Review of Cetacean Distribution and Occurrence off the Western Coast of Kamchatka, eastern Okhotsk Sea

Amanda L. Bradford[1], Yulia. V. Ivashchenko[2,3], Vadim Y. Kirichenko[4,5], and Alexander M. Burdin[5,6]

Contact email: alb992@u.washington.edu

ABSTRACT

The waters off the western coast of Kamchatka in the Okhotsk Sea, particularly those over the continental shelf, are highly productive and contribute a large fraction of Russian commercial fish and shellfish catches. This area is also the site of a sizeable oil and gas license block, which is in the exploratory phase of development, with seismic surveys in two parts of the block planned for the summer of 2010. While fisheries-related research has been conducted off western Kamchatka for several decades, there has been essentially no directed research on cetaceans and other marine mammals in this region. Thus, studies are necessary to assess the status of and habitat use by cetaceans, including several populations of endangered baleen whales, in this rapidly changing ecosystem. To encourage and focus cetacean surveys and habitat studies off the western coast of Kamchatka, we reviewed the distribution and occurrence of cetaceans in this area using all available sources and compiled a spatial database of cetacean sightings from recent decades, which is available upon request to interested user groups. This effort resulted in the accumulation of 351 separate or aggregate sightings made between 1941 and 2009 of 14 cetacean species off western Kamchatka, although a few newly acquired sources have yet to be incorporated into the review. These sightings indicate that a large and diverse complex of cetaceans utilize this region throughout the year, particularly in summer and autumn months. While demonstrating that the western coast of Kamchatka is used, likely frequently, by abundant populations of small and large cetaceans, the sightings also suggest that the area could serve as important recovery habitat for depleted baleen whale populations, particularly Okhotsk Sea bowhead, western North Pacific right, and western gray whales. Overall, this review highlights the need for directed research and monitoring of cetaceans off western Kamchatka, which should begin as soon as possible in areas of existing fisheries and emerging oil and gas development.

INTRODUCTION

The Okhotsk Sea, situated predominantly in the Russian Far East, is noted for its seasonal ice formation, despite being located at mid-latitudes, as well as for its high biological productivity (Talley and Nagata 1995). Within the Okhotsk Sea, the shelf areas are particularly productive, most notably the waters of the western Kamchatka shelf (Lapko and Radchenko 2000, Pinchuk and Paul 2000, Belan *et al*. 2004, Merzlyakov 2004). The hydrology of the western coast of Kamchatka is characterized by dynamic circulatory interactions between the northward offshore West Kamchatka Current (a main source of relatively warm and saline Pacific waters into the cooler and fresher Okhotsk Sea), the southward inshore Compensatory Current, and mesoscale

[1] School of Aquatic and Fishery Sciences, University of Washington, Box 355020, Seattle, WA 98195-5020, USA. *Corresponding email: alb992@u.washington.edu*
[2] Seastar Scientific, Dzerzhinkskogo St., 5-30, Yaroslavl 150033, Russia.
[3] National Marine Mammal Laboratory, Alaska Fisheries Science Center, NOAA Fisheries, 7600 Sand Point Way NE, Seattle, WA 98115, USA.
[4] Kamchatka League of Independent Experts, Partizanskaya St., 56, Petropavlovsk-Kamchatsky, 683001, Russia.
[5] Kamchatka Branch of Pacific Institute of Geography, Far East Branch of the Russian Academy of Sciences, Pr. Rybakov, 19-a, Petropavlovsk-Kamchatsky, 683024, Russia.
[6] Far East Whale Research, P.O. Box 82864, Kenmore, WA 98028, USA

eddies, which are further influenced by river runoff, tidal oscillations, ice thaw, bottom topography, and atmospheric conditions, culminating in extreme productivity on and offshore of the shelf (Figurkin and Ovsyannikov 1999, Zakharov *et al*. 2001, Samko *et al.* 2004, Selin and Lysenko 2006). While ice forms annually throughout the Okhotsk Sea, including over the western Kamchatka shelf, the oceanic waters off southwestern Kamchatka generally remain ice-free due to the influx of warm Pacific waters and limited cold-air advection in this area (Talley and Nagata 1995, Rikiishi and Takatsuji 2005). However, there is pronounced interannual variability in the maximum sea ice extent of the Okhotsk Sea (Ohshima and Nihashi 2006), such that even the southeastern portion can be virtually ice-covered in extreme cold years (Talley and Nagata 1995).

Commercial fishery operations in the eastern Okhotsk Sea, focused primarily on the western Kamchatka shelf, provide more than 20% of Russian catches from the Pacific Ocean, a percentage which would increase if excluded Pacific salmon (*Oncorhynchus spp.*) landings were included in the calculation (Balykin and Terentyev 2004). A wide range of species are targeted by these operations, with walleye pollock (*Theragra chalcogramma*), various flatfishes (Pleuronectidae), Pacific cod (*Gadus macrocephalus*), saffron cod (*Eleginus gracilis*), and sculpins (Cottidae) comprising the bulk of catches (Balykin and Terentyev 2004). Among commercial shellfisheries in Russia, red king crab (*Paralithodes camtschaticus*) is the principal species, with the western Kamchatka shelf serving as the most important fishing area (Ivanov 2002). The western Kamchatka shelf is also rich in oil and gas deposits (Tronova 1992, Verzhbitsky and Kononov 2006) and a large license area has been established in this region, with exploratory seismic and drilling activities ongoing.

Even though the western coast of Kamchatka is a relatively remote and sparsely populated part of the Russian Far East, scientific surveys have been conducted in this area for the last several decades. For example, since the early 1960s, the Kamchatka Institute of Fisheries and Oceanography (KamchatNIRO) in collaboration with the Pacific Research Fisheries Centre (TINRO-Centre), have carried out trawl surveys almost annually off western Kamchatka that have culminated in numerous studies of local fish fauna (e.g., D'yakov 1991, Tokranov 2005). Efforts to measure planktonic and benthic productivity (e.g., Shebanova 1994, Dulepova *et al*. 2008) and oceanographic conditions (e.g., Samko *et al*. 2004), whether in conjunction with or in addition to the trawl surveys, have also taken place. However, like much of the biomonitoring in the Okhotsk Sea, research off western Kamchatka is often dictated by commercial fishing interests (Shuntov and Dulepova 1996).

Although the distribution and abundance of upper trophic-level consumers, such as cetaceans, is often a reflection of the productivity of dynamic marine systems like the western Kamchatka shelf-slope, there has been virtually no concerted research on cetaceans and other marine mammals in this region. Therefore, data are not available to adequately assess the status of and habitat use by cetaceans in an area that is facing ecological change due to fishing pressure, industrial activities, and effects of climate change. In terms of existing information, some aspects of the historical distribution of cetaceans off the western coast of Kamchatka can be found in classic accounts of marine mammals in Russian waters (e.g., Tomilin 1957) and commercial whaling records (e.g., Townsend 1935), while current occurrence data largely consist of observations from Soviet whale scouting surveys (e.g., Rovnin 1969), limited Russian marine mammal sighting surveys (e.g., Vladimirov and Melnikov 1987, Blokhin 1988) and intermittent Japanese-Russian and Japanese cetacean sighting surveys (e.g., Miyashita and Berzin 1991, Miyashita 1999) of the Okhotsk Sea in recent decades. However, an up-to-date and directed synthesis of where and when cetaceans occur off western Kamchatka is lacking and is the main objective of this review.

According to the range maps produced by Artyukin and Burkanov (1999) in their book describing marine birds and mammals of the Russian Far East, there are at least 15 cetacean species that appear to occupy the waters off western Kamchatka. These maps were prepared using information from the aforementioned Russian sources (i.e., classic accounts, recent survey reports), as well as from discussions with leading Russian marine mammal scientists (V. N. Burkanov, pers. comm.). The cetaceans species identified as occurring off western Kamchatka include the short-beaked common dolphin (*Delphinus delphis*), killer whale (*Orcinus orca*), harbor porpoise (*Phocoena phocoena*), Dall's porpoise (*Phocoenoides dalli*), beluga whale (*Delphinapterus leucas*), sperm whale (*Physeter macrocephalus*), Baird's beaked whale (*Berardius bairdii*), gray whale (*Eschrichtius robustus*), bowhead whale (*Balaena mysticetes*), North Pacific right whale (*Eubalaena japonica*), blue whale (*Balaenoptera musculus*), fin whale (*B. physalus*), sei whale (*B. borealis*), common minke whale (*B. acutorostrata*), and humpback whale (*Megaptera novaeangliae*). While the conservation status of these species varies, bowhead (Okhotsk Sea population), North Pacific right, blue, fin, and sei whales are all classified as *Endangered* and the western gray whale population as *Critically Endangered* by the International Union for Conservation of Nature (IUCN 2010).

Directed and systematic cetacean surveys and habitat studies off western Kamchatka are clearly needed, given that so little is known about the habitat use of a large number of cetaceans, including several taxa of conservation concern, in an area with significant and increasing anthropogenic activities. In the interest of promoting and focusing such research, we have reviewed the distribution and occurrence of cetaceans off the western coast of Kamchatka using all available sources, published and otherwise. Although historical information was incorporated into the review, the emphasis of the effort was on summarizing contemporary cetacean sightings, which more likely reflect current conditions, in a way that might inform and facilitate future studies. To this end, cetacean sightings from recent decades were compiled in a spatial database, which was used for the presentation of results herein and is available upon request to interested user groups. Also covered in the review are threats posed to cetaceans from existing fishery operations and expanding oil and gas activities off western Kamchatka. Finally, we make several recommendations related to the increased awareness and research that will be required to adequately manage and protect cetaceans in this region.

METHODS

Information review

The present review of cetacean distribution and occurrence focused on the western coast of the Kamchatka Peninsula, Russia, in the eastern Okhotsk Sea (Fig. 1). In terms of latitude, the study area extends from 51°N to 59°N, since this area overlaps with the long-term KamchatNIRO and TINRO-Centre fishery and oceanography surveys and encompasses the West Kamchatka oil and gas license area. Additionally, above 59°N, the western coast of Kamchatka borders Shelikhov Bay, which is characterized by distinctive oceanographic properties (Talley and Nagata 1995, Figurkin and Ovsyannikov 1999). Although the western Kamchatka shelf is the most productive portion of the study area, and thus the most surveyed in relation to commercial fisheries, observations occurring over the continental slope out to 151°E were also incorporated into the review. Information on western Kamchatka cetacean distribution and occurrence was sought from the following three types of sources.

Published accounts of historical distribution

These sources primarily included: 1) classic reports of marine mammals in Russian waters (e.g., Sleptsov 1952, Tomilin 1957), which generally rely on cetacean data collected during 19th and early 20th century whaling operations by Russia and other nations, and 2)

established summaries and recent species-specific reviews of commercial whaling records (e.g., Townsend 1935, Reeves *et al*. 2008), which are largely based on American ship-based whaling efforts during this time period. Information from these sources was used to provide a qualitative description of where various species of cetaceans were historically distributed along the western coast of Kamchatka and was not incorporated into the sightings database.

Published and gray literature reports of current occurrence

These sources primarily included: 1) syntheses of mid-to-late 19th century Soviet and Japanese whale scouting surveys (e.g., Rovnin 1969, Omura *et al*. 1969), 2) papers providing results of contemporary Russian aerial and ship-based marine mammal sighting surveys and Japanese-Russian and Japanese ship-based cetacean sighting surveys of the Okhotsk Sea (e.g., Vladimirov and Melnikov 1987, Miyashita and Berzin 1991), and 3) miscellaneous materials (e.g., Ivashin 1988, Karyakin 2004). These sources were utilized to extract sighting locations of cetaceans off western Kamchatka for integration into the sightings database. Note that all sightings were cross-referenced so that sightings reported in more than one source were incorporated into the database only once.

Unpublished cetacean sightings

A number of scientists have worked along the western coast of Kamchatka in some capacity during recent decades, whether studying marine mammals, fish, invertebrates, plankton, birds, or oceanography. A subset of these researchers was identified using the published literature (e.g., Sokolov 2001, Tokranov 2005), and these individuals were contacted electronically and asked if they have or know of any unpublished cetacean sightings off western Kamchatka that could be incorporated into the sightings database.

Database compilation

Western Kamchatka cetacean sighting locations that were acquired from the second and third set of sources were compiled in a spatial database. A position for each of these sightings was obtained in one of three ways: 1) taken from an exact position contained in the source, 2) approximated from a geographical reference (e.g., river mouth) mentioned in the source, or 3) approximated from a map included in the source. The date, species, position type, group size, survey type, survey platform, and source of each sighting were also recorded. The positions and associated attributes were then converted into a shapefile in ArcGIS for the plotting of results and eventual dissemination to interested users.

Additional considerations

In order to more easily report and synthesize findings from the review, the study area was subdivided into nine regions, which are separated by two degrees of latitude and three degrees of longitude and serve as a reference to a general area (Fig. 1). Considering the sighting data in a "general area" context is also important given the imprecise nature of many of the positions, which were approximated from large markers (often arranged so as not to overlap with adjacent markers) on apparently hand-drawn maps, as well as the fact that the data are snapshot in nature, spanning a period of climatic shifts in the Okhotsk Sea (e.g., Glebova *et al*. 2009) and intensive removals from some cetacean populations (e.g., Brownell *et al*. 2001).

An additional caveat of the sighting data is that they resulted from surveys that were, with the exception of the Japanese-led cruises, largely unsystematic and lacking sufficient information on survey effort. Further, survey coverage off western Kamchatka has not been spatially or temporally comprehensive, with some surveys consisting of one pass through the study area in a compressed period of time (e.g., Blokhin 1988). To date, there has not been a single survey or set of surveys deemed suitable for discerning spatial and temporal trends of cetaceans in the study

area. Thus, while the compiled sightings provide valuable insights into the species composition, distribution, and occurrence of cetaceans off the western coast of Kamchatka, they should not be used to make inferences about the overall range, habitat use, and abundance of cetaceans in this area.

RESULTS

Sightings summary

In total, 351 separate or aggregate sightings made between 1941 and 2009 of 14 cetacean species off the western coast of Kamchatka were extracted from 40 sources (Table 1, Figs. 2-9). Of these, 300 (85.5%) sightings were made in summer and autumn months, 49 (14.0%) in winter and spring months, and two (0.6%) in unknown months (Table 1). Although the sightings span the entirety of the study area, ships and other large vessels comprised the most common survey platform, leading to a bias against nearshore sightings, as was explicitly stated in more than one source (e.g., Miyashita and Berzin 1991, Shuntov 2001). The sightings and other pertinent findings are presented more explicitly on a species-by-species basis below. Note that unless otherwise stated, the population structure and associated quantitative abundance of these species in the Okhotsk Sea has not been determined.

The treatment of two types of sightings was not straightforward and warrants an explanation. Given the high number and density of killer whale sightings presented via map in Karyakin (2004), it was not possible to approximate the positions of individual sightings. Instead, these sightings were aggregated by subregion for listing in Table 1 and represented by their spatial extent for plotting in Fig. 2. The same challenge was encountered with the sightings from the Japanese-led cruises displayed in Miyashita and Doroshenko (1990), Miyashita and Berzin (1991), Miyashita and Shimada (1994), Miyashita (1997, 1999, 2004), Miyashita and Kato (1998), Miyashita *et al*. (2000, 2001), and Miyashita and Hakamada (2009). These sightings were also aggregated by subregion for inclusion in Table 1, but are represented as relative species proportions by subregion (along with a crude measure of survey effort) in Fig. 9.

The only sightings found that were not incorporated into the database were those depicted on a map in Vladimirov (1994) that was replicated in Vladimirov (2000). This map contained symbols representing, in most cases, aggregates of sightings that could be traced back to other sources already accounted for in the sightings database (e.g., Berzin and Vladimirov 1989, Miyashita 1997), with the exception of two humpback whale “sightings” in the study area. However, these sightings are in conflict with information mentioned in the text, so they were considered to be mislabeled or in error and were not utilized.

The search for unpublished cetacean sightings off western Kamchatka produced minimal results. Current contact information was difficult to obtain and response rate was low. As expected, cetaceans are observed regularly in the study area during the KamchatNIRO and TINRO-Centre fishery and oceanography surveys, but records are generally not kept (A. L. Figurkin, pers. comm.). Fortunately, the TINRO-Centre biologist V. P. Shuntov organized the collection of cetacean sightings during some of these surveys (and others elsewhere) in various years and published these sightings in Shuntov (1993, 1994, 1997, 1999, 2001). Finally, a list of key sources that were searched for information on the distribution and occurrence of cetaceans off western Kamchatka, but did not yield relevant or unique results and thus are not cited in the text, is provided in Appendix 1.

Killer whale

Killer whales are found throughout the Okhotsk Sea (Heptner and Naumov 1976), with the western coast of Kamchatka a noted area of frequent occurrence (Berzin and Vladimirov 1989). Reported killer whale sightings were most common in the central and southern portions of the study area and were restricted to summer and autumn months (Figs. 2 and 9), although a recent survey of local people indicates that killer whales may be present off the northwestern coast (subregion 3) at least in late spring and early summer (Burdin *et al*. 2010). Recorded sightings were concentrated at depths of 500-700 m in the main fishing area for Greenland halibut (*Reinhardtius hippoglossoides*) (Fig. 2; Karyakin 2004), raising an emerging management issue regarding killer whales in the eastern Okhotsk Sea.

Since 2000, a few years after the fishery stopped using bottom trawls, killer whales have been depredating Greenland halibut longlines (Karyakin 2004) and gillnets (Smirnov *et al*. 2004) during hauling operations with increasing frequency, leading to measureable losses in catches. This depredation appears to occur throughout the year, and the use of noisemakers, other scare devices, and evasive measures has proven minimally effective (Karyakin 2004, Smirnov *et al*. 2004). The number of killer whales involved in the depredation is unknown. Smirnov *et al*. (2004) estimated that during the summer and autumn of 2002 and 2003, up to 80 whales were removing halibut from longlines and gillnets; however, the basis for this estimate is unclear.

