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THE FIRST LOCAL MOVEMENTS OF THE KITTIWAKE *RISSA TRIDACTYLA* (LINNAEUS, 1758) ABOVE THE CITY BLOCKS OF MURMANSK

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All over the world, new manifestations of synanthropic tendencies for various bird species are constantly observed. This paper provides data on *Rissa tridactyla* occurrence in Murmansk. Observations were carried out on the route of the summer daily migration of the kittiwake, formed for the first time in 2020, through the center of Murmansk, where this species has not been encountered before. Some features of the flight during the first (2020) and the second year (2021) of the route existence are determined. The approximate abundance of flying birds has been established: 1,500 ind. *per* day. The occurrence of this type of bird activity can be considered as the first stage of the kittiwake adaptation to environment of the residential part of the city.

Keywords: kittiwake, *Rissa tridactyla*, city, lake

Urban ecosystems are periodically subjected to factors mediating shifts in both species composition and demographic indicators of certain species. The number of species in cities is changing, often rising in recent years [Krasnobaev, Konstantinov, 2008; Podolsky, Lobachev, 2016]. This may partly result from the aging of urban ecosystems, as “any biocenosis tends to gradually increase in species richness” and “old biocenoses are generally richer than young ones” [Dajor, 1975]. Due to various circumstances, some species may appear in a biocenosis for the first time, while other ones, previously occurring there, may change their status. The process of species synurbization, when animals adapt to urban environments, has been ongoing for over 100 years, with certain species having their own history of gradual adaptation to urban landscapes in both geographical dimension and time [Luniak, 2004].

This report focuses on the first registration of a migration route of a seabird, the kittiwake *Rissa tridactyla* (Linnaeus, 1758), over the residential part of Murmansk. The route of the summer daily migration of birds was first recorded in 2020; it stretches from the Kola Bay (natural habitat of the kittiwake) to the freshwater Lake Bolshoye and passes through the center of Murmansk which is characterized by high intensity of traffic and pedestrian flow. This route persisted in subsequent years.

The relevance of this work lies in providing information on the first appearance of *R. tridactyla* in the residential area of Murmansk which may be the initial stage of synurbization for this species.

The aim of the study was to describe the newly formed route of *Rissa tridactyla* summer daily migration through the center of Murmansk.

MATERIAL AND METHODS

Observations of the flight were carried out along linear walking routes and from a stationary observation point (Fig. 1). A 12× binocular was used.

