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DISTRIBUTION AND ABUNDANCE OF WATER BIRDS AND SEABIRDS IN SOME AREAS OF THE SOUTHWESTERN KARA SEA IN THE SUMMER-AUTUMN PERIOD 2015–2020

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The southwestern Kara Sea is a scarce studied area in terms of summer-autumn migrations and feeding nomadism of water birds and seabirds. Its shelf includes promising areas for extraction of hydrocarbon raw materials and intensification of navigation along the Northern Sea Route, which makes it necessary to carry out constant monitoring of birds in the area of possible negative effect of those factors. In August–September 2015–2016 and 2018–2020 and in late September–first and second decades of October 2017, bird counts were carried out in the southwestern Kara Sea. Method of ship transect census was applied to obtain the abundance of individuals *per* 1 km^2. For this water area, 28 species of birds representing 7 families were identified (Gaviidae, Sulidae, Procellariidae, Anatidae, Laridae, Stercorariidae, and Alcidae), including 6 species of conservation status. For the group of water birds, the data obtained in August–October are most detailed for the black-throated diver, long-tailed duck, and king eider (Gaviidae and Anatidae). *Prior* to autumn migration (August), their abundance increased in the shallow area adjacent to the coast, later followed by their dispersal to deeper areas west of the Yamal Peninsula. In coastal shallow areas, the population density during the period of the most active colonization of this biotope is as follows (ind.·km^{-2}): (0.17 ± 0.036) for the black-throated diver, (4.87 ± 1.2) for the long-tailed duck, and (2.1 ± 1.25) for the king eider. Presumably, the values are significantly higher for all three species at shorter distances from the coast not examined from the vessel. Other species of the group of water birds (the red-throated diver, Steller's eider, dark-bellied brant goose, European white-fronted goose, and bean goose) are rare in open waters and, apparently, are mainly confined to a narrower coastal zone during the entire summer-autumn period. The same indicator of abundance of migratory seabirds (Procellariidae, Laridae, Stercorariidae, and Alcidae), calculated for the entire water area of the survey site, averaged for 5 years for August–September (ind.·km^{-2}): (0.078 ± 0.026) for the fulmar, (0.067 ± 0.014) for the glaucous gull, (0.061 ± 0.016) for the black-legged kittiwake, (0.025 ± 0.015) for the Arctic tern, (0.066 ± 0.0049) for the Heuglin's gull, (0.046 ± 0.0074) for the pomarine skua, (0.014 ± 0.0023) for the Arctic skua, (0.0039 ± 0.00095) for the long-tailed skua, (0.16 ± 0.094) for the Brünnich's guillemot, and (0.0026 ± 0.0012) for the black guillemot. In late September and October, the abundance of the black-legged kittiwake, fulmar, and Brünnich's guillemot slightly decreases or remains at the level of September one, while the abundance of the black guillemot increases by 7 times. The Arctic tern, Heuglin's gull, and long-tailed skua disappear from the water area. The glaucous gull, pomarine skua, and Arctic skua become much rarer or almost disappear (5-, 40-, and 30-fold drop in abundance, respectively). In general, in the long-term aspect, the fulmar, three Stercorariidae species, the glaucous gull, black-legged kittiwake, Arctic tern, and black guillemot colonize the entire survey site. Interestingly, for the fulmar, black-legged kittiwake, and glaucous gull, uneven distribution is recorded in some years, which is expressed in significant (3 to 17 times) differences in abundance between large (about 25 thousand km^2) spots of the studied water area. During their entire stay at the survey site, the Heuglin's gull and Arctic tern are mainly confined to coastal shallow areas; there, up to 80–90% of the total abundance of individuals in the studied water area is concentrated during periods of seasonal maximum. On the contrary, the Brünnich's guillemot avoids shallow areas (depth of < 50 m). Rare species are vagrant ones (the northern gannet, black-headed gull, European herring gull, and common gull), those found in the peripheral area of their common range (the great skua and grey petrel), and those considered rare at the present stage of the existence of their populations (the white-billed diver). Also, rare species are the birds with insufficiently studied main habitat (the velvet scoter, Steller's eider, dark-bellied brant goose, bean goose, and European white-fronted goose) and seasonally rare ones (the little auk).

Keywords: Kara Sea, seabirds and water birds, migrations, nomadism, annual and seasonal population dynamics

For waters of the southwestern Kara Sea, 33 species of birds are registered in the summer-autumn period; those represent the families Gaviidae, Procellariidae, Sulidae, Anatidae, Stercorariidae, Laridae, and Alcidae [Decker et al., 1998; Lunk, Joern, 2007; Popov, 2012]. With a fairly good study of the species composition of birds in this area, there are no modern data on their abundance (population density) and its dynamics over a number of years which are necessary both for gaining an insight into birds of the spot in population and biocenotic aspects and for assessing their vulnerability to probable negative effect during the exploitation of local promising oil and gas fields. This report is devoted to a description of the species composition and abundance of birds in the southwestern Kara Sea. This area is located west of the Yamal Peninsula, between N70°40′ and N73°50′ and E62°40′ and E70°00′. The data obtained are not an exhaustive description of the bird fauna of the entire southwestern sea area, for those characterize a biotopically specific site: predominantly a medium-deep open water area adjacent to the Arctic tundra zone. This site does not include such bird habitats, as littoral and supralittoral zones, estuaries, islands, lagoons, wet meadows, *etc.*

MATERIAL AND METHODS

Over five seasons, bird counts in the southwestern Kara Sea were carried out in August–September (2015–2016 and 2018–2020); once, a census was carried out later, September 28 to October 22 (2017). Survey routes ran within boundaries of the site with an area of 56 thousand km^2 (Fig. 1) [Itogovyi otchet, 2015, 2016, 2017, 2018a, b, 2019a, b, 2020a, b].

In terms of the depth regime, the area can be classified as zones of the internal shelf (down to 100 m) and, to a lesser extent, external one (100–200 m). According to 293 measurements, the depth at the survey site averages 70 m. Interestingly, the zone with depths down to 100 m occupies 75% of the area, and with a depth 100 to 150 m, 25%. At a minimum depth (6 m), the water area was surveyed at a distance of 3 km from shore (this is the shortest distance from the coast). There was no ice at the survey site in all years of observation. Ice cover in the Kara Sea was low: during investigation periods, ice occurred in small quantities only in the far north and northeast of the sea. The survey site features interaction of the Arctic water mass of the Kara Sea, waters of river runoff, and Atlantic water masses flowing through the Yugorsky and Kara straits. In summer, the vertical structure of the temperature field in the western sea is characterized by occurrence of an upper heated layer, a seasonal thermohalocline, a layer of subsurface minimum (residual cold winter layer), and a layer of Atlantic-origin waters. The vertical distribution of salinity shows its significant increase in the thermohalocline down to depths of 20–30 m and a further gradual rise to bottom horizons. The spot of the bottom slope – the transition from depths of 18–20 to 100–120 m is the location of the frontal zone of the Yamal Current [Zatsepin et al., 2010].

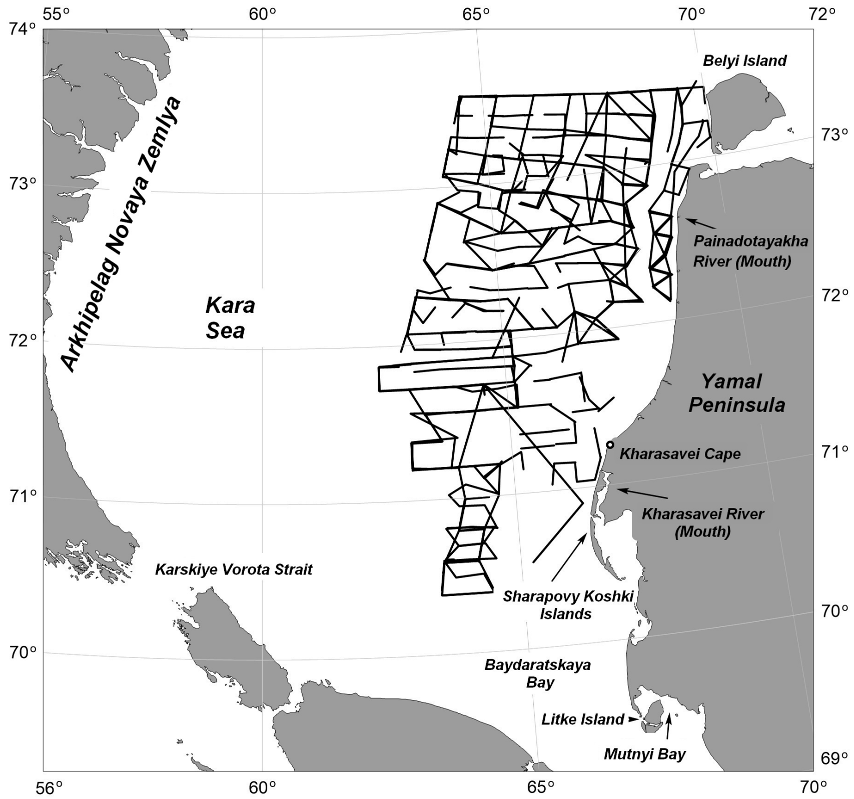

Fig. 1. Map of survey routes in the southwestern Kara Sea in August–October 2015–2020

Bird feeding in this area has not been studied. The potential forage base of piscivorous and planktivorous species (Gaviidae, Sulidae, Procellariidae, Laridae, and Alcidae representatives) may include the most abundant pelagic and bottom–pelagic fish: the polar cod *Boreogadus saida* (Lepechin, 1774), the capelin *Mallotus villosus* (Müller, 1776), and the navaga *Eleginus nawaga* (Walbaum, 1792), as well as pelagic juveniles of various species (*inter alia* benthic ones) of the families Cottidae, Agonidae, and Liparidae. Also, the forage base may cover large zooplankton, primarily of the families Euphasiidae, Hyperiidae, *etc.* Apparently, the diet of Anatidae feeding at sea chiefly includes gastropods common in shallow areas [*Lunatia pallida* (Broderip & G. B. Sowerby I, 1829), *Limneria undata* (T. Brown, 1839), *Buccinum belcheri* (Reeve, 1855), *Buccinum fragile* (Verkrüzen, 1878), and *Murex pullus* (S. Woodward, 1833)], bivalves [*Serripes groenlandicus* (Mohr, 1786) and *Ciliatocardium ciliatum* (O. Fabricius, 1780)], amphipods [*Sabinea septemcarinata* (Sabine, 1824) and *Sclerocrangon ferox* (G. O. Sars, 1877)], as well as such species, as *Stegocephalus inflatus* (Krøyer, 1842), *Lebbeus polaris* (Sabine, 1824), *Pandalus borealis borealis* (Krøyer, 1838), and *Saduria sabini* (Krøyer, 1849) [Ekosistema Karskogo morya, 2008].

