Zoodiversity, **58**(1): 59–68, 2024
DOI 10.15407/zoo2024.01.59

UDC 598.293.1:591.521(477.54)

THE BREEDING POPULATION OF THE ROOK, *CORVUS FRUGILEGUS* (AVES, CORVIDAE), IN KHARKIV, UKRAINE: NEARLY 22-TIMES DECLINE IN NUMBERS OVER AN 80-YEAR PERIOD

O. O. Brezghunova[1] & O. I. Sinna[2]

[1]*Department of Zoology,*
H. S. Skovoroda Kharkiv National Pedagogical University,
Alchevskyh st., 29, Kharkiv, 61002 Ukraine
E-mail: olgabresgunova@gmail.com
[2]*Department of Physical Geography and Cartography,*
V. N. Karazin Kharkiv National University,
Svobody Square, 4, Kharkiv, Ukraine
E-mail: o.sinna@karazin.ua

O. O. Brezghunova (https://orcid.org/0000-0002-7503-2790)
O. I. Sinna (https://orcid.org/0000-0002-7693-7348)

urn:lsid:zoobank.org:pub:38B2DCA4-D367-4F25-B7BF-0D912D551F20

The Breeding Population of the Rook, *Corvus frugilegus* (Aves, Corvidae), in Kharkiv, Ukraine: Nearly 22-times Decline in Numbers Over an 80-year Period. **Brezghunova, O. O., Sinna, O. I.** — Based on regular surveys of the distribution of rookeries and the number of nesting birds of *Corvus frugilegus* Linnaeus, 1758 carried out in 2002–2020 using the TRIM (TRends & Indices for Monitoring data), the trajectory of change in the rook population has been estimated. The total size of the breeding population of rooks in Kharkiv City has decreased by 95.4 % over the last 80 years, from 940 to 43 breeding pairs. The general trend for 1939–2020 is a moderate decline (multiplicative slope 0.980, standard error 0.004; $p < 0.01$). A similar trend was observed for 2002–2020 when surveys were regular, i. e. a moderate decline (multiplicative slope 0.920, standard error 0.021; $p < 0.01$). Rooks still use the centre of the city for nesting, as

they did in the early 1940s, but from the 1980s they began to breed in the eastern part of Kharkiv, where most of the population is now concentrated. Rooks breed in two clustered colonies, one in the central and one in the eastern part of Kharkiv City, about 13 km apart. The colonies are not numerous (all less than 50 pairs) in the last 10 years. The possible causes of the decline of the rook population in Kharkiv City are discussed.
Key words: Rook, rookery, bird surveys, colonies distribution, decline of breeding population, population trend.

Introduction

The Rook (*Corvus frugilegus* Linnaeus, 1758) is a widespread Eurasian corvid species that favours urbanised and rural landscapes, notable for its group living, communal roosting and colonial breeding, and complex social structures (Somov, 1897; Coombs, 1978; Boucherie, 2016). The distribution and size of colonies in urban areas depend on the distribution of suitable nesting habitats, the level of human disturbance and the remoteness of foraging sites (Bokotey, 2011; Kitowski, 2013). The Rook has demonstrated a clear attraction to agricultural and urbanised landscapes across Europe since at least the 19th century, which is presumed to have facilitated the spread of the species and an increase in its numbers. Today, however, despite a very large global population, the Rook is exhibiting a declining trend overall in Europe and particularly in the eastern parts of the continent, including Ukraine (BirdLife international, 2023; Bokotey et al., 2010; Kitowski, 2011; Mikuška et al., 2015; Orłowski & Czapulak, 2007).

The earliest data on rooks in Kharkiv Region, Ukraine, appeared in 1834, and since then the rook has been considered a common species; more than 100 years ago, rookeries were found not only in natural habitats such as pine forests, but also on the streets of towns in Kharkiv Region (Somov, 1897). The city of Kharkiv itself hosted a considerable number of breeding rooks in the middle third of the 20th century (Averin, 1941). The Rook still breeds regularly in Kharkiv City, but numbers have decreased considerably, especially in recent decades. To date, no attempt has been made to assess the rate of decline of the breeding population of rooks in Kharkiv City, although several inventories have been carried out here since the middle of the 20th century.

This research focuses on the dynamics of the number and distribution of the breeding population of rooks in the city of Kharkiv, Eastern Ukraine. It was here that the first ever mapping survey of the distribution of the species in Ukraine was carried out in 1939–1940 by a group of ornithologists led by the renowned zoologist Victor Averin. All the nests in the city were mapped and the size of the breeding population estimated in the first pioneering attempt to map the breeding distribution of this bird species in Ukraine.