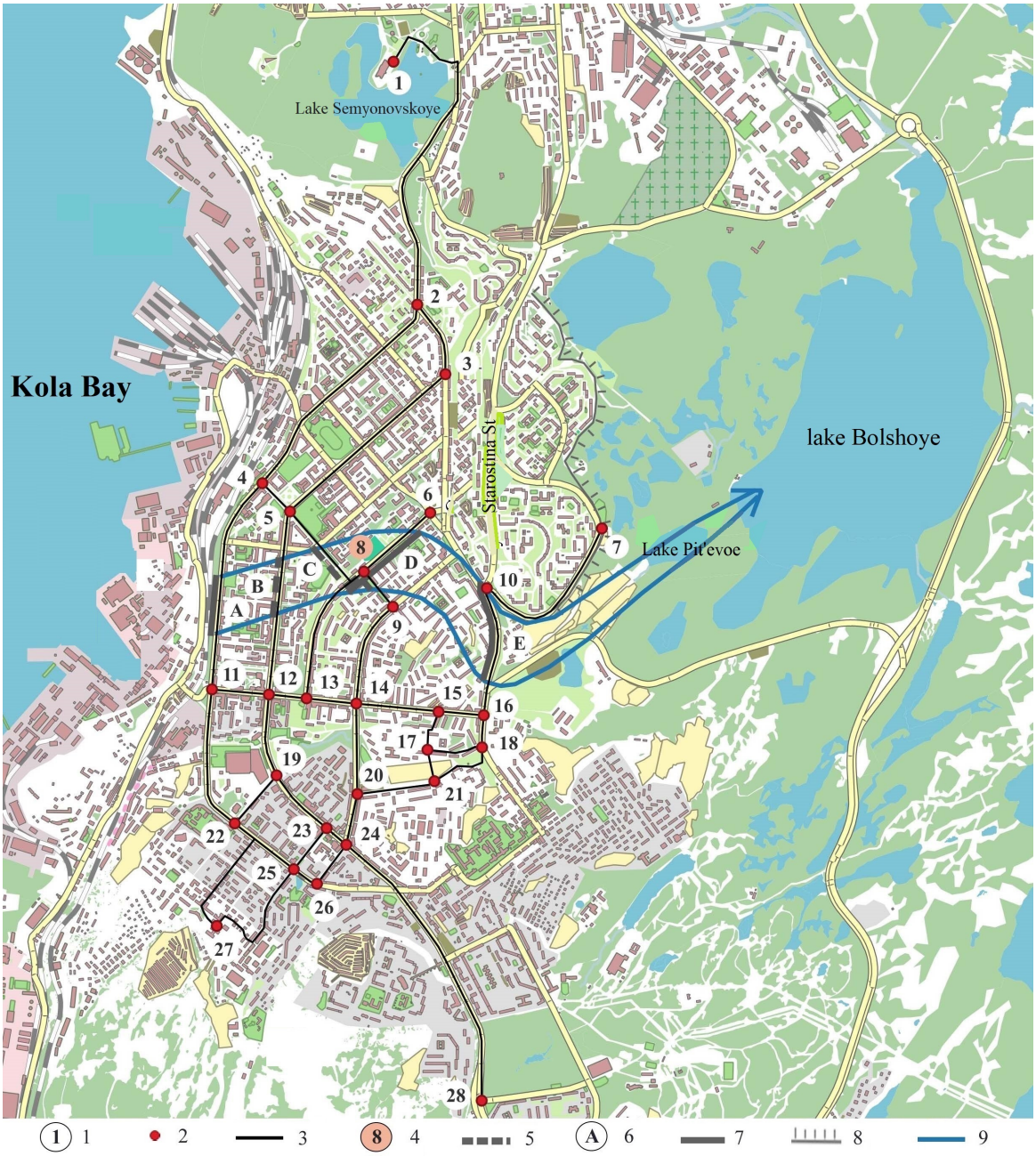

Fig. 1. Scheme of observation routes and trajectory of *Rissa tridactyla* flight over Murmansk: 1, 2, extreme points of the observation routes; 3, the observation routes; 4, stationary observation point; 5, route areas where the kittiwake was observed, with no fixing of the flyway width; 6, 7, route areas where the kittiwake was observed, with fixing of the flyway width; 8, steep cliff; 9, approximate borders of the flyway

On the routes, we recorded spots of the kittiwake movement or absence of birds. Some routes (segments between points 1–28 in Fig. 1) ranged 200–2,000 m in length. The number of surveys *per* year was 2–440. Over two years, the total length of survey routes was approximately 2,300 km. From the stationary observation point, the abundance of kittiwakes flying over the city was recorded from 16 July to 8 August, 2020, and from 14 July to 6 August, 2021. The entire flyway width was visually covered. A series of 30-minute surveys was carried out at different times of the day (between 7:00 and 21:00). The abundance of birds in flying groups, their direction, and flight altitude were registered. Flight altitude was estimated visually relative to the known height of nearby buildings. Weather conditions did not differ much: in observation days, the mean air temperature was +16 °C in 2021 and +17 °C in 2022; the mean wind speed was of 4 $m \cdot s^{-1}$ in both years. There was no precipitation.

The daily density of *R. tridactyla* flow was approximated by a normal distribution, and the total abundance of kittiwakes flying to the lake was estimated using the formula:

$$f(x) = \frac{1}{\sigma(\sqrt{2\pi})} \exp\left[\frac{-(x-a)^2}{2\sigma^2}\right],$$

where x is the variable (time, h);

a is the mean, or expected value, for x;

δ is the standard deviation for x.