We applied the technique of ship transect census [Gould, Forsell, 1989]. While the vessel was moving, a section of the water area limited by distances of 300 m forward and 300 m perpendicular to each side (0.18 km^2) was visually identified. Within a section, all birds were counted for 5–10 s (a so-called snapshot was made). After completing a 300-m distance, the next section was visually identified and inspected in the same way. The time of completing each 300-m section of the transect was determined using a "period" option of a handheld GPS Garmin GPSmap 64st. The mean distribution density of birds at the survey site was calculated by relating the sum of counted individuals to the total area of the transect. For the most common species, the standard error of the mean and the significance of the difference in means were determined (using Student's *t*-test); for this purpose, densities were also established for individual sections of the transect, about 20 km long (and for corresponding areas of about 12 km^2). The water area was surveyed during daylight hours, for 10 h (twilight was excluded from the time of bird counts), by a naked-eyed observer. The observation point was located at a height of 7 m above water. The speed of the vessel was approximately 15 $km \cdot h^{-1}$. Data on the route length in individual years and the corresponding area of the transect are provided in Table 1.

Table 1. Timing and scope of work at the survey site in the southwestern Kara Sea in 2015–2020

Year, months	Transect length, km	Transect area, km^2
2015, August–September	2,692	1,613
2016, August–September	1,563	938
2017, September–October	1,250	750
2018, August–September	1,548	928
2019, August–September	1,694	1,016
2020, August–September	1,378	827

The interannual dynamics of abundance for the investigation period is a series of mean distribution density values calculated from all dates in August and September for each year. The seasonal dynamics in August–October was determined by similar dates for all years grouped into two-decade time periods. The intersection of individual sections of the survey site within the route differed by dates during the investigation period. Also, Gaviidae and Anatidae distribution is characterized by high seasonal and spatial unevenness there. Due to these facts, it is worth noting as follows: the mean abundance values for August–September cannot serve as an indicator of the interannual dynamics for this group of birds. For this purpose, only fluctuations within August–October were compared. The occurrence of shorebirds (waders) in the marine area is not discussed in this report. Names of birds in Latin are given according to a summary [Koblik et al., 2006].

RESULTS AND DISCUSSION

In August–October, 11 species of water birds (Gaviidae and Anatidae) and 17 species of seabirds (Procellariidae, Sulidae, Laridae, Stercorariidae, and Alcidae) were recorded in the southern Kara Sea (Table 2).

Table 2. Species composition and conservation status of seabirds and water birds recorded at the survey site in the southwestern Kara Sea in August–October 2015–2020

Taxon	Species conservation status
Order Gaviiformes	
Family Gaviidae	
Red-throated diver *Gavia stellata stellata* (Pontoppidan, 1763)	–
Black-throated diver *Gavia arctica arctica* (Linnaeus, 1758)	–
White-billed diver *Gavia adamsii* (J. E. Gray, 1859)	IUCN (NT), RF (3 VU III), NAO (3), YaNAO (4)
Order Procellariiformes	
Family Procellariidae	
Fulmar *Fulmarus glacialis glacialis* (Linnaeus, 1761)	–
Grey petrel *Puffinus griseus* (Gmelin, 1789)	–
Order Suliformes	
Family Sulidae	
Northern gannet *Morus bassanus bassanus* (Linnaeus, 1758)	–
Order Anseriformes	
Family Anatidae	
Dark-bellied brant goose *Branta bernicla bernicla* (Linnaeus, 1758)	–
European white-fronted goose *Anser albifrons albifrons* (Scopoli, 1769)	–
Bean goose *Anser fabalis* (Latham, 1787)	RF (2 EN II)
Long-tailed duck *Clangula hyemalis* (Linnaeus, 1758)	IUCN (VU)
King eider *Somateria spectabilis* (Linnaeus, 1758)	–
Steller's eider *Polysticta stelleri* (Pallas, 1769)	IUCN (VU), RF (2 VU III), YaNAO (3)
Common scoter *Melanitta nigra* (Linnaeus, 1758)	–
Velvet scoter *Melanitta fusca* (Linnaeus, 1758)	IUCN (VU), NAO (3), YaNAO (4)
Order Charadriiformes	
Family Stercorariidae	
Great skua *Stercorarius skua* (Brünnich, 1764)	–
Pomarine skua *Stercorarius pomarinus* (Temminck, 1815)	–
Arctic skua *Stercorarius parasiticus* (Linnaeus, 1758)	–
Long-tailed skua *Stercorarius longicaudus longicaudus* (Vieillot, 1819)	–
Family Laridae	
Black-headed gull *Chroicocephalus ridibundus* (Linnaeus, 1766)	–
European herring gull *Larus argentatus argentatus* (Pontoppidan, 1763)	–
Heuglin's gull *Larus heuglini antelius* (Iredale, 1913)	–
Glaucous gull *Larus hyperboreus hyperboreus* (Gunnerus, 1767)	–
Common gull *Larus canus canus* (Linnaeus, 1758)	–

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Taxon	Species conservation status
Black-legged kittiwake *Rissa tridactyla tridactyla* (Stephens, 1826)	IUCN (VU)
Arctic tern *Sterna paradisaea* (Pontoppidan, 1763)	–
Family Alcidae	
Little auk *Alle alle* (Linnaeus, 1758)	–
Brünnich's guillemot *Uria lomvia lomvia* (Linnaeus, 1758)	–
Black guillemot *Cepphus grylle* (Linnaeus, 1758)	–

Note: IUCN, The IUCN Red List of Threatened Species [2023]; RF, The Red Data Book of the Russian Federation [2021]; NAO, The Red Data Book of the Nenets Autonomous Okrug [2020]; YaNAO, The Red Data Book of the Yamalo-Nenets Autonomous Okrug [2023]. Categories according to the IUCN Red List: NT, near threatened; VU, vulnerable. Rarity status of wildlife objects: 2, declining in abundance and/or distribution; 3, rare; 4, uncertain status. Status of the threat of extinction of wildlife objects characterizing their state in natural habitat: EN, endangered; VU, vulnerable. Degree and priority of environmental measures taken and planned (environmental status): priority II, it is necessary to implement one or more special measures to preserve wildlife objects; priority III, general measures are enough, provided by regulatory legal acts of the Russian Federation in environmental protection, organization, protection, and use of specially protected natural areas, and protection and use of wildlife and the habitats, for the conservation of fauna and flora objects listed in the Red Data Book of the Russian Federation.

Water birds. During the investigation period, the most common species of this group were the black-throated diver, long-tailed duck, and king eider.

The black-throated diver. From 8 August to 7 October, it was registered everywhere (Fig. 2). In general, for the entire survey site in August–September, according to averaged data for 2015–2020, the population density varied by 1.8 times [(0.034 ± 0.15) *vs.* (0.06 ± 0.01) ind.·km^{-2}, $P > 0.05$]. During the investigation period, the distribution of birds in the water area changed significantly. In August, density of the black-throated diver was the highest in shallow areas with a mean depth of 12 m (those occupy only 11% of the survey site) at a distance up to 20 km from the Yamal shore, where their abundance accounted for (0.156 ± 0.046) ind.·km^{-2} (Fig. 3). It was the nesting season, and birds seemed not only to stay in the water area, but also to fly out to sea to search for food. At a distance exceeding 20 km from shore, abundance dropped sharply, and birds were pretty evenly distributed up to the western boundary of the survey site, with an 18-fold lower density than in above-mentioned shallow areas [(0.0086 ± 0.0027) ind.·km^{-2}, $P < 0.001$]. In September, as the black-throated diver migrated to its wintering grounds, its distribution was more uniform throughout the survey site. At distances of 0–40 and 40–100 km from the Yamal Peninsula coast, the population density differed only by 2 times [(0.17 ± 0.036) *vs.* (0.082 ± 0.019) ind.·km^{-2}, $P < 0.05$]. Then, throughout the entire survey site to its boundaries (distance from shore up to 180 km), the value was 5 times lower, changed slightly, and averaged (0.018 ± 0.0065) ind.·km^{-2} (the difference with the value at a distance of 40–100 km is significant, $P < 0.01$) (Fig. 3). Next month, a sharp drop in abundance was noted, and the black-throated diver was not counted later than on 8 October. The mean density for the survey site was 6 times lower than in September, (0.01 ± 0.0033) ind.·km^{-2}. According to literature data, in the area of the Yamal Peninsula coast in the southern Baydaratskaya Bay, formed migrating groups of the black-throated diver appear around mid-September; the largest number of groups and the highest abundance of birds in them (up to 62 ind.) is recorded in the third decade; and the last birds disappear from their nesting sites in the third decade of September [Sokolov, 2003]. Within the indicated dates, we did not see even such relatively small groups. Probably, migration of the black-throated diver over the sea is more diffuse there. According to other data [Andreev et al., 2016a], its migration in the Kara Sea ends in the last decade of September – in early October. This is consistent with our observations.

