The Joint Program for the Okhotsk-Korean Gray Whale Monitoring off the North-East Coast of Sakhalin, 2014

Photo taken by M. Swindoll

Prepared for
Exxon Neftegas Limited
and
Sakhalin Energy Investment Company Limited

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EXECUTIVE SUMMARY

The Okhotsk-Korean Gray Whale, also known as the Western Gray Whale (WGW), has been the subject of scientific investigations sponsored by Exxon Neftegas Limited (ENL) and Sakhalin Energy Investment Company Ltd. (Sakhalin Energy) since 1997. The companies combined their efforts in 2002 with the establishment of the Joint Program for monitoring WGW and habitat off northeast Sakhalin. The Joint Program, implemented by scientists from leading Russian institutions, has four primary areas of investigation: WGW photographic-identification, WGW distribution surveys, benthic prey surveys, and acoustic monitoring. The Joint Program efforts have resulted in obtaining information that supports conservation of the WGW and habitat, and helps the companies mitigate potential effect of operations to the WGW. The 2014 Report of the Joint Program for the Okhotsk-Korean Gray Whale Monitoring off the North-East Coast of Sakhalin provides the 2014 results from the implementation of the Joint Program's four primary areas of investigation.

WGW spend the period from June-November off NE Sakhalin where two primary feeding areas for WGW are known. The feeding areas are characterized by high biomass of benthic organisms that include amphipods, isopods, sand lance, and sand dollars. The WGW show a high fidelity to the feeding areas with the vast majority of those WGW identified off Sakhalin each year being the same individuals sighted in previous years. For example, 97.6% of non-calf WGW sighted in 2014 had been identified off NE Sakhalin at least once in previous years. Since the discovery of approximately 20 gray whales off NE Sakhalin in the early 1980s, the numbers of WGWs have steadily increased each year. In 2002, the first year of the Joint Program, 47 WGW were identified. As of 2014, a cumulative total of 243 individual WGW have been identified by the Joint Program. Of these whales, 199 individual WGW have been observed in the last five years. During 2014, 137 identified WGW were sighted, including 12 calves and three first time sighted non-calf WGW.

The winter habitat and migration route of WGW were unknown until satellite tagging sponsored by the companies established the migration of three WGW to coastal North America in 2010-2012. The overlap of the geographic ranges of the Western and Eastern gray whale stocks established through satellite tracking was further verified by other scientists through comparisons of photo-ID catalogs and genetic matches. To date, >30 Sakhalin gray whales have been documented in the ranges of both Western and Eastern gray whales. Based on these finding, a reasonable conclusion can be made that all gray whales found in the Pacific are possibly of a single mega-population of North Pacific gray whales. This understanding could be important for the development and implementation of measures protective of all gray whales.

Gray whales in the North Pacific are faced with natural threats (e.g., predation, disease and starvation) and anthropogenic threats (e.g., entanglement in fishing gear, vessel strikes, pollution, and noise). ENL's and Sakhalin Energy's commitments to minimizes risks of operations to WGW led each company to develop Marine Mammal Protection Plans (MMPPs) that prescribe criteria for conducting their operations in a manner protective of WGW and other marine mammals. Measures implemented by the companies have successfully mitigated potential risk of operations on WGW, and no incidents involving WGW have occurred. Additionally, noise from natural and anthropogenic sources has been monitored in the WGW feeding areas since 2003. The acoustic monitoring has demonstrated that the mitigations resulted in noise levels believed not to affect the WGW.

1. INTRODUCTION

Exxon Neftegas Limited (ENL), operator of the Sakhalin-1 project, and Sakhalin Energy Investment Company, Ltd. (Sakhalin Energy), operator of the Sakhalin-2 project, are developing oil and gas reserves on the continental shelf off northeast Sakhalin Island, Okhotsk Sea, Russia. These projects are located in proximity to habitat used during ice-free months by the Okhotsk-Korean gray whale (*Eschrichtius robustus*), also known as the Western gray whale (WGW). The WGW was believed extinct until approximately 20 gray whales were sighted off the northeast coast of Sakhalin in the early 1980s. The occurrence of gray whales within the former range of the Western gray whale, led to the conclusion that these whales were remnant WGW survivors. Following the discovery of these whales, the population of Okhotsk-Korean gray whale was listed in Category 1 as "threatened to extinction" in the Russian Federation Red Book and as "critically endangered" by the International Union for the Conservation of Nature (IUCN).

The Environmental Impact Assessments (EIAs) and the State Ecological Expert Reviews (SEERs) conducted for the Sakhalin-1 and Sakhalin-2 Projects identified the WGW as being of primary concern for each Company's operations on the northeastern Sakhalin shelf. Based on recommendations of the Project SEERs, monitoring studies of WGW and their habitat were initiated in 1997 by each Company. Since 2002, ENL and Sakhalin Energy (the "Companies") have combined efforts and funding for monitoring of WGW and their habitat under the Joint Monitoring Program for Okhotsk-Korean (Western) Gray Whale off Northeast Sakhalin (i.e., Joint Program). Currently the Joint Program consists of four components: photo-identification of WGW, distribution surveys of WGW, benthic prey studies, and acoustic monitoring.

The Joint Program is one of the few long-term multi-disciplinary research programs with focus on a specific marine mammal and location (Figure 1). Prior to initiating the Joint Program there was relatively little reliable scientific data about WGW, with much of the

Figure 1. The Sea of Okhotsk showing the Joint Program study area off northeast coast of Sakhalin Island, Russia.

understanding of WGW based on unproven or antidotal information, uncertain historical records, and often unsubstantiated assumptions and conclusions. The Joint Program established a scientific framework to obtain information needed to improve knowledge of these whales, their habitat, and potential hazards to these whales.

1.1. Objectives of Joint Program

The Companies' objectives for conducting the Joint Program are to:

- Increase scientific understanding of the WGW aggregation and ecology, and factors that affect the gray whale population and habitat; and,
- Assess condition of WGW aggregation (e.g., size, growth rate, etc.) and habitat

The information obtained from the Joint Program is used by the Companies to:

- Ensure that Companies' activities are conducted in a manner that do not adversely affect the WGW and habitat (per Russian requirements); and
- Identify and implement mitigations that minimize risks of Companies' activities to the WGW and habitat.

1.2. Components of Joint Program

The Joint Program is conducted by Russian researchers from leading Russian research institutes in the Far East and Moscow. The components of the Joint Program, the institutes and key researchers involved in the program are:

WGW Photo-Identification Studies. Photo-ID studies have been conducted each year since 2002 to identify individual gray whales. The identification of individual animals provides information on population dynamics and demography, social structure, and individual life histories. In addition, the photo-ID data provides information for long-term assessments of population status and health. Photo-ID studies are implemented by the A. V. Zhirmunsky Institute of Marine Biology of the Far Eastern Branch of the Russian Academy of Science in Vladivostok (IBM) with Dr. Yuri M.Yakovlev and Olga Y. Tyurneva, Candidate of Biological Sciences, as scientific leads.

WGW Distribution Studies. Since 2002, the Joint Program has studied WGW distribution and abundance in the Piltun and Offshore feeding areas, as well as in the Piltun-Astokh and Arkutun-Dagi concession blocks. Each year, WGW distribution surveys have been conducted by shore-based and vessel-based teams. The distribution studies have been implemented by the Sakhalin State University with Dr. V.A. Vladimirov as scientific lead.

Benthic Prey Studies. Gray whale prey studies have been conducted since 2002 to evaluate status of benthic prey in the study areas. Benthic and sediment samples are collected for analysis from within and close to the two primary WGW feeding areas (i.e., Piltun and Offshore feeding areas). The benthic studies are implemented by the A.V. Zhirmunsky Institute of Marine Biology of the Far Eastern Branch of the Russian Academy of Science in Vladivostok (IBM), with Dr. Viktor V. Ivin as scientific lead.

Acoustic Studies. Acoustic studies, which document both natural (ambient) and anthropogenic sound levels in the WGW feeding areas, have been a component of the Joint Program since 2003. In addition to measuring sound levels, hydrology data are collected that allows the modeling and understanding of sound propagation in the WGW feeding areas. Acoustic studies are implemented by Pacific Oceanological Institute of the Far Eastern Branch of the Russian Academy of Science in Vladivostok (POI) with Dr. Alexander N. Rutenko as scientific lead.

2. JOINT PROGRAM METHODS

The methods used by each study component of the Joint Program have been developed and refined over the course of 13 years implementation of the program. The methods used for each component of the Joint Program reflect the current state-of-the-science and, as needed, are refined each year to meet the current study objectives, and/or technical and logistical requirements. Importantly, methods that are used by the Joint Program reflect a Best Practice that minimizes disturbance to WGW. The methods used for the 2014 Joint Program are described in the"2012 Methods Report" (WGW Program, 2013). Any revisions to these methods that occurred for the implementation of the 2014 components are described in the Joint Program individual scientific reports provided as Appendices I – IV.

