Russian Federations State Committee on Fisheries
Federal Unitarian Enterprise TINRO-Center

REPORT
ON THE RESEARCH PROJECT

The Abundance, Distribution, and Movement Patterns of Gray Whales *(Eschrichtius robustus)* in Coastal Waters off the Northeast Sakhalin Island Coast in 2002 Based on the Aerial Survey Data

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Vladivostok
July, 2003

Russian Federations State Committee on Fisheries

Federal Unitarian Enterprise TINRO-Center

UDK 639.24.053.7:599.745
№ ГР 01880073029
Инв. №

Approved
First Deputy Director, TINRO-Center
D.Sc. _____ Yu.G. Blinov
_____ 2003

REPORT

ON THE RESEARCH PROJECT

The abundance, distribution, and behavior of gray whale *(Eschrichtius robustus)* in coastal waters of the northeast Sakhalin in 2002 (aerial survey data)

Theme 1.26

Agreement № C-60326 (Y-00566) between Sakhalin Energy Investment Company and Exxon Neftegaz Limited

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ABSTRACT

Key words: gray whale, abundance, distribution, activity, Piltun feeding area, Offshore feeding area, aerial survey, An-28, monitoring, migration, mud feeding plumes.
Tables, 7; figures, 23; references, 16; appendix, 1; pages, 52.

Aerial surveys of marine mammals along the northeast Sakhalin Island coast were conducted under the SERVICE AGREEMENT between Exxon Neftegas Ltd. (ENL), Sakhalin Energy Investment Company Ltd. (SEIC), and TINRO-Center. The main goal of this study was to determine the abundance, distribution, and activities of western, or Korean-Okhotsk population of gray whales (*Eschrichtius robustus*) in the region. Aerial surveys were conducted using the Russian-designed aircraft An-28 at 300 m ASL (Piltun grid) or 500 m ASL (Offshore, Lunskoye, and Extensive grids) using predesigned sets of transects to cover the coastal areas of the eastern Sakhalin between 51° N and 54° N. A total of 33 surveys were performed and 114 hrs of flight time were completed between July and November. The surveys confirmed the earlier information that two major feeding areas of the western population of gray whales exist along the northeast coast of Sakhalin. From July to November, the number of observed animals in these areas varied from 4 to 10 in the Piltun feeding area and from 8 to 18 in the Offshore feeding area. The distribution of animals in the areas was not static, and general seasonal trends noted in 2001 were also observed in 2002. The composition of whale groups and their movement patterns (orientation direction) also did not change.

A relatively large number of gray whales noted in the Offshore feeding area in November was the most unexpected observation of this season. In addition, it was confirmed that gray whales inhabit the Offshore feeding area during the entire period of their summering at the Sakhalin Island. The area is comparable in significance with the Piltun feeding area and can even prevail in some time periods.

In general, the surveys performed in 2002 revealed no clear changes in the abundance, distribution, and behavior of gray whales in the coastal waters of the northeast Sakhalin compared with those in 2001. The earlier hypothesis about a very small number of gray whales (no more than 100 animals) arriving in these feeding areas was corroborated by the aerial survey data. This and the close proximity of gray whale feeding habitat to the oil-producing areas call for further studies and careful monitoring of the portion of the western population of gray whales summering along the northeastern coast of Sakhalin.

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ACKNOWLEDGMENTS

We thank Sergei B. Yazvenko, Sonya K. Meier, and Stephen R. Johnson of LGL Limited, Sidney, BC Canada, for significant support in survey design, organization, valuable consultations, and report reviews.

We are also grateful to Aleksandr A. Pustovoi, the chief pilot of the An-28, for his professionalism and organization of safe flights under various weather conditions.

This study was financed jointly by Exxon Neftehas Limited (ENL) and Sakhalin Energy Investment Company (SEIC).

Financial support from the TINRO-Center (Deputy Director Yurii G. Blinov who advanced payments in order to lease the aircraft for several surveys in 2002) was essential for the conduct of our studies.

INTRODUCTION

In accordance with the SERVICE AGREEMENT between Exxon Neftegas Ltd. (ENL), Sakhalin Energy Investment Company Ltd. (SEIC), and the Pacific Fisheries Research Center (TINRO-Center) no. C-60326, aerial surveys focused on the western population of gray whales were conducted by the Laboratory of Marine Mammals of TINRO-Center in the coastal areas of the northeast Sakhalin in 2002.

The interest in this population of gray whales is due to two reasons. First, summer feeding areas of gray whales are in close vicinity to some of the major oil and gas fields on the shelf of the eastern Sakhalin, including the SEIC Molikpaq platform and the planned development of oil and gas field seaward of the Piltun and Chayvo bays. Second, animals in this population are critically endangered with an estimated population of approximately 100 animals and are included in the International and Russian Red Books (Hilton-Taylor 2000, Russian Red Book 2001).

TINRO-Center has studied the western population of gray whales since 1983, when they were discovered along the northeast Sakhalin coast (Blokhin *et al.* 1985). These surveys were conducted regularly up to 1991; their results were summarized by Berzin *et al*. (1990) and Vladimirov (1994). During this period of time, aerial, vessel-based, and land-based surveys examined both the regional and local distribution and abundance of gray whales in this region of the Sea of Okhotsk (Blokhin *et al.* 1985, Berzin *et al*. 1990, Vladimirov 1994, Blokhin 1996, Blokhin *et al.* 1999, Blokhin and Burdin 2001, Sobolevsky 2000, 2001, Blokhin *et al.* 2002, Maminov and Yakovlev 2002, Yazvenko *et al.* 2002, Weller *et al.* 1999, Weller *et al.* 2002). It was found that the majority of gray whales are distributed in two regions: (1) a shallow (<20 m deep) coastal zone adjacent to Piltun Bay (between 52°40' and 53°30' N) and (2) an area 25–40 km off the coast at about the latitude of the Chayvo and Nyjskiy bays (between 51°55' and 53°30' N); at depths of 35–45 m. The latter area was found during the intensive monitoring studies associated with a seismic program conducted in 2001 that were financed by ENL (Maminov and Yakovlev 2002, Perlov *et al.* 2002, Yazvenko *et al.* 2002).

In the Offshore feeding area, gray whales (five animals) were first observed in 1995 (Sobolevsky 1999). Since then, gray whales were seen twice within this area: three whales in 1998 (I.A. Naberezhnykh, pers. comm.) and eight whales in 2000 (Miyashita *et al*. 2001). Unfortunately, these few records did not stimulate further survey efforts. However, when seven gray whales were detected in this area on 10 September 2001 from the seismic support vessel *Rubin* (Maminov and Yakovelv 2002, Perlov *et al*. 2002), the Offshore feeding area

attracted particular attention of the researchers. An aerial survey conducted immediately after 10 September 2001 confirmed the presence of gray whales in this area (Yazvenko *et al.* 2002). In 2001, gray whales in this area were observed until mid-November. The presence of mud plumes near the animals in 2001 indicated that some or all were feeding on benthic organisms. Thus, aerial surveys in 2001 documented a second important feeding area for gray whales in offshore waters of northeastern Sakhalin Island.

The main objective of the studies in 2002 was to determine the temporal and spatial distribution of gray whales and their relative abundance in this region of the Sea of Okhotsk. This work fulfilled the objectives of aerial surveys that were funded by the Sakhalin Energy and Exxon Neftegas companies within the framework of the joint program for the monitoring of gray whales and other marine mammals

METHODS

Aerial surveys off the northeast Sakhalin Island coast were conducted in a twin-engined Russian-designed fixed-wing aircraft An-28 (Figure 6) provided by the Vostok Air, Khabarovsk. The design of this aircraft allowed approximately four hours of flight before refueling and the total daily flight time of the crew could not legally exceed seven hours.

The survey grids (Figure 1) were designed by the environmental consulting company LGL Limited, which acted as the project adviser. Four survey grids were proposed for the most complete coverage of coastal waters along the northeast Sakhalin Island in the areas of concentrations of gray whales and/or in the vicinity of current/planned activities by ENL and SEIC (Figure 1).

Study Area

Intensive (Piltun) Survey Grid

The Intensive (Piltun) aerial survey grid covered specific coastal areas, mainly waters <20 m deep, near and adjacent to the ENL Odoptu license area and adjacent to Piltun Lagoon, where gray whales were known to aggregate (Berzin *et al*. 1988, 1990, 1991; Sobolevsky 2000, 2001; Weller *et al*. 2000, 2001b). The four transect lines in this coastal grid were spaced 2 km apart parallel to the shoreline, and extended 8 km seaward covering the entire ~100 km long stretch of coast (100% coverage) from 52° 37.5' N to 53° 37.5' N. Each transect was subdivided into five segments, or "blocks", with block 5 in the far north and block 1 in the far south (Table 1). Although gray whales and other cetaceans were the highest

priority during the surveys, most previously known aggregation areas of pinnipeds, i.e., near the entrances of Piltun, Chayvo and Nyjskiy bays, were also surveyed.

The Intensive (Piltun) aerial survey grid covered the entire 800 km^2 (8 km x 100 km) coastal area adjacent to the Piltun Bay (Figure 2). This sampling grid included all areas where gray whales were previously known to feed in the Piltun Bay area. Surveys were flown at the altitude of 300 m above sea level (ASL).

Extensive (Broad-Scale) Survey Grid

The Extensive (Broad-Scale) aerial survey grid sampled a broad area of nearshore and offshore waters along the entire northeast coast of Sakhalin Island. This survey grid consisted of 34 transects, each 50-km long and aligned E-W perpendicular to the coast (Figure 1, Figure 5, Table 4). This sampling grid was originally designed in 1999 (with 50 km long transects) to sample nearshore and offshore areas away from the known gray whale aggregation area near Piltun Bay and to document other groups or aggregations of gray whales that may be present in this broader area (Sobolevsky 2000, 2001). It was modified in 2000 (transects were shortened to 20 km long). Surveys of the Extensive grid in 2002 covered the approximately 330 km long stretch of coast extending from ~51° 00' N to ~54° 00' N.

By adopting an effective strip width of 2 km (1 km on either side of the aircraft) for conspicuous animals, the 34 transects of the Extensive grid sampled about 3300 km^2 or 20% of the extensive study area. Transect lines were spaced 10 km apart, were oriented E-W, and were flown in an E-W and W-E direction. The surveys of the Extensive grid also included 10-km segments between transects. These segments were oriented along the coast (roughly N-S) in the shoreline leg between transects and N-S in the offshore leg between transects. Surveys were flown at the altitude of 500 m ASL.

Offshore Feeding Area Survey Grid

This grid covered the feeding area discovered in 2001 (Maminov and Yakovlev 2002) (Figure 1, Figure 3, Table 2). The grid stretches from 51° 52'850"N to 52° 25'196"N and from 143° 23'E to 143° 44'E. Each of nine transect lines was ~100 km long and were spaced 3 km apart. Surveys were conducted at 500 m ASL; therefore, at this altitude, objects seen at 30% declination angle were 1500 m away from the centerline of the moving aircraft, thus providing intensive (100%) cover of the survey area, except for the blind strip underneath the aircraft (Figure 8).

Lunskoye Area Survey Grid

Twelve transect lines were established to cover the entire Lunskoye License area and the surrounding area (Table 3, Figure 1, Figure 4). Each of 12 transect lines was ~100 km long and spaced 3 km apart. Surveys in this area were conducted at 500 m ASL; therefore, at this altitude, objects seen at 30% declination angle were 1650 m away from the centerline of the moving aircraft, thus providing intensive (100%) cover of the survey area, except for the blind strip underneath the aircraft (Figure 8), if all transect lines were flown. Time and budget constraints dictated that every second line (odd numbers) were flown; therefore, at a minimum of 30% declination angle, 50% of the area was surveyed, except for the blind strips (450 m from the centerline of the transect on each side of the aircraft at 500 m ASL).

Survey Design

Two pilots were present in the cockpit of the An-28 aircraft at all times. The design of the aircraft precluded the possibility of placing a third person, i.e., an aerial survey observer in the cockpit. Therefore, each of the two observers surveyed a strip on each side of the aircraft extending from 270 m to 1000 m outward from the centerline of the transect at an altitude of 300 m ASL (Piltun grid) and a strip extending from 450 m to 1650 m from the centerline at an altitude of 500 m ASL (Extensive, Offshore, and Lunskoye grids) (Figure 8). As in 2001, the Piltun grid was surveyed at 300 m ASL and all other grids (Offshore, Lunskoye, and Extensive) were surveyed at 500 m ASL.

The aircraft was equipped with survival equipment and supplies, a radar altimeter and Global Positioning System (GPS) equipment, which allowed replicate sampling of the same sets of transects during each survey. The aircraft was also equipped with headphones for all marine mammal observers to enable immediate real-time communication, including communication with the aircraft crew. In addition to the aircraft GPS system, marine mammal observers had a dedicated Garmin© 12XL GPS unit. This GPS unit automatically logged track-line positions and precise times every 30 s, and was able to store up to 500 waypoints. The track-line positions and times were used to reconstruct the route and the time of each survey.

Aerial Survey Personnel

Aerial surveys were conducted by experienced personnel. Each of the marine mammal observers had at least several years of experience in conducting aerial surveys and identifying and recording information about marine mammal species likely to be present in the area. The

surveys were performed with the participation of Sergei A. Blokhin (observer on the left side of the aircraft), Nikolai V. Doroshenko (observer on the right side of the aircraft) from TINRO-Center, and Ivan P. Marchenko (GPS and computer operator); Blokhin also recorded meteorological conditions with a tape recorder and computer.

Safety Procedures

All aerial survey crew members passed a Russian training program roughly equivalent to the North American Basic Ocean Safety and Survival (BOSS) training course. The An-28 fixed-wing aircraft was equipped with survival equipment and clothing.

Survey Procedures

On average, during the three years of gray whale behavior observations in the Piltun area (Würsig *et al.* 1999, 2000, 2002), gray whales spent about 1.4 min on the surface ("surface time") and 2.1 min during a dive ("dive time") during an average 3.5 min surface-dive cycle ("surface time" plus "dive time" in Würsig *et al*. 2002: Table 39). Thus, on average, gray whales in the Piltun feeding area are present at the surface and potentially visible for detection approximately 40% of the time. Consequently, a large fraction of gray whales are not detected from a fast moving aircraft (covering 3.3 km/min at a survey speed of 200 km/hr) conducting surveys over a broad area. Although, similar behavioral data are not yet available for areas other than Piltun feeding area, it is expected that only a portion of the whales are sighted at the surface on the many grids (Extensive, Offshore, and Lunskoye). Systematic aerial surveys of strip transects designed to provide 100% coverage of a study area provide the best snap-shot or index of gray whale abundance in an area[1]; however, sightings and whales mentioned in this report should not be viewed as the actual numbers of whales present, but as quantitative indices of distribution, abundance and feeding activity.

The aircraft flew along pre-selected transects (see Survey Design section above). Every effort was made to maintain a steady ground speed in the aircraft. The actual ground speed for the aircraft averaged around 200 km/hr but ranged from 180-220 km/hr from line to line, depending on wind direction and velocity. All observers had digital watches that displayed hh:mm:ss, and all watches were synchronized with the GPS unit at the start of each

[1] The actual coverage of the survey area depends on the design of the survey aircraft. The An-28 used in these surveys leaves a blind strip from approximately 110% declination angle towards the centerline, i.e., 270 m on each side of the centerline at aircraft's altitude of 300 m ASL and 450 m on each side at 500 m ASL. However, this shortcoming does not represent a problem for the method as long as the blind strip is consistent among surveys.

survey. Portable tape recorders were used to record all data during the surveys. As noted above, each transect in the Piltun and Lunskoye grids was broken into five smaller segments (blocks) with fixed boundary points (waypoints taken at each passing) that remained consistent throughout the season. Each transect in the Offshore grid was broken into six smaller blocks with fixed boundary points. The survey of each segment in the Piltun, Lunskoye, and Offshore areas required approximately five to six min. Transects of the Extensive grid were not broken down to smaller segments. Weather (cloud cover in percents, estimated wind direction and speed, temperature, precipitation), fog, sea state (wave height in feet, swell height in feet, Russian white cap index, Russian sea state index), glare, visibility, were recorded at these boundary waypoints if weather did not change, or at the point of change if the weather did change (Appendix 2). Transect start and end time information was also recorded both on the tape recorder and as GPS waypoints (Table 5).

Marine mammal observers continually scanned the sea, focusing on the 270-m to 1000-m wide section of the transect strip on each side of the aircraft at 30-110% clinometer reading, but also recording all important sightings observed inside and outside that strip. Clinometers were used to determine the angle and thus the outer edge of the 1000 m wide (on each side of the aircraft) transect strip. No attempt was made to adjust the strip boundaries or adjust whale densities (number of whales per square km) to account for "earth curvature" as described by Lerczak and Hobbs (1998). Consequently, the transect width used in the surveys is probably slightly underestimated (Richardson and Williams 2000). When marine mammals were sighted, a "marine mammal sighting" was logged as a GPS waypoint and also recorded on tape. For gray whales, a sighting consisted of an observation of a group of one or more gray whales; specific attention was paid to whether the gray whale was or was not associated with a mud benthic feeding plume(s), or whether mud benthic feeding plumes were associated with a nearby gray whale. For gray whales, the orientation (compass direction) and activity (i.e. feeding on benthic organisms) of the whales were also recorded on tape (see Table 5). The GPS coordinates of the aircraft were immediately recorded when a gray whale was logged. Clinometers were used to measure the vertical angle (measured as a percent) to each gray whale (or group of gray whales) or mud benthic feeding plume(s). Aircraft position, clinometer angle, aircraft altitude, and GPS waypoint number were recorded at the point of closest approach, i.e., when the whale was directly perpendicular to the course of the aircraft.

Observations of mud benthic feeding plumes were recorded both near observed whales and when whales were not observed; GPS positions and clinometer angles were recorded for each mud feeding plume. Considering that the aircraft covered over 3 km/min while cruising, and that gray whales in shallow coastal waters spend about 60% of time

underwater (i.e., diving for 2-6 min), it is reasonable to assume that observers did not detect some gray whales that were present in the area. In contrast, a benthic feeding plume probably remained visible for several minutes and was often spotted with no whale seen on the surface near it.

All cetacean sightings were recorded with the same degree of detail. Pinnipeds were considered a lower priority than cetaceans during our surveys; however, their locations and approximate numbers were recorded whenever possible. Weather data were recorded with extreme degree of detail during all overflights (see Table 5) either every 5 min (every segment on the Piltun and Offshore grids) or every time that the condition changed, whichever came first. Weather data are provided in Appendix 2.

The support base for the survey aircraft and crew was Okha, at the extreme northern end of the study area, so it was not always possible to predict the weather/sightability conditions in the entire survey area before a survey started. Also, weather forecasts were sometimes lacking sufficient detail to plan the survey appropriately. These shortcomings resulted in some surveys or parts of surveys flown under less than ideal conditions (see Appendix 2).

Aerial surveys were conducted monthly, provided that the total flight time was no more than 30 h. Between July and November 2002, four sets of aerial surveys were performed in the following time periods:

1. from 26 July to 2 August;
2. from 26 August to 5 September;
3. from 30 September to 10 October; and
4. from 31 October to 18 November.

The detailed description of surveys is in Table 6; sampling grids for these aerial surveys are given in Figure 2, Figure 3, Figure 4, and Figure 5.

Unfavorable weather conditions created in the Far East region because of frequent cyclones in the summer and fall of 2002 forced the aerial survey team to make some adjustments in the program. First of all, the time of work was significantly changed. Out of the 49 days that the aerial survey team with the aircraft was on Sakhalin Island, actual surveys were performed during only 20 days (40.8%). In addition, the runway in the Nogliki airport was unusable during the rain periods; therefore, most of the time the aircraft was based in Okha, at the northern end of the Intensive (Piltun) survey area. The remoteness of this locality from the main survey areas increased the flight time. Therefore, it was decided to reduce the number of transect lines in the Lunskoye and Piltun grids by half; in the Piltun grid, the aircraft surveyed only the first two (most coastal) transects. A total of 114 h of flight time

were completed during the period under study; most time was devoted to surveys of the extensive survey grid (32 hrs, or 28.1%) and the Lunskoye grid (25 hrs, or 21.9%; Figure 7).

During the aerial surveys, the pilot sought to maintain the flight speed at 180 km/h. However, the minimum safe cruising speed for the An-28 was frequently no less than 200 km/h when there was a tail wind and even 220–230 km/h with a strong tail wind. In good weather, an observer detecting a whale (whales) in a 10–11 or 1–2 o'clock direction could see it (them) for 15–20 seconds.

Although the activity (i.e. feeding) of whales is difficult to determine from an aircraft, it can be characterized by some well-detectable traits. The position/orientation of an animal body at the moment of observation circumstantially indicates the direction of its movement. This direction was designated as southward for the whales headed to the south, southwest, or southeast, and northward for the opposite orientations.

Gray whales primarily feed on benthic (bottom) organisms, and gray whale sightings are frequently accompanied by mud plumes differing in color and size and are a characteristic feature unique to gray whales. However, it is important to note that some eastern gray whales have been documented to feed periodically on epibenthic and planktonic crustaceans, such as mysids, cumaceans, and crab larvae (Nerini 1984; Dunham and Duffus 2001, 2002) and some recently reported behavioral observations along the northeast coast of Sakhalin Island during 2002 suggest that western gray whales may be utilizing non-benthic food resources during part of the summer (Würsig *et al.* 2003). Therefore, mud plumes only facilitate the detection from an aircraft of gray whales feeding on benthic food resources. The presence of mud plumes near a whale provides evidence that the animal is feeding on benthic organisms at the moment of observation and whales feeding on other (non-benthic) resources may not have am associated plume.

Good meteorological conditions were necessary for aerial survey. White caps on the sea surface were the most significant factor limiting detectability of whales, as was shown in preceding years. However, the weather could sometimes deteriorate during a flight or vary within a survey area. Therefore, surveys sometimes continued in the presence of small white caps. This was more frequent for aerial surveys of the extensive grid. Fog was only present on transect lines 1 and 2 during surveys conducted in the Offshore grid on 27 July 2002 (see Appendix 2).

Under good weather conditions, gray whales could be recorded at different distances from the aircraft even beyond the survey strip. However, only the data from observations within the clinometer indication range 30–110% were used. This corresponded to the survey strip of 730 m (270 m to 1 km from the aircraft) for flights at 300 m ASL, and about 1200 m

(< 1.65 km from the aircraft) at 500 m ASL (Figure 8). At the same time, the data on sightings of animals in the 10–120% survey strip were used to describe distribution of whales in the Piltun and Offshore feeding areas. As the main focus was on gray whales, data on sightings of other cetaceans are presented without much discussion. Raw data on gray whale sightings are given in Appendix 1.

RESULTS

During the study period, a total of 26 aerial surveys in all areas (Piltun, Extensive, Offshore, and Lunskoye sampling grids) were conducted, including partial surveys that covered at least one full transect (Table 6). Of these, 10 surveys of the Piltun feeding area, 8 surveys of the Offshore area, 4 surveys of the Lunskoye area and 4 surveys of the Extensive grid, were conducted. A total of 242 sightings of 340 individual marine mammals were recorded by all aerial observers in all survey areas. Of this total, there were 232 sightings of 327 individual gray whales (excluding mud/feeding plumes without associated gray whales). It is important to note that this includes multiple sightings of the same animals and does not have any implications on population size. As for the other cetaceans, six minke whales and one fin whale were observed; six sighted whales could not be identified, including two whales within the Lunskoye area grid (Figure 25, Table 7).

Intensive (Piltun) Aerial Survey Grid

In the Piltun feeding area, 120 sightings of 161 gray whales were made (excluding benthic mud/feeding plumes with no associated gray whales). Of these, 86 sightings of 113 gray whales (excluding benthic mud/feeding plumes with no associated gray whales) were made within the 1 km survey strip. Gray whales were most often observed from the aircraft at angles ranging from 30-110%, i.e., at distances of 270-1000 m from the centerline. About 21% of gray whales were observed beyond 1000 m-wide transect strips on each side of the aircraft (angles of 0 to 29% on Figure 9). Hereafter in this report, only the whales observed within the transect strip (30 to 110%) will be discussed. The data of the aerial surveys of gray whales in the Piltun area are given in Appendix 1 and Figure 10. In order to facilitate comparison between different surveys, some of which included only Transect 1, the data for Transect 1 only are given in Figure 10.

The abundance of gray whales observed in the Piltun feeding area varied among surveys. However, the dependence of survey results on the particular observation conditions (see Appendix 2) and the limited number of observations do not allow us to make definite

conclusions about the within-season dynamics of the abundance and density of gray whales in the Piltun feeding area in 2002. At the same time, it can be supposed that the maximum number of gray whales in the Piltun feeding area was confined to the second survey period (the end of August and the beginning of September). The lowest number of gray whales were observed in November (Appendix 1, Figure 10, Figure 26).

