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**DISTRIBUTION AND ABUNDANCE OF WESTERN GRAY WHALES OFF
NORTHEAST SAKHALIN ISLAND, 2004-2010**

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ABSTRACT

Data from systematic shore- and vessel-based distribution surveys conducted offshore northeast Sakhalin in the summer-to-fall seasons of 2004-2010 indicate the presence of two primary gray-whale feeding areas. The first, nearshore Piltun Feeding Area is located adjacent to Piltun Bay and extends from Ekhaba Bay in the north to Chayvo Bay in the south over a coastline stretch of about 120 km; whales predominantly feed in this area at a distance <5 km from shore and in water depths <20 m. The second, deeper Offshore Feeding Area is located at a distance of about 35-50 km from shore to the southeast of Chayvo Bay; the water depth in this area is about 35-60 m.

In 2010, the maximum number of whales seen during one survey day in the Piltun Feeding Area remained relatively stable, except for the low numbers of whales observed in the southern portions of the feeding area. In 2010, there was an increase of approximately 42% in the maximum number of whales observed in the Offshore Feeding Area, as compared to 2009 surveys. Based on comparative analysis of the survey and photo-ID data, total number of gray whales in the northeast Sakhalin feeding areas in 2010 is assessed at 110-120 individuals, which indicates a relatively stable level of their abundance for 2004-2010.

Introduction

The distribution of gray whales in the offshore waters of NE Sakhalin was monitored in August-September 2010 as part of a Joint Monitoring Program funded by Exxon Neftegas Limited and Sakhalin Energy Investment Company Ltd., the operators of the Sakhalin-1 and Sakhalin 2 projects. Studies conducted over the last decade have revealed the existence of two primary feeding areas in this region, where the whales are

sighted during the ice-free season from late May/early June to late November/early December.

The first of the two feeding areas, the near-shore area known as the Piltun area, extends roughly 120 km along the island coast from the latitude of Ekhaba Bay in the north to the latitude of Chayvo Bay in the south; the whales are sighted primarily in the shallow waters at depths of up to 20 m at distances of up to 5 km from shore. The second of these areas, the deeper feeding area discovered in 2001 and known as the Offshore area, is situated 40-50 km S/SE of the first area, opposite Chayvo and Nyisky bays, about 30-50 km from the coast in waters ranging from 35 to 65 m deep. Surveys conducted in 2004-2009 attest to the almost yearly variations in gray whale abundance and distribution that occur in these two feeding areas (Vladimirov et al., 2010). These areas were once again surveyed in 2010 in order to continue the long-term effort to monitor the abundance and distribution of this group of whales in the Sakhalin feeding areas. Recent photo-identification studies (Yakovlev and Tyurneva, 2008; Tyurneva et al., 2009, 2010) revealed that a portion (about 50) of the Sakhalin whales also feed in the Olga Bay area off eastern Kamchatka, sometimes within a single season. This paper focuses primarily on results from distribution surveys in the 2 main feeding areas off northeast Sakhalin Island in 2010

Methodology

Vessel-based Surveys: Vessel-based surveys were conducted onboard the *Akademik Oparin* research vessel from early August to late September 2010 by specialists from the Institute of Marine Biology (IBM) at DVO RAN (Vladivostok). The 2010 transect lines in the Piltun and Offshore feeding areas and the Arkutun-Dagi license area were the same as in 2009 (Figure 1). The vessel-based survey program scheduled 12 dedicated gray whale surveys (5 in the Offshore Feeding Area, 3 in the Piltun-Astokh License Block, and 2 each in the Piltun Area and the Arkutun-Dagi License Block). Because of bad sea and weather conditions in the second half of September 2010, 10 of the planned surveys were completed (4 in the Offshore Area and 2 each in the Piltun Area and waters of the Arkutun-Dagi and Piltun-Astokh License Blocks).

The methodology for the vessel-based surveys remained the same throughout all the years of monitoring and closely followed recommendations from the International Whaling Commission for visual vessel-based surveys of cetaceans. The surveys were conducted from the bridge simultaneously by two surveyors, with the first whale sighting made with the naked eye, followed by the azimuth of the whales being determined using the vessel's gyrocompass, and the distance determined using range-finding Fujinon 7x50 binoculars, which were also used to identify the species and number of whales in groups.

