PHOTOGRAPHIC IDENTIFICATION OF GRAY WHALES (*ESCHRICHTIUS ROBUSTUS*) OF THE KOREAN-OKHOTSK POPULATION ON THE NORTHEAST SHELF OF SAKHALIN ISLAND, RUSSIA, 2004

Final Report

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FINAL REPORT

THE MATERIALS FROM FIELD STUDIES ON THE
RESEARCH VESSEL «OPARIN» IN 2004

PHOTOIDENTIFICATION OF THE KOREAN-OKHOTSK GRAY WHALE (ESCHRICHTIUS ROBUSTUS) POPULATION ALONG THE NORTHEAST COAST OF SAKHALIN, RUSSIA, 2004

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INTRODUCTION

The Pacific Gray whale (*Eschrichtius robustus*) is currently divided into two populations: eastern (California-Chukotka) and western (Korean-Okhotsk). The eastern gray whale population reached its peak in 1999, when it exceeded 26,000 animals (Rugh et al. 1999), although some data from recent studies in 2001/2002 suggest that the population has since declined to approximately 18,000 (Rugh, 2003). In November 1991, by resolution of the U. S. National Oceanic and Atmospheric Administration (NOAA), the eastern gray whale was removed from the endangered species list, which had been its status since 1967.

In contrast, the western gray whale population differs sharply from the eastern population, and the conservation status of the Korean-Okhotsk gray whale population has received increasing attention in recent years (Webster, 2003). The western gray whale population has been classified as endangered (Category I) in the Russian Federation Red Book (Perlov et al., 1996; Russian Federation Red Book, 2000). The United States government also classifies the western population as an endangered species (U. S. Fish and Wildlife Service [USFWS], 1997).

Presently, western gray whales are considered by the IUCN to be critically endangered (Hilton-Taylor, 2000; Weller and Brownell, 2000). The IUCN criteria used to support this classification were as follows: (1) the population in question is both geographically and genetically isolated (LeDuc et al., 2002); and (2) there are probably fewer than 50 animals in the population capable of reproduction (Hilton-Taylor, 2000; Weller and Brownell, 2000; Bradford, 2003).

Much of the gray whale life cycle takes place in the coastal waters of densely populated countries with intensive fishing and shipping. Western gray whales are vulnerable to hazards during all three stages of their life cycle: (1) during whale reproduction in the southern part of their range, the location of which is currently unknown; (2) during prolonged north-south migrations, the route which is currently unknown; and (3) in their known feeding areas off the northeast coast of Sakhalin Island, Russia. Historically, the distribution of gray whales in the Sea of Okhotsk apparently has included Sakhalin Bay (on the west side of the NW end of Sakhalin Island), Akademiya and Tugurskiy bays south of the Shantarskiy Islands (in the far western Okhotsk Sea, west of the NW end of Sakhalin Island), the northeast shelf of Sakhalin Island, Shelikhova, Penzhinskaya and Gizhiginskaya bays in the far northeast portion of the Okhotsk Sea, and the waters west of the Kamchatka Peninsula (Krupnik, 1984; Yablokov and Bogoslovskaya, 1984; Perlov et al., 1996). The long-held belief that the whales' wintering grounds were along the southern coast of the Korean Peninsula (Rice, 1998) has not been substantiated to date. The gray whales' wintering grounds are now believed to be located in the South China Sea, possibly along the coast of Guangdong province and/or around Hainan Island (Rice, 1998). However, specific calving sites have never been observed. In addition to potential impacts on whales from increased vessel traffic associated with intensive fishing and commercial and recreational navagation, the countries of Southeast Asia still have strong traditions involving the consumption of whale meat (Lento et al., 1998; Wang, 1998).

Photographic identification (hereafter referred to as "photo-ID") of marine mammals has proven to be a useful tool for monitoring wild populations of animals while minimizing the impact on individuals. When incorporated into a long-term monitoring program, photo-ID can be a valuable tool used to answer many ecological questions about populations of marine mammals. For small or isolated populations, photo-ID can be used effectively in assessing population size and variation over time (Whitehead et al., 1997; Cerchio, 1998; Stevick et al., 2001; Bradford, 2003; Weller et al., 2003, 2004; Calambokidis and Barlow, 2004). For large whale populations, photo-ID has been used to identify long migration routes (Best et al., 1993; Darling et al., 1996; Craig and Herman, 1997; Salden et al., 1999; Weller at al., 2002), feeding ranges, and and interannual changes in whale distribution (Calambokidis et al., 2002, Clapham et al., 1993). For these large whale species, photo-ID can be used as an effective method of examining health indicators of individuals as well as the overall health of groups or populations (Pettis et al., 2004). Photo-ID has proven to be an especially useful tool in gray whale studies (Darling, 1984; Würsig et al., 1999, Calambokidis et al., 2002), as individuals are distinctly distinguishable by characteristic markings on their sides, backs and flukes.

Coastal areas are often acute conflict zones (Goldberg, 1993), and photo-ID is often the only method available for identifying outward health indicators of the animals. In many cases, photo-ID of whales can help in coastal regions with an elevated risk for anthropogenic environmental impact (coastal cities with industrial and domestic wastewater, oil and gas development, intensive fishing and shipping, large-scale mariculture, and mass tourism). The important role of photo-ID for population monitoring and timely identification of negative phenomena may sometimes prevent conflict or reduce its intensity.

PURPOSE AND OBJECTIVES

Sakhalin Energy Investment Company Ltd. (SEIC) and Exxon Neftegas Limited (ENL) are currently participating in the development of oil and gas reserves on the Okhotsk Sea shelf off the northeast coast of Sakhalin Island, Russia, while a number of other companies are poised to begin developing reserves in the region. Oil and gas development in proximity to gray whale feeding areas on the northeast shelf of Sakhalin Island, especially during the spring or fall migration and feeding periods, could negatively affect the western gray whale population without appropriate measures to limit the impact. Photo-ID work is a key tool in effective monitoring studies necessary for providing feedback and input into mitigation development strategies and in monitoring their effectiveness.

The technical objective of the work was to conduct a photo-ID study to assess the whales' annual return rates and patterns of site fidelity for known individuals to define the size, structure and status of the population. Photo-ID techniques can be used to assess various aspects of western gray whale ecology such as:

- abundance estimate of small or isolated populations;

- inter and intra-annual fidelity of individual whales to specific feeding areas and individual foraging patterns;
- individual associations and group stability;
- number, status and habitat use of cow/calf pairs (calf birth and survival rates) and timing of cow-calf separation (weaning);
- physical status and individual health indicators;
- population demographics and structure; and
- population status.

BACKGROUND

Two primary gray whale feeding areas have been identified off Sakhalin Island. A shallow-water (generally <20 m) feeding area is located along the coast adjacent to Piltun Bay (Brownell and Chun, 1977; Sobolevsky, 2000; Weller et al., 2004; Blokhin et al., 2003, 2004; Yakovlev and Tyurneva, 2003, 2004). Another deeper water "Offshore" feeding area is located about 30-40 km off of Chayvo Bay, in waters of 35-60 m deep (Miyashita et al., 2001; Maminov and Yakovlev, 2002; Blokhin et al., 2003, 2004; Yakovlev and Tyurneva, 2003, 2004) (Figure 1). However, whales are also observed along the entire northeast coast of Sakhalin Island (Blokhin et al. 2004). Gray whales begin arriving off northeast Sakhalin Island in late May, when when the sea ice has cleared, and some can remain until early December, when ice formations reappear.

Photo-ID of western gray whales is currently performed by two research teams. A US-Russian photo-ID team has worked in the Piltun feeding area from 1994 to 2004 (Würsig et al., 1999; Weller et al., 2000, 2001, 2003, 2004). Specialists from the Institute of Marine Biology (IBM) of the Far East Branch of the Russian Academy of Science (DVO RAN) began working in the two (Piltun and Offshore) feeding areas in 2002 (Yakovlev and Tyurneva, 2003) and 2003 (Yakovlev and Tyurneva, 2004).

The US-Russian photo-ID team has concentrated their effort in the waters off Piltun Bay, where the presence of whales was discovered. From the results of these observations, 131 whales had been identified by the end of 2003 and the population is estimated at less than 100 individuals (Weller et al., 2004). This team observed a high annual return rate and a high degree of seasonal site fidelity for most of the known individual whales in the Piltun feeding area (Weller et al., 2004). It was also noted that not all the individuals are always present in the Piltun area, and their frequent absence in the coastal waters may be explained in part by the recent discovery of the Offshore feeding area in 2001.

There have been reports of previous observations in this Offshore area (Sobolevsky, 2000; Miyashita et al., 2001), and it is quite probable that the area was used by gray whales prior to 2001. Any data on whale sightings in the Offshore prior to 2001 are incidental and survey effort was low. Photo-ID of gray whales in the Offshore area in 2002 (Yakovlev and Tyurneva, 2003) confirmed that some individuals observed in the Offshore area were also present in the Piltun feeding area; inter- and intra-year

interchange of whales between feeding areas was also confirmed. These results suggest that the whales travel between their summer feeding sites, most likely in search of their preferred prey. The US-Russian photo-ID team has reported that nine of ten whales photographed in the Offshore area, in 2003 had also been sighted previously in the Piltun feeding area that year (D. Weller, pers. comm., May 2004).

Large-scale studies of whale food resources on the northeast shelf of Sakhalin Island funded by the oil and gas production sector began in 2001 and continued in 2002, 2003 and 2004 (Fadeev, 2002, 2003, 2004, 2005). The shallows (5-15 m) in the Piltun feeding area are distinguished by an abundance of potential prey for gray whales, including amphipods, isopods, bivalve mollusks and worms that form concentrations along the ocean bottom. The offshore area is characterized by high concentrations of tube-dwelling ampeliscid amphipods. “Shifts” in the gray whale distribution in both the Piltun and the Offshore feeding areas within and between seasons have been noted by a number of authors (Johnson, 2002; Weller et al., 2004; Perlov et al., 2003; Blokhin et al., 2003, 2004) and are considered to be at least partially a reaction to seasonal changes in the distribution and abundance of prey (Fadeev, 2003, 2004, 2005; Weller et al., 2004). Higher whale population density has been reported in some parts of feeding areas compared to others. For example, a high whale population density has been reported, as a rule, (1) in the southern part of the Piltun feeding area near the mouth of Piltun Bay (Maminov, 2004; Weller et al., 2004), where cow/calf pairs are often observed (unpublished ENL/SEIC), and (2) in the northern part of the Piltun feeding area (Blokhin et al., 2003, 2004; Gailey et al., 2004; Maminov, 2004). The irregular gray whale prey distribution may explain the aggregations or seasonal changes in the distribution the whales and the movement of individual animals both within feeding areas and between the Piltun and Offshore feeding areas (Maminov and Yakovlev, 2002).

Seasonal fluctuations in blubber fat reserves in baleen whales are normal after winter periods of fasting and during migration (Perryman and Lynn, 2002), and cows can be significantly thinner during years in which they are nursing calves (Pettis et al., 2004; Weller et al., 2004). However, to date, western gray whales have not been observed feeding on cumaceans. In 2004, concentrations of sand lance, also known to be a gray whale prey item, were found off Piltun in waters more than 20 m deep (Fadeev, 2005). Photo-ID methods can be used to detect changes in body condition outside the norm due to disease or starvation (Thompson and Hammond, 1992; Pettis et al., 2004).

Studies indicate a relationship between reproductive success and body condition (Pettis et al., 2004), and photo-ID makes it possible look at the relationship between the birth rate and physical condition at both individual and population levels. In 1999, the US-Russian photo-ID team noted that some of the whales they observed were noticeably thin (Weller et al., 2000). They used the following features to identify an abnormally thin whale:

- visible subdermal protrusion of the scapulas with characteristic thoracic depressions where the pectoral flippers connect with the body;
- noticeable depressions around the blowhole and head; and

- a pronounced ridge along the dorsal spine of the lumbar and caudal vertebrae resulting in a bulge along the lateral flank.

It was recognized that 23.2% of all identified whales (16 of 69) possessed one or several of these features in the course of photo-ID studies in 1999 (Weller et al., 2000, 2004), and half the gray whales identified in similar studies in 2000 (30 of 58, i.e., 51.7%) were classified as thin (Weller et al., 2001, 2004). In 2001, 21 of 72 adult gray whales (29.2% of the adults) in the western population were classified as thin (Weller et al., 2004). The relative numbers of thin whales declined to 11.8% of the total number of animals observed (9 of 76) in 2002 (Weller et al., 2004), and 4.0% (3 of 75) were classified as thin in 2003 (D. Weller, pers. comm., May 2004). It is worth noting, however, that some gray whales classified as thin in studies for one year were observed to be recovering their weight the next year, and some whales not previously classified as thin were considered thin the following year (Weller et al., 2004). During these years, all cows with calves were assumed to be thin.

In 2002 (September - October), photo-ID was conducted by the Institute of Marine Biology (IBM) in both the Piltun and Offshore feeding areas. Photo-ID was conducted from a deployed zodiac when the opportunity presented itself during the performance of other ongoing studies being conducted on the base ship, the seagoing tug *Nevelskoy*. The zodiac was launched when gray whales were encountered, and sea conditions were favorable for photo-ID work. Because a number of other gray whale studies (prey sampling, vessel surveys, acoustic monitoring) were also being conducted from this research vessel, photo-ID surveys were conducted opportunistically, performed only when gray whales were sighted during other vessel tasks.

The discovery in September 2001 of a new primary gray whale feeding area, the Offshore area (Maminov and Yakovlev, 2002), offered IBM researchers the opportunity to study whales in detail in this area for the first time and to determine whether there were movements of whales between the two feeding areas. The significant presence of large numbers of gray whales in the offshore area continued in 2002 and 2003 (Yakovlev and Tyurneva, 2003, 2004; Blokhin et al., 2003, 2004, 2004; Maminov, 2003; Weller et al., pers. comm., May 2004). Photo-ID of gray whales was conducted along the entire northeast shelf of Sakhalin Island, including both the Piltun and Offshore feeding areas, in 2002, 2003, and 2004.