The distribution of gray whales in the Piltun feeding area during a period from July to November also varied among surveys. During the first survey, most of the whales were observed in the southern part of the survey area (Block 1, Figure 12). Thereafter, the number of whales recorded in this block decreased markedly. During the second and third surveys, more than a half of whales were observed in central parts of the survey grid (Blocks 2 and 3). In November, about 70% of observed whales were observed in the northern part of the survey grid (Block 4, Figure 12). No gray whales were observed in 2002 in the northernmost part (Block 5) of the survey grid during intensive surveys. However, two gray whales were observed in sector 5 during an extensive survey on 31 July (Figure 12).

In 2002, all gray whales, except five, were observed within the 4-km-wide strip of nearshore feeding habitat along the Piltun feeding area; 69.8% of gray whales were observed within 2 km from the coast. No gray whales were observed further than 5 km offshore during the surveys of the Piltun grid (Figure 15). The five gray whales recorded outside the 0-4 km coastal strip were sighted 5-7 km from the coast during extensive aerial surveys (Appendix 1; Figure 13).

Solitary whales were observed most often (70 groups, or 73.7% of all groups). Groups of two (17 groups) represented 17.9% of sightings and groups of three (8 groups) represented 8.4% of sightings (Figure 16). The average group size was 1.347 gray whales. Most whales in the Piltun feeding area were observed moving northward or southward parallel along the shoreline. The predominant direction of their movement during the three survey periods was not constant. During the first survey, most whales were moving southward; during the second and third surveys, most whales were moving northward (Figure 17). In general, during the entire survey period, 53% of gray whales were oriented north and 29% were oriented south.

The index of benthic feeding activity of gray whales in the Piltun Bay (the ratio of whale groups with associated benthic feeding plumes to the total number of observed whale groups) also varied among surveys. The maximum benthic feeding activity was observed during the first survey (late July). Thereafter, the number of whales feeding on benthic organisms decreased. In October 2002, only two unassociated mud feeding plumes were recorded and all other gray whales recorded in October did not have an associated mud

plume. In November, we failed to observe gray whales associated with mud benthic feeding plumes or unassociated mud feeding plumes (Figure 18).

Offshore Aerial Survey Grid

In the Offshore feeding area, there were 86 sightings of 125 gray whales recorded (excluding benthic feeding mud/feeding plumes with no associated gray whales). Of this total, 32 sightings of 50 gray whales (excluding mud/feeding plumes with no associated gray whales) within the 1 km wide transect strip. Thus, 63% sightings of whales were outside the transect strip.

The area in which gray whales were observed in 2002 stretches between 51°51' N and 52°24' N and between 143°31' E and 143°44' E. This area comprises about 900 km^2, which indicates that this Offshore feeding area is larger overall than the Piltun feeding area (~500 km^2). However, it is important to note that little is presently known about the distribution and composition of suitable gray whale feeding habitat "patches" within both the Piltun and Offshore feeding areas, therefore it is impossible at the time of this report's completion to determine which area possesses the highest quality and quantity of food resources. However, detailed gray whale prey studies funded by ENL and SEIC that were conducted in 2001 and 2002, and are planned in 2003, will provide valuable information about the distribution and abundance of gray whale feeding habitat along the northeast coast of Sakhalin Island.

The observed numbers of gray whales recorded within the Offshore survey grid varied during the 2002 season, partly because (a) the number of surveyed transects was not constant among surveys (Appendix 1) and (b) because the weather conditions were suboptimal during some surveys (see Appendix 2). Only the surveys on 27 July, 5 and 30 September, 9 October, and 18 November can be considered complete (Table 6). The highest number of gray whales (13 animals) recorded in the Offshore grid during 2002 was recorded on 18 November (

Figure 11, Appendix 1).

In the Offshore feeding area, the number of observed whales varied among survey transects. The highest density of gray whales in the Offshore grid recorded along transects 6 and 7 (Appendix 1; Figure 20 and Figure 21). The latitudinal distribution of gray whales also varied. During the first two surveys, the largest numbers of gray whales recorded in north-central part of the Offshore feeding area, between 52˚10' N and 52˚15' N (Figure 22). During the fourth survey however, most gray whales were recorded in the southern part of the Offshore feeding area, between 52°00' N and 52°05' N; the latitudes of their distribution were significantly more southern than those in the previous surveys (Newman-Keuls test, $P<0.01$).

The direction of movement was recorded for each whale sighting and on average for the four surveys, 22.5% of gray whales were oriented north, 36.3% south, 20% east, and 21.3% west (Figure 23).

Most of the gray whales recorded in the Offshore feeding area were observed as solitary animals (68.7%) (Figure 24) but some small groups of whales were also observed. The average group size in the Offshore area was 1.45 animals (on and off transect) or 1.56 (on transect only).

During most surveys, mud benthic feeding plumes were observed near some whales (Figure 18 and Figure 19). The highest benthic feeding activity of gray whales was observed during the third survey period (30 September - 10 October 2002; Figure 18).

Extensive and Lunskoye Aerial Survey Grids

Aerial surveys within the extensive survey grid showed the presence of gray whales within the Piltun and Offshore feeding areas (Figure 25). A total of 18 sightings of 26 gray whales (excluding mud/feeding plumes with no associated gray whales) were recorded. Of these, 9 sightings were of 14 gray whales (excluding mud/feeding plumes with no associated gray whales) were made within 1-km wide transect strips. Thus, 9 sightings of 12 whales were recorded outside the transect strip (i.e. off-transect). Within the Lunskoye area survey grid, one sighting of four gray whales was recorded in 2002 (Figure 25, Appendix 1). In addition, two minke whales and two unknown whales were observed in this survey grid (Table 7).

DISCUSSION

Piltun Feeding Area

General Distribution and Abundance

Previous investigations showed that most of gray whales in the Piltun feeding area remain near the coast (within 4-5 km) (Blokhin *et al*. 1999, Blokhin and Burdin 2001, Blokhin *et al*. 2002, Sobolevsky 2000, 2001, Weller *et al.* 2002, Würsig *et al.* 1999, 2000). This same nearshore distribution was recorded in 2002 (Figure 15).

The abundance of gray whales recorded in the Piltun feeding area in 2002 (Figure 26) was not significantly different compared with that during corresponding periods in 2001 (*t*-test, $P<0.405$; Wilkoxon matched pairs test, $P<0.465$). As in 2001 (Yazvenko *et al.* 2002, Perlov *et al.* 2002), the number of gray whales observed in the Piltun survey grid differed between surveys. In 2002, the highest numbers of gray whales were observed in late August. A decrease in abundance was recorded in the fall (starting in October). This decrease in the number of recorded whales is typical and indicates that the number of gray whales present in the Piltun feeding area decreases in the fall. In general, the limited amount of aerial survey data does not allow us to make definite conclusions about the seasonal dynamics gray whale population distribution and abundance in the Piltun area from 1984 to 2002.

Group size of gray whales in 2002 was similar to those recorded in earlier years. Solitary animals predominated: in 1998, they comprised 87.5% of all observed whales (Weller *et al*. 2002); in 1999, 60.8 % (Sobolevsky 2000); in 2001, 65% (Blokhin *et al.* 2002); and in 2002, 60.4%. We agree with Weller *et al.* (2002) that aerial survey data give low estimates of true group sizes. This is because some of the whales are under water and cannot be detected when the survey aircraft passes overhead. Thus, observations from a small boat indicated that solitary animals constitute only 52.9% of the total number of whales observed in the Piltun feeding area (Würsig *et al*. 2000).

The data in 2002 confirm earlier conclusions (Blokhin 1996, Blokhin *et al.* 1999, Blokhin and Burdin 2001, Yazvenko *et al.* 2002) regarding the within-season shifts of gray whales within the Piltun feeding area. As shown in previous studies (Blokhin *et al.* 1999, Weller *et al.* 1999, Sobolevsky 2000, Blokhin and Burdin 2001, Yazvenko *et al.* 2002), the distribution of gray whales in the Piltun feeding area is not static and is subject to considerable within-and-between season variation and this conclusion is supported by the aerial survey data of 2002. In early summer, gray whales tended to aggregate in the southern

part of the area, whereas in November, most were recorded in the north (Figure 12). In 2001, a predominance of whales in the north (Blocks 3 and 4) was also observed in November (Perlov *et al.* 2002, Yazvenko *et al.* 2002). The results of vessel-based (Maminov and Perlov 2003) and behavioral (Würsig *et al.* 2003) studies conducted in 2002 also indicate the presence of seasonal shifts. It is also possible that late-season/fall changes in the species, distribution, and abundance of gray whale prey within the Piltun feeding area causes whales to shift their distribution towards the northern end of the survey area. It is also possible that concurrent changes in the distribution and abundance of gray whale prey late in the season in both the Piltun and Offshore feeding areas influence the foraging decisions and distributions of whales. The observed late-season "shift" to the north may occur because some gray whales in southern portions of the Piltun feeding area may have moved from the Piltun feeding area to the Offshore feeding area. This is supported by the fact that proportionally more gray whales occur in the Offshore feeding area late in the season compared to early in the season (Figure 26.

Directional Orientation

Until 2001, aerial survey data did not include information on the orientation direction of gray whale movements. However, observations from the shore indicated that most of the feeding whales move parallel along the coast in either northward or southward directions (Blokhin 1996, Blokhin *et al.* 1999). Aerial survey data from 2001 confirmed this observation; it was also found that the direction of whales' movement changed during the day (Blokhin *et al*. 2002, Perlov *et al.* 2002, Fedoseev 2001 pers. comm.). Aerial surveys in the Piltun feeding area in 2002 documented northward movements of whales in about 50% of cases; southward movements were documented in 29% of cases.

Benthic Feeding Activity

For the Western Pacific population of gray whales, the main feeding area is found in the nearshore zone of northeastern Sakhalin Island. At present, there are few reliable data to assess gray whale feeding habitat in this area, as there is no information on the contents of whales' stomachs, whale fatness, and there is limited information on prey species, abundance and density in summer feeding areas. Gray whale prey studies initiated in 2001, continued in 2002, and planned for 2003, will help define the quantity and quality gray whale feeding habitat. We can only indirectly assess gray whale benthic feeding activity from the presence of mud feeding plumes recorded near the whales during aerial surveys. The first quantitative data on the occurrence of mud plumes near western gray whales on the Sakhalin shelf were obtained during aerial surveys in 2001 (Figure 19); see also Perlov *et al.* 2002, Yazvenko *et*

al. 2002). In 2002, these observations were continued and they showed that the highest benthic feeding activity of gray whales (55% of the total number of observed groups of gray whales had associated mud plumes) in the Piltun feeding area was observed during the first set of surveys in 31 July 2002. Thereafter, the benthic feeding activity fluctuated and ceased in November (no mud benthic feeding plumes observed; Figure 18).

In 2001, the benthic feeding activity of gray whales in the Piltun area in the end of August and the beginning of September was approximately the same as during the corresponding period of 2002 (Figure 18 and Figure 19). No mud plumes associated with gray whales were observed in October and November 2001 (Figure 19). Thus, though the number of observations in 2002 is small, it seems from the 2001 and 2002 data that the intensity of feeding by gray whales on benthic organisms in the Piltun feeding area was highest July through September. In October, feeding on benthic organisms apparently declined and it is possible that whales are spending more time searching for instead on feeding on benthic food resources. It is also possible that some gray whales feed on zooplankton swarming over the ocean bottom or in the water column during this period. Causes for eastern gray whales to switch prey types and feeding areas within and between seasons is explained in detail in Dunham and Duffus (2001, 2002) and Meier (2003).

Offshore Feeding Area

General Distribution and Abundance

Aerial surveys in 2002 confirmed the presence of gray whales in the Offshore feeding area and showed that their numbers vary throughout the season (

Figure 11; Appendix 1). The distribution of gray whales in the Offshore feeding area varied temporally; most often, the animals were observed between 52°10' N and 52°15' N (Figure 28). In both years of observations, the distribution pattern of gray whales in the fall was the same - most of the whales were detected in the southern part of this area (Figure 28). The aerial survey in November 2001 was complicated by unfavorable weather conditions, thus it is not possible to compare the results of November 2001 with those from November 2002.

Results from 2002 confirm the earlier hypotheses (Blokhin *et al.* 2002, Perlov *et al.* 2002, Yazvenko *et al*. 2002) that the Offshore feeding area is an area utilized during the entire feeding season, rather than only during the late-season. In 2002, gray whales were observed in the Offshore feeding area during the first aerial survey in July and remained until the last aerial survey in November. The Offshore feeding area seems to be at least as important as a

feeding area for the population of gray whales as the Piltun feeding area; in the fall, the Offshore feeding area may be even more important than the Piltun feeding area. However, the shallow Piltun feeding area is possibly critically important for rearing the calves.

Benthic Feeding Activity

As the presence of gray whales in feeding areas is likely related to the distribution and availability of prey, one can speculate that the concentration of animals in the southern part of the Offshore area in November is related with decreased prey availability in the central part of this area and/or an increase in prey availability in the south. In November 2001, no mud plumes were observed near the whales (Yazvenko *et al*. 2002). Two years of aerial surveys indicate that benthic feeding activity by gray whales in the Offshore area decreases by November. This decrease in the observation of mud plumes may indicate that gray whale spend more time searching for benthic food instead of actively feeding. It is also possible that gray whales target non-benthic prey during this fall period, however this has not been quantified.

Distribution and Abundance of Gray Whales Along the Entire Northeast Coast of Sakhalin Island

The variable distribution of gray whales in two feeding areas observed both in 2001 and 2002 could be due to a number of factors including differences in sightability (see Appendix 2). However, changes suggest that there could be exchange and movement of these animals between and within these two feeding areas. Changes in the density of gray whales within these areas and several records of the presence of gray whales beyond these areas (Yazvenko *et al*. 2002) suggest that some exchange of whales takes place between these two major feeding areas. This idea is supported by 2000 and 2002 data from the Offshore feeding area of several gray whales that were earlier observed or photographed in the Piltun feeding area (Weller *et al*. 2002, Yakovlev and Tyurneva 2003). Changes in the density of whales in the two feeding areas in 2002 (Figure 10) suggest that a higher proportion of whales occur in the Offshore feeding area in the fall compared to the Piltun feeding area, although individuals may continuously move back and forth between the two areas. Based on an apparent decrease in benthic feeding activity (few or no mud plumes) of gray whales in the fall (November), benthic feeding activity appeared to decline in both feeding areas. A decrease in suitable prey densities may be one of the main reasons for gray whales leaving the waters of northeastern Sakhalin Island in November, long before the formation of fast ice (end of December) in this area, however a need to maximize time in calving and breeding areas may also drive this

departure from feeding areas. It is possible that some epibenthic or planktonic feeding occurs in the water column during this period. It is also possible that there are some favorable feeding areas between summer and winter habitats of gray whales, where whales can remain for some time. Eastern gray whales commonly feed opportunistically along their entire migration route (Sánchez-Pacheco *et al.* 2001; Dunham and Duffus 2001, 2002; Calambokidis *et al.* 2002).

CONCLUSIONS

Aerial surveys of gray whales in the Offshore areas of northeastern Sakhalin in 2002 were a continuation of a long-term program of marine mammal research and monitoring in this region. Aerial surveys were performed by specialists from TINRO-Center (Vladivostok) with the financial support from Exxon Neftegas Limited (ENL) and Sakhalin Energy Investment Company (SEIC).

Aerial survey effort in coastal waters of northeastern Sakhalin Island in 2002 was less intensive than in 2001. In addition, unfavorable weather conditions and frequent shut-downs of the Nogliki airport considerably reduced the efficiency of aerial surveys in 2002. Nevertheless, important new information was obtained in 2002. This new information confirms the results of aerial surveys conducted in 2001. In 2002, the presence of two major feeding areas of the Western population of gray whales were confirmed and the distribution, abundance and activities (i.e. feeding) of gray whales in these feeding areas was further documented.

Overall, from July to November, four sets of aerial surveys were conducted and results can be summarized as follows:

1. Gray whales were the most abundant cetaceans recorded.
2. Six minke whales, one fin whale, and six unidentified cetaceans were also recorded.
3. The existence of two separate gray whale feeding areas (the Piltun feeding area and the Offshore feeding area) off the northeastern coast of Sakhalin Island was confirmed. The numbers of gray whales recorded in these two areas during different aerial surveys were not constant throughout the season.
4. Feeding of gray whales on benthic organisms varied considerably throughout the season but declined in October and November in both the Piltun and Offshore areas.

5. Within the limitations of our data, the distribution of gray whales in 2002 did not differ markedly from that observed in 2001:

    (a) Gray whales within the Piltun survey grid tended to concentrate in a relatively narrow strip (4-5 km) from shore. Most of the whales in the Piltun feeding area were oriented in northward or southward directions (mainly parallel to the shoreline).

    (b) In the Offshore feeding area, gray whales were primarily recorded in the central part of the aerial survey grid; no predominant orientation or movement patterns were identified.

6. The 2002 aerial surveys confirmed the earlier hypothesis that the Offshore feeding area is primary feeding habitat for gray whales during the entire summer-fall period. As a feeding habitat, the Offshore feeding area is likely no less important than the Piltun feeding area; in some periods (i.e. in the fall), it may be even more important.

7. A considerable number of whales were recorded in the Offshore feeding area in November.

8. The increase in the use of the Offshore feeding area in November is concurrent with the decrease in the use of the Piltun feeding area.

9. As in 2001, a decrease in benthic feeding activity of gray whales was noted in October and November.

In general, aerial surveys in 2002 have continued to broaden our understanding of gray whale distribution and abundance along the northeastern Sakhalin shelf in the summer and fall periods. The small size of the gray whale population in this region and the proximity of its feeding areas to oil and gas development areas on the shelf of eastern Sakhalin warrant further monitoring and research studies. Further studies are needed also because, despite a considerable amount of data, many aspects of the feeding ecology of the western population of gray whales remain poorly understood.

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FIGURES

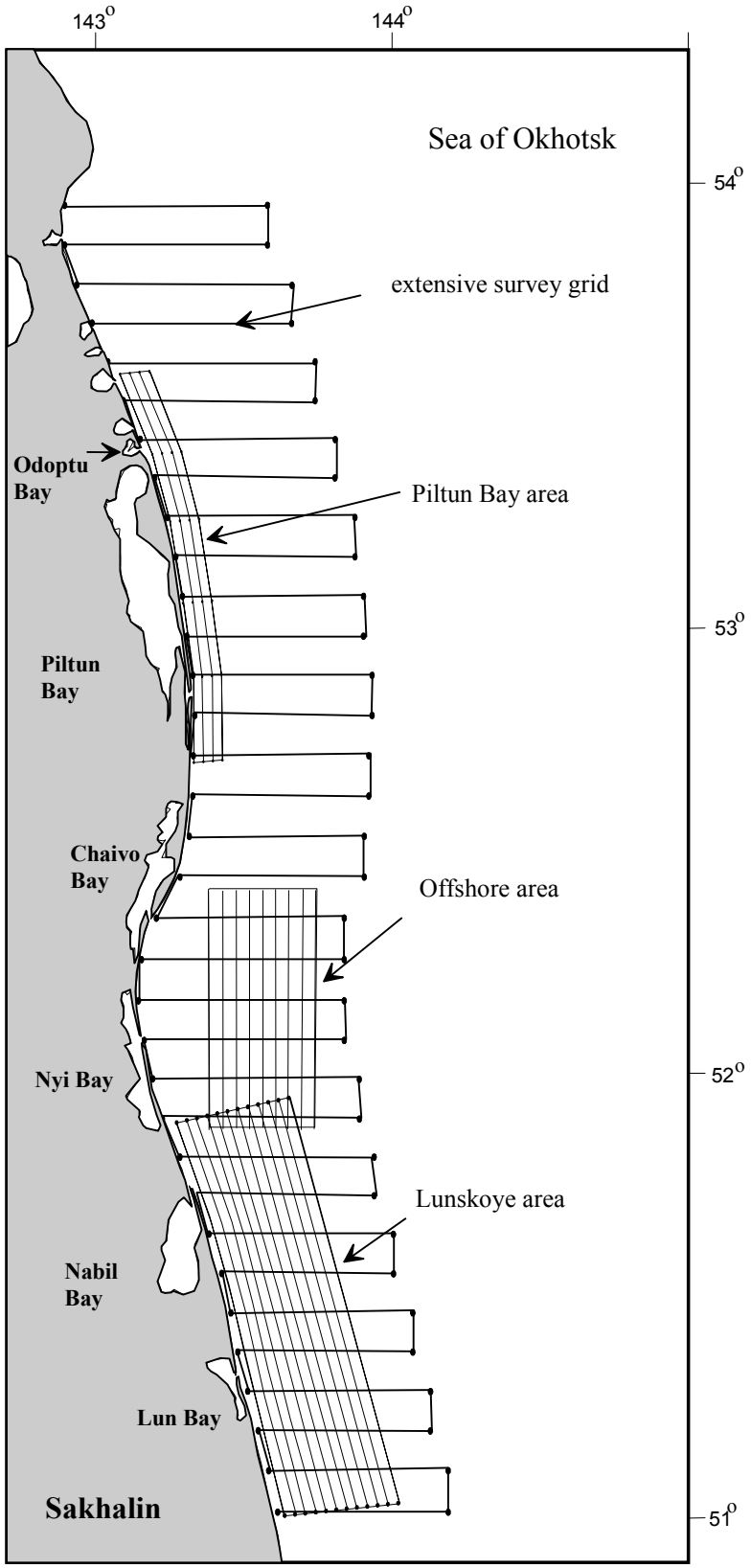

Figure 1. Aerial survey grid of marine mammals in coastal waters of the northeast Sakhalin in July-November, 2002 (AN-28 aircraft).

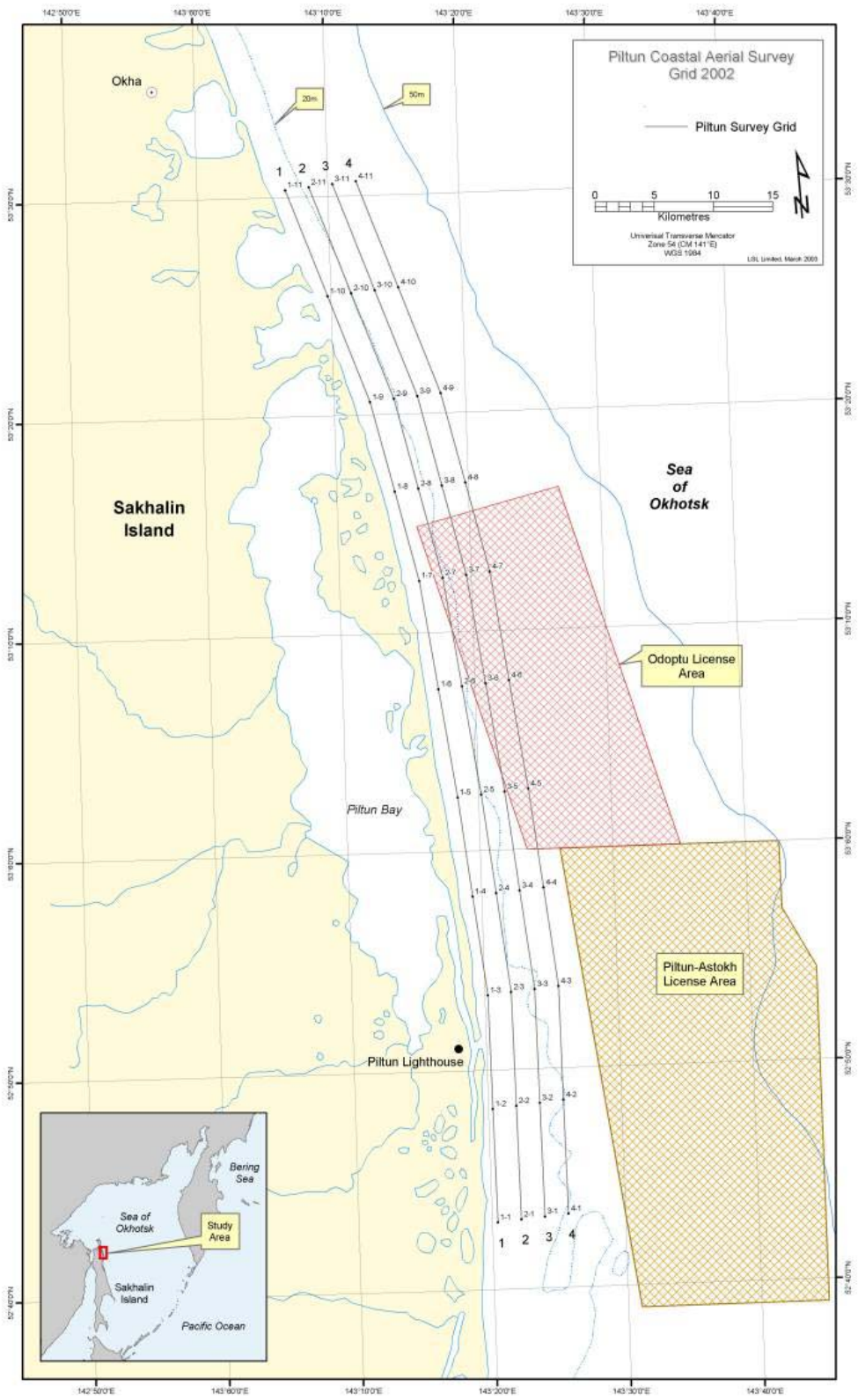

Figure 2. Piltun Bay feeding area survey grid.