In this paper we try to summarise the data on the changes in the distribution of rookeries and the dynamics of the breeding population in the city of Kharkiv, the second largest city in Ukraine, over the last 80 years. The available data were used to identify the trend of changes in the size of the breeding population of rooks over time and the distribution of rookeries in the study area.

Material and Methods

The study area was the city of Kharkiv in Eastern Ukraine, with an area of 370 km² and an estimated population of almost two million people. Data were collected from 2002 to 2020. A single observer inspected all rookeries and counted breeding pairs of rooks at nests in the area. Nesting pairs (or active/occupied nests) were counted to avoid adding old unoccupied structures from previous breeding seasons to the count (see also Chmielewski et al., 2017). Thus, a nest was deemed active if it contained an adult bird sitting on it or adults visiting to feed chicks. We use the term 'rookery' to refer to rook breeding sites (in this case only on the trees and well separated from each other), while 'colony' refers to a group of birds breeding within a rookery (Richardson et al., 1979). We collected the coordinates of all rookeries within the boundaries of Kharkiv City. The only problem was to survey those territories within Kharkiv plants, factories and other industrial areas, as most of these sites could only be checked along their borders. Despite this difficulty, we are confident that all the rookeries were detected.

Four colonies were found in 2002, some of which used two or three neighbouring sites for nesting. Such sub-colonies are hereafter referred to as "colony units". As breeding rooks from neighbouring sites form foraging groups and feed and roost together, we count them as a single colony. If, during early post-breeding period, rooks continue to appear at any of the colony sites during the day, but form part of a communal roost at another colony site at night (Bresgunova, 2009), we refer to them as a "clustered colony".

We recorded all general changes in population size and mapped all rookeries during a 19-year observation period. Our data include records from breeding pair counts in April–May or early June in 2002–2006 and 2016–2020, and partly in 2007–2015, when we checked the distribution of all rookeries.

We also collected all available information on the distribution of rookeries and the number of breeding birds since 1939. Firstly, we interviewed all biologists, especially ornithologists, working in the city of Kharkiv. Secondly, we collected information about extinct colonies from scientific publications. The main and most important data came from 1939–1940 (we have reinstated the date as the actual date of this undertaking is missing from the paper) by O. O. Lisetskii, H. P. Moskovskii and V. V. Shevchenko in a comprehensive survey of breeding rooks in Kharkiv City, with a result in the form of a map of species distribution using a grid in the style of a bird atlas. Probably the first survey of its kind in Ukraine was planned, organised and published by a famous Kharkiv zoologist V. G. Averin (1941). However, the map illustrating the distribution of nests was drawn by hand. Averin (loc. cit.) used the word "nests" to refer to active nests, and we therefore assume that we can count "nests" as "breeding pairs". Unfortunately, the data published in 1941 did not include information on rookery boundaries, only the number of nests per square and the total number of rookeries and breeding pairs in the city at that time. Furthermore, this paper was published in a local journal during a wartime period and was never made available to a wider scientific audience. We use ArcGIS Desktop 10.8 to restore it and plot all the data we receive on the map and geodatabase.

Moreover, we use the archival records of O. O. Lisetskii. Some of his records on the distribution of breeding rooks in Kharkiv City in 1959–1960 and 1964–1968 were kept in the library of the Department of Zoology and Animal Ecology, Karazin National University of Kharkiv (unfortunately, half of these papers/documents/notes were completely destroyed during a Russian bombing in March 2022).

We used the cartographic method to visualize and compare the distribution of nests and location of colonies of rooks in Kharkiv City in different time periods. We created the geodatabase and maps using geographic information systems (GIS), in particular ArcGIS Desktop 10.8. Mapbox and OpenStreetMap data were used as the basemap for all our maps in this paper.

The overall trend of changes in breeding numbers of rooks in Kharkiv City for the period 1939–2020 and the trend for our data from 2002–2020 were estimated using TRIM (TRends & Indices for Monitoring data) vers. 3.53 software (TRIM, 2019). TRIM uses generalised linear models (log-linear regression models) to calculate expected values and then to obtain trends, which can be classified by their magnitude and significance (Pannekoek & van Strien, 2005).