We are continuing to monitor the number of individuals in the population and the number of cows with calves, to determine the physiological condition of gray whale individuals, and to track the whales' seasonal and daily movements in both the Piltun and Offshore feeding areas.

METHODS

Study Area

The study area covers the entire northeast coast of Sakhalin Island, including the Piltun feeding area (52°40' N. L. to 53°30' N. L.) stretching along the shore of Piltun Bay, and the Offshore feeding area located offshore of Chayvo Bay (51°50' N. L. to 52°25' N. L.) at depths of 35-60 m. Photo-ID effort was concentrated in these two

feeding areas, but whales were also photographed opportunistically if encountered outside of these regions.

The research vessel *Akademik RV Oparin* was the base ship for photo-ID and other parts of the monitoring program, including vessel observations of marine mammals, analysis of the gray whale food resources, and acoustic studies.

Field Photo-ID

Photo-ID of gray whales in 2002 and 2003 was conducted from a zodiac with a two-stroke outboard motor. In 2004, a 3.8 m Zodiac was equipped with a 45 HP four-stroke Mercury outboard motor to reduce noise, pollution, and increase efficiency. Photography work was conducted from the zodiac when weather and sea conditions allowed it to be used safely. The work was halted in the presence of weather conditions unfavorable for photo-ID (dense fog; high, wind-driven waves; torrential rain; high seas; and poor light) due to extremely low effectiveness, the danger of damaging the optical equipment, and potential risk to crew safety.

In some cases, photo-ID was conducted from aboard the base ship *RV Oparin*. Due to safety concerns, photo-ID was never conducted from the mother ship and zodiac simultaneously. Prey sampling and/or acoustic studies were also being conducted from the ship, regardless of weather conditions. Photo-ID from the zodiac was never conducted while the mother ship was anchored while performing other expedition tasks and could therefore not accompany the zodiac in accordance with safety procedures.

Visual observations of marine mammals were conducted during daylight hours in all types of weather. Information about the locations of gray whales gathered in the course of these continuous observations, conducted concurrently with other vessel research monitoring tasks, allowed the photo-ID team to travel directly to gray whale aggregations and reduce search time. This was particularly important in the Offshore feeding area, where the distances between groups of whales or individuals were relatively large, and the whales' movements were less predictable.

When the *Oparin* approached within ~ 2 km of a group of gray whales in the Offshore area, the vessel was brought to a full stop. The bridge then informed the photo-ID team members of the whale sighting, and after a safety briefing, the zodiac was launched from the ship. In the Piltun area, a precautionary protocol was utilized for photo-ID for whale and vessel safety and the zodiac was used as the primary search vessel. The base ship cruised parallel to shore at required safety distances in order to provide assistance to the crew of the zodiac if required.

The zodiac was equipped with a digital depth finder and a portable global positioning system (GPS) navigator. Each zodiac was also outfitted with all safety equipment called for by sea safety procedures. The research team consisted of a boat driver, a data recorder, a digital video camera operator and a digital camera photographer.

Upon initial sighting of a whale, the driver slowed the zodiac to idling speed and maneuvered to a vantage point approximately 100 m from the whale(s). From that point, the whales' position (as determined by the GPS), the time, the behavior, and number of whales in the area, the direction of their movement and the presence of killer whales, passing vessels, airplanes or helicopters in the observation area were noted. The presence of mud plumes, both at whale feeding sites near the launch and when no whales were visible, was also recorded. Secondary indicators of whale feeding, such as circling or diving birds or shoaling fish, were also recorded. If whale foraging was observed (as confirmed by mud plumes or assumed from typical movements and behavior), the exact GPS position of the whales was recorded and communicated to the base ship *Oparin* via VHF radio.

Upon completion of the photo-ID mission, and only after the zodiac and the whales had vacated the area in question, the research vessel *Oparin* would return to the previously transmitted GPS coordinates to obtain benthic prey samples using a Van Veen bottom grab sampler (see Fadeev 2005). All data was recorded on waterproof data sheets similar to those used in 2002 and 2003 and entered into a laptop computer at the end of each photo-ID mission.

To minimize potential impacts on whales', the zodiac would approach to a distance of 100 m from the whale to photograph an individual. The frame and video recording counter numbers in reference to the whales identified, the position (as determined by GPS), the depth (according to digital depth finder data), the temperature (at the sea surface) and salinity of the water, the distance to the whale, and the course according to compass readings were indicated on the data sheets. The data was recorded during each mission and each photo session as the parameters changed.

A Nikon D1X 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 use of a high-quality digital camera provided the possibility of rapid data acquisition and reduced the time spent on image processing and archiving at the end of the survey season. The photographs were recorded at a high resolution setting in large RGB JPEG format. Video footage was recorded using a Canon Optura 20 miniDV digital video camera. The video camera was used for "tracking" and to provide supplementary backup information.

Video footage was particularly important for documenting body condition characteristics of the whales (e.g., protruding scapulae, depressions behind the blowhole) that are often difficult to distinguish in a still photograph due to lighting features, timing, and position of the whale in the picture. Contact with a group of whales was maintained until all the individuals sighted had been photographed, if possible, or until a predetermined amount of time had passed. Whale photographic sessions were terminated after about approximately one hour, regardless of the number of aspects photographed, to avoid the potential for disturbing the animal over an extended time period. The zodiac then withdrew from the group of whales. These procedures were repeated each time additional whale groups were sighted and photographed. A sighting number was given to each of these encounters.

A “sighting” is defined as the observation and photographing of a single individual or group of two or more whales in direct proximity to each other (within 10 body lengths) and coordinated dive and surfacing times and direction of movement in relation to other individuals in the group.

Group size estimates were based on a consensus of the observers aboard the zodiac. A “calf” was defined as an individual up to one year old (current year’s offspring) as established by their small body size (about one-third that of a mature adult) and demonstrating a close association with a particular adult whale (Wells and Scott, 1990; Weller et al., 2004).

Images of individual gray whales consist of various views of the body: head, back flanks, and flukes. An attempt was made to photograph all views of each whale. Whales were 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 right and left sides of each whale, as fluking tendencies vary with individual behavior and foraging depth. Traditionally, the right and left flanks have been considered for standard identification in photo-ID of gray whales. The ventral surface of the flukes was considered as a supplemental view to aid in identification (Weller et al., 2002; Calambokidis et al., 2002). Since the likelihood of repeated recognition of an individual (via matching) increases as more information for that individual is amassed in the catalogue, a fourth view – the dorsal fluke surface – was added as supplemental information for the identification process. The dorsal fluke surface of individual whales can often be displayed even in shallow feeding areas, when deeper diving may not be feasible. The method of adding additional aspects in an attempt to improve recognition accuracy, especially during the early years of data collection and catalog preparation has been used successfully in work with other marine mammal species (McConkey, 1999; Bannister, 2000; Glockner-Ferrari and Ferrari, 2000).

After each photo-ID mission was completed, the zodiac would return to the *Oparin*. All the digital images were loaded into a notebook computer and a backup external hard disk from the camera memory cards (CF Lexar 2 GB) and were also archived on CD and DVD. The information recorded on data sheets was entered into a database in Excel format and also archived on external disks, CD and DVD. All digital data was stored on three different digital media at all times. All archival data CDs were also duplicated and the backups were stored at various offsite locations whenever possible.

Photo and Video Analysis

Digital photographs of whales were processed for subsequent identification work and updating of the gray whale database using Adobe Photoshop 7.0 and Adobe Illustrator 10. The best photographs from each sighting were printed using an Epson Photo Stylus 960 color printer on high-quality photographic paper and kept in a pre-catalog portfolio. Digital backups of all the photographs were made daily.

Standard photographic matching procedures for pattern-based matching of flanks and flukes were followed as described in the International Whaling Commission

Special Issue No. 12 (Hammond et al., 1990). The process has been improved since that time by other specialists studying gray whales and other large whales (Weller et al., 2004; Calambokidis et al., 2002).

The following aspects of the whale's body were selected to create the catalogue (in order of priority): right (RS) and left (LS) sides of the body, ventral (VF) and dorsal (DF). For every daily mission aboard the zodiac, all photographs were reviewed and the "best" type-specimens were selected for each individual whale. These type-specimen photos were then compiled into an annual pre-catalogue. Each subsequent whale sighting was then compared to all previous type specimen photographs taken that year. If a match was made to an existing image, the photograph was grouped with other photos of the same individual.

After the photographs had been grouped by individual animals based on available views, the pictures were compared to the catalogue images for previous years, 2002 and 2003. It was decided during processing of the 2004 materials that in the event of the discovery of a new whale, if high-quality photographs of the right side of the individual were available, it would be assigned a new identification number. In the discovery of a left side only or the discovery of a left side with other aspects, but without the right side, the whale would be given a provisional number, to avoid situations with composite whales, or whales with more than one idendification number. Identification numbers were not assigned on the basis of fluke photos that could not be matched to corresponding right or left side images of known whales.

All images were then cross compared to all of the "best" type-specimen photographs of existing whales from 2002 and 2003 to establish the recurrence of sightings of the same whales and to ensure that no duplicate whales were included in either the previous years' catalogs or the current pre-catalogue.

All photos were rated on a five-tier system: excellent, good, fair, poor, and trash/other photographs. A confident match was not made unless the photographs were considered to be of good or excellent quality (poor-quality photographs were used for supplemental information only or were digitally archived for potential future use). Trash photos (or 'other' photos) are either place holding photos used to separate whale sightings in the field, or contain no gray whale information and are archived offsite.

Side to fluke matches were considered to be reliable when taken in sequential order, and when each successive frame contained parts of the animal visible in the previous frame. Digital photography greatly assisted during the side to fluke matching process.

Confident left to right side matches were established based on **all** the following criteria: 1) the whale was photographed as a solitary individual; (2) two sequences 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 (see Calambokidis et al., 1999). This process was conducted at least three times before left to right matches could be assigned a probability of 90% or higher, after which the images were transferred from the pre-

catalog to the annual catalog. All whale sighting matches, as well as (a) right-left matches and (b) side-fluke matches, were verified by at least two identification specialists. Whale body pigmentation was the primary feature used to distinguish individuals, with scars and body markings supplementing the matching process.

If the annual pre-catalogue matching appeared reliable, the whales would be given permanent identification numbers and transferred to the final catalogue. After the annual catalogue was complete, discrepancies between the current catalogue and the main catalogue were corrected. Then any new information and photographs obtained during the last expedition were added to the main catalogue. Special attention was devoted to identifying whales with various deviations from the "physiological norm," including: (1) dividing whales with deviations in body physical conditions (BC) into four categories; and (2) whales with obvious sloughing of skin.

Complete analysis of video footage had not been peformed at the time this report was prepared. Video data to date has only been used as an ancilliary aid to assist in solving any discrepancies with whale sightings and questions about body condition.

RESULTS

Scope of Work

Photography and video photography of whales were conducted from the deck of the *Oparin* from 7 August to 29 August and from both the deck of the *Oparin* and via zodiac surveys from 29 August until 1 October 2004. The effectiveness of the photo-ID team was largely dependent on weather conditions. Work effort was often separated not only by periods of ship travel, but also by storm layovers. In addition, much of the Photo-ID work in 2004 was concentrated in the latter half of the field season for a number of reasons including temporary permit restrictions. By shifting the field season by several weeks, the bulk of the study effort coincided with the regular timing of cow/calf separation at the end of the season. Recognition of mother-calf pairs late in the season becomes very difficult. Few cow/calf pairs were observed in 2004 due to survey limitations and protocol changes.

The breakdown of time spent by the expedition aboard the *Oparin* in 2004 was as follows: out of the 70 days of the voyage, 56 were working days; 9 were travel to from the work (and refueling) stations; and 5 were storm shelter days. A survey day was counted if any whale (or group of whales) was photographed, from either the zodiac or main ship deck, during a dedicated photo-ID survey or opportunistically while the *Oparin* was anchored performing other tasks. A 'survey day' is therefore not a quantative measure of survey effort. Whales were photographed from a zodiac or from the *Oparin* on a total of 24 days. Combined data from a number of years regarding the breakdown of time spent on photo-ID work in the study of whales are given in Table 1.

Table 1. Photo-ID effort during expeditions to Sakhalin Island in 2002-2004.

Year	Dates	Duration of expedi-tion (days)	Number of working days	Travel time (days)	Storm shelter time (days)	PhotoID days (from zodiac/ zodiac + ship deck)	Number of missions	Number of sightings from zodiac/ ship deck	Numer of identified whales from zodiac/ ship deck	Total number of whale photos
2002	30.08.-25.10	57	27	17	13	13/-	24	72 / -	93 / -	2602
2003	21.07 - 27.09	69	40	16	13	17 / 22	35	86 / 36	146 / 37	7482
2004	30.07 - 07.10	70	56	9	5	16 /24	27	113 / 57	209 / 57	9647

To determine the overall scope of work, we combined the data for photo-ID work conducted from both the zodiac and from the deck of the *Oparin*. The scope of work and photo-ID effort for field work conducted on gray whales along the Sakhalin Island shelf are given in Tables 2 and Appendices A1 and A2.