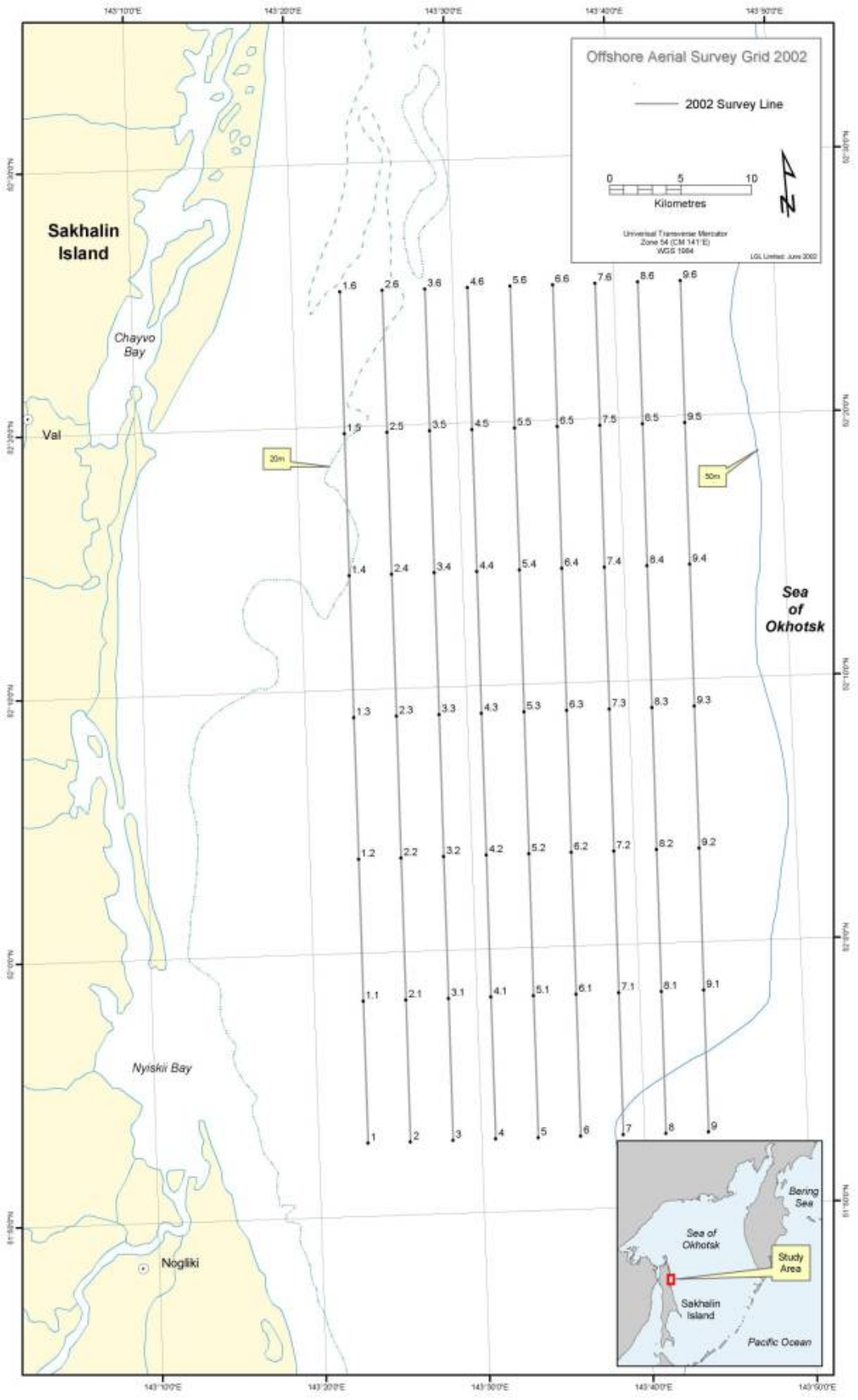

Figure 3. Offshore feeding area survey grid.

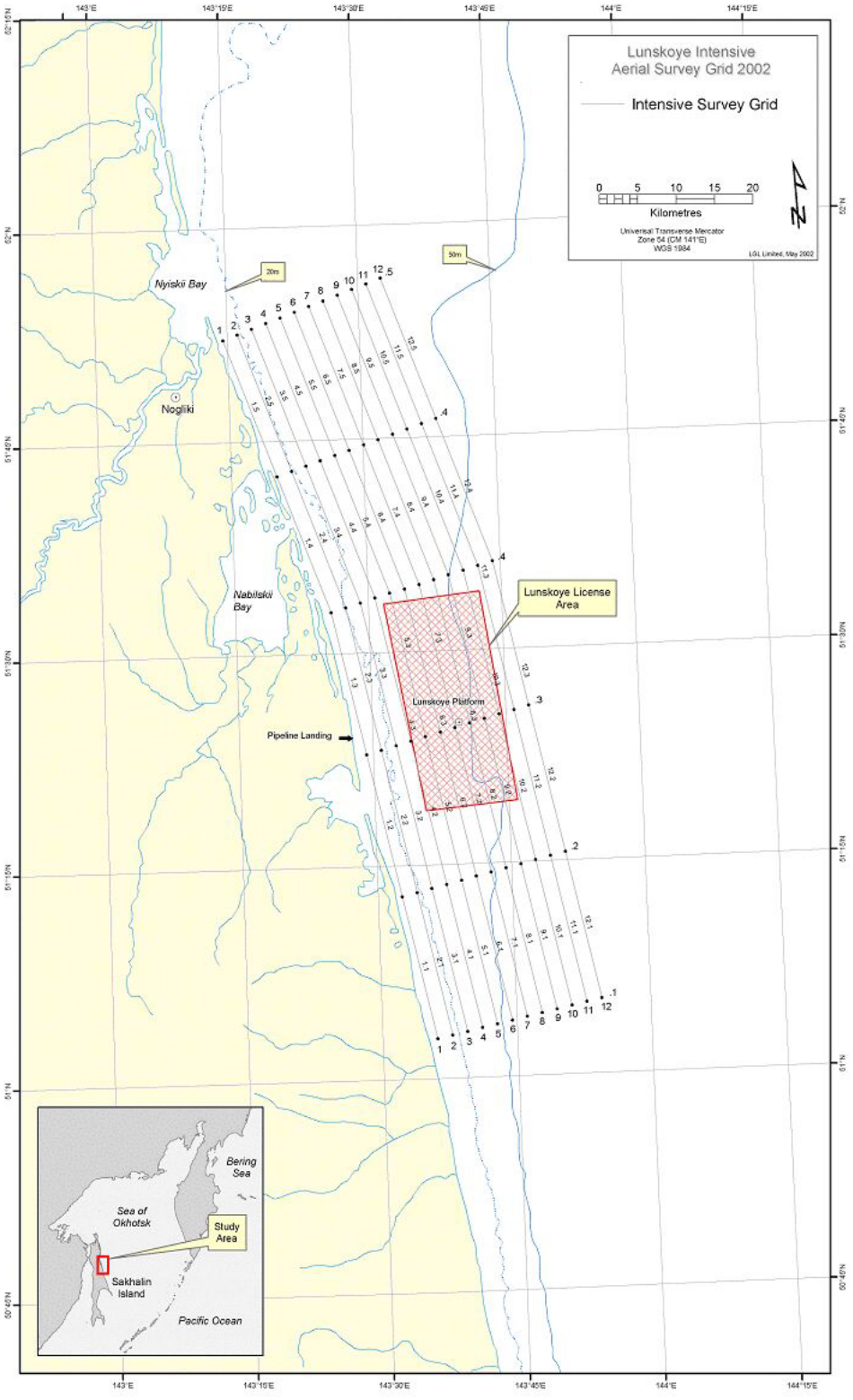

Figure 4. Lunskoye area survey grid.

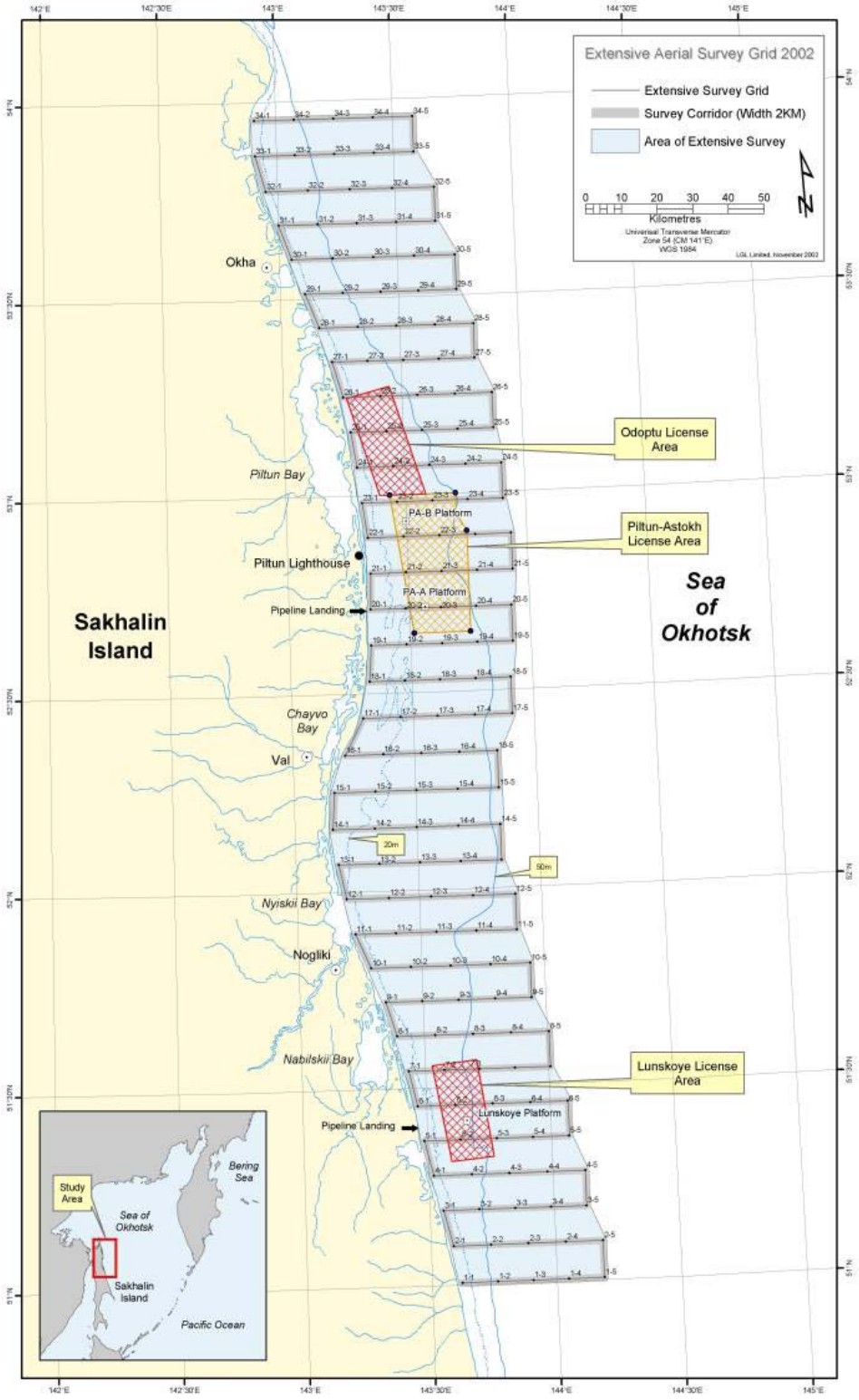

Figure 5. Extensive survey grid.

Figure 6. Russian-designed aircraft Antonov-28 used for all aerial surveys in 2002.

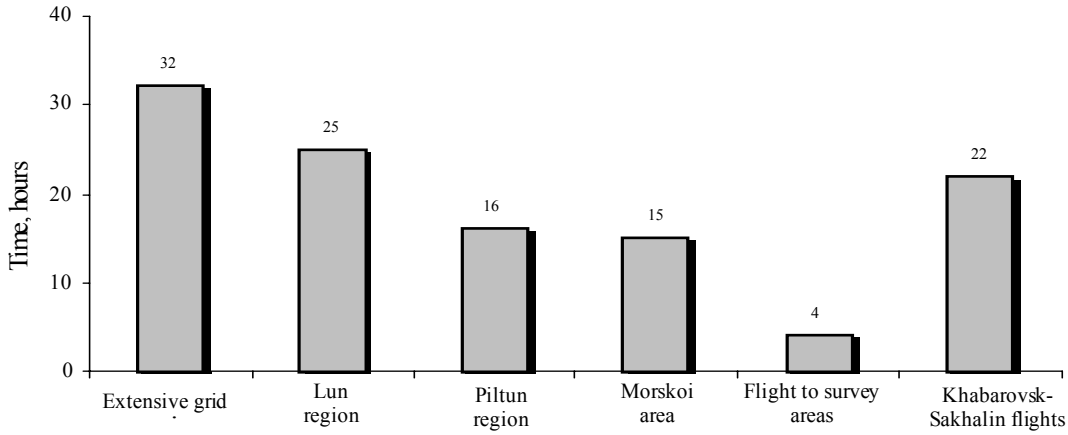

Figure 7. Time espenditure for aerial surveys of marine mammals at the northeast Sakhalin coast in 2002 (AN-28 aircraft, Figure 1).

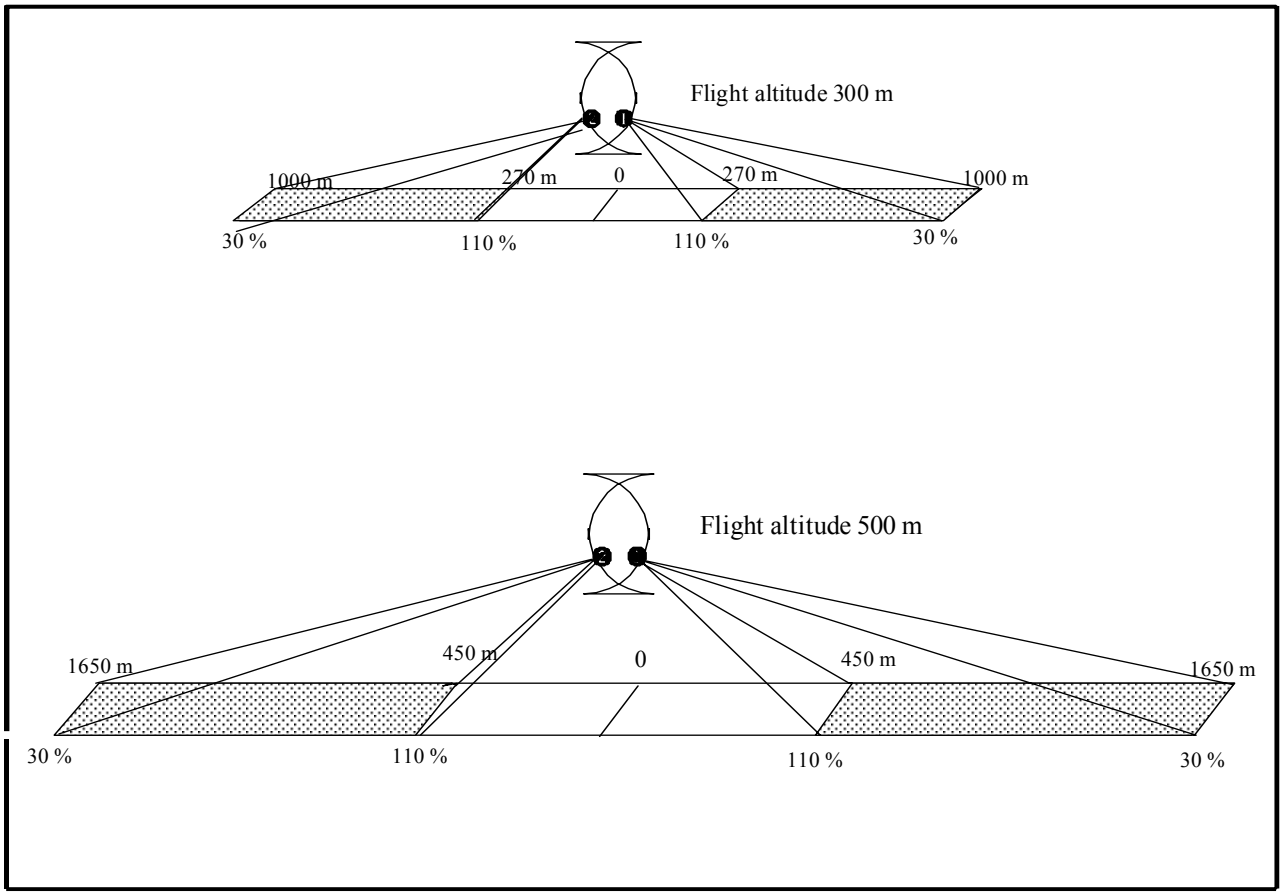

Figure 8. Aerial survey design for two observers at the northeast Sakhalin coast (AN-28 aircraft) (%) PM 5/360 PC clinometer indication, %.

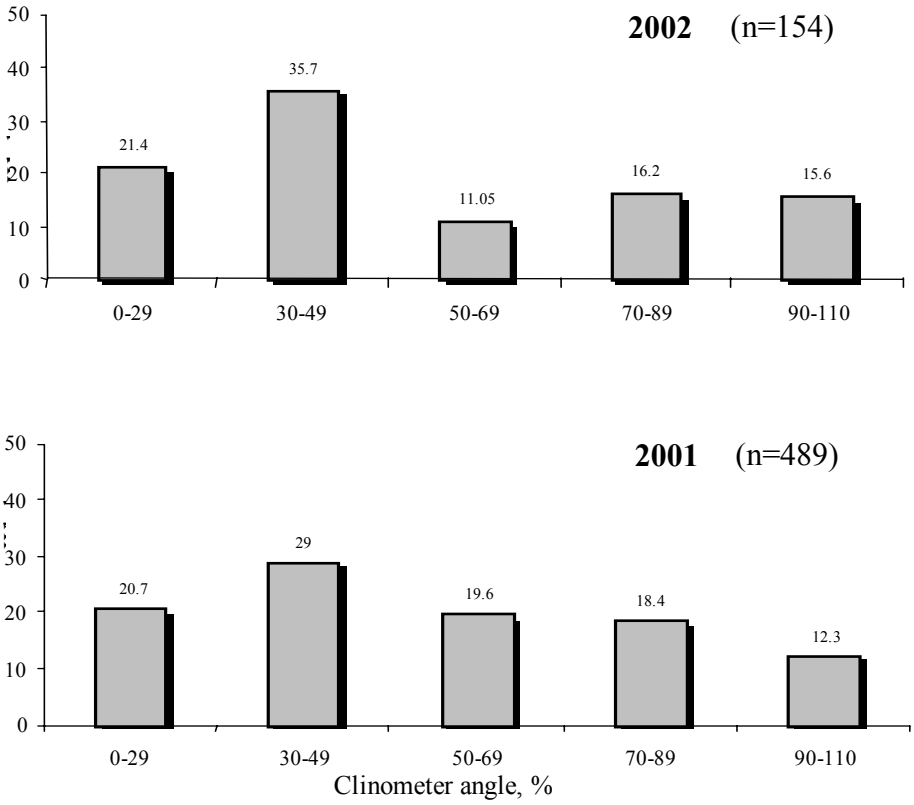

Figure 9. Sighting frequency of gray whales at different distances from the aircraft in the Piltun region, coastal waters of the northeast Sakhalin, in 2001-2002 (AN-28 aircraft, flight altitude 300 m).

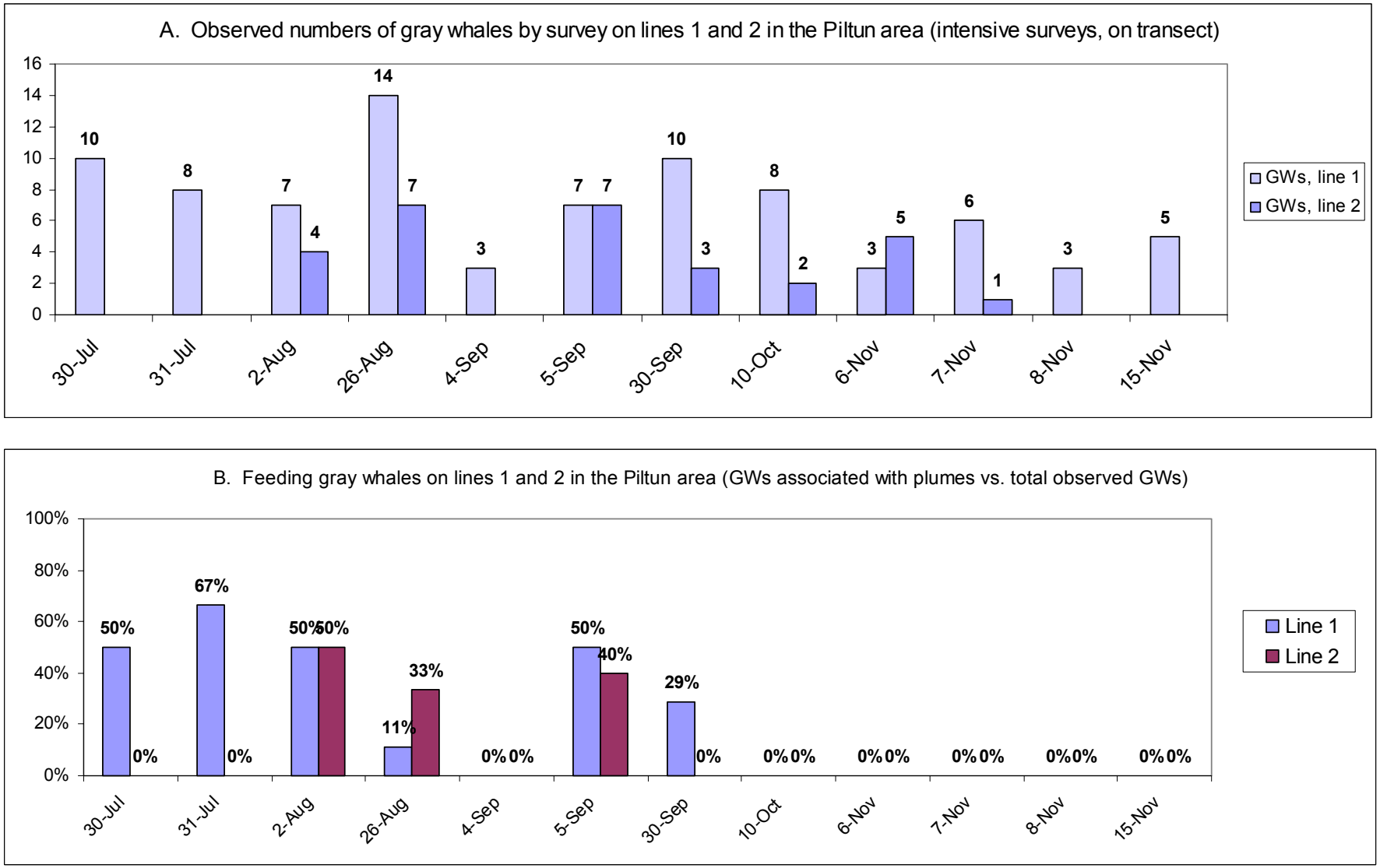

Figure 10. A and B. Observed numbers and benthic feeding activity of gray whales in the Piltun area, 2002.

