khalaktyrsky Beach, Vestnik and Olga Bays) during 2004 and 2006-2009. Fifty three of these whales were also observed in different areas of

the Sakhalin shelf during various years, and are most likely western gray whales. It is yet unclear which population the other 63 animals belong to that were photographed near Kamchatka peninsula, but are not identified in the Sakhalin catalogue.

#### 3.2. Identified western gray whales in 2009 (Sakhalin and Kamchatka)

In 2009, 117 whales were observed off the shore of Sakhalin (not including temporary whales). We identified 12 new gray whales including 8 calves that were not seen before in the shelf waters off Sakhalin. From May 30 to June 14 of 2009, a total of 11 whales were identified off the Kamchatka peninsula in Vestnik Bay. All of them had been registered in previous years in the Sakhalin catalogue. Field observations showed that the animals stayed in the bay for a short period of time (from several hours to two days) and then left the region.

From July 11 to September 2, 2009, 64 + 2 Temp whales were observed in Olga Bay, Kamchatka of which 28 + 1 Temp whale were registered in the Sakhalin catalogue (one whale remains a temporary because non-standard aspects (i.e. head shots) were used to match this whale between catalogues). Thirty four of them were already included in the Kamchatka catalogue, have been observed previously in Olga Bay. The other 30 + 2 Temp whales were new to the region.

Since 2006, the number of identified whales in Olga Bay has grown every year. However, this could be attributed to the start day and increased duration of the field seasons. In 2009, the number of new whales that were identified for the first time in Olga Bay also strongly depended on the observation dates. After July 21, on which the maximum number of whales (30) was registered, sightings dropped. By the beginning of September the number of whales in the bay was considerably smaller (10 whales) compared to the beginning of the survey season (25 whales).

Since the start of the surveys in Olga Bay (Kamchatka) in 2006, researchers have identified some whales that had been registered as calves in Piltun area (Sakhalin) in the previous year. In 2009, three of the five calves registered in the Sakhalin shelf in 2008 were identified in Olga Bay.

In 2009, 138 of 177 animals contained in the IBM DVO RAN Sakhalin catalogue of western gray whales were observed in both Sakhalin and Kamchatka. The total number of identified gray whales in Kamchatka and Sakhalin catalogues in 2009 alone was 174 + 1 TEMP, 100 of them being registered only on Sakhalin shelf and 56 + 1 TEMP – only off the shore of Kamchatka (21 of which have been registered in the Sakhalin catalogue in the previous years) and 18 + 1 TEMP were seen in both locations. At present, it is unknown whether all of the animals observed in the Olga Bay, Kamchatka belong to the western stock, or whether some of them belong to the eastern gray whale population.

**Cow-calf pairs:** Until 2008, cow-calf pairs had only been recorded in the Piltun feeding area, and often near the mouth of Piltun Bay, where prey abundance is high and water is shallow, giving mothers & calves ideal foraging opportunities. In 2008, for the first time, one cow-calf pair was recorded in the shallow waters of Olga Bay, Kamchatka. The mother had been previously recorded offshore Sakhalin in 2002-2006 and in Olga Bay in 2007; also had been seen with a calf offshore Sakhalin in 2003.

In 2009, 6 cow-calf pairs and 2 solitary calves (recorded without mothers) were identified on the Sakhalin shelf. Separation of the pairs started in the end of August and lasted until the middle of September, which is consistent with long-term observations. One of the photo-identified mothers was recorded with calves in both 2004 and 2006. Two other whales identified as mothers in 2009 were previously seen 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 in good physical body condition for their age class and did not show signs of emaciation.

The early start of the 2009 survey season in Olga Bay allowed for the collection of more comprehensive data about mother-calf pairs in this region. A total of seven mother-calf pairs were identified in Olga Bay in 2009. Four of the seven cows had been observed in previous years on the Sakhalin shelf, one of them was also photo-identified in the Piltun area during the 2009 season. This particular animal had been identified as a mother with a calf on the Sakhalin shelf for the first time in 2007. The remaining three mothers were observed only in Olga Bay and never before had been registered as mothers; one of them already had been observed in the Olga Bay during previous years and the two others were new to the Kamchatka catalogue.