Assuming that these two curves are sufficiently close, we determined the total abundance of birds flying to the Lake Bolshoye; MS Office Excel was used for the calculations. By adjusting the parameters a and δ, the one can approximate observation results as closely as possible to the normal distribution curve, and the value of the integral distribution function F(x) for $x = \infty$ can provide the total abundance N.

RESULTS

R. tridactyla migration route over Murmansk, from the Kola Bay area to the lake and back, covered the central part of the city, where traffic is the heaviest. The flyway width was about 300 m (see Fig. 1). Kittiwakes did not fly in a straight line: on the second half of their route, they skirted a hill with high-rise buildings.

The final destination of the flight is the Lake Bolshoye located 3.7 km from the bay and 0.8 km from the residential part of the city. The Eastern Bypass Road, with its constant traffic, runs near the eastern shore of the lake. During the observation period, 200–300 kittiwakes were encountered on the Lake Bolshoye surface during the day. Interestingly, kittiwakes ignored the smaller Lake Pit'evoye which lies under the flyway and is situated 0.2 km from the Lake Bolshoye. Additionally, in July 2020 and 2021, the Semyonovskoye and Ledovoye lakes located within the city were repeatedly surveyed, but no *R. tridactyla* were recorded there, the same as in previous years (summer seasons of 2000–2019). Thus, during the observation period, the Lake Bolshoye was the only one that attracted kittiwakes in Murmansk vicinity.

The dynamics of the abundance of birds flying during the day followed a bell-shaped curve (Fig. 2). The first flying birds were registered at 9:00, and the last ones, at 18:00; the peak occurred between 12:00 and 14:00, close to noon for Murmansk (12:56). Birds moved along the migration route in both directions simultaneously.

In both years of our observations, there were more birds flying toward the Lake Bolshoye than returning to the Kola Bay. Apparently, this is due to the fact that kittiwakes flew to the lake in organized flocks and tended to return individually choosing their own flyways. As a result, the flight front could widen, and the flow density could decrease. In both years, the proportion of single birds returning from the lake was 2–3 times higher compared to that of kittiwakes flying to the lake.