Harbor porpoise

Harbor porpoise are considered common in the Okhotsk Sea (Heptner and Naumov 1976), although no details were found regarding specific areas of occurrence. Reported harbor porpoise sightings in the study area were few, occurring only in summer and autumn months, and were concentrated over the northeastern shelf (subregions 2 and 3) (Figs. 3 and 9), although a few sightings were made in the southern subregions of 6 and 9 during the Japanese-led sighting surveys (Fig. 9). However, bycatch records suggest harbor porpoise occurrence in the southern part of the study area may be high, at least in late spring and early summer.

Specifically, harbor porpoise are known to be bycaught in the Japanese salmon driftnet fishery that takes place in the southern portion of the study area from May through July (Burkanov and Nikulin 2001). A study of marine mammal bycatch in this fishery from 1993-1999 found that harbor porpoise comprised a relatively higher proportion of the bycatch off southwestern Kamchatka as compared to five other fishing areas in the Okhotsk and Bering Seas and Pacific Ocean (Burkanov and Nikulin 2001). Further, using observed bycatch rates and known fishing effort, the resulting estimate of harbor porpoise bycatch in the southwestern Kamchatka fishery (approximately 200 individuals) was among the highest for the species during the study period, despite the fact that fishing effort is comparatively low in this region.

Dall's porpoise

Dall's porpoise are regarded as the most widely distributed small cetacean in the Okhotsk Sea (Berzin and Vladimirov 1989), and Tomilin (1957) noted that Soviet ships off western Kamchatka mainly encountered this species, which could occur hundreds of kilometers offshore. Reported Dall's porpoise sightings reflect their ubiquitousness and relatively high abundance off the western coast of Kamchatka (Figs. 3 and 9). Both color morphs are found in the study area, with the *dalli*-type distributed throughout (except mother-calf pairs, which concentrate in the northern and central portions), while the *truei*-type has rarely been seen outside the area encompassed by subregions 6 and 8 (Miyashita 1997). Using line transect techniques, the abundance of the two stocks of Dall's porpoise whose range includes the study area (i.e., the northern Okhotsk *dalli*-type stock and the central Okhotsk *truei*-type stock) was estimated to be over 110,000 and 165,000 individuals, respectively (Miyashita 1991). Henceforth, for the

purposes of this review, the color morphs are considered collectively, since they are generally not differentiated in the Russian literature.

Although Dall's porpoise were found throughout the study area in all seasons (Fig. 3), they are thought to make seasonal north-south movements along the western coast of Kamchatka in relation to ice cover (Shuntov 2001). Dall's porpoise were once taken by Japanese fishermen off the western coast of Kamchatka during the early part of the 20th century (Sleptsov 1961). Although this fishery is no longer in existence, there is presently a hand-harpoon fishery for Dall's porpoise in northern Japan, with the winter fishery on the Pacific side capturing mainly individuals of the aforementioned central Okhotsk *truei*-type stock (Miyashita 1991). Like harbor porpoise, Dall's porpoise are also subject to bycatch in the Japanese salmon driftnet fishery. They were proportionally the most bycaught species in the fishery across all six areas where bycatch was monitored according to the study referred to previously (Burkanov and Nikulin 2001). The estimated bycatch of Dall's porpoise in the southwestern Kamchatka fishery during the period of 1993-1999 was on the order of 1,000 individuals (Burkanov and Nikulin 2001).

Beluga whale

Three populations of belugas are recognized in the Okhotsk Sea: 1) the Shantar population, distributed throughout the Shantar Archipelago (northwestern Okhotsk Sea), 2) the Sakhalin-Amur population, found along northern Sakhalin Island and in the region of the Amur River mouth (western Okhotsk Sea), and 3) the Shelikhov population, occurring in and around Shelikhov Bay (northeastern Okhotsk Sea) (Berzin and Vladimirov 1989). Arsenev (1939) proposed that belugas inhabiting Shelikhov Bay from spring to autumn migrate south along the western coast of Kamchatka in winter, but this does not appear to be the case based on subsequent observations. While belugas, presumably belonging to the Shelikhov population, are common off western Kamchatka south of Shelikhov Bay, they are found there in summer and autumn months (Sleptsov 1952, Heptner and Naumov 1976). There they utilize northwestern coastal areas, often overlapping with upriver salmon migrations (Sleptsov 1952), but retreat with the formation of winter fast ice (Heptner and Naumov 1976). Instead of moving south in winter, Shelikhov belugas appear to move offshore in the pack ice or along the ice edge (Fedoseev 1984, Vladimirov and Melnikov 1987, Berzin *et al*. 1996).

The reported beluga sightings, albeit few, are in line with this idea, revealing belugas close to shore (and entering rivers) in the study area in summer and autumn and offshore (and ice-associated) in winter and spring (Table 1, Fig. 4). Not reflected in Fig. 3 is an anecdotal observation of 150 belugas distributed along the coastline between the mouths of the Tigil (58°1' N) and Voyampolka (58°31' N) Rivers (subregion 3) in July of 1984 (Berzin and Vladimirov 1989). Belugas were hunted along the western coast of Kamchatka during the 18th and 19th centuries (Tomilin 1957), although it is not understood if these hunts were for subsistence or another purpose. Scammon (1874) referred to a specific fishery on the aforementioned Tigil River, where belugas were taken approximately 50 km upriver by harpoon and lance. Belugas in the three Okhotsk Sea populations were taken regularly in Soviet fisheries during the 1920-30s, but catches were reduced by the 1950s due to decreased beluga abundance, and the fishery was closed in the late 1960s (Berzin *et al*. 1986). Berzin and Vladimirov (1989) suggested that this fishery led to pronounced changes in beluga distribution and abundance in the Okhotsk Sea, but how this has or will be manifested in the study area is unclear. There are currently no known removals of belugas in the Shelikhov population.

Sperm whale

Sperm whales in the North Pacific are currently managed by the International Whaling Commission (IWC) as western and eastern stocks (Donovan 1991), although there are alternative hypotheses involving additional stocks (e.g., Bannister and Mitchell 1980, Kasuya and Miyashita 1988). In the Okhotsk Sea, male and female sperm whales of the western stock(s) are, or at least were, relatively abundant in the Kuril Islands (southern Okhotsk Sea) as suggested by Soviet whaling data, although seasonal movements to and from this area were documented (Kasuya and Miyashita 1988). Sperm whales have been noted to occur off the western coast of Kamchatka in summer and autumn up to approximately 56°N, although these whales are generally considered to be adult males migrating through the Kuril Islands (Sleptsov 1952, Zenkovich 1955, Heptner and Naumov 1976).

Reported sperm whale sightings in the study area, mostly made in association with summer-autumn Soviet whaling efforts and all made more than 40 years ago, were all below 56°N and tended to be closer to the shelf than in deeper waters (Table 1, Fig. 5). Sperm whaling took place in the study area, but was apparently limited, offering no additional insight into the distribution of these animals (Townsend 1935, Smith *et al*. 2008). It is unknown if the lack of sperm whale sightings off western Kamchatka in recent years is a result of stock depletion by late 20th century whaling in other range areas (including the Kuril Islands) or of limited survey effort in the study area. Note that small numbers of sperm whales have been regularly sighted in recent years around the Kuril Islands (e.g., Shuntov 1994, Ivannikov and Doroshenko 2001). Since 2000, a few sperm whales (10 individuals or less) from the western North Pacific have been incorporated into the Japanese catches taken annually under IWC scientific permit.

Baird's beaked whale

The distribution of Baird's beaked whales in the Okhotsk Sea is not well understood, but the western coast of Kamchatka is a known area of occurrence (Heptner and Naumov 1976). Tomilin (1957) noted that Baird's beaked whales enter the Okhotsk Sea in spring and leave in autumn, but winter and early spring observations of these whales in the pack ice of the northwestern part of the sea suggest that they can remain longer, if not year-round (Fedoseev 1984, Ivashin 1986). Only two Baird's beaked whale sightings were reported in the study area, in subregion 6 in September (Table 1, Fig. 9), preventing a more specific description of the distribution and occurrence of this species off western Kamchatka. Baird's beaked whales have long been the target of a coastal fishery in Japan that is ongoing (Kasuya 2009), although the impact on whales utilizing the western coast of Kamchatka or other parts of the Okhotsk Sea is unknown.

Gray whale

Gray whales that migrate annually to feed in the Okhotsk Sea belong to the critically endangered western North Pacific population, which numbers less than 150 individuals according to current abundance estimates (Bradford *et al*. 2008, Cooke *et al*. 2008). Historical sources noting gray whales in Shelikhov Bay (referred to as Penzhina Bay or Sea in older literature) in large numbers (Krasheninnikov 1755) and off the western coast of Kamchatka near the Kikhchik River (53°26'N) (Ditmar 1901) have long been cited in the classic Russian literature (e.g., Tomilin 1957). For centuries, gray whales were potentially utilized by aborigines in these areas, either hunted or taken when stranded, but aboriginal whaling in this region ended early in the 19th century (Krupnik 1984). A recent examination of some mid to late 19th century logbooks from American ship-based whalers hunting bowhead and right whales in the Okhotsk Sea produced additional information about the distribution and occurrence of gray whales (a secondary target) off western Kamchatka (Reeves *et al*. 2008). Although there was a lack of whaling effort in

coastal areas below 55°N, the logbook analysis revealed: 1) a cluster of encounters between May and August in the northeastern region of the present study area (subregion 3 and northern half of subregion 2), 2) a July sighting in the central coastal portion (55°51'N, 155°52'E), and 3) and a September sighting offshore of the southern coast (51°16'N, 155°23'E).

While western gray whales were not the primary target of ship-based whalers in the Okhotsk Sea, they were targeted by coastal whaling operations in Japanese and Korean waters until the 1960s, which culminated in the near decimation of the population (Brownell and Chun 1977, Kato and Kasuya 2002). This depletion was reflected in the results of concerted aerial and ship-based surveys of the Okhotsk Sea between 1979-1989, which located few gray whales and failed to find them in most areas of their historical distribution (Berzin 1990). Although six gray whale sightings were reported in the study area, only four of them were made after the cessation of western gray whaling (Table 1). This subset of sightings (from subregions 2, 3, and 9) indicates that gray whales can occur along the western Kamchatka coast as early as July and as late as November (Table 1, Fig. 5) and highlights the potential of this population to reoccupy parts of their former range if recovery takes place. A recent survey of local people suggests that gray whales may occur off the northwestern coast (subregion 3) as early as April (Burdin *et al*. 2010). Spring sightings (some in the presence of ice) in the northeastern Okhotsk Sea (including Shelikhov Bay and adjacent gulfs) were also recorded by ship-based whalers, leading Reeves *et al*. (2008) to propose that some gray whales either overwinter in the Okhotsk Sea or enter it via a Kuril Island-Western Kamchatka corridor in order to reach these northeastern regions by spring. In each scenario, the western coast of Kamchatka would serve as important gray whale habitat, either for overwintering or early foraging.

Bowhead whale

Bowhead whales comprise a separate, endangered population in the Okhotsk Sea, and all evidence suggests they remain there year-round (Ivashchenko and Clapham 2010). Okhotsk bowheads were significantly depleted from heavy hunting in two periods, during the latter half of the 19th century by ship-based whalers and during the 1960s (illegally) by Soviet whalers, although limited records exist from the Soviet phase (Doroshenko 2000a). There has been considerable debate in the Russian literature about the existence, distribution, and occurrence of bowhead whales in the Okhotsk Sea (Doroshenko 1996), so many accounts of bowheads in the classic literature are not entirely reliable (e.g., Sleptsov 1952). Most information about the historical distribution of Okhotsk bowheads comes from the American ship-based whaling records compiled by Townsend (1935). According to these records, whaling effort occurred throughout the study area, but catches of bowheads were clustered in only two areas: 1) in the northwestern portion (subregion 4 and southern half of subregion 1) between April and July, and 2) in the northeastern portion (subregion 3) between June and September. However, it should be pointed out that the Townsend (1935) summary likely includes misidentifications of bowhead and right whales (Scarff 1991). Reeves *et al*. (2008) anecdotally referred to two bowhead encounters by whalers in the southern half of subregion 1 in June, one of which took place in the same area as several right whales. Overall, these sources indicate that the historical summer distribution of bowhead whales was concentrated in the northern half of the Okhotsk Sea.

Likewise, information obtained from aerial and ship-based surveys subsequent to Soviet whaling reveals that bowheads are currently distributed in the northern Okhotsk Sea during spring through early autumn, with concentrations in the Shantar Archipelago and Shelikhov Bay (Ivashchenko and Clapham 2010). Doroshenko (1996) proposed that some whales utilize both areas during this period, moving from Shelikhov Bay to Shantar upon summer, in which case the northern portion of the study area (subregions 1-3) would serve as a movement corridor for these whales. It has been suggested that bowheads may be found further south in the Okhotsk Sea in

winter, including speculation that they overwinter near the ice edge in the vicinity of the Kuril Islands and western Kamchatka (Berzin and Doroshenko 1979, 1981), but in general the winter distribution of Okhotsk bowheads is unknown (Ivashchenko and Clapham 2010). The little that is known is based on ice-associated sightings reported in Fedoseev (1984), but these surveys did not cover the western coast of Kamchatka south of 56°N (Ivashin 1986). There were few reported bowhead sightings in the study area, with only two made after the Soviet whaling period, but these sightings indicate that bowheads can utilize the northern portion (subregions 1-3) in spring and summer and be found as far south as subregion 9 in winter (Table 1; Fig. 6).

Four additional sightings were made during the summer that could not be attributed to the exact balaenid species (Fig. 6). Although these sightings were reported as right whales, it was in the collective sense, as is often the case in the Russian literature. While it is most likely that the unidentified balaenid in subregion 8 is a right whale (see below), the other three could be either species. If it was a bowhead, the October sighting in subregion 5 is further south than what might be expected, but note that Tomilin (1957) referred to a stranding reported in Eschricht and Reinhardt (1866) of a bowhead whale off the western coast of Kamchatka near the mouth of the Kolpakovo River (54°39'N). Finally, the vulnerability of Okhotsk Sea bowhead whales to incidental mortality and serious injury from fishing gear is worth mentioning. Brownell (1999) described an account of a male bowhead fatally entangled in a Japanese-type crab trap in an area just west of subregion 1 in September of 1995, highlighting the potential for bycatch in regions where bowheads and fisheries overlap.

North Pacific right whale

Endangered North Pacific right whales consist of an eastern and western population, with the Okhotsk Sea serving as an important feeding ground for the western population from spring to autumn (Brownell *et al*. 2001). Western North Pacific right whales were heavily hunted in the Okhotsk Sea in the same periods described for bowhead whales, although intensive whaling in other parts of their range during the 19th and 20th centuries also contributed to the considerable depletion of the population (Clapham *et al*. 2004). Given the aforementioned confusion surrounding bowhead whales in the Okhotsk Sea, several older Russian sources are also not completely dependable in their treatment of right whale information (e.g., Klumov 1962). There are conflicting ideas regarding right whale distribution in the Okhotsk Sea in accounts from the 19th century (Lindholm 1863, Scammon 1874). According to the whaling records compiled by Townsend (1935), keeping in mind the potential for misidentification with bowheads (Scarff 1991), catches of right whales occurred in three general regions in the study area: 1) over the TINRO Basin (basin centered in subregion 4, but extending into subregions 1, 2, and 5) between June and September, 2) in the southern portion (subregions 8 and 9 and southern halves of subregions 6 and 7) between August and September, and 3) along the coastal margins of all coastal subregions between June and September. Reeves *et al*. (2008) anecdotally mentioned a few right whale encounters by whalers in an area encompassed by the southern half of subregion 1 and the northern half of subregion 4. Many analyses of historical right whale distribution have utilized the larger sample of catches represented in the 1850's Maury Whale Charts (Scarff 1991, Josephson *et al*. 2008), but the large spatial scale of the charts makes them difficult to use in localized studies like the present review.

The reported right whale sightings in the study area can generally be divided temporally into those that occurred during the Soviet whaling period (Fig. 6, although note this figure includes the 1991 sighting detailed in Table 1) and those that took place during the Japanese-led sighting surveys between 1989 and 2003 (Fig. 9). Most sightings during the early period were made in the southeastern portion of the study area (subregion 9 and eastern half of subregion 8), although two sightings from subregion 2 indicate that right whales were present in the northern

portion of the study area (Fig. 6). However, in the later period, when the population was likely much smaller following substantial (illegal) removals by Soviet whalers (Brownell *et al*. 2001), all sightings were restricted to the southern portion of study area (subregions 6, 8, and particularly 9) (Fig. 9). Using the information collected during the 1989-1992 surveys and line transect methods, Miyashita and Kato (1998) produced an estimate of approximately 900 right whales in the Okhotsk Sea, but the estimate is imprecise (CV=0.433) and may be overly optimistic (Clapham *et al*. 2004). Although the reported sightings are confined to summer months, a right whale stranded on the western coast of Kamchatka (the specific location was not provided) in November of 1999 (Brownell *et al*. 2001). Ivashchenko and Clapham (2010) pointed out the possibility for overlap, at least spatially, in the distribution of bowhead and right whales in the Okhotsk Sea. The reported sightings of bowheads and right whales suggest that spatial and temporal overlap between the two species is feasible in the northern part of the study area, with spatial, but not temporal, overlap possible in the southern portion (Fig. 6). Like bowhead whales, right whales are also at risk of entanglement in fishing gear. One of the whales sighted in subregion 9 in 1992 was observed to be entangled in fishing line (Table 1; Miyashita 1998), a whale with entanglement scarring on its head and caudal peduncle was seen in the southwestern Okhotsk Sea in August of 2003 (Burdin *et al*. 2004), and a whale entangled in a gillnet stranded off the southern point of Kamchatka in October of 1989 (Kornev 1994).

