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Distribution, number and species composition of large gulls *Larus* sp. breeding in Belarus in 2018–2022

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Abstract: For the first time since 2009, the population status and dynamics of large white-headed gulls from the genus *Larus* have been assessed based on all known breeding cases in Belarus. We collated all the available (both published and unpublished) data and results of our own censuses in most important breeding sites. The total population size was estimated at 8,000–9,500 breeding pairs in 2018–2022 and have increased about 3.5 times since 2009. 70–80% of gulls nested in 8 large colonies with more than 100 pairs, including the largest Gatovo colony, which grew to 5,000 pairs. About 75% of gulls nested on the roofs in 9 cities and towns, and 25% in the natural habitats. During the study period, there were at least 4,800 pairs of Caspian Gulls *L. cachinnans* and 800 pairs of Herring Gulls *L. argentatus*. Several Lesser Black-backed *L. fuscus* and Yellow-legged Gulls *L. michahellis* nested in Gatovo colony, mostly paired with other species. The rest of the estimated population may include both mixed and 'pure' pairs, as well as hybrids, the number of which could not be more accurately determined. Two numerous species entered Belarus in the 1980s: Herring Gulls – probably from the north, Caspian Gulls – from the south. By now, the Caspian Gull can be found almost all over the country and dominates most of the known nesting sites, except for a few sites on raised bogs and lakes in the north, where the Herring Gull can still be the most numerous. The increase of the Herring Gull's population was much stronger until the 2000s and has slowed down more recently, but the growth rate of the Caspian Gull exceeded it by more than an order of magnitude in the last two decades. The newly observed rooftop nesting of the Caspian Gull contributed to the rapid expansion and current high numbers of this species in Belarus, and, interestingly, this phenomenon is extremely rare elsewhere. The rapid growth of populations of large gulls in the area of Minsk city is most likely linked to the vicinity of an abundant foraging ground in the largest landfill in the country as well as availability of secure nesting sites (rooftops).

Key words: abundance, distribution, breeding pairs, population trends, Caspian Gull, *Larus cachinnans*, Herring Gull, *Larus argentatus*, Lesser Black-backed Gull, *Larus fuscus*, Yellow-legged Gull, *Larus michahellis*, Belarus

Rozmieszczenie, liczebność i skład gatunkowy dużych mew *Larus* sp. lęgowych na Białorusi w latach 2018–2022. Abstrakt: W niniejszej pracy oceniono aktualny stan i dynamikę populacji dużych mew z rodzaju *Larus* na podstawie wszystkich znanych przypadków ich gniazdowania na Białorusi po raz pierwszy od 2009 roku. Ich liczebność oszacowano na 8 000–9 500 par lęgowych w latach 2021–2022 (3,5-krotny wzrost od 2009 roku). 70–80% wszystkich mew gnieździło się w 8

dużych koloniach liczących > 100 par, w tym największej kolonii w Gatovie (5 000 par). Około 75% kolonii znajdowało się na dachach budynków w 9 miastach, a 25% w siedliskach naturalnych. Z całkowitej liczby gniazdujących na Białorusi par dużych mew, co najmniej 4 800 stanowiły mewy białogłowe *Larus cachinnans*, a 800 – mewy srebrzyste *L. argentatus*. W kolonii w Gatovie stwierdzono także gniazdowanie kilku osobników mew żółtonogich *L. fuscus* i romańskich *L. michahellis*, głównie w parach z innymi gatunkami. Pozostała część oszacowanej liczebności populacji może obejmować zarówno pary mieszane oraz „czyste", jak i mieszańce międzygatunkowe, których liczebności nie można dokładniej określić. Mewa białogłowa zdominowała prawie cały kraj, z wyjątkiem kilku stanowisk na torfowiskach wysokich i jeziorach na północy i północnym zachodzie, gdzie mewa srebrzysta była najliczniejsza. Oba te gatunki zaczęły gniazdować na Białorusi w latach 80. XX w., ale ich ekspansja rozpoczęła się z różnych kierunków. Wzrost liczebności mewy srebrzystej był znacznie szybszy do roku 2000; tempo wzrostu mewy białogłowej przekroczyło go o ponad rząd wielkości w ciągu ostatnich dwóch dekad. Nowo obserwowane gniazdowanie na dachach przyczyniło się do tak gwałtownego wzrostu mewy białogłowej na Białorusi i jej obecnej wysokiej liczebności. Co ciekawe, zjawisko to jest bardzo rzadkie w innych regionach. Dynamiczny wzrost populacji dużych mew w Mińsku i okolicach miał prawdopodobnie związek z obfitością bazy pokarmowej na największym w kraju składowisku odpadów komunalnych i dostępnością bezpiecznych miejsc lęgowych (dachy budynków).