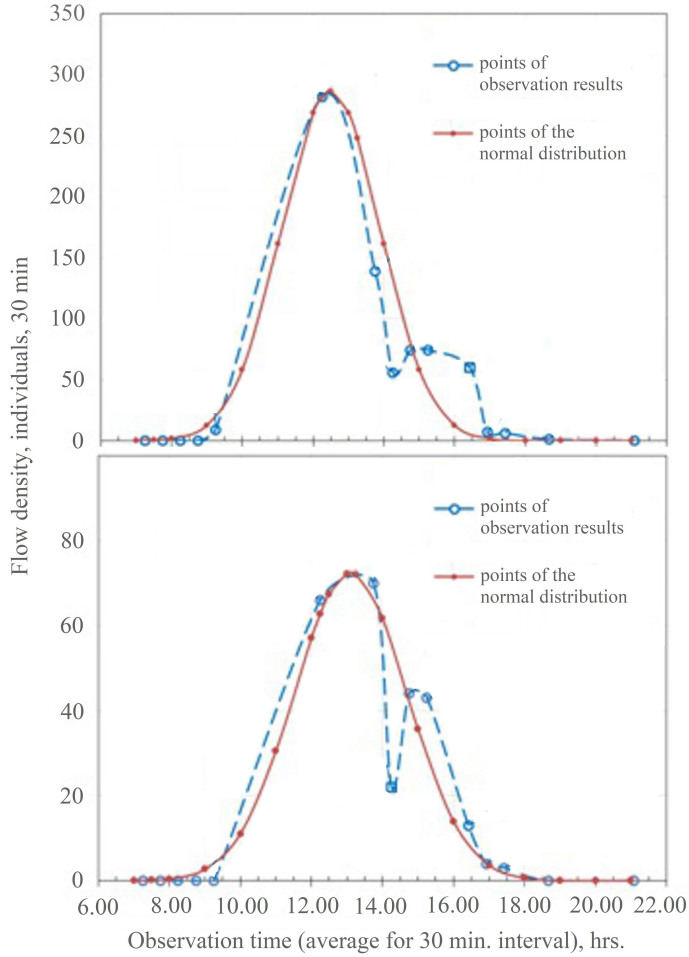

Fig. 2. The results of count observations of birds (2020) flying to the lake (upper diagram) and to the bay (lower diagram); the normal approximation of the observation data. The dots on the dashed line (○) are results of the observations; the dots on the solid line (●) are calculated values of the normal distribution curve

Approximating the daily flow density by a normal distribution for birds flying to the lake, we obtained N = 1,005, with $a \approx 12.50$ (this value corresponds to 12:30 Moscow time) and $\delta \approx 1.4$. For kittiwakes flying to the bay, we had N = 290, with $a \approx 13.10$ (13:06 Moscow time) and $\delta \approx 1.6$.

Considering that some birds flying to the Lake Bolshoye were encountered simultaneously with those returning, it is likely that the total abundance of kittiwakes migrating to the lake and back is around 1,200–1,500 ind.

Flight altitude of birds ranged 10–115 m above the ground. The mean flight altitude differed significantly for two years of our observations. The values were (52.5 ± 2.64) m in 2020 and (40.12 ± 1.65) m in 2021; accordingly, the mean flight attitude decreased by an average of 10 m over the year ($P < 0.001$). In the first year, the straight flyway toward the Lake Bolshoye was frequently interrupted by brief periods of low-altitude circling (noted for 21% of all kittiwakes recorded from the stationary observation point). During the second year, this behavior was registered much less frequently (for 1.5% of birds).

DISCUSSION

Daily migrations to freshwater basins appear to be common for *R. tridactyla* during its breeding season, although their descriptions in scientific literature are rare. In July–August 1996, when carrying out fieldwork authorized by the Kandalaksha State Nature Reserve, A. Goryaeva observed daily flights of kittiwakes from a bird cliff at Cape Krutik (northern coast of the Kola Peninsula) to a small (280 × 140 m) lake (N69.0849°, E35.5693°) located 1 km from the Cape Krutik cliff. Back then, birds flew daily from the cliff to the lake and back ignoring other nearby lakes. Similar migrations of kittiwakes to lakes have been observed in the Svalbard archipelago area. They flew there during the day gathering in flocks up to 200 ind. [Ivanenko, 2012]. According to Yu. Krasnov and N. Nikolaeva [1998], regular occurrence of kittiwake flocks in areas of the Kharlovka River mouth and freshwater lakes on the Kharlov Island (Eastern Murman) is an important element of the birds' behavior during molting, but it is not associated with their feeding activity. When moving toward the river mouth, kittiwakes form flocks resembling a winding ribbon and occasionally stretching over 1 km in length. V. Modestov called the Kharlovka River mouth, where he observed large aggregations of *R. tridactyla*, their favored feeding site. There, he documented 1 ind. of a small trout *Salmo trutta* in a kittiwake's stomach [Modestov, 1967]. Although this bird relies entirely on marine-derived food (fish, crustaceans, and molluscs) [Belopolsky, 1957], its foraging territories on the mainland coast also cover inland sites, including tundra lakes and rivers [Kuklin, 2013]. When occurring in such biotopes, *R. tridactyla* become infected with freshwater helminths, and this evidences for their foraging activity in these freshwater systems [Kuklin, 2013].

A directed flight of gulls is not widely discussed in literature. N. Tinbergen [1974] distinguishes the following types of a directed flight for the European herring gull: a flight to a roosting site, a return from the sea to the breeding colony, and a flight to a feeding site. This researcher considers migration to be an extreme case of a directed flight differing only quantitatively from a flight to a roosting site, a return from the sea to the breeding colony, or a flight to a feeding site. V. Dolnik, in his fundamental work "Migratory State of Birds" [1975], identifies the following types of bird movements: daily migrations between feeding and resting sites, shifts in habitats due to changes in food availability or population density, dispersal for settlement, invasions as the expulsion of excess individuals beyond the species range, and regular seasonal migrations. Based on V. Dolnik's classification, we can conclude that this case most likely represents "a daily migration between feeding and resting sites."

