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Cetacean fauna of the southern part of the Barents Sea in winter 2019–2023 under changing climate conditions

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ABSTRACT

Biophysical changes occurring in Arctic marine ecosystems under the influence of climatic factors may affect cetaceans staying here. For this reason, the urgent task is to conduct regular monitoring of marine mammals in order to assess the state of their populations and preserve the biodiversity of species. We analyzed the results of ship-based surveys of marine mammals carried out by the Polar branch of VNIRO in January–March 2019–2023 in the south of the Barents Sea and compared them with the observation data of earlier years. As the studies have shown, the winter cetacean fauna is currently represented by six species of baleen Mysticeti and toothed Odontoceti whales. White-beaked dolphin *Lagenorhynchus albirostris* Gray, 1846 was the most abundant and widespread species among all cetaceans; however, since 2022 we have seen a decrease in both the number of observations and abundance of this species. Fin whale *Balaenoptera physalus* Linnaeus, 1758 and killer whale *Orcinus orca* Linnaeus, 1758 were regularly registered in the study area, while sightings of harbor porpoise *Phocoena phocoena* Linnaeus, 1758 and humpback whale *Megaptera novaeangliae* Borowski, 1781 were single. Comparative analysis of the obtained data with the materials of 2012–2013 revealed some changes in the cetacean fauna that occurred during the last decade. In the waters of the southern part of the Barents Sea, there began met species that had not been previously recorded in our surveys, first of all, minke whale *Balaenoptera acutorostrata* Lacépède, 1804 and humpback whale. The materials we collected expanded our understanding of cetaceans staying in the western sector of the Russian Arctic during the winter.

Keywords: Barents Sea, Cetacea, cetaceans, distribution, global warming, marine mammals, occurrence, vessel survey

Фауна китообразных южной акватории Баренцева моря в зимний период 2019–2023 гг. в условиях меняющегося климата

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РЕЗЮМЕ

Биофизические изменения, происходящие в морских экосистемах Арктики под воздействием климатических факторов, могут оказывать влияние на пребывающих здесь китообразных. В этой связи актуальной задачей является проведение регулярных наблюдений морских млекопитающих с целью

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оценки состояния их популяций и сохранения биоразнообразия. Мы проанализировали результаты судовых учетных съемок морских млекопитающих, выполненных Полярным филиалом ФГБНУ «ВНИРО» в январе–марте 2019–2023 гг. на юге Баренцева моря и сравнили их с данными наблюдений более ранних лет. Зимняя фауна китообразных в настоящее время представлена 6 видами усатых Mysticeti и зубатых Odontoceti китов. Беломордый дельфин *Lagenorhynchus albirostris* Gray, 1846 являлся наиболее многочисленным и распространенным видом среди всех китообразных, тем не менее, начиная с 2022 г. наблюдается уменьшение числа встреч и количества особей этого вида. Финвала *Balaenoptera physalus* Linnaeus, 1758 и косатку *Orcinus orca* Linnaeus, 1758 регулярно регистрировали на акватории проведения работ, в то время как встречи обыкновенной морской свиньи *Phocoena phocoena* Linnaeus, 1758 и горбача *Megaptera novaeangliae* Borowski, 1781 были единичными. Сравнительный анализ полученных данных с материалами 2012–2013 гг. выявил некоторые изменения в фауне китообразных, произошедшие за последнее десятилетие. В частности, наблюдается увеличение видового разнообразия усатых и зубатых китов и их более широкое распределение. На акватории южной части Баренцева моря начали встречаться виды, которых ранее в съемках не регистрировали, прежде всего, это малый полосатик *Balaenoptera acutorostrata* Lacépède, 1804 и горбатый кит. Собранные материалы расширили представление о китообразных, присутствующих в западном секторе Российской Арктики в зимний период.

Ключевые слова: Баренцево море, Cetacea, китообразные, распределение, глобальное потепление, морские млекопитающие, встречаемость, учетные съемки

INTRODUCTION

The cetacean fauna inhabiting the waters of the Northeast Atlantic (NEA) is generally well studied (Leonard and Øien 2020; Storrie et al. 2018). However, shipboard and aerial observations of baleen and toothed whales at high latitudes, due to extreme climatic conditions and short daylight hours in December–February, are primarily conducted during the summer months (Ahonen et al. 2017). For this reason, materials on cetacean records during the winter period are scarce and come mainly from stationary acoustic devices that record whale voices (Klinck et al. 2012; Papale et al. 2023). Since 2012 the Polar Branch of VNIRO regularly conducts trawl-acoustic surveys of groundfish in the southern part of the Barents Sea outside the territorial waters from January to March. In addition to ichthyological work, other studies aimed at studying hydrobionts and their habitats are also conducted, including oceanographic surveys and marine mammal monitoring. Vessel-based cetacean surveys provide unique data on the distribution, species and quantitative composition of baleen and toothed whales, to determine their likely feeding objects. This work has recently become increasingly important due to climatic changes occurring in the western sector of the Arctic, including the Norwegian and Barents Seas. For example, according to materials published in the Journal of Operational Oceanography, since 1979, the ice cover area in the Arctic has decreased by 13%, while the average ice thickness in the Barents Sea has decreased by 90% (Schuckmann et al. 2021). Oceanographic work carried out by the Polar Branch of VNIRO has shown that since the mid-2000s, high water temperatures have been record in all layers in the Kola Meridian section in the Barents Sea (Karsakov et al. 2022). Due to the hydrological and ecological changes occurring in the habitat of cetaceans, manifested mainly in the loss of ice, increase in sea temperature and increase in primary production (Moore et al. 2019), regular observations of marine mammals become an urgent task, which allow assessing the current state of populations and predicting their further dynamics.

Abbreviations. IMR – The Institute of Marine Research (Bergen, Norway); Polar Branch of VNIRO – Polar Branch of Russian Federal research institute of fisheries and oceanography (PINRO named after N.M. Knipovich) (Murmansk, Russia); RV – research vessel; TAS – trawl-acoustic survey.