Blue whale

Endangered blue whales in the North Pacific are presently managed by the IWC as a single stock (Donovan 1991). However, acoustic and other evidence indicates that there is at least an eastern and western population, with individuals in the vicinity of the Okhotsk Sea belonging to the latter (Stafford *et al*. 2001). Blue whales are generally not described as ranging in the Okhotsk Sea (Tomilin 1957, Sokolov and Arsen'ev 1984), although they are known from Soviet whaling records to occur in the Kuril Islands (Doroshenko 2000b), where they presumably migrate during spring (Tomilin 1957). From the Kuril Islands, it has been suggested that solitary individuals may occasionally visit the western coast of Kamchatka (Berzin and Vladimirov 1989). There was only one blue whale sighting reported in the study area, made in the southwestern portion of subregion 9 during an October 1948 Soviet whale scouting survey (Table 1, Fig. 7). Berzin and Vladimirov (1989) referred to a sighting of two blue whales off southwestern Kamchatka in February 1986, but did not provide a precise location or additional details. Despite the fact that survey effort in the study area has been limited and that blue whales in the northwestern Pacific are likely still significantly reduced in number following 20th century whaling, there is little historical or current information that indicates these whales regularly utilize western Kamchatka waters.

Fin whale

Endangered fin whales in the North Pacific, excluding individuals occurring in the East China Sea, are currently managed by the IWC as a single stock (Donovan 1991). However, available evidence is suggestive of east-west stock structure, with fin whales in the Okhotsk Sea belonging to the putative western stock (Mizroch *et al*. 2009). Fin whales were taken by Soviet whalers in the Okhotsk Sea during summer and autumn months, predominantly off the western coast of Kamchatka (Mizroch *et al*. 2009), although the recovery status of fin whales in the Okhotsk Sea and other parts of the northwestern Pacific following 20th century whaling is not well understood. Reported fin whale sightings off western Kamchatka have been consistent over recent decades and were made in almost all subregions of the study area during summer and early autumn (Table 1, Figs. 7 and 9). Berzin and Vladimirov (1989) indicated that fin whales rarely occur in the Okhotsk Sea aside from the western coast of Kamchatka, but ship-based surveys in recent years have demonstrated that fin whales can be found throughout the Okhotsk Sea (e.g., Shuntov 1993, Miyashita *et al*. 1997). Although fin whales are thought to migrate to the Okhotsk

Sea in spring (Tomilin 1957), Sleptsov (1952) mentioned reports of fin whales overwintering off the southern and western coast of Kamchatka, but current data are not available to inform this possibility.

Sei whale

Endangered sei whales in the North Pacific are managed by the IWC as a single stock (Donovan 1991), although there is evidence of stock structure, with individuals in the western Pacific comprising a putative stock (Mazaki 1977). Accounts of the occurrence of sei whales in the Okhotsk Sea are conflicting, with some authors excluding it (e.g., Tomilin 1957) and others including it (e.g., Solokov and Arsen'ev 1984) in descriptions of the distribution of this species. However, Japanese and Soviet whale scouting surveys revealed that sei whales can occur off the Kuril Islands and the western coast of Kamchatka, if only in small numbers (Horwood 1987, Berzin and Vladimirov 1989). Only two reported sightings of sei whales in the study area were located, both from early decades, which corroborate that sei whales can be found in at least the southeastern portion of the study area (subregions 7 and 9) in the summer-autumn period (Table 1; Fig. 7). While survey effort in the study area has been limited and sei whales in the northwestern Pacific have likely not recovered from substantial 20th century removals, available information on the importance of the study area to sei whales in the western North Pacific is equivocal. Note that in recent years a minimum of 50 western North Pacific sei whales have been factored into the Japanese catches taken annually under IWC scientific permit.

Common minke whale

Minke whales are found throughout the Okhotsk Sea (Berzin and Vladimirov 1989), and are common off the western coast of Kamchatka (Sokolov and Arsen'ev 1984). Reported sightings reflect a broad use of the study area by minke whales and were more concentrated in coastal areas (Figs. 8-9), as has been mentioned previously (Miyashita and Berzin 1991). Minke whales are noted for their relatively solitary occurrence in the Okhotsk Sea (Berzin and Vladimirov 1989), which is corroborated by the reported sightings (Table 1), although Miyashita and Doroshenko (1990) mentioned a group of 25 individuals observed feeding in subregion 2. Results of Japanese test whaling conducted in the Okhotsk Sea between 1973 and 1975 led to the suggestion that minke whales enter the Okhotsk Sea in April and May and move northward as the feeding season progresses, and pointed to possible age and sex segregation in migration and distribution patterns (Hatanaka and Miyashita 1997). However, Shuntov (2001) found that minke whales can be as far north as the northeastern part of the study area and Shelikov Bay as early as late April, but that interannual variability in ice conditions likely influences the distribution of whales in spring. The last reported sighting was made in October, indicating that minke whales remain in the Okhotsk Sea at least until early autumn. Minke whales in the Okhotsk Sea were most recently estimated by line transect techniques to number around 28,000 individuals and are managed by the IWC as a part of the Okhotsk Sea-West Pacific Stock (O Stock) (Hatanaka and Miyashita 1997). This stock comprises the main component of the Japanese scientific whaling program in the North Pacific, with approximately 200 whales taken annually in recent years.

Humpback whale

Humpback whales of the western North Pacific stock currently are rarely encountered in the Okhotsk Sea during their summer-autumn feeding season (Berzin and Vladimirov 1989), but it is difficult to discern from available data if this reflects a lack of sighting effort in coastal areas and if this was the situation historically. Zenkovich (1937) mentioned that humpback whales were common in summer and autumn months off the western coast of Kamchatka, albeit not in large numbers. There were only three reported sightings of humpback whales in the study area (in the coastal subregions of 3, 7, and 5), all made in summer months of recent years (Table 1; Figs. 7 and 9), although a recent survey of local people suggests that humpback whales may occur

off the northwestern coast (subregion 3) in spring (Burdin *et al*. 2010). A female humpback whale was found stranded near the mouth of the Bolshaya River (52°28'N) during a shore-based pinniped survey in September of 1991 (A. M. Burdin, pers. comm.). As is true with blue and sei whales, assessing the importance of the study area to humpback whales is problematic given the lack of historical information, limited survey effort, and effects of stock depletion from 20th century whaling. However, in the case of humpbacks, that sightings have been made in recent years provides some indication that the western coast of Kamchatka could be utilized by humpback whales as their numbers rebound.

Other species

Range maps included in Heptner and Naumov (1976) indicated that three dolphin species can be found in the study area, although details were not provided in the text and no data were found in other sources to confirm the suggested ranges. The species in question are striped dolphins (*Stenella coeruleoalba*), short-beaked common dolphin (also included by Artyukin and Burkanov (1999) as mentioned above), and northern right whale dolphins (*Lissodelphis borealis*). Additionally, Burkanov and Nikulin (2001) estimated that a small number of Pacific white-sided dolphins (*Lagenorhynchus obliquidens*) were bycaught in the Japanese salmon driftnet fishery off southwestern Kamchatka between 1993 and 1999. However, the boundary of this fishery extended south of the study area in some years, where this species is known to occur (Sleptsov 1952).

CONCLUSIONS

The reported sightings compiled in this review demonstrate that the shelf and slope regions off the western coast of Kamchatka are utilized by several cetacean species throughout the year, particularly during summer and autumn months. These sightings also highlight the potential importance of this region, especially the northern and coastal shelf areas, for recovering populations of depleted baleen whales, notably Okhotsk Sea bowhead, western North Pacific right, and western gray whales. However, that only 351 separate or aggregate sightings were available from disjointed and limited surveys over a period of 70 years emphasizes how little effort has been made to monitor cetaceans in this region and how much remains to be learned about their status and habitat use, especially in the present day.

The need for directed scientific assessment of cetaceans occurring off the western coast of Kamchatka is especially critical in light of current and imminent anthropogenic activities, namely commercial fisheries and oil and gas development, which pose known threats to cetaceans. In terms of fishery interactions, mention was made of some species (Dall's and harbor porpoise, bowhead and right whales) vulnerable to entanglement and bycatch from fisheries occurring in the study area. However, this vulnerability likely extends to other species. In their assessment of bycatch from Japanese salmon driftnet fisheries, Burkanov and Nikulin (2001) noted that the bycatch of large whales was difficult to estimate, since nets with bycaught whales were too heavy to retrieve, precluding species identification. Nikulin *et al*. (2004) summarized known large cetacean bycatch off Kamchatka (seemingly the eastern coast, although such is not explicitly stated) and found that a variety of species were incidentally caught in multiple types of fishing gear, including driftnets, crab traps, longlines, gillnets, and coastal set nets, which are all used off western Kamchatka. Incidentally caught species consisted of right, sperm, minke, humpback, beluga, and killer whales, although about half of the records pertained to whales that were released alive. Further, since many of the western Kamchatka cetacean populations are susceptible to entanglement in fishing gear in other parts of their range (e.g., western gray whale; Bradford *et al*. 2009), it is reasonable to assume that this susceptibility exists in the study area.

Regarding oil and gas development, associated activities can disturb and harm cetaceans and physically alter their habitat (see IUCN 2005, for review). The western coast of Kamchatka has long been noted for its oil and gas deposits, but exploratory activities have only recently begun. After a few years characterized by changing operators, shifting boundaries, and unsuccessful exploratory drilling, plans for the West Kamchatka license area have progressed (Fig. 10), with seismic operations slated to resume in the summer of 2010. In the near future, development of the Koryakia-1 block in adjacent Shelikhov Bay will be pursued (Fig. 10). International concern about the environmental impacts of western Kamchatka oil and gas development has been growing, particularly in the non-governmental organization sector, but to date has focused primarily on the ecological, economic, and social costs to threatened fisheries (e.g., Diver 2008). However, in order to be comprehensive, environmental impact assessments, as well as associated monitoring and protection plans, developed for the West Kamchatka Project will also need to incorporate cetaceans and other marine mammals. There are existing directives that can be used to support the cetacean research, management, and conservation required in this regard. For example, the IWC has made specific recommendations to further investigate the range of the critically endangered western gray whale and the status of the endangered Okhotsk Sea bowhead whale (IWC 2008).

We recommend that directed and systematic research and monitoring of cetaceans off the western coast of Kamchatka be initiated as soon as possible, focusing first on populations of conservation concern in areas of commercial fishing and, especially, oil and gas activity. However, studies of more abundant species would also be useful for establishing baseline conditions that could be evaluated for signals of ecological change from anthropogenic activities, as well as from effects of climate change. Both conservation-focused and ecologically-oriented research will require adequate spatial and temporal coverage in order to capture the seasonal and annual variability in cetacean habitat use expected in a region characterized by dynamic variations in hydrology and ice cover (Talley and Nagata 1995, Shuntov 2001, Samko *et al*. 2004). These projects could be informed by, and potentially integrated with, the substantial amount of biological oceanography data that continues to be collected off western Kamchatka (e.g., Shebanova 1994, Samko *et al*. 2004, Dulepova *et al*. 2008), but has so far only been applied to commercially important species. In order to develop the recommended cetacean research programs, pilot studies such as that conducted by Burdin *et al*. (2010) may be required and are encouraged. Pilot work would ideally include interactions with local people, especially fishers, who are familiar with the marine mammal fauna occurring in nearshore waters, an area noticeably underrepresented in the cetacean sightings reported here. While the data necessary for a proper assessment of cetaceans off western Kamchatka will only be obtained through concerted research, continued and enhanced indirect studies would also contribute valuable information. For example, the observer-based schemes described in Burkanov and Nikulin (2001) to monitor marine mammal bycatch aboard fishing vessels, and in Shuntov (1993, 1994, 1997, 1999, 2001) to record cetacean sightings during ship-based biological surveys, produced important findings and should be resumed.

When considering the potential for ecological change off the western coast of Kamchatka, cetaceans are not the only group of species of non-commercial value requiring additional research and conservation. This region is also utilized by a large number of pinniped (e.g., Lagerev 1988), seabird (e.g., Kondratyev *et al.* 2000) and shorebird (e.g., Huettmann and Gerasimov 2006) species that are sensitive in various ways to anthropogenic disturbance, and these taxa will also need to be properly considered in environmental assessments. Likewise, the western coast of Kamchatka is not the only part of the Okhotsk Sea lacking critical information on the status of and habitat use by associated cetaceans. While rigorous and long-term cetacean studies are needed in most regions, they would have important management applications for

productive areas such as Shelikhov Bay and the northern shelf, which are both sites of future oil and gas development. Overall, the Okhotsk Sea represents a unique marine ecosystem characterized by high biodiversity and important natural resources that would benefit from increased conservation initiatives (Huettmann 2008). In addition to intensifying human activities, the Okhotsk Sea is particularly vulnerable to the effects of climate change, since its climatic conditions are similar to those of a polar ocean (Sakamoto *et al*. 2005). In fact, the East Siberia region to the north, which drives ice formation in the Okhotsk Sea, has been identified as one of the most sensitive areas to global warming in the Northern Hemisphere, with such warming expected to decrease ice formation and lower biological productivity in the Okhotsk Sea (Wakatsuchi 2006).

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Table 1. Summary of compiled cetacean sightings made off the western coast of Kamchatka between 1941 and 2009. Explanations of subregions and position types can be found in the text. Note that footnotes are included as a group at the end of the table.

Year	Month	Day	Species	Subregion	Position Type	Group Size	Survey Type	Survey Platform	Source	Comments
1948	Oct	7	killer	1	1	50	cetacean sighting	scout	Sleptsov (1961)	Observed feeding on herring (*Clupea pallasii*).
1989 or 1991	Jun-Aug		killer	1	3	<4	biological oceanography	ship	Shuntov (1993)	
1989 or 1991	Jun-Aug		killer	5	3	<4	biological oceanography	ship	Shuntov (1993)	
1989 or 1991	Jun-Aug		killer	7	3	<4	biological oceanography	ship	Shuntov (1993)	
1989 or 1991	Jun-Aug		killer	7	3	<4	biological oceanography	ship	Shuntov (1993)	
1989 or 1991	Jun-Aug		killer	9	3	<4	biological oceanography	ship	Shuntov (1993)	
1989-1992[1]	Aug-Sep		killer	1	NA[2]	2[3]	cetacean sighting	ship	Miyashita and Doroshenko (1990), Miyashita and Berzin (1991), Miyashita (1997)	
1989-1992[1]	Aug-Sep		killer	5	NA[2]	1[3]	cetacean sighting	ship	Miyashita and Doroshenko (1990), Miyashita and Berzin (1991), Miyashita (1997)	
1989-1992[1]	Aug-Sep		killer	6	NA[2]	3[3]	cetacean sighting	ship	Miyashita and Doroshenko (1990), Miyashita and Berzin (1991), Miyashita (1997)	
1989-1992[1]	Aug-Sep		killer	7	NA[2]	1[3]	cetacean sighting	ship	Miyashita and Doroshenko (1990), Miyashita and Berzin (1991), Miyashita (1997)	
1989-1992[1]	Aug-Sep		killer	8	NA[2]	1[3]	cetacean sighting	ship	Miyashita and Doroshenko (1990), Miyashita and Berzin (1991), Miyashita (1997)	
1989-1992[1]	Aug-Sep		killer	9	NA[2]	4[3]	cetacean sighting	ship	Miyashita and Doroshenko (1990), Miyashita and Berzin (1991), Miyashita (1997)	
1995	Jun-Jul		killer	9	3	2	biological oceanography	ship	Shuntov (1997)	
1997	Jul-Aug		killer	6	3	10	biological oceanography	ship	Shuntov (1999)	

1997	Jul-Aug		killer	6	3	2	biological oceanography	ship	Shuntov (1999)	
1998	Sep		killer	6	NA[2]	1[3]	cetacean sighting	ship	Miyashita (1999)	
1998	summer-autumn		killer	9	3	1-2	biological oceanography	ship	Shuntov (2001)	
1999	Sep		killer	6	NA[2]	4[3]	cetacean sighting	ship	Miyashita *et al.* (2000)	
1999	Sep		killer	8	NA[2]	1[3]	cetacean sighting	ship	Miyashita *et al.* (2000)	
1999	summer-autumn		killer	5	3	1-2	biological oceanography	ship	Shuntov (2001)	
2001	Sep	22	killer	1	1	6	cetacean sighting	ship	Ivannikov and Doroshenko (2001)	
2001	Jun-Sep		killer	1	NA[4]	18[3]	Greenland halibut fishing	longliner	Karyakin (2004)	Presumed to be depredating longlines.
2001	Jun-Sep		killer	4	NA[4]	20[3]	Greenland halibut fishing	longliner	Karyakin (2004)	Presumed to be depredating longlines.
2001	Jun-Sep		killer	6	NA[4]	46[3]	Greenland halibut fishing	longliner	Karyakin (2004)	Presumed to be depredating longlines.
2001	Jun-Sep		killer	7	NA[4]	4[3]	Greenland halibut fishing	longliner	Karyakin (2004)	Presumed to be depredating longlines.
2001	Jun-Sep		killer	8	NA[4]	14[3]	Greenland halibut fishing	longliner	Karyakin (2004)	Presumed to be depredating longlines.
2009	Sep	21	killer	5	1	2	cetacean sighting	ship	Burdin *et al.* (2010)	Included adult male and female.
2009	Sep	30	killer	7	1	12	cetacean sighting	ship	Burdin *et al.* (2010)	Included four adult males and two calves.
1989-1992[1]	Aug-Sep		harbor	3	NA[2]	4[3]	cetacean sighting	ship	Miyashita and Doroshenko (1990), Miyashita and Berzin (1991), Miyashita (1997)	
1989-1992[1]	Aug-Sep		harbor	6	NA[2]	4[3]	cetacean sighting	ship	Miyashita and Doroshenko (1990), Miyashita and Berzin (1991), Miyashita (1997)	
1989-1992[1]	Aug-Sep		harbor	9	NA[2]	1[3]	cetacean sighting	ship	Miyashita and Doroshenko (1990), Miyashita and Berzin (1991), Miyashita (1997)	

