

Urban population of the Common Wood Pigeon in Krasnodar

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Abstract Data on population density and location of nests of the Common Wood Pigeon (*Columba palumbus*) in Krasnodar is presented for the first time. The highest population density was recorded in cemeteries (10.4 ± 1.4 pairs/10 ha, reaching 12.1 pairs/10 ha in one cemetery). The population density values in green residential areas with a predominance of 5-story housing blocks and in parks are comparable 2.9 ± 1.2 and 2.7 ± 1.0 pairs/10 ha, respectively. The average Common Wood Pigeon population density in the city was 3.4 ± 0.8 pairs/10 ha. In residential areas with a predominance of 5-story housing blocks, the nests were located in trees and shrubs belonging to 13 taxa, predominantly in ash (18.4%), linden (15.8%), horse chestnut (13.2%) and elm (13.2%) trees. The nests were located at a height of 5.5 to 15 m above the ground, (9.6 ± 0.4 m). The higher location of Common Wood Pigeon nests in Krasnodar compared to other European cities is probably associated with a lower level of predation by the Hooded Crow (*Corvus cornix*). The Common Wood Pigeon began to breed in Krasnodar in the early 2000s during a period of a phenomenal upsurge in construction activity in the city when the pace of development was comparable to that in Moscow.

Keywords: city birds, breeding, synanthropization, population density, Common Wood Pigeon

Összefoglalás A Krasznodarban élő örvös galamb (*Columba palumbus*) populáció állománysűrűségének és fészkelőhelyeinek adatait jelen tanulmányban összegezzük. A legnagyobb állománysűrűséget a temetőben figyelhető meg ($10,4 \pm 1,4$ pár/10 ha, egy temetőben elérve a $12,1$ pár/10 ha értéket is). Az 5 emeletes lakótömböket körülvevő zöld övezetekben és a parkokban az állománysűrűség értékei hasonlóak: $2,9 \pm 1,2$ és $2,7 \pm 1,0$ pár/10 ha. A városban a faj átlagos állománysűrűsége $3,4 \pm 0,8$ pár/10 ha volt. Az 5 emeletes lakótömbök környezetében a fészkek 13 különböző fa-, és cserjefajon találhatók, többségében kőris (18,4%), hárs (15,8%), vadgesztenye (13,2%) és szil (13,2%) fák. A fészkek 5,5 és 15 m közötti magasságban helyezkedtek el ($9,6 \pm 0,4$ m). Más európai városokhoz képest Krasznodarban a magasabban elhelyezkedő fészkek valószínűleg a dömlyös varjú (*Corvus cornix*) jelenlétével és hatásával függnek össze. Az örvös galamb a 2000-es évek elején kezdett el költeni Krasznodarban, a városépítési tevékenységek fellendülése idején, amikor a fejlődés üteme a moszkvaihoz hasonló volt.

Kulcsszavak: állománysűrűség, költés, örvös galamb, városiasodás, városi madarak

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Introduction

Urban habitats are markedly different from suburban habitats. The major difference is the transformation of the land: from natural green areas to man-made structures and impervious surfaces. To survive in the urban habitat, birds are forced to either accept or avoid the new conditions (Isaksson 2018).

The Common Wood Pigeon (*Columba palumbus*) has been successfully colonizing urban areas in Europe and Asia for many years, forming specialized urban populations there.

Such populations have been recorded in cities in Germany, France, Poland, Belarus, Great Britain, Slovakia, Finland, Hungary and other countries (Tomiałojć 1976, 1978, 1998, Luniak *et al.* 2001, Kopij & Zendwalewicz 2009, Astafieva *et al.* 2011, Bea *et al.* 2011, Albrycht & Ciach 2013, Mošanský *et al.* 2014, Fey *et al.* 2015, Luniak & Węgrzynowicz 2019, Sakhvon & Kövér 2020, Csathó & Bozó 2022). Urban populations of the Common Wood Pigeon differ from natural ones in several significant features, including a noticeably higher population density, longer breeding period, tolerance to humans and flexibility in nest placement, including the building of nests on man-made structures (Tomiałojć 1976, Górski *et al.* 1998, Šťastný *et al.* 2005, Lykov 2009, Briedik & Šípkovský 2012). The timing of the emergence of urban populations varies significantly between different urban areas. The first urban population of the species was registered approximately in the 1830–1840s in the parks of Paris (Tomiałojć 1976). The species colonized some urban areas only in recent times, with full-fledged urban populations either having only recently formed there or being at the stage of formation (Mošanský *et al.* 2014, Fey *et al.* 2015, Faragó *et al.* 2019, Csathó & Bozó 2022).