Results

The survey of 1939–1940 (V. G. Averin, O. O. Lisetskii, H. P. Moskovskii, V. V. Shevchenko data)

The first data on the number of breeding rooks and the size of rookery in the city of Kharkiv were presented in a paper by V. Averin (1941). It discussed the results of the first comprehensive survey of breeding rooks in Kharkiv. This survey also revealed the distribution of nests within the boundaries of Kharkiv City. The original and restored maps (Averin, 1941) are shown in figure 1. Thus, in 1939–1940, V. Averin and his group counted 940 nests (breeding pairs) in 310 trees on Kharkiv streets and in parks in the city centre. These older data show the real number of breeding rooks at that time. It is easy to explain the absence of rooks in the eastern parts of the city on this map: there were no suitable nesting sites for rooks at that time, because trees were not planted there until the early 1930s.

On Averin's map, only the scale was displayed, while rectangular or geographic coordinates, coordinate or kilometre grid were not indicated (fig 1, a). We used such elements as confluences of rivers, bridges, and street intersections as control points for georeferencing the map in GIS. As we can see on the original map (fig 1, a), in order to display the thematic content of the map the researchers did not use the coordinates of each rook nest and every rook colony. For this, a conventional grid of 1,000 m × 1,000 m squares was used. The total number of nests (breeding pairs) was recorded within the square according to Averin's map and the paper text. Nevertheless, the method of display is quantitative, which made it possible to operate with these data in further comparisons of the number of rooks in Kharkiv City for different time periods.

The survey of 1959–1968 (O. O. Lisetskii, unpublished data; archives)

Compared with the level of the late 1930s–early 1940s the breeding population of rooks in Kharkiv City declined significantly towards the 1960s. In 1959–1968 O. O. Lisetskii counted from 159 to 211 (average 174) pairs of breeding rooks (Lisetskii, 1969). However, these birds bred mainly in the centre of the city, and we still know nothing about the distribution of rook colonies in the eastern part of Kharkiv at that time.

The survey of 1980s (Nadtochii, Ziomenko, 1989, data; I. V. Kolesnikov, pers. comm.) and 1990s (H. S. Nadtochii, O. S. Reutskii, L. P. Babkin unpublished data, pers. comm.)

In the mid-1980s there were several rookeries, mostly in the city centre, for example, during 1984–1988 the number of breeding rooks in the city centre almost doubled (Nadtochii & Ziomenko, 1989). At that time the breeding of rook was also recorded in the eastern part of city (I. V. Kolesnikov, pers. comm.; fig. 2). Unfortunately, we do not know the exact number of nesting birds there, but it was not less than 100 pairs (I. V. Kolesnikov, L. P. Babkin pers. comm.). Thus, by the end of the 1980s the breeding population of rooks in Kharkiv was estimated at 326–525 pairs.