The kittiwake breeds in dense colonies on steep cliffs along sea coasts forming so-called bird cliffs [Belopolsky, 1957].

The first evidence of *R. tridactyla* breeding in the Kola Bay dates back to 1999. Since then, there was a small breeding colony (about 50 pairs in 1999) on a floating dock near southern piers of the commercial port. In 2004, its population reached approximately 200 pairs. In the 2000s, there was a small colony of kittiwakes (50–60 breeding pairs) on walls of a dock in the inner harbor of the Roslyakovo village (middle section of the Kola Bay). In 2009, the dock was sunk; *R. tridactyla* moved to the mainland coast of the harbor and established a colony. In the summer of 2010, 75–80 pairs of birds bred there. Also, kittiwakes breed in small colonies in the northern Kola Bay; the largest and most stable colony (at least 100–200 pairs) is located on the eastern shore of the Pala Bay. In summer, *R. tridactyla* periodically occur in high abundance in the northern Kola Bay pursuing schools of small pelagic fish [Krasnov, Goryaev, 2013].

Unlike large gulls, the European herring gull and sea gull which have been breeding in the residential area of Murmansk for many years [Goryaeva, 2007, 2013], the kittiwake has not been encountered in the city or on nearby lakes since 1998 [Kharlamova, Novikov, 2019]. According to A. Goryaeva, *R. tridactyla* was not observed during bird surveys in Murmansk in 2000–2019 (approximately 300 km of survey routes *per* year in the residential part of the city). Moreover, at the spots where kittiwakes were recorded in 2020 (the flight route over the city center), A. Goryaeva had been carrying out annual summer observations of breeding European herring gulls since 2005, and no kittiwakes have been previously noted. The Kola Bay shores are under much anthropogenic load since the late 1990s; apparently, because of the fact that *R. tridactyla* breed there, birds became able to fly over Murmansk by 2020.

Synanthropic tendencies in the behavior of the kittiwake are not observed everywhere. In literature, there are no mentions of the presence of this species in residential areas of Russian cities. Foreign publications report cases of the kittiwake breeding in cities in the UK and Norway [Nilsen, 2020; Turner, 2010].

The combination of the kittiwake's choice of man-made structures for breeding (synanthropization) and its occurrence on freshwater basins has been described for the River Tyne area (the North East England) [Coulson, MacDonald, 1962; Temperley, 1951; Turner, 2010]. Kittiwakes were not encountered on the River Tyne until 1951; that year, a single bird was registered [Temperley, 1951]. Over the next decade, the situation changed significantly, and by 1961, *R. tridactyla* could be seen almost every day February to June within sight of the bridge over the River Tyne. During this period, most kittiwakes noted on the river were foraging – picking up food from the water's surface [Coulson, MacDonald, 1962]. Moreover, birds gathered to feed near sewage outflows. In the same years, on the freshwater River Derwent (17 km inland from the coast of England) which flows into the River Tyne, kittiwakes fed almost exclusively on fish sometimes reaching 6 inches (15 cm) in length (its species was not identified). According to [Coulson, MacDonald, 1962], kittiwakes tend not to fly over land, except when they gather to bathe in freshwater or, in High Arctic, when they migrate to inland nesting cliffs and back. By 1961, these birds began visiting a freshwater lake in a park in South Shields (a town on the right bank of the River Tyne). Initially, they came to this lake just to bathe, but after five years, they started feeding on bread thrown to other birds – the black-headed gull *Larus ridibundus* and mute swan *Cygnus olor*. By 1961, kittiwakes were regularly flying over the center of North Shields (a town on the left bank of the River Tyne) to a small reservoir in the town center, approximately 1.5 miles from the coast. After visiting the lake, these birds rested on a parapet of a nearby church. In 1962, J. Coulson noted for the first time that *R. tridactyla* was likely feeding regularly on fish caught in freshwater and more and more often feeding on bread. The researcher suggested as follows: in the coming years, this bird might be more frequently observed in freshwater during its breeding season. By 1962, the kittiwake was resting on buildings along the River Tyne leading J. Coulson to predict the establishment of breeding colonies there. His expectations were fulfilled in the subsequent years. *R. tridactyla* breeding colonies began to appear on walls of buildings along the River Tyne and accounted for 450–550 pairs within 1995–2005 and 755 pairs in 2007 [Turner, 2010]. Thus, in this region, manifestations of synurbization cover the occurrence of birds in urban spaces and their visits to freshwater basins in anthropogenic landscapes.