Słowa kluczowe: liczebność, rozmieszczenie, pary lęgowe, trendy populacji, mewa białogłowa, *Larus cachinnans*, mewa srebrzysta, *Larus argentatus*, mewa żółtonoga, *Larus fuscus*, mewa romańska, *Larus michahellis*, Białoruś

Belarus is located within the ranges of several large white-headed gull species from the genus *Larus* (hereafter: large gulls). In the 20th century, they began expanding their ranges – the Herring Gull *Larus argentatus* to the south (Holling 2020), and both Caspian Gull *L. cachinnans* and Yellow-legged Gull *L. michahellis*, to the north and northwest (Grishchenko & Atamas 2020, Carboneras & Cama 2020). Impressive population growth and invasion of some of large gull species into new areas occurred also in Poland (Neubauer et al. 2006), Ukraine (Gavrilyuk et al. 2015) and continental European Russia near the eastern border of Belarus (Borisov 2012, Numerov & Vengerov 2012, Zubakin 2013). The Caspian Gull was probably the most successful when colonizing not only Eastern Europe (Atamas & Loparev 2005, Yakovets & Nikiforov 2009, Groot Koerkamp 2013), but also its central part and it currently continues to expand the range further west (Litwiniak et al. 2021). The population dynamics of large gulls, especially of the Caspian Gull, is well documented and monitored in neighbouring Poland (Neubauer et al. 2006, Przymencki et al. 2022). Significantly less attention was paid to these species in Belarus, mainly due to the difficulties with identification of the species and hybrids, and the published results of studies from the 1990s–2010s were extremely incomplete. Most of these data were presented in the form of brief notes in the proceedings of regional conferences (mainly in Russian) and therefore are not easily accessible to the researchers; moreover, they were usually limited to the study of single colonies or several nesting sites.

The last review on the abundance and distribution of large gulls in Belarus dates back to 2009 (Yakovets & Nikiforov 2009). Since then, the information on some breeding sites of large gulls could only be found in few published articles, for example, data on the breeding Herring Gull at the raised bogs of northern Belarus (Ivanovski 2011) and the number of breeding pairs on Chygirinskoye Reservoir in the eastern part of the country (Kitel et al. 2016). In recent years, Minsk with its environs can be considered the best-studied region of Belarus, as we have been conducting a detailed investigation of large gulls in this area since 2018. We published some information on the abundance and

distribution of gulls there, but only for the period 2018–2019 (Samusenko et al. 2019, Pyshko & Samusenko 2019, 2020). However, special assessment of the abundance, distribution and species composition of large gulls for the entire territory of the country has not been carried out for more than a decade. Given that and the fact that sufficiently large amount of data have been accumulated from the central part of the country over the period of five-year study, in this paper we report an up-to-date summary of the status of large gulls breeding in Belarus.

Material and methods

The summary was prepared on the basis of all available data on breeding large gulls in Belarus from 2018 to 2022. In addition to hardly available published information, the results of our own research was included, mainly from the central part of the country. Field work consisted of searching for nesting sites or controlling already known ones, and counting the number of occupied nests in late April–May, or estimating the number of nesting pairs based on the birds present in the colony. In addition, a survey of professional and amateur ornithologists was conducted, and in total, more than 20 experts were interviewed. Emphasis was put on information for the specified period, checking data on known or putative breeding sites, and obtaining new, previously unknown data.

All breeding sites known in 2018–2022 (single nest sites and colonies), mostly confirmed in 2021–2022, were analyzed to describe the spatial distribution of large gulls in

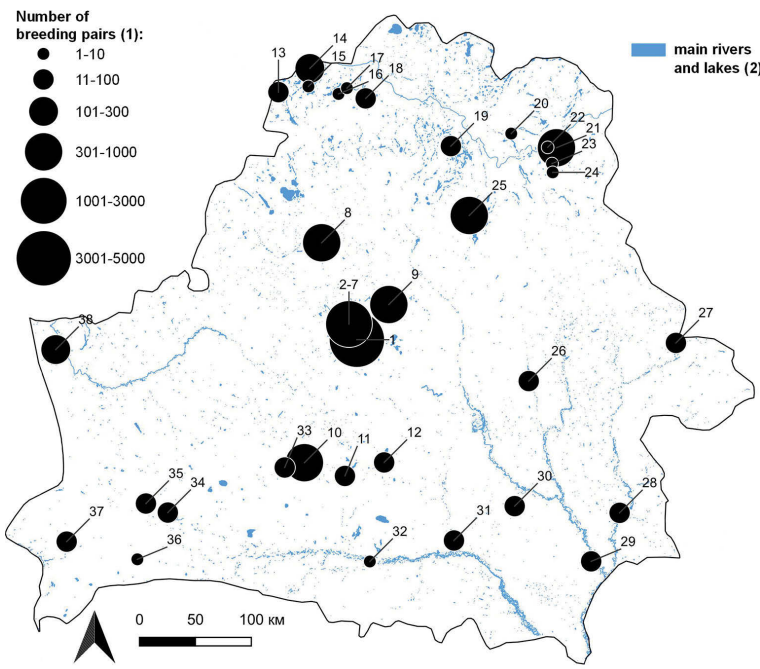

Fig. 1. Distribution of breeding sites of the large gulls in Belarus in 2018–2022. Size of circles reflects the highest abundance at each locality; their numbering corresponds to that given in Table 1
Rys. 1. *Rozmieszczenie miejsc gniazdowania dużych mew na Białorusi w latach 2018–2022. Wielkość kół odzwierciedla najwyższą liczebność w każdym miejscu; ich numeracja odpowiada podanej w tabeli 1. (1) – liczba par lęgowych, (2) – główne rzeki i jeziora*