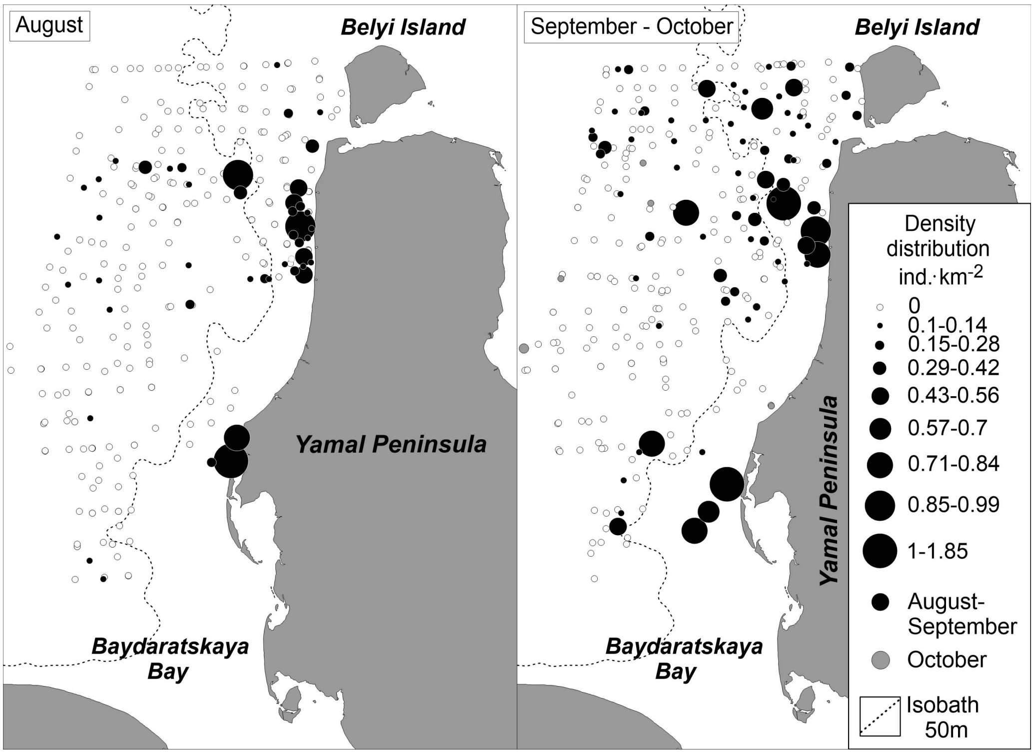

Fig. 2. Distribution of the black-throated diver in the survey site area in the southwestern Kara Sea in August–September 2015–2020 and October 2017

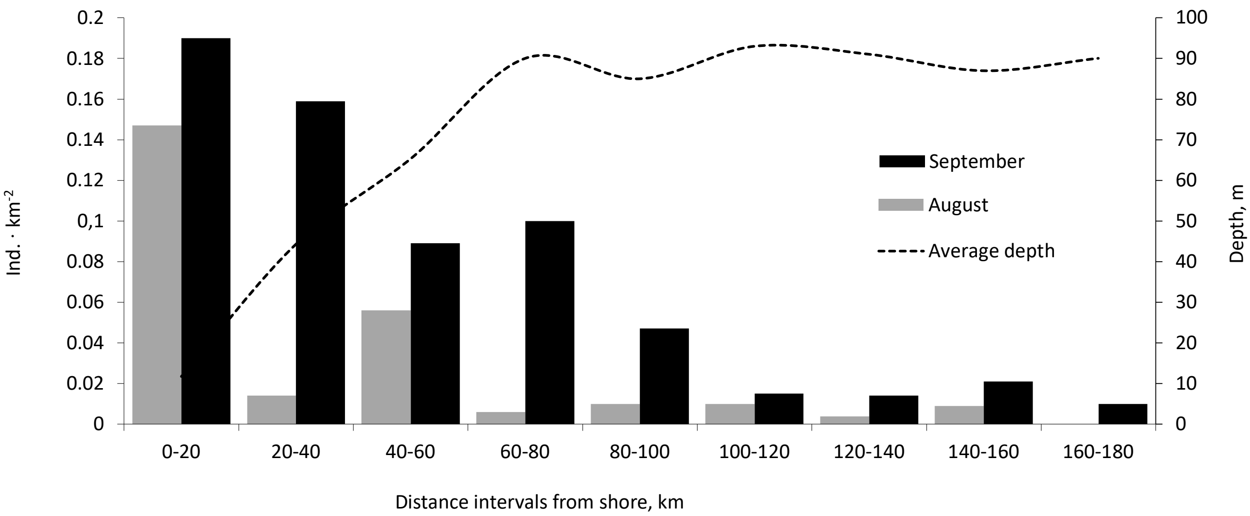

Fig. 3. Distribution of the black-throated diver in the survey site area in the southwestern Kara Sea at different distances from the Yamal Peninsula coast in August and September

The red-throated diver. Single individuals were recorded on 22 September, 2015, and 5 September, 2020, in 47 and 11 km from shore, respectively. The lack of counts on earlier dates may be due to the fact that this bird colonizes biotopes not fully investigated by us. Thus, according to some data, on the western Yamal, the red-throated diver uses the sea area during its nesting season moving away from shore mostly up to 10 km [Dmitriev et al., 2015]. Later, 28 September to 20 October (2017), we also did not see this species at the survey site, despite the fact that these dates correspond to the time of autumn migration in the studied area [Dmitriev et al., 2015; Sokolov, 2003].

The white-billed diver. It was recorded only once during the investigation period. On 15 August, 2015, a bird flew southwest–west at a point with coordinates 71°71′N, 62°39′E.

The long-tailed duck. On all observation dates, its habitat was limited almost exclusively to a spot in the northern part of the survey site with an area of 16,700 km^2 (almost 30% of the total area). Therefore, all indicators were calculated only for this spot (Fig. 4).

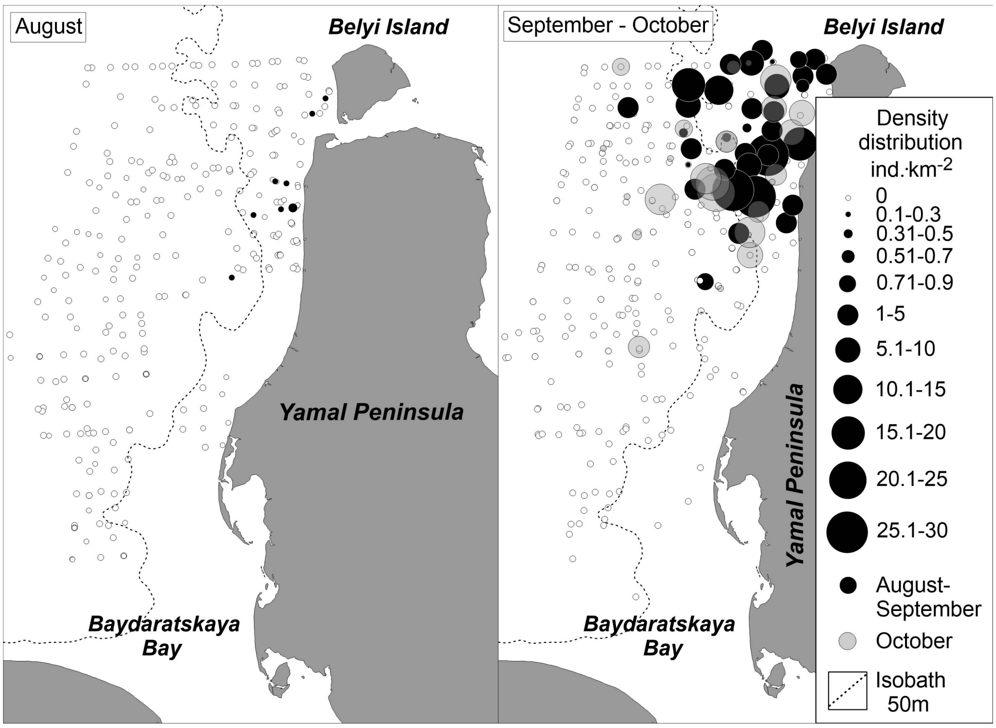

Fig. 4. Distribution of the long-tailed duck in the survey site area in the southwestern Kara Sea in August–September 2015–2020 and October 2017

The first long-tailed ducks were noted in the last decade of August. On these dates, birds were concentrated in a strip of the water area 0–60 km from the Yamal Peninsula. Their abundance decreased with distance from shore, and it differed by 5 times for distances of 0–20 and 20–60 km [(0.1 ± 0.059) *vs.* (0.02 ± 0.013) ind.·km^{-2}, $P < 0.05$]. As known, this bird uses shallow areas adjacent to the Yamal Peninsula from the west not only during pre-migration, but also during molting [Ryabitsev, 1986]. For example, thousands of ducks of an unknown species (assumably, including the long-tailed duck) were recorded on 31 August in the vicinity of the Painadotoyakha River mouth (72°66′N). Taking into account this assumption, the population density of birds during pre-migration may reach its maximum in a narrow coastal strip already in late August. The species was not observed further from shore, in the sea. During September, the area of bird encounters expanded westward to a distance of 120 km from shore.

Within 0–60 and 60–120 km, the distribution density averaged (2.58 ± 0.72) and (0.99 ± 0.51) ind.·km^{-2}, respectively; interestingly, with a visible difference in its values, statistically significant differences were not revealed. Abundance continued to increase in October and exceeded values of August by 88 times [(4.87 ± 1.2) *vs.* (0.055 ± 0.026) ind.·km^{-2}]. Apparently, the water area to the south of the survey site is used by the long-tailed duck in August–October much less frequently. Thus, on 1–24 September in different years, observations were carried out along 3,000 km of the route there, but the long-tailed duck was not registered even off the coast. A census in the southern part of the survey site on 6–22 October, 2017, showed that bird occur in low abundance, while in the northern part, even on 28 September – 5 October, the long-tailed duck was common and most abundant. Thus, in the first five days of October, autumn migration of this species seems to be directed to the southwest: from shallow areas adjacent to the Malygin Strait and Bely Island to the Kara Strait. This is consistent with dates of migration in the Onega Bay of the White Sea, where the long-tailed duck migrates en masse on 2–9 October, with a pronounced peak on 6–7 October [Kondratyev et al., 2016]. During the investigation period, among individuals whose plumage could be clearly seen, only females were noted (and, possibly, similarly colored immature birds).

The king eider. This species was recorded from 19 August until the latest observation date, 22 October; probably, it occurred in the studied water area later as well. The distribution in August was clearly confined to shallow areas off the western coast of the Yamal Peninsula (Fig. 5). Specifically, on 19–31 August, with the mean value for the survey site of (0.0091 ± 0.0053) ind.·km^{-2}, the population density in shallow areas, at a distance of 0–20 km, was 89 times higher than in water areas with other depths [(0.046 ± 0.043) *vs.* (0.00052 ± 0.00051) ind.·km^{-2}]. In September, abundance in the survey site area increased by 26 times, to (0.24 ± 0.1) ind.·km^{-2}.