3. JOINT PROGRAM RESULTS

Each year since the 2002 field season, the results of the Joint Program have been presented in the annual reports that are provided to the Russian authorities and other stakeholders. The results for the 2014 Joint Program field work, as well as compilations of results for the entire period of the Joint Program (2002-2014) are provided in the scientific reports prepared for each component in the Appendices of this report as follows:

- **Appendix I.** Photo-Identification of Gray Whale (*Eschrichtius robustus*) Off the Northeast Coast of Sakhalin Island in 2014 (March 2015)
- **Appendix II**. Distribution and Abundance of Gray Whales In Northeast Sakhalin Coastal Waters in August-September 2014. (March 2015)
- **Appendix III**. Benthos studies in the feeding grounds of gray whales (*Eschrichtius robustus*) off the North-East coast of Sakhalin Island in 2014 (March 2015).
- **Appendix IV**. Acoustic and Hydrological Studies on the Northeast Sakhalin Shelf June 10 through October 10, 2014 (March 2015)

4. CURRENT UNDERSTANDING OF WGW AND HABITAT

Since the Companies began investigations of WGW in 1997 and initiated their Joint Program collaboration in 2002, a great deal has been learned about the WGW and their habitat, including population parameters, movements, behaviors, and food resources. This section of the report provides a discussion of the current understanding of the Sakhalin gray whale aggregate and its habitat, and includes a discussion of the potential threats to the WGW, and the mitigations implemented by ENL and Sakhalin Energy that reduce potential risks posed to the WGW and habitat by the Companies' operations.

4.1. WGW Population

Historically, gray whales of the north Pacific Ocean have been considered to comprise two populations or stocks: (1) the Okhotsk-Korean or western gray whales (WGW) population that inhabits the north Pacific coastal areas of Asia (e.g., Russia, Japan, China, Korea), and (2) the Chukchi-Californian or eastern gray whale (EGW) population that inhabits the Pacific coastal water of North America (e.g., Canada, USA, Mexico) and Chukotka Peninsula region, Russia (Figure 2). During the 19th and 20th centuries, the numbers of Pacific gray whales were significantly reduced by commercial whaling. In 1938, the US Government set a moratorium on the commercial whaling of the Eastern gray whale; the moratorium was expanded in 1948 by the International Whaling Commission to include all gray whales. These actions resulted in a steady recovery of the gray whale numbers. Based on the latest surveys taken in 2006 / 2007, the population of the Eastern gray whale was estimated to consist of 19,126 (CV=7.1%) whales (Laake et al. 2009) and is not considered threatened. The population of the Okhotsk-Korean gray whales was believed to have been essentially hunted to extinction by the mid-20th century. However, in 1983, approximately 20 gray whales were observed off northeast Sakhalin (Blokhin et al. 1985) and at the time, it was concluded that these whales were the remnant survivors of the Okhotsk-Korean gray whale population (i.e., Western gray whale, WGW).

Since the sighting of the WGW in Sakhalin waters in the 1980s, the cumulative total of individual WGW identified off NE Sakhalin has steadily increased. In 2002, the first year of Joint Program photo-ID studies, there were 47 individual WGW identified. In 2003, with the inclusion of WGW sighted at both the Piltun and Offshore feeding areas, the number of identified WGW increased to 92 individuals. As of 2014, a cumulative total of 243 individual WGW have been identified and are included in the IBM catalog of Sakhalin WGW. During the 2014 field season, 12 young-of-the-year calves and three non-calf adults were identified and added to the IBM photo-ID catalog.

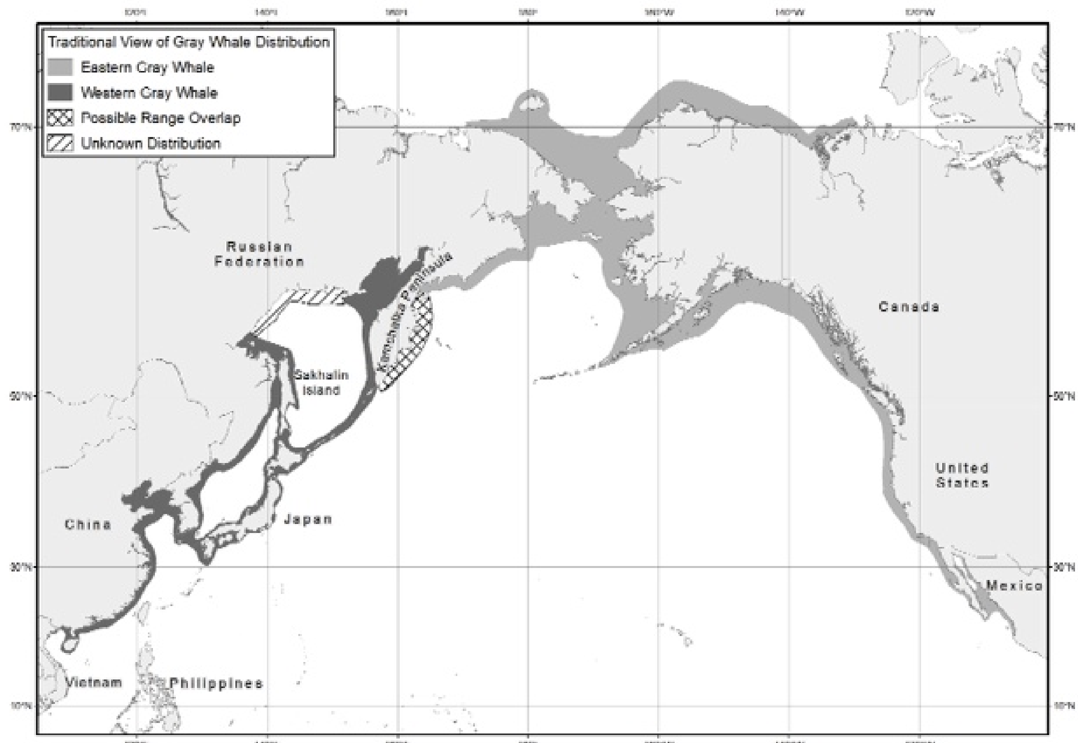

Figure 2. Distribution of the two currently recognized stocks of North Pacific Gray Whales (from Bickham et al., submitted)

4.1.1. Population Growth

The growth and sustainability of any population is dependent upon a multitude of factors including successful reproduction and survival of offspring. Two key issues related to population growth of the Sakhalin WGW are: 1) to obtain an accurate estimate of the annual rate of increase, and 2) estimate the degree to which any observed increase is due to internal recruitment (calves born to females of the population) or external recruitment (immigrants from other populations). Population modeling utilizing the WGW photo-ID data of the Russian-American team collected from the Piltun feeding area was used to estimate an annual population growth rate of3.3% (±0.5%) (Cook et al., 2013). The accuracy of this growth rate calculation is dependent on several key assumptions of the model (e.g., number of females of reproductive age; calf mortality rate; and a closed system) that are not known, uncertain, and may be inaccurate (e.g., the population may not to be a closed system since new non-calf whales are identified each year).

The WGW population modeling conducted using data (1995 - 2011) from Russian-American photo-ID catalog projected a WGW population of 151 whales (90% CI: 132-166) for 2012, including 32 (90% CI: 18-36) breeding females (WGWAP-11 February, 2012). However, based on the Joint Program data, it is believed that the number of WGW could be at least 20% higher than this estimate and that there could be more than 200 individual Sakhalin WGW. Reasons for believing that the actual numbers of WGW could be greater than the population estimate include: (1) the high number of identified WGW that have been sighted by the Joint Program. Even with the limited size of the geographic area that is included in the monitoring program, there are 200 individual WGW identified in the IBM catalog that have been sighted since 2010. During the 2012 season alone, 150 WGW identified in the IBM catalog were sighted; (2) the model used to develop the population estimate assumes it to be a closed system. However, tracking from the satellite tagging of WGW in 2010 and 2011 and comparison of photo-ID data have demonstrated the overlap of ranges of the western and eastern gray whales. Additionally, each year new non-calf whales are identified which indicates that not all WGW occurring off Sakhalin are seen each year and/or that new whales are coming into the area; and (3) there are routine sightings of gray whales at other locations within the Sea of Okhotsk and off Kamchatka in which the individual whale is not identified within the IBM catalog; these whales are not included in the estimation of population size. When WGW sighted by the Joint Program are combined with whales sighted at Kamchatka, there are > 260 individual gray whales that have been sighted since 2010; whether all these whales are members of the Sakhalin gray whale feeding aggregate is unknown.

What is certain is that the number of WGW that have been identified off NE Sakhalin has increased each year since the sighting of ~20 WGW in 1983. For the period 2006 to 2014, the number of identified WGW (both calves and non-calf WGW) added to IBM catalog each year averaged 6.7% (range: 3.1% - 9.5%). Some of the increases to the IBM catalog in the early years of the study were due to increased effort and/or increased area of coverage. Nonetheless, the consistent addition of whales each year and documentation of calf production over the past decade confirms both a growing population and one that is not solely dependent upon external recruitment for recovery. The estimated 3.3% annual growth rate of the Sakhalin WGW aggregate compares favorably with the Bering-Chukchi-Beaufort Seas (BCB) population of bowhead whales which has grown from approximately 1,000 whales in the early part of the 20th Century to an estimate 16,892 with an estimated annual rate of increase of 3.7% in 2011 (Givens et al., 2013). In short, the current estimate of the growth rate of the Sakhalin WGW, while it may be underestimated, is consistent with the observed growth rate of another species of great whale that has recovered from the devastating effects of commercial whaling.