2009	Aug	5	harbor	2	1	2	cetacean sighting	ship	Burdin *et al.* (2010)
2009	Aug	5	harbor	3	1	2	cetacean sighting	ship	Burdin *et al.* (2010)
2009	Sep	23	harbor	3	1	3	cetacean sighting	ship	Burdin *et al.* (2010)
1974-1984	unknown		Dall's	9	3	10^5	cetacean sighting	Ship	Berzin and Vladimirov (1989)
1984 or 1986	autumn		Dall's[6]	1	3	<5	biological oceanography	ship	Shuntov (1993)
1984 or 1986	autumn		Dall's[6]	1	3	10-20	biological oceanography	ship	Shuntov (1993)
1984 or 1986	autumn		Dall's[6]	2	3	<5	biological oceanography	ship	Shuntov (1993)
1984 or 1986	autumn		Dall's[6]	9	3	5-10?	biological oceanography	ship	Shuntov (1993)
1984 or 1986	autumn		Dall's[6]	9	3	5-10?	biological oceanography	ship	Shuntov (1993)
1986	Oct		Dall's	5	3	?	cetacean sighting	ship	Blokhin (1988)
1989 or 1991	Jun-Aug		Dall's[6]	4	3	5-10	biological oceanography	ship	Shuntov (1993)
1989 or 1991	Jun-Aug		Dall's[6]	4	3	10-20?	biological oceanography	ship	Shuntov (1993)
1989 or 1991	Jun-Aug		Dall's[6]	5	3	>20	biological oceanography	ship	Shuntov (1993)
1989 or 1991	Jun-Aug		Dall's[6]	4	3	10-20?	biological oceanography	ship	Shuntov (1993)
1989 or 1991	Jun-Aug		Dall's[6]	5	3	5-10?	biological oceanography	ship	Shuntov (1993)
1989 or 1991	Jun-Aug		Dall's[6]	5	3	>20	biological oceanography	ship	Shuntov (1993)
1989 or 1991	Jun-Aug		Dall's[6]	6	3	5-10	biological oceanography	ship	Shuntov (1993)
1989 or 1991	Jun-Aug		Dall's[6]	7	3	<5	biological oceanography	ship	Shuntov (1993)
1989 or 1991	Jun-Aug		Dall's[6]	7	3	10-20	biological oceanography	ship	Shuntov (1993)
1989 or 1991	Jun-Aug		Dall's[6]	8	3	<5	biological oceanography	ship	Shuntov (1993)
1989 or 1991	Jun-Aug		Dall's[6]	8	3	<5	biological oceanography	ship	Shuntov (1993)
1989 or 1991	Jun-Aug		Dall's[6]	9	3	>20	biological oceanography	ship	Shuntov (1993)

1989 or 1991	Jun-Aug	Dall's[6]	9	3	<5	biological oceanography	ship	Shuntov (1993)
1989 or 1991	Jun-Aug	Dall's[6]	9	3	10-20?	biological oceanography	ship	Shuntov (1993)
1989 or 1991	Jun-Aug	Dall's[6]	8	3	5-10	biological oceanography	ship	Shuntov (1993)
1989-1992[1]	Aug-Sep	Dall's	1	NA[2]	21[3]	cetacean sighting	ship	Miyashita and Doroshenko (1990), Miyashita and Berzin (1991), Miyashita (1997)
1989-1992[1]	Aug-Sep	Dall's	2	NA[2]	22[3]	cetacean sighting	ship	Miyashita and Doroshenko (1990), Miyashita and Berzin (1991), Miyashita (1997)
1989-1992[1]	Aug-Sep	Dall's	3	NA[2]	1[3]	cetacean sighting	ship	Miyashita and Doroshenko (1990), Miyashita and Berzin (1991), Miyashita (1997)
1989-1992[1]	Aug-Sep	Dall's	4	NA[2]	1[3]	cetacean sighting	ship	Miyashita and Doroshenko (1990), Miyashita and Berzin (1991), Miyashita (1997)
1989-1992[1]	Aug-Sep	Dall's	5	NA[2]	5[3]	cetacean sighting	ship	Miyashita and Doroshenko (1990), Miyashita and Berzin (1991), Miyashita (1997)
1989-1992[1]	Aug-Sep	Dall's	6	NA[2]	16[3]	cetacean sighting	ship	Miyashita and Doroshenko (1990), Miyashita and Berzin (1991), Miyashita (1997)
1989-1992[1]	Aug-Sep	Dall's	7	NA[2]	3[3]	cetacean sighting	ship	Miyashita and Doroshenko (1990), Miyashita and Berzin (1991), Miyashita (1997)
1989-1992[1]	Aug-Sep	Dall's	8	NA[2]	25[3]	cetacean sighting	ship	Miyashita and Doroshenko (1990), Miyashita and Berzin (1991), Miyashita (1997)
1989-1992[1]	Aug-Sep	Dall's	9	NA[2]	21[3]	cetacean sighting	ship	Miyashita and Doroshenko (1990), Miyashita and Berzin (1991), Miyashita (1997)
1995	Jun-Aug	Dall's[6]	1	3	<5	biological oceanography	ship	Shuntov (1997)
1995	Jun-Aug	Dall's[6]	1	3	5-10	biological oceanography	ship	Shuntov (1997)
1995	Jun-Aug	Dall's[6]	1	3	5-10	biological oceanography	ship	Shuntov (1997)

1995	Jun-Aug	Dall's[6]	1	3	>20	biological oceanography	ship	Shuntov (1997)
1995	Jun-Aug	Dall's[6]	2	3	<5	biological oceanography	ship	Shuntov (1997)
1995	Jun-Aug	Dall's[6]	1	3	<5	biological oceanography	ship	Shuntov (1997)
1995	Jun-Aug	Dall's[6]	5	3	<5	biological oceanography	ship	Shuntov (1997)
1995	Jun-Aug	Dall's[6]	2	3	<5	biological oceanography	ship	Shuntov (1997)
1995	Jun-Aug	Dall's[6]	4	3	<5	biological oceanography	ship	Shuntov (1997)
1995	Jun-Aug	Dall's[6]	5	3	5-10	biological oceanography	ship	Shuntov (1997)
1995	Jun-Aug	Dall's[6]	5	3	<5	biological oceanography	ship	Shuntov (1997)
1995	Jun-Aug	Dall's[6]	6	3	<5	biological oceanography	ship	Shuntov (1997)
1995	Jun-Aug	Dall's[6]	7	3	5-10	biological oceanography	ship	Shuntov (1997)
1995	Jun-Aug	Dall's[6]	6	3	<5	biological oceanography	ship	Shuntov (1997)
1995	Jun-Aug	Dall's[6]	6	3	<5	biological oceanography	ship	Shuntov (1997)
1995	Jun-Aug	Dall's[6]	7	3	<5	biological oceanography	ship	Shuntov (1997)
1995	Jun-Aug	Dall's[6]	8	3	<5	biological oceanography	ship	Shuntov (1997)
1995	Jun-Aug	Dall's[6]	9	3	<5	biological oceanography	ship	Shuntov (1997)
1995	Jun-Aug	Dall's[6]	9	3	<5	biological oceanography	ship	Shuntov (1997)
1995	Jun-Aug	Dall's[6]	8	3	<5	biological oceanography	ship	Shuntov (1997)
1995	Jun-Aug	Dall's[6]	9	3	<5	biological oceanography	ship	Shuntov (1997)
1995	Jun-Aug	Dall's[6]	9	3	<5	biological oceanography	ship	Shuntov (1997)
1995	Jun-Aug	Dall's[6]	9	3	>20	biological oceanography	ship	Shuntov (1997)

1997	Jul-Aug	Dall's[6]	1	3	<5	biological oceanography	ship	Shuntov (1999)
1997	Jul-Aug	Dall's[6]	2	3	<5	biological oceanography	ship	Shuntov (1999)
1997	Jul-Aug	Dall's[6]	2	3	<5	biological oceanography	ship	Shuntov (1999)
1997	Jul-Aug	Dall's[6]	1	3	5-10	biological oceanography	ship	Shuntov (1999)
1997	Jul-Aug	Dall's[6]	2	3	<5	biological oceanography	ship	Shuntov (1999)
1997	Jul-Aug	Dall's[6]	2	3	10-20	biological oceanography	ship	Shuntov (1999)
1997	Jul-Aug	Dall's[6]	2	3	<5	biological oceanography	ship	Shuntov (1999)
1997	Jul-Aug	Dall's[6]	1	3	5-10	biological oceanography	ship	Shuntov (1999)
1997	Jul-Aug	Dall's[6]	4	3	5-10	biological oceanography	ship	Shuntov (1999)
1997	Jul-Aug	Dall's[6]	4	3	10-20	biological oceanography	ship	Shuntov (1999)
1997	Jul-Aug	Dall's[6]	5	3	<5	biological oceanography	ship	Shuntov (1999)
1997	Jul-Aug	Dall's[6]	5	3	<5	biological oceanography	ship	Shuntov (1999)
1997	Jul-Aug	Dall's[6]	4	3	<5	biological oceanography	ship	Shuntov (1999)
1997	Jul-Aug	Dall's[6]	5	3	5-10	biological oceanography	ship	Shuntov (1999)
1997	Jul-Aug	Dall's[6]	4	3	5-10	biological oceanography	ship	Shuntov (1999)
1997	Jul-Aug	Dall's[6]	4	3	5-10	biological oceanography	ship	Shuntov (1999)
1997	Jul-Aug	Dall's[6]	6	3	>20	biological oceanography	ship	Shuntov (1999)
1997	Jul-Aug	Dall's[6]	6	3	<5	biological oceanography	ship	Shuntov (1999)
1997	Jul-Aug	Dall's[6]	6	3	<5	biological oceanography	ship	Shuntov (1999)
1997	Jul-Aug	Dall's[6]	7	3	5-10	biological oceanography	ship	Shuntov (1999)

1997	Jul-Aug	Dall's[6]	6	3	<5	biological oceanography	ship	Shuntov (1999)
1997	Jul-Aug	Dall's[6]	6	3	5-10	biological oceanography	ship	Shuntov (1999)
1997	Jul-Aug	Dall's[6]	7	3	<5	biological oceanography	ship	Shuntov (1999)
1998	Sep	Dall's	4	NA[2]	4[3]	cetacean sighting	ship	Miyashita (1999)
1998	Sep	Dall's	6	NA[2]	17[3]	cetacean sighting	ship	Miyashita (1999)
1998	Sep	Dall's	8	NA[2]	3[3]	cetacean sighting	ship	Miyashita (1999)
1998	winter-spring	Dall's[6]	2	3	<5	biological oceanography	ship	Shuntov (2001)
1998	winter-spring	Dall's[6]	4	3	5-10	biological oceanography	ship	Shuntov (2001)
1998	winter-spring	Dall's[6]	4	3	<5	biological oceanography	ship	Shuntov (2001)
1998	winter-spring	Dall's[6]	7	3	<5	biological oceanography	ship	Shuntov (2001)
1998	winter-spring	Dall's[6]	6	3	5-10	biological oceanography	ship	Shuntov (2001)
1998	winter-spring	Dall's[6]	6	3	<5	biological oceanography	ship	Shuntov (2001)
1998	winter-spring	Dall's[6]	6	3	5-10	biological oceanography	ship	Shuntov (2001)
1998	winter-spring	Dall's[6]	8	3	>10	biological oceanography	ship	Shuntov (2001)
1998	winter-spring	Dall's[6]	8	3	>10	biological oceanography	ship	Shuntov (2001)
1998	winter-spring	Dall's[6]	8	3	5-10	biological oceanography	ship	Shuntov (2001)
1998	summer-autumn	Dall's[6]	2	3	<5	biological oceanography	ship	Shuntov (2001)
1998	summer-autumn	Dall's[6]	2	3	<5	biological oceanography	ship	Shuntov (2001)
1998	summer-autumn	Dall's[6]	2	3	5-10	biological oceanography	ship	Shuntov (2001)
1998	summer-autumn	Dall's[6]	4	3	5-10	biological oceanography	ship	Shuntov (2001)
1998	summer-autumn	Dall's[6]	5	3	<5	biological oceanography	ship	Shuntov (2001)

1998	summer-autumn	Dall's[6]	4	3	<5	biological oceanography	ship	Shuntov (2001)
1998	summer-autumn	Dall's[6]	7	3	<5	biological oceanography	ship	Shuntov (2001)
1998	summer-autumn	Dall's[6]	9	3	<5	biological oceanography	ship	Shuntov (2001)
1999	Sep	Dall's	6	NA[2]	8[3]	cetacean sighting	ship	Miyashita *et al.* (2000)
1999	Sep	Dall's	8	NA[2]	3[3]	cetacean sighting	ship	Miyashita *et al.* (2000)
1999	winter-spring	Dall's[6]	2	3	<5	biological oceanography	ship	Shuntov (2001)
1999	winter-spring	Dall's[6]	4	3	5-10	biological oceanography	ship	Shuntov (2001)
1999	winter-spring	Dall's[6]	9	3	>10	biological oceanography	ship	Shuntov (2001)
1999	winter-spring	Dall's[6]	9	3	<5	biological oceanography	ship	Shuntov (2001)
1999	winter-spring	Dall's[6]	9	3	5-10	biological oceanography	ship	Shuntov (2001)
1999	winter-spring	Dall's[6]	9	3	>10	biological oceanography	ship	Shuntov (2001)
1999	winter-spring	Dall's[6]	9	3	5-10	biological oceanography	ship	Shuntov (2001)
1999	winter-spring	Dall's[6]	9	3	<5	biological oceanography	ship	Shuntov (2001)
1999	summer-autumn	Dall's[6]	2	3	<5	biological oceanography	ship	Shuntov (2001)
1999	summer-autumn	Dall's[6]	1	3	5-10	biological oceanography	ship	Shuntov (2001)
1999	summer-autumn	Dall's[6]	1	3	<5	biological oceanography	ship	Shuntov (2001)
1999	summer-autumn	Dall's[6]	5	3	<5	biological oceanography	ship	Shuntov (2001)
1999	summer-autumn	Dall's[6]	5	3	<5	biological oceanography	ship	Shuntov (2001)
1999	summer-autumn	Dall's[6]	4	3	<5	biological oceanography	ship	Shuntov (2001)
1999	summer-autumn	Dall's[6]	5	3	<5	biological oceanography	ship	Shuntov (2001)
1999	summer-autumn	Dall's[6]	5	3	<5	biological oceanography	ship	Shuntov (2001)

1999	summer-autumn		Dall's[6]	5	3	5-10	biological oceanography	ship	Shuntov (2001)
1999	summer-autumn		Dall's[6]	4	3	<5	biological oceanography	ship	Shuntov (2001)
1999	summer-autumn		Dall's[6]	5	3	<5	biological oceanography	ship	Shuntov (2001)
1999	summer-autumn		Dall's[6]	5	3	<5	biological oceanography	ship	Shuntov (2001)
1999	summer-autumn		Dall's[6]	5	3	<5	biological oceanography	ship	Shuntov (2001)
1999	summer-autumn		Dall's[6]	5	3	<5	biological oceanography	ship	Shuntov (2001)
1999	summer-autumn		Dall's[6]	5	3	<5	biological oceanography	ship	Shuntov (2001)
1999	summer-autumn		Dall's[6]	5	3	<5	biological oceanography	ship	Shuntov (2001)
1999	summer-autumn		Dall's[6]	5	3	<5	biological oceanography	ship	Shuntov (2001)
1999	summer-autumn		Dall's[6]	7	3	5-10	biological oceanography	ship	Shuntov (2001)
1999	summer-autumn		Dall's[6]	6	3	5-10	biological oceanography	ship	Shuntov (2001)
1999	summer-autumn		Dall's[6]	8	3	<5	biological oceanography	ship	Shuntov (2001)
1999	summer-autumn		Dall's[6]	7	3	5-10	biological oceanography	ship	Shuntov (2001)
1999	summer-autumn		Dall's[6]	9	3	5-10	biological oceanography	ship	Shuntov (2001)
1999	summer-autumn		Dall's[6]	9	3	5-10	biological oceanography	ship	Shuntov (2001)
1999	summer-autumn		Dall's[6]	9	3	5-10	biological oceanography	ship	Shuntov (2001)
1999	summer-autumn		Dall's[6]	9	3	<5	biological oceanography	ship	Shuntov (2001)
1999	summer-autumn		Dall's[6]	9	3	5-10	biological oceanography	ship	Shuntov (2001)
1999	summer-autumn		Dall's[6]	9	3	5-10	biological oceanography	ship	Shuntov (2001)
2001	Oct	1	Dall's	7	1	5	cetacean sighting	ship	Ivannikov and Doroshenko (2001)

1969	Apr		beluga	2	3	19	pinniped aerial	plane	Fedoseev (1984, 1985)	Observed in pack ice.
1969	Apr		beluga	1	3	17	pinniped aerial	plane	Fedoseev (1984, 1985)	Observed in pack ice.
1969	Apr		beluga	1	3	20	pinniped aerial	plane	Fedoseev (1984, 1985)	Observed in pack ice.
1974	Apr		beluga	2	3	27	pinniped aerial	plane	Fedoseev (1984, 1985)	Observed in pack ice.
1983	Feb		beluga	2	3	35	beluga aerial	plane	Vladimirov and Melnikov (1987)	Observed at ice edge.
2001	summer		beluga	5	2	21	opportunistic observation	shore	F. Huettmann, pers. comm.	Observed chasing salmon over 1 km upriver.
2002	summer		beluga	5	2	21	opportunistic observation	shore	F. Huettmann, pers. comm.	Observed chasing salmon over 1 km upriver.
2004	Aug		beluga	5	2	21	opportunistic observation	shore	F. Huettmann, pers. comm.	Observed chasing salmon over 1 km upriver.
2007	Jul	28	beluga	2	2	6	opportunistic observation	shore	S. W. Diver, pers. comm.	
2007	Jul	28	beluga	2	2	1	opportunistic observation	small boat	S. W. Diver, pers. comm.	
2009	Aug	13	beluga	3	2	50	cetacean sighting	small boat	Burdin *et al.* (2010)	Included four mother-calf pairs and 10 juveniles.
2009	Aug	16	beluga	3	2	35	cetacean sighting	small boat	Burdin *et al.* (2010)	Included one mother-calf pair and one juvenile.
2009	Aug	17	beluga	3	2	50	cetacean sighting	small boat	Burdin *et al.* (2010)	
2009	Aug	18	beluga	3	2	50	cetacean sighting	small boat	Burdin *et al.* (2010)	
1948	Oct		sperm	5	3	?	cetacean sighting	scout	Sleptsov (1955a)	
1948	Oct		sperm	9	3	?	cetacean sighting	scout	Sleptsov (1955a)	
1958-1968	summer-autumn		sperm	7	3	1-5[5]	commercial whaling/cetacean sighting	catcher/scout/ ship	Rovnin (1969)	Reported as a sighting, not a take.
1958-1968	summer-autumn		sperm	7	3	1-5[5]	commercial whaling/cetacean sighting	catcher/scout/ ship	Rovnin (1969)	Reported as a sighting, not a take.