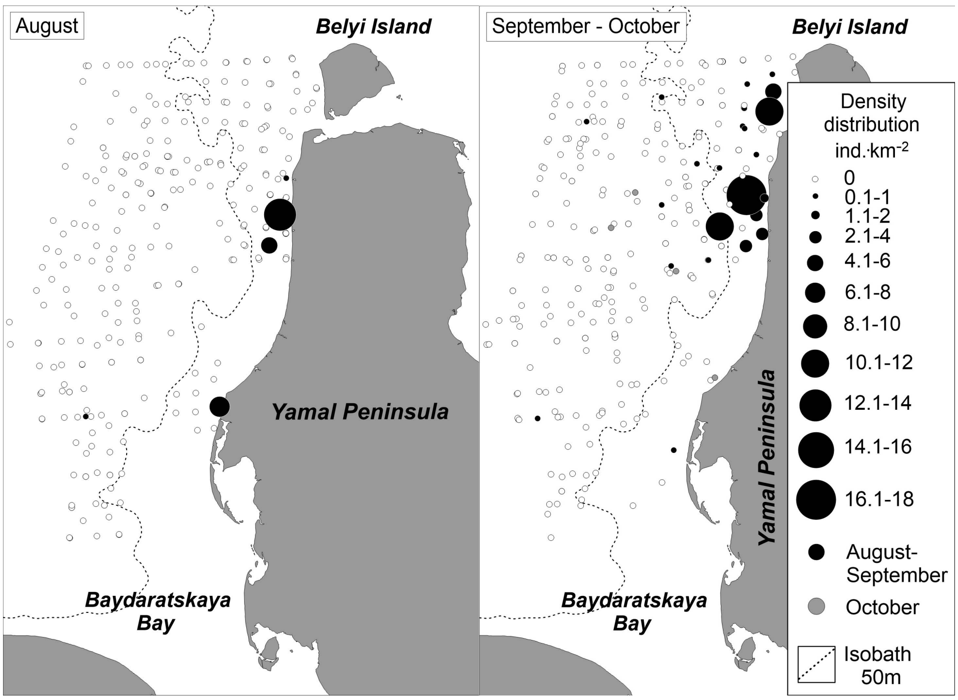

Fig. 5. Distribution of the king eider in the survey site area in the southwestern Kara Sea in August–September 2015–2020 and October 2017

The same as in August, the overwhelming majority of birds (87%) stayed in shallow areas, 0–20 km from shore [(2.1 ± 1.25) ind.·km^{-2}]. As moving further from shore, the distribution density dropped sharply and averaged (0.067 ± 0.055) ind.·km^{-2} for the remaining part of the survey site, *i. e.*, it was more than 30 times lower than in shallow areas. Observations on 28 September – 22 October, 2017, showed that abundance of the species was low everywhere (only 26 ind. *per* 1,250 km of the route, or about 0.02 ind.·km^{-2}, with a fairly uniform distribution throughout the studied water area). Changes in population density of the king eider recorded west of the Yamal Peninsula in August–September seem to be governed by the fact that birds use this water area during molting and pre-migration. King eiders (both immature and adult) are believed to molt near the nesting sites, and the studied Kara Sea area may be one of such sites for the Yamal group of this species. Mass aggregations of molting king eiders were reported for the middle part of the Yamal Peninsula western coast, between Cape Kharasavey and Mutnyi Bay [Brude et al., 1998; Vidy – biologicheskie indikatory, 2020]. As already mentioned, we observed thousands of large ducks of an unknown species (assumably, including the king eider) on 31 August much further north, in the vicinity of the Painadotoyakha River mouth. Birds preferred shallow areas (depth of 10–15 m) 1 km from shore or closer; however, because of the large distance from the vessel (about 5 km), we were unable to identify them down to the species level.

The mass migration of this species to its wintering grounds occurs, probably, in the first half of October. This is supported by the fact that the authors observed flocks of hundreds of king eiders flying through the Kara Strait into the Barents Sea during the indicated period. In another case, a similar migration was seen earlier, in early October, by Yu. Krasnov [Krasnov et al., 2002]. At the survey site, no such migrations were recorded in October, and this evidences for the fact that birds flew mostly near the Yamal shore and over the Baydaratskaya Bay mouth, *i. e.*, in areas almost not investigated by us on these dates. Importantly, in addition to precisely identified individuals of the of king eider, there were many eiders that observers reported as “unidentified down to the species level” and did not use later when determining abundance. Assumably, those were mostly king eiders; however, there were several common eiders whose occurrence is likely in this area, according to reports of rare cases of their nesting on the Yamal [Danilov et al., 1984]. Taking into account this assumption, the distribution density of the species may be approximately 30% higher than determined by us. During the investigation period (2015–2020), only birds colored as females were registered (females themselves and, probably, young individuals similar to them).

The dark-bellied brant goose. We recorded this species only three times in five years – on 8 September, 2018, 28 August, 2019, and 4 September, 2020 (30, 47, and 55 ind., respectively) – at a distance of 35–60 km from shore. According to O. Brude *et al.* [1998], mass aggregations of the dark-bellied brant goose, up to 1,000 ind., during the non-breeding period were observed off the Yamal Peninsula coast, *e. g.*, in lagoons between Cape Kharasavey and Litke Island, as well as off the Bely Island. The period of our most active survey (between mid-August and the first decade of September) coincided with the autumn migration of this species [Andreev et al., 2016b]. Its abundance was insignificant in our observations before and during migration, and this seems to result from the fact that birds inhabit a narrow coastal strip of the water area or tundra mostly inaccessible for the research from the vessel. The geographical location of the area might be important as well: on 20 August, 2020, during work outside the survey site, in shallow areas of the Baydaratskaya Bay (120 km south of the studied water area, 15 km from shore), we noted 31 dark-bellied brant geese during 10 h of our work at the station (6, 5, and 20 ind.).

The European white-fronted goose. This species was seen only once, on 4 September, 2020, 10 km west of the Bely Island. It was a flock of 6 ind.

The bean goose. Birds were recorded on 12 August – 8 September, chiefly in the southern part of the survey site, at a distance of 7–130 km from the Yamal shore. In total, there were 5 registrations of the bean goose (1 to 150 ind.). Encounters of this bird over the sea may evidence for its migration (probably, for its very beginning and in rarely used areas). Specifically, according to V. Sokolov [2003], in southwestern Yamal, the mass migration of geese (the European white-fronted and bean ones) occurs mostly along seashore and is noted on 21–25 September (up to 800 birds *per* day); after 28 September, no geese were registered. On 28–30 September and the first two decades of October, we encountered the bean goose only once (near the southern boundary of the survey site).

The Steller's eider. This bird was seen twice, on 30 August, 2018 (1 female), and 20 August, 2019 (4 males and 11 females), in 5 and 30 km from shore, respectively, in the northern part of the survey site. Males were partially molted and distinguished from females by their white wing coverts. Also, on 30 August, 2015, 10 ind. were noted not during the transect census, but while drifting at the station. The species nests in tundra of the Yamal Peninsula adjacent to the survey site [Dmitriev et al., 2015]. During the non-breeding period, the Steller's eider prefers the marine area, but at the survey site, as well as in other parts of its range, the bird seems to inhabit the shallowest littoral zone [del Hoyo et al., 1992] not examined by us.

The common scoter. One individual was recorded on 8 September, 2018, near the southern boundary of the survey site (70°66′N, 64°20′E), 80 km from the Yamal Peninsula coast.

The velvet scoter. One bird was registered on 6 September, 2020, 8 km from Cape Kharasavey (71°25′N, 66°70′E).

A small number of observations of *Melanitta* scoters may result from the fact that the surveyed water area is rarely used by those species or is used beyond the dates of our census. A high abundance of velvet and common scoters is likely in July, when there is the mass migration of mixed flocks of males of these species through the southern Kara Sea to the Baltic Sea for molting [Krasnov et al., 2002]. However, there are no data on whether the migration passes through the survey site or is oriented further south (the northern border of the nesting range of both species is located in the Yamal Peninsula area at approximately 70°N, 100 km south of the survey site). According to some our observations outside the studied water area, spots of concentration of scoters are situated, for example, to the west and south of Litke Island, in Mutnyi Bay (120 km south of the described water area): there, we registered 572 scoters along 55 km of the route on 6 September, 2020. Moreover, 200 km north of this spot, we also observed a large aggregation of ducks (approximately, up to 10 thousand individuals) on 28 August, 2019, from one of marine ship stations. It was noticeable even at a distance of 10 km. Birds were taking off into the air and landing again on water at the Kharasaveyakha River mouth which is separated from the sea by the Sharapovy Koshki Islands. Because of the great distance, it was impossible to identify the species; perhaps, those were also scoters.

Seabirds. The seasonal distribution of several studied species within the survey site area (the fulmar, black-legged kittiwake, glaucous gull, Heuglin's gull, and Brünnich's guillemot) is shown in Figs 6–10. The interannual and seasonal population dynamics of the most common seabirds are shown in Figs 11–13. Distribution and abundance of other species are not illustrated, but are discussed in the text.

The fulmar. Its mean long-term population density during the investigation period was (0.078 ± 0.008) ind.·km^{-2}; lim (range of values) was 0.028–0.18. Abundance differed significantly between 2016–2018 ($P < 0.01$) and between 2018–2020 ($P < 0.05$). In 2015–2020, the species colonized the entire survey site, but in some years, its distribution over the area was noticeably uneven. Thus, in 2016, abundance was significantly higher in the northern part of the survey site (north of the conventional boundary along 72°N) differing from the value in the southern part by 4.2 times [(0.08 ± 0.011) *vs.* (0.02 ± 0.014) ind.·km^{-2}, $P < 0.05$]. In 2019, on the contrary, 3 times more birds were concentrated in the southern half [(0.035 ± 0.011) *vs.* (0.1 ± 0.026) ind.·km^{-2}, $P < 0.05$]. In the year of the highest abundance (2018), the distribution density in the northern and southern parts of the survey site was almost the same accounting for (0.17 ± 0.058) and (0.19 ± 0.03) ind.·km^{-2}, respectively. We did not record mass feeding aggregations of the fulmar which are characteristic, for example, of the Barents Sea. The number of individuals simultaneously observed in a section of 300 × 600 m (0.18 km^2, see "Material and Methods" section) was no more than 1–2 in 90% of cases and 3–5 in 9% of cases. Flocks of 10–40 ind. were encountered only twice – in the extreme western part of the survey site (less than 0.5% of cases). August to September, on average for several years, no trend in abundance was revealed for the species (differences were non-significant between the means for the groups of dates 1–20 August, 21 August – 9 September, 10–29 September, and 30 September – October 22). In October, the population density of the fulmar might remain relatively high, although data for this month are based on observations from one year (2017) and may not be consistent with those for several years.