Table 2. Photo-ID effort in 2004: time spent and numbers of photographs taken from the zodiac and the RV *Oparin.*

N	Data	Number of Zodiac mission per day	Duration of each mission in min.				Number of whale photos from Zodiac				Number of pictures whale photos from ship deck	Total number of photos from zodiac + ship deck
			m1	m2	m3	Total	m1	m2	m3	Total		
1	2004_08_07									0	23	23
2	2004_08_17									0	36	36
3	2004_08_26									0	12	12
4	2004_08_29	2	35	33		68	51	53		104		104
5	2004_08_30	1	303			303	432			432		432
6	2004_09_04	1	125			125	97			97	25	122
7	2004_09_05	3	220	95	80	395	579	516	657	1752		1752
8	2004_09_06	2	228	72		300	247	153		400		400
9	2004_09_08									0	62	62
10	2004_09_10	3	186	168	201	555	489	301	503	1293		1293
12	2004_09_11	2	111	205		316	218	941		1159		1159
11	2004_09_13	1	170			170	570			570	119	689
13	2004_09_14	2	276	179		455	316	411		727	34	761
14	2004_09_15	1	70			70	291			291	63	354
15	2004_09_18									0	43	43
16	2004_09_20									0	15	15
17	2004_09_21									0	9	9
18	2004_09_22	1	130			130	326			326		326
19	2004_09_23	1	118			118	241			241	52	293
20	2004_09_24	1	178			178	681			681	101	782
21	2004_09_28					0				0	6	6
22	2004_09_29	2	172	100		272	182	27		209		209
23	2004_09_30	2	59	52		111	46	27		73	49	122
24	2004_10_01	2	54	47		101	104	373		477	166	643
	Total	27				3667				8832	815	9647

The number of high quality photographs taken from the ship deck, especially those containing aspects relevant for photoi dentification of whales, was significantly lower than in photography from the zodiac. Photographs taken from the ship, however, can be considered good supplemental data to support the primary methodology of photo-ID from the zodiac. Processing the photographs in Photoshop 7 made it possible to enhance the quality of most of these photographs to “fair” or “good” usable condition. These ship deck photos provide satisfactory supplemental material on the whales' daily and seasonal movements in the feeding areas, and does increase the number of repeated encounters with known individuals in any given field season (Yakovlev and Tyurneva, 2003, 2004).

The larger number of photographs and the higher intensity of the whale photo-ID work in 2004 as compared to the work of previous years can easily be explained by the development and purchase of new technology equipment. The use of faster, higher-capacity 2 GB Lexar memory cards, larger and faster storage devices on the ship, improved photographic equipment, and a better quality zodiac equipped with a 4-stroke engine, all increased productivity of the photo-ID operations. By further adding the additional supplemental photographs taken from the deck of the *Akademik Oparin,* additional sighting and photographic information was obtained that greatly enhanced the catalogue development as well as resighting statistics. The effectiveness of the work also improved in 2004 due to new knowledge and experience obtained in the course of previous field studies in 2002-2003.

By increasing the technical capabilities of the photo-ID research, it was possible to take large numbers of photos at each whale sighting. The supplemental photos became useful matching aids in the photo lab, and have dramatically improved the likelihood of matching any given photograph to the catalogue. Because of this dynamic method of photography, even pictures displaying non-standard photo-ID aspects (RS, LS, DF, VF) proved useful on occasion in assisting with the matching process. Technology, thereby served to improve the overall effectiveness of the survey by reducing the likelihood of inaccurate or mis-identification.

Photo-ID from the *Akademik Oparin*

Photo-ID was performed from the deck of the base ship when the opportunity arose during the voyage of the seagoing tug *Nevelskoy* in 2003 and was also conducted on 16 days during the voyage of the research vessel *Oparin* (Table 3). From the ship deck, 815 photographs of whales were taken, including 742 in the Piltun feeding area and 73 in the Offshore feeding area (Table 3). The small number of photographs taken in the Offshore area is explained by the unusually small number of whales observed there in 2004.

Table 3. Descriptive statistics of photo-ID work from the zodiac and the RV *Oparin*, 2004.

N	Description	Piltun area	Offshore area	Total for both areas
1	Numbers of survey days (from Zodiac / deck of main ship).	21 (15 / 14)	4 (2 / 3)	24* (16 / 16)
2	Number of sightings(from Zodiac / from deck of main ship).	158 (109 / 49)	12 (4 / 8)	170 (113 / 57)
3	Total number of whales sighted (field data only from Zodiac).	202	7	209
4	Average number of whales per survey day (field data only from Zodiac).	13,466	3,500	13,062
5	Average number of whales per sighting (field data only from Zodiac).	1,853	1,750	1,849
6	Total duration of sighting in minutes (from Zodiac / from deck of main ship).	1976 (1836 / 140)	81 (68 / 13)	2057 (1904 / 153)
7	Number of whale photos (from Zodiac / from deck of main ship).	9349 (8607 / 742)	298 (225 / 73)	9647 (8832 / 815)
8	Average number of whale photos per survey day (from Zodiac / from deck of main ship).	445 (574 / 53)	74 (112 / 24)	402 (520 / 54)
9	Average number of whale photos per sighting (from Zodiac / from deck of main ship).	59 (79 / 15)	25 (56 / 9)	57 (78 / 14)
10	Average number of photos per whale from Zodiac **.	42,6	32,1	42,3

*- Survey day (2004_09_06) contained sightings in both areas.

** - due to insufficient data statistics for ship deck photo-sighting are not shown.

Photo-ID from the Zodiac

In 2004, whales were photographed on 16 days from the zodiac, including 15 days in the Piltun area and 2 days in the Offshore area. The photographic survey work on 6 September consisted of two missions (launch of the zodiac from the ship to photograph whales); the first photographic mission ran along the coast in the Piltun area, and the second was in the Offshore area. In 2004, 8,607 whale photographs were taken from the zodiac in the Piltun area, and 225 photographs were taken in the Offshore area.

Combined data of photographic characteristics, time parameters (effort) and other characteristics of the surveys are given in Tables 1, 2, 3 and Appendices A1 and A2. The corresponding water depths taken at the locations where gray whales were photographed were different in the Offshore area and the Piltun area. In 2004, depths were only measured from the zodiac (Table 4).

Table 4. Depths recorded from the zodiac during photo-ID, 2004.

N	Date	Sea depths taken from zodiac at each sighting (m)																Average depth (Piltun)	Average depth (Offshore)
		N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11	N12	N13	N14	N15	N16	N17	
1	2004_08_29	16																	16.00	
2	2004_08_30	8	10	5	14	25													12.40	
3	2004_09_04	36	35																35.50	
4	2004_09_05	20	6	12	16	23	20	26	26	30	31	30	17	20	19	22	9		20.44	
5	2004_09_06	14	16																15.00	
6	2004 09 06			**52**	**52**															52.00
7	2004_09_10	9	12	10	22	20	21	32	31	15	18	7	8	12	14	14	16	18	16.41	
8	2004_09_11	26	30	33	30	30	30	30											29.86	
9	2004_09_13	9	5	5	9	13													8.20	
10	2004_09_14	17	26	16	16	14	17	10	10	5	7	11	6	14	13				13.00	
11	2004_09_15	16	15	14	19	18	24												17.67	
12	2004_09_22	14	15	15															14.67	
13	2004_09_23	14	12	12	10	10	12	14											12.00	
14	2004_09_24	11	5	5	5	5	5	6	5	10	10	12	19	16					8.77	
15	2004_09_29	16	19	17	13	15	16												16.00	
16	2004_09_30	**31**	**30**																	30.50
17	2004_10_01	17	10	11	10	8													11.20	

Data pertaining to whales identified during previous study years are of the greatest interest, since they provide more extensive and precise information about specific animals. Data on the numbers of whales identified in three years of studies are given in Table 5.

Table 5. Numbers of whales identified in 2002–2004.

Year	Number of whales (total for year)	From 2002	From 2003	Number of new whales for year	Number of whales from previous years not sighted in current year	Number of whales in catalog
A	B = C + D + E	C	D	E	F	G = B + F
2002	46			46		46
2003	82	32		50	14	96
2004	96	38	33	25	25	121

Photographing all four aspects of the whales proved extremely useful, not only for creating the pre-catalog of whales photographed for the first time in 2004, but also for updating the images of whales in the final master catalogue: (1) with additional aspects that were not photographed in 2002 and 2003; and (2) with photographs showing any changes in body markings that had occurred during the study years, such as the appearance or disappearance of scars, camouflaging of natural pigmentation by rock barnacle spots, etc. Every year we obtain a more comprehensive description of each animal and a more comprehensive catalogue of the gray whales of the Okhotsk-Korean-Okhotsk population. This annual updating of the catalogue will aid in streamlining the matching process as the number of known individuals in the catalogue increases each year, and the annual discovery rate of new animals declines. The complete understanding of each individual (100% capture of all four aspects, right, left, dorsal, and ventral) also increases each year as more and more photographs are added to the catalogue. Table 6 and Appendix Table A3 present data for all the study years and the total number of aspects captured per individual for all study years.

Table 6. Efficiency table for complete documentation of the 4 standard photographed aspects for all known individualsAssessment of the comprehensiveness of data on the numbers of views of gray whales identified fromin 2002-2004.

Year		**# Aspects Photographed**				**Total # whales**
		4	**3**	**2**	**1**	
2002	number	17	3	9	17	**46**
	%	36.96%	6.52%	19.57%	36.96%	
2003	number	39	11	23	8	**81**
	%	48.15%	13.58%	28.40%	9.88%	
2004	number	51	12	27	6	**96**
	%	53.13%	12.50%	28.13%	6.25%	
2002-2004	number	75	6	31	9*****	**121**
	%	61.98%	4.96%	25.62%	7.44%	

* Of 9 whales in the catalogue that have only 1 photographed aspect, 5 individuals contain a right side only photo, and 4 individuals have contain a left side only photo (these 4 whales were identified prior to 2004 when the protocol was modified to right sides only in the final catalogue).

Two composite whales from 2002 and 2003 were discovered in 2004. To preserve the sequential numbering system previously assigned to the whale catalogue, the numbers of composite whales were deleted; retaining the first number designated to the set the composite match. The numbers RGW010 and RGW072 are no longer listed and the last whale in the catalogue has the sequence number RGW123. The numbering system should not be confused with the least count estimate of individuals in the catalogue, which currently is 121 individuals (123 minus 2 composite whales). The appearance of composite whales can be explained using the example of RGW072.

In 2002, RGW033 was identified based on the right side. In 2003, RGW072 was identified based on the left side and the dorsal and ventral flukes. In 2004, it was discovered based on a right side of RGW033 to dorsal/ventral fluke match (*RGW072) that RGW033 and RGW072 were in fact the same individual or a composite whale. The whale was given the first sighted identification number (RGW033), and the number RGW072 has ceased to exist.

To avoid this situation in the future, beginning in 2004, whales identified only by the left side are given provisional numbers (temp IDs) RGW0QN for further identification. These whales are not placed in the master catalogue but are only included in the annual catalogue and are considered as having been sighted in the annual report. This procedure for designation of temporary identifiers and classification of whale sides and flukes is generally accepted among photo-ID experts throughout the world and has been adapted for our procedures (Calambokidis et al., 1994, 2002; Clapham et al., 1993; Weller et al., 1999, 2000).

With the 2004 field season, new information was obtained that facilitated the identification of two new whales from archived photographs of past field seasons. The first new whale RGW097 had originally been grouped with another similar looking individual (RGW076). Once more detailed photographs were obtained in 2004, the appropriate distinction into two separate individuals was made, and the 2003 photograph was catalogued as a new and distinct individual seen in 2003. In the second case, RGW098 had only one left side (LS) photo and wasn't included in the annual catalogue for 2003. In 2004, all four aspects (RS, LS, DF, VF) were photographed and it too, was added to the catalogue for 2003.

Calves rarely showed their flukes, hence only their sides generally were photographed (Yakovlev and Tyurneva, 2003). No cow/calf pairs were observed in the Offshore area during any of the study years. It has been noted that whales feeding in deeper waters show their flukes more frequently than whales in the shallow-water Piltun area.

A comparison of the study results from 2002 – 2004 indicates that a more complete capture (all four aspects) of each individual whale was photographed in 2004 than in previous years (Tables 6, Appendix 3), despite the fact that the survey was conducted primarily in the Piltun area, where flukes are rarely seen. This was probably due to the additional experience of the zodiac driver and the photographer and to better weather conditions during the season, and as mentioned previously, to upgraded equipment.

Group Sizes and Distribution

The 2004 studies were distinguished from the studies of previous years by a significant increase in the proportion of observations conducted in the Piltun area (Tables 2 and 3, and Appendices A1 and A2). Four days were spent in the Offshore area during the entire survey period, and photography from the zodiac was conducted on only two days, on which four individual whales were photographed. Photography was performed from the deck of the research vessel *Oparin* in the Offshore area on three other days. During the entire survey period, we were able to identify only eight individual whales in the Offshore area, six of which were also sighted in the Piltun area in 2004. The data for all the study years are presented in Table 7, and Appendix A4.

Table 7. Movement of whales between feeding areas in each of three years from 2002 to 2004.

Year	Number of individual whales sighted in Piltun area	Number of individual whales sighted in Offshore area	Number of individual whales sighted in 2 areas
2002	13	35	1
2003	51	34	4
2004	95	8	6

In 2004, the group size of whales sighted differed when compared to 2003 data. Comparative data obtained in studies conducted only from the zodiac are presented in Table 8 and Appendix A5).

Table 8. Gray whale group size and encounter rates in 2003-2004 compared geographically by feeding area. Numbers reflect groups of whales photographed from the zodiac only.