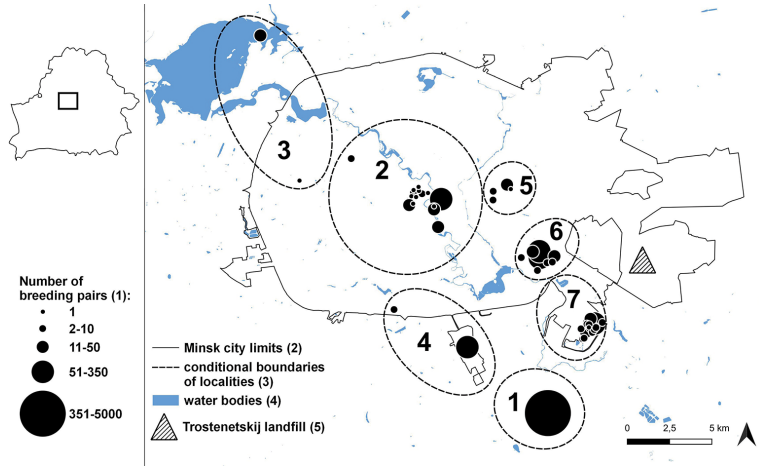

Fig. 2. Distribution of breeding sites of the large gulls in Minsk city area in 2018–2022. Size of circles reflects the highest abundance on each site. The numbering of localities encircled with a dashed circles or ovals corresponds to the one in Table 1 and Fig. 1

Rys. 2. *Rozmieszczenie miejsc gniazdowania dużych mew w Mińsku i okolicach w latach 2018–2022. Wielkość kół odzwierciedla najwyższą liczebność w każdym miejscu. Numeracja stanowisk połączonych (patrz Materiał i metody, otoczone przerywanymi liniami) odpowiada tej w tabeli 1 i na rys. 1. (1) – liczba par lęgowych, (2) – granica miasta, (3) – granice warunkowe grup, (4) – rzeki i zbiorniki wodne, (5) – wysypisko śmieci 'Trostenetskij'*

Belarus. The nesting site was treated as a separate building if it was located on a rooftop or a separate island if it was located on the water body. The colony was considered large when > 100 pairs nested, medium – from 11 to 100 pairs, small ≤10 pairs.

The distribution of gulls was presented for each of the six administrative Regions (Oblast') of the country and separately for the capital city of Minsk. In the case of high density, a group of nesting sites situated at a distance ≤5 km on the same water body, in the same city or in the same quarter of Minsk was combined into one breeding locality (Table 1 and Fig. 1). A detailed location of nesting sites in the Minsk city with its environs (up to 5 km from the city boundaries) is shown in Fig. 2. When checking the site several times during 2018–2022, the maximum registered number of breeding pairs was taken into account (Fig. 2); the same approach was adopted when summing these maximum numbers to map larger localities (Fig. 1). The maps were prepared in QGIS software, version 3.22.1 (QGIS Development Team 2023).

To estimate the population size of large gulls in Belarus, minimum and maximum limits were given. The minimum was estimated by summing the latest known data on gull abundance for each nesting site. The maximum was estimated by summing the largest known numbers in each nesting site over the entire study period (years 2018–2022). The resulting numbers can only be considered as a minimum expert estimate, since more nesting sites were expected, especially in large cities where gulls occupy the roofs of buildings during migration and in summer time. However, the species composition of both small and large gulls and their possible nesting sites are unknown without dedicated study.

Table 1. Known breeding sites of large gulls in Belarus in 2018–2022. Numbering of sites in the first column correspond with the numbering on the maps, except the Minsk city, for which the localities 2–7 and the number of breeding pairs there were pooled and represented by a single symbol on the Fig. 1. Region of Belarus (3): MN – Minsk, VT – Vitebsk, BR – Brest, GR – Grodno, GO – Gomel, MG – Mogilev. Trend abbreviations (7): ↑ – increase, ↓ – decrease, ≈ – fluctuations, X – colony abandoned, ? – unknown

Tabela 1. *Znane miejsca gniazdowania dużych mew w Białorusi w latach 2018–2022. (1) – numer (odpowiada numeracji stanowisk na mapach), (2) – nazwa miejsca gniazdowania, (3) – region Białorusi: MN – Mińsk, VT – Witebsk, BR – Brześć, GR – Grodno, GO – Homel, MG – Mohylew, (4) – koordynaty, (5) – liczebność par lęgowych, (6) – liczba miejsc gniazdowania, (7) – trend, (8) – środowisko, (9) – źródło*

No (1)	Breeding locality (2)	Region (3)	Coordinates (4)	N pairs (5)	N nest. sites (6)	Trend (7)	Habitat (8)	Source (9)
1	Gatovo	MN	53.775, 27.651	3400–5000	1	↑	roof	This paper
2	Minsk Center (city & TEC-2 reservoir)	MN	53.893, 27.550	85–240	16	↑	roof+reservoir	This paper
3	Minsk W-NW (Zaslavskoyje Reservoir & city)	MN	53.992, 27.435	0–20	2	↑	reservoir+roof	This paper
4	Minsk S (Kolyadichi & city)	MN	53.815, 27.586	60–110	2	↓	roof	This paper
5	Minsk E (MTZ)	MN	53.898, 27.639	10–20	4	≈	roof	This paper
6	Minsk SE (MAZ & Volat)	MN	53.857, 27.660	75–170	8	≈	roof	This paper
7	Minsk SE (Shabany)	MN	53.819, 27.702	340–470	14	↑	roof	This paper
8	Vilejskoye Reservoir	MN	54.498, 27.203	300–350	1	↑	reservoir	This paper
9	Smolevichskoye Reservoir	MN	54.039, 28.058	400–450	2	↑	reservoir	This paper
10	Krasnoslobodskoye Reservoir	MN	52.840, 26.983	100–320	1	↓	reservoir	This paper
11	Soligorskoye Reservoir	MN	52.738, 27.499	<20	1	?	reservoir	I. Bogdanovich
12	Lyuban fish farm	MN	52.842, 27.998	10–15	1	?	fish farm	I. Bogdanovich
13	Drysviaty Lake	VT	55.596, 26.652	60–70	2	↓	lake	V. Koscheev
14	Snudy Lake	VT	55.766, 27.052	140–170	3	↓	lake	V. Koscheev
15	Braslav town	VT	55.637, 27.034	1–5	1	↑	roof	V. Koscheev
16	Vazha Lake	VT	55.583, 27.417	5	1	?	lake	P. Pakul & M. Dmitrenok