4.1.2. Cow / Calf Pairs

The Joint Program has recorded cow / calf pairs (i.e., mother with offspring) in Sakhalin and Kamchatka waters through sightings by photo-ID, and shore- and vessel-based distribution teams. Although the number of cow / calf pairs sighted varied from year to year (between 3 and 15 from 2003–2014), it provides information about the health of the population and the reproductive success of female whales. Obtaining an accurate count of the number of new calves each year is challenging, since a calf is often difficult to identify when separated from its mother. Cow / calf separation can happen anytime throughout the summer, but accelerates by late August, with most calves in the Piltun feeding area believed to be independent from their mothers by mid-September. The number of cow / calf pairs derived from photo-ID data is generally considered the most accurate, since observations of cow / calf pair or of single calf can be individually identified only through photographic analyses.

Within the Piltun feeding area, cow / calf pairs were most often observed around the mouth of Piltun Bay. Although cow / calf pairs have also been observed feeding in other parts of the Piltun feeding area and in Olga Bay off SE Kamchatka (this was first observed in 2008), the area near the mouth of Piltun Bay seems to be the preferred area since this is where cow / calf pairs are most often observed. Over the entire monitoring period of the Joint Program, calves have never been observed in the Offshore feeding area. It is hypothesized that calves may require shallow waters (e.g., 10 m or less) to learn to feed and to readily obtain prey, and that at the greater depths (e.g., ~ 40-60 m) of the Offshore feeding area it would be difficult for calves to feed.

During 2014, 12 calves were identified. For the period from 2002–2014, a total of 97 calves from 26 mothers in the Sakhalin catalog have been identified. During the 2002-2014 period, 9 of these cows (37.5%) were only observed with a calf in one year; five cows (19,2%) were seen with a calf in two separate years; seven cows (26,9%) were seen with a calf in three separate years; and five cows (19,2%) were seen with a calf in four separate years. The average calf interval was 3 years for the 17 cows with multiple calves.

Olga Bay off SE Kamchatka may be more important for cow / calf pairs than data from earlier years suggested. Since the first observation in 2008, cow / calf pairs were seen in Olga Bay each year thereafter (i.e., seven in 2009, three in 2010, two in 2011, and three in 2012). No surveys were conducted in Kamchatka in 2013 or 2014. The majority of mothers (55%) seen in Kamchatka with a calf were also photographed offshore Sakhalin Island, either during the same year or in previous years, and are included in the Sakhalin

WGW catalog. Three mothers observed in 2009 in Olga Bay were never seen off Sakhalin, but were observed in Kamchatka before and after 2009.

It is believed that an important reason for cow / calf pairs to concentrate in coastal shallow waters such as the mouth Piltun Bay is that they are more protected here from attacks of transient killer whales, typical for east Sakhalin waters. In cases of such attacks, WGW can escape to coastal shallow waters where the cow can more easily protect the calf. The potential predation of gray whale calves by killer whales could help explain the absence of cow / calf pairs in deep waters of the Offshore feeding area where they would be vulnerable to killer whale attacks. Cases of predatory behavior of killer whales towards gray whales have been observed within the Piltun feeding area, although rarely. It is difficult to assess if predation is an important factor affecting calf survival during the feeding season while in Sakhalin waters.

4.1.3. Whale Body Condition

Based on photographs of WGW, it was observed that some individual WGW appear to be thin or in poor body condition, at least early in the feeding season.During the past 12 years, the photo-ID data for each year showed 10-20% of WGW with poor body condition, with most of these observations occurring early in the feeding season. The body condition of individual whales over the course of the feeding season showed two main trends: (1) the body conditions of most whales that were assessed as poor at the start of the feeding season improved towards the end of the season, and (2) most whales with a poor body condition were lactating females (i.e., mother observed with a calf). Both trends make sense considering the life history of gray whales. Early spring gray whales migrate from their winter habitat to feed in areas rich in prey resources. It is believed that the whales do not feed or feed very little during their migrations (Nerini, 1984), thus their body-fat reserves are being depleted during the migrations.

4.2. WGW Annual Migrations

Prior to 2010, little was known of the winter migrations and habitat of the gray whales observed off NE Sakhalin during ice-free months (e.g., June-November). Each year as the sea ice clears in late May to early June, gray whales begin to appear off the coast of NE Sakhalin. During June and July the number of WGW observed increases, and by August most of the sighted WGW are concentrated in the two primary feeding areas (Figure 3). WGW are observed off NE Sakhalin until they begin their winter migration usually during November, and by early December, essentially all WGW have departed from NE Sakhalin.

Based on historical records of gray whale sightings in the waters of Japan, Korea and China by whalers and seamen, it has been assumed by many scientists that WGW migrate to winter grounds at undetermined locations in the South China Sea. This assumption was bolstered by infrequent gray whale sightings and reports of gray whales tangled in fishing nets or stranded on beaches in Japan and China. However, due to the paucity of gray whale sightings in the South China Sea and other areas along their assumed Asian migration route (e.g., Japan, Korea, China), scientists remained uncertain as to where WGW go each winter when they leave the ice-bound waters of Sakhalin.

The sightings of a gray whale in 2010 in the Mediterranean Sea near Spain and Israel (Scheinin et al. 2011) and the sighting of another gray whale in 2013 in the Atlantic Ocean off the coast of Namibia (Africa), provide evidence that gray whales are capable of undergoing long-distance dispersal. Thus the occasional sighting of gray whales off of Japan and other areas south of Sakhalin does not come as a surprise. The Atlantic Ocean sightings hold promise that gray whales have the potential of repopulating areas, such as the North Atlantic Ocean from which they have been extirpated. Such a repopulation may be an explanation for the occurrence of gray whale in the Sea of Okhotsk and off of Sakhalin following a period when the WGW was assumed extinct.

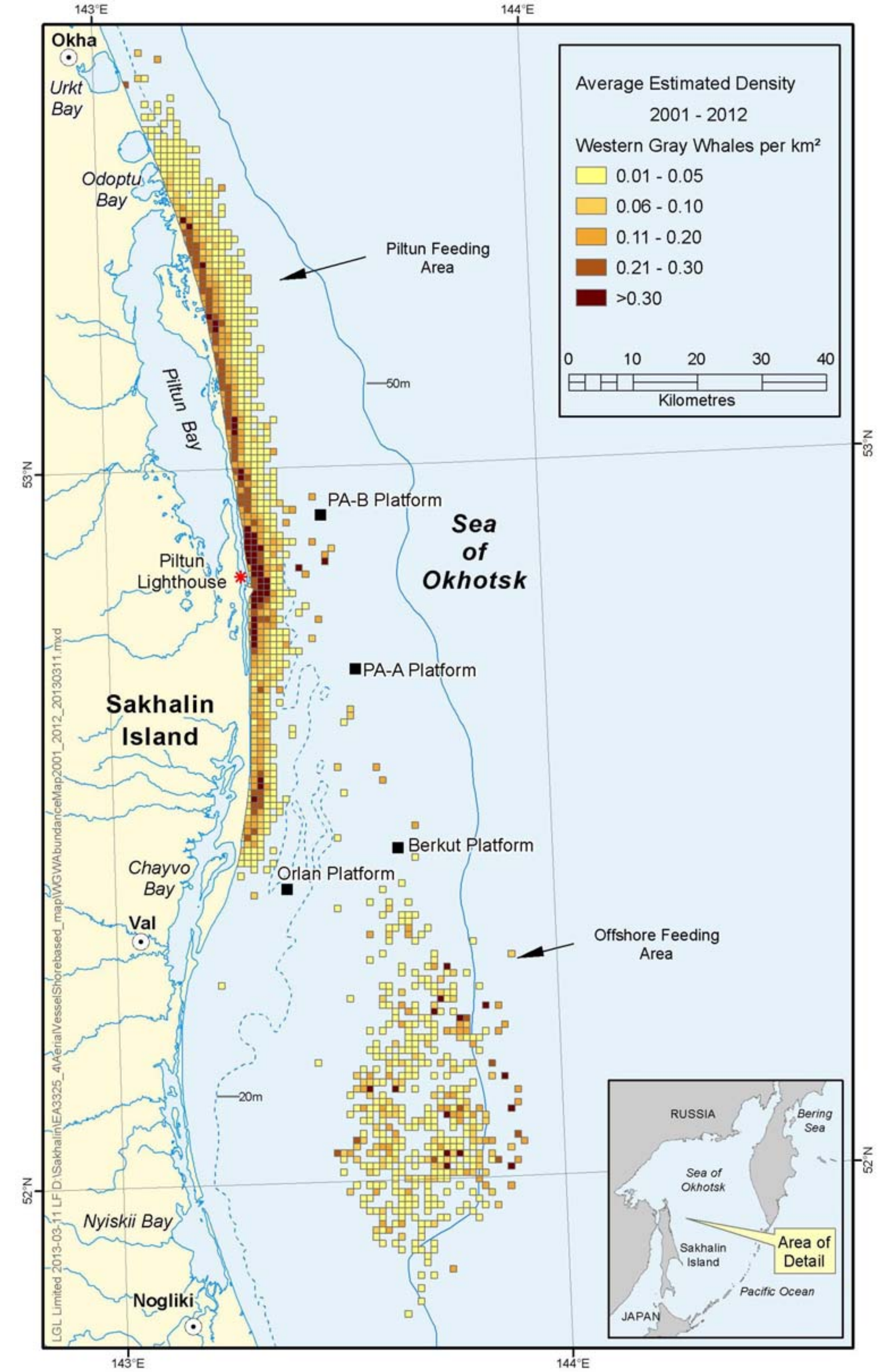

Figure 3. Locations of sightings of WGW in the Piltun and Offshore feeding areas.