1958-1968	summer-autumn		sperm	7	3	1-5[5]	commercial whaling/cetacean sighting	catcher/scout/ship	Rovnin (1969)	Reported as a sighting, not a take.
1958-1968	summer-autumn		sperm	7	3	>50[5]	commercial whaling/cetacean sighting	catcher/scout/ship	Rovnin (1969)	Reported as a sighting, not a take.
1958-1968	summer-autumn		sperm	9	3	>50[5]	commercial whaling/cetacean sighting	catcher/scout/ship	Rovnin (1969)	Reported as a sighting, not a take.
1958-1968	summer-autumn		sperm	8	3	>50[5]	commercial whaling/cetacean sighting	catcher/scout/ship	Rovnin (1969)	Reported as a sighting, not a take.
1967	Sep		sperm	4	3	18	cetacean sighting	ship	Rovnin (1969), Kuzmin and Berzin (1974)	
1999	Sep		Baird's	6	NA[2]	2[3]	cetacean sighting	ship	Miyashita *et al.* (2000)	
1948	Oct		gray	5	3	?	cetacean sighting	scout	Sleptsov (1955a)	
1958-1968	summer-autumn		gray	5	3	1-5[5]	commercial whaling/cetacean sighting	catcher/scout/ship	Rovnin (1969)	Reported as a sighting, not a take.
1984	Nov		gray	9	2	2	unknown	unknown	Ivashin (1988), Berzin and Vladimirov (1989), Berzin (1990)	
1986	Sep		gray	3	3	1	pinniped aerial	plane	Maminov and Blokhin (2004)	
2000	Aug		gray	9	2	1	unknown	unknown	Vertyankin *et al.* (2004)	
2008	Jul	1	gray	2	1	1	marine mammal sighting	ship	Burdin *et al.* (2010)	Observed near temporary drilling rig.
1958-1968	summer-autumn		bowhead	3	3	1-5[5]	commercial whaling/cetacean sighting	catcher/scout/ship	Rovnin (1969)	Reported as a sighting, not a take.
1958-1968	summer-autumn		bowhead	1	3	1-5[5]	commercial whaling/cetacean sighting	catcher/scout/ship	Rovnin (1969)	Reported as a sighting, not a take.
1967	Aug	9	bowhead	2	1	1	cetacean sighting	ship	Rovnin (1969)	
1982	May	15	bowhead	3	1	5-6	pinniped aerial	plane	Ivashchenko and Clapham (2010)	
1988	winter		bowhead	9	2	6-8	pinniped aerial	plane	Ivashchenko and Clapham (2010)	

1948	Oct	right or bowhead[7]	2	3	2-15	cetacean sighting	scout	Sleptsov (1952, 1955a, b)	
1948	Oct	right or bowhead[7]	1	3	2-15	cetacean sighting	scout	Sleptsov (1952, 1955a, b)	
1948	Oct	right or bowhead[7]	8	3	?	cetacean sighting	scout	Sleptsov (1955a)	
1986	Oct	right or bowhead[7]	5	3	3	cetacean sighting	ship	Blokhin (1988)	
1941-1968	Aug	right	8	3	?	commercial whaling	catcher	Omura *et al.* (1969), citing Klumov (1962)[8]	Reported as a sighting, not a take.
1941-1968	Aug	right	8	3	?	commercial whaling	catcher	Omura *et al.* (1969), citing Klumov (1962)[8]	Reported as a sighting, not a take.
1941-1968	Aug	right	9	3	?	commercial whaling	catcher	Omura *et al.* (1969), citing Klumov (1962)[8]	Reported as a sighting, not a take.
1941-1968	Aug	right	9	3	?	commercial whaling	catcher	Omura *et al.* (1969), citing Klumov (1962)[8]	Reported as a sighting, not a take.
1941-1968	Aug	right	9	3	?	commercial whaling	catcher	Omura *et al.* (1969), citing Klumov (1962)[8]	Reported as a sighting, not a take.
1941-1968	Aug	right	9	3	?	commercial whaling	catcher	Omura *et al.* (1969), citing Klumov (1962)[8]	Reported as a sighting, not a take.
1941-1968	Aug	right	9	3	?	commercial whaling	catcher	Omura *et al.* (1969), citing Klumov (1962)[8]	Reported as a sighting, not a take.
1941-1968	Aug	right	9	3	?	commercial whaling	catcher	Omura *et al.* (1969), citing Klumov (1962)[8]	Reported as a sighting, not a take.
1941-1968	Aug	right	9	3	?	commercial whaling	catcher	Omura *et al.* (1969), citing Klumov (1962)[8]	Reported as a sighting, not a take.
1941-1968	Aug	right	9	3	?	commercial whaling	catcher	Omura *et al.* (1969), citing Klumov (1962)[8]	Reported as a sighting, not a take.
1941-1968	Aug	right	9	3	?	commercial whaling	catcher	Omura *et al.* (1969), citing Klumov (1962)[8]	Reported as a sighting, not a take.
1941-1968	Aug	right	9	3	?	commercial whaling	catcher	Omura *et al.* (1969), citing Klumov (1962)[8]	Reported as a sighting, not a take.
1941-1968	Aug	right	9	3	?	commercial whaling	catcher	Omura *et al.* (1969), citing Klumov (1962)[8]	Reported as a sighting, not a take.
1941-1968	Sep	right	8	3	?	commercial whaling	catcher	Omura *et al.* (1969), citing Klumov (1962)[8]	Reported as a sighting, not a take.
1941-1968	Sep	right	8	3	?	commercial whaling	catcher	Omura *et al.* (1969), citing Klumov (1962)[8]	Reported as a sighting, not a take.
1941-1968	Sep	right	8	3	?	commercial whaling	catcher	Omura *et al.* (1969), citing Klumov (1962)[8]	Reported as a sighting, not a take.

1941-1968	Sep		right	8	3	?	commercial whaling	catcher	Omura *et al.* (1969), citing Klumov (1962)[8]	Reported as a sighting, not a take.
1941-1968	Sep		right	8	3	?	commercial whaling	catcher	Omura *et al.* (1969), citing Klumov (1962)[8]	Reported as a sighting, not a take.
1941-1968	Sep		right	9	3	?	commercial whaling	catcher	Omura *et al.* (1969), citing Klumov (1962)[8]	Reported as a sighting, not a take.
1941-1968	Sep		right	9	3	?	commercial whaling	catcher	Omura *et al.* (1969), citing Klumov (1962)[8]	Reported as a sighting, not a take.
1941-1968	Sep		right	9	3	?	commercial whaling	catcher	Omura *et al.* (1969), citing Klumov (1962)[8]	Reported as a sighting, not a take.
1941-1968	Sep		right	8	3	?	commercial whaling	catcher	Omura *et al.* (1969), citing Klumov (1962)[8]	Reported as a sighting, not a take.
1941-1968	Sep		right	9	3	?	commercial whaling	catcher	Omura *et al.* (1969), citing Klumov (1962)[8]	Reported as a sighting, not a take.
1941-1968	Sep		right	8	3	?	commercial whaling	catcher	Omura *et al.* (1969), citing Klumov (1962)[8]	Reported as a sighting, not a take.
1941-1968	Sep		right	9	3	?	commercial whaling	catcher	Omura *et al.* (1969), citing Klumov (1962)[8]	Reported as a sighting, not a take.
1955	Aug	11	right	9	1	1?	scientific whaling	catcher	Klumov (1962)	Research take of an 11.4 m female.
1958-1968	summer-autumn		right	2	3	1-5[5]	commercial whaling/cetacean sighting	catcher/scout/ship	Rovnin (1969)	Reported as a sighting, not a take.
1958-1968	summer-autumn		right	9	3	1-5[5]	commercial whaling/cetacean sighting	catcher/scout/ship	Rovnin (1969)	Reported as a sighting, not a take.
1958-1968	summer-autumn		right	9	3	1-5[5]	commercial whaling/cetacean sighting	catcher/scout/ship	Rovnin (1969)	Reported as a sighting, not a take.
1967	Sep		right	2	3	1	cetacean sighting	ship	Rovnin (1969), Kuzmin and Berzin (1974)	
1973	Sep		right	9	3	2	commercial whaling	catcher	Berzin (1978)	Reported as a sighting, not a take.
1973	Sep		right	9	3	3	commercial whaling	catcher	Berzin (1978)	Reported as a sighting, not a take.
1973	Sep		right	9	3	6	commercial whaling	catcher	Berzin (1978)	Reported as a sighting, not a take.

1989-1992[1]	Aug-Sep		right	6	NA[2]	3[3]	cetacean sighting	ship	Miyashita and Doroshenko (1990), Miyashita and Berzin (1991), Miyashita (1997), Miyashita and Kato (1998)	
1989-1992[1]	Aug-Sep		right	9	NA[2]	10[3]	cetacean sighting	ship	Miyashita and Doroshenko (1990), Miyashita and Berzin (1991), Miyashita (1997), Miyashita and Kato (1998)	The caudal peduncle of a whale in one of these sightings was entangled in fishing line.
1991	Sep		right	9	2	2	pinniped aerial	helicopter	A. M. Burdin, pers. comm.	
1998	Sep		right	6	NA[2]	2[3]	cetacean sighting	ship	Miyashita (1999)	
1999	Sep		right	8	NA[2]	4[3]	cetacean sighting	ship	Miyashita *et al.* (2000)	
1999	Sep		right	9	NA[2]	1[3]	cetacean sighting	ship	Miyashita *et al.* (2000)	
2003	Jul-Aug		right	8	NA[2]	1[3]	cetacean sighting	ship	Miyashita (2004)	
2003	Jul-Aug		right	9	NA[2]	1[3]	cetacean sighting	ship	Miyashita (2004)	
1948	Oct		blue	9	3	?	cetacean sighting	scout	Sleptsov (1955a)	
1948	Oct		fin	7	3	?	cetacean sighting	scout	Sleptsov (1955a)	
1948	Oct	7	fin	1	1	20	cetacean sighting	scout	Sleptsov (1955a, 1961)	
1953-1954	summer-autumn		fin	9	3	?	cetacean sighting	scout	Sleptsov (1955a)	
1958-1968	summer-autumn		fin	4	3	1-5[5]	commercial whaling/cetacean sighting	catcher/scout/ ship	Rovnin (1969)	Reported as a sighting, not a take.
1958-1968	summer-autumn		fin	7	3	1-5[5]	commercial whaling/cetacean sighting	catcher/scout/ ship	Rovnin (1969)	Reported as a sighting, not a take.
1958-1968	summer-autumn		fin	9	3	1-5[5]	commercial whaling/cetacean sighting	catcher/scout/ ship	Rovnin (1969)	Reported as a sighting, not a take.
1967	Sep		fin	1	3	3	cetacean sighting	ship	Kuzmin and Berzin (1974)	
1967	Sep		fin	2	3	1	cetacean sighting	ship	Rovnin (1969), Kuzmin and Berzin (1974)	
1986	Oct		fin	9	3	?	cetacean sighting	ship	Blokhin (1988)	
1989-1992[1]	Aug-Sep		fin	1	NA[2]	4[3]	cetacean sighting	ship	Miyashita and Doroshenko (1990), Miyashita and Berzin (1991), Miyashita (1997)	
1989-1992[1]	Aug-Sep		fin	2	NA[2]	9[3]	cetacean sighting	ship	Miyashita and Doroshenko (1990), Miyashita and Berzin (1991), Miyashita (1997)	

1989-1992[1]	Aug-Sep	fin	3	NA[2]	2[3]	cetacean sighting	ship	Miyashita and Doroshenko (1990), Miyashita and Berzin (1991), Miyashita (1997)
1989-1992[1]	Aug-Sep	fin	6	NA[2]	3[3]	cetacean sighting	ship	Miyashita and Doroshenko (1990), Miyashita and Berzin (1991), Miyashita (1997)
1989-1992[1]	Aug-Sep	fin	7	NA[2]	4[3]	cetacean sighting	ship	Miyashita and Doroshenko (1990), Miyashita and Berzin (1991), Miyashita (1997)
1989-1992[1]	Aug-Sep	fin	9	NA[2]	5[3]	cetacean sighting	ship	Miyashita and Doroshenko (1990), Miyashita and Berzin (1991), Miyashita (1997)
1997	Jul-Aug	fin	4	3	1	biological oceanography	ship	Shuntov (1999)
1997	Jul-Aug	fin	4	3	10	biological oceanography	ship	Shuntov (1999)
1997	Jul-Aug	fin	6	3	2	biological oceanography	ship	Shuntov (1999)
1998	Sep	fin	6	NA[2]	7[3]	cetacean sighting	ship	Miyashita (1999)
1998	Sep	fin	8	NA[2]	1[3]	cetacean sighting	ship	Miyashita (1999)
1999	Sep	fin	6	NA[2]	8[3]	cetacean sighting	ship	Miyashita *et al.* (2000)
2000	Jul	fin	6	NA[2]	2[3]	cetacean sighting	ship	Miyashita *et al.* (2001)
2003	Jul-Aug	fin	6	NA[2]	1[3]	cetacean sighting	ship	Miyashita (2004)
2003	Jul-Aug	fin	9	NA[2]	1[3]	cetacean sighting	ship	Miyashita (2004)
1948	Oct	sei	7	3	?	cetacean sighting	scout	Sleptsov (1955a)
1974-1984	Aug-Oct	sei	9	3	4[5]	cetacean sighting	ship	Berzin and Vladimirov (1989)
1948	Oct	minke	1	3	?	cetacean sighting	scout	Sleptsov (1955a)
1948	Oct	minke	5	3	?	cetacean sighting	scout	Sleptsov (1955a)
1948	Oct	minke	9	3	?	cetacean sighting	scout	Sleptsov (1955a)
1967	Sep	minke	2	3	1	cetacean sighting	ship	Kuzmin and Berzin (1974)
1967	Sep	minke	2	3	1	cetacean sighting	ship	Kuzmin and Berzin (1974)
1967	Sep	minke	2	3	1	cetacean sighting	ship	Kuzmin and Berzin (1974)
1967	Sep	minke	1	3	1	cetacean sighting	ship	Kuzmin and Berzin (1974)
1967	Sep	minke	1	3	1	cetacean sighting	ship	Kuzmin and Berzin (1974)
1967	Sep	minke	1	3	1	cetacean sighting	ship	Kuzmin and Berzin (1974)
1967	Sep	minke	1	3	1	cetacean sighting	ship	Kuzmin and Berzin (1974)
1967	Sep	minke	1	3	1	cetacean sighting	ship	Kuzmin and Berzin (1974)
1967	Sep	minke	4	3	1	cetacean sighting	ship	Kuzmin and Berzin (1974)
1967	Sep	minke	4	3	1	cetacean sighting	ship	Kuzmin and Berzin (1974)