No (1)	Breeding locality (2)	Region (3)	Coordinates (4)	N pairs (5)	N nest. sites (6)	Trend (7)	Habitat (8)	Source (9)
17	Boloto Mokh (Kamenpolje)	VT	55.625, 27.524	<10	1	↓	raised bog	V. Ivanovski
18	Yelnia	VT	55.551, 27.763	10–20	1	↓	raised bog	V. Ivanovski
19	Cherstvyatskoye Lake	VT	55.206, 28.848	13	1	?	lake	P. Pakul & M. Dmitrenok
20	Shumilino town	VT	55.297, 29.616	5–10	1	?	roof	M. Koloskov
21	Vitebsk city	VT	55.194, 30.192	200–300	6	?	roof+ground	V. Ivanovski
22	Dymovshchina	VT	55.197, 30.080	1	1	?	raised bog	V. Ivanovski
23	Gorodniansky Mokh	VT	55.079, 30.136	1	1	?	raised bog	V. Ivanovski
24	Chernetsky Mokh	VT	55.015, 30.144	1–2	1	?	raised bog	V. Ivanovski
25	Lukomskoye Lake	VT	54.699, 29.082	170–300	2	↓	lake	V. Koscheev
26	Chygirinskoye Reservoir	MG	53.463, 29.839	80	2	?	reservoir	I. Bogdanovich
27	Krichev town	MG	53.751, 31.713	>50	1	?	roof	I. Bogdanovich
28	Gomel city	GO	52.453, 30.996	10–15	2	↑	roof	Z. Goroshko
29	Dniepro-Braginskoye Reservoir	GO	52.075, 30.634	0–50	1	X	reservoir	P. Pinchuk & Z. Goroshko
30	Svetlogorskoye Reservoir	GO	52.505, 29.660	10–20	1	?	reservoir	I. Bogdanovich
31	Tremlia fish farm	GO	52.238, 28.887	10–20	1	≈	fish farm	D. Zhuravlev & A. Shevchik
32	Chernichi (Pripyat river floodplain)	GO	52.074, 27.816	2–3	1	≈	pillars	V. Khursanov
33	Loktyshi Reservoir	BR	52.803, 26.732	10–50	1	≈	reservoir	I. Bogdanovich
34	Chernoye Lake	BR	52.455, 25.244	ca. 10	1	?	lake	I. Bogdanovich
35	Berioza town	BR	52.525, 24.965	10–15	2	?	roof	This paper
36	Dnieprobugsky (Novosiolki) fish farm	BR	52.091, 24.856	0–3	1	≈	fish farm	I. Bogdanovich
37	Sokolovo fish farm	BR	52.229, 23.956	10–15	1	≈	fish farm	I. Bogdanovich
38	Grodno city	GR	53.701, 23.817	100–200	6	↑	roof	D. Vinchevski

Results

The total number of large gulls in Belarus was estimated at 8,000–9,500 breeding pairs, of which Caspian Gull and Herring Gull were the most numerous species. A total of 96 individual nesting sites of large gulls were identified that held from 1 to 5,000 breeding pairs. Half of all known nesting sites in Belarus were medium-sized colonies, however about 70–80% of pairs bred in eight large colonies. There were 40 nesting sites with less than 10 pairs, including 14 single-pair sites. Single breeding pairs were recorded only in the well-studied Minsk city area and on raised bogs of northern Belarus.

In total, 63 rooftop nesting sites in nine cities and towns were recorded (65% of all breeding sites in Belarus). Most of them were represented by single pairs and small colonies, but also by at least 15 medium to large-sized colonies ranging from 15 to 5,000 pairs and several more sites with dozens of pairs with inaccurately determined numbers. On 10 artificial dam reservoirs there were 12 nesting sites holding between 20 to 350 pairs, on 6 natural lakes – 10 sites with 5 to 100–110 pairs, on raised bogs – 5 sites with 1 to 20 pairs, on fish farms – 4 sites with colonies of up to 20 pairs each. In total, about 75% of pairs were breeding on rooftops in nine cities and towns, about 20% – on 20 water bodies (reservoirs, lakes, fish ponds), and up to 5% – in the other places. Among unusual habitats, annual nesting of up to 2–3 pairs on high concrete pillars in the Pripyat River floodplain was recorded (I. Bogdanovich, V. Khursanov – pers. comm.), as well as a colony of up to 20 pairs on the ground in a fenced area with partially dismantled old industrial buildings in the center of Vitebsk (V. Pshenichkin – pers. comm.).