Shore-based Surveys: Shore-based surveys of whales in the Piltun Area in 2010 were conducted using the same methodology employed in 2004-2009 using 13 fixed observation points located on elevated shore areas spaced roughly 8-10 km apart. The surveys were synchronized between two groups of surveyors, one of which (the northern group) conducted surveys in waters to the north of the Piltun Bay mouth, and the other conducted surveys in waters south of the bay mouth (Figure 1). The surveys were conducted by scientists from the All-Russian Fisheries and Oceanography Research Institute in Moscow with the assistance of biologists from other Far East research institutes and universities. Total survey time in 2010 was 54 days (from August 5 to September 27). During this time the surveyors conducted 19 complete synchronized surveys (i.e., observations were made at all survey stations in both the northern and southern areas) over the entire Piltun Area. Moreover, 4 complete surveys were conducted at one of the areas (1 in the north area and 3 in the south), when the weather conditions at the other area made it impossible to conduct complete surveys. In another 23 cases surveys that had begun at the areas were interrupted at different stages because of bad weather (reduced visibility or rough seas).

The surveys were conducted by scanning a water area visible from the survey station in 10-degree sectors, and Fujinon 7 x 50 binoculars with a built-in compass and range finder grid were used to determine distances and azimuths to the sighted animals. All-wheel drive Toyota Land Cruiser 100 vehicles were used to move quickly from one survey station to the next. The field surveying methodology has remained unchanged since 2004.

Data Analysis: Distance to the whales sighted during the vessel-based and onshore surveys was calculated using the method developed by J. Lerzak and R. Hobbs (Lerzak and Hobbs, 1998) with a correction for refraction (Leaper and Gordon, 2001). The whale coordinates were calculated using an adaptation of the method developed by G.G. Ermolaev and E.S. Zoteev (1988). The actual data on whale distribution obtained in the course of the onshore and vessel-based surveys were analyzed in order to estimate their density distribution throughout the water area at a resolution of 1 km², and the results were graphed on density maps, which were compared with maps from previous years.

Results and Discussion

1. General Results:

Vessel-based surveys in 2010 resulted in the sighting of a total of 673 gray whales, 153 of which were sighted during dedicated surveys. The shore-based surveys in the Piltun Bay Area produced 964 sightings of groups and lone gray whales, for a total of 1219 individuals.

Overall, the distribution of gray whales in waters off northeast Sakhalin remained unchanged in 2010. Throughout the summer and fall, whales were concentrated in two traditional feeding areas: the nearshore Piltun area and the Offshore area (Fig. 2).

2. Distribution and Abundance of Gray Whales in the Piltun Feeding Area

The August-September 2010 whale distribution data (Fig. 2) indicate there was a general northward shift in the concentration of whales in 2010, accompanied by a decline in the presence of whales on the southern periphery of the area (near stations 10-13). When compared to August-September 2009 data, almost twice as many whales (up to 11.5%) were observed in the deep water (> 20 m) zone of the Odoptu-Piltun (Northern) Area in 2010. This may be attributed to corresponding changes in the distribution of biomass of their preferred benthic and/or epibenthic prey species (Fadeev 2011).

Compared to previous years (2004-2009), the distribution of whales in 2010 was fairly even across the Piltun Feeding Area, i.e., there were no substantial density 'peaks' near certain stations (Figure 3). Past years' distributions were characterized by either localized peaks of abundance in the zone adjacent to the mouth of Piltun Bay, in the northern part of the feeding area or, as in 2006, along its southern periphery. In 2010 the average number of whales in the entire central part of the waters (from stations 3-4 to 9-10) varied little (from 3,84 to 6,53 individuals), except for the low number of whales observed in the extreme northern and southern part of the Piltun Feeding Area (especially near the southern stations, 11-13). Because whale distribution in the feeding season is primarily determined by the availability of prey, it is possible to assume the distribution of benthos in the near shore waters in 2010 was more even across the feeding ground.

The maximum abundance of gray whales in the Piltun Area reported in the surveys was 66 individuals (August 7) in 2010. Subsequent trends were comparable to previous years. During the last 10 days of September, the number of animals sighted remained quite stable and then began to decline. The decline in the abundance of gray whales in the Piltun Area in the second half of September is a normal event associated with the start of fall migration and gradual withdrawal of the whales from their near shore feeding grounds. In previous years, whales moved to the Offshore Feeding Area but unfortunately, we were unable to document this trend in 2010 due to bad weather that limited completion of the Offshore Feeding Area survey at the end of September.