	# Sightings in 2003	% encountered in 2003	# Sightings in 2004	% encountered in 2004
Both Areas				
1	58	48.33	55	50.93
2	38	31.66	28	25.93
3	18	15	14	12.96
4	4	3.33	7	6.48
5	2	1.66	1	0.93
6	0	0	1	0.93
7	0	0	1	0.93
8	0	0	1	0.93
Total	120		108	
Offshore area				
1	33	56.89	4	100
2	13	22.41		
3	10	17.24		
4	2	3.44		
5	0	0		
Total	58			
Piltun area				
1	25	40.32	51	50.00
2	25	40.32	28	26.42
3	8	12.9	14	13.21
4	2	3.22	7	6.60
5	2	3.22	1	0.94
6	0	0	1	0.94
7	0	0	1	0.94
8	0	0	1	0.94
Total	62		104	

For the 108 groups sighted in 2004 from the zodiac, the average group size was 1.92 whales, with groups ranging in size from 1 to 8 whales. For the 120 groups sighted in 2003, the average group size was 1.78 whales, with groups ranging in size from 1 to 5 whales (Table 8).

The average depth at locations where whales were photographed in the Piltun area was 16.47 m (a range of 5 to 36 m) in the Piltun area and 51.24 m (a range of 30 – 52 m) in the Offshore area (Table 4). The sightings are shown in Figure 1.

"Sightings" and Identified Whales

Between 7 August and 1 October 2004 (24 photo-ID working days), there were 170 encounters (sightings) with 228 gray whales, including repeat sightings (Tables 3, and Appendices Table A4, A5, and A6). Of these whales, 220 were sighted in the Piltun area, while 8 were sighted in the Offshore area. During the laboratory identification process, 95 and 7 individual gray whales were identified in the Piltun and Offshore feeding areas, respectively. Six individuals sighted in the Offshore area

were also observed in the Piltun area during the same season. A total of 121 whales were identified from the expeditions of 2002 - 2004 (Appendices A4, A6).

Repeat Sightings, Site Fidelity and Association Patterns

The following repeat sightings of identified whales were noted during the study period in 2004; data are given in Table 9).

Table 9. Frequency of repeat sightings of photo-identified gray whales in 2004.

Number of re-sightings for any individual within the 2004 season	Whales sighted each indicated number of times
1	34
2	31
3	19
4	9
5	3
6	4

Analysis of the inter- and intra-year frequency of sightings of identified whales in 2002 – 2004 is of great interest; data are given in Tables 10 and Appendices A5 and A6.

Table 10. Inter- and intra-year frequency of sightings of identified whales in 2002-2004.

Year	**2002**	**2003**	**2004**
Number of sightings of IDW	66	154	228
Number of IDW	47	81	96
Average frequency of IDW sightings	1.40	1.90	2.38

The presence or absence of whales by months in 2002 - 2004 is shown in Appendix A6.

As we can see from the examples given, repeat sightings of whales and photographing of whales over the course of a day, as well as sightings of the same whales over the course of a season, provide important data on the movements of the whales within their feeding areas and the dynamics of their visits to these areas.

Cow/Calf Pairs

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

Due to the late start of the photographic surveys in 2004, we managed to identify with certainty only two cow/calf pairs which had not separated by mid-September (Appendix A7). For example, RGW052-cow and RGW101-calf were observed together for the last time on 14 September. RGW101 was observed alone, without the mother, on 23 September (Appendix A7), and RGW052 and RGW101 were seen in different groups on 24 September (Appendices A6, A7). In 2004, we had the opportunity to track the status of animals that we had recorded as cows or calves in 2003. Comparative data is presented in Table 11.

Table 11. Inter-year comparison of the status of cows and calves from 2003 sighted in 2004.

Mother calf	Number of whales in 2003	Number of whales in 2003 with substandard BC[1]	Number of whales in 2004 from 2003	Changes in BC identified from 2003 as of 2004	
				BC improvement	BC deterioration
Mother in 2003	9	9	7	7	0
Calf in 2003	9	0	6	0	0

[1]BC = body condition

The table shows that mothers with peculiarities in body physical condition in 2003 which were sighted in 2004 had improved their condition as of the next year.

Whale Movement between Piltun and Offshore Feeding Areas

The discovery of a second main feeding area offshore from Chayvo Bay in 2001 (Maminov and Yakovlev, 2002) allowed us to observe and describe the nature of the movement of animals between the Piltun area and the Offshore area. The frequency of repeat sightings of identified individual whales during the entire survey period is important in determining the extent of the movement of whales between these two regions (see Tables 7, 8, and Appendix A4).

During the 23 days in which photo-ID was performed from the zodiac and the deck of the research vessel *Oparin*, only four days were spent in the Offshore area, and photography was performed from the zodiac on only twp of these days. Ship deck photo-ID was performed on two other days from the *Oparin*. During the entire study period in 2004, six whales observed previously in the Piltun area were also identified in the Offshore area (Appendices A4, A6).

For the entire photo-ID study period in 2004, 95 animals observed in the Piltun area were observed, of which six were also described in the Offshore area (Appendices A4, A5). Of the eight whales identified in the Offshore area in 2004, two whales were identified in two areas in the same year for the first time. The others had been described previously in 2002 and 2003 as only having been sighted in the Offshore

area. Six whales of those sighted in the offshore Area in 2004 were also observed in the Piltun area during the same year. For additional information on these whales (RGW001, RGW020, RGW047, RGW053, RGW065, RGW103, RGW110), see Appendix A.

According to our data from 2002, only one whale was observed in both the Piltun and Offshore feeding areas in the same season.

In 2002 and 2003, 11 individuals changed feeding areas between seasons, and of these, 4 whales were observed in both areas during the same season. The whales observed in the Offshore area in 2002 included cows that were observed with calves in the Piltun area in 2003 (Appendices A4, A6). For all the study years, there have been 45 whales identified using both feeding areas during one year and between years (Appendices A4, A6).

A more precise understanding and statistical substantiation of the movement of whales both within one feeding area and between areas and the conditions of the use of the feeding areas can be obtained only after the accumulation of data in further studies. For example, D. Weller, a member of the US-Russian photo-ID team, has reported that 9 of 10 whales photographed by members of the US-Russian team in the offshore area up to 2003 had been observed previously in the Piltun feeding area (D. Weller, pers. comm., May 2004).

Physical Condition

Body Weight

It was observed during data processing in 2003 that several whales appeared visibly thinner than expected after wintering. A hierarchic system for classifying the degree of emaciation of whales was developed based on the original procedure created by Weller et al. (2001). A whale is considered to have a deficient body condition if it has one or more of the following features:

- an obvious subdermal protrusion of the scapulae from the body with associated thoracic depressions at the anterior and posterior insertions of the pectoral flipper;
- the presence of noticeable depressions around the blowhole and head with a post-cranial “hump” on the dorsal surface;
- a pronounced ridge of lumbar and caudal vertebrae along the spine giving the body a bell shape (frontal view) with bulging along the lateral flanks;
- the presence of protruding ribs and vertebrae along the dorsal surface and/or lateral flanks or ribcage.

If any one or more of the above criteria were observed and noted in photographs or video data, the subject animal was classified based on the body condition as of the time of that sighting. The final classification given to a subject animal is the highest class number associated with that animal during that field season. The body condition classes for whales are defined as follows:

class 0: standard body condition whale shows none of the four criteria listed above;

class I: whale shows any of the four criteria listed above to a mild degree, but not more than two criteria;

class II: whale shows any of the four criteria listed above to a moderate degree, but not more than two criteria;

class III: whale shows any of the four criteria listed above to an extreme degree, but not more than two criteria; and

class IV: whale shows more than two of the four criteria listed above to an extreme degree.

The subjective terminology of "mild," "moderate" and "extreme" degrees of the criteria were agreed upon within the photo-ID team by comparison of photographic and video samples as a "key". Photographic illustrations of each of these cases will be prepared (when sufficient numbers of example photos are available) for subsequent reports.

A total of 15 whales in condition close to the standard (class 1) and 11 whales with obvious deviations from the standard were observed in 2004 (Table 12). Two of the 11 in the latter group were identified as cows (Table A7).

Table 12. Numbers of gray whales and associated body condition (BC) classes observed in 2003 and 2004.

BC classes	Number of whales in each BC class in 2003	% of whales in each BC class in 2003	Number of whales in each BC class in 2004	% of whales in each BC class in 2004
0	**60**	74.1	**70**	72.9
1	**6**	7.4	**15**	15.6
2	**12**	14.8	**8**	8.3
3	**2**	2.5	**3**	3.1
4	**1**	1.2	**-**	**-**

When we calculated the percentage of thin whales in relationship to the total number of animals observed, class I was disregarded, since its manifestation approximates the standard of class 0, and its occurrence was regarded as insignificant. Hence thin animals (class II or higher) identified in 2004 made up 11.46% of the total number of individuals identified (11 of 96). Thin whales (class II or higher) in 2003 made up 18.52% (15 of 81) of the total number of individuals considered (Appendix A7). In most cases, whales assigned to class I were considered to be within normal body weight limits for migrating and seasonally foraging populations. A comparison of the numbers of identified whales that changed their body condition classes from 2003 to 2004 is outlined in Table 13.

Table 13. Inter-year comparison of body condition of whales sighted in 2003 and 2004.

Description of body physical condition	Whales
Poor, but condition improved	12
Normal, but condition deteriorated	7
Poor and condition did not change	1

A classification system for body condition for calves has not been developed for 2003-2004 calves; accordingly, all calves were classified as class 0 (Appendix A7).

Skin Sloughing

During the processing of photo-ID data for 2003, skin damage that had not been observed in 2002 was noted in nine whales (Appendix A7). With the exception of one animal, all the whales with various degrees of skin sloughing were observed in the Piltun area. Some whales were encountered over a period of several days. Skin sloughing appeared to begin from the dorsal surface of the backbone in two cases. Skin sloughing progressed noticeably on one whale in a single day, from 24 August to 25 August 2003. The whale was observed a few days later with no sign of skin sloughing. The picture was similar for another whale. This sloughing or skin-shedding process progressed in stages starting again at the dorsal surface of the backbone (m1, or molt stage 1) and progressing downward on the body toward the ventral surface (m2) until all dead or damaged skin was sloughed and the whale was observed with no sign of skin sloughing (m3). Four whales with signs of skin sloughing were classified as “thin” (≥ class II). Individuals with signs of severe sloughing or skin damage were observed most frequently in August.

In 2004 we were able to identify two whales with such skin damage (m1) (Appendix A7). One of them proved to be foraging cow RGW052, which had similar damage in 2003, but in a more advanced stage (m2). Of the nine whales with skin sloughing sighted in 2003, we were able to re-identify seven during the 2004 season. Of these seven individuals, six whales showed no deviations from normal skin condition (demonstrated no skin sloughing), and one whale (RGW052) had the skin damage described directly above (Appendix A7).

DISCUSSION

Preliminary photo-ID results for 2002 – 2004 for gray whales in feeding areas on the northeast shelf of Sakhalin Island identified 121 distinct individual whales. The final consolidation of the results of three years’ work into a single current master catalogue and the development of a protocol for a minimum population count, i.e., a count of only the right or left sides of individuals (Darling, 1984; Weller et al., 2001; Weller et al., 2004) have made it possible to achieve higher reliability of least count totals for the current 2002-2004 Master Catalogue. To continue to increase the

accuracy of the total population estimate, a comprehensive statistical model incorporating capture-recapture methodologies, and a systematic sampling scheme could be incorporated into future work.

Naturally, the number of sightings of previously identified whales continue to increase with each new study season, which improves confidence levels and facilitates the photographic matching process. Newly obtained data on the known individual whales are valuable to continue monitering any changes in physical characteristics or markings that may have occurred since the last recorded sighting. Keeping sighting data current also maintains up-to-date site-fidelity records on known whales and whale groups which are important baseline information to compare if future geographical or temporal shifts occur in the whales feeding areas or feeding patterns. The geographical shift of known individual utilization of the Offshore feeding area in 2002 and 2003 to the Piltun feeding area in 2004, demonstrates that continuous monitoring of the whales and their movements is needed to track these spatial patterns.

The results of analysis of the data for 2002 - 2004 indicate inter- and intra-year movement of the gray whales, both within the Piltun and Offshore areas and between these areas. As was shown above, information about the whales' movement between areas over the course of a single season can only be provided by repeat sightings of individuals recognized during the same season. A single gray whale sighting in one area during a season and subsequent re-sightings of the same animal in the other area during the subsequent years, is also an example of interchange between the feeding areas, but on a different time scale (see Table 10).

If the western gray whale population is indeed a geographically and genetically isolated population of animals (LeDuc et al., 2002), with a significant change in the number of whales in one area, one would expect a reverse effect in the number of whales in the other area. Recent observations of foraging gray whales south of Piltun Bay, near Lunsky Bay (unpublished SEIC data), and identification of individuals in other areas of the Sea of Okhotsk indicate that the seasonal foraging habitat range of the gray whales requires additional research.

Seasonal changes in the whale distribution have been described in numerous studies and are considered a reaction to seasonal variations in habitat and movement of whale prey (Payne et al., 1986; Calambokidis et al., 1989; Calambokidis et al., 1990; Calambokidis et al., 1995; Weinrich et al., 1997; Wilson et al., 1997; Forney and Barlow, 1998; Karczmarski et al., 1999). Eastern gray whales feeding along the west coast of Vancouver Island, Canada, rotate feeding areas and prey types within and between summer feeding seasons as a function of the distribution and abundance of their prey (Bass, 2000; Dunham and Duffus, 2001, 2002; Meier 2003).

The distribution of feeding eastern gray whales along the west coast of North America is variable within and between years with whales utilizing areas from northern California to southeast Alaska from spring to fall involving significant interchange of individuals between areas with variable use of habitat within and between years (Calambokidis et al. 2002).

Recent research has indicated that eastern gray whales are not exclusively benthic foragers but are rather dynamic and selective foragers capable of utilizing a variety of prey types and foraging tactics, switching between prey species and techniques rapidly in order to take advantage of short-term availability of food resources (Dunham and Duffus, 2001, 2002; Moore et al., 2003). Eastern gray whales are multi-scale animals that can show site-fidelity at a regional scale (e.g. northeast Sakhalin Island shelf) but range over a larger area to use smaller sites or "nodes" within the region as a function of the distribution and abundance of prey over time.