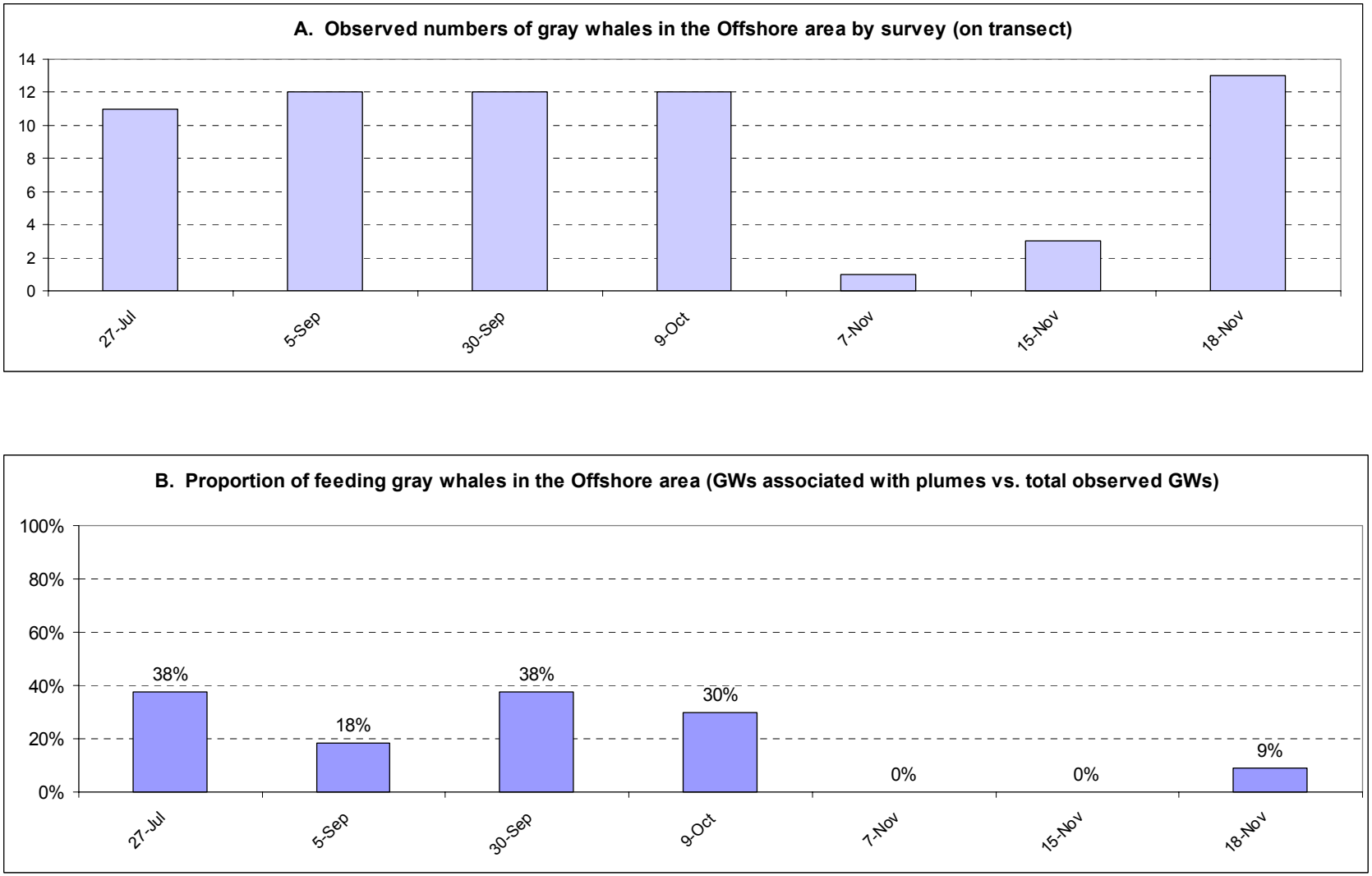

Figure 11. A and B. Observed numbers and benthic feeding activity of gray whales in the Offshore area, 2002.

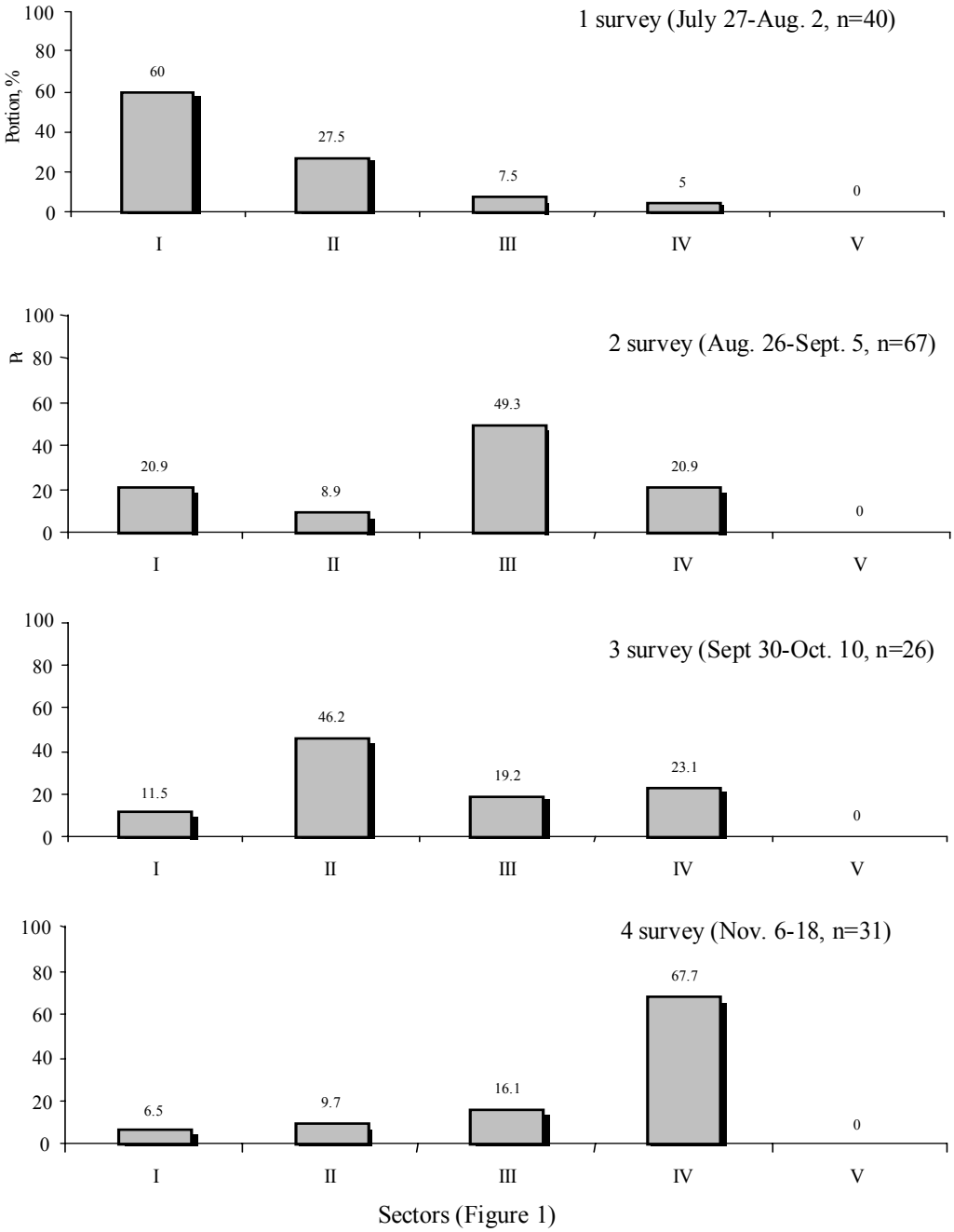

Figure 12. Distribution of gray whales in the Piltun region, coastal waters at the northeast Sakhalin different time periods, 2002 (AN-28, flight altitude 300 m, viewing strip 10-120% on the clinometer).

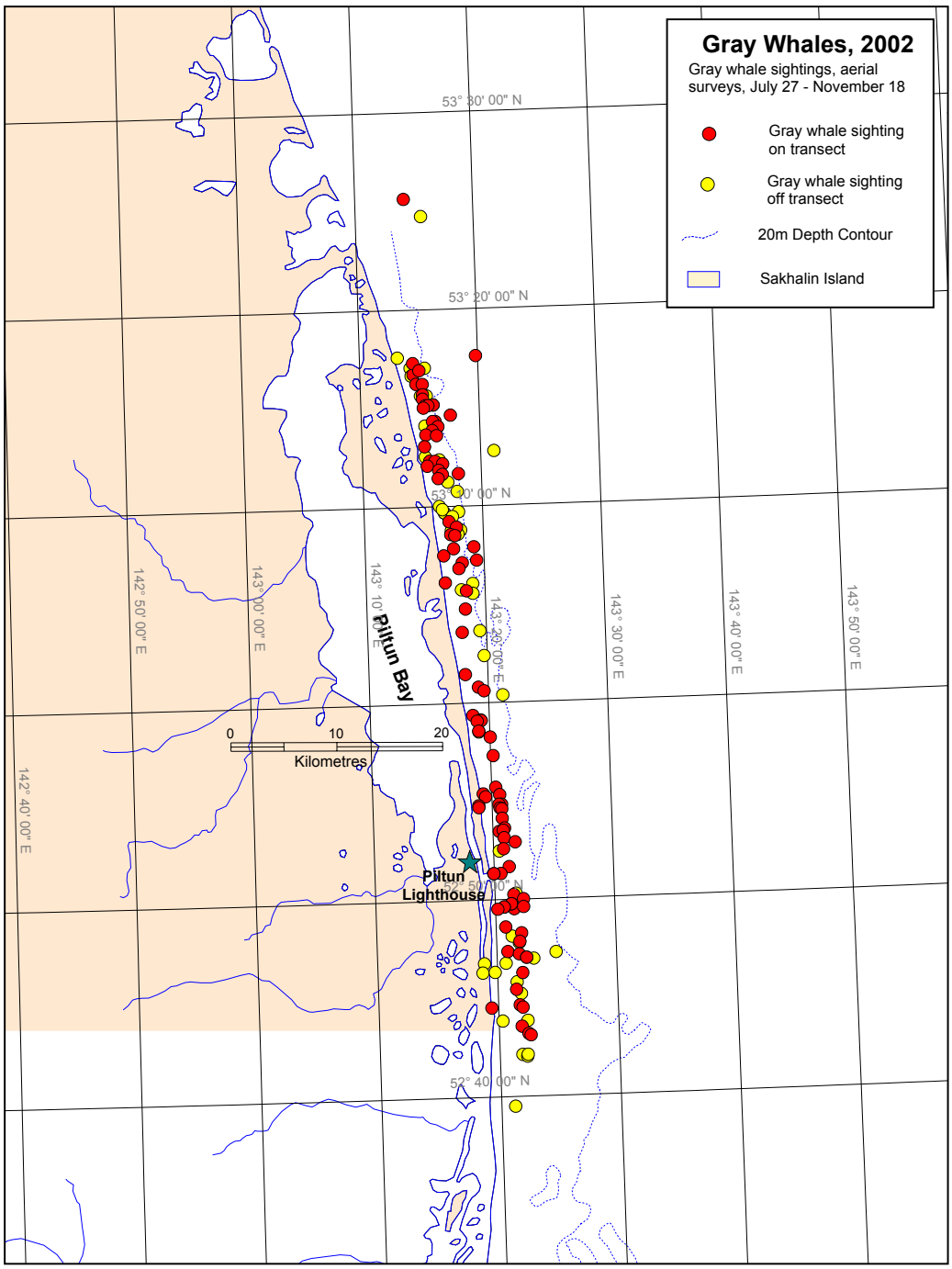

Figure 13. The distribution of gray whales in the Piltun Bay feeding area, northeast Sakhalin, in July-November 2002 (aerial survey data).

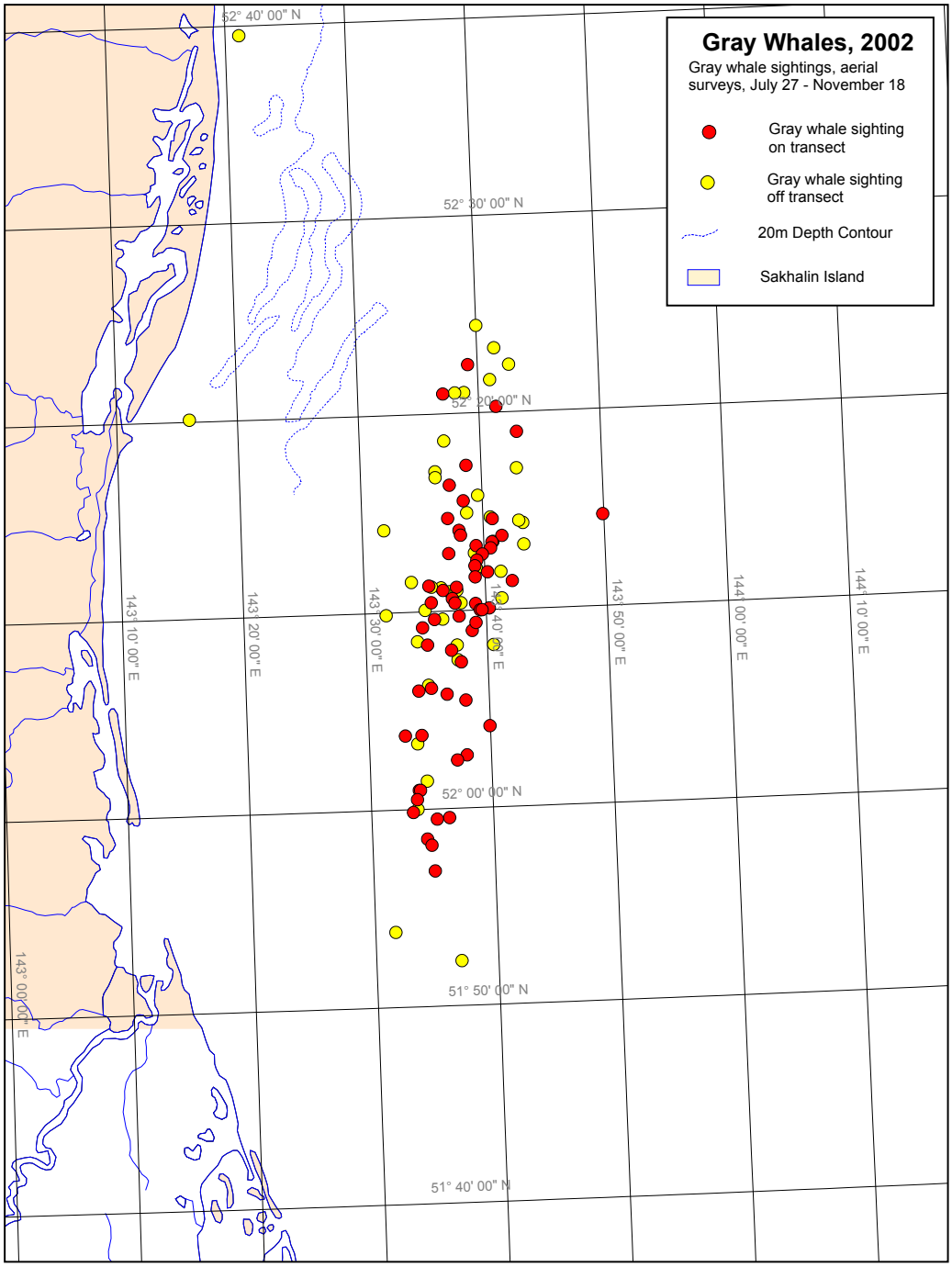

Figure 14. The distribution of gray whales in the Offshore feeding area, northeast Sakhalin, in July-November 2002 (aerial survey data).

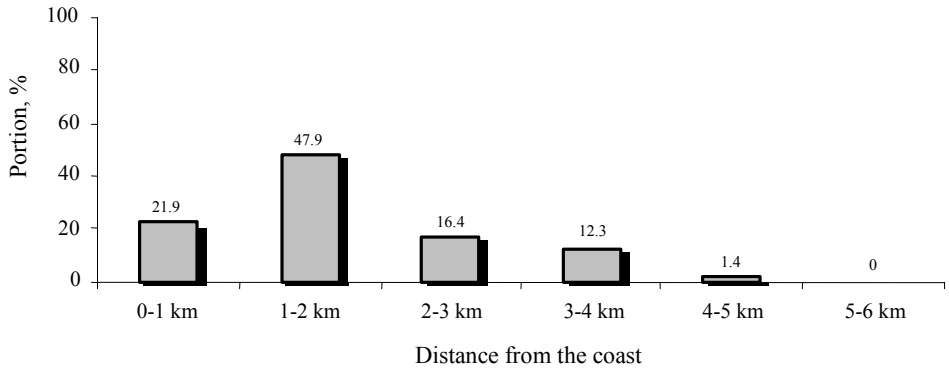

Figure 15. Sighting frequency of gray whales at different distances from the coast in the Piltun region, coastal waters at the northeast Sakhalin, in 2002 (AN-28 aircraft, flight altitude 300 m, (103) transects, survey strip 6 km from the coast, n = 38).

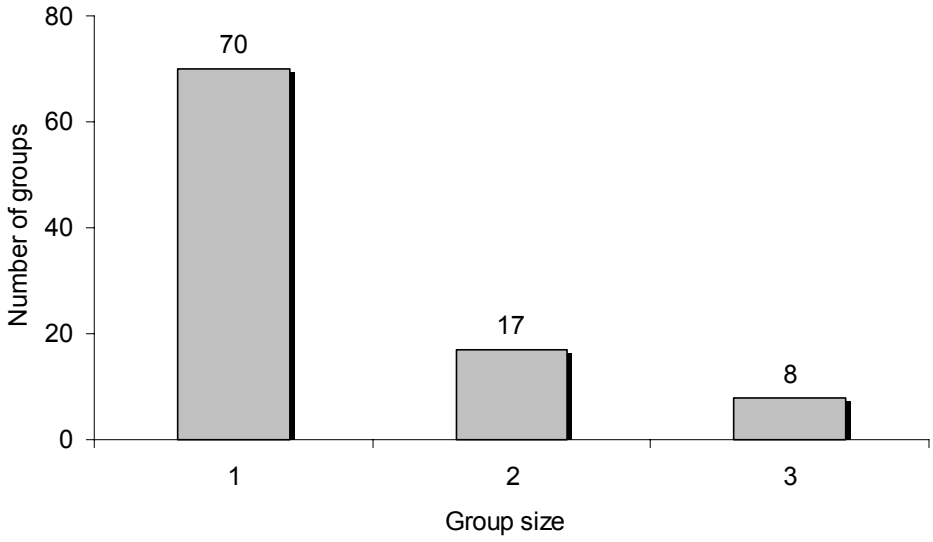

Figure 16. Groups of gray whales recorded in the Piltun region, northeast Sakhalin, in 2002.

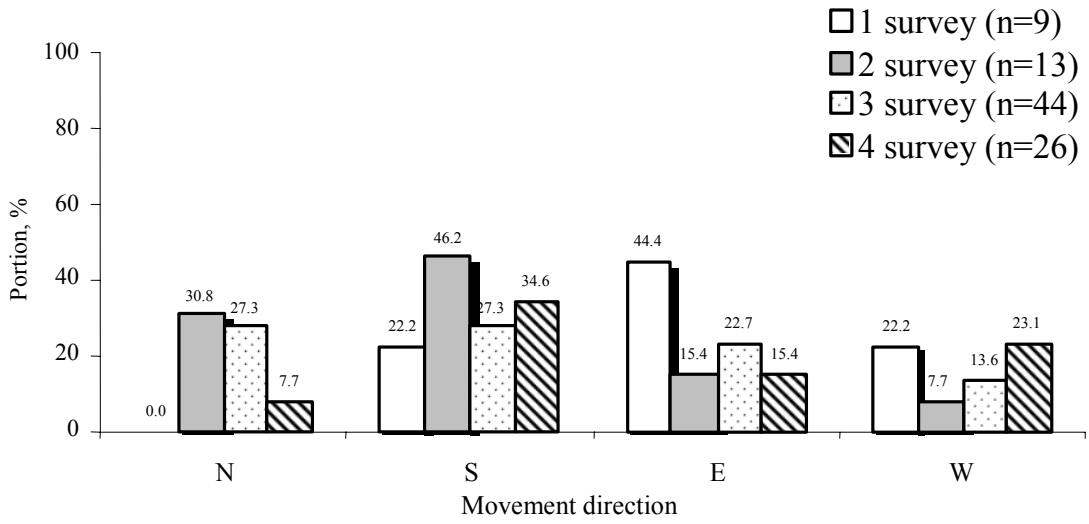

Figure 17. Orientation of gray whales in the Offshore feeding area, coastal waters of the northeast Sakhalin, in July-November, 2002 (aerial survey data, AN-28, flight altitude 500m ASL, viewing angle 30-110%).

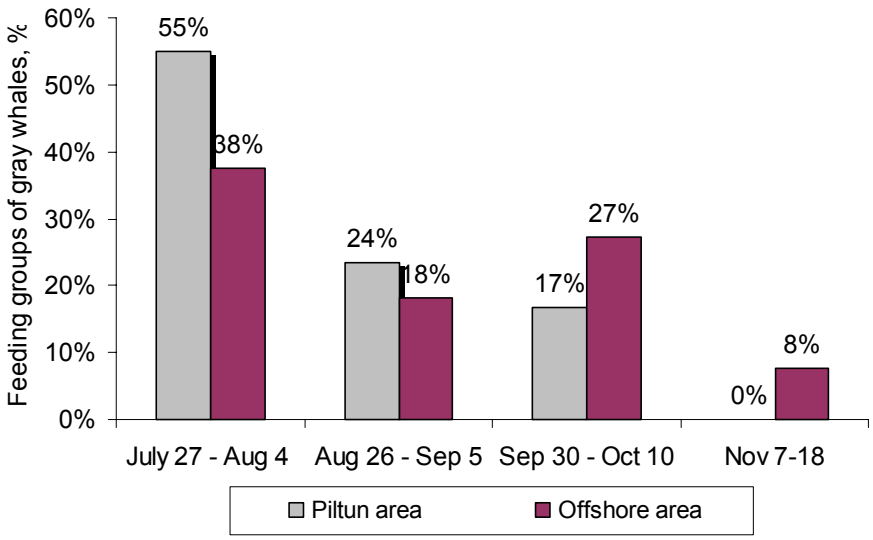

Figure 18. Benthic feeding activity of gray whales in two main feeding areas, northeast coast of Sakhalin, in 2002 (aerial survey data, viewing angle 30-110%).

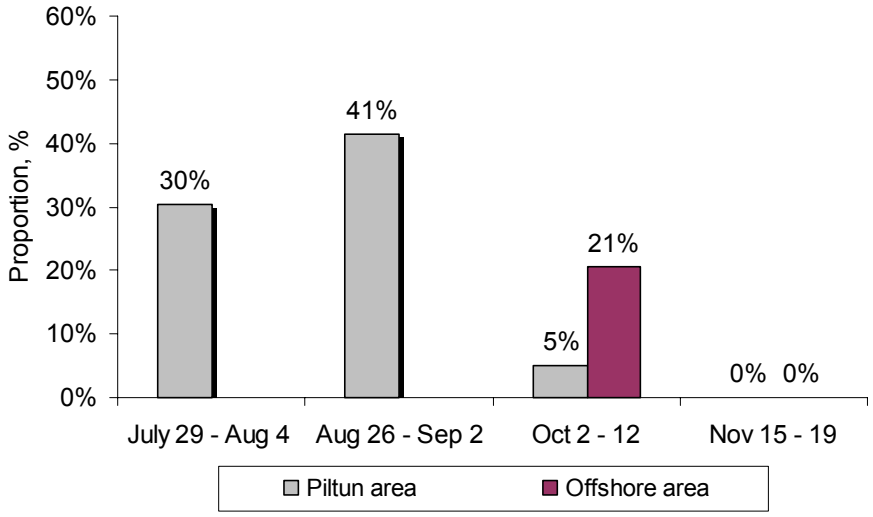

Figure 19. Benthic feeding activity of gray whales in two main feeding areas, northeast coast of Sakhalin, in 2001 (aerial survey data, viewing angle 30-110%). Offshore area was not surveyed before 11 September, 2001.