3. Distribution and Abundance of Gray Whales in the Offshore Feeding Area

The first systematic survey in the Offshore Feeding Area on August 3 resulted in sighting of just one whale in the eastern region of the feeding area. A second systematic survey in the Offshore Feeding Area was performed on August 19. During 4 sightings, six whales were observed in the eastern and northeastern portions of the area. Whales were dispersed over a large area of water in the northeastern portion of the survey area. A third survey in this area was made on September 2. Five sightings were made comprised of ten gray whales. All ten whales were observed in a compact group in the northeastern portion of the area. The last systematic survey in the Offshore Area was made on September 14. During this survey observers sighted 18 gray whales, i.e. almost twice the number sighted in the previous survey. Whales were located in the eastern part of the area, but were dispersed across the area's northeast and southeast portions.

As in previous years, number of whales increased in the Offshore Feeding Area during the field season. The majority of whales were observed in the northeastern portion of the feeding area in deeper waters (up to 50-65 m). Compared to previous years, maximum number of whales observed during one survey in the Offshore Area in 2010 decreased by almost one third from 2009 - from 27 to 18, and by a factor of 4 from 2008 (82 whales). Planned September 30th survey in the Offshore Area was not conducted, so these results should be interpreted with caution.

When estimating the gray whale abundance offshore Sakhalin in 2010, the numbers of animals in the Offshore area and the Arkutun-Dagi license area were combined, due to the areas' close proximity. In order to improve accuracy of estimating the total number of whales, only the surveys conducted within brief time intervals (i.e. over the course of two consecutive days) were used. In 2010 there were two occasions that met this requirement, i.e. surveys in the Offshore and Arkutun-Dagi Areas on August 19-20 and September 13-14. The September 13-14 surveys yielded a higher total and were used for estimation purposes. On September 13, 19 whales were sighted in the Arkutun-Dagi area and the adjacent waters on its west side, while 18 animals were sighted in the Offshore Area the following day (September 14). Thus, assuming there was no migration between the two areas on these consecutive days, the total number of gray whales offshore Sakhalin was estimated to be 37 in 2010. This figure constitutes an increase of ~42% compared to 2009, when a maximum of 26 whales were seen in the Offshore area.

4. Estimate of the Total Abundance of Gray Whales off the Northeastern Coast of Sakhalin Island

Compared to 2009, there was a slight decline in maximum number of gray whales sighted during shore-based surveys in 2010 (from 73 to 66). As described in the previous section, there was an increase of approximately 42% in the maximum number of whales observed offshore Sakhalin in 2010 compared to 2009. Historical data indicate that the maximum number of whales in the Offshore area were usually observed at the end of September/early October but, due to poor weather conditions, surveys could not be completed at this time in 2009 or 2010.

Similar to the estimation of the maximum number of whales offshore Sakhalin, the total number of whales in both both feeding areas (i.e. Piltun Feeding Area, and the Offshore Feeding Area - including Arkutun-Dagi) can only be calculated when they were surveyed on the same day or on two consecutive days. An increased duration between the surveys increases likelihood of double counting or undercounting whales that move between the two areas.

In 2010, surveys of gray whales in the Piltun and Offshore feeding areas were made on September 13-14. Fifty-two whales were observed during the shore-based survey on September 14, while during the vessel-based survey, 37 whales were observed on September 13-14. Assuming there was no double counting of animals, the total number of gray whales in the waters of northeast Sakhalin was 89 in 2010. In 2009 this value was 77 (Vladimirov *et al.* 2010). Thus, judging by the surveys, in 2010 there was a 15.6% increase in the overall abundance of gray whales in their feeding areas off the shores of northeast Sakhalin. The total number is, however, lower than in 2007 and 2008 when synchronized surveys revealed totals of 98 and 101 whales, respectively.