1974	Jul	minke	5	1	2	cetacean sighting	ship	Berzin and Vladimirov (1989)
1974	Sep	minke	3	3	7	cetacean sighting	ship	Kuzmin and Berzin (1974)
1974	Sep	minke	3	3	9	cetacean sighting	ship	Kuzmin and Berzin (1974)
1974-1984	unknown	minke	7	3	3[5]	cetacean sighting	ship	Berzin and Vladimirov (1989)
1983	Jul	minke	9	1	2	cetacean sighting	ship	Berzin and Vladimirov (1989)
1986	Oct	minke	5	3	?	cetacean sighting	ship	Blokhin (1988)
1989-1992[1]	Aug-Sep	minke	1	NA[2]	7[3]	cetacean sighting	ship	Miyashita and Doroshenko (1990), Miyashita and Berzin (1991), Miyashita and Shimada (1994), Miyashita (1997)
1989-1992[1]	Aug-Sep	minke	2	NA[2]	6[3]	cetacean sighting	ship	Miyashita and Doroshenko (1990), Miyashita and Berzin (1991), Miyashita and Shimada (1994), Miyashita (1997)
1989-1992[1]	Aug-Sep	minke	3	NA[2]	5[3]	cetacean sighting	ship	Miyashita and Doroshenko (1990), Miyashita and Berzin (1991), Miyashita and Shimada (1994), Miyashita (1997)
1989-1992[1]	Aug-Sep	minke	4	NA[2]	1[3]	cetacean sighting	ship	Miyashita and Doroshenko (1990), Miyashita and Berzin (1991), Miyashita and Shimada (1994), Miyashita (1997)
1989-1992[1]	Aug-Sep	minke	5	NA[2]	5[3]	cetacean sighting	ship	Miyashita and Doroshenko (1990), Miyashita and Berzin (1991), Miyashita and Shimada (1994), Miyashita (1997)
1989-1992[1]	Aug-Sep	minke	7	NA[2]	1[3]	cetacean sighting	ship	Miyashita and Doroshenko (1990), Miyashita and Berzin (1991), Miyashita and Shimada (1994), Miyashita (1997)

1989-1992[1]	Aug-Sep	minke	8	NA[2]	3[3]	cetacean sighting	ship	Miyashita and Doroshenko (1990), Miyashita and Berzin (1991), Miyashita and Shimada (1994), Miyashita (1997)
1989-1992[1]	Aug-Sep	minke	9	NA[2]	1[3]	cetacean sighting	ship	Miyashita and Doroshenko (1990), Miyashita and Berzin (1991), Miyashita and Shimada (1994), Miyashita (1997)
1997	Jul-Aug	minke	1	3	1	biological oceanography	ship	Shuntov (1999)
1997	Jul-Aug	minke	2	3	2	biological oceanography	ship	Shuntov (1999)
1997	Jul-Aug	minke	2	3	8	biological oceanography	ship	Shuntov (1999)
1998	Sep	minke	4	NA[2]	1[3]	cetacean sighting	ship	Miyashita (1999)
1998	Sep	minke	7	NA[2]	1[3]	cetacean sighting	ship	Miyashita (1999)
1998	winter-spring	minke	2	3	3-5	biological oceanography	ship	Shuntov (2001)
1998	winter-spring	minke	2	3	1-2	biological oceanography	ship	Shuntov (2001)
1998	winter-spring	minke	2	3	3-5	biological oceanography	ship	Shuntov (2001)
1998	winter-spring	minke	2	3	3-5	biological oceanography	ship	Shuntov (2001)
1998	winter-spring	minke	2	3	1-2	biological oceanography	ship	Shuntov (2001)
1998	winter-spring	minke	2	3	1-2	biological oceanography	ship	Shuntov (2001)
1998	winter-spring	minke	2	3	1-2	biological oceanography	ship	Shuntov (2001)
1998	winter-spring	minke	2	3	1-2	biological oceanography	ship	Shuntov (2001)
1998	winter-spring	minke	5	3	1-2	biological oceanography	ship	Shuntov (2001)
1998	winter-spring	minke	5	3	1-2	biological oceanography	ship	Shuntov (2001)
1998	winter-spring	minke	5	3	1-2	biological oceanography	ship	Shuntov (2001)

1998	winter-spring		minke	7	3	1-2	biological oceanography	ship	Shuntov (2001)
1998	winter-spring		minke	7	3	1-2	biological oceanography	ship	Shuntov (2001)
1998	winter-spring		minke	7	3	1-2	biological oceanography	ship	Shuntov (2001)
1998	winter-spring		minke	9	3	1-2	biological oceanography	ship	Shuntov (2001)
1998	winter-spring		minke	9	3	1-2	biological oceanography	ship	Shuntov (2001)
1998	winter-spring		minke	9	3	3-5	biological oceanography	ship	Shuntov (2001)
1998	winter-spring		minke	9	3	3-5	biological oceanography	ship	Shuntov (2001)
1998	summer-autumn		minke	2	3	1-2	biological oceanography	ship	Shuntov (2001)
1998	summer-autumn		minke	4	3	1-2	biological oceanography	ship	Shuntov (2001)
1999	winter-spring		minke	5	3	1-2	biological oceanography	ship	Shuntov (2001)
1999	winter-spring		minke	7	3	1-2	biological oceanography	ship	Shuntov (2001)
1999	winter-spring		minke	7	3	1-2	biological oceanography	ship	Shuntov (2001)
1999	winter-spring		minke	9	3	1-2	biological oceanography	ship	Shuntov (2001)
1999	winter-spring		minke	8	3	3-5	biological oceanography	ship	Shuntov (2001)
1999	winter-spring		minke	9	3	1-2	biological oceanography	ship	Shuntov (2001)
1999	summer-autumn		minke	7	3	3-5	biological oceanography	ship	Shuntov (2001)
1999	summer-autumn		minke	6	3	1-2	biological oceanography	ship	Shuntov (2001)
2001	Sep	22	minke	1	1	2	cetacean sighting	ship	Ivannikov and Doroshenko (2001)
2001	Oct	1	minke	7	1	1	cetacean sighting	ship	Ivannikov and Doroshenko (2001)
2003	Jul-Aug		minke	2	NA[2]	2[3]	cetacean sighting	ship	Miyashita (2004), Miyashita and Hakamada (2009)

2003	Jul-Aug		minke	7	NA[2]	1[3]	cetacean sighting	ship	Miyashita (2004), Miyashita and Hakamada (2009)	
2009	Aug	4	minke	7	1	1	cetacean sighting	ship	Burdin *et al.* (2010)	
2009	Aug	14	minke	3	1	5	cetacean sighting	small boat	Burdin *et al.* (2010)	Observed feeding.
2009	Aug	14	minke	3	1	3	cetacean sighting	small boat	Burdin *et al.* (2010)	Observed feeding.
2009	Aug	16	minke	2	1	1	cetacean sighting	small boat	Burdin *et al.* (2010)	Observed feeding.
2009	Aug	16	minke	3	1	2	cetacean sighting	small boat	Burdin *et al.* (2010)	Observed feeding.
2009	Sep	20	minke	7	1	1	cetacean sighting	ship	Burdin *et al.* (2010)	
2009	Sep	21	minke	5	1	1	cetacean sighting	ship	Burdin *et al.* (2010)	
1989-1992[1]	Aug-Sep		humpback	3	NA[2]	1[3]	cetacean sighting	ship	Miyashita and Doroshenko (1990), Miyashita and Berzin (1991), Miyashita (1997)	
1997	Jul-Aug		humpback	5	3	1	biological oceanography	ship	Shuntov (1999)	
2004	Jul	6	humpback	7	1	13	opportunistic observation	ship	S. Frolov, pers. comm.	

[1]Results from surveys conducted in 1989, 1990, and 1992 are combined following Miyashita (1997), since not all species were reported in the individual survey reports.
[2]Given the high number and density of sightings presented via map in this source(s), it was not possible to approximate the positions of individual sightings. Instead, these sightings are presented as relative species proportions by subregion in Fig. 9.
[3]Group size in this case represents the minimum number of sightings (of unknown group size) in a given subregion of the study area.
[4]Given the high number and density of sightings presented via map in this source, it was not possible to approximate the positions of individual sightings. Instead, the spatial extent of these sightings is shown in Fig. 2.
[5]Group size in this case appears to represent the number of whales in aggregated sightings within the same general area over some period of time rather than the group size of a single sighting.
[6]This sighting was plotted as "dolphin" in source, but text makes clear that it is a Dall's porpoise sighting.
[7]Exact species was not confirmed in this case. Although this sighting was reported as a right whale, note that right and bowhead whales are often referred to collectively as "right" whales in the Russian literature.
[8]This source combined Japanese (1941-1968) and Soviet (1951-1957) sightings, with the latter sightings from Klumov (1962).

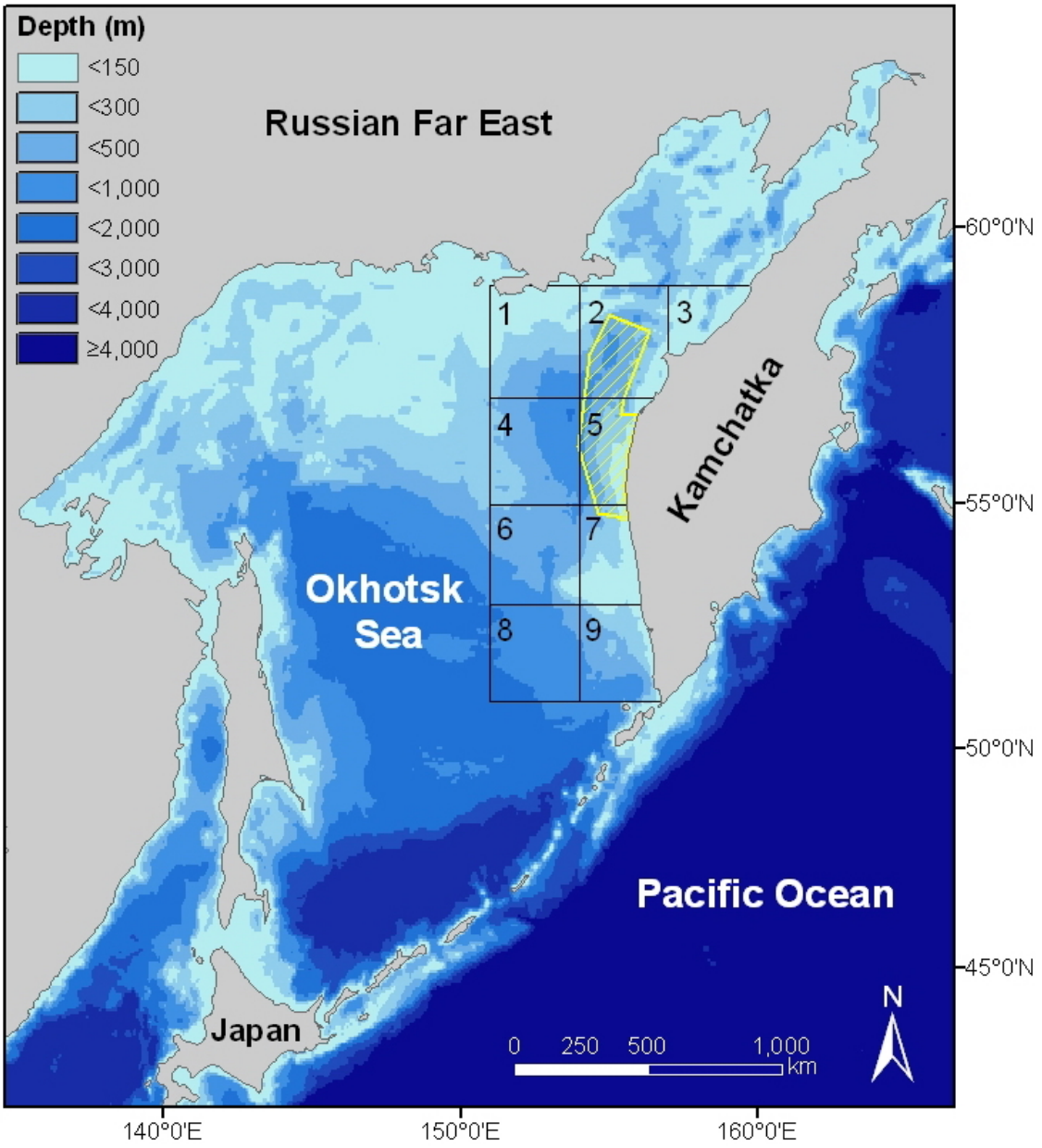

Figure 1. Map of the Okhotsk Sea, located primarily in the Russian Far East. The cetacean distribution and occurrence review study area, subdivided into nine regions, is outlined in black. The hashed yellow block represents the current boundary of the West Kamchatka oil and gas license area (data layer provided by the Kamchatka League of Independent Experts). Bathymetry data were obtained from the National Geophysical Data Center at <http://www.ngdc.noaa.gov/mgg/geodas/geodas.html>.

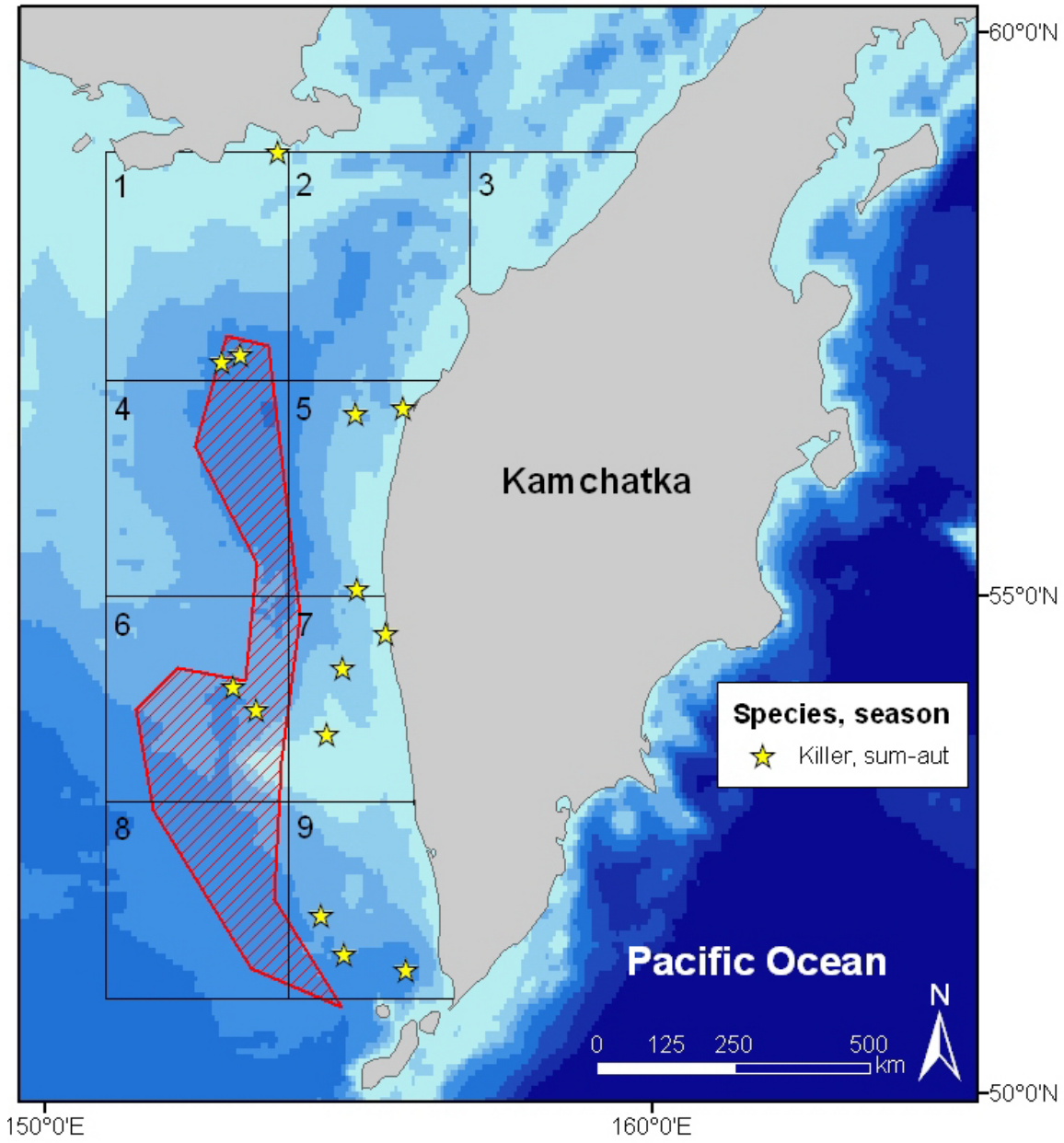

Figure 2. Distribution of killer whale groups (n=14) sighted in the study area during summer and autumn months (see Table 1 for sources of sightings). The hashed red region approximates the spatial extent of over 100 sightings of killer whale groups reported to be depredating Greenland halibut longlines from June to September 2001 (Karyakin 2004).