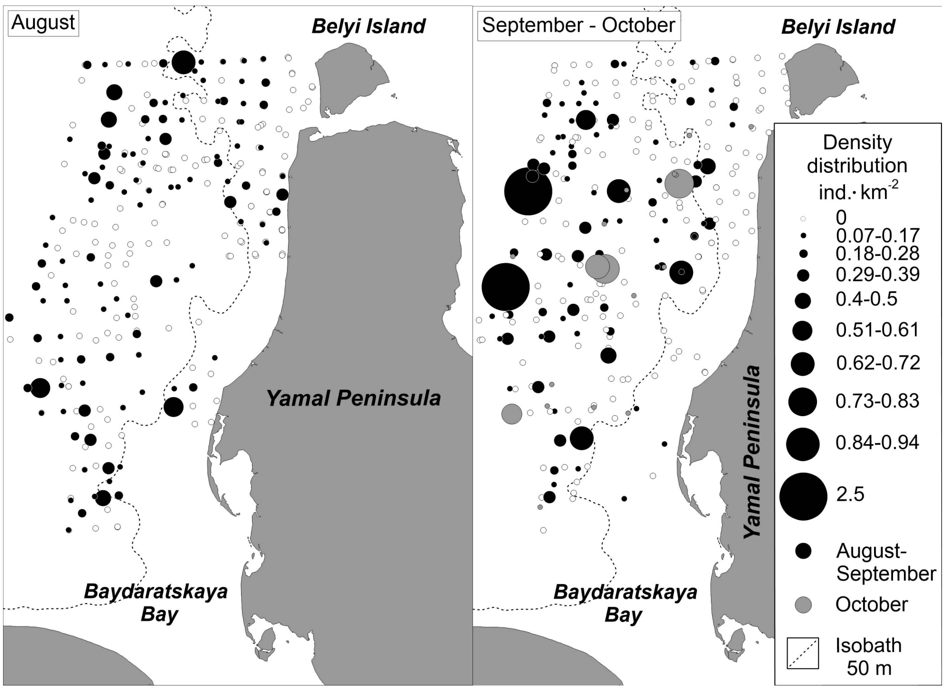

Fig. 6. Distribution of the fulmar in the survey site area in the southwestern Kara Sea in August–September 2015–2020 and October 2017

The grey petrel. Apparently, this species expands its range of summer nomadism eastward in recent decades [Goryaev et al., 2021]. At the survey site, single birds were recorded twice: on 20 September, 2016 (73°53′N, 63°38′E), and 2 September, 2018 (72°68′N, 65°73′E). Outside the studied area, the grey petrel was also registered: off the eastern coast of the Yugorsky Peninsula (69°71′N, 63°75′E).

The black-legged kittiwake. During the investigation period, the mean long-term abundance of this species was (0.061 ± 0.007) ind.·km^{-2}; lim was 0.005–0.096. According to the results of observations of 2015–2020, the bird was recorded throughout the survey site. Importantly, it was noticeably more common in its northern half, where the population density over five years was on average approximately twice as high as in the southern half [(0.073 ± 0.01) *vs.* (0.037 ± 0.0079), $P < 0.05$]. In some years, such unevenness was characterized by a difference from 6.8 times [(0.016 ± 0.0057) *vs.* (0.11 ± 0.024) ind.·km^{-2} in 2015] to 14 times [(0.0037 ± 0.0037) *vs.* (0.051 ± 0.0099) ind.·km^{-2} in 2016]. On average for the investigation period, the black-legged kittiwake was the most abundant in the extreme northwestern part of the survey site, where its density was (0.15 ± 0.038) ind.·km^{-2}. We did not note mass aggregations: in 77% of cases, the number of birds simultaneously observed in a section of 0.18 km^2 was 1–2, and in other ones, 3–10. The share of encounters of more abundant groups (*e. g.*, 45 ind. on 25 August) did not exceed 1.5%. In a seasonal aspect, on average for several years, abundance increased August to September. Thus, according to our census in October 2017, distribution within the survey site was uniform, and population density was relatively high, close to the maximum for August–September 2015–2020: the value was (0.11 ± 0.023) ind.·km^{-2} (for two-decade time periods we identified, means are significantly different, $P < 0.01$). Dynamics registered in August–October is generally consistent with phenology and nature of post-breeding nomadism of the black-legged kittiwake during which birds are widely distributed throughout the water area; under favorable conditions in terms of food supply, they can stay in these spots until late autumn [Krasnov, Nikolaeva, 2016]. A high abundance persisting in October can be partly determined by migration of birds from waters adjacent to the Kara Sea (on the islands of the Severnaya Zemlya archipelago and on other islands, colonies consist of about 20 thousand pairs) which they leave in late September and in October, sometimes even in late October [Brude et al., 1998; Vidy – biologicheskie indikatory, 2020]. The black-legged kittiwake is also known to nest on the western shore of the Novaya Zemlya archipelago and to migrate through the Kara Sea to the Pacific Ocean [Ezhov et al., 2021].

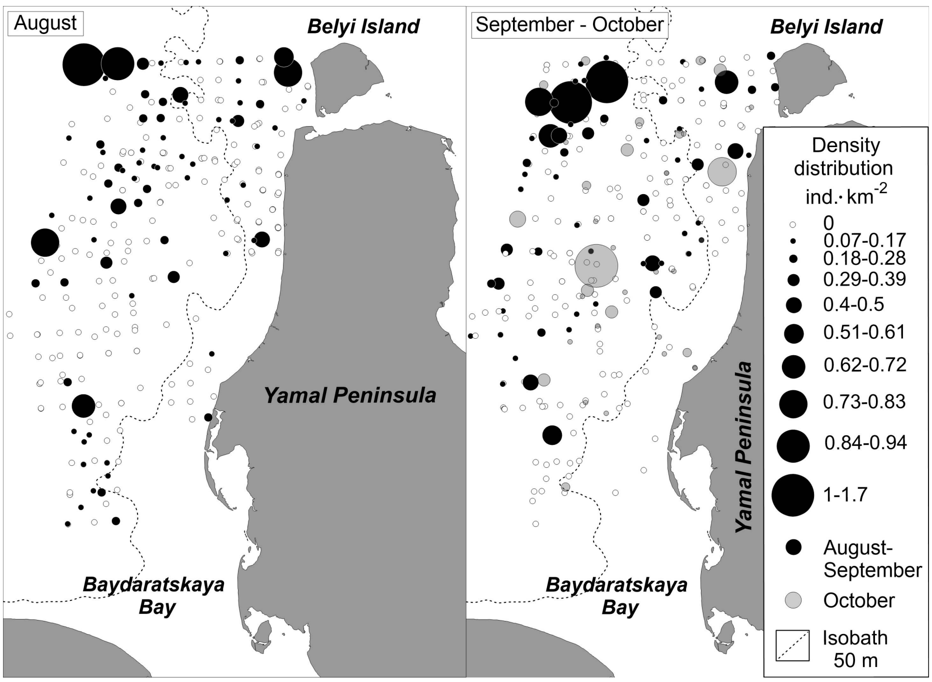

Fig. 7. Distribution of the black-legged kittiwake in the survey site area in the southwestern Kara Sea in August–September 2015–2020 and October 2017

The glaucous gull. Its mean long-term abundance during the investigation period was (0.067 ± 0.014) ind.·km^{-2}; lim was 0.031–0.1. With the exception of a pair of 2018 and 2019, differences between years are significant (P from < 0.01 to < 0.05). The glaucous gull was recorded throughout the survey site. However, in some years, we revealed a definite confinement to shallow areas (< 50 m) adjacent to the Yamal Peninsula coast. For example, in August–September 2019 and 2020, more than 82% of birds were counted within the boundaries of the specified area (0.12 and 0.025 ind.·km^{-2} for shallow areas and other depths, respectively, $P < 0.001$). No latitudinal interannual differences were established in distribution throughout the survey site (see paragraphs on the fulmar and black-legged kittiwake). There was practically no flocking: in 95% of cases, the number of glaucous gulls simultaneously observed in a section of 0.18 km^2 was 1–2, and the highest number registered did not exceed 10 (less than 1% of encounters). In August–September, population density was stable or slightly decreased in the second half of September (the differences for three identified two-decade time periods are non-significant). In October, the value was 5 times lower (difference with abundance in the second and third decades of September is significant, $P < 0.01$).

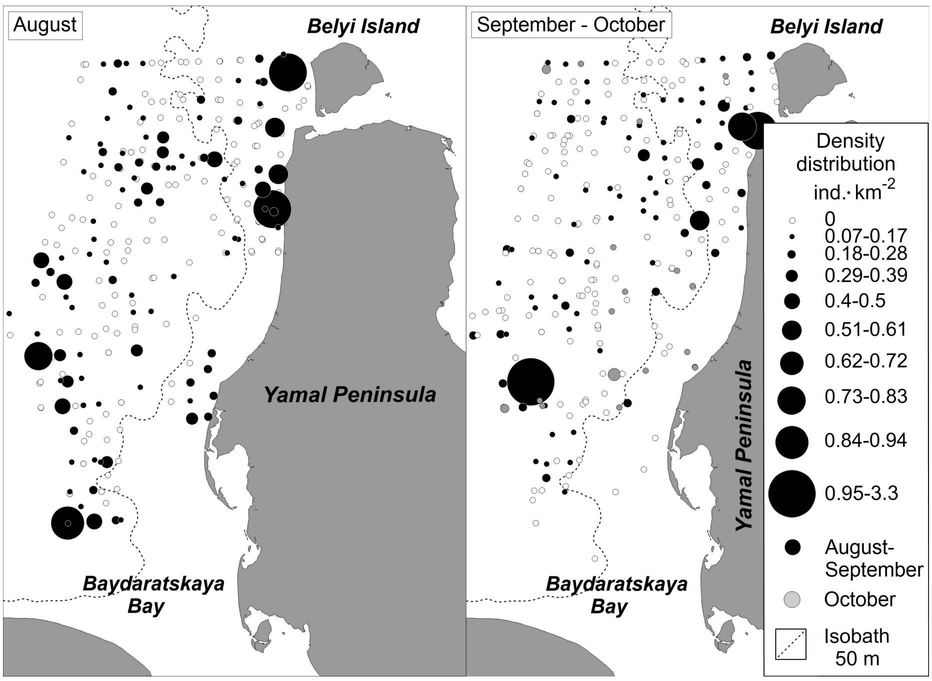

Fig. 8. Distribution of the glaucous gull in the survey site area in the southwestern Kara Sea in August–September 2015–2020 and October 2017

The Heuglin's gull. Interannual fluctuations in its abundance are the least pronounced among those for Laridae representatives. Specifically, with the mean long-term population density of (0.066 ± 0.0049) ind.·km^{-2}, the minimum and maximum in 2015–2020 were related as 1 : 1.6 accounting for 0.05 and 0.08 ind.·km^{-2}, respectively (differences in annual values are non-significant). Assumably, this is driven by the facts that the species is not prone to long migrations and inhabits tundra and coastal zone for most of summer: there, food resources are more stable, and their occurrence is more predictable [Yudin, Firsova, 2002]. This assumption is consistent with the recorded change in the seasonal distribution of the Heuglin's gull, as it preferred coasts and shallow areas in August and September. Within 1–20 August on average for 2015–2020, this species stayed in coastal shallow areas: at a distance of 0–20 km from shore, birds were encountered 4.7 times more often than in other spots [(0.043 ± 0.025) *vs.* (0.009 ± 0.0036) ind.·km^{-2}, $P < 0.005$]. Within 21 August – 9 September, with a 5-fold rise in the total distribution density throughout the survey site (0.016 to 0.08 ind.·km^{-2}, $P < 0.01$), the difference in values was 3.4 times [(0.2 ± 0.049) *vs.* (0.058 ± 0.091) ind.·km^{-2}]. For 10–30 September, we have no data for the immediate coastal area (0–20 km). A comparison of the population density in a zone of 20–40 km and in other water areas even shows a slight relative increase in abundance with distance from shore [(0.025 ± 0.01) *vs.* (0.032 ± 0.01) ind.·km^{-2}] (the difference for these two areas is non-significant) against the backdrop of a decrease in abundance in the survey site area compared to that for previous time period by 2.6 times (0.08 to 0.03 ind.·km^{-2}, $P < 0.001$). Birds were seen until 24 September. Taking into account the complete absence of encounters in the first two decades of October (2017), we can presume that the latest dates of the Heuglin's gull leaving the site are the last five days of September.