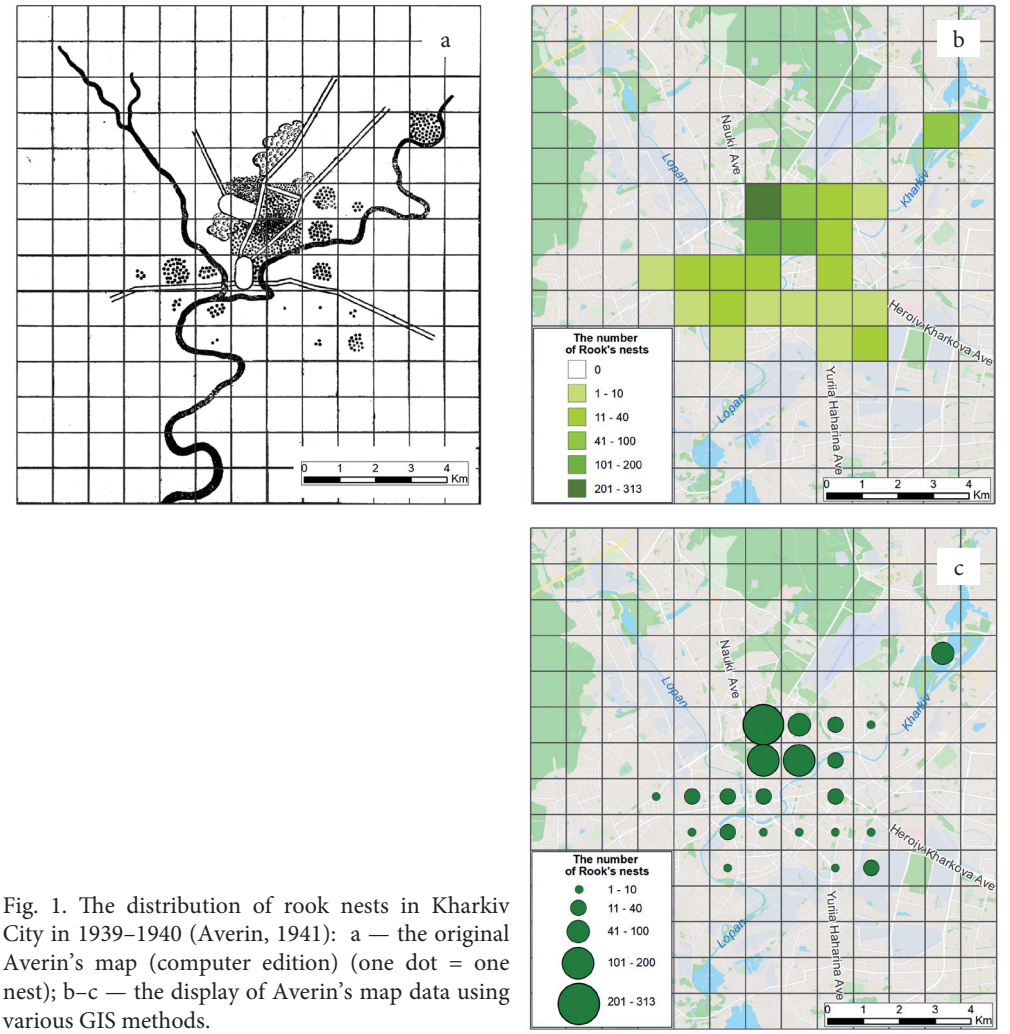

Fig. 1. The distribution of rook nests in Kharkiv City in 1939–1940 (Averin, 1941): a — the original Averin's map (computer edition) (one dot = one nest); b–c — the display of Averin's map data using various GIS methods.

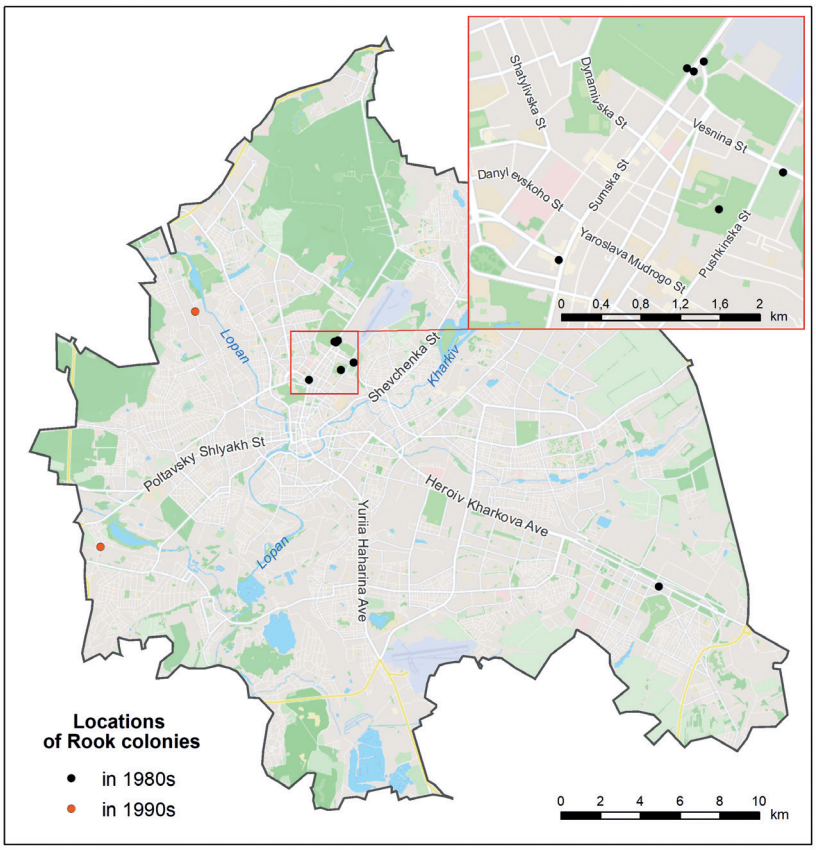

Fig. 2. The location of rook colonies in Kharkiv during 1980s and 1990s (from Nadtochii, Ziomenko, 1989; I. V. Kolesnikov, H. S. Nadtochii, O. S. Reutskii, L. P. Babkin, pers. comm.).