Three of the seven mother-calf pairs seen in Olga Bay in 2009 were observed there only during the month of July; one of these three pairs, one was later observed off Sakhalin on August 25 and subsequently was seen there many times during the 2009 feeding season. One other calf was photographed near Sakhalin on August 19 and 20 without its mother, together with another calf registered in the Sakhalin catalogue. The third calf was registered as a transient whale in Vestnik Bay in November during pilot surveys. Its whereabouts during the feeding season are still unknown. In total, two out of the seven calves registered in Olga Bay in 2009 were observed in the Piltun area during the same season, one of them with its mother. The obtained data suggest 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 Bay, Kamchatka.

Starting around the middle of August, calves near the Kamchatka shores began to appear without mothers in calf groups. If these calves had not been previously identified as such with their mothers earlier in the season, identification of these whales as first-year

calves would have been difficult. The early timing of the field season offshore Kamchatka in 2009 allowed for early surveys and photographic capture of mother-calf pairs prior to separation of the calves from their mothers. It is quite possible that cow-calf pairs were present in this area even before 2008, but that they were not identified as such because the calves had already separated from their mothers prior to the beginning of the season's field studies

In total 10 calves with mothers registered in Sakhalin catalogue were observed in 2009 in two distinct regions, i.e., near the northeastern shores of Sakhalin Island and the southeastern shores of Kamchatka.

### 3.3. Movement between feeding areas by young whales

Every year during the photo-ID studies, yearling whales were recorded that had been previously identified either in the Piltun area, Sakhalin or in Olga Bay, Kamchatka. Of 5 calves registered on the shelf of Sakhalin Island in 2008, three were seen in Olga Bay in 2009. A total of eight whales that were sighted in Olga Bay offshore Kamchatka in 2008 had been recorded as calves offshore Sakhalin in 2007. One of the whales identified offshore Kamchatka in 2006, 2007 and 2008 had been recorded as a calf in the Piltun area in 2004, and was not sighted offshore Sakhalin in subsequent years. Two whales identified offshore Kamchatka in 2006, 2007 and 2008 had been recorded as calves in the Piltun area in 2003, and were not sighted offshore Sakhalin in subsequent years. One whale sighted offshore Kamchatka in 2007 and 2008 had been recorded as a calf offshore Sakhalin in 2005 and has also been sighted offshore Sakhalin in 2006 and 2007.

On 8 May 2010, a gray whale was sighted off the Israeli Mediterranean shore and twenty-two days later, the same individual was sighted in Spanish Mediterranean waters. Since gray whales were last recorded in the North Atlantic in the 1700s, these sightings prompted much speculation about this whale's population origin. Here, we consider three hypotheses for the origin of this individual: (1) it represents a vagrant individual from the larger extant population of gray whales found in the eastern North Pacific; (2) it represents a vagrant individual from the smaller extant population found in the western North Pacific; or (3) it represents an individual from the previously thought extinct North Atlantic population. We believe that the first is the most likely, based on current population sizes, on known summer distributions, on the extent of cetacean monitoring in the North Atlantic and on the results of a performed route analysis. While it is difficult to draw conclusions from such singular events, the occurrence of this individual in the Mediterranean coincides with a shrinking of Arctic Sea ice due to climate change and suggests that climate change may allow gray whales to re-colonize the North Atlantic as ice and temperature barriers for mixing between

northern North Atlantic and North Pacific biomass are reduced. Such mixing, if it was to become widespread, would have implications for many aspects of the marine conservation and ecology of these two regions (Scheinin *et al.*, 2011).



Plate 1. gray whales, body and tail

#### 4. Conclusions

Recent identification of cow/calf pairs western gray whale on the southeastern shelf Kamchatka, suggests that the Piltun area of the Sakhalin shelf is not the only feeding area for calves and that a second “nursery ground” for foraging whales is located in Olga Bay, Kamchatka.

A better understanding of the western gray whales' movements between feeding areas and their degree of site fidelity (e.g., how many feeding areas exist, how frequently are they visited and under which conditions) can be only obtained after accumulation of additional data in further studies.

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