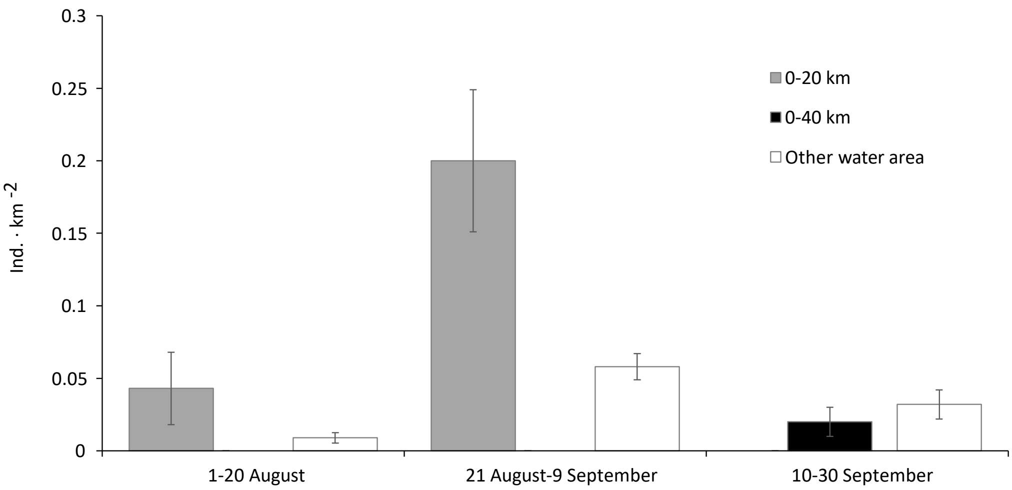

Fig. 9. Seasonal changes in the distribution density of the Heuglin's gull at different distances from the coast in the southwestern Kara Sea

The Arctic tern. Apparently, the given graph of the interannual dynamics of the species abundance does not reflect the real picture. The peak in the population density in 2019 is a consequence of the coincidence of observation dates within many sections in the coastal zone with the dates of the seasonal concentration of birds in this biotope. So, the mean annual abundance of the Arctic tern at the survey site was lower than that determined for five years [(0.025 ± 0.015) ind.·km^{-2}]. Moreover, annual fluctuations occurred within a range of values for other years (lim was 0.0026–0.014). In August, the mean abundance for the entire area was (0.036 ± 0.014) ind.·km^{-2}. Birds were noted everywhere, but way more often (by 9 times), they were encountered at a distance up to 20 km from the Yamal Peninsula coast [(0.13 ± 0.06) *vs.* (0.014 ± 0.0061) ind.·km^{-2}, $P < 0.01$]. In September, the Arctic tern was no longer recorded in the coastal zone; throughout the survey site, the distribution density averaged (0.0014 ± 0.00087) ind.·km^{-2} having decreased by 25 times compared to that for August ($P < 0.01$). In the studied water area, the same as in many other spots of the range, the coastal zone is the main place for searching for food during the nesting season [Dmitriev et al., 2015]. According to our data, the confinement of migrating broods of the Arctic tern to coastal shallow areas may be due to a persistent preference of this zone as the main feeding biotope at the beginning of autumn migration.

A 20 km wide strip of the water area named coastal is arbitrary, as it shows the difference between two identified zones quite schematically. Probably, closer to shore, the population density can be much higher than 0.13 ind.·km^{-2}.

The pomarine, Arctic, and long-tailed skuas. The mean abundance for these three species for 2015–2020 was (0.046 ± 0.0074), (0.014 ± 0.0023), and (0.0039 ± 0.00095) ind.·km^{-2}, respectively (72, 22, and 6%). Taking into account individual significantly different pairs of years (2015 and 2020 for the pomarine skua, $P < 0.01$; 2019 and 2016 for the Arctic and long-tailed skuas, $P < 0.05$), lim values for three species were close to 0.025–0.1, 0.0047–0.29, and 0.002–0.01 ind.·km^{-2}, respectively, *i. e.*, ratios were fairly similar (1 : 4, 1 : 6, and 1 : 5). Fluctuations in the population density of the long-tailed skua are likely to be greater: its abundance is extremely low, and in some years, no birds of this species were observed in sections. In 92% of cases, the pomarine skua was noted in a section of 0.18 km^2 alone or in pairs; in 7% of cases, 3–6 ind. were recorded. The most abundant group consisted of 17 birds (< 1% of cases). For the Arctic skua, the results of division into similar groups show encounters of 1–2 ind. in 100% of cases; for the long-tailed skua, those show encounters of single birds in 100% of cases. The quantitative prevalence of the pomarine skua is consistent both with its greater propensity for sea nomadism, especially in years of poor breeding [Yudin, Firsova, 2002], and with a higher abundance in nesting sites. Thus, observations in a permanent stationary spot of 25 km^2 on the Yamal Peninsula (data averaged for 1988–1993) allowed revealing a ratio of breeding pairs (%) close to 84 : 8 : 8 [Ryabitsev, 1995]. In our study, all three species were represented almost exclusively by adult and immature individuals older than one year which were found everywhere. During the investigation period, we saw a yearling (a skua unidentified down to the species level) only once, and this suggests either very low breeding success in all years of observation, or minor use of the marine area by young skuas during our bird counts. The last single pomarine and Arctic skuas were noted on 9 and 20 October, respectively.

The great skua. The survey site is located near the modern periphery of the species range; apparently, this factor, along with other ones, determines the rarity of this bird in the studied water area [The IUCN Red List, 2023]. A total of 6 great skuas were encountered over five summer seasons (26 August to 12 September): from 1 ind. *per* season (2015, 2018, and 2020) to 2 ind. *per* season (2019). This bird was not noted in 2016.

The Brünnich's guillemot. Its mean long-term abundance was (0.16 ± 0.094) ind.·km^{-2}; lim was 0.001–0.44. The southern Kara Sea is the area of post-breeding migrations of this species, presumably, from the nearest colonies of the Southern Island of the Novaya Zemlya [Belopolsky, 1957; Vidy – biologicheskie indikatory, 2020]. In its vicinity and to the west, a high abundance of the Brünnich's guillemot (up to 5.2 ind.·km^{-2}) is revealed since the first five days of August, and values can remain at this level up to the third decade of October [Krasnov et al., 2002]. Population density of birds migrating to the survey site fluctuates sharply from year to year; probably, it depends on the state of food supply both in the southeastern Barents Sea and southern Kara Sea. Dynamics of the species abundance in the studied water area is not similar to dynamics of abundance of the above-mentioned black-legged kittiwake and fulmar which also migrate there from the Barents Sea. Accordingly, abundance of the Brünnich's guillemot may vary depending on availability of other food items localized in the depth range inaccessible to the fulmar and kittiwake. The results of hydrobiological studies in the Kara Sea evidence for the formation of a high density of macroplankton in August–September in the southern sea (in the area exposed to the effect of Atlantic water masses). Macroplankton belongs to key food items of the Brünnich's guillemot in some parts of its range [Bakken, 1990; Barrett et al., 1997]. Moreover, distribution of macroplankton [*Themisto libellula* (Lichtenstein in Mandt, 1822) (Hyperiidae) and *Thysanoessa inermis* (Krøyer, 1846) (Euphausiidae)] may be related to the occurrence of the guillemot in the studied water area [Ekosistema Karskogo morya, 2008]. In September, aggregations of the polar cod 8–25 cm long are noted there as well [Dolgov et al., 2011; Ekosistema Karskogo morya, 2008]. The fact that the Brünnich's guillemot searches for food at relatively great depths can be indirectly confirmed by frequent observations of its diving for 2–3 min. Its low abundance in the shallow coastal zone with a depth down to 50 m (in a shelf area with a moderate distribution density of food zooplankton) can also indicate the specificity of its feeding [Orlov et al., 2020]. Thus, for 2,502 km of the route within the boundaries of indicated shallow areas in 2015–2020 (31% of the total length of the route), 27 Brünnich's guillemots were encountered (2.5% of the total). Outside shallow areas, these birds were recorded everywhere, without a noticeable drop in population density with increasing depth and even *vice versa*. Thus, the species was more often registered in the deepest parts of the survey site: in isobath intervals of 50–100 and 100–150 m, with similar census, we encountered 264 and 646 ind., respectively. Apparently, the seasonal dynamics of the Brünnich's guillemot is not correct for 10–29 September: within these dates, the vessel was located in the northern part of survey site, where the population density of this species was relatively low in all years of observation. Analyzing data for October 2017, it can be assumed as follows: abundance of the Brünnich's guillemot was also high in August–September of the year when there were no bird counts. Because of molting of flight feathers in August and September and the loss of the ability to fly, 86% of birds were observed on water during these months (in October, only in 29% of cases). Birds formed small groups, and population density was similar in August and September 2019 and 2020 and in October 2017: (3.57 ± 0.3), (3.43 ± 0.27), and (3 ± 0.37) ind. *per* encounter, respectively.