MATERIAL AND METHODS

Data on marine mammals were collected on board of the R/V Vilnius (Polar Branch of VNIRO) during the international multispecies TAS of groundfish in the Barents Sea in 2019–2023. In this study, the survey area is limited by the southern part of the Barents Sea and does not include territorial waters of Russia (Fig. 1).

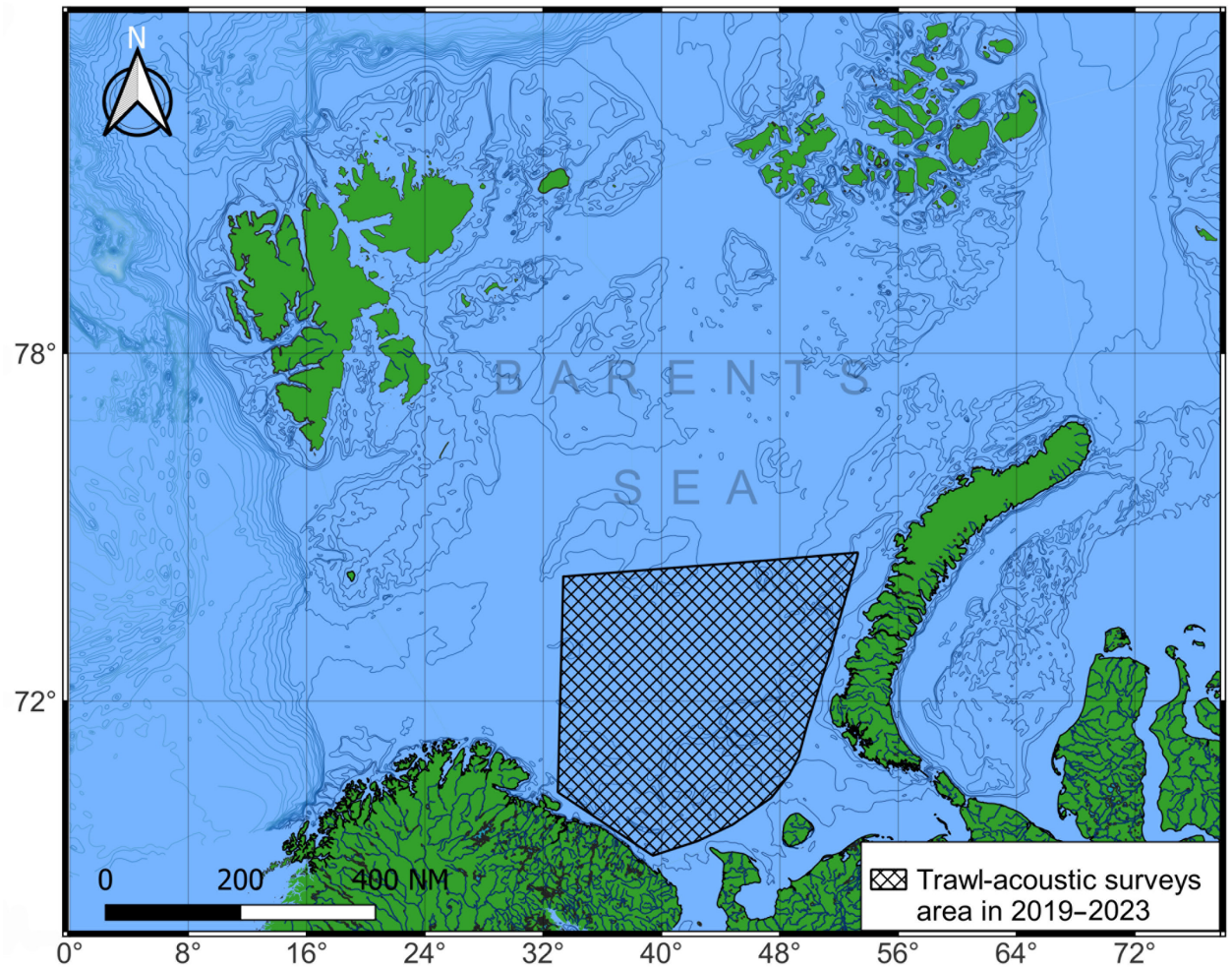

Fig. 1. Trawl acoustic surveys (TAS) area in the Barents Sea in 2019–2023.

Some data of TAS conducted in the southern part of the Barents Sea in January – March 2019–2023 is presented in Table 1.

Vessel-based cetacean surveys were conducted by one observer from the bridge (9 m above sea level) in accordance with the methodology of the Polar Branch of VNIRO (Shevelev 2004).

The transect method was used to visually assess the species composition and abundance of cetaceans. Every 60 minutes of transect counting, an observer recorded coordinates, including start and end points of the transect, using a portable GPS receiver. The width of the survey strip usually did not exceed 1500 meters, and the field of view was up to 160 degrees. A waterproof binocular 7×50 with a grid of sighting threads and an angle meter were used to identify the species and determine the distance to the object. Marine mammals were also recorded outside the transect count. Such observations were carried out under unfavorable weather conditions, when the vessel was drifting and during trawling operations. The time spent on observations corresponded to the length of the daylight, but did not exceed 12 hours. During the winter period the length of daylight hours in the Barents Sea varies depending on the area. For this reason, Table 1 presents the calculated data on the change in daylight hours for the central area of the works, corresponding to the coordinates 71°53'N, 41°35'E. The number of daylight hours was calculated using software provided in electronic form (https://planetcalc.ru/300/).

Ichthyologic data were collected according to standard methods adopted by IMR (Jakobsen et al. 1997) and the Polar Branch of VNIRO (Shevelev,

Table 1. Summary of trawl acoustic surveys in 2019–2023.

Period of surveys		Total length of transects, km	Number of transects	Number of observation hours	Duration of daylight, h	Number of lost days due to storms
2019	19.02–23.03	2578	204	230	7:35–12:45	2
2020	14.02–19.03	2137	149	191	6:28–12:16	6.5
2021	17.02–25.03	2293	155	202	7:03–13:05	4.6
2022	18.01–26.02	1630	121	165	1:10–8:39	8.2
2023	24.01–27.02	1474	107	150	1:10–8:49	4.2

Table 2. Some data of bottom trawls setting in the southern part of the Barents Sea in January–March 2019–2023.