We also have some information from the 1990s about two other rookeries in Kharkiv. One was at Khvylynka station (south-west of Kharkiv City) and the second was somewhere near the railway line at Sortyrovka station, north of Kharkiv. Both colonies had disappeared by 2002. Unfortunately, we do not know the number of breeding birds or the exact years of these colonies' existence. We only know that the rook population in Kharkiv was estimated at 624 breeding pairs in the middle of 1990s but definitely not allowing for the colonies in the eastern part of the city (Nadtochii & Ziomenko, 2001).

The survey of 2002–2020

a. Kharkiv City centre

Two colonies existed in the centre of Kharkiv until 2009 (fig. 3), but one of them ("Central Park") disappeared completely in 2009–2010 (fig. 3; points 1, A and 1, B). This was caused by the cutting of trees in 2009–2010. From 2003 to 2008, this colony comprised 50–70 breeding pairs and consisted of two parts (or sub-colonies) separated by 300 m.

The second colony near the Museum of Nature traditionally included nearly 30 breeding pairs (29–34) and three sub-colonies from 2002 to 2017. However, only 9–10 pairs nested here in 2018–2019 and only four breeding pairs in 2020 (fig. 3; points 2, A, 2, B, 2, C). During the early post-breeding period, rooks from two colonies (one clustered colo-

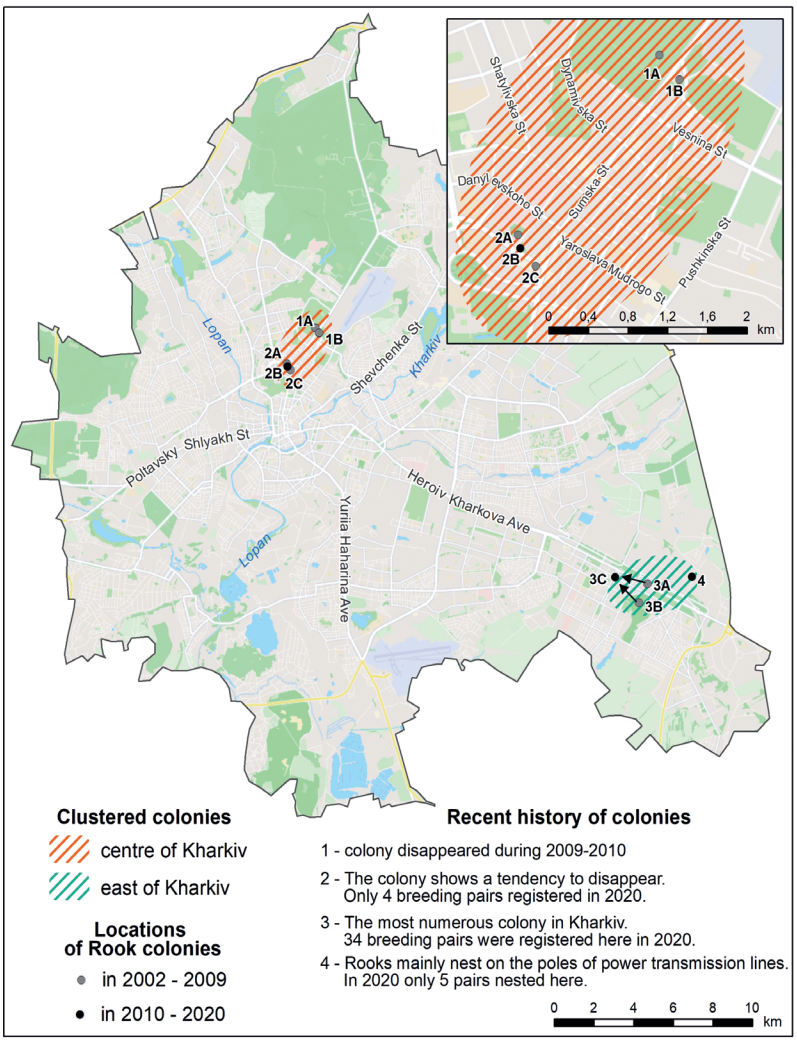

Fig. 3. Location of rook colonies in Kharkiv City in 2002–2020. Letters designate units within colonies.

ny) roost together, but from October some other rooks joined the gathering (Bresgunova, 2009), however in 2019 only 100–150 individuals gathered here. The rooks nest here and form a communal roost despite systematic persecution by humans: their nests were destroyed several times during the observation period. We also documented the destruction of rookeries by trimming branches with occupied nests . Moreover, the rooks were forced to change nesting trees at least three times (fig. 3; points 2, A; 2, B and 2, C). The colony itself showed a tendency to disappear.

b. Eastern part of Kharkiv City

Two colonies are located in the eastern part of the city, 13 km from the centre of Kharkiv. Colony 3 was also observed to change its nesting site (fig. 3, points 3, A, and 3, B) due to tree cutting. One of its nesting sites disappeared, but rooks started nesting on another one (fig. 3, point 3, C). The number of nesting birds decreased from 60 (2002–2003) to 32–34 pairs (2020).