In addition to their responding to the distribution and abundance of prey, there is some evidence that eastern gray whales, like other apex predators, can significantly influence the distribution and abundance of their prey through foraging (Bowen, 1997). These "top-down" effects can alter a prey community to the extent that whales will abandon it for months or years while it recovers to a richness that can be utilized again, thereby influencing the seasonal distribution of the whales. Although western gray whales are genetically isolated from eastern gray whales, it is likely that the manner in which eastern and western gray whales make foraging decisions in response to the distribution and abundance of prey, even in different ecological contexts, is similar.

There is no question that it is more difficult to conduct photo-ID work in the Offshore area. One possible reason is the greater water depths in the area, which translates to longer diving times for the whales, and more unpredicatability in their surface locations than in the Piltun area. This unpredictability often results in whales surfacing farther from the zodiac than in the Piltun area, making them less accessible for photographing. The Offshore area is not sheltered by proximity to the shore or shallows, as is the nearshore Piltun area, and is therefore subject to more pronounced wind and wave effects – conditions unfavorable for photo-ID. Due to the larger size of the Offshore area, it is also more difficult to locate aggregations of whales or solitary individuals in the area from the zodiac or base ship deck. The large size of this area means that the observers may be unaware that the whales have moved into previously surveyed section or vacated the area completely, making survey effort less efficient for whale capture rate than the smaller inshore region.

Our observations support Weller's hypothesis (Weller et al., 2000) that calves make the transition to swimming independently during the period between July and September. According to Bogoslovskaya's data (1996) on the gray whales in waters of the Chukotka Peninsula shelf, age differentiation of the groups begins in July and August, when the calves leave their mothers and gather into groups in the shallowest waters rich in food.

The regular presence of anomalously emaciated whales remains unexplained. The causes of emaciation in both Pacific gray whale populations are not clear, but a rather extensive body of evidence suggests that over-exploitation of the available food supply and/or a possible large scale climatic/oceanographic regime shift affecting productivity in the North Pacific region have been at least partially responsible. As the population of eastern gray whales increases to levels estimated

to exceed the levels prior to the period of American commercial whaling, intraspecific competition pressures in the subarctic feeding grounds may be increasing (LeBoeuf et al., 2000; Moore et al., 2001, 2003). Other authors have suggested that changes in the extent and concentration of sea ice in the Arctic Ocean due to global warming over the past 20 to 30 years may alter seasonal distributions, geographic ranges, patterns of migration, nutritional status or reproductive status of the whales (Tynan and DeMaster, 1997; Perryman et al., 2002), potentially resulting in increased use of subarctic areas. Grebmeier and Barry (1991) suggest that due to global warming, primary production in surface waters may be depressed, resulting in reduced availability of benthic prey. LeBoeuf et al. (2000) suggested that reduced availability of prey caused by a decline in productivity in the North Pacific may be limiting gray whale feeding in subarctic waters. It is conceivable that these large-scale climatic/oceanographic events may have affected the entire North Pacific region and thus may have had simultaneous and similar impacts on both the western and the eastern gray whale populations (see Brownell and Weller, 2001). However, recent gray whale prey studies have identified the Piltun area and, in particular, the Offshore feeding area as very rich prey sources (Fadeev, 2002, 2003, 2004, 2005), and it is unlikely that food resources are limited, although this issue requires further study. It is also conceivable that some other factor(s) such as disease or anthropogenic impacts during the winter migration and/or the summer feeding period may have simultaneously and similarly affected one or both gray whale populations. Interestingly, some whales that showed signs of emaciation in 2003 failed to exhibit such signs in 2004. This seasonal ability of 'thin' whales to recover to standard body condition was also previously observed between the 2002 and 2003 seasons (Yakovlev and Tyurneva, 2003, 2004; Weller et al., 2004). The energetics of gray whale foraging when combined with bi-annual feast and forage life-cycle of migrating, feeding, and breeding, are a dynamic process. Recovery and decline in body condition for both lactating and non-lactating whales does not seem to be able to be described using simple formula. This temporal scale of this process changes with each individual and demographic group, and long-term monitering is needed to form a solid basis for understanding.

In addition to the unexplained appearance of thin individuals, skin sloughing was observed among some of the animals in 2003. When the affected individuals were re-encountered in 2004, from review of the photographs, it seems that the skin sloughing recorded in 2003 has had no lasting visible effect on the external physical condition of the whale's skin. This skin sloughing phenomenon remains unexplained, but may be a result of several factors including bacterial, viral or fungal diseases (Gaydos et al., 2004), internal or external parasites, pollution, or excessive exposure to fresh water (Thompson, 1999). Organic pollutants have been implicated in the high incidence of tumors and skin lesions in marine mammals by disrupting hormonal metabolism in the body (Béland et al., 1992). Such shedding of skin has been observed among blue (Sears et al., 2000) and Greenland whales (Pettis et al., 2004), although it had not been observed previously among eastern or western gray whales.

Our preliminary observations suggest that this skin sloughing resembles what would appear to be a natural annual molting, although to date the white whale (beluga) is

the only whale species that molts annually (Boily, 1995). Beluga whales go through an annual molt, which takes place when the temperature and salinity of the water change. The examples of skin sloughing that we documented showed that the skin recovers quickly after sloughing, and no subsequent pathological consequences were observed on the surface of the whales' skin.

This phenomenon continues to require further study to understand the duration and significance of skin sloughing events and before conclusions can be drawn to the triggers or causes of the sloughing process. It is especially important to document any future whale skin sloughing in 2005 for whales recorded with skin sloughing in 2003-2004 to continue to observe the affected group of animals for long-term patterns or change. It is also important to note that individuals identified in 2002 that were observed with sloughing in 2003 had not shown any shedding of skin in the 2002 photographs, and there were no traces of shedding in 2004. Further additional photographs of the whales' skin, as well as biological skin samples from the affected areas for histological study and analysis, could be collected to establish if there are any pathogenic viruses, microbes or fungi present.

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FIGURES

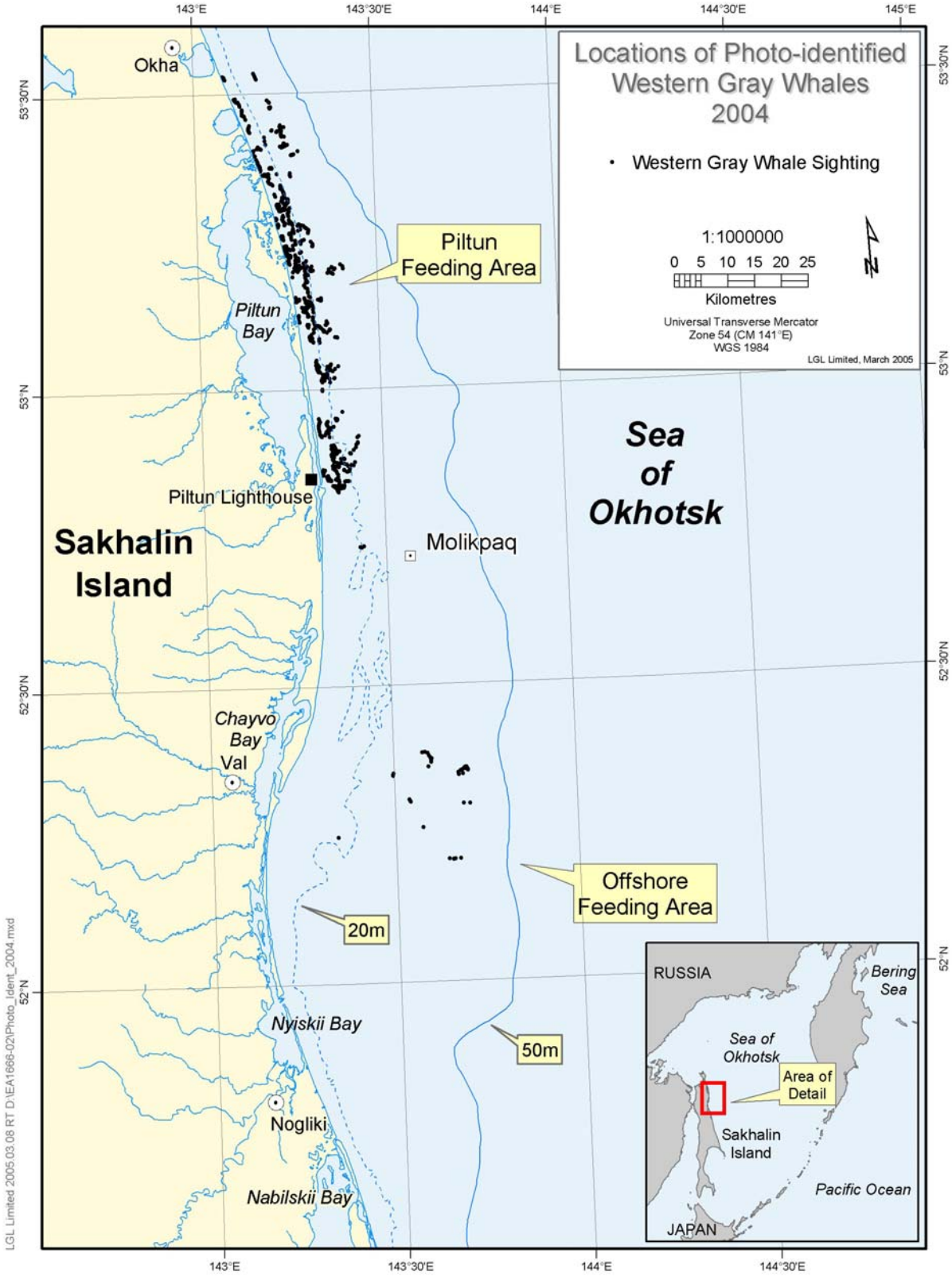

Figure 1. Sightings of photo-identified gray whales along the northeast coast of Sakhalin Island, 2004.

APPENDICES

Table A 1. Time spent at each photo-sighting during the expedition on the RV *Oparin*, 2004.

N	Date	Number of Zodiac photo-mission per day	Duration of each photo-sighting from zodiac (min)																		Duration of each photo-sighting from ship deck (min)												
			N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11	N12	N13	N14	N15	N16	N17	Total	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	Total
1	2004_08_07																				32												32
2	2004_08_17																				4												4
3	2004_08_26																				2	1											3
4	2004_08_29	2	11	16																27													
5	2004_08_30	1	20	26	26	14	26													112													
6	2004_09_04	1	4	3																7	3	1	1	1									6
7	2004_09_05	3	14	17	14	8	68	28	26	16	10	15	11	7	15	23	27	14		313													
8	2004_09_06	2	36	46	12	31														125													
9	2004_09_08																				2	1	1	1	1	1							7
10	2004_09_10	3	10	64	40	10	8	4	4	55	12	13	17	6	5	4	15	3	40	310													
11	2004_09_11	2	93	45	6	7	18	16	26											211													
12	2004_09_13	1	29	45	26	17														117	1	1	1	4	1	5	1	2	1	1	1	2	21
13	2004_09_14	2	18	20	12	12	11	14	6	3	9	11	9	16	13	15				169	1	2											3
14	2004_09_15	1	16	9	10	10	7	11												63	2	2	2	1	1	1							9
15	2004_09_18																				1	3	7	2									13
16	2004_09_20																				1	2											3
17	2004_09_21																				3												3
18	2004_09_22	1	12	74																86													
19	2004_09_23	1	3	8	8	1	3	13	5											41	3	2											5
20	2004_09_24	1	11	1	3	9	11	7	5	15	2	11	2	9	15					101	2	2	4										8
21	2004_09_28																				6												6
22	2004_09_29	2	14	14	8	17	35	8												96													
23	2004_09_30	2	21	4																25	1	3	1	1	1								7
24	2004_10_01	2	11	13	11	16	25	25												101	1	3	3	2	14								23
	Total	27																		1904													153

Table A 2. Gray whale group sizes at each photoID sighting from the zodiac and the ship deck of the RV *Oparin* in the Piltun and Offshore feeding areas, 2004.

N	Date	Group size at each photo sighting (from Zodiac)																Total Number Whales Sighted (from Zodiac)	Group size at each photo sighting (from ship)												Total number whales sighted (from ship)	Total count of whales in Piltun area
		N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11	N12	N13	N14	N15	N16	N17	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12		
1	2004_08_07																		n/d											0	
2	2004_08_17																		2											2	2
3	2004_08_26																		1	1										2	2
4	2004_08_29	1	1															2													2
5	2004_08_30	2	1	2	1	1												7													7
6	2004_09_04	2	1															3	2	1	1	1								5	8
7	2004_09_05	1	2	3	1	2	5	4	2	1	3	2	1	7	3	2	2		41											41	
8	2004_09_06	1	1	1	1													4												2	2
9	2004_09_08																		3	n/d	n/d	n/d	n/d	n/d						3	3
10	2004_09_10	1	2	2	1	1	1	1	3	1	2	2	1	1	4	3	1	3	30												
11	2004_09_11	3	4	1	1	4	3	8											24												
12	2004_09_13	2	1	2	2														7	n/d	1	1	3	2	2	2	2	1	1	1	17	24
13	2004_09_14	1	2	1	3	1	2	1	1	1	1	1	2	1	1				19	1	2										3	3
14	2004_09_15	1	1	1	3	1	1												8	2	1	1	1	1	1						7	7
15	2004_09_18																			1	1	2	1								5	5
16	2004_09_20																			1	1										2	
17	2004_09_21																			1											1	
18	2004_09_22	1	5																6													
19	2004_09_23	2	1	1	1	1	2	1											9	2	1										3	3
20	2004_09_24	2	1	2	2	1	2	2	1	2	4	1	2	2					24	2	2	3									7	7
21	2004_09_28																			1											1	1
22	2004_09_29	1	1	1	1	1	2												7													
23	2004_09_30	4	1																5	2	1	1	1	1							6	
24	2004_10_01	3	2	2	2	2	2												13	1	1	2	1	2							7	7
	total:																		209												59	83

Table A3. Target aspects photographed for individual gray whales off the northeastern coast of Sakhalin Island, 2002 - 2004.