Year	Number of bottom trawls	Area covered by trawl stations, thousand square miles	Trawl station staging area,°
2019	132	73.4	68.35–74.47N, 32.04–53.01E
2020	128	73.4	68.34–73.43N, 32.03–53.33E
2021	126	54.0	68.35–74.21N, 32.08–45.58E
2022	143	71.6	68.35–73.57N, 32.00–48.59E
2023	121	75.1	68.35–73.23N, 32.08–49.27E

2004). Trawl catch data were get on surveys in combination with marine mammal monitoring. A summary of trawl stations in 2019–2023 is summarized in Table 2. The gear used was a Norwegian Campelen-1800 bottom-mounted shrimp trawl with a minimum mesh size of 22 mm in the haul. The bottom trawl was fitted with a rockhopper. Trawling speed was 3.1–3.5 knots, duration – 15 min.

Acoustic data were taken using SIMRAD EK-60 echo sounder at 38 kHz according to the standard methodology adopted at the Polar Branch of VNIRO (Mamylov and Ratushny 1996), taking into account the IMR methodology (Jakobsen et al. 1997).

RESULTS

The cetacean fauna of the southern part of the Barents Sea in the winter period 2019–2023 was represented by 6 species from baleen and toothed whale families. A total 55 sightings of marine mammals (1571 individuals) were recorded during these years. The species composition and distribution of cetaceans are presented in Table 3 and Fig. 2.

As shown in Table 3, the white-beaked dolphin (Fig. 3) was the most abundant and most frequently encountered species.

White-beaked dolphins were recorded mainly in small groups of 2 to 25 individuals, while larger groups of up to 70 animals were encountered less frequently (Fig. 2A–E). Sea depth at the meeting areas varied from 74 to 326 meters. In early March 2021 large herds of white-beaked dolphins totaling more than 1000 individuals were observed in the southwest of the study area (Fig. 2C).

Observations of white-beaked dolphin's behavior have shown that in 55% cases of meetings they demonstrated feeding behavior, actively diving to depth or feeding in the surface layers. Sometimes

Table 3. Occurrence and abundance of cetaceans observed in the southern part of the Barents Sea in January–March 2019–2023.

Species	Occurrence		Number of individuals	
	number of meetings	%	ind.	%
White-beaked dolphin	38	69.09	1532	97.52
Fin whale	8	14.55	19	1.21
Killer whale	4	7.27	14	0.89
Minke whale	3	5.45	3	0.19
Harbour porpoise	1	1.82	2	0.13
Humpback whale	1	1.82	1	0.06
Total	55	100	1571	100

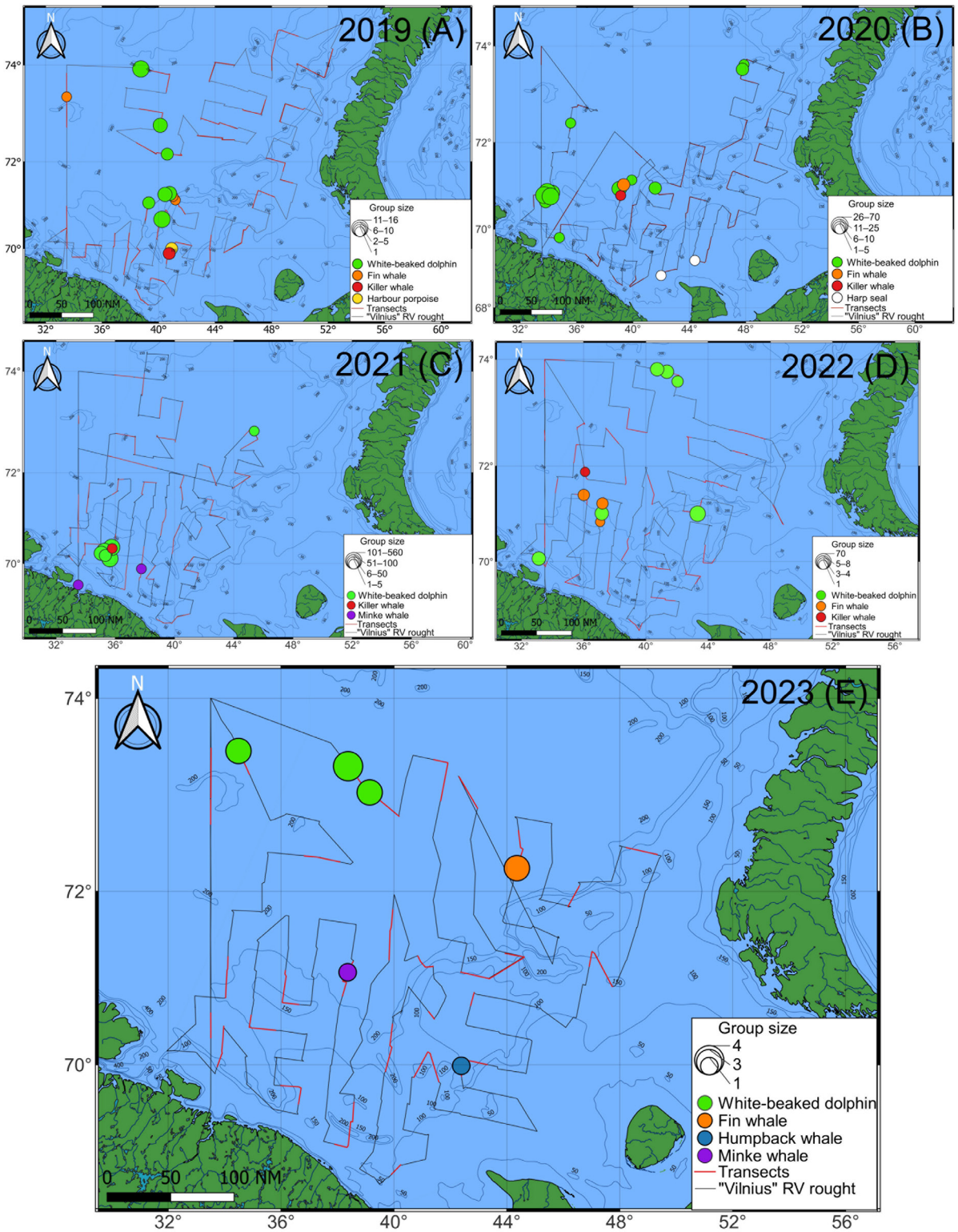

Fig. 2. Distribution of marine mammals in the southern part of the Barents Sea in winter 2019 (A), 2020 (B), 2021 (C), 2022 (D) and 2023 (E).