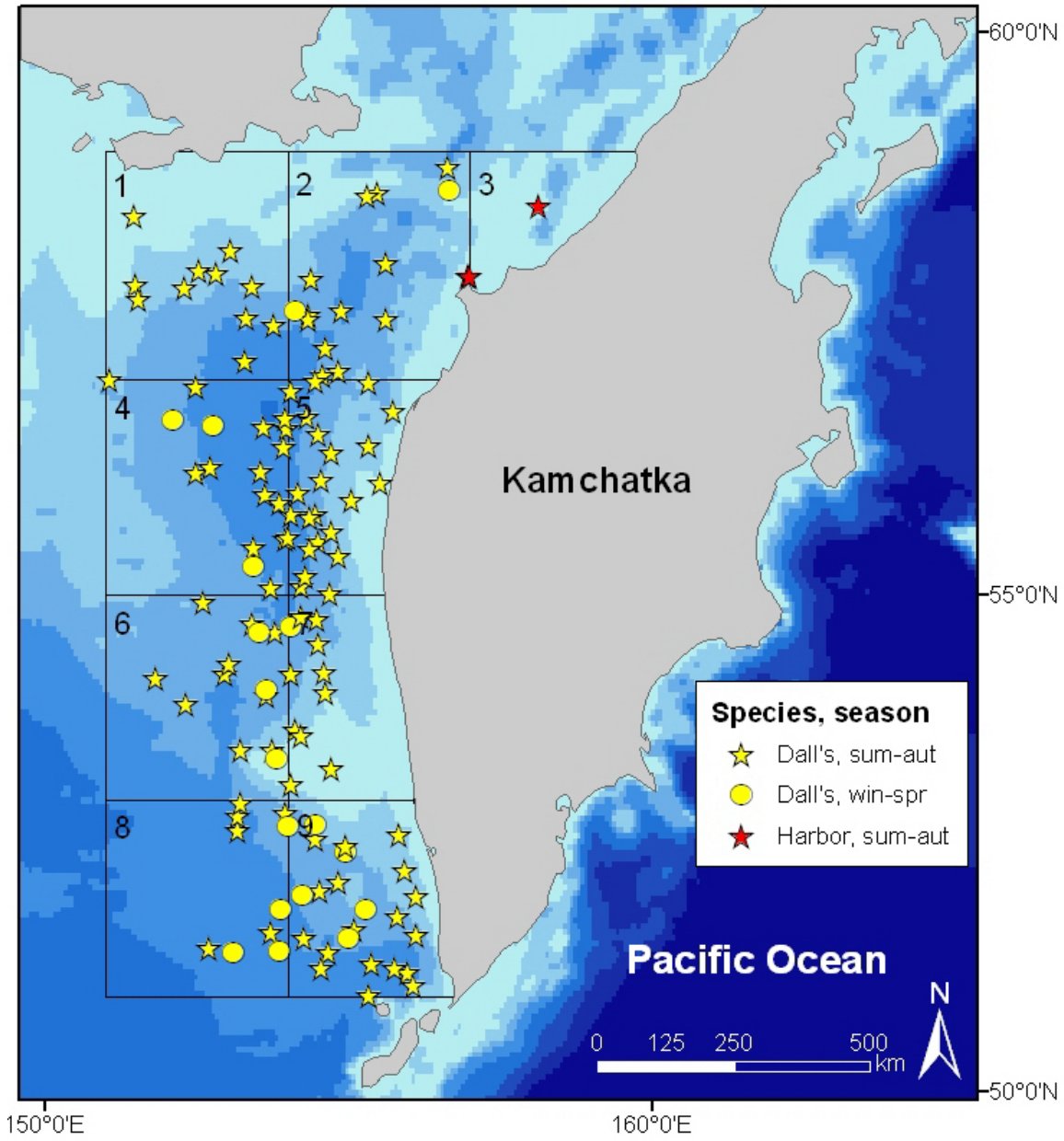

Figure 3. Distribution of Dall's porpoise groups sighted in the study area during summer and autumn (n=104, note this sample includes one sighting that occurred in an unknown month) and winter and spring (n=18) months, as well as of harbor porpoise groups (n=3) during the summer and autumn period (see Table 1 for sources of sightings).

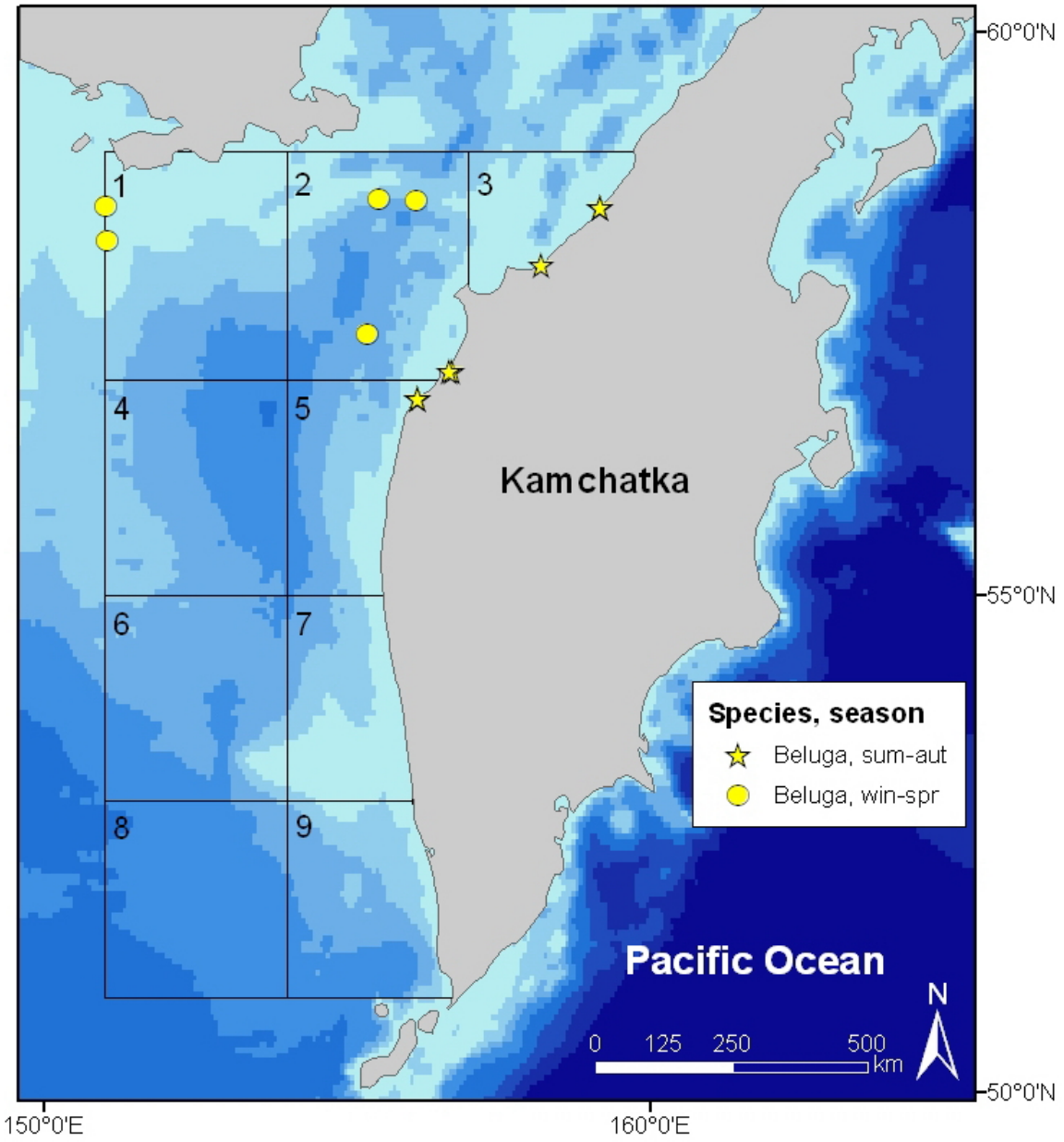

Figure 4. Distribution of beluga whale groups sighted in the study area during summer and autumn (n=9) and winter and spring (n=5) months (see Table 1 for sources of sightings).

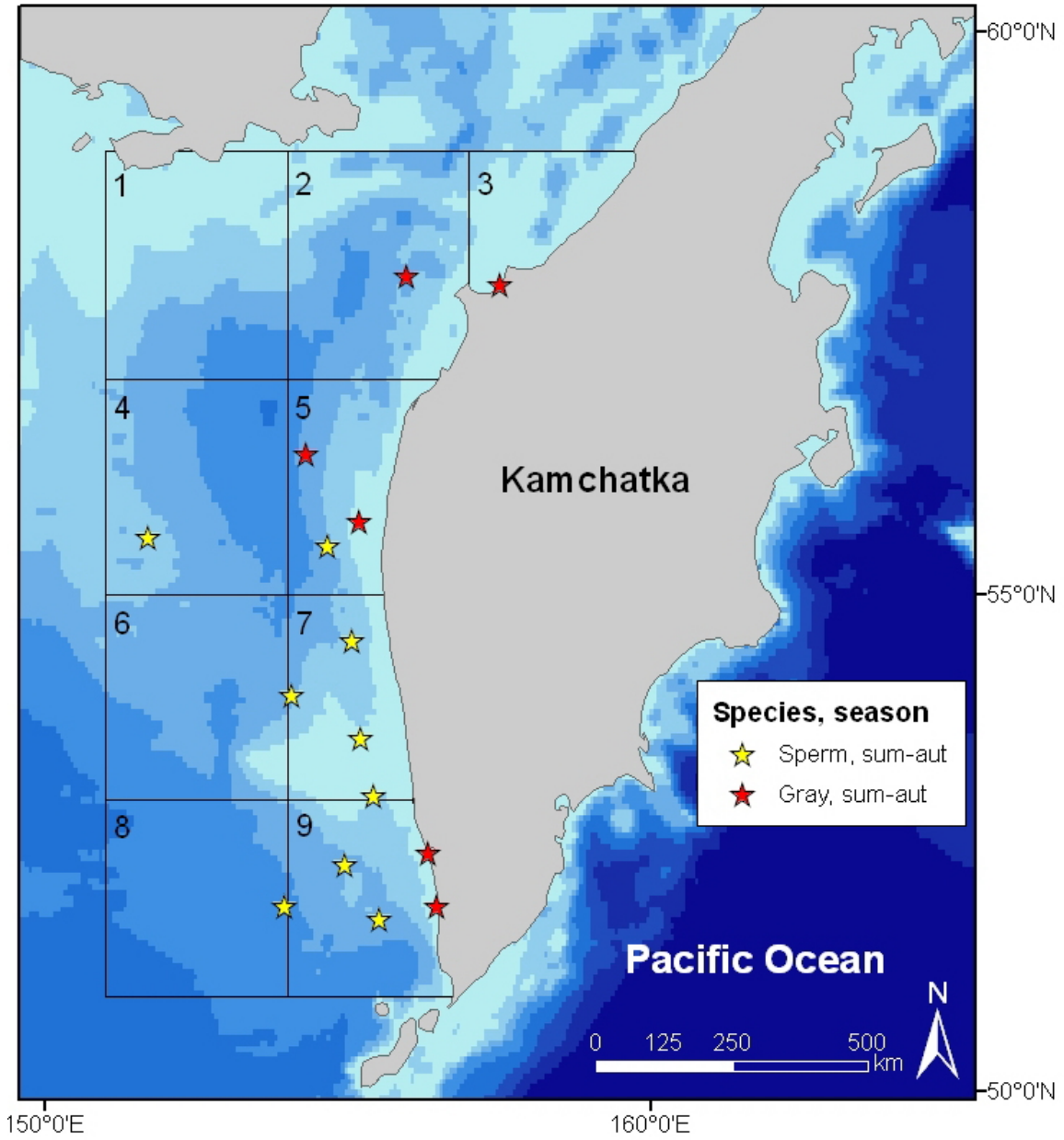

Figure 5. Distribution of sperm whale (n=9) and gray whale (n=6) groups sighted in the study area during summer and autumn months (see Table 1 for sources of sightings).

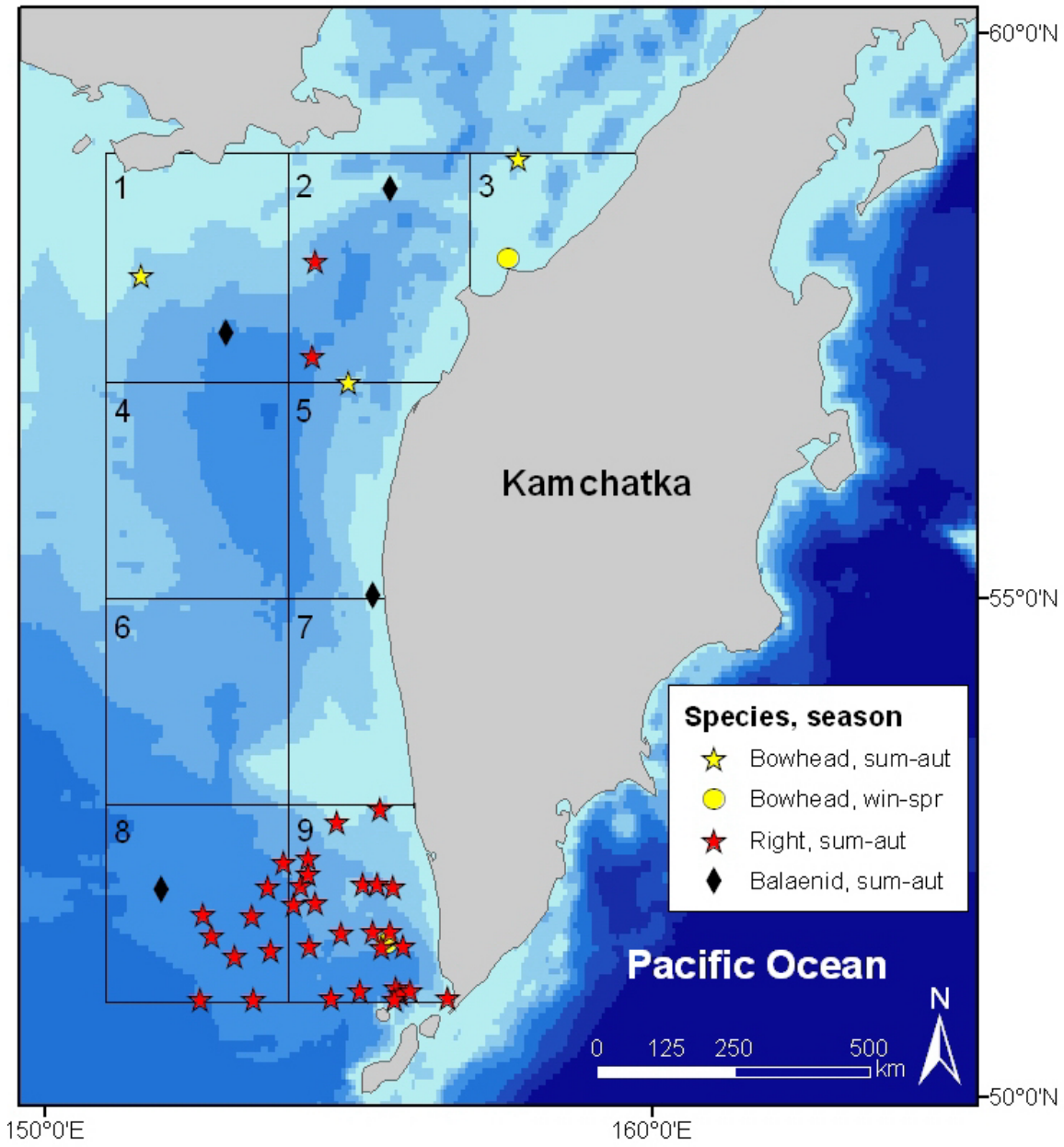

Figure 6. Distribution of bowhead whale groups sighted in the study area during summer and autumn (n=3) and winter and spring (n=2) months, as well as of right whale groups during the summer and autumn period (n=34). Also shown are summer and autumn sightings of bowhead or right whale groups (n=4) in which the species was not confirmed. Sources of sightings are available in Table 1.

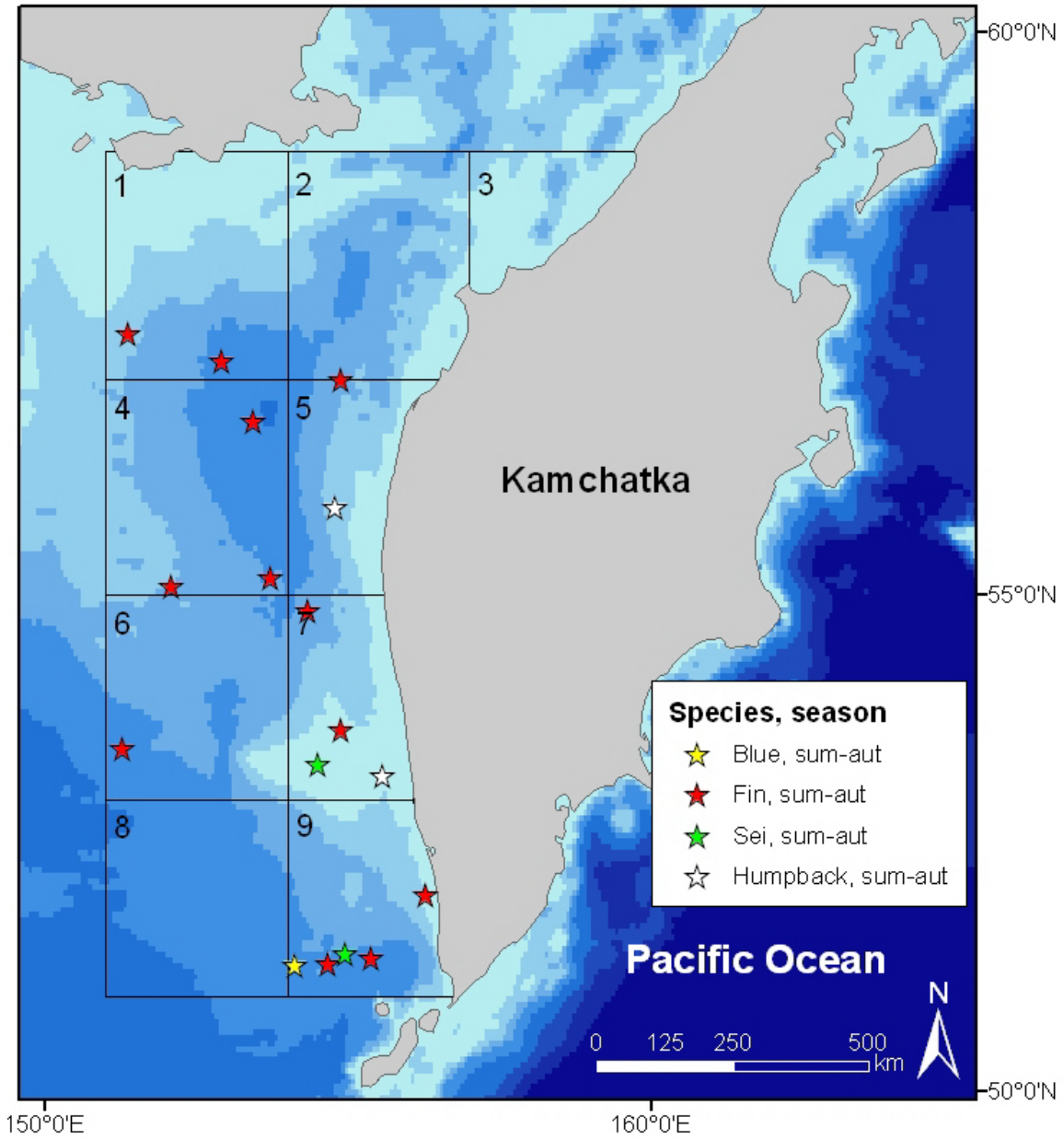

Figure 7. Distribution of blue whale (n=1), fin whale (n=12), sei whale (n=2), and humpback whale (n=2) groups sighted in the study area during summer and autumn months (see Table 1 for sources of sightings).