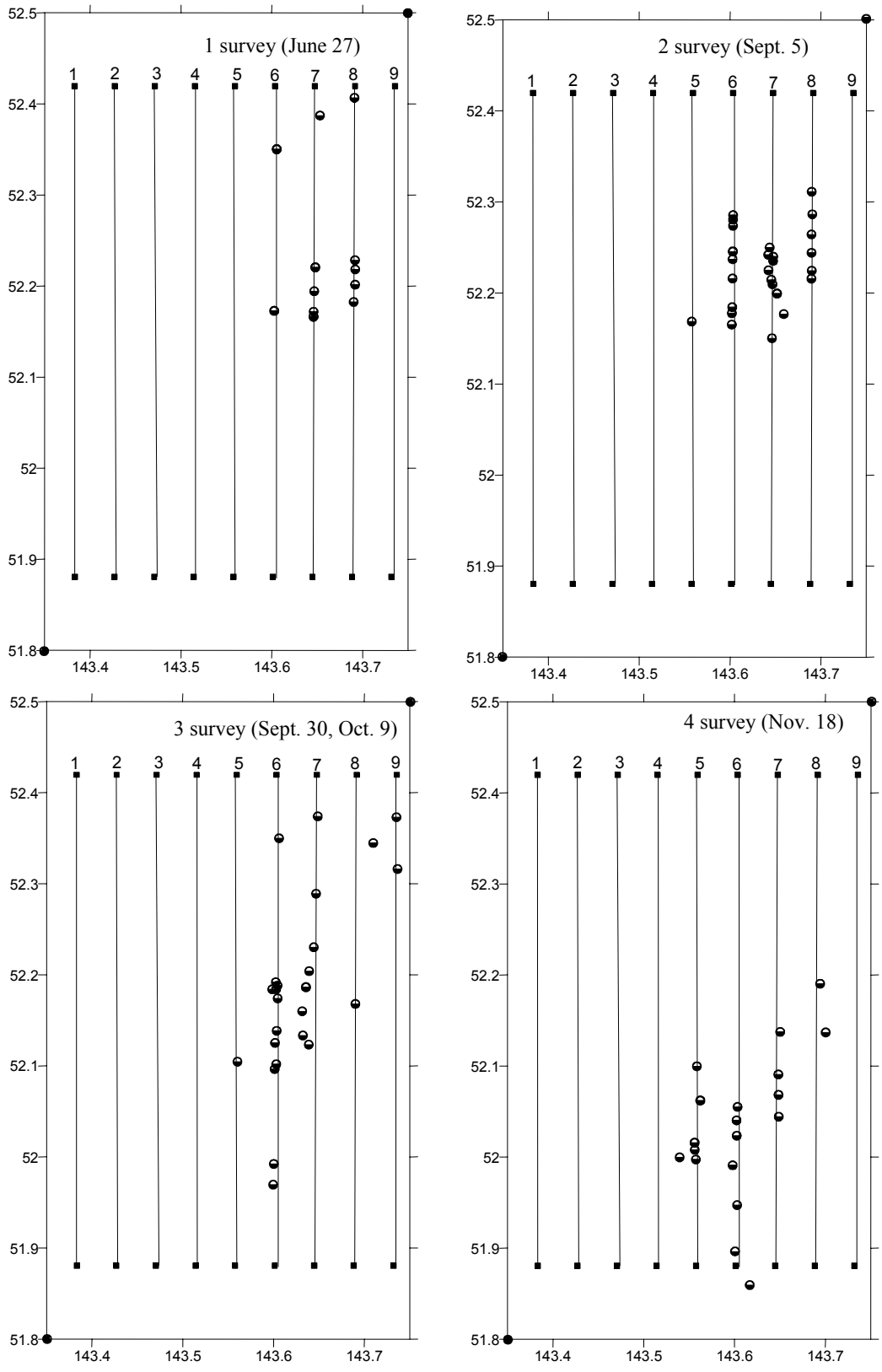

Figure 20. Distribution of gray whales in the Offshore area, coastal waters of the northeast Sakhalin (Figure 1), in July-November, 2002 (aerial survey data, AN-28 aircraft, flight altitude 500 m ASL).

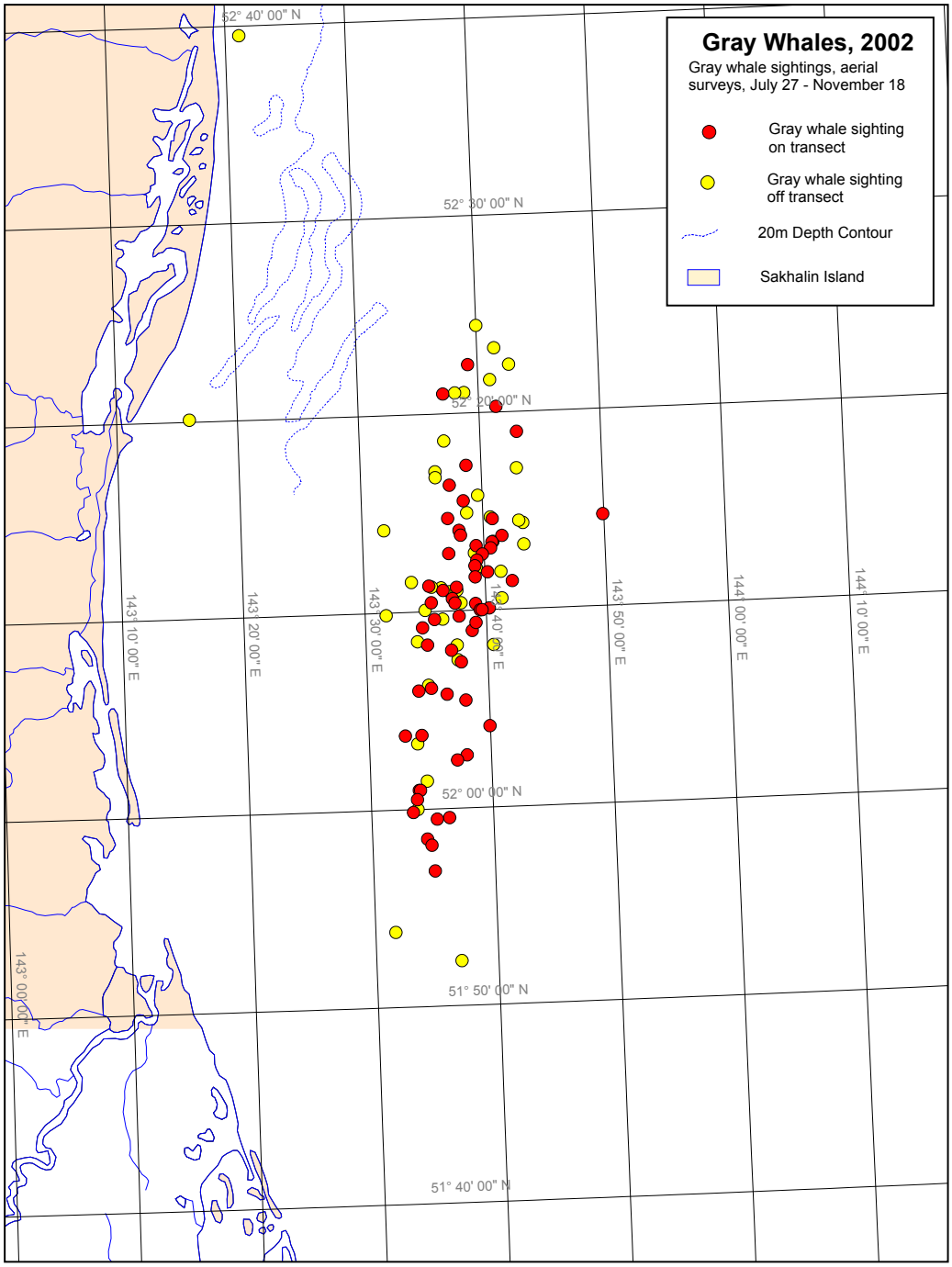

Figure 21. The distribution of gray whales in the Offshore feeding area in July – November 2002.

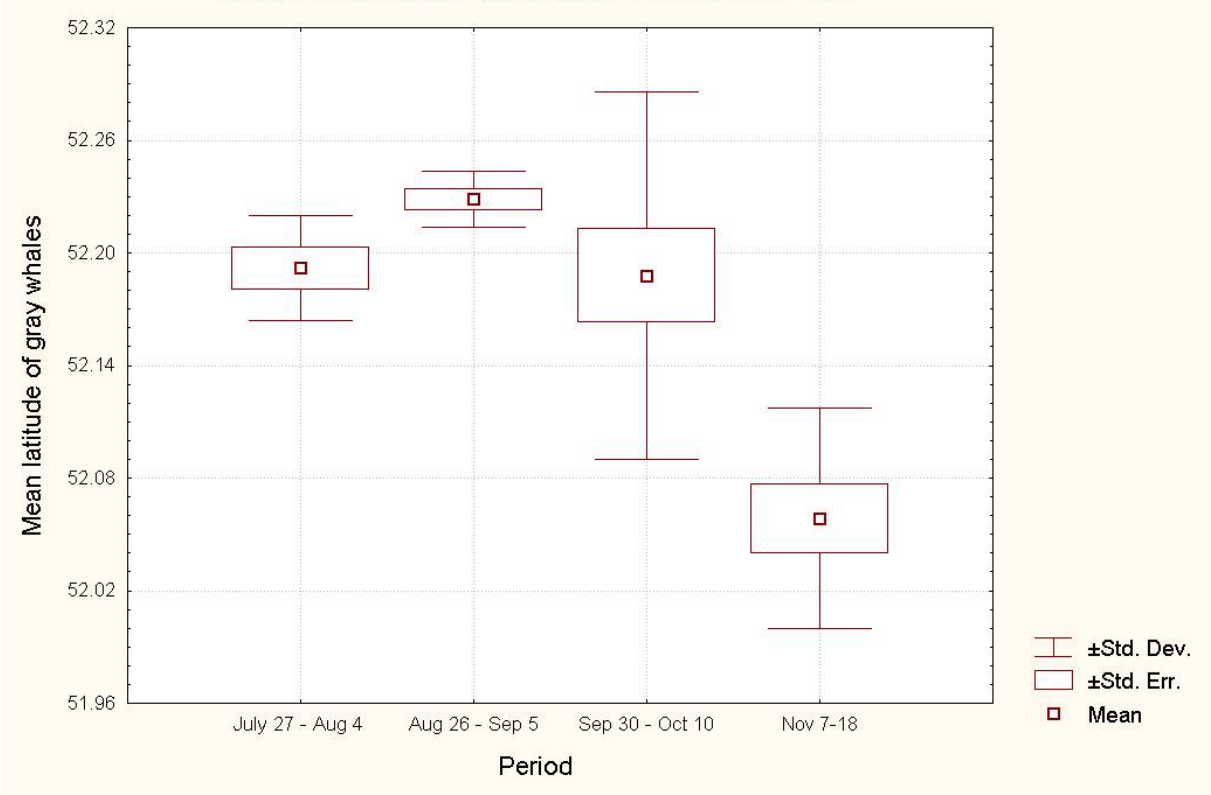

Figure 22. Latitudinal distribution of gray whales in the Offshore area, coastal waters of the northeast Sakhalin, in different survey periods, 2002 (AN-28 aircraft, viewing angle 30-120%, flight altitude 500 m.

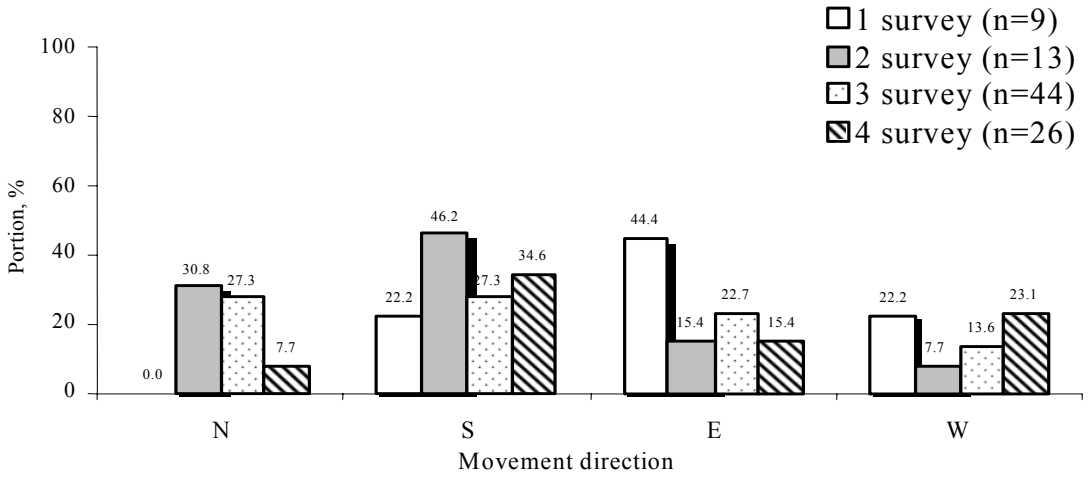

Figure 23. Movements of gray whales in the Offshore feeding area, coastal waters of the northeast Sakhalin, in July-November, 2002 (aerial survey data, An-28 aircraft, altitude 500 m ASL, viewing angle 30-110%)

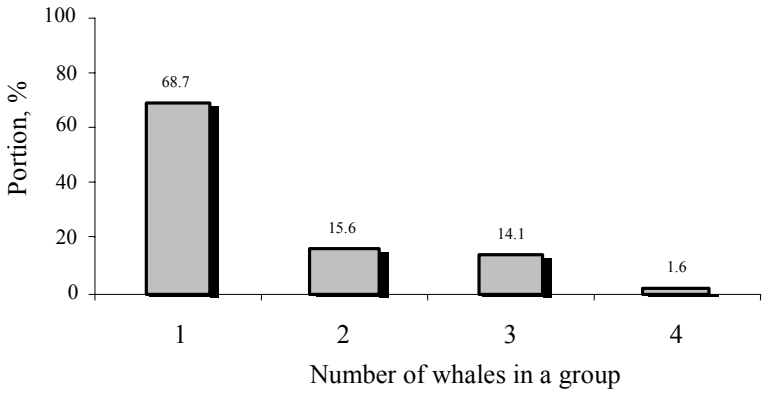

Figure 24. Percentages of gray whale groups of different sizes recorded in the Offshore area in 2002 (AN-28 aircraft, flight altitude 500 m ASL)

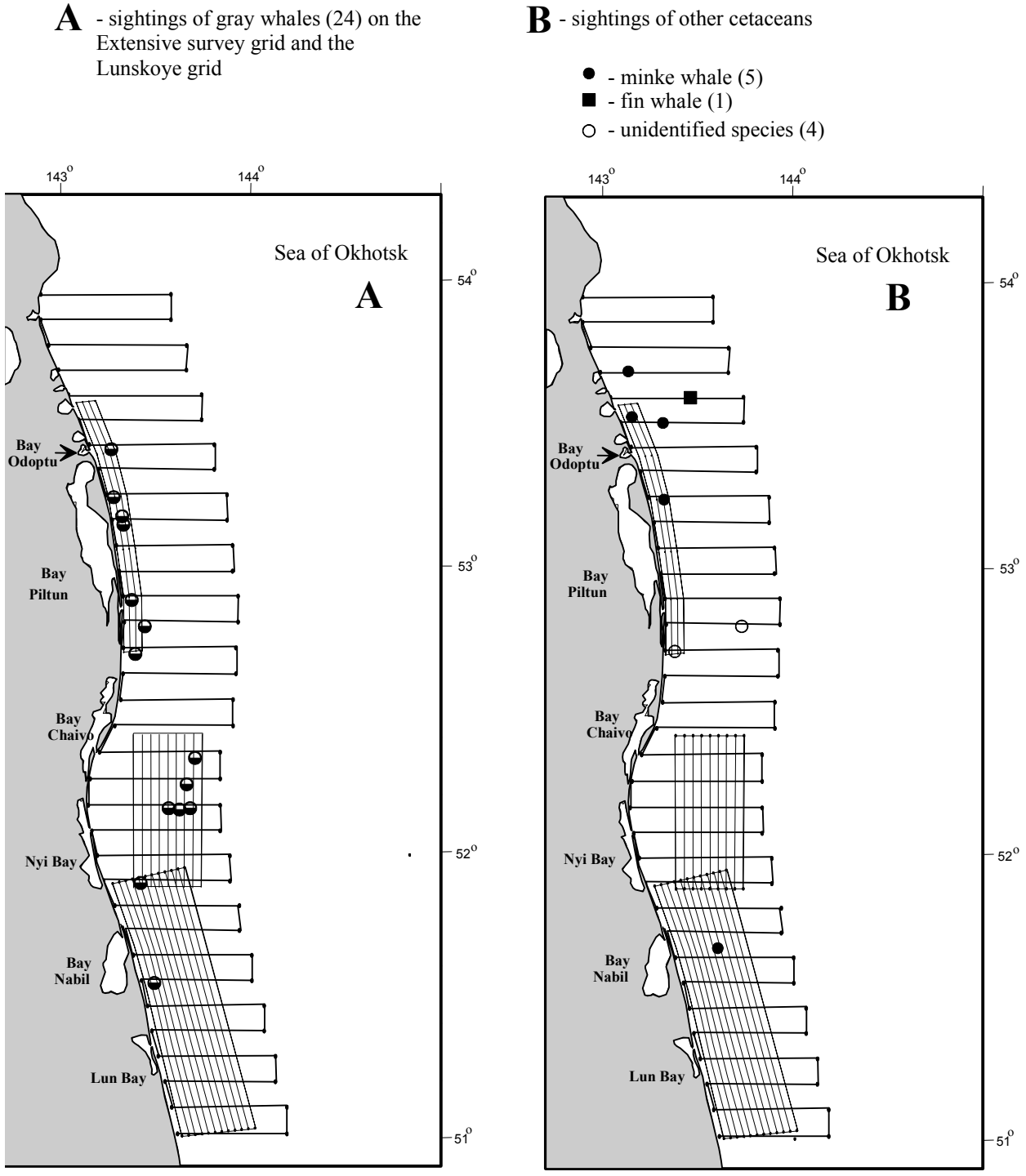

Figure 25. Additional data on sightings of gray whales and other cetaceans during aerial surveys at the northeast Sakhalin coast in July-November, 2002.

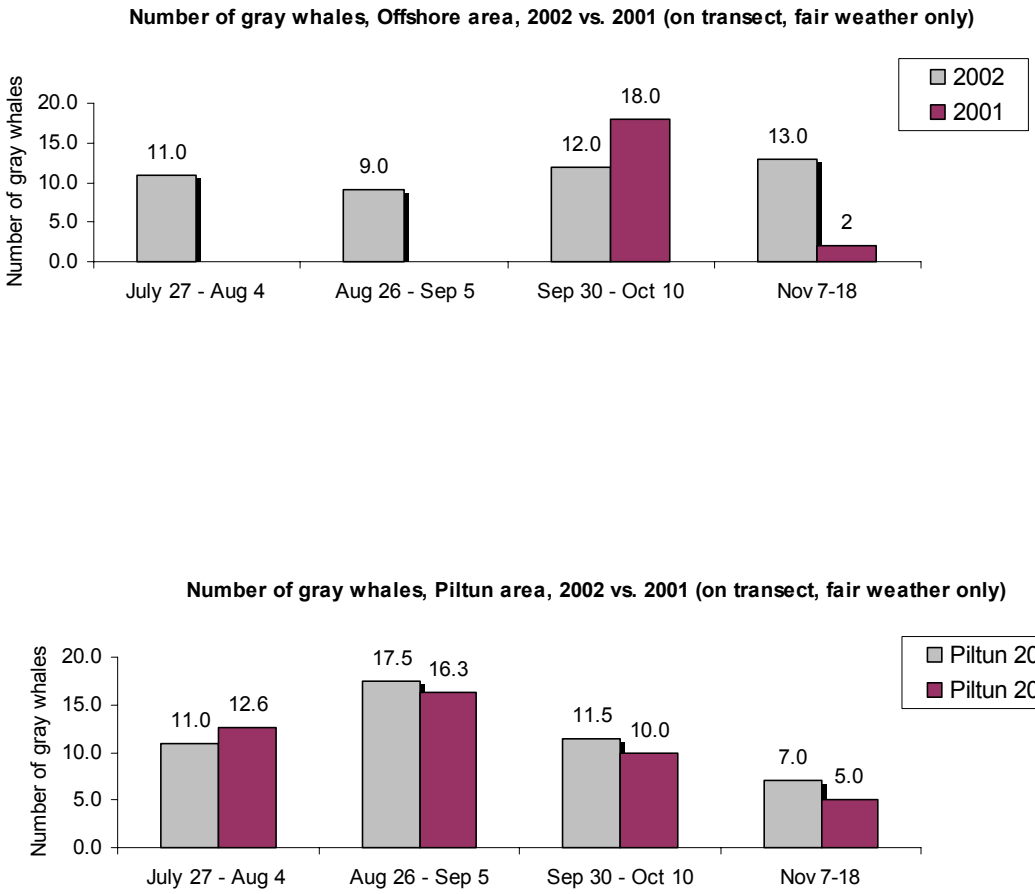

Figure 26. Abundance of gray whales in the Offshore and Piltun feeding areas, coastal waters of the northeast Sakhalin, in 2001-2002 (from aerial survey data, AN-28 aircraft, 2 observers, viewing angle 30-110%). There were no surveys of the Offshore area before 11 September 2001.

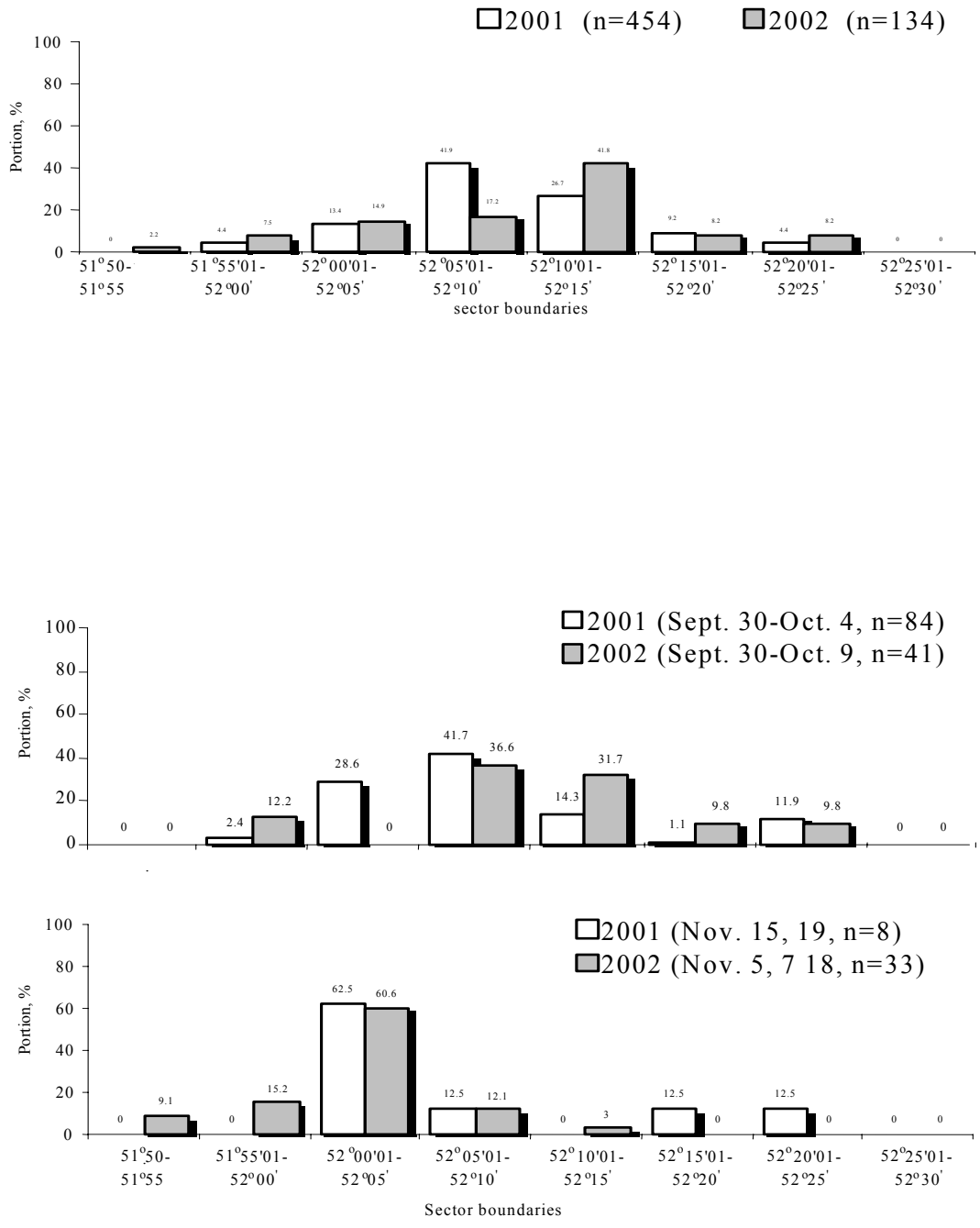

Figure 27. Latitudinal distribution of gray whales in the Offshore area, coastal waters of northeast Sakhalin, in 2001-2002 (from aerial survey data, AN-28 aircraft, flight altitude 500 m, viewing angle 10-120%).