4.3. WGW Distribution off Northeast Sakhalin

WGW are known to migrate to the Sea of Okhotsk each spring and summer, and spend much of the ice-free months in the two identified feeding areas off NE Sakhalin where they have access to abundant benthic food resources. The data collected by the Joint Program distribution and Photo-ID teams since 2002 has facilitated the understanding of WGW abundance, distribution, and movements off NE Sakhalin. However, the distribution and abundance of the WGW in other areas of the Sea of Okhotsk remains uncertain since monitoring conducted by the Joint Program is limited to the immediate area of NE Sakhalin that includes the Piltun and Offshore feeding areas.

The Joint Program has identified two areas off NE Sakhalin that serve as primary feeding areas for WGW: the Piltun or "near shore" feeding area and the Morskoy or "offshore" feeding area. Each year, most WGW sighted by Joint Program monitoring teams are within these two primary feeding areas. However, in addition to the these feeding areas, WGW have also been observed feeding in other locations in the Sea of Okhotsk and near Kamchatka. From the Joint Program Photo-ID and distribution studies it is clear that individual WGW move back and forth between the two primary feeding areas within each feeding season and that the distribution of WGW and their relative abundance within each feeding area are variable both across each feeding area (i.e., space) and within each year and among years (i.e., time).

4.3.1. Piltun Feeding Area

The Piltun feeding area, or the "near shore" feeding area, located just east of Piltun Bay extends along the coast from approximate latitudes 52 20' to 53 20' with an area of ~1000 km^2 (Figure 3). WGW within the Piltun feeding area are sighted along a 60 km stretch of coast line and typically remain in waters depths of less than 15-20 m and typically no more than 4-5 km away from shore. Based on WGW sighting data, it can be concluded that the boundaries of the area defined as the Piltun feeding area have gradually expanded southwards over the last 30 years (i.e., 1984-2014).

Each year, the WGW begin arriving in the Piltun feeding area in May as the winter ice begins to breakup along the coast of NE Sakhalin. Due to ice and fog conditions in May and early June, WGW are not easily sighted from shore; therefore, the abundance of WGW and their distribution within the Piltun feeding area during the early season are not well documented. In 2012, satellite-tagged whale Varvara was tracked arriving in the Piltun feeding area on May 18 following her migration from Mexico and Kamchatka, which was earlier than complete breakup of the winter ice cover.

Each year, the greatest abundance and concentration of WGW are typically observed congregating in waters adjoining the mouth of the Piltun Bay (Figure 3). Based on the 2002-2014 distribution data it can be concluded that the highest densities of whales are typically near the mouth of the Piltun Bay, and there is considerable variability in WGW use of the northern and southern part of the Piltun feeding area. In late summer, WGW have also been observed congregating in the northern part of the Piltun feeding area (near survey stations No. 4-6) and in some years (e.g., 2004 and 2005) WGW congregated here in large groups that remained, more-or-less, throughout the season. In some years, smaller groups are also sighted southward in the vicinity of Chayvo Bay.

The numbers of WGW sighted within the Piltun feeding area by the on-shore distribution survey teams fluctuates from year to year. Based on shore-based survey data, the number of WGW observed during single-day synchronize counts were highest in the years 2004-2006 (range 128-138 WGW) and lowest in years 2007-2010 and 2013 (range 47-73 WGW). In 2014, the maximum number of WGW sighted in the Piltun feeding area for a single day was 44 whales (September 15). The fluctuations of the numbers of WGW observed in Piltun feeding area within a single year and between years are believed to be due to a redistribution of WGWs among the feeding areas (i.e., Piltun, Offshore and Kamchatka).

Distance from Shore

Based on the Joint Program monitoring data, it appears that WGW tend to stay closer to shore during the early months of the feeding season (i.e., June-August) as compared to later during the season (i.e., September). Up to the end of August, approximately 80% (in 2007-2010) of the whales sighted in the Piltun feeding area were within two kilometers from shore, with corresponding water depths of < 10 meters. Cow / calf pairs and single calf were typically observed even closer to shore (< 1 km) than were non-calf individuals.

The greater abundance and distribution of both adults and calves in the near shore areas of the Piltun feeding area during June and July may be due to a combination of the occurrence of high biomass of benthic food resources and the shallow water depths. Cow / calf pairs have only been observed off Sakhalin in the shallow, near shore areas and have not been sighted in deeper areas of the Piltun feeding area or the Offshore feeding area. The young-of-year calves may have limited abilities to dive to depth, thus it would be advantageous for calves to remain in shallow areas to feed. In addition, the calves as well as non-calves would have to exert less effort feeding in shallow water. As benthic biomass is probably easier to harvest at shallower depths, whales are likely to start feeding here upon arrival off Sakhalin. Another factor that could contribute to why the WGW appear to prefer shallow areas during the early feeding season is that protection of the calves (and adults) from predation would be much easier in the shallow waters where their primary predator the killer whales (Orca) can be more readily fended off by gray whales.

Later in the season (i.e., September), some WGW appear to venture into deeper depths of the Piltun feeding area, and have been observed in the areas that are two to five km from shore where water depths range from approximately 10 to 20 meters. WGW are believed to make the movement to deeper areas of the Piltun feeding area and to the Offshore feeding area in search for the higher biomass of their preferred prey which may be somewhat reduced in near-shore areas by intense feeding. However, the majority of WGW observed in the Piltun feeding area through the entirety of the feeding season were sighted in the near shore zone of less than two km from shore.

4.3.2. Offshore Feeding Area

The Offshore feeding area (OFA) or the Morskoy feeding area, located about 40-50 km South-South-East of the Piltun feeding area and eastward of Chayvo and Nyisky Bays, extends from ~25 to 50 km from shore at approximate latitudes of 51 50' to 52 30' and covers of areas of ~1400 km^2 (Figure 3). Prior to the discovery of the OFA by Joint Program scientists in 2001, it was assumed that the Piltun feeding area was the sole Sakhalin feeding area for WGW. The importance of the OFA to the WGW is now well established. The OFA is characterized by water depths ranging from 35 to 60 m and benthic biomass that has remained high and stable over the years of monitoring. Importantly, the OFA provides a source of preferred benthic food resource (i.e., amphipods) that can supplement the Piltun feeding area. Due to the greater depth of the OFA, WGW feeding is much more energy intensive than is feeding in the shallow Piltun feeding area.

There has been considerably less survey effort in the Offshore feeding area than has been conducted in the Piltun feeding area. Typically, four to six vessel-based distribution surveys of the OFA are done each year during the August-September timeframe (Figure 4). The Offshore feeding area surveys required the use of a vessel, which was not available every day since it is also shared for other work activities. These surveys are dependent upon favorable weather and sea conditions to allow the completion of each day-long survey; due to poor weather and sea conditions surveys are not typically conducted during June, July, or October. Nevertheless, due to the vessel-based surveys conducted in the OFA it is possible to assess both the inter-seasonal and intra-seasonal variability in use of the OFA. Over the course of the feeding season the number of WGW in the OFA gradually increases. This increase typically corresponds with an observed decrease in numbers of WGW in the Piltun feeding area towards the end of the feeding season (i.e., September), suggesting a possible preference for feeding in the OFA at this time. As with the Piltun feeding area, there is substantial inter-seasonal variation in the distribution and abundance of WGW sighted in the Offshore feeding area.

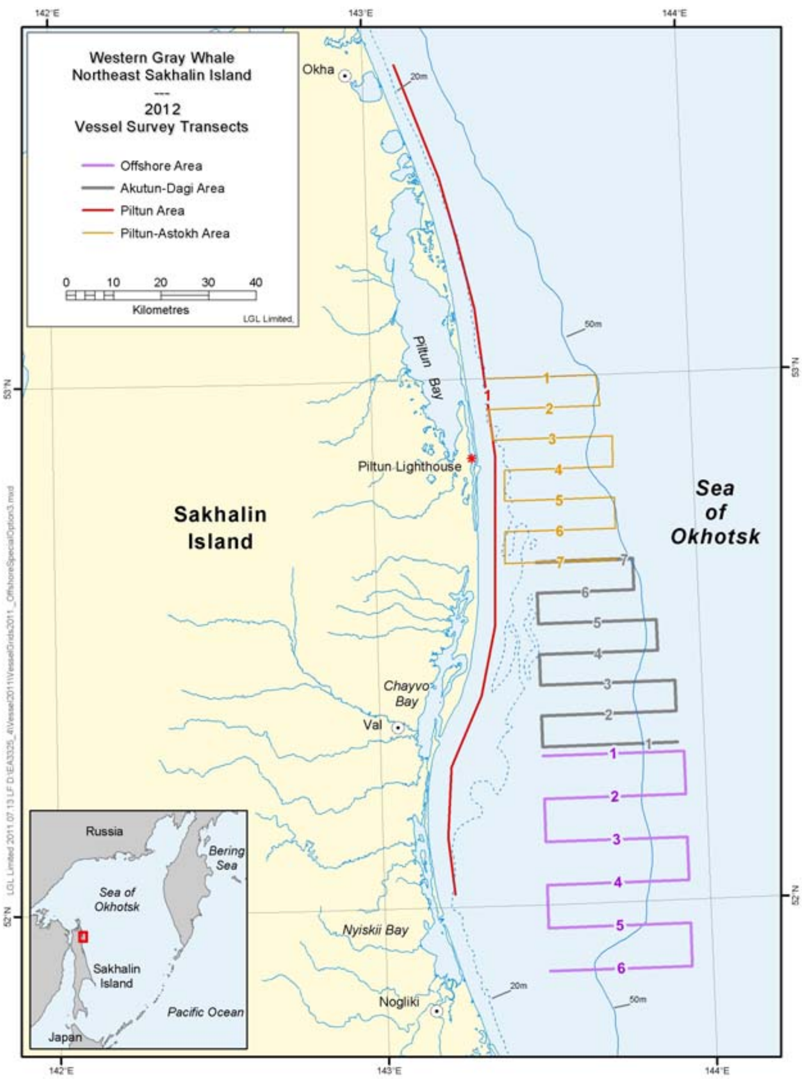

Figure 4. The transects of vessel-based distribution surveys of gray whales.