	2002					2003					2004					# Aspects
N	**RS**	**LS**	**DF**	**VF**		**RS**	**LS**	**DF**	**VF**		**RS**	**LS**	**DF**	**VF**		**02-04**
RGW001	Y	Y	Y	Y	**Y**						Y	Y	Y	Y	**Y**	**4**
RGW002	Y	Y	Y	Y	**Y**	Y	Y	Y	Y	**Y**	Y	Y	Y	Y	**Y**	**4**
RGW003	Y	Y	Y	Y	**Y**											**4**
RGW004	Y	Y			**Y**	Y	Y	Y	Y	**Y**						**4**
RGW005	Y	Y	Y	Y	**Y**	Y	Y	Y	Y	**Y**	Y	Y	Y	Y	**Y**	**4**
RGW006	Y	Y	Y	Y	**Y**	Y	Y	Y	Y	**Y**	Y	Y	Y	Y	**Y**	**4**
RGW007	Y	Y	Y	Y	**Y**			Y	Y	**Y**		Y	Y		**Y**	**4**
RGW008	Y	Y	Y	Y	**Y**	Y	Y	Y	Y	**Y**	Y	Y	Y	Y	**Y**	**4**
RGW009	Y	Y	Y	Y	**Y**					**Y**	Y	Y	Y	Y	**Y**	**4**
RGW010	DEL					DEL					DEL					
RGW011	Y	Y			**Y**						Y	Y	Y	Y	**Y**	**4**
RGW012	Y	Y			**Y**	Y	Y	Y	Y	**Y**	Y	Y	Y	Y	**Y**	**4**
RGW013	Y	Y	Y		**Y**	Y	Y	Y	Y	**Y**	Y	Y	Y	Y	**Y**	**4**
RGW014	Y	Y	Y	Y	**Y**	Y	Y	Y	Y	**Y**	Y	Y	Y	Y	**Y**	**4**
RGW015	Y	Y	Y	Y	**Y**						Y	Y	Y	Y	**Y**	**4**
RGW016	Y	Y	Y	Y	**Y**	Y	Y	Y	Y	**Y**						**4**
RGW017	Y	Y			**Y**	Y	Y	Y	Y	**Y**	Y	Y	Y	Y	**Y**	**4**
RGW018		Y			**N**											**1**
RGW019	Y	Y	Y	Y	**Y**		Y			**Y**	Y	Y	Y	Y	**Y**	**4**
RGW020	Y	Y	Y	Y	**Y**	Y	Y	Y	Y	**Y**	Y	Y	Y	Y	**Y**	**4**
RGW021	Y				**N**	Y	Y	Y		**Y**	Y	Y	Y	Y	**Y**	**4**
RGW022	Y	Y	Y	Y	**Y**	Y	Y	Y	Y	**Y**	Y	Y	Y	Y	**Y**	**4**
RGW023	Y	Y	Y	Y	**Y**						Y	Y	Y	Y	**Y**	**4**
RGW024	Y	Y			**Y**						Y	Y	Y	Y	**Y**	**4**
RGW025	Y				**N**											**1**
RGW026	Y	Y	Y	Y	**Y**	Y	Y	Y	Y	**Y**	Y				**Y**	**4**
RGW027	Y	Y			**Y**	Y	Y			**Y**						**2**
RGW028		Y	Y	Y	**Y**	Y	Y	Y	Y	**Y**	Y	Y	Y	Y	**Y**	**4**
RGW029	Y	Y	Y		**Y**	Y	Y	Y	Y	**Y**	Y	Y			**Y**	**4**
RGW030	Y	Y			**Y**	Y	Y			**Y**	Y	Y			**Y**	**2**
RGW031	Y				**N**											**1**
RGW032	Y	Y			**Y**	Y	Y	Y	Y	**Y**	Y	Y	Y	Y	**Y**	**4**
RGW033	Y				**N**		Y	Y	Y	**Y**	Y		Y		**Y**	**4**
RGW034	Y	Y		Y	**Y**	Y	Y	Y		**Y**	Y	Y	Y	Y	**Y**	**4**
RGW035	Y	Y			**Y**	Y	Y	Y	Y	**Y**	Y	Y		Y	**Y**	**4**
RGW036	Y	Y			**Y**							Y			**Y**	**2**
RGW037	Y	Y			**Y**	Y	Y	Y	Y	**Y**	Y	Y			**Y**	**4**
RGW038	Y				**N**	Y	Y	Y	Y	**Y**	Y	Y	Y		**Y**	**4**
RGW039	Y	Y	Y	Y	**Y**	Y	Y			**Y**	Y	Y	Y	Y	**Y**	**4**
RGW040	Y	Y			**Y**	Y	Y	Y	Y	**Y**	Y	Y	Y	Y	**Y**	**4**
RGW041	Y				**N**	Y	Y		Y	**Y**						**3**
RGW042	Y	Y	Y	Y	**Y**	Y	Y	Y	Y	**Y**	Y	Y			**Y**	**4**
RGW043	Y	Y			**Y**						Y	Y	Y	Y	**Y**	**4**
RGW044	Y	Y	Y	Y	**Y**						Y	Y	Y	Y	**Y**	**4**
RGW045		Y	Y		**Y**	Y	Y	Y	Y	**Y**	Y	Y	Y	Y	**Y**	**4**
RGW046	Y	Y	Y	Y	**Y**	Y	Y	Y	Y	**Y**	Y	Y			**Y**	**4**
RGW047	Y	Y	Y		**Y**		Y			**Y**	Y	Y	Y	Y	**Y**	**4**
RGW048						Y	Y	Y	Y	**Y**	Y	Y		Y	**Y**	**4**
RGW049						Y	Y	Y	Y	**Y**						**4**
RGW050						Y	Y			**Y**	Y	Y		Y	**Y**	**3**

- continued next page-

Table A3 (*cont*.) Target aspects photographed for individual gray whales off the northeastern coast of Sakhalin Island, 2002 - 2004.

	2002					2003					2004					# Aspects
N	**RS**	**LS**	**DF**	**VF**		**RS**	**LS**	**DF**	**VF**		**RS**	**LS**	**DF**	**VF**		**02-04**
RGW051						Y	Y	Y	Y	**Y**	Y	Y		Y	**Y**	**4**
RGW052						Y	Y	Y	Y	**Y**	Y	Y	Y	Y	**Y**	**4**
RGW053						Y	Y	Y	Y	**Y**	Y	Y	Y	Y	**Y**	**4**
RGW054						Y	Y			**Y**						**2**
RGW055						Y	Y	Y	Y	**Y**	Y	Y	Y		**Y**	**4**
RGW056						Y	Y	Y	Y	**Y**						**4**
RGW057						Y	Y	Y	Y	**Y**			Y	Y	**N**	**4**
RGW058						Y	Y	Y	Y	**Y**						**4**
RGW059						Y	Y	Y	Y	**Y**	Y	Y	Y	Y	**Y**	**4**
RGW060						Y	Y	Y	Y	**Y**						**4**
RGW061						Y	Y	Y	Y	**Y**	Y	Y	Y		**Y**	**4**
RGW062						Y	Y			**Y**						**2**
RGW063						Y	Y	Y	Y	**Y**	Y	Y			**Y**	**4**
RGW064						Y	Y	Y	Y	**Y**	Y	Y	Y	Y	**Y**	**4**
RGW065						Y	Y			**Y**	Y	Y	Y	Y	**Y**	**4**
RGW066						Y	Y			**Y**	Y	Y	Y	Y	**Y**	**4**
RGW067						Y	Y	Y		**Y**	Y	Y			**Y**	**3**
RGW068						Y	Y			**Y**						**2**
RGW069						Y	Y	Y	Y	**Y**	Y		Y	Y	**Y**	**4**
RGW070						Y	Y			**Y**		Y	Y	Y	**Y**	**4**
RGW071						Y	Y	Y	Y	**Y**	Y	Y	Y	Y	**Y**	**4**
RGW072						DEL					DEL					
RGW073						Y	Y			**Y**	Y	Y			**Y**	**2**
RGW074						Y	Y	Y	Y	**Y**	Y	Y	Y	Y	**Y**	**4**
RGW075						Y		Y	Y	**Y**	Y	Y	Y	Y	**Y**	**4**
RGW076						Y	Y			**Y**	Y	Y			**Y**	**2**
RGW077						Y	Y			**Y**						**2**
RGW078						Y	Y	Y	Y	**Y**			Y		**N**	**4**
RGW079						Y	Y			**Y**						**2**
RGW080						Y	Y			**Y**	Y	Y			**Y**	**2**
RGW081						Y	Y			**Y**						**2**
RGW082						Y	Y			**Y**	Y	Y	Y		**Y**	**3**
RGW083						Y	Y			**Y**						**2**
RGW084						Y	Y	Y	Y	**Y**	Y	Y	Y	Y	**Y**	**4**
RGW085						Y	Y	Y	Y	**Y**	Y	Y	Y		**Y**	**4**
RGW086						Y	Y			**Y**	Y	Y			**Y**	**2**
RGW087						Y	Y			**Y**	Y	Y			**Y**	**2**
RGW088						Y	Y	Y	Y	**Y**	Y	Y	Y	Y	**Y**	**4**
RGW089						Y				**N**	Y	Y	Y	Y	**Y**	**4**
RGW090						Y	Y			**Y**	Y	Y	Y		**Y**	**3**
RGW091							Y			**N**	Y	Y	Y	Y	**Y**	**4**
RGW092						Y	Y	Y	Y	**Y**						**4**
RGW093						Y				**N**						**1**
RGW094							Y			**N**						**1**
RGW095							Y			**N**						**1**
RGW096							Y			**N**						**1**
RGW097						Y				**N**						**1**
RGW098							Y			**N**	Y	Y			**Y**	**2**
RGW099											Y	Y			**Y**	**2**
RGW100											Y	Y	Y	Y	**Y**	**4**

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Table A3 (*cont*.) Target aspects photographed for individual gray whales off the northeastern coast of Sakhalin Island, 2002 - 2004.

	2002					2003					2004					# Aspects
N	**RS**	**LS**	**DF**	**VF**		**RS**	**LS**	**DF**	**VF**		**RS**	**LS**	**DF**	**VF**		**02-04**
RGW101											Y	Y	Y	Y	**Y**	**4**
RGW102											Y	Y			**Y**	**2**
RGW103											Y		Y	Y	**Y**	**3**
RGW104											Y	Y			**Y**	**2**
RGW105											Y	Y			**Y**	**2**
RGW106											Y	Y			**Y**	**2**
RGW107											Y	Y			**Y**	**2**
RGW108											Y	Y			**Y**	**2**
RGW109											Y	Y	Y	Y	**Y**	**4**
RGW110											Y	Y	Y	Y	**Y**	**4**
RGW111											Y	Y	Y	Y	**Y**	**4**
RGW112											Y	Y			**Y**	**2**
RGW113											Y	Y			**Y**	**2**
RGW114											Y				**N**	**1**
RGW115											Y	Y	Y	Y	**Y**	**4**
RGW116											Y	Y			**Y**	**2**
RGW117											Y	Y	Y	Y	**Y**	**4**
RGW118											Y	Y			**Y**	**2**
RGW119											Y	Y	Y	Y	**Y**	**4**
RGW120											Y	Y			**Y**	**2**
RGW121											Y	Y			**Y**	**2**
RGW122											Y	Y			**Y**	**2**
RGW123											Y	Y			**Y**	**2**
RGWOQ1											Y				**N**	**1**
RGW0Q2												Y			**N**	**1**
RGW0Q3												Y		Y	**N**	**2**
RGW0Q4												Y		Y	**N**	**2**

Table A4. Sightings of photo-identified gray whales in both the Piltun and Offshore areas during the 2002-2004 field expeditions along the northeast Sakhalin Island shelf.

Whale No.	2002		2003		2004	
	Area		Area		Area	
	Piltun	Offshore	Piltun	Offshore	Piltun	Offshore
RGW001		1			2	1
RGW002		3		4	2	
RGW003		2				
RGW004		1		2		
RGW005		1	2		5	
RGW006		2	2		2	
RGW007		1		1	1	
RGW008		2		1	3	
RGW009		2			2	
RGW010		1				
RGW011		1			3	
RGW012		2		3	3	
RGW013		1		3	3	
RGW014		1		2	2	
RGW015		2			1	
RGW016		3		1		
RGW017		2	1		3	
RGW018		1				
RGW019	1		1		1	
RGW020		3		4	4	2
RGW021		1		2	2	
RGW022		2		4	5	
RGW023	1				3	
RGW024	2				2	
RGW025	1					
RGW026	2	1		2	1	
RGW027	2		2			
RGW028	1		2		1	
RGW029		1	3		2	
RGW030	1		1		2	
RGW031	1					
RGW032	2		2		3	
RGW033	1				1	
RGW034		2	1		2	
RGW035		1		2	2	
RGW036		2			1	
RGW037		1	2	2	3	
RGW038		1		3	1	
RGW039		2	1		3	
RGW040		1	2	1	6	
RGW041		1	2			
RGW042		1	1		1	
RGW043		1			2	
RGW044	1				2	
RGW045		1	2	2	3	

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Table A4. (*cont.)* Sightings of photo-identified gray whales in both the Piltun and Offshore areas during the 2002-2004 field expeditions along the northeast Sakhalin Island shelf.