The highest number of observed whales off northeast Sakhalin is not a clear indicator for the total population size. Photo-ID studies demonstrated the rather active movements of gray whales between East Sakhalin and East Kamchatka in recent years (Tyurneva *et al.*, 2010). This means not all the whales that visit Sakhalin waters during a season are there at the same time and may therefore not be included in the survey results. For example, according to the results of photo-identification, in which all the whales sighted over a season are recorded individually, 105 (+2 temporary) gray whales were sighted in 2010 in the waters of NE Sakhalin (Tyurneva *et al.*, 2011). During the concurrent distribution counts, only 89 whales were sighted. Therefore, the distribution surveys counted only 83.2% of the individuals that were actually present in these feeding grounds in August-September, while in 2009 this indicator was even lower - 65.8% (77 of the 117 photo-identified individuals were counted). Given that it is also practically impossible to photograph 100% of the

animals present in the area, we estimate the abundance of gray whales that used the Sakhalin feeding grounds to be approximately 110-120 animals. Distribution surveys and photo-identification data indicate that the number of whales observed has remained relatively constant. Further analyses of whale abundances need to take into account the nature and magnitude of their movements between other feeding regions, such as Kamchatka.

Conclusions

As evidenced by the results of shore-based and vessel-based surveys conducted in 2010 off the northeast coast of Sakhalin, the abundance of western gray whales along northeast Sakhalin Island, has remained stable at a level of approximately 110-120 individuals in recent years. Approximately 60% of the gray whales in 2010 were sighted in the Piltun Area, and the remaining 40% in the Offshore Area, including the Arkutun-Dagi License Block.

It should be noted that there were a number of offshore seismic exploration activities in the region in August and September of 2010 (unrelated to the Sakhalin-1 and Sakhalin 2 projects), which coincided with the onshore and vessel distribution surveys. One of the seismic exploration areas was entirely located in the northern half of the Piltun Area, while the second covered the eastern half of the Offshore Feeding Area and the southeast corner of the Arkutun-Dagi License Block and the waters east of them. A preliminary analysis of the survey data did not reveal any clear evidence of adverse impacts on whale distributions, but this topic will require more detailed analysis using acoustic and behavioral monitoring data and the acquisition of necessary technical data from the companies that conducted exploration activities.

Plans call for continuing surveys under the auspices of the Monitoring Program for Western gray whales off the northeast coast of Sakhalin, because these surveys have yielded valuable information on the condition of this protected population. These studies are also necessary for developing procedures to minimize potential anthropogenic impact on the population in the course of developing Sakhalin's offshore resources.

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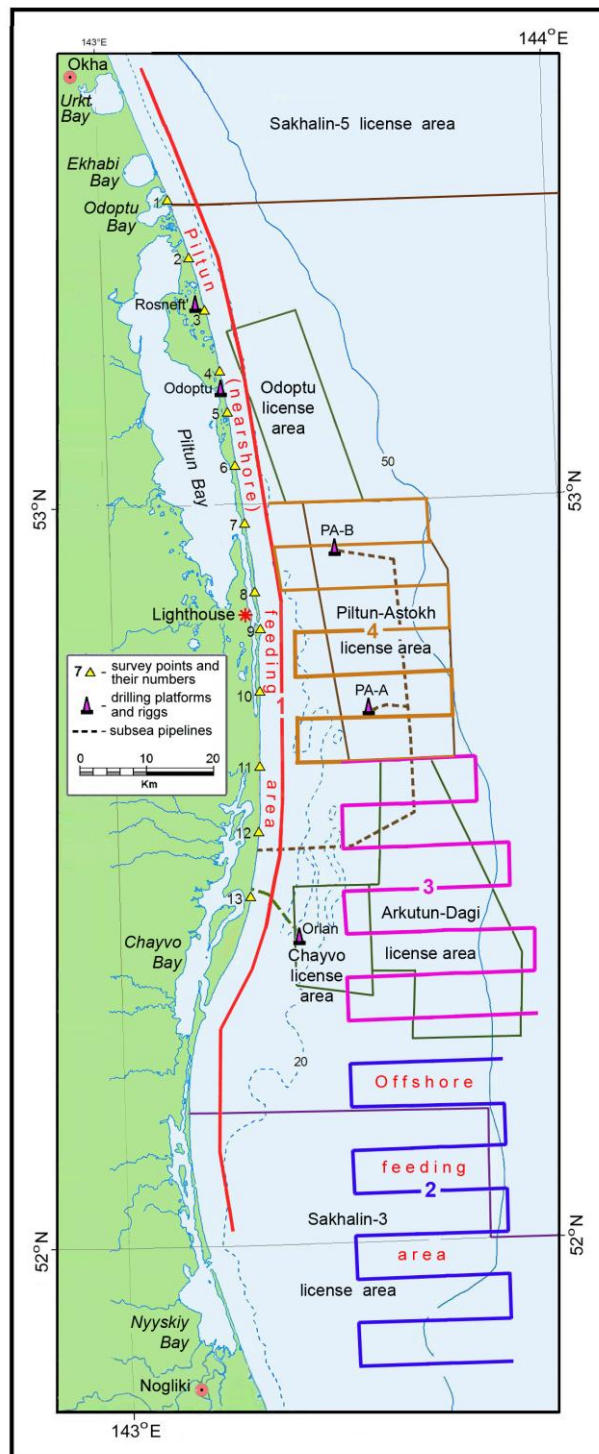