Since 2004, there has been a gradual expansion of the OFA eastward, with more frequent sightings of WGW along the eastern portion of the survey grid. In 2009, a considerable number of whales (11 WGW) were sighted north-east of the OFA survey grid in an area where WGW had not been previously sighted. This eastward shift towards deeper waters was also observed in 2010. In 2012 the concentration of WGW shifted to the central, most shallow part of the OFA; while in 2013 the WGW shifted to the south-eastern part of the OFA with depths of about 50 m. The sighting of actively feeding WGW at varied locations within the OFA and beyond the eastern boundary of the OFA confirms that suitable feeding areas for WGW are not limited to the boundaries of the OFA as established by the survey grid, but instead extend to a much larger area that has yet to be fully delineated.

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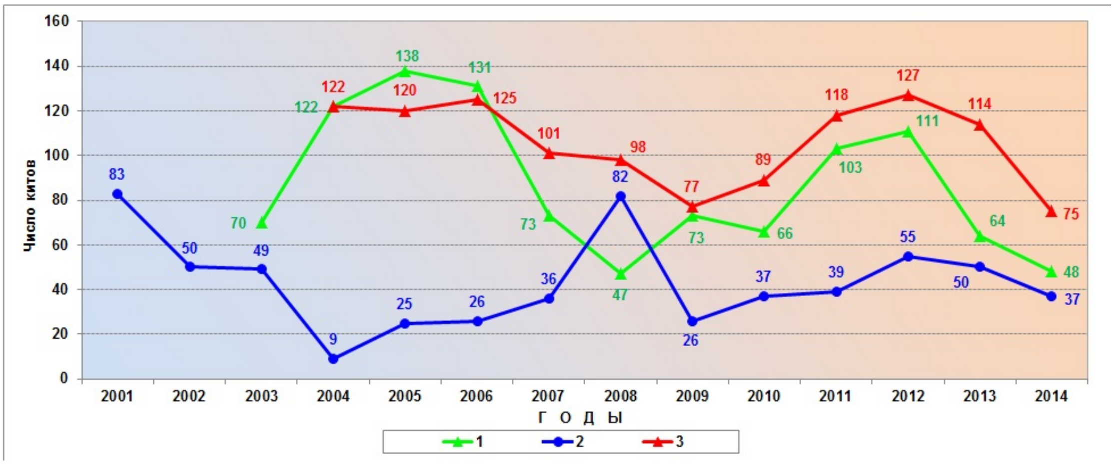

Figure 5. Interannual variations in Gray whale maximum numbers in feeding areas (i.e. Piltun (1), Offshore (2) and in both feeding areas (3) during the simultaneous surveys (not the sum of maximum numbers of Gray whales in Piltun and Offshore feeding areas) the simultaneous surveys (not the sum of maximum numbers of Gray whales in Piltun and Offshore feeding areas)

4.3.3. WGW Site Fidelity

The WGW identified off Sakhalin show a high site fidelity to the Piltun and Offshore feeding areas. Year after year, the vast majority of those WGW identified in a given year off Sakhalin are the same individual WGW sighted in previous years. For example, of the 125 non-calf WGW identified in 2014 off Sakhalin, 122 or 97.6% had been identified off NE Sakhalin at least once in previous years. Approximately one-third of all identified Sakhalin WGW have been seen every year since the year of their first sighting; while most of the other individual WGW have been re-sighted in some or most of the years following their first sighting. The formation of feeding groups that show high site fidelity is not uncommon among gray whales. A group of Eastern gray whale has been identified that consistently feeds in the area between the coast of Californian and the Alaskan peninsula and is referred to as the Pacific Coast Feeding Group (Calambokidis et al., 2010; Scordino et al., 2011).

Why the WGW have a high fidelity for the Sakhalin feeding areas is not certain but can be reasonably surmised. Each year, cows with calves are observed in the Piltun feeding area (as discussed in Section 4.1.2). It seems probable that a WGW calf travelling with its mother learns the migration route from their winter habitat (which possibly includes lagoons of Baja California, Mexico) to the Sakhalin feeding areas. Once the migration route is known to the WGW as a calf, the individual WGW continues to following the route each year to the location where preferred food is known to the whale to be available. It is also probable that these migrations are conducted with WGW traveling in groups, which would further reinforce the learning the migration routes, feeding areas, and winter habitats. Although little is known concerning the social structures of gray whales, the high fidelity of those gray whales sighted each year off Sakhalin suggests that these whales have strong social bonds that contributes to the maintenance of an "aggregate" of Sakhalin whales that feed in waters off Sakhalin.

Not all individual whales identified in the IBM Sakhalin WGW catalog are sighted every year. For example, for the year 2014, 122 individuals or 53.5% of the WGW in the IBM catalog were sighted, and in 2013, 119 individuals or of the WGW in the IBM catalog were sighted. However, over the last two years (2013 and 2014) there were 167 individuals in the catalog sighted; over the last three years (2012-2014) there were 176 individual WGW sighted; and over the past four years (2011-2014),181 individual WGW or 78% of the WGW in the catalog were sighted. On average, 89% of the WGW seen in a given year are seen the next year and 97.6% are seen within two years.

There are a number of possible explanations as to why WGW known to Sakhalin are not sighted during a single year or for multiple years. First, the individual WGW may not be using the Sakhalin feeding areas during the period that monitoring occurred, but instead use the feeding areas at times other than during the monitored period (e.g., October-December). Alternatively, it is possible that an individual WGW was present during the monitoring period but was not sighted by the Photo-ID team. Due to the vast size of the Sakhalin feeding areas (~2400 km^2), the Photo-ID team is only able to monitor a limited area on any given day; therefore, it is expected that not all WGW present during the monitoring period will be sighted by the Photo-ID team. In addition, the WGW are frequently moving within the Sakhalin feeding areas, thus may be missed and not photographed for identification. In some cases, an individual WGW is observed, but the Photo-ID team is unable to acquire the photographs necessary for identification of the WGW (these WGW are assigned as "Temporary" in the IBM catalog). From the 2010 and 2011 satellite tagging data, at least two occurrences are known when WGW were in the Sakhalin feeding area during the monitoring period but were not sighted by the Photo-ID team. Another explanation as to why an individual WGW is not sighted is that the WGW did not migrate to the Sakhalin feeding areas during the monitored year and instead the WGW used other feeding areas. It is also possible that WGW are not being sighted because the individual is no longer alive. Fatalities of WGW are known. In 2010, a dead WGW was discovered on the beach south of Chayvo, and an unidentified dead WGW was sighted in 2011 offshore east of Chayvo Bay. Additionally, some WGW fatalities are known as the result of entanglement in fishnets off Japan.

First-Time Sightings

First-time sightings of non-calf (i.e.,subadult and adult) individual WGW off Sakhalin have occurred every year of the Joint Program, with the exception of 2008. Typically, three to five non-calf WGW (average 3.4 for 2007-2014) are sighted each year that had not been identified in previous years. These first-time sightings result in the addition of new whales to the IBM Sakhalin WGW catalog. The number of first-time sightings of non-calf WGW was higher during the first few years of the Joint Program; however, as the catalog grew larger, the number of first-time sightings decreased. In some cases, these new whales are not seen again, while for others, these new whales have been sighted in subsequent years.

It is unknown whether an individual WGW sighted for the first time is new to Sakhalin (i.e., first time) or whether the individual WGW has been off Sakhalin in previous years but just had not been identified by the Photo-ID team. Further evidence that not all WGW are seen every year occurred in 2010 when a satellite tag was place on a whale; however, this whale was not observed by the photo-ID team.

4.4. WGW Food Resources

The WGW feed primarily on benthic (bottom) and epibenthic (near-bottom) invertebrates (Fadeev, 2011, Nerini, 1984; Blokhin and Pavlyuchkov, 1996). Since 2002, the Joint Program has monitored benthic biota off NE Sakhalin, studying the dynamics of benthos and characterizing spatial and temporal differences of the benthic biota believed to serve as prey for WGW (Figure 6). Since WGW migrate each year to coastal waters of Sakhalin to feed, the examination of the benthos that could serve of food resources for the WGW provides important information for understanding WGW ecology, abundance, distribution, movement, and behavior within the Sakhalin feeding areas. The high biomass of benthos that can serve as food resource for WGW in the Piltun and Offshore feeding areas provides a compelling explanation as to why WGW return to Sakhalin year after year (i.e., high site fidelity). The monitoring of the benthic communities has significantly increased knowledge of the WGW food resources, including composition of benthic communities, abundance of individual species, and the influence of environmental parameters (e.g., hydrology, sediment) on these benthic communities.