Whale No.	2002		2003		2004	
	Area		Area		Area	
	Piltun	Offshore	Piltun	Offshore	Piltun	Offshore
RGW046		1	2		4	
RGW047		1		1		1
RGW048				2	1	
RGW049			2			
RGW050			1		2	
RGW051			1		1	
RGW052			3		6	
RGW053				3	3	1
RGW054			2			
RGW055				2	3	
RGW056			1			
RGW057				1	1	
RGW058			1			
RGW059			3		2	
RGW060				1		
RGW061				2	2	
RGW062			2	1		
RGW063			2		2	
RGW064			1		3	
RGW065			1		1	1
RGW066			1		4	
RGW067			1		3	
RGW068			1			
RGW069				3	1	
RGW070			2		1	
RGW071				1	4	
RGW072				1		
RGW073			2		2	
RGW074				3	2	
RGW075			1		4	
RGW076			4		1	
RGW077			1			
RGW078			3		1	
RGW079			2			
RGW080			1		2	
RGW081			1			
RGW082			3		2	
RGW083			1			
RGW084			1		4	
RGW085			3		2	
RGW086			3		1	
RGW087			1		1	
RGW088				3	3	
RGW089				2	1	
RGW090				2	3	

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Table A4. (*cont*.) Sightings of photo-identified gray whales in both the Piltun and Offshore areas during the 2002-2004 field expeditions along the northeast Sakhalin Island shelf.

Whale No.	2002		2003		2004	
	Area		Area		Area	
	Piltun	Offshore	Piltun	Offshore	Piltun	Offshore
RGW091				1	5	
RGW092				1		
RGW093			1			
RGW094			1			
RGW095			1			
RGW096			1			
RGW097				1		
RGW098			1		4	
RGW099					1	
RGW100					3	
RGW101					6	
RGW102					4	
RGW103					2	1
RGW104					1	
RGW105					1	
RGW106					2	
RGW107					2	
RGW108					3	
RGW109					2	
RGW110					1	1
RGW111					1	
RGW112					1	
RGW113					2	
RGW114					1	
RGW115					1	
RGW116					2	
RGW117					4	
RGW118					1	
RGW119					1	
RGW120					1	
RGW121					2	
RGW122					2	
RGW123					1	
RGW0Q1					2	
RGW0Q2					1	
RGW0Q3					1	
RGW0Q4					1	

Table A5. Sighting frequency of photo-identified gray whales on the northeast Sakhalin Island shelf, 2002-2004.

RGW ID#	Number of days seen			Total 3 years
	2002	2003	2004	
RGW001	1		3	4
RGW002	3	4	2	9
RGW003	2			2
RGW004	1	2		3
RGW005	2	2	5	9
RGW006	2	2	2	6
RGW007	1	1	1	3
RGW008	1	1	3	5
RGW009	1		2	3
RGW010	2	deleted		
RGW011	1		3	4
RGW012	2	3	3	8
RGW013	1	3	3	7
RGW014	1	2	2	5
RGW015	1		1	2
RGW016	3	1		4
RGW017	1	1	3	5
RGW018	3			3
RGW019	1	1	1	3
RGW020	1	4	6	11
RGW021	2	2	2	6
RGW022	1	4	5	10
RGW023	1		3	4
RGW024	2		2	4
RGW025	1			1
RGW026	2	2	1	5
RGW027	1	2		3
RGW028	2	2	1	5
RGW029	2	3	2	7
RGW030	2	1	2	5
RGW031	1			1
RGW032	2	2	3	7
RGW033	1		1	2
RGW034	1	1	2	4
RGW035	1	2	2	5
RGW036	1		1	2
RGW037	1	4	3	8
RGW038	1	3	1	5
RGW039	1	1	3	5
RGW040	1	3	6	10
RGW041	2	2		4
RGW042	2	1	1	4
RGW043	1		2	3
RGW044	1		2	3
RGW045	1	4	3	8

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Table A5. (*cont.*) Sighting frequency of photo-identified gray whales on the northeast Sakhalin Island shelf, 2002-2004.

RGW ID#	Number of days seen			Total 3 years
	2002	2003	2004	
RGW046	1	2	4	7
RGW047		1	1	2
RGW048		2	1	3
RGW049		2		2
RGW050		1	2	3
RGW051		1	1	2
RGW052		3	6	9
RGW053		3	4	7
RGW054		2		2
RGW055		2	3	5
RGW056		1		1
RGW057		1	1	2
RGW058		1		1
RGW059		3	2	5
RGW060		1		1
RGW061		2	2	4
RGW062		3		3
RGW063		2	2	4
RGW064		1	3	4
RGW065		1	2	3
RGW066		1	4	5
RGW067		1	3	4
RGW068		1		1
RGW069		3	1	4
RGW070		2	1	3
RGW071		1	4	5
RGW072		1	deleted	
RGW073		2	2	4
RGW074		3	2	5
RGW075		1	4	5
RGW076		4	1	5
RGW077		1		1
RGW078		3	1	4
RGW079		2		2
RGW080		1	2	3
RGW081		1		1
RGW082		3	2	5
RGW083		1		1
RGW084		1	4	5
RGW085		3	2	5
RGW086		3	1	4
RGW087		1	1	2
RGW088		3	3	6
RGW089		2	1	3
RGW090		2	3	5

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Table A5. (*cont.)* Sighting frequency of photo-identified gray whales on the northeast Sakhalin Island shelf, 2002-2004.

RGW ID#	Number of days seen			Total 3 years
	2002	2003	2004	
RGW091		1	5	6
RGW092		1		1
RGW093		1		1
RGW094		1		1
RGW095		1		1
RGW096		1		1
RGW097		1		1
RGW098		1	4	5
RGW099			1	1
RGW100			3	3
RGW101			6	6
RGW102			4	4
RGW103			3	3
RGW104			1	1
RGW105			1	1
RGW106			2	2
RGW107			2	2
RGW108			3	3
RGW109			2	2
RGW110			2	2
RGW111			1	1
RGW112			1	1
RGW113			2	2
RGW114			1	1
RGW115			1	1
RGW116			2	2
RGW117			4	4
RGW118			1	1
RGW119			1	1
RGW120			1	1
RGW121			2	2
RGW122			2	2
RGW123			1	1
RGW0Q1			2	2
RGW0Q2			**1**	1
RGW0Q3			1	1
RGW0Q4			1	1
Total	66	154	228	448
	66 sightings of 47 whales	154 sightings of 81 whales	228 sightings of 96 whales	

Average sightings per whale in 2002 - 1.40
Average sightings per whale in 2003 - 1.90
Average sightings per whale in 2004 - 2.38

Table A6. Sighting data for identified gray whales along the northeast Sakhalin Island shelf from 2002-2004.

Whale ID No.	2002	Near-Shore/Off-shore	2003	Near-Shore/Off-shore	2004	Near-Shore/Off-shore
RGW001					2004_09_05	pil
					2004_09_11	pil
					2004_09_30	off
RGW002	2002_09_11	off	2003_08_27	off	2004_09_11	pil
	2002_09_14	off	2003_08_28	off	2004_09_24	pil
	2002_09_14	off	2003_09_05	off		
	2002_09_23	off	2003_09_08	off		
RGW003	2002_09_14	off				
	2002_09_24	off				
RGW004	2002_09_14	off	2003_08_27	off		
			2003_09_06	off		
RGW005	2002_09_23	off	2003_08_25	pil	2004_09_05	pil
			2003_09_18	pil	2004_09_14	pil
					2004_09_22	pil
					2004_09_24	pil
					2004_09_29	pil
RGW006	2002_09_16	off	2003_08_24	pil	2004_08_17	pil
	2002_09_24	off	2003_09_02	pil	2004_09_04	pil
RGW007	2002_09_16	off	2003_08_18	off	2004_09_08	pil
RGW008	2002_09_16	off	2003_09_18	off	2004_09_05	pil
	2002_10_12	off			2004_09_14	pil
					2004_09_24	pil
RGW009	2002_09_16	off			2004_08_07	pil
	2002_09_17	off			2004_09_05	pil
RGW010	2002_09_23	off				
RGW011	2002_09_24	off			2004_09_13	pil
					2004_09_15	pil
					2004_09_23	pil
RGW012	2002_09_24	off	2003_08_18	off	2004_09_05	pil
	2002_10_10	off	2003_08_27	off	2004_09_10	pil
			2003_09_07	off	2004_09_23	pil
RGW013	2002_09_23	off	2003_08_28	off	2004_08_07	pil
			2003_09_05	off	2004_09_13	pil
			2003_09_13	off	2004_09_24	pil
RGW014	2002_09_24	off	2003_09_06	off	2004_08_07	pil
			203_09_10	off	2004_09_11	pil
RGW015	2002_09_24	off			2004_09_11	pil
	2002_10_11	off				
RGW016	2002_09_23	off	2003_09_07	off		
	2002_09_24	off				
	2002_10_11	off				
RGW017	2002_09_24	off	2003_09_04	pil	2004_08_29	pil
	2002_10_12	off			2004_09_13	pil
					2004_09_22	pil
RGW018	2002_09_24	off				
RGW019	2002_09_28	pil	2003_08_25	pil	2004_09_10	pil
RGW020	2002_09_17	off	2003_08_07	off	2004_09_05	pil
	2002_09_23	off	2003_08_27	off	2004_09_11	pil
	2002_09_24	off	2003_09_05	off	2004_09_14	pil
			2003_09_08	off	2004_09_15	pil

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Table A6. (*cont*.) Sighting data for identified gray whales along the northeast Sakhalin Island shelf from 2002-2004.

Whale ID No.	2002	Near-Shore/Off-shore	2003	Near-Shore/Off-shore	2004	Near-Shore/Off-shore
RGW021	2002_09_24	off	2003_08_07	off	2004_09_05	pil
			2003_08_18	off	2004_09_10	pil
RGW022	2002_09_24	off	2003_08_27	off	2004_08_07	pil
	2002_10_10	off	2003_08_28	off	2004_09_14	pil
			2003_09_05	off	2004_09_18	pil
			2003_09_10	off	2004_09_23	pil
					2004_10_01	pil
RGW023	2002_09_27	pil			2004_09_10	pil
					2004_09_10	pil
					2004_09_10	pil
RGW024	2002_09_28	pil			2004_09_05	pil
	2002_10_07	pil			2004_09_10	pil
RGW025	2002_09_28	pil				
RGW026	2002_09_28	pil	2003_09_07	off	2004_09_05	pil
	2002_10_10	off	2003_09_13	off		
	2002_10_11	off				
RGW027	2002_09_28	pil	2003_08_24	pil		
	2002_10_07	pil	2003_08_25	pil		
RGW028	2002_10_07	pil	2003_08_25	pil	2004_09_05	pil
			2003_09_03	pil		
RGW029	2002_10_11	off	2003_08_24	pil	2004_09_23	pil
			2003_08_25	pil	2004_09_24	pil
			2003_09_18	pil		
RGW030	2002_10_07	pil	2003_09_18	pil	2004_09_15	pil
					2004_09_24	pil
RGW031	2002_10_07	pil				
RGW032	2002_10_07	pil	2003_08_15	pil	2004_09_05	pil
	2002_10_15	pil	2003_09_03	pil	2004_09_11	pil
					2004_09_24	pil
RGW033	2002_10_07	pil			2004_09_04	pil
RGW034	2002_09_23	off	2003_08_25	pil	2004_08_17	pil
	2002_09_24	off			2004_09_05	pil
RGW035	2002_09_23	off	2003_09_05	off	2004_09_10	pil
			2003_09_09	off	2004_09_23	pil
RGW036	2002_09_23	off			2004_09_10	pil
	2002_09_24	off				
RGW037	2002_09_23	off	2003_08_15	pil	2004_09_05	pil
			2003_09_07	off	2004_09_15	pil
			2003_09_13	off	2004_09_22	pil
			2003_09_19	pil		
RGW038	2002_09_23	off	2003_09_05	off	2004_09_10	pil
			2003_09_07	off		
			2003_09_13	off		
RGW039	2002_10_10	off	2003_08_25	pil	2004_09_06	pil
	2002_10_12	off			2004_09_22	pil
					2004_09_24	pil

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Table A6. (*cont.)* Sighting data for identified gray whales along the northeast Sakhalin Island shelf from 2002-2004.

Whale ID No.	2002	Near-Shore/Off-shore	2003	Near-Shore/Off-shore	2004	Near-Shore/Off-shore
RGW040	2002_10_10	off	2003_08_24	pil	2004_08_07	pil
			2003_08_25	pil	2004_08_30	pil
			2003_09_08	off	2004_09_05	pil
					2004_09_10	pil
					2004_09_11	pil
					2004_09_14	pil
RGW041	2002_10_10	off	2003_08_25	pil		
			2003_09_19	pil		
RGW042	2002_10_12	off	2003_09_02	pil	2004_09_01	pil
RGW043	2002_10_12	off			2004_09_05	pil
					2004_09_14	pil
RGW044	2002_10_15	pil			2004_09_11	pil
					2004_09_23	pil
RGW045	2002_09_24	off	2003_08_23	pil	2004_09_05	pil
			2003_08_25	pil	2004_09_15	pil
			2003_09_05	off	2004_09_24	pil
			2003_09_08	off		
RGW046	2002_10_12	off	2003_09_04	pil	2004_08_30	pil
			2003_09_19	pil	2004_09_05	pil
					2004_09_24	pil
					2004_10_01	pil
RGW047	2002_09_17	off	2003_08_28	off	2004_09_06	off
RGW048			200_08_27	off	2004_09_24	off
			2003_09_05	off		
RGW049			2003_08_28	pil		
			2003_08_25	pil		
RGW050			2003_09_04	pil	2004_09_05	pil
					2004_10_01	pil
RGW051			2003_09_24	pil	2004_09_11	pil
RGW052			2003_08_13	pil	2004_08_30	pil
			2003_08_23	pil	2004_09_05	pil
			2003_08_25	pil	2004_09_13	pil
					2004_09_14	pil
					2004_09_24	pil
					2004_10_01	pil
RGW053			2003_08_07	off	2004_09_04	pil
			2003_08_29	off	2004_09_05	pil
			2003_09_13	off	2004_09_15	pil
					2004_09_30	off
RGW054			2003_08_25	pil		
			2003_09_03	pil		
RGW055			2003_08_28	off	2004_09_15	pil
			2003_09_05	off	2004_09_24	pil
					2004_10_01	pil

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Table A6. (c*ont.)* Sighting data for identified gray whales along the northeast Sakhalin Island shelf from 2002-2004.