The rooks of the fourth colony traditionally nest on the metal poles of power lines and not far from them on trees (fig. 3; point 4). In this settlement 9–33 pairs nested in different years. However, in 2020 only five pairs nested here.

Thus, in 2020 only three colonies (2, 3 and 4) with a total of 41–43 breeding pairs were left in Kharkiv (fig. 3).

Declining trend in changes in the number of breeding rooks

As mentioned before, the numbers of breeding rooks has dropped dramatically since the 1940s, e. g. from 940 pairs in 1940 to only 43 pairs in 2020. That simply means that the population of rooks in Kharkiv City decreased by 95.4 % during an 80-year period. The trend in the changes of the numbers for 1939–2020 period analysed by means of programme TRIM is a moderate decline (multiplicative slope 0.980, standard error 0.004; $p < 0.01$). That means that on average the numbers of the species dropped by 2 % per year within this nearly 80-year period. But since there are a lot of missing values it's better to look at the latest part of this period (2002–2020).

The trend for 2002–2020, when the surveys were more regular, is also a moderate decline (multiplicative slope 0.920, standard error 0.021; $p < 0.01$). For this period, the rate of decline is higher at around 8 % per year. This clear trend is reflected in the disappearance of one colony and several colony units during this period.

Discussion

The trend of European Rook population is characterised by a moderate increase in the period 1980–2000, but after 2000, the trend showed a decrease in many European countries (BirdLife International, 2017, 2023; Spiess & Keller, 2020). For example, in Poland (Kitowski, 2013); Hungary (Fehérvári et al., 2009); Croatia (Mikuška et al., 2015); the Netherlands (Spiess & Keller, 2020); etc.

In Ukraine, trends in changes in rook numbers are declining in most regions. In Mykolaiv Region the number of breeding rooks decreased between 1991 and 2010 (Redinov & Petrovych, 2011). In the centre of the city of Uzhhorod the last numerous rookery was observed in the 1980s; the species nested in neighbouring areas in 2000 (Stankevych, 2000), but no longer. In Lviv the rook population declined from 14 colonies (1,000 breeding pairs) to 4 colonies (350 breeding pairs) between 1985 and 2005 (Bokotey, 2011).

Our data clearly show that the breeding population of rooks in Kharkiv City declined from a maximum in the early 1940s (940 breeding pairs) to a minimum in 2020 (43 pairs). The population of wintering rooks in Kharkiv also decreased from 97,000 in 2004/2005 to 50,000 in 2016/2017 (O. O. Brezghunova, our data).

One of the causes (perhaps not the main one) of the disappearance of rookeries and the decrease in the number of rooks in the city of Kharkiv is direct persecution by the municipal services (Spiess, Keller, 2020). In some other Ukrainian cities, direct persecution by humans is the key factor determining the decrease in the number of rooks (Shevtsov, 2001). In other parts of Ukraine, the illegal shooting or killing of nesting rooks and reducing the number of their nests by cutting down trees may play a significant role in the decline (Koshelev et al., 2019). In western Poland, rook numbers have declined due to the felling of trees with nests (Kitowski, 2013). Systematic persecution by humans has also led to the disappearance of rookeries in Croatia (Mikuška et al., 2015).

The process of extinction of rook colonies may also be linked to climate change (Bokotey, 2011). Furthermore, the rook is considered to be a species with low plasticity in the face of climate change (Zbyryt et al., 2022). A major cause of population decline is the use of pesticides and chemical seed treatments (Spiess, Keller, 2020).

Another factor may be relevant in explaining the observed rate of decline. In Poland, the smaller colonies disappeared faster than the larger ones (Jyzefik, 1976; Kitowski, 2013; Orłowski & Czapulak, 2007). In other words, in smaller colonies, the lack of strong social relationships among rooks can lead to desertion. For the last 10 years the colonies in Kharkiv City can be classified as small according to the latest surveys, e. g. the maximum size of the rook colony is only 34 active nests in 2020. It is clear that several factors, including suitable nesting and foraging sites and the presence of conspecifics, play the key role in the suitability of urban habitat for breeding (Griffin, 1998; Bokotey, 2011).