Figure 1. Location of shore-based survey points and systematic vessel-based survey transects in the gray whale feeding range in northeast Sakhalin area, 2010

1 - Piltun Feeding Area, 2 - Offshore Feeding Area, 3 - Arkutun-Dagi license area, 4 - Piltun-Astokh license area

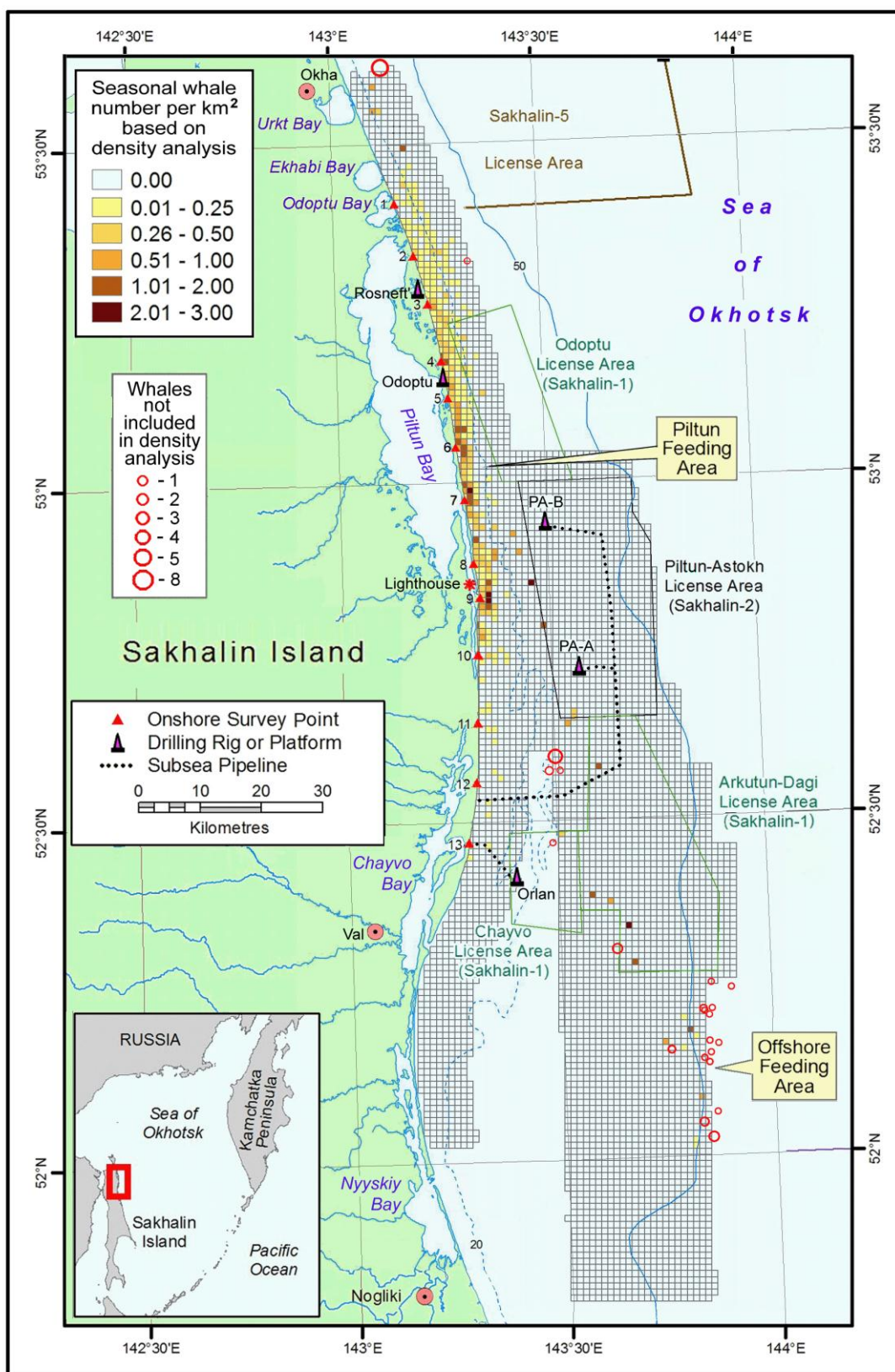