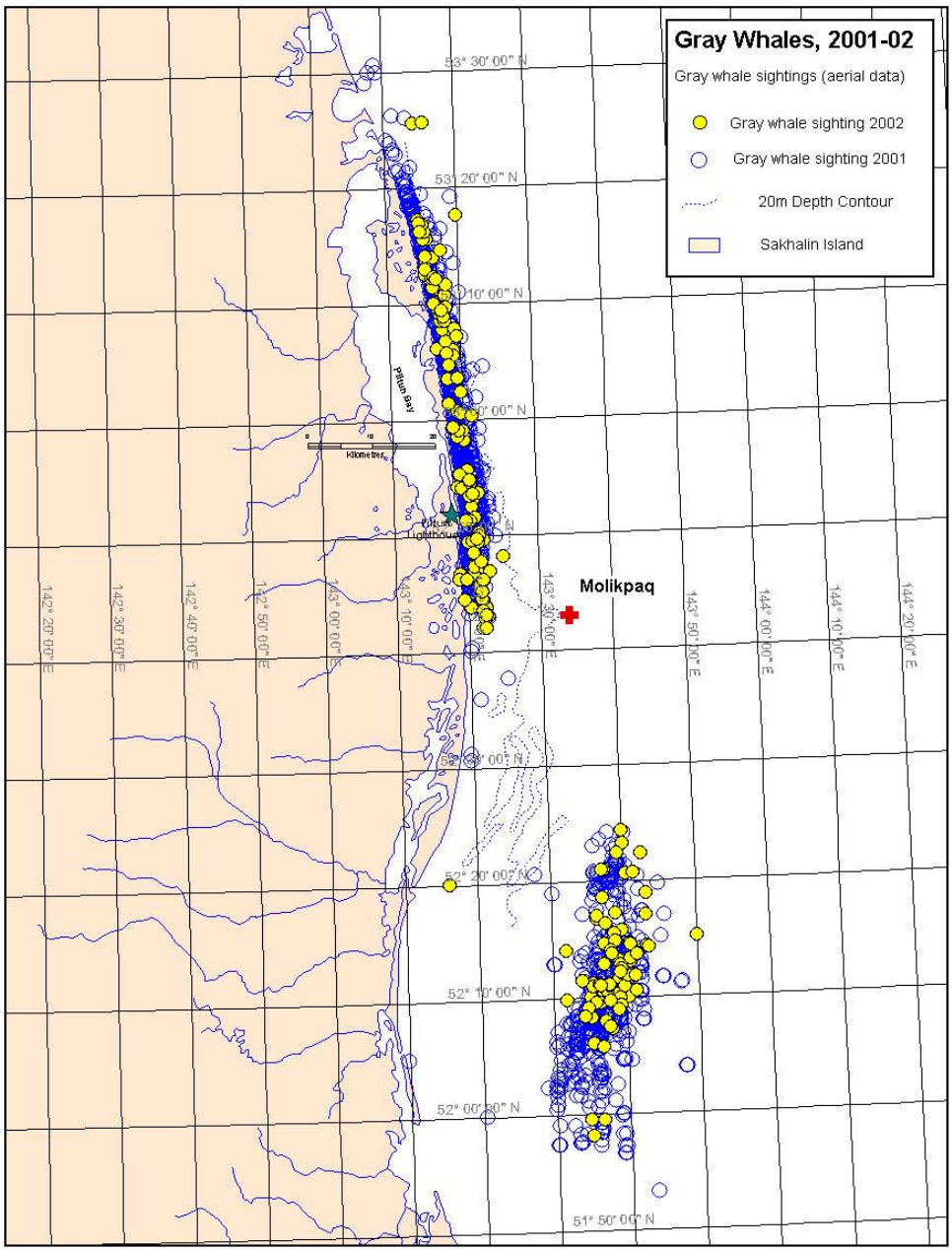

Figure 28. The distribution of gray whales in 2001 and 2002 (aerial survey data).

TABLES

Table 1. Transect coordinates in Piltun region.

Transect number	Transect point	Longitude	Latitude
4	4.6	143.2028	53.51089
3	3.6	143.1725	53.50922
2	2.6	143.1425	53.50727
1	1.6	143.1125	53.50561
4	4.5	143.302	53.34811
3	3.5	143.2723	53.34645
2	2.5	143.2423	53.34478
1	1.5	143.2123	53.34283
4	4.4	143.3567	53.21144
3	3.4	143.3267	53.2095
2	2.4	143.297	53.20784
1	1.4	143.2673	53.20617
4	4.3	143.3962	53.04589
3	3.3	143.3665	53.04422
2	2.3	143.3367	53.04256
1	1.3	143.307	53.04089
4	4.2	143.4256	52.89534
3	3.2	143.3959	52.89367
2	2.2	143.3662	52.892
1	1.2	143.3367	52.89006
4	4.1	143.4287	52.72256
3	3.1	143.3993	52.72089
2	2.1	143.3698	52.71922
1	1.1	143.3404	52.71756

Table 2. Transect coordinates, Offshore area.

Transect number	Transect point	Longitude	latitude
1	1.1	143.38339	51.88049
1	1.2	143.38306	52.41976
2	2.1	143.42696	51.88050
2	2.2	143.42716	52.41976
3	3.1	143.47053	51.88049
3	3.2	143.47125	52.41974
4	4.1	143.51410	51.88046
4	4.2	143.51535	52.41971
5	5.1	143.55766	51.88042
5	5.2	143.55945	52.41966
6	6.1	143.60123	51.88036
6	6.2	143.60355	52.41959
7	7.1	143.64480	51.88028
7	7.2	143.64764	52.41951
8	8.1	143.68836	51.88019
8	8.2	143.69174	52.41941
9	9.1	143.73192	51.88008
9	9.2	143.73583	52.41929

Table 3. Transect coordinates in the Lunskoye.

Transect number	Transect point	Latitude	Longitude
1	1.1	143.60154	51.04734
1	1.2	143.54459	51.21432
1	1.3	143.48725	51.38128
1	1.4	143.42952	51.54821
1	1.5	143.33642	51.70886
1	1.6	143.24268	51.86945
2	2.1	143.62943	51.0511
2	2.2	143.57242	51.21856
2	2.3	143.51502	51.386
2	2.4	143.45717	51.5534
2	2.5	143.36390	51.71452
2	2.6	143.26998	51.87557
3	3.1	143.65732	51.05485
3	3.2	143.60025	51.2228
3	3.3	143.54279	51.39071
3	3.4	143.48482	51.55858
3	3.5	143.39138	51.72017
3	3.6	143.29729	51.88169
4	4.1	143.68522	51.0586
4	4.2	143.62809	51.22702
4	4.3	143.57056	51.39542
4	4.4	143.51249	51.56376
4	4.5	143.41888	51.72582
4	4.6		
7	7.6	143.40661	51.90611
8	8.1	143.79685	51.07353
8	8.2	143.73949	51.24386
8	8.3	143.68172	51.41417
8	8.4	143.62410	51.58282
8	8.5	143.52891	51.74833
8	8.6	143.43395	51.91220
9	9.1	143.82477	51.07725
9	9.2	143.76735	51.24806
9	9.3	143.70952	51.41884
9	9.4	143.65192	51.58774
9	9.5	143.55643	51.75394
9	9.6	143.46131	51.91828
10	10.1	143.85269	51.08095
10	10.2	143.79521	51.25224
10	10.3	143.73733	51.42351
10	10.4	143.67975	51.59265
10	10.5	143.58397	51.75955
10	10.6	143.48867	51.92435
11	11.1	143.88062	51.08466
11	11.2	143.82308	51.25642
11	11.3	143.76514	51.42817
11	11.4	143.70758	51.59755

Table 4. Extensive grid coordinates.

Transect number	Transect point	Longitude	Latitude
1	1.0	143.62000	51.00650
1	1.1	144.18900	51.00650
2	2.0	143.59000	51.10000
2	2.1	144.18900	51.10000
3	3.0	143.55500	51.19030
3	3.1	144.12941	51.18960
4	4.0	143.52000	51.27930
4	4.1	144.13002	51.27855
5	5.0	143.48700	51.36770
5	5.1	144.07100	51.36770
6	6.0	143.46400	51.45590
6	6.1	144.07100	51.45590
7	7.0	143.43300	51.54490
7	7.1	144.00669	51.54421
8	8.0	143.39100	51.63390
8	8.1	144.00621	51.63316
9	9.1	143.94200	51.72040
10	10.0	143.29400	51.80750
10	10.1	143.94200	51.80750
11	11.0	143.23500	51.89450
11	11.1	143.89276	51.89348
12	12.0	143.20300	51.98390
12	12.1	143.89245	51.98283
13	13.0	143.17457	52.07060
13	13.1	143.84200	52.07060
14	14.0	143.15529	52.16000
14	14.1	143.84200	52.16000
15	15.0	143.16545	52.25290
15	15.1	143.84200	52.25290
16	16.0	143.21500	52.34640
16	16.1	143.84200	52.34640
17	17.0	143.29400	52.43900
17	17.1	143.90900	52.43900
18	18.0	143.32500	52.53080
18	18.1	143.90900	52.53080
19	19.0	143.33662	52.62180
19	19.1	143.92400	52.62180
20	20.0	143.33860	52.71270
20	20.1	143.92400	52.71270
21	21.0	143.34335	52.80350
21	21.1	143.93500	52.80350
22	22.0	143.33700	52.89410
22	22.1	143.93500	52.89410
23	23.0	143.31700	52.98250
23	23.1	143.90614	52.98250
24	24.0	143.30200	53.07240
24	24.1	143.90646	53.07240
25	25.0	143.28000	53.16140
25	25.1	143.87800	53.16140
26	26.0	143.25200	53.25020
26	26.1	143.87800	53.25020
27	27.0	143.21000	53.34030
27	27.1	143.81101	53.33956
28	28.0	143.16100	53.42680
28	28.1	143.81171	53.42600
29	29.0	143.10500	53.51370
29	29.1	143.74500	53.51370
30	30.0	143.05300	53.60150
30	30.1	143.74500	53.60150
31	31.0	143.00100	53.68890
31	31.1	143.66645	53.68790
32	32.0	142.95000	53.77490
32	32.1	143.66765	53.77382
33	33.0	142.90900	53.86480
33	33.1	143.58600	53.86480
34	34.0	142.90900	53.95420
34	34.1	143.58600	53.95420

Table 5. Information recorded by observers during aerial surveys in all survey grids, 2001.

Marine Mammal Sighting Data	Survey Data
TIME: Time of sighitng, hh:mm:ss GPS: GPS waypoint in degrees:min:sec SPECIES: Species of marine mammal TYPE: If gray whales, the type of observation: whale(s) associated with plumes, whale(s) not associated with plumes, plumes not associated with whales NUMBER: Number of individuals sighted PLUMES: Number of mud feeding plumes if present ORIENTATION OR DIRECTION OF MOVEMENT OF WHALE(S): Estimated clock direction relative to aircraft GROUP TYPE: Single, adult-calf, pod CLINOMETER: Vertical angle (in percent) to the sighted whales(s) OTHER COMMENTS	LOCAL DATE: dd:mm:yy SURVEY START AND END TIME: hh:mm:ss AIRCRAFT TYPE: MI-8 helicopter or AN-28 fixed-wing aircraft SURVEY ALTITUDE: Meters above sea level (ASL) FLIGHT DIRECTION: Compass heading from survey pilots and intervals TRANSECT SEGMENT START AND END TIME: hh:mm:ss WAVE HEIGHT: Measured in meters, every 3 hrs from the Molikpaq. SWELL HEIGHT: Measured in meters, every 3 hrs from Molikpaq. WIND DIRECTION AND SPEED: Estimated degrees and kts obtained from the survey pilots at intervals along each transect. LATERAL VISIBILITY (of sea surface): 5 > 10 km; 4 = 1000 m; 3 = 600 m; 2 = 300 m; 1 = directly under the aircraft; 0 = zero. WHITE CAP INDEX: 0 = no white caps; 1 = solitary white caps; 2 = significant white caps limiting whale detectability. FOG: 1A >50% of the transect segment was partially obscured by haze; 1B >30% of the segment obscured by heavy fog; 2 >50% of the transect segment obscured by heavy fog. GLARE: 0 or 1, with 1=significant glare limiting whale detectability. CLOUD COVER (OVERCAST): Estimated in 10ths obscuration of the sky OTHER COMMENTS

Table 6. Detailed breakdown of aerial survey activities in 2002.

Date	Survey in day	Type of survey	Lines flown	Survey start	Survey end	Duration
27-Jul	1	Offshore	1-9	12:26:30	18:17:05	5:50:35
28-Jul	1	Lunskoye	12-1	10:35:45	17:44:53	7:09:08
28-Jul	2	Extensive	1,2	17:52:40	18:11:21	0:18:41
30-Jul	1	Extensive	3-20	9:58:38	17:54:44	7:56:06
30-Jul	2	Piltun	1	18:06:02	18:36:02	0:30:00
31-Jul	1	Extensive	34-21	11:17:41	16:20:46	5:03:05
31-Jul	2	Piltun	1	16:36:53	16:54:23	0:17:30
2-Aug	1	Piltun	1-4	10:07:00	11:58:08	1:51:08
26-Aug	1	Piltun	1-4	15:27:15	17:15:16	1:48:01
1-Sep	1	Extensive	34-25	15:56:48	18:44:07	2:47:19
2-Sep	1	Extensive	24-13	9:58:55	13:16:45	3:17:50
4-Sep	1	Piltun	1	10:24:43	10:48:02	0:23:19
4-Sep	2	Extensive	12-5	11:10:30	13:18:49	2:08:19
4-Sep	3	Lunskoye	1	14:41:22	15:07:19	0:25:57
4-Sep	4	Extensive	1-4	15:10:03	16:11:43	1:01:40
4-Sep	5	Lunskoye	3-7	16:20:41	17:53:11	1:32:30
5-Sep	1	Offshore	1-9	9:25:44	12:18:51	2:53:07
5-Sep	2	Lunskoye	9, 11	13:48:28	14:50:19	1:01:51
5-Sep	3	Offshore	7	14:56:38	15:14:14	0:17:36
5-Sep	4	Piltun	1,3,2	15:26:27	16:52:20	1:25:53
30-Sep	1	Offshore	1-9	9:23:58	12:26:47	3:02:49
30-Sep	2	Piltun	1,4,2,3	14:32:45	16:24:34	1:51:49
9-Oct	1	Lunskoye	1,3,5,7,9,11	11:18:39	14:17:10	2:58:31
9-Oct	2	Offshore	7,6	14:21:55	14:58:27	0:36:32
9-Oct	3	Extensive	1-12	16:36:13	18:39:11	2:02:58
10-Oct	1	Extensive	13-20	9:26:43	11:38:34	2:11:51
10-Oct	2	Piltun	2,1	11:41:18	12:56:31	1:15:13
10-Oct	3	Extensive	21-28	14:58:31	17:02:40	2:04:09
11-Oct	1	Extensive	29-34	12:03:10	13:38:51	1:35:41
6-Nov	1	Piltun	1	10:16:11	10:41:32	0:25:21
6-Nov	2	Offshore	3,2	10:54:03	11:27:17	0:33:14
7-Nov	1	Piltun	2	9:57:38	10:22:31	0:24:53
7-Nov	2	Offshore	4,5,6,8,9,7	10:32:05	12:29:49	1:57:44
7-Nov	3	Piltun	1,3,2	12:43:17	15:03:49	2:20:32
7-Nov	4	Extensive	34-31	15:18:49	16:21:13	1:02:24
8-Nov	1	Extensive	30-19	9:50:36	12:55:42	3:05:06
8-Nov	2	Piltun	1	12:59:26	13:30:31	0:31:05
15-Nov	1	Piltun	1	14:04:49	14:30:37	0:25:48
15-Nov	2	Offshore	6,7,8	14:42:16	15:37:00	0:54:44
17-Nov	1	Extensive	12-19	12:27:05	14:40:07	2:13:02
17-Nov	2	Lunskoye	1,3	15:04:49	16:05:13	1:00:24
18-Nov	1	Lunskoye	5,7,9,11	9:32:18	11:24:59	1:52:41
18-Nov	2	Offshore	5,6,7,8,4,3	11:28:57	13:23:17	1:54:20

Table 7. Locations of sighted whales other than gray whales, aerial survey data, 2002.

Date	Survey Type	Aircraft	Altitude	On or off-transect	Time	Species	# of Whales	Offset, m	Latitude	Longitude
31-Jul	Ext	An-28	500	ON	12:42:22	Minke	1	1000	53.681649	143.123352
31-Jul	Ext	An-28	500	ON	12:53:46	Minke	1	1000	53.505067	143.304428
26-Aug	Int	An-28	300	ON	16:13:50	Minke	1	750	53.246674	143.323331
26-Aug	Int	An-28	300	OFF	16:23:30	Minke	1	-30	53.531489	143.146725
1-Sep	Ext	An-28	500	OFF	17:27:22	Unknown	2	2500	53.536029	143.546637
1-Sep	Ext	An-28	500	ON	18:49:00	Unknown	2	625	53.343840	143.648411
5-Sep	Lun	An-28	500	ON	13:56:30	Minke	2	625	51.674079	143.613477
8-Nov	OFF	An-28	500	ON	9:58:38	Finwhale	1	714	53.611370	143.444066
18-Nov	LUN	An-28	500	ON	11:19:38	Unknown	1	833	51.612243	143.688925
18-Nov	LUN	An-28	500	ON	11:24:58	Unknown	1	833	51.765312	143.600525

APPENDIX 1

Sighting data of cetaceans recorded during the 2002 aerial surveys in coastal areas of northeastern Sakhalin.

Date	Survey Type	Line	On Transect	Time	Whales	Plumes	Latitude, digital degrees	Longitude, digital degrees	Orientation
27-Jul	Int	1	OFF	12:16:10	1	0	52.796624	143.365001	S
27-Jul	Off	6	OFF	17:11:14	2	-999	52.350658	143.646669	W
27-Jul	Off	6	OFF	17:11:14	2	0	52.350658	143.634083	W
27-Jul	Off	6	ON	17:15:01	1	0	52.173284	143.623998	S
27-Jul	Off	6	OFF	17:15:01	1	0	52.173284	143.632378	S
27-Jul	Off	7	OFF	17:17:31	2	0	52.387608	143.690224	S SE
27-Jul	Off	7	ON	17:23:15	4	1	52.221059	143.655952	-999
27-Jul	Off	7	OFF	17:23:15	1	-999	52.221059	143.721635	-999
27-Jul	Off	7	ON	17:24:11	1	1	52.194784	143.653111	-999
27-Jul	Off	7	ON	17:24:40	0	1	52.172334	143.652464	-999
27-Jul	Off	7	ON	17:25:08	2	0	52.166788	143.658471	-999
27-Jul	Off	7	ON	17:25:08	1	0	52.166788	143.660915	-999
27-Jul	Off	8	OFF	17:47:25	2	0	52.183009	143.617064	-999
27-Jul	Off	8	OFF	17:48:03	1	0	52.202042	143.655315	-999
27-Jul	Off	8	ON	17:48:30	1	0	52.218758	143.675804	-999
27-Jul	Off	8	ON	17:49:00	1	1	52.228923	143.691908	-999
27-Jul	Off	8	OFF	17:55:30	1	0	52.407017	143.666691	NE
28-Jul	Lun	3	ON	16:34:40	4	0	51.560431	143.459184	E
30-Jul	Ext	14	ON	15:59:02	2	0	52.156261	143.651947	N
30-Jul	Ext	15	ON	16:26:11	1	0	52.259312	143.640518	-999
30-Jul	Ext	15	ON	16:29:55	0	1	52.244069	143.831757	-999
30-Jul	Ext	16	ON	16:40:56	1	1	52.338059	143.690292	E
30-Jul	Int	1	OFF	18:13:00	1	0	52.763546	143.360180	S
30-Jul	Int	1	ON	18:15:36	3	0	52.837379	143.359512	W
30-Jul	Int	1	ON	18:16:25	1	1	52.860962	143.354245	W
30-Jul	Int	1	ON	18:17:05	1	0	52.825306	143.359469	W
30-Jul	Int	1	ON	18:17:21	0	1	52.885559	143.348513	-999
30-Jul	Int	1	ON	18:17:50	1	1	52.891872	143.347594	W
30-Jul	Int	1	ON	18:18:05	0	1	52.910782	143.344203	W
30-Jul	Int	1	OFF	18:18:55	1	0	53.039902	143.328884	E
30-Jul	Int	1	ON	18:25:30	1	1	53.094997	143.307059	N
30-Jul	Int	1	ON	18:26:30	1	0	53.118820	143.302319	S
30-Jul	Int	1	ON	18:33:50	1	1	53.288158	143.241422	W
30-Jul	Int	1	ON	19:17:05	1	-999	52.825306	143.336553	-999
31-Jul	Ext	28	ON	13:03:02	1	0	53.427082	143.235474	N
31-Jul	Ext	28	OFF	13:03:30	1	1	53.412198	143.259109	-999
31-Jul	Ext	22	ON	16:03:00	1	1	52.913119	143.314590	S
31-Jul	Ext	22	ON	16:03:00	0	1	52.911620	143.314590	-999
31-Jul	Ext	22	OFF	16:04:58	1	1	52.874406	143.341248	S
31-Jul	Ext	22	ON	16:05:22	1	0	52.881823	143.363770	S
31-Jul	Transit	1	OFF	16:30:50	1	0	52.779556	143.315444	S
31-Jul	Transit	1	OFF	16:30:50	2	0	52.779556	143.345630	S
31-Jul	Transit	1	OFF	16:34:07	1	0	52.771759	143.312867	-999
31-Jul	Transit	1	OFF	16:35:50	1	1	52.730740	143.373574	S
31-Jul	Transit	1	OFF	16:35:50	1	1	52.730740	143.338505	-999
31-Jul	Int	1	OFF	16:38:12	1	1	52.802204	143.355316	S
31-Jul	Int	1	OFF	16:40:10	2	1	52.838390	143.362630	S
31-Jul	Int	1	ON	16:40:40	2	0	52.855419	143.342489	S
31-Jul	Int	1	ON	16:40:40	1	0	52.855419	143.332559	S

Date	Survey Type	Line	On Transect	Time	Whales	Plumes	Latitude, digital degrees	Longitude, digital degrees	Orientation
31-Jul	Int	1	ON	16:40:40	1	1	52.855419	143.332559	S
31-Jul	Int	1	ON	16:42:50	1	1	52.928356	143.339018	S
31-Jul	Int	1	ON	16:44:05	1	1	52.970932	143.333722	N
31-Jul	Int	1	ON	16:45:18	2	1	53.013287	143.319507	S
2-Aug	Int	1	ON	10:23:16	1	1	53.024326	143.301722	N
2-Aug	Int	1	ON	10:24:29	2	0	52.984566	143.316147	-999
2-Aug	Int	1	ON	10:27:14	1	1	52.902012	143.346755	SE
2-Aug	Int	1	ON	10:29:40	1	0	52.827049	143.345465	N
2-Aug	Int	1	ON	10:29:40	1	1	52.827049	143.345465	E
2-Aug	Int	1	ON	10:30:56	0	1	52.789322	143.348603	-999
2-Aug	Int	1	ON	10:32:26	1	0	52.742012	143.323827	N
2-Aug	Int	2	ON	10:34:26	1	0	52.742012	143.367191	-999
2-Aug	Int	2	ON	10:35:30	1	0	52.744007	143.363314	N
2-Aug	Int	2	ON	10:38:30	1	1	52.826988	143.372546	S
2-Aug	Int	2	ON	10:38:37	1	1	52.833519	143.372852	-999
2-Aug	Int	3	OFF	11:29:00	1	0	53.100986	143.316188	N
2-Aug	Int	4	ON	11:56:01	0	1	53.293358	143.330394	-999
26-Aug	Int	2	ON	16:48:50	1	-999	52.829607	143.355721	E
26-Aug	Int	2	ON	16:48:50	1	-999	52.829607	143.355721	E
26-Aug	Int	2	ON	16:49:40	2	1	52.784031	143.374534	S
26-Aug	Int	2	ON	16:49:40	1	1	52.784031	143.374534	S
26-Aug	Int	2	ON	16:51:11	1	-999	52.725966	143.365064	-999
26-Aug	Int	2	ON	16:53:19	1	-999	52.718381	143.377208	-999
26-Aug	Int	1	ON	16:57:07	1	-999	52.876261	143.347309	W
26-Aug	Int	1	ON	17:00:17	1	1	52.890960	143.342106	N
26-Aug	Int	1	ON	17:05:23	1	-999	53.060009	143.299139	-999
26-Aug	Int	1	ON	17:06:02	3	-999	53.102248	143.277716	-999
26-Aug	Int	1	ON	17:07:28	1	0	53.113953	143.297507	S
26-Aug	Int	1	ON	17:07:50	1	0	53.130872	143.290846	E
26-Aug	Int	1	ON	17:08:20	3	0	53.142835	143.287498	S
26-Aug	Int	1	ON	17:08:42	1	0	53.153816	143.285599	N
26-Aug	Int	1	ON	17:09:02	2	0	53.205411	143.261190	SE
1-Sep	Ext	25	OFF	18:43:30	2	0	53.146464	143.301623	S
1-Sep	Ext	25	OFF	18:43:59	2	0	53.146174	143.288475	S
1-Sep	Int	0	OFF	18:44:17	2	0	53.161198	143.279692	N
1-Sep	Int	0	OFF	18:44:17	1	0	53.161198	143.279692	N
1-Sep	Int	0	OFF	18:44:35	3	0	53.166932	143.272741	N
1-Sep	Int	0	OFF	18:47:50	1	1	53.260654	143.259294	N
1-Sep	Int	0	OFF	18:47:50	3	0	53.260654	143.250940	-999
2-Sep	Ext	0	OFF	9:54:20	1	-999	53.187236	143.285697	SE
2-Sep	Ext	0	OFF	9:54:50	1	-999	53.179227	143.298521	SE
2-Sep	Ext	21	OFF	10:56:58	1	-999	52.788030	143.415746	N
2-Sep	Ext	20	OFF	11:03:17	1	1	52.700477	143.371521	S
2-Sep	Int	0	OFF	13:32:37	1	0	52.772025	143.330062	N
2-Sep	Int	0	OFF	13:42:44	0	1	53.209032	143.255184	-999
4-Sep	Int	1	ON	10:37:26	2	0	53.079621	143.304803	N
4-Sep	Int	1	ON	10:40:01	1	-999	52.985105	143.321884	-999
4-Sep	Int	0	OFF	10:59:31	1	-999	52.335174	143.267005	S
5-Sep	Off	5	OFF	10:51:40	2	0	52.167943	143.582714	S
5-Sep	Off	6	OFF	11:12:15	3	-999	52.164612	143.528987	-999
5-Sep	Off	6	ON	11:12:40	1	-999	52.177084	143.620676	-999
5-Sep	Off	6	OFF	11:12:42	1	0	52.183736	143.627220	N
5-Sep	Off	6	ON	11:14:00	1	0	52.215225	143.617848	-999
5-Sep	Off	6	OFF	11:14:59	1	-999	52.236361	143.529818	-999
5-Sep	Off	6	ON	11:15:10	1	0	52.244832	143.618120	W
5-Sep	Off	6	OFF	11:15:10	2	-999	52.244832	143.676879	S
5-Sep	Off	6	ON	11:16:10	1	1	52.272941	143.622041	S