Fig. 3. White-beaked dolphins observed in the TAS area in February 2022.

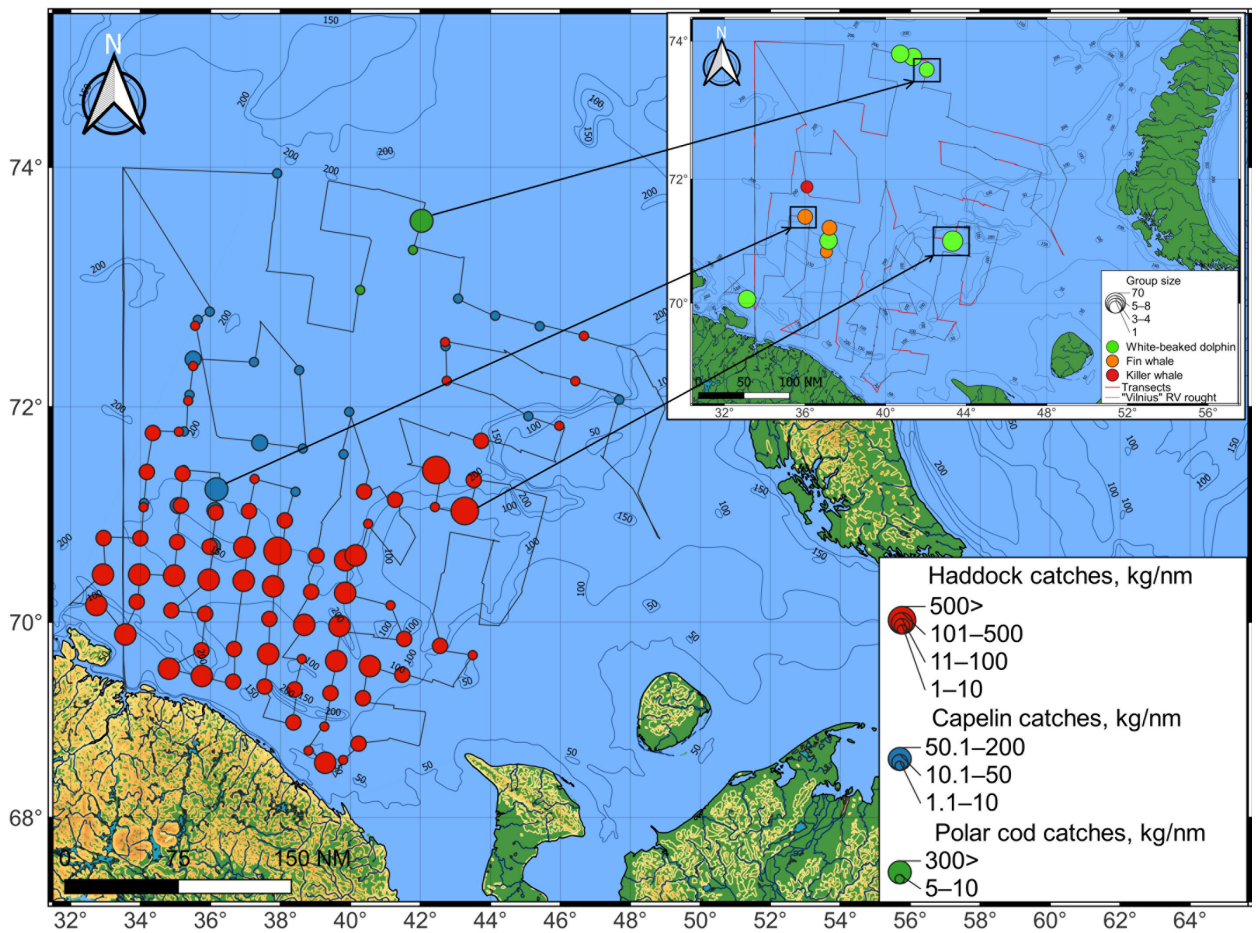

Fig. 4. Catches of some fish species and association with them of the distribution of cetaceans according to TAS 2022.

Table 4. Occurrence of white-beaked dolphin over aggregations of some fish species in the southern part of the Barents Sea during the winter period, 2019–2023.

Year	Number of sightings per year	Number of sightings in the areas with fish aggregations				Number of sightings in areas where fish aggregations were not detected
		capelin	herring	polar cod	haddock	
2019	8	–	5	–	–	3
2020	15	4	2	–	–	9
2021	6	5	–	–	–	1
2022	6	–	–	3	1	2
2023	3	1	–	–	–	2
Total	38	10	7	3	1	17
In %	100	26	18	8	3	45

feeding dolphins were accompanied by seabirds, such as black-legged kittiwake *Rissa tridactyla* Linnaeus, 1758 and northern fulmar *Fulmarus glacialis* Linnaeus, 1761, which picked up small fish from the water surface. Taking into account the results of trawling and acoustic data, it can be assumed that the food diet of *Lagenorhynchus albirostris* Gray, 1846 included mainly capelin *Mallotus villosus* Müller, 1776 and Atlantic herring *Clupea harengus* Linnaeus, 1758, less often polar cod *Boreogadus saida* Lepechin, 1774 and juvenile haddock *Melanogrammus aeglefinus* Linnaeus, 1758 (Table. 4). No foraging activity was detected in 45% cases of meetings – dolphins migrated at a distance from the vessel, sometimes approaching and accompanying it for 10–15 minutes. As an example, Fig. 4 provides a map of fish catches during TAS 2022 and their relationship to cetacean distribution.