Minsk city area. The city of Minsk with its environs accounts for most of known nesting sites and the highest number of large gulls in Belarus. At least 6,000 pairs nested here in 2021–2022 (70–80% of the known breeding population in the country). A total of 47 nesting sites were identified (no. 1–7 in Table 1 and Figs 1–2), including 27 single pairs or small colonies, 17 medium colonies and 3 large ones. Most nesting sites were located on the roofs of industrial, residential and administrative buildings, both in industrial zones and in the central quarters. Key colonies occupied large flat roofs with substantial size, window sills and supporting air-conditioning systems, ducting, stink pipes, ceiling opening windows etc. The largest colony was located on the huge rooftop (500 × 250 m, 12.5 ha) of a leather factory building in the industrial area of Gatovo town, a few kilometers southeast of Minsk (locality 1 in Fig. 2). The colony has been in existence since at least 2002 and has been under surveillance since 2006 (Yakovets & Nikiforov 2009, Goncharov & Neubauer 2012, Samusenko et al. 2019). According to the counts conducted at the end of April of each year, 3,404 occupied nests were recorded in this colony in 2018, 4,092 – in 2019, 4,140 – in 2020, 4,940 – in 2021, and 4,927 – in 2022. Up to 4% of the nests did not contain eggs during the counts, and some birds, especially young ones, started nesting later than in April. Thus, according to our assessment, in Gatovo colony up to 5,300 pairs could nest in 2021–2022. High breeding density was also observed in the large industrial zones mostly located in the eastern and southeastern parts of the city: Kolyadichi (locality 4 in Fig. 2), Minsk Tractor Works 'MTZ' (5), Minsk Automobile Plant 'MAZ' & Minsk Wheel Tractor Plant 'Volat' (6), Shabany (7). Here, the largest rooftop colonies reached 350 pairs (in Shabany industrial zone) and 100 pairs (in MAZ & Volat industrial zone and in Kolyadichi zone) in different years. The first case of large gulls breeding on rooftops in Belarus was recorded for these industrial areas of Minsk: 'MAZ' & 'Volat' in 1999 (Yurko & Kozulin 2000) and in Shabany in 2004 (Yurko et al. 2006). In the city center (locality 2 in Fig. 2), mostly 1–3 pairs nested on one breeding site, however, there were also 3 rooftop colonies: of up to 50 pairs (Belarusian

State University), along with up to 50 and 120 pairs (small old industrial zone used for offices and warehouses). Only in recent years two colonies of up to 20 pairs each occurred in the natural (traditional) habitats: on the islets of Zaslavskoye Reservoir outside the city limits (locality 3 in Fig. 2) and on small reservoir of the Svislach River, serving the thermal plant 'TEC–2' in the city center.

Minsk Region. About 900–1,200 pairs, i.e. 10–15% of the known number of large gulls population in Belarus, nested in this central region of the country (excluding Minsk city described before). In total, 5 breeding sites were known in 2018–2022 (no. 8–12 in Table 1 and Fig. 1), including 3 large-sized colonies on the islands in reservoirs and 2 medium-sized colonies. The largest colonies had different histories. The colony on Vilejskoye Reservoir is the oldest one known for central part of Belarus, where gulls started to breed in 1990 (Stavrovski 1993). The Krasnoslobodskoye Reservoir colony is known since the mid-2000s. The number of nesting pairs of gulls was very unstable throughout the existence of the colony due to water level fluctuations and human disturbance. The colony on Smolevichskoye Reservoir was formed in 2016 on one small islet (20 × 40 m) in the central part of the reservoir, and then the gulls colonized another islet closer to the bank, forcing Black-headed gulls *Chroicocephalus ridibundus* to abandon the first islet after 3–4 years since establishing the colony, and subsequently also removing them from the main part of the second islet.

Vitebsk Region. About 750–1,000 pairs, i.e. about 10% of the known number, nested in this northern region on 22 nesting sites (no. 13–25 in Table 1 and Fig. 1). The largest colonies were located on the lakes: Snudy – formed in 1983 (Naumchik & Biriukov 1988), and in Lukomskoye – established in 2010–2012 (Koscheev 2013). The colonies were very unstable due to human illegal persecution of piscivorous birds and high levels of human recreational pressure. On the Snudy lake, Herring Gull was the most numerous during the 2000s (Yakovets 2006), and its dominance probably has continued until recently, but the total number of large gulls has decreased there about twice in comparison to the maximum in 2009. On Lukomskoye Lake in the southeastern part of the region, Caspian and Herring Gulls were breeding together with – probably – the former species outnumbering the latter. A high nesting density was also observed in the city of Vitebsk, where large gulls have been breeding since 2007 (Ivanovski 2011). Over the past decade, six nesting sites were observed in different parts of the city, mainly on the roofs of buildings: industrial areas, including 'Vistan' and 'Vityaz' plants, hospital, residential houses in the central part of the city. Caspian Gulls dominated there. In addition to Vitebsk, large gulls have begun recently nesting on the roofs in small towns in the region: Braslav and Shumilino. Nesting of large gulls was recorded on 5 raised bogs, and only Herring Gulls breed in these habitats (V. Ivanovski – pers. comm). But only in two bog localities more than two pairs were breeding: in Yelnia – the first breeding in 1982 (Naumchik & Biriukov 1988) and in Boloto Mokh – in 1986 (Gritschik & Ivanovski 1992). In recent years, the number of nesting pairs on these two bogs was at least two times lower than the maximum recorded in the late 1990s and early 2000s (V. Ivanovski – pers. comm.).

Mogilev Region. The minimum estimation for this eastern region is 100–130 pairs of large gulls on the basis of data from two localities (no. 26–27 in Table 1 and Fig. 1). The breeding place was discovered on Chygirinskoye Reservoir in 2016 (Kitel et al. 2016) and confirmed in recent years. Another rooftop colony with several dozen breeding pairs was found in Krichev town in 2014, and the colony probably still exists (I. Bogdanovich – pers. comm). For some cities of this region, where nesting of large gulls on the roofs is also

probable, additional surveys are needed. Therefore, the current number of large gulls for this region may be underestimated.