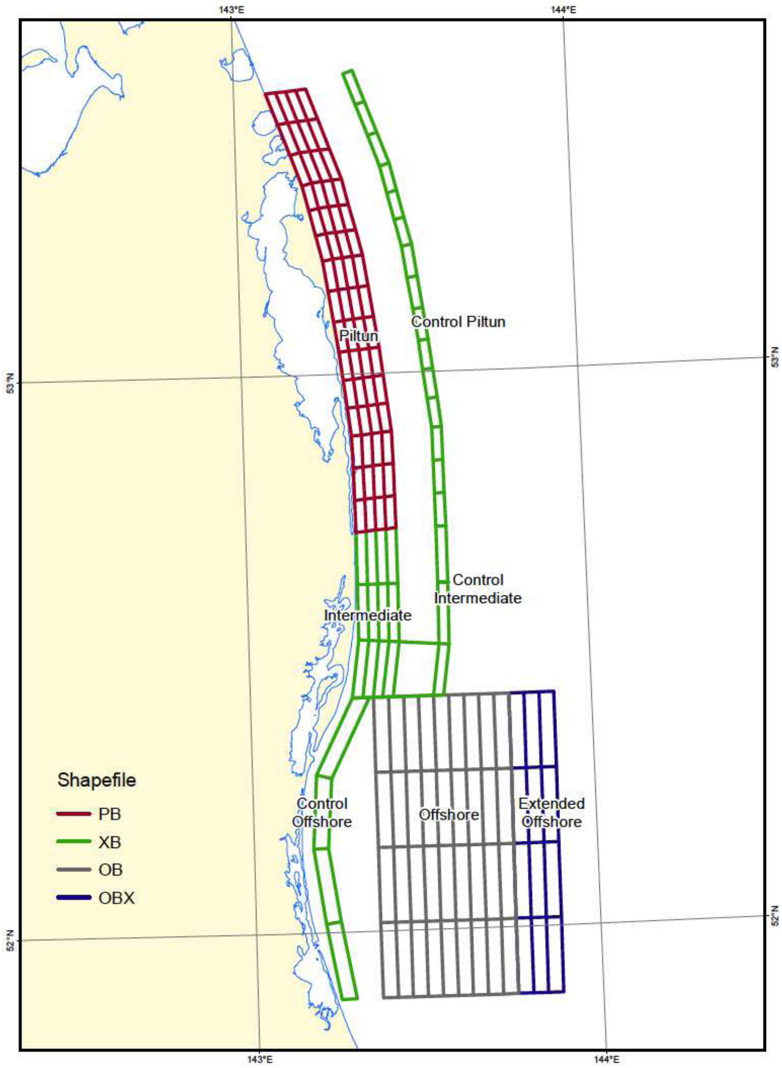

Figure 6. Sampling grid for collection of benthic samples in Piltun and Offshore feeding areas.

4.4.1. Benthos In Piltun Feeding Area

The average total biomass of benthos in the Piltun feeding area measured from 2002-2014 was relatively stable from year to year, ranging from an average of 414 to 556 g/m2. Amphipods and isopods are believed to be the most important food resource for the WGW (Fadeev, 2011). Other benthic organisms, such as sand lance (a fish) and sand dollars were also major contributors to the total benthic biomass. Although sand dollars dominated the overall biomass, they are believed to have little food value for gray whales.

Two complexes of benthic organisms cover most of the Piltun feeding area: a shallow-water, coastal amphipod-dominated complex with a high portion of the biomass consisting of amphipod and isopod species, and a deeper-water, sand dollar complex with a low portion of the biomass consisting of prey organisms of WGW (i.e., amphipods and isopods). The approximate boundary between these two complexes lies at depths of about 20 m. In the Piltun feeding area, WGW do not commonly feed at depths >25 m, probably because amphipods comprise on average < 2% of benthos biomass and sand dollars commonly comprising > 90% of the biomass at these depths.

4.4.2. Benthos in the Offshore Feeding Area

For the Offshore feeding area, 17 taxonomic groups accounted for more than 90% of the average total benthos biomass (Fadeev, 2012). Benthic organisms in the Offshore feeding area with occurrence in >50% of the samples were amphipods, cumaceans, bivalve mollusks, marine worms and sea anemones. The average total biomass of benthos in the Offshore feeding area from 2002-2014 ranged from 489 to 655 g/m^2. Forage benthos biomass in the Offshore feeding area has remained relatively stable over the course of Joint Program monitoring (2002 - 2014) with statistically significant year-to-year variations observed. Benthic groups with lower biomass contributions, such as sand dollars, nevertheless formed localized high concentrations of biomass.

4.4.3. Factors Affecting Benthos Abundance and Distribution

The abundance and distribution of benthic biota are affected by a variety of abiotic and biotic factors. As part of the Joint Program, measures of abiotic parameters including temperature, salinity, hydrology parameters, and sediment characterization were conducted to help elucidate factors that influence benthos abundance and distribution in the Sakhalin feeding areas.

Sediment

Sediments at most sampling locations are characterized by predominance of sandy (psammite) fractions. Of the 223 stations analyzed in 2012, 86% were predominantly sands, while 14% consisted of gravel-pebble soils containing some sands of various grain sizes. The proportion of the fine sand fraction exceeded 70% at most locations. For the monitoring period (2002–2014), fine sands predominate at depths up to 10–15 m throughout the Piltun feeding area. With increasing depth, the fine sands are replaced by medium- and coarse-grained sands and areas with gravel–pebble soils containing some sands of varying grain size.

In the Offshore feeding area the portion of silt-clay in the sediment increased with increased water depth. Overall, fine sands predominate at >85% of the stations in the Offshore area. Gravel soils and coarse-grained sands occur in patches mainly in shallower parts along the western part of the Offshore feeding area.

Hydrology

The Piltun feeding area can be characterized as a shallow-water coastal area with a 20-meter isobath at 5-10 km from the shore and the 50-meter isobath at 20-30 km from shore. The Piltun feeding area receives freshened water from the Amurskiy Estuary and water from Piltun and Chayvo Bays. The nature of aperiodic currents is primarily determined by the effects of south and southeast winds (summer monsoon) and by northwest winds (winter monsoon) in autumn. Because the Sakhalin shelf is shallow in the region of the Piltun feeding area, atmospheric circulation that controls the prevailing winds causes typical wind drift that deflects the current to the right of the direction of the wind. These currents have a significant effect on the hydro-physical and hydrodynamic processes in the region and determine their seasonal and year to year variability, which depends on the development of these monsoons.

During upwelling the coastal area is filled with cold and salty water from the Sea of Okhotsk, while relatively warm and freshened-surface water shifts to the offshore deep water area. The Amur River water reaches this area in early June as the ice recedes. For example, on June 12, 2010 during ice flow southwards the water of Piltun area was characterized with a temperature of 5ºC and salinity of 23 psu. In July of some years prevailing southern winds trigger upwelling resulting in freshened water getting to the eastern offshore area from Severny (North) Bay, but in a favorable northwest wind the movement of freshened water may acquire the nature of an “invasion”.

The occurrence of colder surface water observed in the northern part of the Piltun feeding area 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 2006-2012. 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).

Ice Cover

Ice-cover dynamics have major influence on phytoplankton growth, and in many ways determines the direction of energy transfer along the food chain. If phytoplankton outbursts happen in cold waters (as usually the case), its low consumption rate at low temperatures affects the food chain status conditional upon availability of resources rather than consumption of such. This scenario ensures more energy is supplied to the benthos community rather than remaining in the pelagic zone. Thus, seasonal and inter-annual variations in phytoplankton blooms may affect the entire food chain. The food chain energy direction surface–bottom and bottom-surface may affect the number and biomass growth of both pelagic and benthic communities.

Considering actual meteorological conditions of northern Sakhalin, it is worth mentioning that winter water temperature variations are insignificant from year to year as the temperature is always below zero and close to the water freezing temperature. This results in initial winter hydrological conditions for phytoplankton spring bloom that are essentially the same every year. If there are variations between the rate of primary production and subsequent variations in benthos biomass, such are conditional upon (for instance) the time of ice breakup.

Wind

Wind and associated summer south-eastern monsoon are another metrological factor which determines the start of coastal upwelling and its duration. On one hand, upwelling creates favorable conditions for phytoplankton growth via additional supply of biogenic substances from the sea bottom. On the other hand, it destroys water stratification and hinders sustainable growth of phytoplankton, because it may move down to the poorly-lit bottom horizons.

Influx From Amur River, and Piltun and Chayvo Bays

Benthos is also influenced by the influx of freshwater and detritus from the Amur River flow and shallow-waters from Piltun and Chayvo Bays. This influx to the shallow waters appears to be a permanent and sustainable factor, which does not vary significantly from year to year. Therefore, ice (breakup time), biogenic and organic substances brought by the Amur River waters and summer upwelling brought in from Piltun and Chayvo Bays during flooding and bringing water from the Sea of Okhotsk full of biogenic substances are variable factors which can affect biological productivity of the area. Apparently, these very processes ensure high biological productivity in this area of the Sea of Okhotsk and make this area a primary feeding area for the WGW in the summer-autumn season. The Piltun Bay may provide nutrients (nitrogen and phosphorous) required for phytoplankton blooms.

Primary Production

Development of the benthos is affected by the material produced on the sea surface. In spring and early summer, the benthos grows rapidly feeding on detritus produced by phytoplankton blooming during the winter-spring period. The primary benthic prey of gray whales in the Piltun and Offshore feeding areas (i.e., amphipods and isopods) feed mainly on diatom phytoplankton, or on other organisms that feed on diatom phytoplankton.