Almost 80 years ago the rook was considered a pest in the city of Kharkiv (Averin, 1941). Disturbance and severe persecution, especially cutting trees and harassment of colonies, are the significant factors in distribution of colonies and impacting their size not only in Ukraine (Lviv: Senik & Kasparova, 2012), but in other countries (Poland: Kitowski, 2013; Croatia: Mikuška et al., 2015; Germany: Krüger et al., 2020; Europe in general: Spiess, Keller, 2020). Thus, rooks are not only facing climate change and lack of suitable foraging habitats, but also direct persecution. In any case, the conflict between humans and rooks in the city of Kharkiv needs to be addressed, as Kharkiv could potentially be completely deserted by this species.

Conclusion

The rookeries in the city of Kharkiv, eastern Ukraine, show a tendency to disappear. Data on the size of the breeding population of rooks collected by a dozen ornithologists over an 80-year period show an almost 22-fold decrease in numbers. The overall population declined by 95.4 % and the trend of change was a significant moderate decline throughout the period, including the most recent period when surveys became more regular. At the beginning of 2020, only three rook colonies remained, with a total of 43 breeding pairs. Rooks are still numerous during the winter, but the number of wintering birds is also declining.

Acknowledgments

The authors are deeply grateful to Igor A. Krivitskii (1935–2008) for granting access to the O. O. Lisetskii archives in the early 2000s at the library of the Department of Zoology and Animal Ecology, V. N. Karazin National University of Kharkiv, where one of us was a student at the time. He emphasised the importance of monitoring birds in the city of Kharkiv. The authors are grateful to Mykhailo Banik and Oleksandr Zinenko for their support. We are also very grateful to our colleagues from the Department of Physical Geography and Cartography of V. N. Karazin National University of Kharkiv for their support and valuable advice on the design of the maps. We are grateful to Tim Knight for valuable comments that improved the manuscript. Most of all, we are grateful to all the soldiers, including scientists, who protect us from Russian aggression.

References

Averin, V. H. 1941. About events to enrichment of beet fields by useful wild birds (in the order of setting the question). *Notes of Kharkiv Agricultural Institute. Anniversary edition*, 267–288 [In Russian].

BirdLife International. 2017. *Corvus frugilegus*. The IUCN Red List of threatened species: 2017.

BirdLife International. 2023. Species factsheet: *Corvus frugilegus*. Downloaded from http://www.birdlife.orh om 04/05/2023

Bokotey, A. A. 2011. Nesting of the rook *Corvus frugilegus* L. in the city of Lviv and main reasons of changing his quantity. *Scientific Bulletin of UNFO*, **21** (4), 114–122 [In Ukrainian].

Bokotey, A. A., Dzyubenko, N. V., Gorban, I. M., Kuchynska, I. V., Bashta, A.-T. V., Pohranychny, V. O., Buchko, V. V. & Senyk, M. A. 2010. *Breeding avifauna of the Upper Dnister basin*. Lviv, 1–400 [In Ukrainian].

Boucherie, P. 2016. *Layers of social organisation in rooks, a monogamous bird species.* Thèse dirigée. Chargée de recherche HDR, CNRS, Université de Strasbourg, 1–309.

Bresgunova, O. A. 2009. Organization of Rooks (*Corvus frugilegus* L.) and Jackdaws' (*C. monedula* L.) communal roosts in Kharkiv City, Ukraine. *Conference's materials. The conference dedicated to the memory of 80 years of prof. A. P. Krapivniy's birth* (Kharkiv, 4–5 of December 2009). Kharkiv, 21–26 [In Russian].

Chmielewski, S., Dombrowski, A., Jabłoński, P., Łukaszewicz, M., Nicewicz, Ł., Trębicki, Ł., Pagórski, P. & Tabor, J. 2017. Breeding population of the Rook *Corvus frugilegus* in the Mazovian lowland: Current status and changes. *International Studies on Sparrows*, **41**, 4–21.

Coombs, F. 1978. *The Crows. A study of the corvids of Europe*. London, 1–255.

Fehérvári, P., Harnos, A., Neidert, D., Solt, Sz. & Palatitz, P. 2009. Modeling habitat selection of the Red-footed falcon (*Falco vespertinus*): a possible explanation of recent changes in breeding range within Hungary. *Applied Ecology and Environmental Research*, **7** (1), 59–69.

Griffin, R. L. 1998. *The distribution and abundance of the rook Corvus frugilegus L. as influenced by habitat suitability and competitive interactions*. Durham theses, Durham University. Available at Durham E-Theses Online: http://etheses.dur.ac.uk/4640/

Jyzefik, M. 1976. Occurrence of the Rook, *Corvus frugilegus* L. in Poland. Part I. Spatial structure and self-regulatory mechanisms of population. *Acta Ornitho*logica, **15**, 339–482.