Date	Survey Type	Line	On Transect	Time	Whales	Plumes	Latitude, digital degrees	Longitude, digital degrees	Orientation
5-Sep	Off	6	OFF	11:16:20	1	-999	52.279722	143.602920	-999
5-Sep	Off	6	OFF	11:16:31	1	-999	52.284721	143.603038	-999
5-Sep	Off	7	OFF	11:28:11	1	1	52.249177	143.644613	-999
5-Sep	Off	7	OFF	11:28:19	1	-999	52.241259	143.715846	-999
5-Sep	Off	7	OFF	11:29:00	1	-999	52.224232	143.679331	-999
5-Sep	Off	7	ON	11:29:20	1	-999	52.213841	143.664121	S
5-Sep	Off	7	ON	11:29:30	2	-999	52.198687	143.670407	-999
5-Sep	Off	7	OFF	11:30:27	1	-999	52.176156	143.688833	-999
5-Sep	Off	8	OFF	11:52:48	1	-999	52.214984	143.653189	-999
5-Sep	Off	8	ON	11:52:59	0	1	52.223803	143.677969	-999
5-Sep	Off	8	ON	11:53:40	2	1	52.243405	143.679531	N, E
5-Sep	Off	8	OFF	11:54:17	1	-999	52.263516	143.660572	-999
5-Sep	Off	8	OFF	11:55:00	1	0	52.285639	143.715334	E
5-Sep	Off	8	OFF	11:55:53	1	-999	52.310385	143.616599	-999
5-Sep	Off	7	OFF	12:29:30	2	-999	52.198687	143.688750	-999
5-Sep	Off	7	ON	15:06:43	1	0	52.149656	143.646534	-999
5-Sep	Off	7	ON	15:07:17	0	1	52.208901	143.656217	-999
5-Sep	Off	7	ON	15:08:10	2	0	52.234467	143.633103	N, E
5-Sep	Off	7	OFF	15:08:20	1	-999	52.239199	143.721379	N
5-Sep	Int	0	OFF	15:08:50	2	0	52.702105	143.364805	N
5-Sep	Int	0	OFF	15:08:50	1	-999	52.702105	143.372227	N
5-Sep	Int	1	OFF	15:27:38	1	-999	52.753625	143.365515	NE
5-Sep	Int	1	OFF	15:28:40	1	-999	52.783065	143.384297	E
5-Sep	Int	1	OFF	15:34:56	1	0	52.975492	143.318124	N
5-Sep	Int	1	ON	15:36:16	2	0	53.010114	143.327156	N
5-Sep	Int	1	OFF	15:37:48	1	-999	53.060953	143.324014	N
5-Sep	Int	1	OFF	15:38:50	1	-999	53.092769	143.315904	NE
5-Sep	Int	1	OFF	15:41:01	1	-999	53.161986	143.299498	N
5-Sep	Int	1	ON	15:42:22	1	0	53.193904	143.278284	N
5-Sep	Int	1	ON	15:43:20	1	1	53.227604	143.256897	N
5-Sep	Int	1	ON	15:43:27	1	0	53.234325	143.274271	N
5-Sep	Int	1	ON	15:44:59	1	1	53.270358	143.254077	N
5-Sep	Int	1	ON	15:45:28	1	1	53.282074	143.249869	N
5-Sep	Int	3	OFF	16:07:59	3	-999	53.143109	143.297793	NE
5-Sep	Int	3	OFF	16:12:14	1	-999	53.006262	143.353150	NE
5-Sep	Int	2	ON	16:25:05	1	0	52.719695	143.374134	N
5-Sep	Int	2	ON	16:26:21	0	1	52.757219	143.358996	-999
5-Sep	Int	2	ON	16:27:20	1	1	52.787099	143.364493	N
5-Sep	Int	2	ON	16:27:41	2	1	52.797672	143.365736	N
5-Sep	Int	2	OFF	16:37:32	1	-999	53.095993	143.299905	-999
5-Sep	Int	2	ON	16:38:46	2	0	53.132010	143.319360	N
5-Sep	Int	2	ON	16:39:25	1	-999	53.148924	143.295939	-999
5-Sep	Int	2	OFF	16:39:40	1	-999	53.158043	143.290617	-999
5-Sep	Int	2	OFF	16:39:50	2	-999	53.164094	143.276848	-999
5-Sep	Int	2	OFF	16:42:15	2	-999	53.235135	143.255958	-999
5-Sep	Int	2	OFF	16:44:00	1	-999	53.283265	143.242181	N
30-Sep	Off	5	OFF	10:51:59	1	0	52.104667	143.583920	E
30-Sep	Off	6	ON	11:07:00	1	0	52.350090	143.617618	W
30-Sep	Off	6	ON	11:12:05	1	0	52.188309	143.588992	N
30-Sep	Off	6	ON	11:12:41	1	1	52.174217	143.591489	S
30-Sep	Off	6	ON	11:13:44	1	0	52.138608	143.584352	E
30-Sep	Off	7	ON	11:38:51	3	-999	52.289203	143.646063	S
30-Sep	Off	8	ON	11:53:15	1	0	52.168112	143.671034	-999
30-Sep	Off	9	ON	12:20:33	1	-999	52.316331	143.717391	-999
30-Sep	Off	9	OFF	12:22:37	1	-999	52.373258	143.709990	S
30-Sep	Off		OFF	12:29:24	1	0	52.360808	143.683004	S
30-Sep	Off		OFF	12:35:00	2	2	52.187348	143.592597	SW

Date	Survey Type	Line	On Transect	Time	Whales	Plumes	Latitude, digital degrees	Longitude, digital degrees	Orientation
30-Sep	Off	6	ON	13:31:00	3	2	52.101958	143.587615	E
30-Sep	Int	1	ON	14:33:27	2	0	52.909985	143.346478	N
30-Sep	Int	1	ON	14:33:58	1	0	52.923084	143.321379	N
30-Sep	Int	1	ON	14:36:05	3	1	52.976208	143.317879	N
30-Sep	Int	1	ON	14:36:11	0	1	52.985607	143.321040	-999
30-Sep	Int	1	ON	14:36:40	1	0	52.989619	143.310414	N
30-Sep	Int	1	ON	14:44:32	1	0	53.190495	143.272353	N
30-Sep	Int	1	ON	14:45:00	1	1	53.205124	143.268568	N
30-Sep	Int	1	ON	14:45:35	1	-999	53.217725	143.254648	N
30-Sep	Int	2	ON	15:28:33	2	-999	52.771180	143.368406	S
30-Sep	Int	2	ON	15:47:41	1	0	53.243705	143.292278	N
9-Oct	Off	7	ON	14:29:42	3	3	52.123424	143.630026	-999
9-Oct	Off	7	ON	14:30:03	1	0	52.133498	143.617053	-999
9-Oct	Off	7	OFF	14:30:59	1	0	52.160079	143.606492	-999
9-Oct	Off	7	ON	14:31:55	1	0	52.186531	143.626914	N
9-Oct	Off	7	OFF	14:31:55	1	-999	52.186531	143.605723	N
9-Oct	Off	7	ON	14:32:33	1	0	52.204137	143.653303	N
9-Oct	Off	7	ON	14:33:23	1	-999	52.230364	143.635058	N
9-Oct	Off	7	ON	14:38:17	1	0	52.374157	143.653372	N
9-Oct	Off	6	OFF	14:48:51	2	-999	52.191981	143.565167	-999
9-Oct	Off	6	ON	14:49:02	2	0	52.184240	143.608288	W
9-Oct	Off	6	OFF	14:50:52	3	3	52.125291	143.625461	-999
9-Oct	Off	6	ON	14:51:45	2	0	52.096564	143.608786	-999
9-Oct	Off	6	ON	14:54:59	0	2	51.992323	143.606283	-999
9-Oct	Off	6	ON	14:55:42	0	3	51.969503	143.580761	-999
9-Oct	Ext	12	ON	18:30:40	3	0	51.974788	143.575090	NW
10-Oct	Ext	14	ON	9:48:09	3	0	52.162193	143.629110	-999
10-Oct	Ext	14	ON	9:48:52	0	1	52.159991	143.595234	-999
10-Oct	Ext	14	ON	9:49:13	1	-999	52.153294	143.578411	-999
10-Oct	Ext	14	OFF	9:49:22	2	-999	52.141654	143.570767	N
10-Oct	Int	2	ON	11:55:51	1	0	53.120669	143.322717	-999
10-Oct	Int	2	ON	11:58:26	1	-999	53.194157	143.300947	-999
10-Oct	Int	2	OFF	11:58:56	1	-999	53.206275	143.274602	-999
10-Oct	Int	1	ON	12:38:36	0	2	53.270637	143.245091	-999
10-Oct	Int	1	ON	12:40:40	3	0	53.202906	143.279266	SE
10-Oct	Int	1	ON	12:50:01	2	0	52.913909	143.342770	S
10-Oct	Int	1	ON	12:50:01	1	0	52.913909	143.346499	N
10-Oct	Int	1	ON	12:50:50	1	0	52.893712	143.349630	N
10-Oct	Int	1	ON	12:59:27	1	0	52.810123	143.346718	N
6-Nov	INT	1	ON	10:24:59	1	0	53.226823	143.271989	N
6-Nov	INT	1	ON	10:51:59	1	0	53.238754	143.270573	N
6-Nov	INT	1	ON	10:51:59	1	0	53.238754	143.266816	N
6-Nov	INT	2	ON	11:44:58	2	0	52.804794	143.368551	-999
6-Nov	INT	2	ON	12:02:39	2	0	53.252782	143.268393	-999
6-Nov	INT	2	ON	12:02:39	1	0	53.252782	143.268393	-999
7-Nov	OFF		OFF	10:24:15	1	0	52.658506	143.352479	N
7-Nov	OFF	8	OFF	11:39:14	1	0	52.137111	143.675133	E
7-Nov	OFF	8	ON	11:41:01	1	0	52.190568	143.703922	S
7-Nov	INT	1	ON	12:49:39	1	0	52.920585	143.324500	N
7-Nov	INT	1	ON	12:56:47	1	0	53.125082	143.276661	-999
7-Nov	INT	1	ON	12:59:36	2	0	53.201203	143.257533	N
7-Nov	INT	1	ON	13:01:30	1	0	53.250352	143.254476	N
7-Nov	INT	1	ON	13:02:40	1	0	53.278654	143.241432	N
7-Nov	INT	1	OFF	13:02:50	2	-999	53.284040	143.257791	W
7-Nov	INT	2	ON	14:42:24	1	-999	52.922044	143.344207	-999
7-Nov	INT	2	OFF	14:55:00	2	-999	53.277651	143.238677	-999
7-Nov	INT	2	OFF	14:55:20	1	-999	53.284292	143.237573	-999

Date	Survey Type	Line	On Transect	Time	Whales	Plumes	Latitude, digital degrees	Longitude, digital degrees	Orientation
7-Nov	INT	2	OFF	14:55:50	1	-999	53.293224	143.220089	-999
8-Nov	OFF	26	ON	10:56:59	1	-999	53.261643	143.253930	W
8-Nov	OFF	26	ON	10:56:59	4	-999	53.257895	143.253930	-999
8-Nov	INT	1	ON	13:08:58	1	0	52.955105	143.336902	N
8-Nov	INT	1	OFF	13:19:00	2	-999	53.212704	143.351922	-999
8-Nov	INT	1	ON	13:20:30	1	0	53.252293	143.257426	S
8-Nov	INT	1	ON	13:20:30	1	0	53.252293	143.261185	S
15-Nov	INT	1	ON	14:14:16	3	0	53.231235	143.266011	W
15-Nov	INT	1	ON	14:15:19	1	0	53.197504	143.273476	SE
15-Nov	INT	1	ON	14:17:00	1	0	53.141988	143.293095	NW
15-Nov	OFF	6	ON	14:55:39	2	0	51.991379	143.589270	W
15-Nov	OFF	6	ON	14:56:51	1	0	51.947702	143.584047	S
15-Nov	OFF	6	OFF	14:58:20	2	-999	51.896933	143.527167	S
18-Nov	OFF	5	ON	11:32:43	2	-999	51.997709	143.556926	E
18-Nov	OFF	5	ON	11:33:00	1	1	52.008336	143.563101	S
18-Nov	OFF	5	ON	11:33:28	1	0	52.016190	143.565992	N
18-Nov	OFF	5	ON	11:33:28	0	2	52.016190	143.567732	-999
18-Nov	OFF	5	ON	11:33:33	3	0	52.062458	143.572253	W
18-Nov	OFF	5	ON	11:33:33	1	-999	52.062458	143.549611	-999
18-Nov	OFF	5	ON	11:35:57	1	0	52.100014	143.570223	N
18-Nov	OFF	6	OFF	11:59:31	5	-999	52.055436	143.566121	S
18-Nov	OFF	6	ON	12:00:05	1	0	52.040716	143.619869	SW
18-Nov	OFF	6	OFF	12:00:37	1	0	52.023780	143.577432	W
18-Nov	OFF		OFF	12:06:01	1	0	51.871210	143.616112	W
18-Nov	OFF	7	ON	12:12:30	1	0	52.044718	143.633288	E
18-Nov	OFF	7	ON	12:13:14	1	0	52.068648	143.665999	NE
18-Nov	OFF	7	ON	12:13:57	1	0	52.091055	143.634240	-999
18-Nov	OFF	7	OFF	12:15:30	1	-999	52.137758	143.625103	-999
18-Nov	OFF	4	OFF	12:52:19	3	0	52.000139	143.563315	SE

Note: Survey Type: (Int) Piltun grid; (Off) Offshore grid; (Lun) Lunskoye grid; (Ext) Extensive aerial survey grid; On Transect: (on) within the transect strip (30-110%); (off) outside the transect strip; -999 – undetermined.

APPENDIX 2

Environmental and weather conditions during aerial surveys in 2002.

Date	Survey Type	Line	Block	Cloud Cover (%)	Sea State (0-4)	Visibility Distance (m)	Glare Left	Glare Right	White Caps	Fog
27-Jul	Offshore	1	5	0	0	≤ 1000	0	0	0	No
27-Jul	Offshore	1	4	0	0	≤ 300	0	0	0	Yes
27-Jul	Offshore	1	3	0	0	≤ 300	0	0	0	Yes
27-Jul	Offshore	1	2	0	0	≤ 1000	0	0	0	Yes
27-Jul	Offshore	1	2	0	0	~ 10 000	0	0	0	No
27-Jul	Offshore	2	1	0	0	~ 10 000	0	0	0	No
27-Jul	Offshore	2	2	0	0	≤ 300	0	0	0	Yes
27-Jul	Offshore	2	3	0	0	≤ 300	0	0	0	Yes
27-Jul	Offshore	2	4	0	0	≤ 300	0	0	0	Yes
27-Jul	Offshore	2	5	0	0	≤ 1000	0	0	0	Yes
27-Jul	Offshore	3	1 - 5	0	0	~ 10 000	0	1	0	No
27-Jul	Offshore	4	1 - 4	0	0	~ 10 000	1	0	0	No
27-Jul	Offshore	5	1 - 5	0	0	~ 10 000	0	1	0	No
27-Jul	Offshore	6	1 - 5	0	0	~ 10 000	1	0	0	No
27-Jul	Offshore	7	1 - 5	0	0	~ 10 000	0	1	0	No
27-Jul	Offshore	8	1 - 5	0	0	~ 10 000	1	0	0	No
27-Jul	Offshore	9	1 - 5	0	0	~ 10 000	0	1	0	No
28-Jul	Lunskoye	6 - 12	1 - 5	100	0 - 1	~ 10 000	0	0	0	No
28-Jul	Lunskoye	5	5	100	0 - 1	~ 10 000	0	0	0	No
28-Jul	Lunskoye	5	1 - 4	100	0	~ 10 000	0	0	0	No
28-Jul	Lunskoye	4	1 - 4	100	0	~ 10 000	0	0	0	No
28-Jul	Lunskoye	4	5	100	0 - 1	~ 10 000	0	1	0	No
28-Jul	Lunskoye	3	4 - 5	100	0 - 1	~ 10 000	0	1	0	No
28-Jul	Lunskoye	3	1 - 3	100	0 - 1	~ 10 000	0	0	0	No
28-Jul	Lunskoye	2	1 - 4	100	0	~ 10 000	0	0	0	No
28-Jul	Lunskoye	2	5	100	0 - 1	~ 10 000	0	0	0	No
28-Jul	Lunskoye	1	3 - 5	100	0 - 1	~ 10 000	0	0	0	No
28-Jul	Lunskoye	1	1 - 2	100	0	~ 10 000	0	0	0	No
28-Jul	Extensive	1	1	100	0	~ 10 000	0	0	0	No
28-Jul	Extensive	2	2	100	0	~ 10 000	0	0	0	No
30-Jul	Extensive	3	3	100	0	~ 10 000	0	0	0	No
30-Jul	Extensive	4	4	100	0 - 1	~ 10 000	0	0	0	No
30-Jul	Extensive	5	5	50-70	0 - 1	~ 10 000	0	1	0	No
30-Jul	Extensive	6	6	50-70	0 - 1	~ 10 000	0	0	0	No
30-Jul	Extensive	7	7	20-40	0 - 1	~ 10 000	0	1	0	No
30-Jul	Extensive	8	8	0	0 - 1	~ 10 000	0	0	0	No
30-Jul	Extensive	9	9	0	0 - 1	~ 10 000	0	1	0-1	No
30-Jul	Extensive	10	10	0	0 - 1	~ 10 000	0	0	0-1	No
30-Jul	Extensive	11	11	0	0 - 1	~ 10 000	0	1	0	No
30-Jul	Extensive	12	12	0	0 - 1	~ 10 000	1	0	0	No
30-Jul	Extensive	13	13	0	0 - 1	~ 10 000	0	1	0-1	No
30-Jul	Extensive	14	14	0	0 - 1	~ 10 000	1	0	0	No
30-Jul	Extensive	15	15	0	0 - 1	~ 10 000	0	0	0	No
30-Jul	Extensive	16	16	0	0 - 1	~ 10 000	1	0	0	No
30-Jul	Extensive	17	17	0	0 - 1	~ 10 000	0	0	0	No
30-Jul	Extensive	18	18	0	0 - 1	~ 10 000	1	0	0	No

Date	Survey Type	Line	Block	Cloud Cover (%)	Sea State (0-4)	Visibility Distance (m)	Glare Left	Glare Right	White Caps	Fog
30-Jul	Extensive	19	19	0	0 - 1	~ 10 000	0	0	0-1	No
30-Jul	Extensive	20	20	0	0 - 1	~ 10 000	1	0	0	No
30-Jul	Intensive		1 - 5	0	0 - 1	~ 10 000	1	0	0	No
31-Jul	Extensive	34	34	0	0 - 1	~ 10 000	0	1	1	No
31-Jul	Extensive	33	33	0	0	~ 10 000	0	0	0	No
31-Jul	Extensive	32	32	0	0	~ 10 000	0	1	0	No
31-Jul	Extensive	31	31	0	0	~ 10 000	0	0	0	No
31-Jul	Extensive	30	30	0	0	~ 10 000	0	1	0	No
31-Jul	Extensive	29	29	0	0 - 1	~ 10 000	1	0	0	No
31-Jul	Extensive	28	28	0	0 - 1	~ 10 000	0	1	0	No
31-Jul	Extensive	27	27	0	0 - 1	~ 10 000	1	0	0-1	No
31-Jul	Extensive	26	26	0	0 - 1	~ 10 000	0	1	1	No
31-Jul	Extensive	25	25	0	0 - 1	~ 10 000	1	0	1	No
31-Jul	Extensive	24	24	0	0 - 1	~ 10 000	0	1	1	No
31-Jul	Extensive	23	23	0	0 - 1	~ 10 000	1	0	1	No
31-Jul	Extensive	22	22	0	0 - 1	~ 10 000	0	1	1	No
31-Jul	Extensive	21	21	0	0 - 1	~ 10 000	1	0	1	No
31-Jul	Intensive	1	1 - 2	0	0 - 1	~ 10 000	1	0	1	No
31-Jul	Intensive	1	3 - 4	0	0 - 1	~ 10 000	1	0	2	No
31-Jul	Intensive	1	5	0	0 - 1	~ 10 000	1	0	1-2	No
2-Aug	Intensive	1	1 - 5	100	0 - 1	~ 10 000	0	0	0	No
2-Aug	Intensive	2	1 - 5	100	0	~ 10 000	0	0	0	No
2-Aug	Intensive	3	5	50	0 - 1	~ 10 000	1	0	0	No
2-Aug	Intensive	3	4	60-80	0	~ 10 000	1	0	0	No
2-Aug	Intensive	3	1 - 3	100	0	~ 10 000	0	0	0	No
2-Aug	Intensive	4	1 - 4	100	0	~ 10 000	0	0	0	No
2-Aug	Intensive	4	5	50	0 - 1	~ 10 000	0	0	0	No
26-Aug	Intensive	4	1 - 5	100	0 - 1	~ 10 000	0	0	0	No
26-Aug	Intensive	3	1 - 5	100	0 - 1	~ 10 000	0	0	0	No
26-Aug	Intensive	2	1 - 5	100	0 - 1	~ 10 000	0	0	0	No
26-Aug	Intensive	1	1 - 5	100	0 - 1	~ 10 000	0	0	0	No
1-Sep	Extensive	34	34	0	0 - 1	~ 10 000	0	0	1	No
1-Sep	Extensive	33	33	0	0 - 1	~ 10 000	1	0	1	No
1-Sep	Extensive	32	32	0	0 - 1	~ 10 000	0	0	1	No
1-Sep	Extensive	31	31	0	0 - 1	~ 10 000	1	0	0	No
1-Sep	Extensive	30	30	0	0 - 1	~ 10 000	0	0	0	No
1-Sep	Extensive	29	29	0	0 - 1	~ 10 000	1	0	0	No
1-Sep	Extensive	28	28	0	0 - 1	~ 10 000	0	0	0	No
1-Sep	Extensive	27	27	0	0 - 1	~ 10 000	1	0	0	No
1-Sep	Extensive	26	26	0	0 - 1	~ 10 000	0	0	0	No
1-Sep	Extensive	25	25	0	0 - 1	~ 10 000	1	0	0	No
2-Sep	Extensive	24	24	0	0 - 1	~ 10 000	0	1	1	No
2-Sep	Extensive	23	23a	0	0 - 1	~ 10 000	0	0	1	No
2-Sep	Extensive	23	23b	0	0 - 1	~ 10 000	0	0	0	No
2-Sep	Extensive	22	22	0	0 - 1	~ 10 000	0	1	0	No
2-Sep	Extensive	21	21a	0	0 - 1	~ 10 000	0	0	1	No
2-Sep	Extensive	21	21b	0	0 - 1	~ 10 000	0	0	0	No
2-Sep	Extensive	20	20	0	0 - 1	~ 10 000	0	1	0	No
2-Sep	Extensive	19	19	0	0 - 1	~ 10 000	0	0	0	No
2-Sep	Extensive	18	18	0	0 - 1	~ 10 000	0	1	0	No
2-Sep	Extensive	17	17a	0	0 - 1	~ 10 000	1	0	1	No