For the kittiwake flying over Murmansk, a decline in flight altitude over the city in the second year of the migration route existence can presumably be considered as the fact of birds becoming accustomed to the urban environment. This is supported by the reduction in circling behavior during flight in the second year.

Some questions arise regarding *R. tridactyla* selectivity in choosing the Lake Bolshoye, as kittiwakes were recorded only on this lake within the city and its immediate vicinity. According to other Murmansk researchers [Kharlamova, Novikov, 2019], during surveys on birds visiting the Lake Bolshoye, no *R. tridactyla* were registered there between 1998 and 2019. As reported in [Zubova et al., 2021], in 2020, in the Lake Bolshoye, *S. trutta* occurred, 149–233 mm in length (the species previously found by V. Modestov [1967] in a kittiwake's stomach in the Kharlov Island area), along with the vendace *Coregonus albula* and three-spined stickleback *Gasterosteus aculeatus*. For comparison: from the Lake Semyonovskoye, only two fish species were reported, the European perch *Perca fluviatilis* and northern pike *Esox lucius*; in the Lake Ledovoye, no fish were caught [Zubova et al., 2021], likely due to its severe pollution. Thus, the ichthyofauna of the Lake Bolshoye meets dietary requirements of the kittiwake. Although foraging is not the primary aim of the bird's visits to freshwater basins [Krasnov, Nikolaeva, 1998], the availability of food seems to play a determining role in *R. tridactyla* choice of lakes.

Conclusions:

- In 2020, a daily migration route of a seabird, the kittiwake *Rissa tridactyla*, was registered over the residential part of Murmansk for the first time.
- The daily dynamics of the abundance of flying birds followed a normal distribution curve occurring between 9:00 and 18:00, with a peak at 13:00–14:00.
- The abundance of *R. tridactyla* flying through the center of Murmansk in July–August 2020–2021 reached 1,500 ind. *per* day, with a flyway width of about 300 m.
- The behavior of the birds in the first year of the migration route's formation differed slightly from that in the following year in terms of flight patterns and altitude.
- The kittiwakes' visits to the Lake Bolshoye may be related to bathing in freshwater and feeding there during the breeding season.

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ПЕРВЫЕ ЛОКАЛЬНЫЕ ПЕРЕМЕЩЕНИЯ МОЕВКИ *RISSA TRIDACTYLA* (LINNAEUS, 1758) НАД ЖИЛЫМИ КВАРТАЛАМИ ГОРОДА МУРМАНСКА

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Во всём мире регистрируют новые проявления синантропных тенденций у разных видов птиц. В данной работе описано появление моевок в городе Мурманске. Проведено наблюдение за впервые сформированным в 2020 г. маршрутом летней суточной миграции *Rissa tridactyla* через центр Мурманска, где этот вид ранее не встречали. Определены некоторые особенности пролёта в первый (2020 г.) и второй год (2021 г.) существования маршрута. Установлена приблизительная численность пролетающих птиц — до 1500 особей в сутки. Появление этого вида активности птиц можно считать первым этапом в освоении моевкой жилой части города.

Ключевые слова: моевка, *Rissa tridactyla*, город, озеро