Whale ID No.	2002	Near-Shore/Off-shore	2003	Near-Shore/Off-shore	2004	Near-Shore/Off-shore
RGW056			2003_09_03	pil		
RGW057			2003_08_27	off	2004_09_11	pil
RGW058			2003_08_24	pil		
RGW059			2003_08_24 2003_09_03 2003_09_04	pil pil pil	2004_09_10 2004_09_23	pil pil
RGW060			2003_08_07	off		
RGW061			2003_08_07 2003_09_07	off off	2004_09_14 2004_09_24	pil pil
RGW062			2003_09_03 2003_09_04 2003_09_13	pil pil off		
RGW063			2003_08_23 2003_08_25	pil pil	2004_09_10 2004_09_23	pil pil
RGW064			2003_08_24	pil	2004_09_04 2004_09_11 2004_09_24	pil pil pil
RGW065			2003_09_04	pil	2004_09_06 2004_09_29	off pil
RGW066			2003_08_25	pil	2004_09_10 2004_09_14 2004_09_22 2004_10_01	pil pil pil pil
RGW067			2003_08_25	pil	2004_09_05 2004_09_10 2004_09_23	pil pil pil
RGW068			2003_09_04	pil		
RGW069			2003_08_18 2003_08_28 2003_09_10	off off off	2004_09_13	pil
RGW070			2003_09_03 2003_09_04	pil pil	2004_09_13	pil
RGW071			2003_09_18	off	2004_09_05 2004_09_15 2004_09_24 2004_10_01	pil pil pil pil
RGW072			2003_08_18	off		
RGW073			2003_09_03 2003_09_18	pil pil	2004_08_30 2004_09_14	pil pil
RGW074			2003_08_18 2003_08_28 2003_09_05	off off off	2004_09_05 2004_09_10	pil pil

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Table A6. (*cont.)* Sighting data for identified gray whales along the northeast Sakhalin Island shelf from 2002-2004.

Whale ID No.	2002	Near-Shore/Off-shore	2003	Near-Shore/Off-shore	2004	Near-Shore/Off-shore
RGW075			2003_08_15	pil	2004_09_10	pil
					2004_09_11	pil
					2004_09_23	pil
					2004_09_29	pil
RGW076			2003_08_13	pil	2004_09_05	pil
			2003_08_25	pil		
			2003_09_03	pil		
			2003_09_18	pil		
RGW077			2003_08_25	pil		
RGW078			2003_08_13	pil	2004_10_01	pil
			2003_09_03	pil		
			2003_09_04	pil		
RGW079			2003_08_25	pil		
			2003_09_03	pil		
RGW080			2003_08_25	pil	2004_09_07	pil
					2004_09_05	pil
RGW081			2003_08_25	pil		
RGW082			2003_08_15	pil	2004_09_10	pil
			2003_08_25	pil	2004_09_14	pil
			2003_09_03	pil		
RGW083			2003_08_25	pil		
RGW084			2003_08_25	pil	2004_09_04	pil
					2004_09_05	pil
					2004_09_11	pil
					2004_09_14	pil
RGW085			2003_08_25	pil	2004_09_14	pil
			2003_09_03	pil	2004_09_24	pil
			2003_09_18	pil		
RGW086			2003_08_25	pil	2004_09_24	pil
			2003_09_03	pil		
			2003_09_18	pil		
RGW087			2003_08_25	pil	2004_09_24	pil
RGW088			2003_08_14	off	2004_09_05	pil
			2003_08_18	off	2004_09_11	pil
			2003_08_28	off	2004_09_13	pil
RGW089			2003_08_18	off	2004_09_05	pil
			2003_09_07	off		
RGW090			2003_09_08	off	2004_09_10	pil
			2003_09_13	off	2004_09_13	pil
					2004_09_14	pil
RGW091			2003_09_18	off	2004_09_04	pil
					2004_09_05	pil
					2004_09_08	pil
					2004_09_11	pil
					2004_09_18	pil

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Table A6. (cont.) Sighting data for identified gray whales along the northeast Sakhalin Island shelf from 2002-2004.

Whale ID No.	2002	Near-Shore/Off-shore	2003	Near-Shore/Off-shore	2004	Near-Shore/Off-shore
RGW092			2003_08_07	off		
RGW093			2003_08_13	pil		
RGW094			2003_09_18	pil		
RGW095			2003_08_13	pil		
RGW096			2003_08_15	pil		
RGW097			2003_09_18	off		
RGW098			2004_08_26	pil	2004_08_26 2004_08_29 2004_09_06 2004_09_28	pil pil pil pil
RGW099					2004_09_10	pil
RGW100					2004_08_30 2004_09_18 2004_09_18	pil pil pil
RGW101					2004_08_30 2004_09_05 2004_09_13 2004_09_14 2004_09_23 2004_09_24	pil pil pil pil pil pil
RGW102					2004_08_30 2004_09_05 2004_09_24 2004_10_01	pil pil pil pil
RGW103					2004_09_08 2004_09_10 2004_09_20	pil pil off
RGW104					2004_09_14	pil
RGW105					2004_09_05	pil
RGW106					2004_09_14 2004_09_15	pil pil
RGW107					2004_09_05 2004_09_10	pil pil
RGW108					2004_09_13 2004_09_14 2004_09_24	pil pil pil
RGW109					2004_09_05 2004_09_11	pil pil
RGW110					2004_09_15 2004_09_30	pil off
RGW111					2004_09_11	pil
RGW112					2004_09_14	pil
RGW113					2004_09_13 2004_09_14	pil pil
RGW114					2004_09_05	pil

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Table A6. (*cont.)* Sighting data for identified gray whales along the northeast Sakhalin Island shelf from 2002-2004.

Whale ID No.	2002	Near-Shore/Off-shore	2003	Near-Shore/Off-shore	2004	Near-Shore/Off-shore
RGW115					2004_09_10	pil
RGW116					2004_09_08 2004_10_01	pil pil
RGW117					2004_09_08 2004_09_18 2004_09_24 2004_10_01	pil pil pil pil
RGW118					2004_09_29	pil
RGW119					2004_09_05	pil
RGW120					2004_09_14	pil
RGW121					2004_09_23 2004_10_01	pil pil
RGW122					2004_09_05 2004_09_23	pil pil
RGW123					2004_09_29	pil
RGW0Q1					2004_09_05 2004_09_13	pil pil
RGW0Q2					2004_09_04	pil
RGW0Q3					2004_09_05	pil
RGW0Q4					2004_09_13	pil

*** Abbreviations:: pil – Piltun/Near-Shore area; off - Offshore area

Table A7. Observation records for individual gray whales from 2002-2004 including observed cows and calves and notable physical body parameters.

Whale No.	Years		Mother calf	BC class	Skin condition	Year 2004	Mother calf	BC class	Skin condition
	2002	2003							
RGW001	x			0	0	x		0	0
RGW002	x	x		1	0	x		1	0
RGW003	x								
RGW004	x	x		0	0				
RGW005	x	x	cow	2-3	0	x		0	0
RGW006	x	x		0	0	x		2	0
RGW007	x	x		0	0	x		0	0
RGW008	x	x		3	0	x		0	0
RGW009	x					x		0	0
RGW010									
RGW011	x					x		1	0
RGW012	x	x		1	0	x		0	0
RGW013	x	x		1	0	x		1	0
RGW014	x	x		2	0	x		0	0
RGW015	x					x		1	0
RGW016	x	x		0	0				
RGW017	x	x		0	0	x		0	0
RGW018	x								
RGW019	x	x	cow	2	0	x		0	0
RGW020	x	x		2	0	x		0	0

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Table A7. (cont.) Observation records for individual gray whales from 2002-2004 including observed cows and calves and notable physical body parameters.

Whale No.	Years		Mother calf	BC class	Skin condition	Year 2004	Mother calf	BC class	Skin condition
	2002	2003							
RGW021	x	x		0	0	x		0	0
RGW022	x	x		0	0	x		2	0
RGW023	x				0	x		0	0
RGW024	x					x		0	0
RGW025	x								
RGW026	x	x		1	0	x		0	0
RGW027	x	x	cow	2	2				
RGW028	x	x	cow	4	2	x		2	0
RGW029	x	x		0	from 1 to 3	x		0	0
RGW030	x	x		0	0	x		1	0
RGW031	x								
RGW032	x	x		0	0	x		0	0
RGW033	x	x		0	0	x		0	0
RGW034	x	x	cow?	0	1	x		1	0
RGW035	x	x		0	0	x		0	0
RGW036	x					x		0	0
RGW037	x	x		0	0	x		0	0
RGW038	x	x		0	0	x		0	0
RGW039	x	x	cow	2	0	x		0	0
RGW040	x	x		0	0	x		0	0

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Table A7. (cont.) Observation records for individual gray whales from 2002-2004 including observed cows and calves and notable physical body parameters.

Whale No.	Years		Mother	BC	Skin	Year	Mother	BC	Skin
	2002	2003	calf	class	condition	2004	calf	class	condition
RGW041	x	x	cow	3	0				
RGW042	x	x	cow	2	0	x		0	0
RGW043	x					x		0	0
RGW044	x					x		0	1
RGW045	x	x		1	0	x		0	0
RGW046	x	x		2	0	x		3	0
RGW047	x	x		0	0	x		0	0
RGW048		x		0	0	x		2	0
RGW049		x		0	1			0	0
RGW050		x		0	0	x		0	0
RGW051		x		2	2	x		0	0
RGW052		x		0	2	x	cow	3	1
RGW053		x		0	0	x		2	0
RGW054		x	calf?	0	0				
RGW055		x		0	0	x		1	0
RGW056		x	cow?	0	0				
RGW057		x		0	0	x		0	0
RGW058		x		0	0				
RGW059		x		0	from 1 to 3	x		1	0
RGW060		x		0	0				

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Table A7. (cont.) Observation records for individual gray whales from 2002-2004 including observed cows and calves and notable physical body parameters.

Whale No.	Years		Mother calf	BC class	Skin condition	Year 2004	Mother calf	BC class	Skin condition
	2002	2003							
RGW061		x		0	0	x		0	0
RGW062		x		0	0				
RGW063		x		0	0	x		0	0
RGW064		x		0	0	x		0	0
RGW065		x		0	0	x		0	0
RGW066		x	cow	2	0	x		1	0
RGW067		x		0	0	x	cow	2	0
RGW068		x		0	0				
RGW069		x		0	0	x		0	0
RGW070		x		0	0				
RGW071		x		2	1	x		0	0
RGW072									
RGW073		x	cow?	0	0	x		1	0
RGW074		x		2	0	x		1	0
RGW075		x		0	0	x		0	0
RGW076		x		0	0	x		0	0
RGW077		x		0	0				
RGW078		x	cow	0	0	x		0	0
RGW079		x	cow	0	0				
RGW080		x	cow	0	0	x		0	0

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Table A7. (cont.) Observation records for individual gray whales from 2002-2004 including observed cows and calves and notable physical body parameters.

Whale No.	Years		Mother	BC	Skin	Year	Mother	BC	Skin
	2002	2003	calf	class	condition	2004	calf	class	condition
RGW081		x	cow	0	0				
RGW082		x	cow	0	0	x		0	0
RGW083		x	cow	0	0				
RGW084		x	cow	0	0	x		1	0
RGW085		x	cow	0	0	x		0	0
RGW086		x	cow	0	0	x		0	0
RGW087		x	cow?	0	0	x		0	0
RGW088		x		1	0	x		0	0
RGW089		x		0	0	x		1	0
RGW090		x		0	0	x		0	0
RGW091		x		0	0	x		0	0
RGW092		x		0	0			0	0
RGW093		x		0	0			0	0
RGW094		x		0	0			0	0
RGW095		x		0	0			0	0
RGW096		x		0	0			0	0
RGW097		x		0	0			0	0
RGW098		x		0	0	x		2	0
RGW099						x		0	0
RGW100						x		0	0

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Table A7. (cont.) Observation records for individual gray whales from 2002-2004 including observed cows and calves and notable physical body parameters.

Whale No.	Years		Mother calf	BC class	Skin condition	Year 2004	Mother calf	BC class	Skin condition
	2002	2003							
RGW101						x	calf	0	0
RGW102						x		1	0
RGW103						x		0	0
RGW104						x		0	0
RGW105						x		0	0
RGW106						x		3	0
RGW107						x	calf	0	0
RGW108						x		0	0
RGW109						x		0	0
RGW110						x		0	0
RGW111						x		0	0
RGW112						x		0	0
RGW113						x		0	0
RGW114						x		0	0
RGW115						x		1	0
RGW116						x		0	0
RGW117						x		2	0
RGW118						x		0	0
RGW119						x		0	0
RGW120						x		0	0

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Table A7. (cont.) Observation records for individual gray whales from 2002-2004 including observed cows and calves and notable physical body parameters.

Whale No.	Years		Mother calf	BC class	Skin condition	Year 2004	Mother calf	BC class	Skin condition
	2002	2003							
RGW121						x		0	0
RGW122						x		0	0
RGW123						x		0	0
RGW0Q1						x		0	0
RGW0Q2						x		0	0
RGW0Q3						x		0	0
RGW0Q4						x		0	0