As can be seen from Fig. 4, in the northern areas catches of polar cod exceeded 300 kg/mile. White-beaked dolphins were sighted in the same area and were likely had a feeding interest in it. Two other groups of dolphins were observed northwest of the trawl station. According to echosounder readings, shoals of polar cod were present in the water area with vertical development up to 150 m (Fig. 5). To the

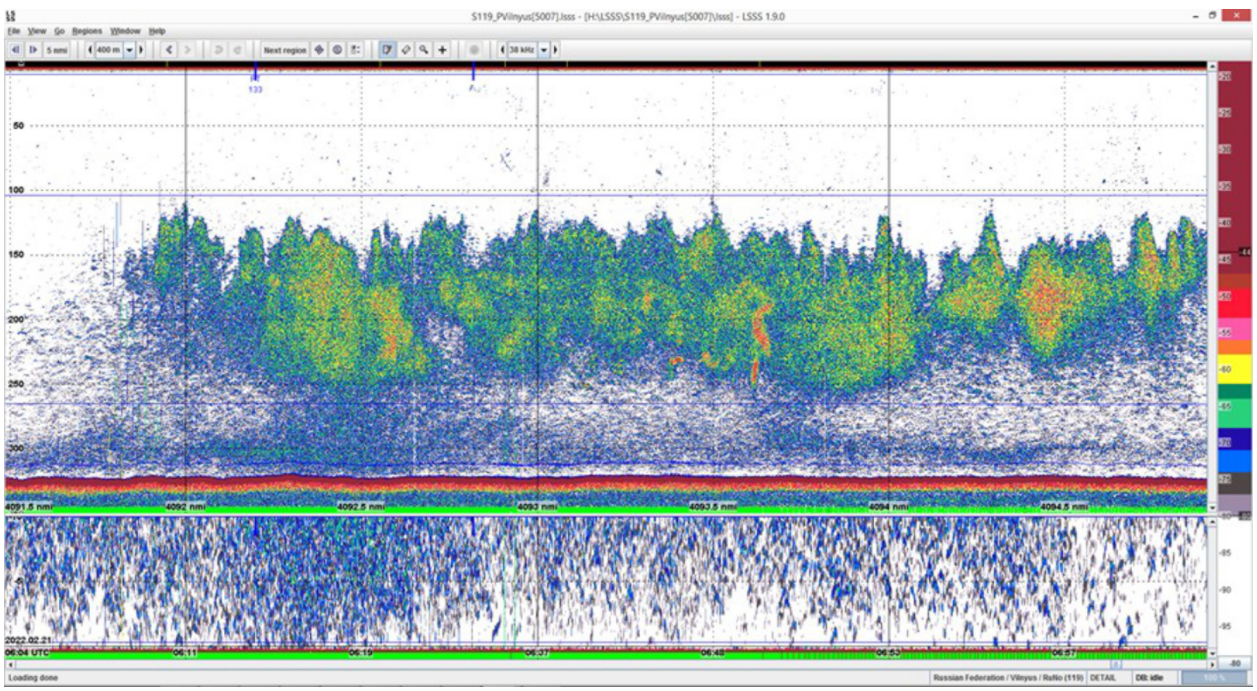

Fig. 5. Acoustic recordings showing polar cod shoals in the north of the TAS area in February 2022.

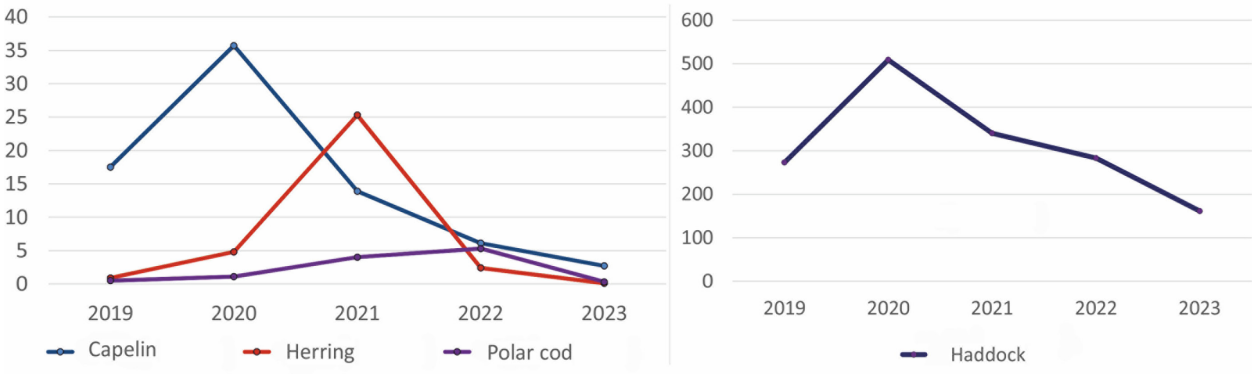

Fig. 6. Changes in average bottom catches (kg/h) of capelin, herring, polar cod and haddock in winter 2019–2023.

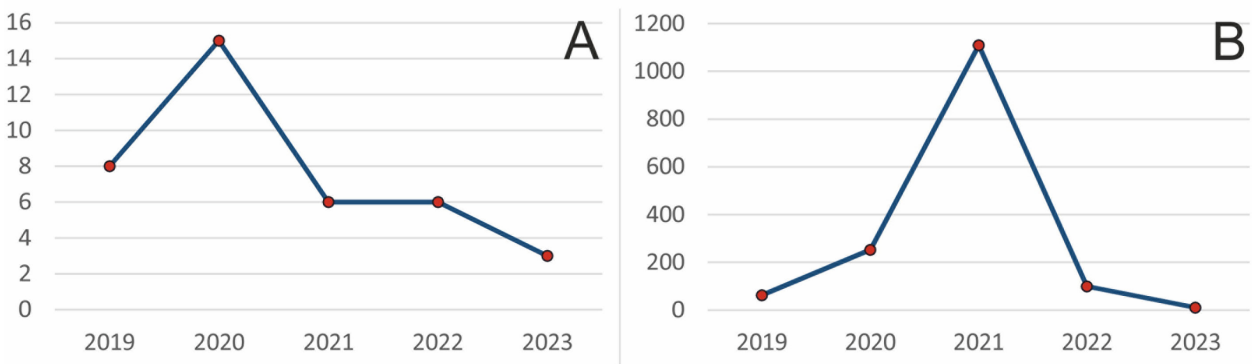

Fig. 7. Changes in the occurrence (A) and number (B) of white-beaked dolphins in winter 2019–2023.

south, close by 71°N, foraging activity was recorded in the area where shoals of juvenile haddock were localized, with catches of more than 500 kg per mile. In other cases of white-beaked dolphin sightings, which occurred in the western areas with less pronounced haddock concentrations, as well as in the southwestern areas, no foraging behavior was detected.