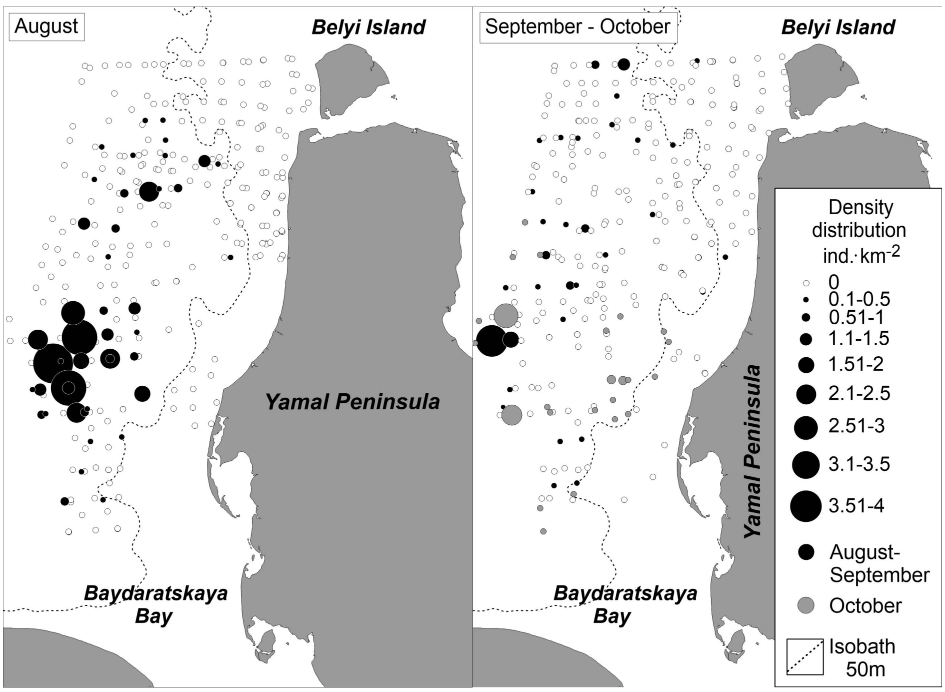

Fig. 10. Distribution of the Brünnich's guillemot in the survey site area in the southwestern Kara Sea in August–September 2015–2020 and October 2017

The black guillemot. This Alcidae species is also characterized by sharp fluctuations in the population density over the years. With the mean value for five years close to (0.0026 ± 0.0012) ind.·km^{-2} and lim of 0.0006–0.007, against the backdrop of significant differences in data for adjacent years (2018, 2019, and 2020, $P < 0.01$), abundance values between individual years could be related as 1 : 13. In a seasonal aspect, there is a gain in the number of the black guillemot encounters, especially clear September to October: the population density rises (0.004 ± 0.002) to (0.03 ± 0.014) ind.·km^{-2} ($P < 0.05$). In the European North, juvenile migrations of the black guillemot occur in August–September and are followed by mass post-molting migrations in October [Gaginskaya, 2016]. This may have caused an increase in abundance we observed in October. The black guillemot winters in polynyas of the southwestern Kara Sea (Ob–Yenisei and Yamal polynyas) [unpublished data of Yu. Goryaev]. A noticeable rise in its population density by autumn may also be associated with the beginning of concentration in spots of upcoming wintering. We registered the first birds in winter plumage already on 24 August, and such encounters amounted to more than half of all observations in September.

The little auk. This rare species was seen in the survey site area during its migration. It was noted only once, on 3 October, 2017. There were no observations on earlier dates, and this may evidence for the fact that the little auk does not appear at the site until October.

Possible reasons for fluctuations in abundance of some seabirds at the survey site. Groups of seabirds of various species in the studied water area may include different individuals: for some of them, summer-autumn nomadism may be limited to the Kara Sea, while for others, it may also cover the Barents Sea. The similarity of these water areas as a habitat for birds during the investigation period is confirmed, for example, for the black-legged kittiwake, fulmar, and Brünnich's guillemot [Seabird Tracking Database, 2023; Seapop, 2023]. For other species of seabirds, migration to the Kara Sea from neighboring seas (or its absence) has not been proven, and it remains unclear within the boundaries of which areas certain factors determine dynamics of the population density. For some species migrating to the Kara Sea from the Barents Sea, abundance in the studied area may be driven, among other factors, by the trophic situation outside the Kara Sea. Thus, as established earlier, the summer-autumn distribution of the black-legged kittiwake and fulmar in the Barents Sea is largely governed by abundance and localization of mass species of schooling fish, in particular, the polar cod and capelin in the eastern sea [Borkin et al., 2006]. When comparing the dynamics of the total stock of these fish in the Barents Sea [Barentsportal, 2023] with the interannual dynamics of density for the black-legged kittiwake and fulmar, a certain negative correlation ($r = -0.83$) can be traced, for example, for the black-legged kittiwake. This may evidence for its more active penetration into the Kara Sea during years of the low stock of the polar cod in the eastern Barents Sea due to the lack of concentration of this food items and wider dispersal of birds during feeding nomadism. A less close correlation is seen (in 2016–2020) for the fulmar which is also concentrated in the Barents Sea on aggregations of the polar cod and capelin (Fig. 11). According to the literature source cited, the size of stock of the capelin and polar cod is given with an indication of possible over- or underestimations of the results of ichthyological surveys. Our data on abundance are also characterized by pretty high representativeness errors. Anyway, for the black-legged kittiwake and fulmar, values of the maximum and minimum abundance coincide with values of the minimum and maximum stock of the capelin and polar cod in the Barents Sea, respectively.

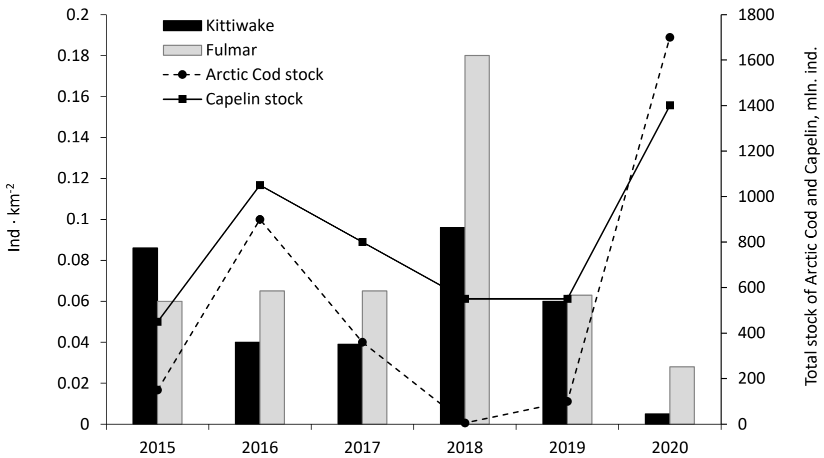

Fig. 11. Population dynamics of the black-legged kittiwake and fulmar at the survey site in the south-western Kara Sea and stock of the polar cod and capelin in the Barents Sea (stock is given according to [Barentsportal, 2023])

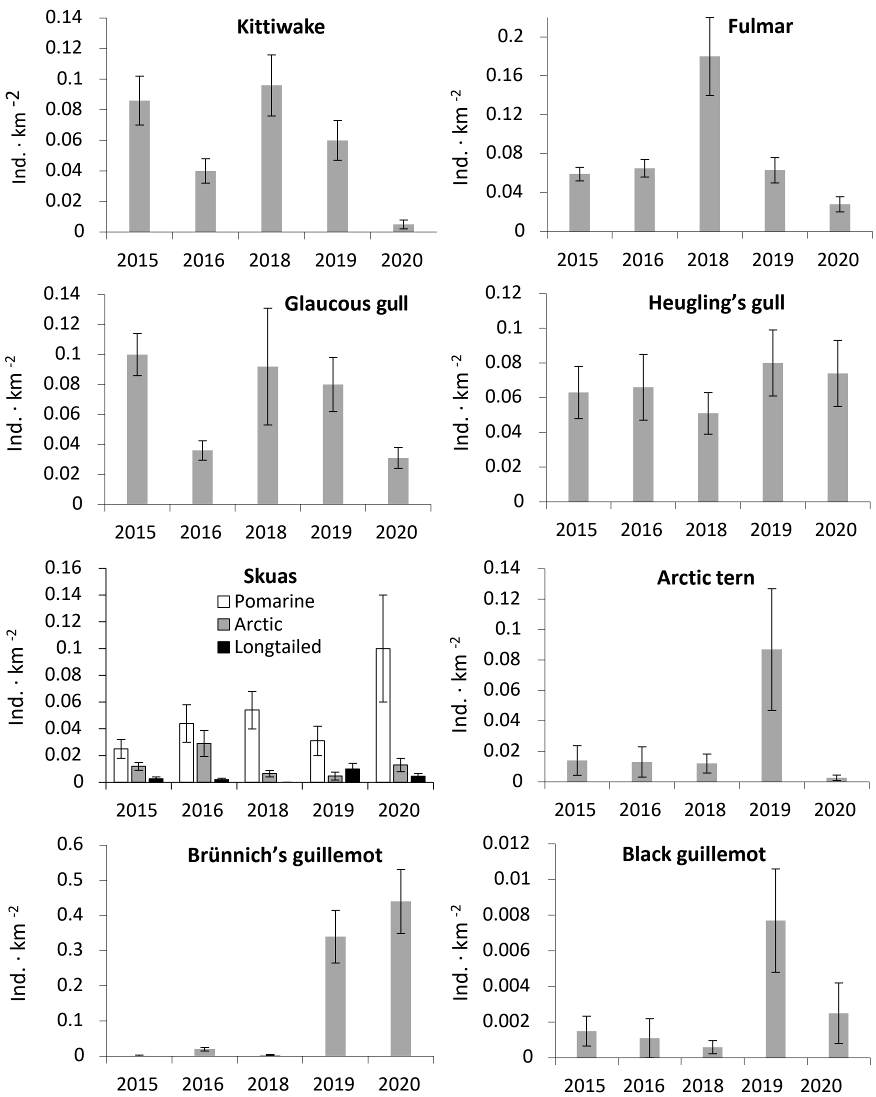

Fig. 12. Interannual dynamics of Procellariidae, Laridae, Stercorariidae, and Alcidae birds at the survey site in the southwestern Kara Sea in August–September 2015, 2016, and 2018–2020

Vagrant species. The group of species recorded outside the range includes the northern gannet, common gull, black-headed gull, and European herring gull observed 1 to 2 times over six years. When reporting vagrant species at the survey site or in its vicinity, other researchers also listed the lesser black-backed gull *Larus fuscus* (Linnaeus, 1758), great black-backed gull *Larus marinus* (Linnaeus, 1758), and the little gull *Larus minutus* (Pallas, 1776) not encountered by us [Dmitriev et al., 2006; Lunk, Joern, 2007].