Phytoplankton production during the spring bloom is conditional on surface water salinity. Peak phytoplankton production only occurs if the surface water is freshened to a high degree. Phytoplankton bloom happens not only in spring, but may be triggered by intensive summer showers brought by deep cyclones. Such phytoplankton blooms may occur off NE Sakhalin not only the result of precipitation in the immediate area, but may also be triggered by remote storm rainfall getting into the sea via runoff from the Amur River. Productive capacity of phytoplankton spring bloom depends on a variety of external meteorological factors. For instance, despite sufficiency of biogenic organic matter in spring, phytoplankton bloom may be limited by dynamics of currents (water movements) caused by intensive vertical wind mixing, convection or limitation of light (e.g., light blocked by ice cover). Phytoplankton blooming does not start until sustainable water stratification sets in as a result of summer heat, ice melting or fresh water inflow.

4.5. Risks to Gray Whales

Gray whales face potential threats throughout their range from both natural and anthropogenic sources. Threats to gray whales include entanglement in fishing nets and gear, ship strikes, pollution, habitat damage, oil spills, and disturbance/displacement from key habitats.

4.5.1. Natural Threats

Natural threats to gray whales include predation, disease, epizootic mass mortality, climate change followed by the ecosystems degradation, and insufficient food resources. The killer whale (*Orcinus orca*) is the only non-human predator of gray whales. Predation of WGW calves by killer whales is perhaps the greatest threat to the WGW, and is a threat not unique to the Sea of Okhotsk. Although the extent of WGW losses to predation is not known, it is believed that predation may be responsible for losses of >30% of calves in their first two years. Attacks on WGW by pods of killer whales are well known and has been witnessed by Joint Program scientists (which fortunately did not result in loss of the WGW).

Threats to WGW from disease are not well understood. However, decrease in Eastern gray whales (EGW) that occurred during the period of 1980-1990s (estimated decrease from ~30,000 to ~20,000 individuals), is believed the result of the numbers of gray whales exceeding the carrying capacity of the environment, which could have led to disease and/or insufficient food resources to support the large number of whales.

4.5.2. Anthropogenic Threats

Potential anthropogenic threats to gray whale arise from fishing, industrial, military, and tourism activities. The primary anthropogenic threats that have potential to adversely impact WGW include: entanglement in fishing nets and lines, vessel strikes, pollution, oil spills, habitat impairment, and noise. In recent years, cruise ships have visited the Piltun feeding area to allow tourist to see the gray whales. During 2014 cruise ships visited Piltun feeding area on a least two occasions; during the second visit on September 2, nine inflatable boats each with 10 persons approached and followed gray whales to allow the tourist to take photographs.

Environmental Impact Assessments (EIAs) conducted by each Company for their respective offshore developments identified three main risk posed to the WGW by the Companies operations: collisions with ships, noise that could affect hearing and cause WGW to leave their feeding areas, and oil spills.

Each Company has implemented mitigation measures through their Marine Mammal Protection Plans (MMPPs) to reduce risk to whales. The MMPPs have been effective and during the period that the Companies have been working off Sakhalin, neither ENL nor Sakhalin Energy have had any vessel collision or near misses with WGW or other cetaceans. The MMPPs provide specific vessel operation criteria that minimize potential for vessel collisions with WGW. Key MMPP mitigations include use of Marine Mammal Observers (MMOs) and Watch Standers, vessel speed restrictions, defined navigation corridors, vessel avoidance and minimal operating distance to WGW, and the prohibiting of vessels in feeding areas.

Sediment contaminant monitoring is conducted as part of the Joint Program benthic studies and separately by each Company as a component of their environmental compliance monitoring programs. Analytical results have consistently shown that contaminant levels (e.g., hydrocarbons, metals) in sediment in monitored areas are not above background level. The potential impact of oil spill to WGW would depend upon a variety of factors including proximity of the spill to WGW and their habitat, the size, location, and timing of the spill, and existing environmental conditions (e.g., wind, rough seas, ice, etc.). Spilled oil could potentially have a direct impact to the whale through contact to skin and other surfaces, which could result in irritation and other responses; potentially indirect impact of oil spill to WGW could result for damage to habitat and food resources.

It has long been recognized that anthropogenic sound from oil and gas industry activities, such as seismic exploration and the construction and operation of offshore assets, has the potential to disturb whales. Noise disturbance of whales could possibility result behavioral disruption, displacement from critical habitat and in extreme cases, physiological injury. In 2003, the Joint Program began a standardized annual acoustic monitoring program to further the understanding of the sound levels generated by the Companies' operations (e.g., exploration, construction and production) and where necessary, suggest mitigations including revised planning of activities and/or engineering modifications.

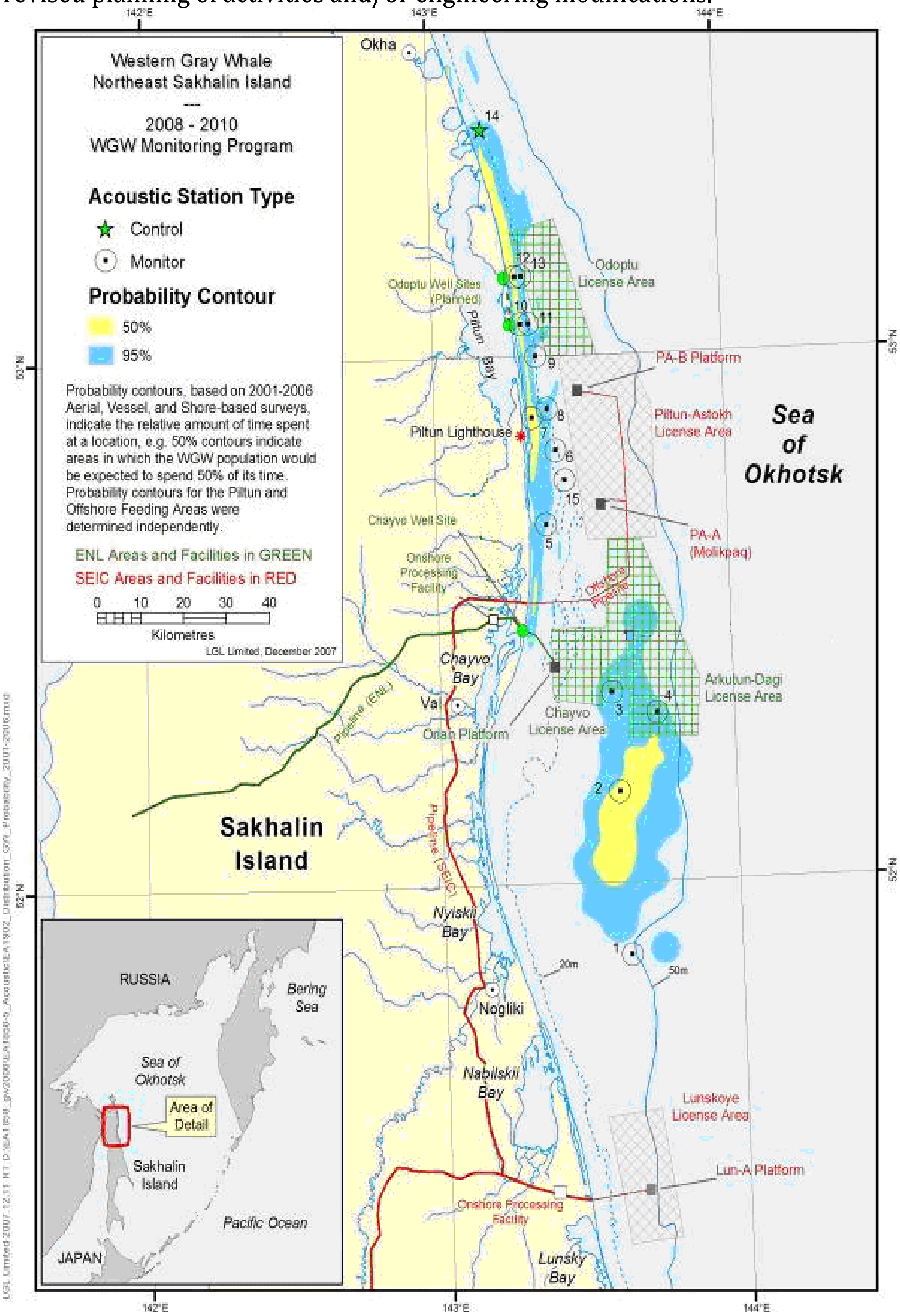

Figure 7. Locations of Joint Program acoustic monitoring stations.

5. CONCLUSIONS

The implementation of the Joint Program and investigations sponsored by each Company, have resulted in significant increase in the understanding of the WGW and their habitat. The annual reports of the Joint Program (2002-2014) include a record of the progression in the understanding the WGW and provide the Companies and other interested parties the basis to assess the status of the WGW and habitat. Below are key conclusions and learnings about the WGW and habitat that have been obtained through the conduct of the Joint Program and other Company-sponsored investigations.

5.1. WGW Population

- Since 1983 when WGW were sighting off NE Sakhalin, the number of known WGWs has steadily increased from ~20 to >200. As of 2014, a cumulative total of 243 individual WGW have been identified in the IBM Sakhalin WGW catalog. During the 2014 field season, 15 new WGW (i.e., 12 calves and three non-calf WGW) were added to the IBM Sakhalin WGW catalog.

- Typically there are three to five non-calf WGW sighted for the first time off NE Sakhalin each year. It is unknown whether these WGW are new to the region or have just not been previously photographed and identified.