The analysis of catches of suspected prey species of white-beaked dolphin (capelin, herring, polar cod and haddock) by the Campelen-1800 bottom trawl in 2019–2023 revealed some correlation between the dynamics of catches and changes in the occurrence and abundance of white-beaked dolphin. As shown in Fig. 6, the lowest catches of most fish species during the TAS were observed in 2022 and 2023, which correlates well with decrease in total abundance and occurrence of white-beaked dolphin during this period (Fig. 7). At the same time, in 2020, when capelin and haddock catches were highest, an increase in their occurrence was observed. On the other hand, control pelagic trawls based on acoustic data readings in February 2023 revealed aggregations of capelin with vertical development up to 75 m and herring in some survey areas. Maximum catches of these fish species reached 1800 and 115 kg for 10 and 15 minutes of trawling respectively. Large whales such as fin whales and humpback whales were seen in the areas where schools of fish were localized, however, no white-beaked dolphins were recorded there.

Fin whale or herring whale *Balaenoptera physalus* Linnaeus, 1758 was observed in the Barents Sea during the winter seasons of 2019–2020 and 2022–2023. A total of 8 herring whale sightings were recorded, totaling of 19 individuals (Table 3). Cetaceans were recorded both singly and in groups of 2 to 6 individuals primarily in the western survey areas (Fig. 2A–B, D–E).

According to TAS (acoustic sounding and trawling) data, most of fin whale sightings were registered on aggregations of capelin and herring of different

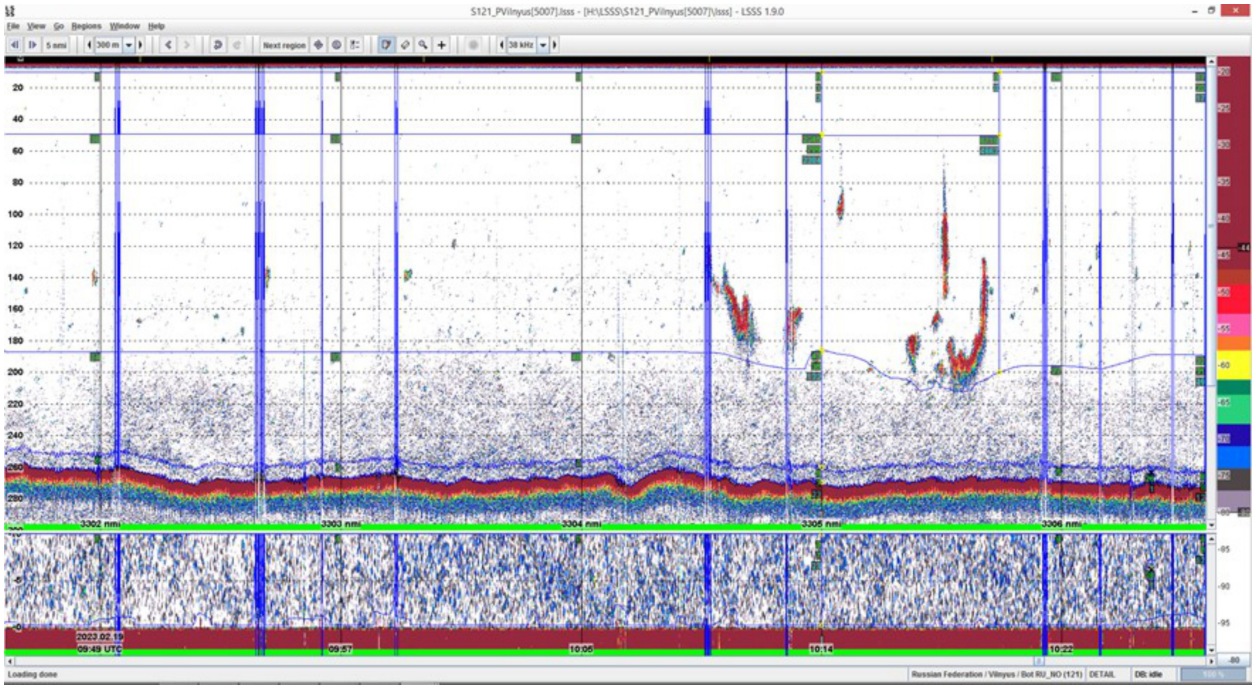

Fig. 8. Acoustic recordings showing capelin shoals in the northeast of the TAS area in February 2023. Scale on the left – depths, meters.

densities, euphausiidae Euphausia Dana, 1850 and occasionally on juvenile codfish Gadidae Rafinesque, 1810. Figure 8 shows an echogram of capelin distribution in the 60–210 m layers in February 2023, on which a group of feeding fin whales was sighted. Also on Fig. 4 shows the catch of capelin in 2022, over the shoals of which herring whales were met. The other two fin whale groups in TAS of 2022 were recorded in areas with small haddock catches and the presence of krill aggregations in the 100–200 m layers, which are likely to be the prey of the cetaceans.

Minke whale *Balaenoptera acutorostrata* Lacépède, 1804 (Fig. 9) was recorded during the TAS in March 2021 (twice) and February 2023 (single). One of the meetings in 2021 was recorded in the area with capelin concentration, while in other cases no significant aggregations of prey items were found.