Gomel Region. The estimation for this southeastern region is 70–120 pairs. Only medium-sized and small-sized colonies were known here (no. 28–32 in Table 1 and Fig. 1). Large gulls began to nest in Gomel city only in recent years, two nesting sites are known on residential buildings in the city center and in the area of the hospital. In 2018, there was a colony with up to 50 pairs on the island of Dniepro–Braginskoye Reservoir, but the birds stopped nesting there due to rising water level and strong recreational disturbance, probably moved to the Dnieper river floodplain (Z. Goroshko – pers. comm.).

Brest Region. The estimation for this southwestern region is 50–100 pairs of large gulls. In 2018–2022, 6 small-sized and medium-sized nesting sites were known (no. 33–37 in Table 1 and Fig. 1). Most of them were located on water bodies, but recently a new nesting site on the roofs appeared in the town of Berioza. About 15–20 years ago, several large colonies were known on fish farms of Brest Region, but recently large gulls nested there in very small numbers: a few pairs occasionally at the Dnieprobugsky fish farm, medium colonies were noted on Sokolovo fish farm and near Loktyshi fish farm.

Grodno Region. At least 6 breeding sites were known in this western region, exclusively in Grodno city (38 in Table 1 and Fig. 1). Special surveys have not been carried out in the city, but colonies with up to several dozen pairs on the roofs were noted (or only suspected) in different areas: in the industrial zones of 'Azot' and 'Khimvolokno' plants, on the building of the Medical University, other industrial and residential buildings (D. Vinchevsky – pers. comm.). The estimate of 100–200 breeding pairs, obtained without special counts, can probably be considered as the minimum for the city and the region.

Current abundance and distribution of species

Despite the fact that the Caspian Gull is currently a dominant species in most of breeding colonies and in Belarus as a whole, the northern part of the country is exceptional. Only there, Herring Gulls nest on raised bogs, and the proportion of the Herring Gull can also be relatively large on the lakes in the northwestern part of the Vitebsk region.

The species composition and actual abundance in recent years is unknown, because both species nest together in superabundant, mixed colonies and form mixed pairs for at least 20 years, and significant proportion of hybrids may be present in the population. Based on all known data from well-studied breeding sites, we estimate that at least 4,800 'pure' pairs of Caspian Gulls and 800 'pure' pairs of Herring Gulls can nest in Belarus. According to this estimate, the proportion of Caspian Gulls is at least 50–60% of the total number of large gulls in the country, and that of Herring Gulls – at least 10%. Another 30–40% of unidentified pairs in the population may be birds of different species nesting in mixed pairs and even in possible underestimated 'pure' pairs, as well as their hybrids (Fig. 3).

The number of other gull species is insignificant in the total population of large gulls in Belarus. The breeding Lesser Black-backed Gull was first confirmed in 2012 in Gatovo colony based on nesting of three birds, which phenotypically matched one of three pale-mantled subspecies – *L. f. graellsii*, *L. f. intermedius* and *L. f. heuglini* (Goncharov & Neubauer 2012). In 2018–2022, only one and the same nesting site of the species was known in Belarus: up to five pairs were breeding in Gatovo colony, including two pure pairs and three other individuals paired with other large gull species. In addition, an offspring of one of these mixed pairs (*L. fuscus* × other species), ringed as a chick

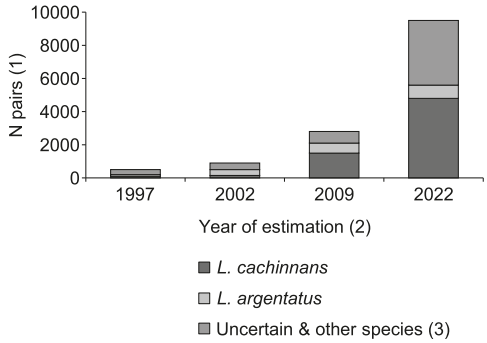

Fig. 3. Estimates of the number of breeding pairs of large gulls in Belarus in different periods. Sources of data: 1997 – Nikiforov et al. (1997), 2002 and 2009 – Yakovets & Nikiforov (2009), 2022 – this study

Rys. 3. *Liczebność lęgowych dużych mew na Białorusi dla różnych lat. (1) – suma par lęgowych, (2) – rok oceny i źródło: 1997 – Nikiforov et al. (1997), 2002 i 2009 –Yakovets & Nikiforov (2009), 2022 – niniejsza praca, (3) – przynależność gatunkowa niepewna i inne gatunki*

in 2019, started breeding in the colony in 2022. This hybrid female had a significantly lighter mantle than that of *L. fuscus* and nested with the Caspian Gull male. In total, at least eight individuals of *L. fuscus*-like phenotype, including hybrids, nested in Gatovo colony in 2022. Furthermore, three adult Lesser Black-backed Gulls were recorded in breeding colony on the Dniepro–Braginskoye Reservoir in 2018, but the nesting site was not surveyed, so it is not known whether these were nesting birds or only summer visitors (P. Pinchuk – pers. comm.).