- The WGW population has an estimated growth rate of ~ 3.3 %. based on modeling conducted by Cooke et al. 2013.

- Typically, 50-60% of the individual WGW identified in the IBM catalog are sighted each year by the Joint Program Photo-ID team. The number of WGW sighted each year is positively correlated to the extent of the Photo-ID effort.

5.2. WGW Migrations

- WGW migrate each spring and summer (~May-July) to the Sea of Okhotsk and some WGW are known to spend the ice-free months in feeding areas off NE Sakhalin.

- Winter migrations and habitat of WGW were unknown until the satellite tagging of WGW in 2010 and 2011 elucidated the timing and route of the winter migration. Three WGW with satellite tags were tracked during their winter migration from Sakhalin to Kamchatka and eastward to North America.

- One satellite-tagged WGW (Varvara) was tracked throughout a complete migratory cycle from Sakhalin to the known wintering habitat of gray whale in Baja California, Mexico, and subsequently back to Sakhalin, arriving in the Piltun feeding area on May 18, 2012.

- The North American migration for >30 Sakhalin WGW has been confirmed by scientists with matches between photographic catalogs, genetic matches of biopsied WGW, and satellite tagging (non-published data).

5.3. WGW Distribution and Abundance

- Through all years of monitoring the main feeding period of WGW remains stable and covers summer-fall season; however, WGW distribution and abundance in the Piltun and Offshore feeding areas vary from year to year.

- For all years the peak season of WGW abundance is observed in August-September.

- The near shore area from the mouth of Piltun Lagoon to about 15 km north is the most stable area in terms of whale numbers, i.e., whales have been seen in this area in relatively large numbers every year.

- The most stable WGW aggregation is one near the Piltun Bay mouth which includes approximately the same number of WGW from year to year

- WGW abundance in the Offshore feeding area usually peaks in late summer (i.e., September-October), possibly due to a decrease in prey organisms in the Piltun feeding area towards the end summer.

5.4. WGW Feeding Areas

- Two primary feeding areas for WGW are known off NE Sakhalin: the Piltun or near-shore feeding area and the Morskoy or Offshore feeding area.

- The Piltun feeding area appears to be the preferred area during early feeding months (i.e., June-August), with the Offshore feeding area utilized more in late summer.

- Some WGW are known to move between the two Sakhalin feeding areas during the feeding season, and are hypothesized to feed opportunistically in the entire area.

- Prior to the discovery in 2001 of the Offshore feeding area, it was assumed that the Piltun feeding area was the only feeding area off NE Sakhalin and that WGW only feed at depths of less than 20 m. Non-calf (i.e., subadult and adult) WGW are known to feed in both feeding areas and are not restricted by depths (up to ~50-60m) for feeding.

- WGW observed feeding in water depths of >20 m in the northern part of the Piltun feeding area coincided with high densities of sand lance in that area.

- WGW have been observed feeding in areas outside of the two primary feeding areas including Severny Bay in North Sakhalin, and Olga and Vestik Bays off southeast Kamchatka. Additional WGW feeding areas that have not yet been identified seem likely since many whales in the IBM Sakhalin WGW catalog are not sighted every year.

5.5. WGW Body Condition

- Each year, some WGW arriving to the Sakhalin area appear to be in an emaciated (“skinny”) or poor body condition. The occurrence of the skinny condition is believed to be the result of the individual WGW having depleted a large proportion of their body fat over the course of their winter migration. About 10 to 20% of WGW off Sakhalin each year have been observed in various levels of poor body condition.

- Mothers with calves are often in poor body condition upon arrival off Sakhalin (beginning of feeding season); however, the calves appear well nourished.

- It is believe that that there is little to no feeding during the winter period while WGW are away from the Sakhalin feeding areas. WGW spend the ice-free months off NE Sakhalin consuming large quantities of prey and “fattening” themselves. Over the course of the feeding season, the body conditions of most WGW improves, and by the end of the feeding season ~ 80-91% of initially-poor body condition WGW are observed in a normal condition.

5.6. WGW Food Resources

- WGW are known to feed upon benthic organisms. It is hypothesized that WGW congregate each year in the Sakhalin feeding areas due to the high biomass of preferred prey organisms, especially amphipods and isopods.

- In the Sakhalin feeding areas, amphipods and isopods occur as the highest percentage of the benthic biomass, and therefore serve as the primary food resource for WGW off NE Sakhalin.

- Amphipod biomass within the Piltun feeding area is highest in the near shore zone in water depths of 5 to 15 m and decreases sharply at depths greater than 20 m. The amphipod biomass varies among years; with average biomass at the sampling locations ranging between 28.5-47.4 g/m2.

- The amphipod *Ampelisca eschrichtii* appears to be the main prey species in the Offshore feeding area. Average amphipod biomass in the Offshore feeding area are stable from year to year. WGW in the Offshore feeding area have been observed to feed at depths of 40 to 60 m with amphipod biomass greater than 300 g/m2.

- Sand lance is a temporary component of the benthic community and, when available, appears to be an opportunistic food source for WGW. The highest sand lance biomasses were recorded in northern and middle part of the Piltun area, at depths greater than 20 m. Observed variability in sand lance biomass are believed to influence the distribution of gray whales within their feeding areas.

- The contribution of amphipods and isopods to the total biomass in the feeding areas was more than 50 % and reached values of more than 100 g/m2. When comparing these numbers with the total amphipod biomass of the grid samples, it is clear that WGW target patches with relatively high prey biomass.

- Olga Bay in Kamchatka has amphipod biomass ranging from 35 to 60 g/m2) that was very similar to that found in the Chayvo area.

5.7. Environmental Contaminants in WGW Feeding Areas

- Levels of contaminants in sediments in the monitored areas of NE Sakhalin do not exceed background levels.

- Levels of petroleum hydrocarbons in the sediments of the feeding areas were below background concentrations measured for the Sakhalin shelf sediments. The lower petroleum hydrocarbon concentrations were found in sediment closer to shore.

- Heavy metals in the sediments did not exceed the background levels for the NE Sakhalin shelf prior to the beginning of active industrial activities and they were substantially below the values of the Probable Active Concentration of toxic metals (PAC) at which negative influence on benthic organisms can be expected. Heavy metal concentrations in polychaetes in the Piltun feeding area confirmed that heavy metals were not above background levels.

5.8. Noise in WGW Feeding Areas

- Since 2003, the Companies have monitored ambient and anthropogenic noise through the Joint Program and with activity-specific monitoring in the feeding areas and offshore work areas to ensure that levels do not exceed prescribed thresholds.

- Ambient noise levels vary significantly because of weather activity (wind, surface waves and rain) which can elevate the background by more than 20 dB; broadband levels can be near 100 dB during storms

- Offshore construction activities by the Companies generally induced broadband sound pressure levels that did not exceed 120 dB re 1 μPa at the nearest boundary of a feeding area except for brief surges in the order of hours. This cap was largely achieved through the planning of activities with the aid of forecasting tools to avoid scenarios that could lead to unnecessary aggregation of noise sources.

- Vessels are the main contributors to the acoustic footprint from Company activities with the exception of seismic surveys or pile driving. Sound levels from moving vessels are generally transient in time and are unlikely to cause sustained disturbance to whales in the area. Vessels associated with a particular operation and remain in place for extended periods could contribute significantly to sound exposure in a given area, and could cause behavioral or distribution changes in whales.

- The systematic monitoring of anthropogenic sound from company activities has allowed the identification of noise, which in turn has led to revision of practices or engineering alterations to minimize acoustic output. Multivariate analyses of behavioral data collected during seismic survey operations have indicated that even at higher received sound exposure levels, any observed changes were relatively subtle.

5.9. Conservation of WGW

- ENL and Sakhalin Energy maintain their commitments to conduct their Sakhalin operations in a manner that does not adversely affect the environment and the Sakhalin gray whales.

- ENL and Sakhalin Energy interact with leading scientists, international organizations, and other stakeholders in public fora through participation in their meetings and scientific publications in order to promote and facilitate efforts to conserve WGW and habitat.

- The Joint Program monitoring from 2002-2014 provides a scientific basis for assessing the well-being of the aggregation of gray whales that feed off Sakhalin each year. Joint Program results demonstrate that the number and distribution of WGW off NE Sakhalin have not been adversely affected by the Companies' activities.

- The Companies' facilities have been designed and constructed to the highest standards in order to minimize risk of environmental impacts. Rigorous operating, services, monitoring, and auditing procedures are adhered to by each Company to mitigation potential risks to the environment and the WGW.

- The Marine Mammal Protection Plans (MMPPs) implemented by each Company have been highly effective at eliminating or mitigating potential effect of offshore operations on WGW and other marine mammals, with has resulted in no incidents with WGW due to Companies' activities.

6. ACKNOWLEDGEMENTS

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Appendices

- **Appendix I.** Photo-Identification of Gray Whale (*Eschrichtius robustus*) Off the Northeast Coast of Sakhalin Island in 2014 (March 2015)
- **Appendix II**. Distribution and Abundance of Gray Whales In Northeast Sakhalin Coastal Waters in August-September 2014. (March 2015)
- **Appendix III**. Benthos studies in the feeding grounds of gray whales (*Eschrichtius robustus*) off the North-East coast of Sakhalin Island in 2014 (March 2015).
- **Appendix IV**. Acoustic and Hydrological Studies on the Northeast Sakhalin Shelf June 10 through October 10, 2014 (March 2015)