Killer whale *Orcinus orca* Linnaeus, 1758 was observed in the TAS of 2019–2022 both singly and in groups of 3–6 individuals. In 2019, three killer whales were sighted in the southern areas of the survey with depths of about 100 m, while no significant clusters of fish were detected. In 2020–2021 in the places of killer whales meetings there were accumulations of capelin with catches ranging from 10–200 kg per 1 nautical mile. In 2022, a male of killer whale

Fig. 9. Minke whale observed in the TAS area in February 2023.

was recorded in the western survey area with depths over 270 m. The orca did not show feeding activity and no schools of fish were found there (Fig. 4).

Common porpoise *Phocoena phocoena* Linnaeus, 1758 was met in the southern area with depths of approximately 100 m (Fig. 2A). In bottom trawls where were present haddock, long rough dab *Hippoglossoides platessoides* Fabricius, 1780 and cod in small

numbers. The catches of this species during 15 minutes of trawling did not exceed 9 kg.

The rarest species among cetaceans during TAS was the humpback whale *Megaptera novaeangliae* Borowski, 1781. During the entire survey period, humpback whale was recorded only in February 2023 in the southeast of the survey area (Fig. 2E). Based on data obtained from pelagic trawling, it can be assumed that the humpback whale meeting was associated with aggregations of juvenile Atlantic herring distributed in the 30–90 m layers.

DISCUSSION

According to the results of our studies, in recent years the cetacean fauna of the southern part of the Barents Sea in the winter period may include up to 6 species of baleen and toothed whales (Table 3).

Of the species presented in the table, the white-beaked dolphin was regularly observed in the study area, being the most abundant and widespread species among all cetaceans. Considering trawl catches and acoustic data, it can be assumed with a high degree of probability that its diet in the southern part of the Barents Sea is represented by at least 4 fish species, among which capelin is probably the dominant prey object. The TAS 2019–2023 showed that in the last 2 years there has been a decrease in the occurrence and abundance of the white-beaked dolphin (Fig. 7), which generally correlates well with a decrease in catches of its likely prey species (Fig. 6). However, the R/V routes varies from year to year due to different factors (ice conditions, temporary closure of water areas, weather conditions, etc.) (Fig. 2). Due to the variable fishery productivity of the fishing areas, it is possible to allow an error in the assessment of comparison of average catches for 2019–2023, which cannot be estimated at present due to the lack of data on fishery statistics.

Johanna Fall and Mette Skern-Mauritzen (IMR, Bergen) analyzed TAS data conducted in 2003–2009 in the western part of the Barents Sea and found some similarities in the distribution of the white-beaked dolphin with blue whiting *Micromesistius poutassou* Risso, 1827 and haddock on the south-western transects and with capelin and cod *Gadus morhua* Linnaeus, 1758 in the frontal areas. As noted by the authors, despite high concentrations of capelin in the central study areas, white-beaked dolphin densities were low here. As one of the possible reasons for the dolphins' preference for less abundant feeding areas, the scientists noted interspecific competition between dolphins and other marine mammals, which forces *L. albirostris* to occupy alternative feeding areas (Fall and Skern-Mauritzen 2014). The absence of white-beaked dolphin in the areas of aggregations of its probable prey species in the TAS of 2023 may also be related to the undercount of this cetacean species due to the dark time of day, which was the time of maximum capelin catch and unfavorable weather conditions in the area of herring shoals localization. It should also be noted that the TAS 2022–2023 were conducted in an earlier period (January–February). Due to shorter daylight hours, the total duration of observations in the last 2 years was reduced to 150–165 hours (Table 1), which could also affect the above-described differences in abundance and occurrence of white-beaked dolphin.

Fin whale is thought to be a typical seasonal migrant, i.e. a species that is present at high latitudes for a limited period of time (Storrie et al. 2018). It is known to arrive in the NEA areas for feeding in late spring/early summer and migrate to the more temperate latitudes areas in the fall for mating and birthing (Ahonen et al. 2021). Studies conducted in the Svalbard area in 2015–2019 showed that most herring whales begin migrating to the temperate and southern North Atlantic areas in September–October (Lydersen et al. 2020). Taking into account the satellite tagging results, whales may stay here at least until November. Some data from passive acoustic devices recorded fin whales in high latitudes throughout the winter (Moore et al. 2012; Papale et al. 2023). As our studies have shown, the herring whale has recently been frequently observed in the waters of the Barents Sea during the winter period (Table 3). Whale sightings were usually associated with the distribution of capelin shoals. Thus, the data on the occurrence of fin whales in January–March, obtained during the TAS of 2019–2023, complement well the materials of our colleagues and confirm their presence in the Barents Sea throughout the year.

Killer whale is also a common cetacean species for this season. This species was regularly, with the exception of 2023, recorded in the southern of the Barents Sea both singly and in small groups of 3 to 6 individuals (Fig. 2A–D). In the last decade, killer whales have been observed in large numbers in the winter-spring period off the northern coast of Norway on spawning aggregations of Atlantic herring. However,

Table 5. Baleen and toothed whales observed in the southern part of the Barents Sea in winter 2012–2013 and 2019–2023.

Species	Year						
	2012	2013	2019	2020	2021	2022	2023
White-beaked dolphin	+	+	+	+	+	+	+
Harbour porpoise	–	–	+	–	–	–	–
Killer whale	–	–	+	+	+	+	–
Minke whale	–	–	–	–	+	–	+
Fin whale	–	+	+	+	–	+	+
Humpback whale	–	–	–	–	–	–	+

despite the abundance of food in these areas, some individuals leave the waters off the northern coast of Norway and migrate to the Barents Sea, almost reaching the Novaya Zemlya archipelago (Dietz et al. 2020). Analyzing data from GPS trackers attached to the animals, the authors note the high speed of movement of killer whales migrating to the Barents Sea and find some similarities in their movement behavior with carnivorous killer whales of the Southern Hemisphere. It is known that the diet of some killer whales in the NEA is not limited to fish and may include seals and porpoises (Jourdain et al. 2017; Cosentino 2015). According to the TAS 2019–2022 killer whales were recorded both in areas with capelin aggregations of varying densities and in areas without schools of fish. Taking into account satellite telemetry data on killer whale migrations noted above, we cannot exclude the presence of cetaceans focused on preying on marine mammals, primarily harp seals, two of which were observed near the ice edge of the Kanin Nos Peninsula during the TAS of 2020 (Fig. 2B).