Figure 2. Gray whale distribution off northeast Sakhalin Island, August-September 2010 (combined results of onshore and vessel-based surveys)

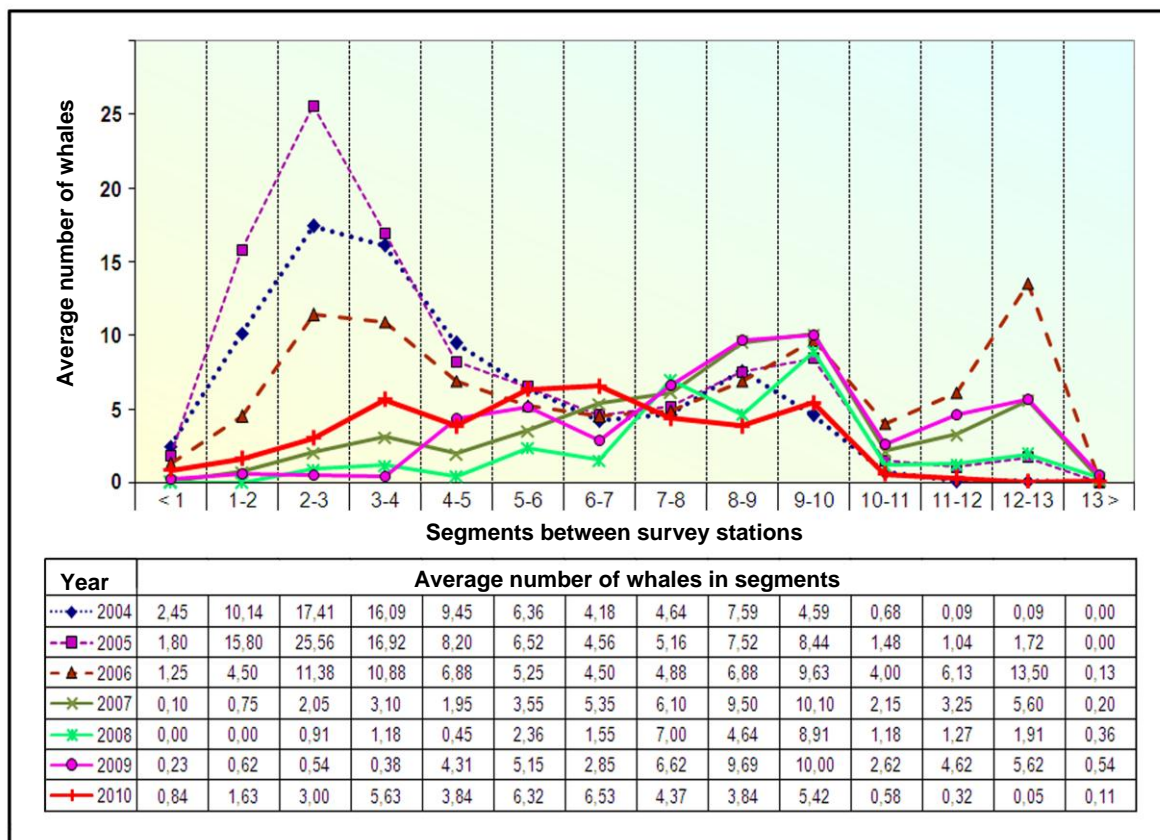


Figure 3. Year-to-year variations in spatial pattern of gray whale abundances in the Piltun area waters, August-September 2004–2010 (from comprehensive synchronized shore-based survey data)