Date	Survey Type	Line	Block	Cloud Cover (%)	Sea State (0-4)	Visibility Distance (m)	Glare Left	Glare Right	White Caps	Fog
2-Sep	Extensive	17	17b	0	0 - 1	~ 10 000	1	0	0	No
2-Sep	Extensive	16	16	0	0 - 1	~ 10 000	0	1	0	No
2-Sep	Extensive	15	15	0	0 - 1	~ 10 000	1	0	1	No
2-Sep	Extensive	14	14a	0	0 - 1	~ 10 000	0	1	0	No
2-Sep	Extensive	14	14b	0	0 - 1	~ 10 000	0	1	1	No
2-Sep	Extensive	13	13a	100	1	~ 10 000	0	0	2	No
2-Sep	Extensive	13	13b	100	0 - 1	~ 10 000	0	0	1	No
4-Sep	Intensive	1	5	0		~ 10 000	1	0	1	No
4-Sep	Intensive	1	2 - 4	0	2	~ 10 000	1	0	1	No
4-Sep	Intensive	1	1	0	2	~ 10 000	1	0	0	No
4-Sep	Extensive	12	12a	0	0 - 1	~ 10 000	0	1	1	No
4-Sep	Extensive	12	12b	0	0 - 1	~ 10 000	0	1	0	No
4-Sep	Extensive	11	11	0	1	~ 10 000	0	0	1	No
4-Sep	Extensive	10	10	0	1	~ 10 000	1	0	1	No
4-Sep	Extensive	9	9a	0	1	~ 10 000	0	0	2	No
4-Sep	Extensive	9	9b	100	1	~ 10 000	0	0	1	No
4-Sep	Extensive	8	8a	100	0 - 1	~ 10 000	0	0	1	No
4-Sep	Extensive	8	8b	100	2	~ 10 000	0	0	2	No
4-Sep	Extensive	7	7a	100	1	~ 10 000	0	0	2	No
4-Sep	Extensive	7	7b	100	1	~ 10 000	0	0	1	No
4-Sep	Extensive	6	6	60-80	1	~ 10 000	0	0	1	No
4-Sep	Extensive	5	5a	60-80	1	~ 10 000	1	0	1	No
4-Sep	Extensive	5	5b	60	1	~ 10 000	1	0	0	No
4-Sep	Lunskoye	1	4 - 5	1-20	1	~ 10 000	0	1	0	No
4-Sep	Lunskoye	1	2 - 3	1-20	1	~ 10 000	0	1	1	No
4-Sep	Lunskoye	1	1	60-80	1	~ 10 000	0	0	0	No
4-Sep	Extensive	1	1a	60-80	0 - 1	~ 10 000	0	0	0	No
4-Sep	Extensive	1	1b	20-40	1	~ 10 000	0	0	0	No
4-Sep	Extensive	2	2a	50	1	~ 10 000	1	0	0	No
4-Sep	Extensive	2	2b	60-80	1	~ 10 000	0	0	0	No
4-Sep	Extensive	3	3a	60-80	0 - 1	~ 10 000	0	0	0	No
4-Sep	Extensive	3	3b	20-40	1	~ 10 000	0	0	0	No
4-Sep	Extensive	4	4a	50	1	~ 10 000	1	0	1	No
4-Sep	Extensive	4	4b	60-80	1	~ 10 000	0	0	1	No
4-Sep	Lunskoye	3	1	60-80	0 - 1	~ 10 000	0	0	0	No
4-Sep	Lunskoye	3	2	40-60	0 - 1	~ 10 000	1	0	1	No
4-Sep	Lunskoye	3	3	40-60	1	~ 10 000	1	0	1	No
4-Sep	Lunskoye	3	4	50	1	~ 10 000	1	0	1	No
4-Sep	Lunskoye	3	5	50	1	~ 10 000	1	0	0	No
4-Sep	Lunskoye	5	5	40-60	1	~ 10 000	0	1	1	No
4-Sep	Lunskoye	5	4	20-40	1	~ 10 000	0	1	1	No
4-Sep	Lunskoye	5	2 - 3	60-80	1	~ 10 000	0	1	1	No
4-Sep	Lunskoye	5	1	60-80	0 - 1	~ 10 000	0	1	0	No
4-Sep	Lunskoye	7	1 - 2	60-80	0 - 1	~ 10 000	1	0	0	No
4-Sep	Lunskoye	7	3	60-80	1	~ 10 000	1	0	1	No
4-Sep	Lunskoye	7	4 - 5	40-60	1	~ 10 000	1	0	0	No
5-Sep	Offshore	1	6	0	1	~ 10 000	1	0	1	No
5-Sep	Offshore	1	1 - 5	0	1	~ 10 000	1	0	0	No
5-Sep	Offshore	2	1 - 6	0	1	~ 10 000	0	0	1	No
5-Sep	Offshore	3	1 - 6	0	1	~ 10 000	1	0	0	No
5-Sep	Offshore	4	1 - 6	0	1	~ 10 000	0	0	0	No

Date	Survey Type	Line	Block	Cloud Cover (%)	Sea State (0-4)	Visibility Distance (m)	Glare Left	Glare Right	White Caps	Fog
5-Sep	Offshore	5	1 - 6	0	1	~ 10 000	1	0	0	No
5-Sep	Offshore	6	1 - 6	0	0 - 1	~ 10 000	0	0	0	No
5-Sep	Offshore	7	1 - 6	0	0 - 1	~ 10 000	1	0	0	No
5-Sep	Offshore	8	1	0	1	~ 10 000	0	0	0	No
5-Sep	Offshore	8	2 - 6	0	0 - 1	~ 10 000	0	0	0	No
5-Sep	Offshore	9	1 - 6	0	1	~ 10 000	1	0	0	No
5-Sep	Lunskoye	9	5	0	0 - 1	~ 10 000	0	0	0	No
5-Sep	Lunskoye	9	1 - 4	0	1	~ 10 000	0	0	0	No
5-Sep	Lunskoye	11	1 - 5	0	1	~ 10 000	0	0	0	No
5-Sep	Offshore	7	1 - 6	0	1	~ 10 000	0	0	0	No
5-Sep	Intensive	1	1 - 5	0	1	~ 10 000	0	0	0	No
5-Sep	Intensive	3	4 - 5	0	2	~ 10 000	0	1	1	No
5-Sep	Intensive	3	2 - 3	0	1	~ 10 000	0	1	0	No
5-Sep	Intensive	3	1	0	1	~ 10 000	0	1	1	No
5-Sep	Intensive	2	1	0	1	~ 10 000	1	0	1	No
5-Sep	Intensive	2	2 - 5	0	1	~ 10 000	1	0	0	No
30-Sep	Offshore	1	1 - 2	0	0 - 1	~ 10 000	0	0	0	No
30-Sep	Offshore	1	3	0	0 - 1	~ 10 000	0	0	1	No
30-Sep	Offshore	1	4	0	1	~ 10 000	0	0	1	No
30-Sep	Offshore	1	5 - 6	0	2	~ 10 000	0	0	1	No
30-Sep	Offshore	2	6	0	2	~ 10 000	1	0	1	No
30-Sep	Offshore	2	5	0	2	~ 10 000	1	0	0	No
30-Sep	Offshore	2	2 - 4	60-80	1	~ 10 000	1	0	0	No
30-Sep	Offshore	2	1	40-60	1	~ 10 000	1	0	0	No
30-Sep	Offshore	3	1 - 2	40-60	1	~ 10 000	0	0	1	No
30-Sep	Offshore	3	3 - 6	0	1	~ 10 000	0	0	1	No
30-Sep	Offshore	4	5 - 6	1-20	1	~ 10 000	1	0	1	No
30-Sep	Offshore	4	3 - 4	0	1	~ 10 000	1	0	1	No
30-Sep	Offshore	4	1 - 2	0	1	~ 10 000	1	0	0	No
30-Sep	Offshore	5	1	0	1	~ 10 000	0	0	0	No
30-Sep	Offshore	5	2 - 6	0	1	~ 10 000	0	0	1	No
30-Sep	Offshore	6	6	0	1	~ 10 000	1	0	0	No
30-Sep	Offshore	6	3 - 5	0	1	~ 10 000	1	0	1	No
30-Sep	Offshore	6	1 - 2	0	1	~ 10 000	1	0	0	No
30-Sep	Offshore	7	1 - 6	0	1	~ 10 000	0	0	0	No
30-Sep	Offshore	8	6	0	1	~ 10 000	1	0	0	No
30-Sep	Offshore	8	3 - 5	0	1	~ 10 000	1	0	1	No
30-Sep	Offshore	8	1 - 2	0	1	~ 10 000	1	0	0	No
30-Sep	Offshore	9	1	0	1	~ 10 000	0	0	0	No
30-Sep	Offshore	9	2 - 3	0	1	~ 10 000	0	0	1	No
30-Sep	Offshore	9	4	0	1	~ 10 000	0	0	0	No
30-Sep	Offshore	9	5 - 6	0	1	~ 10 000	0	0	1	No
30-Sep	Intensive	1	1	0	1	~ 10 000	0	0	0	No
30-Sep	Intensive	1	2 - 3	0	1	~ 10 000	0	0	1	No
30-Sep	Intensive	1	4	0	2	~ 10 000	0	0	1	No
30-Sep	Intensive	1	5	60-80	2	~ 10 000	0	0	2	No
30-Sep	Intensive	4	5	60-80	2 - 3	~ 10 000	0	1	2	No
30-Sep	Intensive	4	4	0	2	~ 10 000	0	1	2	No
30-Sep	Intensive	4	3	40-60	2	~ 10 000	0	1	1	No
30-Sep	Intensive	4	2	20-40	2	~ 10 000	0	1	1	No
30-Sep	Intensive	4	1	0	1 - 2	~ 10 000	0	1	1	No

Date	Survey Type	Line	Block	Cloud Cover (%)	Sea State (0-4)	Visibility Distance (m)	Glare Left	Glare Right	White Caps	Fog
30-Sep	Intensive	2	1	0	1	~ 10 000	0	0	1	No
30-Sep	Intensive	2	2	0	1	~ 10 000	0	0	0	No
30-Sep	Intensive	2	3	0	1 - 2	~ 10 000	0	0	1	No
30-Sep	Intensive	2	4	0	2	~ 10 000	0	0	1	No
30-Sep	Intensive	2	5	0	2	~ 10 000	0	0	2	No
30-Sep	Intensive	3	4 - 5	0	2 - 3	~ 10 000	0	1	2	No
30-Sep	Intensive	3	3	0	2	~ 10 000	0	1	1	No
30-Sep	Intensive	3	1 - 2	0	1 - 2	~ 10 000	0	1	1	No
9-Oct	Lunskoye	1	1 - 5	0	1	~ 10 000	1	0	0	No
9-Oct	Lunskoye	3	1 - 2	0	3	~ 10 000	0	0	1	No
9-Oct	Lunskoye	3	3	0	2	~ 10 000	0	0	0	No
9-Oct	Lunskoye	3	4 - 5	0	1	~ 10 000	0	0	0	No
9-Oct	Lunskoye	5	4 - 5	0	3	~ 10 000	0	0	1	No
9-Oct	Lunskoye	5	3	0	3	~ 10 000	0	0	2	No
9-Oct	Lunskoye	5	1 - 2	0	3	~ 10 000	0	0	1	No
9-Oct	Lunskoye	7	1 - 5	0	3	~ 10 000	0	0	1	No
9-Oct	Lunskoye	9	4 - 5	0	3	~ 10 000	0	1	1	No
9-Oct	Lunskoye	9	2 - 3	0	3	~ 10 000	0	1	2	No
9-Oct	Lunskoye	9	1	0	3	~ 10 000	0	1	1	No
9-Oct	Lunskoye	11	1 - 5	0	3	~ 10 000	0	0	1	No
9-Oct	Offshore	7	1 - 2	0	3	~ 10 000	0	0	1	No
9-Oct	Offshore	7	3 - 5	0	2	~ 10 000	0	0	0	No
9-Oct	Offshore	7	6	0	3	~ 10 000	0	0	0	No
9-Oct	Offshore	6	1 - 6	0	2	~ 10 000	0	1	0	No
9-Oct	Extensive	1	1	0	2	~ 10 000	0	0	0	No
9-Oct	Extensive	2	2	0	2	~ 10 000	1	0	0	No
9-Oct	Extensive	3	3	0	2	~ 10 000	0	0	0	No
9-Oct	Extensive	4	4	0	2	~ 10 000	1	0	0	No
9-Oct	Extensive	5	5	0	3	~ 10 000	0	0	1	No
9-Oct	Extensive	6	6	0	3	~ 10 000	1	0	1	No
9-Oct	Extensive	7	7	0	3	~ 10 000	0	0	1	No
9-Oct	Extensive	8	8	0	2	~ 10 000	1	0	0	No
9-Oct	Extensive	9	9	0	2	~ 10 000	0	0	0	No
9-Oct	Extensive	10	10	0	2	~ 10 000	1	1	0	No
9-Oct	Extensive	11	11	0	3	~ 10 000	0	0	1	No
9-Oct	Extensive	12	12	0	3	~ 10 000	0	0	1	No
10-Oct	Extensive	13	13	0	1	~ 10 000	0	1	0	No
10-Oct	Extensive	14	14	0	2	~ 10 000	0	0	0	No
10-Oct	Extensive	15	15	0	2	~ 10 000	0	1	0	No
10-Oct	Extensive	16	16	0	1	~ 10 000	0	0	0	No
10-Oct	Extensive	17	17	0	1	~ 10 000	0	1	0	No
10-Oct	Extensive	18	18	0	2	~ 10 000	0	0	0	No
10-Oct	Extensive	19	19	0	1	~ 10 000	0	1	0	No
10-Oct	Extensive	20	20	0	2	~ 10 000	0	0	0	No
10-Oct	Intensive	2	1 - 5	0	1	~ 10 000	0	0	0	No
10-Oct	Intensive	1	1 - 5	0	1	~ 10 000	0	0	0	No
10-Oct	Extensive	21	21	0	1	~ 10 000	0	0	0	No
10-Oct	Extensive	22	22	0	1	~ 10 000	1	0	0	No
10-Oct	Extensive	23	23	60-80	1	~ 10 000	0	0	0	No
10-Oct	Extensive	24	24	40-60	1	~ 10 000	0	0	0	No
10-Oct	Extensive	25	25	1-20	3	~ 10 000	0	0	1	No

Date	Survey Type	Line	Block	Cloud Cover (%)	Sea State (0-4)	Visibility Distance (m)	Glare Left	Glare Right	White Caps	Fog
10-Oct	Extensive	26	26	20-40	3	~ 10 000	1	0	1	No
10-Oct	Extensive	27	27	1-20	3	~ 10 000	0	0	2	No
10-Oct	Extensive	28	28	1-20	4	~ 10 000	1	0	2	No
11-Oct	Extensive	29	29	0	3	~ 10 000	0	1	1	No
11-Oct	Extensive	30	30	0	3	~ 10 000	0	0	1	No
11-Oct	Extensive	31	31	0	3	~ 10 000	0	1	1	No
11-Oct	Extensive	32	32	0	3	~ 10 000	1	0	1	No
11-Oct	Extensive	33	33	0	3	~ 10 000	0	1	1	No
11-Oct	Extensive	34	34	0	2	~ 10 000	1	0	0	No
6-Nov	Intensive	1	2 - 5	100	2	~ 10 000	0	0	0	No
6-Nov	Intensive	1	1	60-80	2	~ 10 000	0	0	0	No
6-Nov	Offshore	3	6	20-40	3	~ 10 000	1	0	1	No
6-Nov	Offshore	3	4 - 5	1-20	3	~ 10 000	1	0	1	No
6-Nov	Offshore	3	1 - 3	1-20	4	~ 10 000	1	0	2	No
6-Nov	Offshore	2	1 - 4	1-20	4	~ 10 000	0	0	2	No
6-Nov	Offshore	2	5	1-20	3	~ 10 000	0	0	1	No
6-Nov	Offshore	2	6	100	3	~ 10 000	0	0	1	No
6-Nov	Intensive	2	1 - 4	100	3	~ 10 000	0	0	1	No
6-Nov	Intensive	2	5	60-80	4	~ 10 000	0	0	2	No
7-Nov	Intensive	2	4 - 5	1-20	2	~ 10 000	1	0	0	No
7-Nov	Intensive	2	3	40-60	2	~ 10 000	1	0	0	No
7-Nov	Intensive	2	1 - 2	100	2	~ 10 000	0	0	0	No
7-Nov	Offshore	4	6	40-60	2	~ 10 000	1	0	0	No
7-Nov	Offshore	4	5	40-60	3	~ 10 000	1	0	1	No
7-Nov	Offshore	4	4	1-20	3	~ 10 000	1	0	1	No
7-Nov	Offshore	4	1 - 3	0	3	~ 10 000	1	0	1	No
7-Nov	Offshore	5	1 - 4	0	3	~ 10 000	0	0	1	No
7-Nov	Offshore	5	5	1-20	3	~ 10 000	0	0	1	No
7-Nov	Offshore	5	6	1-20	2	~ 10 000	1	0	0	No
7-Nov	Offshore	6	6	1-20	2	~ 10 000	1	0	0	No
7-Nov	Offshore	6	3 - 5	1-20	3	~ 10 000	1	0	1	No
7-Nov	Offshore	6	2	0	3	~ 10 000	1	0	1	No
7-Nov	Offshore	6	1	0	3	~ 10 000	1	0	1	No
7-Nov	Offshore	8	1 - 6	0	3	~ 10 000	0	0	1	No
7-Nov	Offshore	9	1 - 6	0	3	~ 10 000	1	0	1	No
7-Nov	Offshore	7	1 - 2	0	3	~ 10 000	0	0	1	No
7-Nov	Offshore	7	3 - 6	0	2	~ 10 000	0	0	0	No
7-Nov	Intensive	1	1	60-80	1	~ 10 000	0	0	0	No
7-Nov	Intensive	1	2 - 5	100	1	~ 10 000	0	0	0	No
7-Nov	Intensive	3	3 - 5	40-60	2	~ 10 000	0	1	0	No
7-Nov	Intensive	3	1 - 2	60-80	2	~ 10 000	0	1	0	No
7-Nov	Intensive	2	1 - 4	60-80	2	~ 10 000	0	0	0	No
7-Nov	Intensive	2	5	60-80	1	~ 10 000	0	0	0	No
7-Nov	Extensive	34	34	20-40	1	~ 10 000	0	0	0	No
7-Nov	Extensive	33	33	20-40	2	~ 10 000	1	0	0	No
7-Nov	Extensive	32	32	20-40	2	~ 10 000	0	0	0	No
7-Nov	Extensive	31	31	1-20	2	~ 10 000	1	0	0	No
8-Nov	Extensive	30	30	20-40	2	~ 10 000	0	1	0	No
8-Nov	Extensive	29	29	1-20	1	~ 10 000	0	0	0	No
8-Nov	Extensive	28	28	1-20	1	~ 10 000	0	1	0	No
8-Nov	Extensive	27	27	1-20	1	~ 10 000	0	0	0	No

Date	Survey Type	Line	Block	Cloud Cover (%)	Sea State (0-4)	Visibility Distance (m)	Glare Left	Glare Right	White Caps	Fog
8-Nov	Extensive	26	26	1-20	2	~ 10 000	0	1	0	No
8-Nov	Extensive	25	25	1-20	2	~ 10 000	0	0	0	No
8-Nov	Extensive	24	24	1-20	2	~ 10 000	0	1	0	No
8-Nov	Extensive	23	23	60-80	2	~ 10 000	0	0	0	No
8-Nov	Extensive	22	22	60-80	3	~ 10 000	0	0	1	No
8-Nov	Extensive	21	21	100	3	~ 10 000	0	0	2	No
8-Nov	Extensive	20	20	100	3	~ 10 000	0	0	2	No
8-Nov	Extensive	19	19	100	3	~ 10 000	0	0	2	No
8-Nov	Intensive	1	1 - 3	100	3	~ 10 000	0	0	2	No
8-Nov	Intensive	1	4	100	3	~ 10 000	0	0	1	No
8-Nov	Intensive	1	5	100	2	~ 10 000	0	0	0	No
15-Nov	Intensive	1	5	20	2	~ 10 000	0	1	0	No
15-Nov	Intensive	1	4	20-40	2	~ 10 000	0	1	0	No
15-Nov	Intensive	1	2 - 3	100	2	~ 10 000	0	1	0	No
15-Nov	Intensive	1	1	100	1	~ 10 000	0	1	0	No
15-Nov	Offshore	6	2 - 6	40-60	2	~ 10 000	0	1	0	No
15-Nov	Offshore	6	1	20-40	2	~ 10 000	0	1	0	No
15-Nov	Offshore	7	1 - 2	1-20	2	~ 10 000	1	0	0	No
15-Nov	Offshore	7	3 - 6	60-80	2	~ 10 000	1	0	0	No
15-Nov	Offshore	8	6	60-80	3	~ 10 000	0	1	1	No
15-Nov	Offshore	8	4 - 5	60-80	3	~ 10 000	0	0	1	No
15-Nov	Offshore	8	1 - 3	60-80	3	~ 10 000	0	1	1	No
17-Nov	Extensive	12	12	60-80	2	~ 10 000	0	1	0	No
17-Nov	Extensive	12	12	60-80	3	~ 10 000	0	1	1	No
17-Nov	Extensive	12	12	60-80	4	~ 10 000	0	1	2	No
17-Nov	Extensive	13	13	40-60	4	~ 10 000	1	0	2	No
17-Nov	Extensive	13	13	40-60	3	~ 10 000	1	0	1	No
17-Nov	Extensive	13	13	40-60	2	~ 10 000	1	0	0	No
17-Nov	Extensive	14	14	40-60	2	~ 10 000	0	0	0	No
17-Nov	Extensive	14	14	40-60	3	~ 10 000	0	0	1	No
17-Nov	Extensive	14	14	40-60	4	~ 10 000	0	0	2	No
17-Nov	Extensive	15	15	40-60	4	~ 10 000	1	0	2	No
17-Nov	Extensive	15	15	40-60	3	~ 10 000	1	0	1	No
17-Nov	Extensive	15	15	40-60	2	~ 10 000	1	0	0	No
17-Nov	Extensive	16	16	40-60	2	~ 10 000	0	0	0	No
17-Nov	Extensive	16	16	40-60	3	~ 10 000	0	0	1	No
17-Nov	Extensive	16	16	40-60	4	~ 10 000	0	0	2	No
17-Nov	Extensive	17	17	40-60	4	~ 10 000	1	0	2	No
17-Nov	Extensive	17	17	40-60	3	~ 10 000	1	0	1	No
17-Nov	Extensive	17	17	40-60	2	~ 10 000	1	0	0	No
17-Nov	Extensive	18	18	40-60	2	~ 10 000	0	0	0	No
17-Nov	Extensive	18	18	40-60	3	~ 10 000	0	0	1	No
17-Nov	Extensive	18	18	40-60	4	~ 10 000	0	0	2	No
17-Nov	Extensive	19	19	40-60	4	~ 10 000	1	0	2	No
17-Nov	Extensive	19	19	40-60	3	~ 10 000	1	0	1	No
17-Nov	Extensive	19	19	40-60	2	~ 10 000	1	0	0	No
17-Nov	Lunskoye	1	4 - 5	60-80	1	~ 10 000	0	0	0	No
17-Nov	Lunskoye	1	1 - 3	60-80	2	~ 10 000	0	0	0	No
17-Nov	Lunskoye	3	1 - 2	60-80	1	~ 10 000	0	0	0	No
17-Nov	Lunskoye	3	3 - 5	60-80	2	~ 10 000	0	0	0	No
18-Nov	Lunskoye	5	5	1-20	2	~ 10 000	1	0	0	No

Date	Survey Type	Line	Block	Cloud Cover (%)	Sea State (0-4)	Visibility Distance (m)	Glare Left	Glare Right	White Caps	Fog
18-Nov	Lunskoye	5	3 - 4	20-40	2	~ 10 000	1	0	0	No
18-Nov	Lunskoye	5	1 - 2	40-60	2	~ 10 000	1	0	0	No
18-Nov	Lunskoye	7	1 - 2	40-60	2	~ 10 000	0	0	0	No
18-Nov	Lunskoye	7	3 - 4	20-40	2	~ 10 000	0	0	0	No
18-Nov	Lunskoye	7	5	1-20	2	~ 10 000	0	0	0	No
18-Nov	Lunskoye	9	5	1-20	2	~ 10 000	1	0	0	No
18-Nov	Lunskoye	9	3 - 4	20-40	2	~ 10 000	1	0	0	No
18-Nov	Lunskoye	9	1 - 2	40-60	2	~ 10 000	1	0	0	No
18-Nov	Lunskoye	11	1 - 3	40-60	2	~ 10 000	0	0	0	No
18-Nov	Lunskoye	11	4 - 5	1-20	2	~ 10 000	0	0	0	No
18-Nov	Offshore	5	1 - 4	0	2	~ 10 000	0	0	0	No
18-Nov	Offshore	5	5 - 6	0	3	~ 10 000	0	0	1	No
18-Nov	Offshore	6	4 - 6	0	3	~ 10 000	0	0	1	No
18-Nov	Offshore	6	1 - 3	0	2	~ 10 000	0	0	0	No
18-Nov	Offshore	7	1 - 5	0	2	~ 10 000	0	0	0	No
18-Nov	Offshore	7	6	0	3	~ 10 000	0	0	1	No
18-Nov	Offshore	8	6	0	3	~ 10 000	0	0	1	No
18-Nov	Offshore	8	1 - 5	0	2	~ 10 000	0	0	0	No
18-Nov	Offshore	4	1 - 6	0	2	~ 10 000	0	0	0	No
18-Nov	Offshore	3	1 - 6	0	2	~ 10 000	0	0	0	No