The humpback whale, like the fin whale, is a seasonal migrant in the Barents Sea. Individual coloration and tail fin shape allow tracking their movements in different areas of the North Atlantic. A comparative analysis of humpback whale photographs taken in the Barents Sea during summer and in the southern North Atlantic in early spring revealed the presence of humpback whales at high latitudes meeting in the area of the Azores and Cape Verde Islands (Santos et al. 2022; Wenzel et al. 2020). The data obtained expand the understanding of the migration routes of these large whales in the western sector of the Russian Arctic. According to our studies, humpback whale was rarely observed in the Barents Sea during the TAS, with only one sighting in February 2023 at Atlantic herring aggregations. However, recent (2019–2022) reports from fishermen of humpback whale sightings have become more frequent, primarily in the Teriberskaya Bay in December and February. The increase in sightings of this cetacean species has contributed to the development of a new business for tourist companies in the Murmansk region to show cetaceans from small vessels near the shores of the Kola Peninsula.

The migration of minke whales to the Barents Sea begins in spring, in September–October, they leave high latitudes, but some individuals remain in the Norwegian Sea throughout the winter (Haug et al. 2011). Minke whales were registered during the entire TAS period in 2021 and 2023, with one sighting in March 2021 occurring on capelin aggregations. It is known that the diet of minke whale is quite diverse and includes both fish such as capelin, herring, cod, haddock, etc. and zooplankton (Lindstrøm and Haug 2001; Durant et al. 2014). Registrations of minke whales in winter allow us to presumably speak about wintering of individuals of this species in the Barents Sea.

Despite the year-round presence of harbor porpoise in the Barents Sea (Kovacs et al. 2009), *P. phocoena* was rarely seen during the TAS (Table 3). It mainly inhabits coastal areas of the sea, has a small body size and a low dorsal fin, therefore, in addition to the presence of favorable weather conditions, it is necessary for the vessel to be in areas with shallow depths (up to 100 m) in order to detect it. Due to the fact that winter TAS are conducted mainly in the open part of the Barents Sea, and during the period of increased frequency of cyclones (Table 1), the registration of these animals at the time under consideration is extremely difficult.

Comparing the obtained materials with the TAS data of earlier years, it is necessary to note an increase in the species diversity of cetaceans, whose fauna in 2012–2013 was represented by two species – the white-beaked dolphin and fin whale (Klepikovsky et al. 2017) (Table 5). Whales began to be found in

the sea, that had not previously been registered here, primarily minke whales and humpback whales. The latter is increasingly being seen by fishermen in the coastal areas of Murman. In addition, large baleen whales began to spread more widely across the sea; fin whale, for example, was recorded east of 44°E in the TAS of 2023 (Fig. 2E).

Recently, work aimed at studying marine mammals in the Arctic seas, in connection with global warming, has attracted increased interest from scientists from different countries. Gísli Víkingsson (Marine Research Institute, Reykjavík, Iceland) and his co-authors (Víkingsson et al. 2015) analyzed data from ship-based and aerial cetacean surveys conducted in the area of the Icelandic continental shelf between 1986 and 2009. It was found a decrease in the number of minke whale from 40.000 (2001) to 10.000 (2009) and shift in the habitat of the blue whale *Balaenoptera musculus* Linnaeus, 1758 from southwestern to northeastern areas of the island. The authors of the article attribute these changes primarily to an increase in temperature and salinity of the waters around Iceland, which led to a decrease in the biomass of the main prey species of minke whale – sand lance *Ammodytes* Linnaeus, 1758 in the southern areas and capelin in the north of Iceland. At the same time, a decrease in the biomass of euphausiids in the southern and southwestern waters of the island caused changes in the distribution of the blue whale.

A similar pattern of increasing numbers of large baleen whales can be observed in the eastern seas of the Russian Arctic. As reported by the U.S. National Oceanic and Atmospheric Administration (Moore 2016), the decrease in Arctic sea ice cover has already led to an increase in the occurrence of baleen whales in the Chukchi Sea, which were practically not observed there in the 1980s. In the author's opinion, the increase in ice-free water eventually promotes the growth of zooplankton, which is followed by whales.

Not to be overlooked are the long-term studies conducted in the Svalbard area in 2005–2019 (Bengtsson et al. 2022). According to the data, there is a slight shift in the distribution of minke whale, fin whale, blue whale and humpback whale from the western regions of the continental shelf to the fjords and coastal areas of the archipelago. Such changes are associated with an increase in advection of warm Atlantic waters – one of the main factors determining the modern climate of the Arctic (Bobylevet al. 2003).

Thus, climatic factors directly affect the distribution and abundance of prey resources of cetaceans. It should be noted that in 1985, the international community declared a moratorium on whaling, which probably contributed to the growth of the whale population. This is also evidenced in the literature. According to some estimates, the North Atlantic fin whale population is currently estimated at about 79.000 individuals, which is equal to or even greater than the pre-whaling population size (Ahonen et al. 2021). A similar situation can be observed in areas of the South Atlantic, where the humpback whale population declined rapidly from 27.000 to 450 individuals as a result of whaling between 1830 and 1950, but has now recovered almost completely (Zerbini et al. 2019).

CONCLUSION

Increasing temperature and salinity of the Arctic seas, as well as melting ice, have already begun to affect the distribution and occurrence of cetaceans in high latitudes. As our studies have shown, the cetacean fauna of the Barents Sea has also undergone certain changes over the last decade. First of all, it is necessary to note an increase in the species diversity of baleen and toothed whales, an increase in their occurrence and wider distribution across the sea area. In addition to climate change, which has a direct impact on cetacean prey resources, the main reason for the increased occurrence of baleen whales is likely to be a population growth following after the cessation of whaling. The decrease in the number and abundance of white-beaked dolphin in 2022–2023 may be due to both a decrease in the biomass of their likely prey, primarily capelin and herring, and undercounting due to reduced observation hours.

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