The Yellow-legged Gull probably breeds in Gatovo colony too. At least two trapped and measured birds had clear phenotypic traits of this species. The presence of Yellow-legged Gulls was assumed by previous researchers in Gatovo colony (Yakovets & Nikiforov 2009, Goncharov & Neubauer 2012). The remnants of the worn out colour ring (yellow 'SRL3') from a bird originating from the Adriatic Sea region (ringed as pullus in 2001), was found on July 4, 2020 in Gatovo colony. The bird had still the colour ring when was observed in the Jakuševec landfill in Croatia in February 2007 (L. Jurinović – pers. comm.). Since we repeatedly found fragments of such old plastic rings near the nests of local breeding birds, which they lost after 10–15 years after ringing, we assume that this bird could also breed in the colony in 2020 or a bit earlier. This fact may explain to some extent the hypothesized influence of the Yellow-legged Gull phenotype on breeding birds at Gatovo.

Discussion

Large gulls started to breed in Belarus in the 1980s, and different species entered its territory in different ways. Breeding of the Herring Gull was recorded for the first time in the northwest of the country in 1982 (Naumchik & Biriukov 1988), and the Caspian Gull in the south in 1989 (Yurko & Kozulin 2000). Since then, the number of both species have been steadily increasing and their ranges have expanded, which created a secondary contact zone most likely during the 1990s. In the 2000s, the Herring Gull dominated in the north, the Caspian Gull in the south and mixed colonies with predominance of Caspian were known in the central part of the country (Yakovets 2006). At the first stages of expansion to Belarus during the 1990s and 2000s, both mentioned species showed different preferences for breeding habitats (Yakovets, 2006, Yakovets & Nikiforov 2009). Herring Gulls nested mainly on high islands of large lakes, as well as on ridge-hollow complexes of raised bogs. The nesting of Caspian Gulls was limited mainly to the islands on the ponds of fish farms in the south of the country. Following the contact of both species in central Belarus, they began to nest in the same habitats – on large reservoirs, and, subsequently, on the roofs of buildings (Yakovets & Nikiforov 2009).

It is difficult to estimate the number of each species of large gulls breeding in Belarus, due to large size of their populations, small number of researchers involved in gull research and, in particular, still insufficient level of knowledge that would allow to confidently identify species and hybrids in the contact zone. However, an attempt to estimate the abundance of the two dominant large gull species in Belarus as accurately as possible has been made. In order to do that, all collected data from the country were collated and verified by the authors experienced in determining the species proportion, both in the field in visited colonies and from photos in the case of non-visited colonies.

The population dynamics of both species also have different patterns, as shown by a comparison of the current status with population estimates made in 1997 (Nikiforov et al. 1997), 2002 and 2009 (Yakovets & Nikiforov 2009) (Fig. 3). In 1997–2002, the number of large gulls increased by 2.0–2.5 times over five years – from 200–500 to 500–900 pairs, but the growth rate of the Herring Gull (by 2.5–3.5 times) was much higher than that of the Caspian (by 1.5 times). In 2002–2009, the population growth of large gulls as a whole continued at almost the same pace – number reached 2,100–2,800 pairs, but it was much more spectacular in case of Caspian Gulls (growth by 5–10 times), while the number of Herring Gulls increased only by about 1.5–2.0 times over seven years. Over the past 13 years (2009–2022), the number of large gulls in Belarus increased 3.5 times, and although the growth rate of the Caspian Gull has slowed down (increase by 3.5–4.5 times), it is still much higher than that of the Herring Gull (by 1.5–2.0 times).

We suggest that the dynamics of both species abundance were influenced by differences in their behavior and requirements for nesting sites. At the same time, large gulls have been under pressure from unfavorable factors in the various habitats over the past decades. The following causes were most often recorded as having negative impact on the presence and abundance of large gulls in known nesting areas: artificial regulation of the water level in reservoirs and on fish ponds, falling water levels and drying out of raised bogs, predation by avian (Hooded Crows *Corvus cornix* and Marsh Harriers *Circus aeruginosus*) and terrestrial predators (Red Foxes *Vulpes vulpes* and Raccoon Dogs *Nyctereutes procyonoides*) in natural habitats, disturbance due to high recreational human activity in natural habitats, significant changes in breeding areas that reduce their attractiveness to gulls, direct human persecution – destruction of nests, illegal collection of eggs and even bird shooting. Most of these causes were known primarily for natural terrestrial nesting habitats, but the last two of them negatively affected the gull numbers in both natural and urban nesting sites. For example, some islands in water bodies (lakes, reservoirs) were overgrown with trees and bushes, which led to reduction in the area suitable for nesting. In urban areas, there have been cases of disappearance of nesting sites or a decrease in their numbers as a result of the demolition of buildings, repairs or roof cleaning.

The direct persecution of gulls by humans can be carried out illegally both on natural and urban nesting sites, but it was especially noticeable on fish farms and neighboring reservoirs, as well as on lakes where commercial and amateur fishing was carried out. For example, nesting of large gulls in the past (1990–2000s) was noted on the ponds of Volma fish farm (Minsk Region) and Novinki fish farm (Vitebsk Region), several large colonies existed on or near fish farms in Brest Region: Polesie fish farm – nesting was known from 1995 (Yurko 1999), Dnieprobugsky fish farm (old name – Novosiolki) – known from 2002 (Gritchik & Abramchyk 2004), Selets Reservoir (vicinity of the fish farm with the same name) – nesting was recorded in 2009. These colonies disappeared later mainly due to constant human persecution (Yakovets & Nikiforov 2009). Mass illegal collection of eggs by the local people was known in some colonies on Snudy Lake (Yakovets & Nikiforov

2009), while illegal destruction of nests by farm workers took place on the Dnieprobugsky fish farm (Gritchik & Abramchuk 2004).