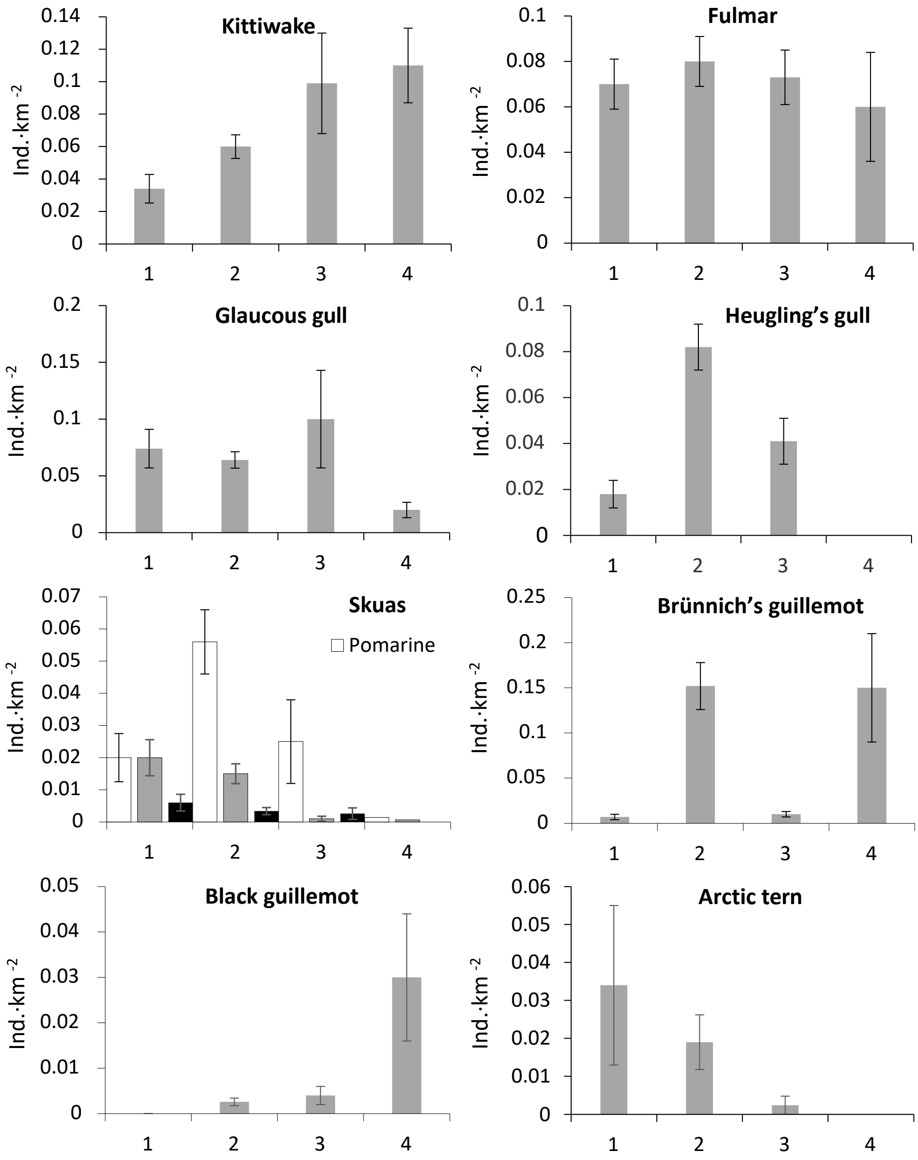

Fig. 13. Seasonal dynamics of Procellariidae, Laridae, Stercorariidae, and Alcidae birds at the survey site in the southwestern Kara Sea in August–October 2015–2020 (1, 1–20 August; 2, 21 August – 9 September; 3, 10–29 September; 4, 30 September – 19 October)

Conclusion. In the studied area of the southwestern Kara Sea, 28 species of water birds and seabirds of 7 families were recorded in the summer-autumn period which use these waters during autumn migration and feeding nomadism.

Among water birds, the most abundant ones are the long-tailed duck, king eider, and black-throated diver (about 62, 14, and 10% of all birds in this group, respectively). Within the summer-autumn season, these species are concentrated in shallow coastal areas of the survey site which may be preceded by their molting in these waters. There is a simultaneous redistribution of the long-tailed duck and divers (it is not yet related to the mass migration) to more seaward areas, up to 200 km from shore. Other Gaviidae and Anatidae species characterized by the low occurrence within the survey site seem to be concentrated or migrate to the south of the studied area or in close proximity to shore.

On average for several years, the group of seabirds is dominated by the Brünnich's guillemot (31%), fulmar (15%), glaucous gull (13%), Heuglin's gull (13%), black-legged kittiwake (11%), and pomarine skua (10%). Less abundant species are the Arctic tern (5%), Arctic skua (2.5%), long-tailed skua (0.7%), and black guillemot (0.5%).

Values of population density we determined are based on a relatively small number of years; those are characterized by high statistical errors and, apparently, do not fully reflect real variability over years and months. Data obtained require further clarification, with the identification and more thorough investigation of individual areas of open water (coastal shallow areas, littoral zone, *etc.*) and analysis of habitat conditions (food supply, breeding conditions, and so on) both within the survey site and in a wider zone of the summer-autumn stay. Taking this into account, the results of the work can have both general scientific significance (study of population dynamics) and environmental one. These data can serve as the basis for the development of a package of measures to protect birds from possible negative effects during the intended exploitation of hydrocarbon deposits on the shelf and the intensification of shipping along the Northern Sea Route.

Field observations were carried out within the environmental monitoring in the licensed areas of the Kara Sea in 2015–2016 and 2018–2020 (Krasnoyarskgazprom Neftegazproekt) and within the industrial environmental monitoring during construction of wells in the licensed areas on the Kara Sea shelf in 2018–2020 (Institute of Environmental Survey, Planning & Assessment). The material was sampled within environmental studies in the Kara Sea waters by order of Gazprom Nedra for Gazprom.

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РАСПРЕДЕЛЕНИЕ И ЧИСЛЕННОСТЬ ВОДНЫХ И МОРСКИХ ПТИЦ В НЕКОТОРЫХ РАЙОНАХ ЮГО-ЗАПАДНОЙ ЧАСТИ КАРСКОГО МОРЯ В ЛЕТНЕ-ОСЕННИЙ ПЕРИОД 2015–2020 ГГ.

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Юго-западная часть Карского моря — малоизученная область летне-осенних нагульных кочёвок и сезонных миграций водных и морских птиц. Её шельф включает районы, перспективные для добычи углеводородного сырья и интенсификации судоходства по Северному морскому пути, что делает необходимым постоянный мониторинг птиц в зоне воздействия этих факторов. На протяжении августа и сентября 2015–2016 и 2018–2020 гг., а также в конце сентября — первой и второй декадах октября 2017 г. проведены учёты птиц на участке акватории в южной части Карского моря. Использована методика судового трансектного учёта для получения показателя численности особей на 1 км^2. На этой акватории определено 28 видов птиц из 7 семейств (гагаровые, олушевые, буревестниковые, утиные, чайковые, поморниковые и чистиковые), в том числе 6 видов, имеющих охранный статус. Из группы водных птиц полученные данные исследований в августе — октябре наиболее обстоятельны для чернозобой гагары, морянки и гаги-гребенушки (гагаровые и утиные). Численность этих видов накануне осеннего отлёта птиц (август) нарастала в мелководной части акватории, прилегающей к побережью; позднее следовало их рассеяние в более глубоководные районы к западу от полуострова Ямал. Плотность популяций на прибрежных мелководьях в период наиболее активного освоения этого биотопа составляет (ос.·км$^{-2}$): чернозобой гагары — (0,17 ± 0,036), морянки — (4,87 ± 1,2), гаги-гребенушки — (2,1 ± 1,25). Предположительно, показатель плотности значительно больше для всех трёх видов птиц на меньших дистанциях от берега, не осмотренных с борта судна. Прочие виды группы водных птиц (краснозобая гагара, сибирская гага, чёрная казарка, белолобый гусь и гусь-гуменник) на открытой акватории редки и, по-видимому, на протяжении всего летне-осеннего периода в основном приурочены к более узкой прибрежной зоне. Этот же показатель численности кочующих особей морских птиц (буревестниковые, чайковые, поморниковые и чистиковые), рассчитанный для всей акватории полигона, в среднем за 5 лет для августа и сентября составляет (ос.·км$^{-2}$): для глупыша — (0,078 ± 0,026), бургомистра — (0,067 ± 0,014), моевки — (0,061 ± 0,016), полярной крачки — (0,025 ± 0,015), западносибирской чайки — (0,066 ± 0,0049), среднего, короткохвостого и длиннохвостого поморников — (0,046 ± 0,0074), (0,014 ± 0,0023) и (0,0039 ± 0,00095) соответственно, толстоклювой кайры — (0,16 ± 0,094), атлантического чистика — (0,0026 ± 0,0012). В конце сентября — октябре численность моевки, глупыша и толстоклювой кайры незначительно снижается или остаётся на уровне сентябрьской, а численность атлантического чистика увеличивается в 7 раз. Полярная крачка, западносибирская чайка и длиннохвостый поморник исчезают с акватории, а бургомистр и средний и короткохвостый поморники встречаются значительно реже или почти исчезают (5-, 40- и 30-кратное снижение численности соответственно). В целом, в многолетнем аспекте, глупыш, три вида поморников, бургомистр, моевка, полярная крачка и атлантический чистик осваивают всю акваторию полигона. При этом для глупыша, моевки и бургомистра в отдельные годы наблюдений отмечена неравномерность распределения, выражающаяся в существенных (от 3 до 17 раз) различиях численности на крупных (порядка 25 тыс. км^2) участках исследованной акватории. Западносибирская чайка и полярная крачка в продолжение всего пребывания на акватории приурочены в основном к прибрежным мелководьям, где в периоды сезонного максимума сосредоточено до 80–90 % общего количества особей на полигоне. Напротив, толстоклювая кайра избегает зоны мелководий (глу́бины до 50 м). Редки на обследованной акватории залётные виды (северная олуша, сизая, озёрная и серебристая чайки), виды, встреченные в периферийной части их общего ареала (большой поморник и серый буревестник), виды, редкие на современном этапе существования их популяций (белоклювая гагара), а также те птицы, основной биотоп обитания которых был недостаточно изучен (турпан, сибирская гага, чёрная казарка, гусь-гуменник и белолобый гусь), и сезонно редкие (люрик).

Keywords: Kara Sea, seabirds and water birds, migrations, nomadism, annual and seasonal population dynamics