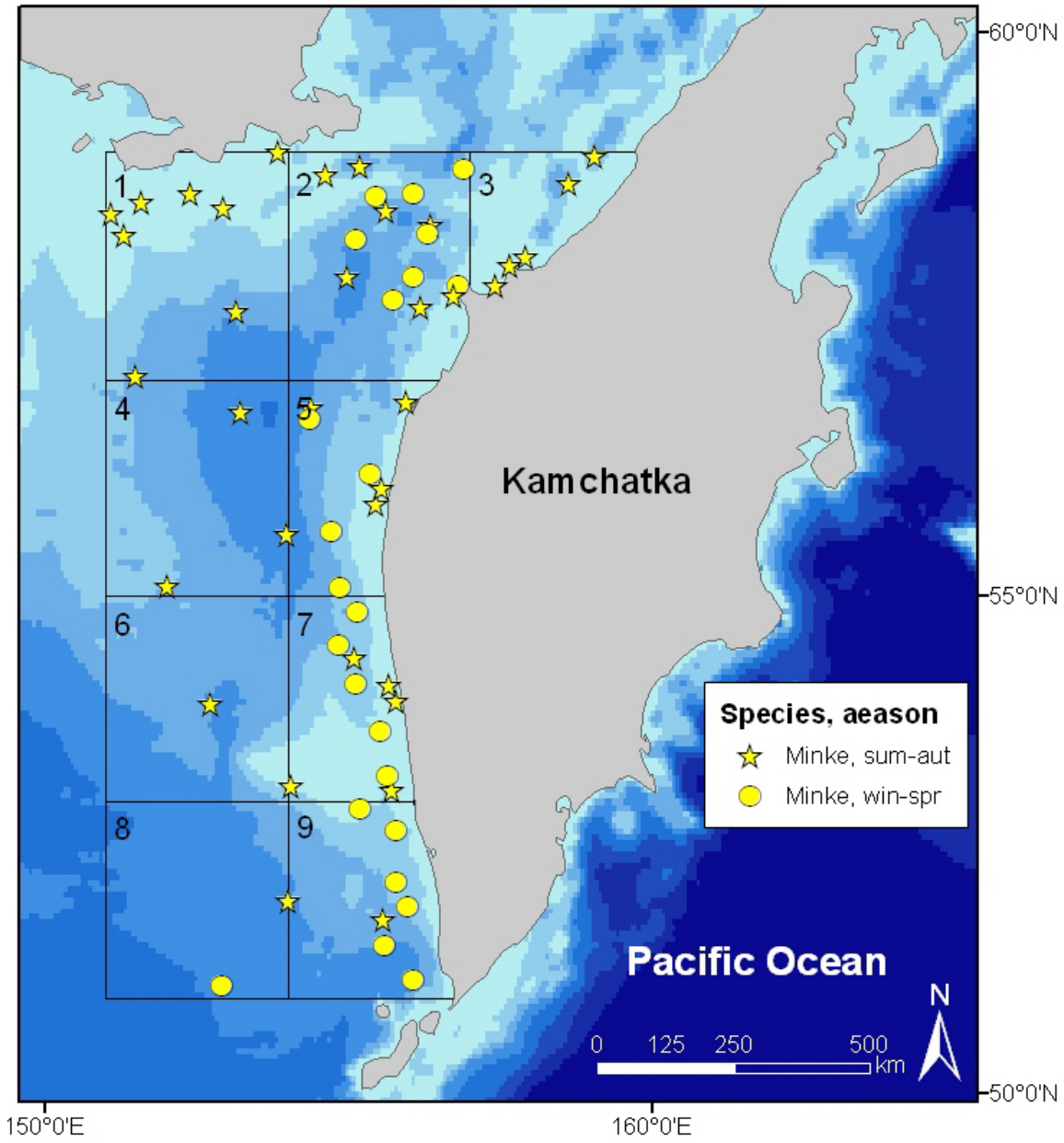

Figure 8. Distribution of minke whale groups sighted in the study area during summer and autumn (n=35, note this sample includes one sighting that occurred in an unknown month) and winter and spring (n=24) months (see Table 1 for sources of sightings).

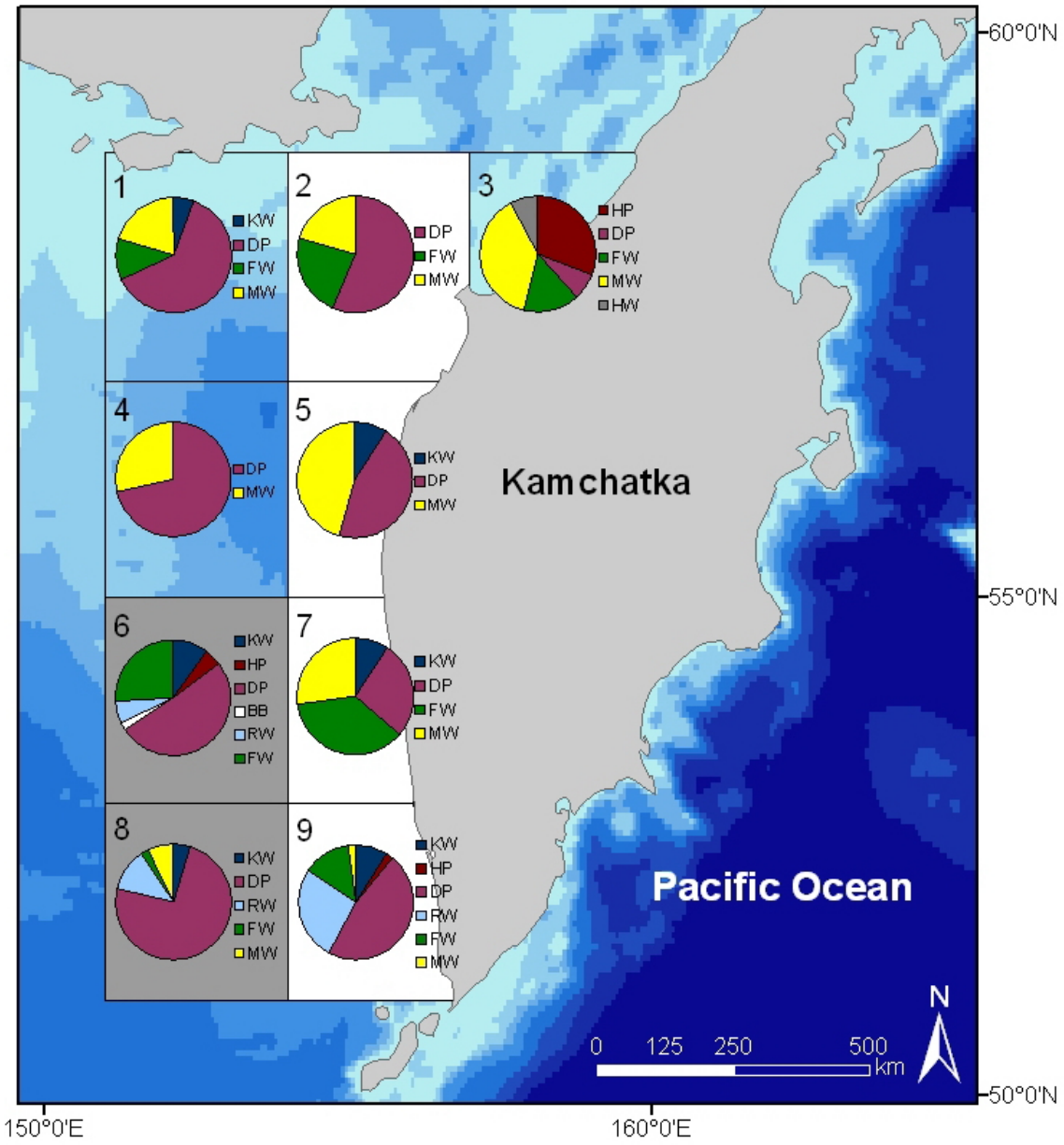

Figure 9. Relative species proportions of reported cetacean sightings (n=a minimum of 283 groups) from Japanese-led summer surveys of the Okhotsk Sea in 1989, 1990, 1992, 1998, 1999, 2000, and 2003, by subregion of the study area, where KW=killer whale, DP=Dall's porpoise, FW=fin whale, MW=minke whale, HP=harbor porpoise, HW=humpback whale, BB=Baird's beaked whale, and RW=right whale (see Table 1 for sample sizes by subregion and for sources of sightings). Note that Dall's porpoise, harbor porpoise, killer whale, and Baird's beaked whale sightings, if any, were not included in the 2000 and 2003 survey reports (Miyashita *et al.* 2001, Miyashita 2004), so there is presumably a downward bias in the proportions associated with these species in subregions 2 and 4-9, which were visited in those years. There was some survey effort within each subregion in at least two years, with some subregions visited in 2-3 years (no shading), in 4-5 years (white shading), and in 6-7 years (gray shading).

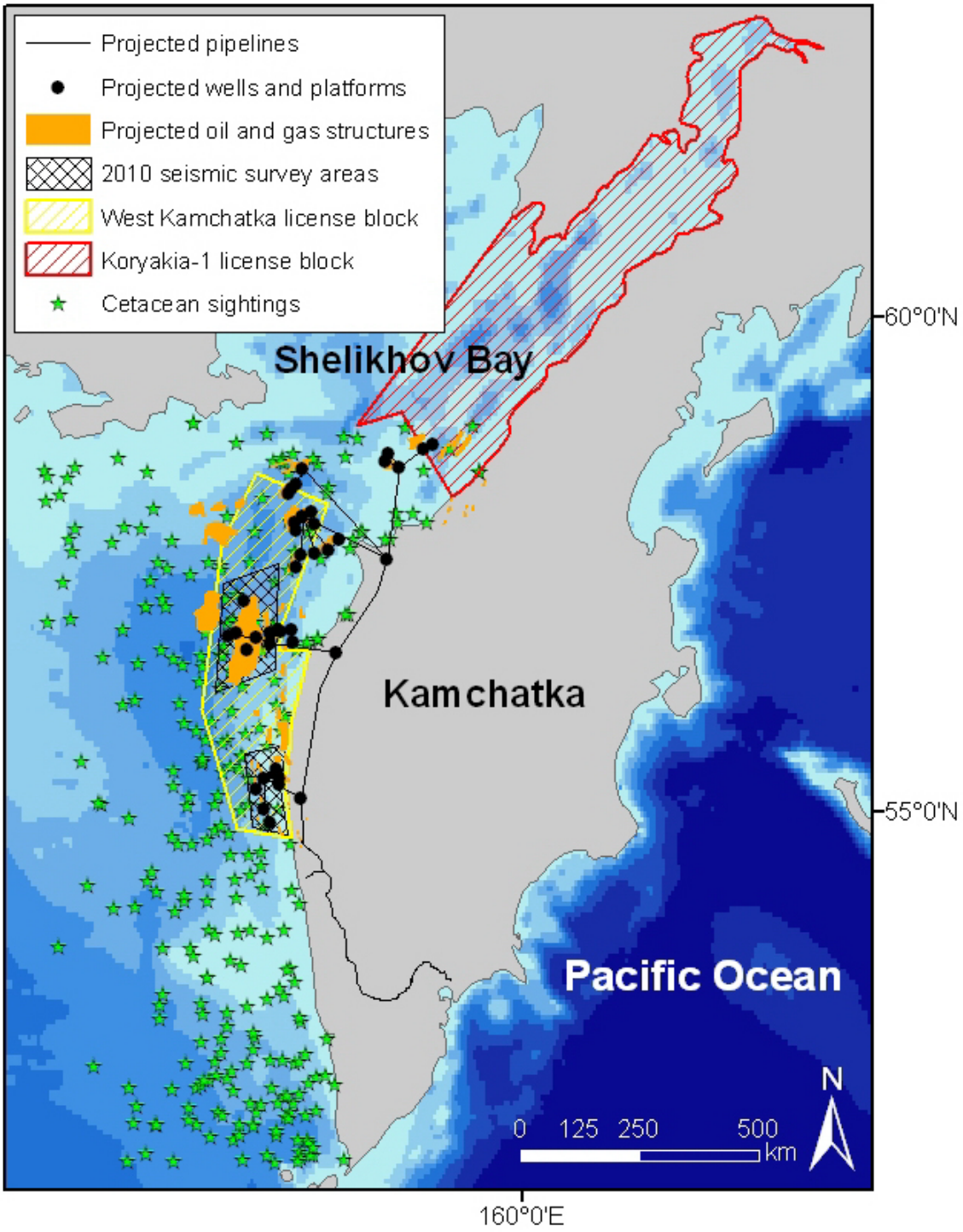

Figure 10. Projected oil and gas development associated with the West Kamchatka license area. Also shown is the current boundary of the Koryakia-1 license area slated for development in Shelikhov Bay. All oil and gas data courtesy of the Kamchatka League of Independent Experts. Cetacean sightings (n=287 groups) are from the present study.

Appendix 1. List of key sources that were searched for information on the distribution and occurrence of cetaceans off the western coast of Kamchatka, but did not yield relevant or unique results and thus are not cited in the text.

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Berzin, A. A., and A. A. Rovnin 1984. Distribution and abundance of right whales (Balaenidae) in the Pacific Ocean. Pages 147-162 in Morskie mlekopitayushchie. Moscow. (In Russian.)

Berzin, A. A., B. L. Vladimirov, and N. V. Doroshenko. 1990. Results of aerial surveys to determine the distribution and abundance of polar gray whales and belugas in the Sea of Okhotsk. Izvestiya TINRO 112:51-60. (In Russian.)

Blokhin, S. A. 1996. Distribution, abundance and behavior of gray whales (*Eschrichtius robustus*) of American and Asian populations in regions of their summer location nearshore of the Far East. Izvestiya TINRO 121:36-53. (In Russian.)

Blokhin, S. A., Maminov, M. K., and G. M. Kosygin. 1985. On the Korean-Okhotsk population of gray whales. Report of the International Whaling Commission 35:375-376.

Ivashin, M. V. 1992. USSR catch and sightings of minke whales. Appendix 7 of Report of the Scientific Committee, Annex F (Report of the Sub-committee on North Pacific Minke Whales). Report of the International Whaling Comission 42:168-169.

Josephson, E. A., T. D. Smith, and R. R. Reeves. 2008. Depletion within a decade: the American 19th-century North Pacific right whale fishery. Pages 133-147 in D. J. Starkey, P. Holm, and M. Barnard, eds. Oceans past: management insights from the history of marine animal populations. Earthscan, Sterling, VA.

Kuzmin, A. A., and A. A. Berzin 1975. Distribution and current abundance of right and gray whales in the Far East seas. Pages 121-122 in Biological Resources of the Far East Seas, Thesis of the All-Union Conference, Vladivostok. (In Russian.)

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Nemoto, T. 1959. Food of baleen whales with reference to whale movements. Scientific Reports of the Whales Research Institute 14:149-290.

Omura, H. 1986. History of right whale catches in the waters around Japan. Report of the International Whaling Commission (Special Issue 10):35-41.

Sleptsov, M. M. 1961. Ecology of cetaceans in zones of mixing of cold (Kurile-Kamchatka) and warm (Kuroshio) currents. Akademiya Nauk USSR, Trudy Instituta Morfologii Zhivoteykh 34:111-135. (In Russian.)

Slu'nin, N. 1895. Natural resources of Kamchatka, Sakhalin, and Commander Islands. Kirshbaum, Saint Petersburg. (In Russian.)

Tillman, M. F., and J. M. Breiwick. 1983. Estimates of abundance for the western North Pacific sperm whale based upon historical whaling records. Report of the International Whaling Commission (Special Issue 5):257-269.

Votrogov, L. M., and L. S. Bogoslovskaya. 1986. A note on gray whales off Kamchatka, the Kuril Islands and Peter the Great Bay. Report of the International Whaling Commission 36:281-282.

Zenkovich, B. A. 1934. The California gray whale (*Rhachianectes glaucus* Cope). Bulletin of the Far Eastern Branch of the Academy of Sciences USSR 10:9-25. (In Russian.)

Zenkovich, B. A. 1937. More on the California gray whale (*Rhachianectes glaucus* Cope, 1864). Bulletin of the Far Eastern Branch of the Academy of Sciences USSR 23:91-103. (In Russian.)

Zenkovich, B. A. 1952. Whales and whaling. Pishchepromizdat, Moscow. (In Russian.)

Zenkovich, B. A. 1955. A brief history of whaling in prerevolutionary Russia and an account of present-day whaling in the USSR. Pages 5-28 in S. E. Kleinenberg and T. I. Makarova, eds. The whaling industry of the Soviet Union, Part 1. VNIRO, Moscow. (In Russian.)