Breeding of the Common Wood Pigeon in Russian cities has not become as common as in the cities of Central and Eastern Europe. The species was recorded breeding, for example, in Kaliningrad, Tula, as well as in the towns of Pre-Caucasus (Astafieva *et al.* 2011, Aralov 2021, Malovichko *et al.* 2021).

The species continues to show a significant population increase in Western and Central Europe, along with an expansion of its range northwards to Fennoscandia (Sattler 2020). The increase in the Common Wood Pigeon numbers is most likely related to an increased reproductive output during the breeding season combined with increased food supplies (O'Regan *et al.* 2012).

Krasnodar, where field research was carried out, at the beginning of the 21st century demonstrates phenomenally high growth rates by Russian standards, which is reflected, in particular, in population dynamics and an increase in built-up area. With a sharp increase in the developed area and at the same time in the volume of construction, the city is witnessing expansion and densification. The surge in housing construction in Krasnodar has been observed since 2005. By 2010–2012, Krasnodar had come close to Moscow in terms of the number of houses built. The urban built-up area has increased by 52.9% by 2019 compared to 2002. At the same time, new built-up areas have a higher proportion of impervious surfaces and a lower proportion of land suitable for landscaping compared to neighborhoods built in the 1960s–1970s (Pogorelov & Kiselev 2020). Phytomass losses have been noted over 26 years (1989–2015) in 60% of the residential area (Pogorelov & Lipilin 2017).

Small-house areas prevail in the city, accounting for more than 80% of all residential areas and being located in all city districts. The city's peripheral belt comprises a mosaic of small-house communities, agricultural land, farming enterprises and land owned by allotment societies (Amendments to the General Plan (<https://genplan.krd.ru/expo/>)).

Dinkevich and Korotky (2004), who studied the avifauna of Krasnodar, state that the first mass wintering of Common Wood Pigeons in the city was during the winter of 2001/2002 when low temperatures and overabundance of snow forced the birds to migrate from the Kuban River floodplain to urban habitats. In that winter, Common Wood Pigeons were

registered for the first time in the residential area of Krasnodar. In the next years, they were recorded breeding in Krasnodar in the botanical garden of the Kuban State Agrarian University (Dinkevich & Korotky 2004). Thus, at the time of our research, the urban population of the species in Krasnodar had already existed for two decades. It should also be noted that the urban population of the Common Wood Pigeon emerged during the period of phenomenally high rates of urban expansion and volume of construction in Krasnodar.

Breeding of the species in the urban environment in Crimea commenced in the same way after a cold winter, but earlier than in Krasnodar, after the 1984/1985 winter (Kostin 2020). Later, from 2008 to 2020, the Common Wood Pigeon was recorded breeding in Krasnodar in almost all parks, squares, cemeteries and residential areas with tall trees (Emtyl *et al.* 2011).

The aim of the work was to determine the main breeding parameters of the urban population of the Common Wood Pigeon in Krasnodar. In addition, the influence of the main nest predators was considered and the food supply of the Common Wood Pigeon was assessed.

Material and Methods

Study area

The Municipal Formation of the City of Krasnodar (hereinafter referred to as Krasnodar) (45°02' N 38°59' E) is located in Southern Russia and stretches along the right bank of the Kuban River. The Kuban River separates the city from the Republic of Adygea. The distance to the Black Sea and the Sea of Azov is 120–150 kilometers, and the distance to Moscow is slightly over 1,300 km. The city covers an area of about 839 km² (Amendments to the General Plan (<https://genplan.krd.ru/expo/>)). Its population is 1.2262 million people (Website of the Krasnodar Krai and Adygea Republic Office of the Federal State Statistics Service ([https://23.rosstat.gov.ru/storage/mediabank/01.01.2023\(1\).htm](https://23.rosstat.gov.ru/storage/mediabank/01.01.2023(1).htm))). The city includes five rural districts divided into 29 rural settlements.