Kitowski, I. 2011. The breeding population of the Rook *Corvus frugilegus* in Chełm (Eastern Poland). A comparison of the surveys of 1991 and 2011. *Teka Komisji Ochrony i Kształtowania Środowiska Przyrodniczego OL PAN*, **8**, 56–62.

Kitowski, I. 2013. The importance of rural parks for the occurrence of the Rook *Corvus frugilegus* in the eastern part of the Lublin region (E Poland) — ecological and social factors. *Ekolygia (Bratislava)*, **32** (3), 283–289.

Koshelev, A. I., Koshelev, V. A., Kopylova, T. V., Bubnov, S. V. & Kucherenko, Yu. A. 2019. Chronicles of rookery and large roost of Rooks in Melitopol. *Melitopol local history readings. Materials of the IV regional scientific conference,* 44–48 [In Russian].

Krüger, T., Heckenroth, H., Prior, N., Seitz, J. & Zang, H. 2020. Persecution and statutory protection have driven Rook *Corvus frugilegus* population dynamics over the past 120 years in NW-Germany. *Journal of Ornithology*, **161**, 569–584.

Lisetskii, A. S. 1969. Notes about nesting rooks in a city. *Ornithology in USSR. Materials of 5th ornithological conference. Ashhabad*, *2,* 372–374 [In Russian].

Mikuška, A., Felja, A. & Mikuška, T. 2015. Breeding of Rook *Corvus frugilegus* in Osijek and Vuka during 2014 and 2015 and itslong-term population trend. *Larus*, **50**, 37–46.

Nadtochii, H. S. & Ziomenko, S. K. 1989. Ecology of Rook in Kharkiv City. *Birds of Corvidae family in natural and transformed landscapes. Materials of conference,* **2**, 117–119 [In Russian].

Nadtochii, H. S. & Ziomenko, S. K. 2001. Corvids of the city of Kharkiv. *Proceeding of the International Conference (XI Ornithological Conference of Eastern Europe and Northern Asia)*, 461–462 [In Russian].

Orłowski, G. & Czapulak, A. 2007. Different extinction risks of the breeding colonies of Rooks *Corvus frugilegus* in rural and urban areas of SW Poland. *Acta Ornithologica*, **42**, 145–155.

Pannekoek, J. & van Strien, A. 2005. *TRIM 3 Manual (TRends & Indices for Monitoring data)*. Statistics Netherlands, 1–58.

Redinov, K.O. & Petrovych, Z.O. 2011. Rook *Corvus frugilegus* L. in Mykolaiv region. *Troglodytes*, **2**, 19–30 [In Ukrainian].

Richardson, S. C., Patterson, I. J. & Dunnet, G. M. 1979. Fluctuations in colony size in the Rook, *Corvus frugilegus*. *Journal of Animal Ecology*, **48** (1), 103–110.

Senik, M. & Kasparova, S. 2012. The peculiarities of the distribution and numbers' dynamics of the Jackdaw at winter and spring-summer periods in Lviv City. *X conference on Birds of Corvidae family in urban and rural landscapes of Northern Eurasia. Yakornaya Shchel*, 234–237 [In Russian].

Shevtsov, A. O. 2001. Rook in the town of Olexandriya. *Berkut*, **10** (2), 226–230 [In Ukrainian].
Somov, N. N. 1897. *Bird fauna of Kharkov province*. A. Darre, Kharkiv, 1–689 [In Russian].
Spiess, M. & Keller, V. 2020. *Corvus frugilegus*. *In European Breeding Bird Atlas 2: Distribution, abundance and change.* European bird census council and Lynx Edicions, Barcelona. 558–559.
Stankevych, O. 2000. Corvid birds of Uzhhorod City. *Scientific issues of Ternopil Volodymyr Hnatiuk National Pedagogical University. Series: Biology*, **4** (11), 25–29 [In Ukrainian].
TRIM (TRends & Indices for Monitoring data). 2019 (https://www.cbs.nl/en-gb/society/nature-and-environment/indices-and-trends--trim--).
Zbyryt, A., Zub, K. & Mitrus, C. 2022. The development of the Rook's (*Corvus frugilegus*) colony in the face of shifting spring phenology. *Avian Research*, **13**, 1–5.

Received 30 May 2023
Accepted 1 February 2024