Most of the recorded cases of the direct persecution of gulls by humans took place where large gulls nested with Great Cormorant *Phalacrocorax carbo*, Grey Heron *Ardea cinerea* or Great White Egret *A. alba* (Loktyshi, Cherstvyatskoye, Krasnoslobodskoye, Sokolovo, Snudy, Vilejskoye etc.). These three species of fish-eating/piscivorous birds are listed as 'game species', and the first two of them were previously treated as 'undesirable animal species' on fish ponds (Samusenko 2013). Therefore, cormorants and herons may be subjected to population control both in official hunting areas and on ponds of fish farms with the permission of the Ministry of Natural Resources in the latter case. The negative hunting pressure on gulls also took place, but illegally. As a result, large colonies on fish ponds in the southern Belarus, where the majority of fish farms is located, and which gulls colonized first in this part of the country (Yakovets & Nikiforov 2009), disappeared or significantly decreased in numbers.

The level of direct human persecution of gulls on rooftop nesting sites is difficult to estimate, because access by unauthorized people to most of urban colonies is limited. Cases of such an impact are known, especially when large colonies appeared on the roofs of industrial buildings, but in general, the array of adverse factors is much more diverse in natural nesting areas both in the north and in the south of the country. As a result, only about 25% of population (from 2,000 to 2,300 pairs) nests in relatively natural habitats now, and the remaining 75% of pairs – on the roofs. Meanwhile, only several pairs (<1% of the total number) nested on the roofs in 2002 and about 1,000 pairs (35–45%) – in 2009. The colonization of the urban environment by large gulls continues not only in Minsk, but also in other cities and towns of Belarus, where new nesting sites have appeared. In the Minsk area from the late 1990s until mid-2010s, large gulls nested only on rooftops, but in the last 5–7 years two colonies formed on the islands of reservoirs in Minsk city and one more colony on the Smolevichskoye Reservoir at a distance of 25–30 km from the city. The beginning of nesting on water bodies only after reaching a high breeding density on rooftops, can be considered a new 'secondary' phenomenon for the Minsk city area, and deserves further attention for understanding expansion and breeding habitat choice of large gulls.

All coastal European countries between Norway and Portugal supported roof-nesting populations of varying sizes (Rock 2005). Urban large colonies of > 3,000 pairs were very rare and were known no further than a few tens of kilometers away from the sea coast, for example, at several sites in Britain and Ireland (Rock & Vaughan 2013), and the Moerdijk colony in the Netherlands (Muusse et al. 2011). Such a high breeding density of large gulls is not typical for the inland areas of Central and Eastern Europe. In continental parts of the countries neighboring Belarus that have access to the sea and many more water reservoirs, colonies of > 500 pairs of gulls were found only on much larger water bodies. Two such colonies in Poland are located on the Vistula River (Przymencki et al. 2022). The colony near Zastów Karczmiski, which arose somewhat earlier than the first Minsk nesting, did not exceed 2,000 pairs in 2021, and the largest Polish colonies (together with Kępa Nadbrzeska colony, located at a distance of about 10 km from each other), were around 2,500 pairs. The two largest colonies in Ukraine are located on the country's largest reservoir on the Dnieper River – Kremenchuk (Gavrilyuk et al. 2015), with an area of more than 2,000 sq. km. The maximum recorded number in several colonies on the Kremenchuk Reservoir was 1,940–1,990 pairs, on the Kaniv Reservoir with an area of 581 sq. km – 495 pairs.

Both the high abundance and rapid growth of the population of large gulls in Minsk city area is clearly associated with birds foraging in the local landfill, which is confirmed by our observations in the colonies and in the landfill, as well as by the diet of urban gulls. The largest landfill in Belarus 'Trostenetskij' (Fig. 2) occupies an area of 30.5 ha and is intended for waste disposal of the most densely populated region of the country – the city of Minsk with its surroundings with a population of more than 2 million people. The maximum recorded number of large gulls in the landfill was 6,500 individuals, and the average number during the breeding period (April–June) increased significantly from 2016 to 2022, which can be associated with an increase in their breeding abundance in Minsk city area in recent years (Chernomorets & Samusenko 2022). 68.8% of the examined 32 flightless chicks that died in May–early June 2014 in Gatovo colony had food of anthropogenic origin in their stomachs (Akimova & Samusenko 2020). Non-organic elements of anthropogenic origin (plastic bags, product wrappers, pieces of paper, plastic, textiles, etc.) were found in 65.5% of the pellets collected and analyzed in Gatovo colony in 2022 (N=374), and food waste – in 28.6% (Pyshko 2023).

Thus, such an impressive success of large gulls in the country, especially in its central part, became possible due to their adaptation to nest and forage in urban areas. As it can be seen from the population dynamics and distribution patterns of two most abundant gull species in Belarus, the Caspian Gull was better adapted to colonization of new breeding habitats. The assumption that the Caspian Gull will outnumber the Herring Gull during its colonization of Central Europe, especially in the eastern part of the inland area, was stated long ago (Klein & Neubauer 2006) and turned out to be true, as it can be seen in Belarus.

Despite the synurbization which allows the populations of large gulls in Belarus to increase quickly, the history of their colonization suggests that the human pressure increases with their presence and abundance. Possible illegal impacts in many cases cannot be assessed, which makes any future predictions of the population status of large gulls on the territory of Belarus difficult.

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