Krasnodar is located in the steppe zone with mild continental climate. The coldest month is January with an average temperature of –0.2 °C, the average temperature of the warmest month, July, is 23.8 °C, the average annual temperature is 11.8 °C. The Kuban steppe is a typical European-type steppe. The steppes are characterized by the dominance of herbaceous vegetation, and forests are scarce.

Due to the natural geographical factors, Krasnodar, has no actual green belt. The main urbanized area does not feature any continuous structure of green spaces (Pogorelov & Kiselev 2020). Green spaces are predominantly concentrated in the old central part of the city, while new neighborhoods are characterized by poor and insufficient greening (Greenologia life quality website (<https://greenologia.ru/eko-problemy/goroda/krasnodar.html>)).

The green spaces within the boundaries of Krasnodar have a total area of 110.4 km² according to 2019 aerial photography data (Amendments to the General Plan (<https://genplan.krd.ru/expo/>)). Linden, maple, liriiodendron, cercis, plane tree, ginkgo, catalpa, pyramidal English oak, red oak, black pine, European yew, boxwood, barberry, spiraea, weigela, dogwood,

ninebark, as well as various species of thuja, juniper, cypress, ornamental fruit trees and many other trees and shrubs can be found in the city (Portal of the Administration of the Municipal Formation of the City of Krasnodar and the City Duma of Krasnodar (Portal of the Administration of the Municipal Formation of the City of Krasnodar and the City Duma of Krasnodar (<https://krd.ru/administratsiya/administratsii-krasnodara/departament-gorodskogo-khozyaystva-i-toplivno-energetichesk/zelenye-nasazhdeniya-goroda/>)).

Data collection

The field research was carried out within the administrative boundaries of Krasnodar as part of a program to study model bird species in Russian urban areas. Six main habitats were examined: the forest park, cemeteries, recreational parks, garden squares, small-house areas and green residential areas with a predominance of 5-story housing blocks.

The small-house areas have low-rise single-family or two-family houses built on individual land plots, which are planted mainly with fruit trees and exotic conifers. The green residential areas with a predominance of 5-story housing blocks are neighborhoods with a high proportion of greening along highways and inside yards.

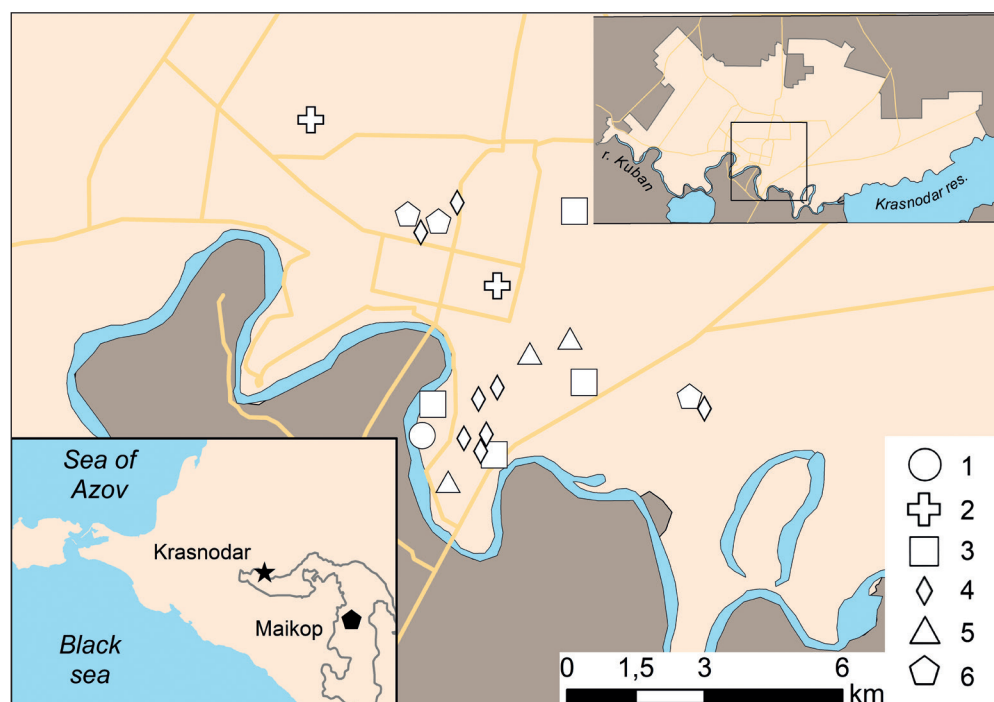


Figure 1. Placement of census plots in Krasnodar. Legend: 1 – forest park, 2 – cemetery, 3 – recreational park, 4 – garden square, 5 – small-house areas, 6 – green residential areas with a predominance of 5-story housing blocks

1. ábra A felmérési pontok elhelyezkedése Krasznodarban. Jelmagyarázat: 1 – erdős park, 2 – temető, 3 – szabadidőpark, 4 – virágos tér, 5 – alacsony házas lakóövezet, 6 – öteemeletes lakóépületek zöldövezete

Censuses of breeding pairs of the Common Wood Pigeon were carried out using the method of breeding territories mapping on designated census plots on 15–16 May 2021 and 13–14 June 2023. The census activities were carried out during the daylight hours, including the periods of maximum bird activity in the morning and evening. A total of 21 census plots were allocated (*Figure 1*), with a total area of 337.3 ha. The number of breeding pairs on each census plot was determined by the number of territorial birds, singing males and occupied nests found. Transiting birds have not been included into the registry. The 2021 and 2023 data were merged. The census activities were carried out only once on each plot. As a result, the average population density of the species was determined for each habitat and the city as a whole.

In addition, to assess the impact of species of the family Corvidae on the population of the Common Wood Pigeon, nests of the Hooded Crow (*Corvus cornix*) and Eurasian Magpie (*Pica pica*) were counted during the leafless period on 17–18 April 2020. The Hooded Crow and Eurasian Magpie nests were counted on 3 census plots with a total area of 89.5 ha in the small-house areas and on 4 census plots with a total area of 86.3 ha in the green residential areas with a predominance of 5-story housing blocks, with simultaneous observation of the Common Wood Pigeon on the same census plots.

A targeted search for Common Wood Pigeon nests, including a search with the use of 8×30 binoculars, was carried out only in the green residential areas with a predominance of 5-story housing blocks during the period of the Common Wood Pigeon breeding censuses, as well as during the complete count of Hooded Crow and Eurasian Magpie nests.

All found occupied and unoccupied Common Wood Pigeon nests were plotted on the map with an indication of their location and height above the ground.

The colonization of the Krasnodar urban areas by the species was assessed using five stages of synanthropization, which were proposed by Tomiałojć (1976):

- stage 0. Breeding in forests and groves away from populated areas;
- stage 1. Breeding of individual pairs in urban forests, as well as in peripheral parks on the outskirts of cities or smaller settlements;
- stage 2. Breeding in urban parks with a higher density than in natural habitats;
- stage 3. Breeding in urban parks with a high density, as well as regular breeding in residential areas (on the streets);
- stage 4. Breeding in urban parks with a high density, as well as breeding on the streets, including the downtown, cases of breeding on man-made structures.

Statistical analysis

The obtained data was statistically processed using the Stat Soft STATISTICA 6.0 software. Regarding the Common Wood Pigeon population density and nest height, the mean and standard error of the mean ($M \pm SE$) were calculated. The Common Wood Pigeon population densities in different habitats were compared using the Kruskal-Wallis non-parametric test.

Table 1. Population density (mean±SE) of the Common Wood Pigeon on census plots in Krasnodar in 2021, 2023*

1. táblázat Az örvös galamb állománsűrűsége (átlag±standard hiba) Krasznodarban két független felmérés alapján, 2021-ben és 2023-ban

Nº	Habitat	Census plot location	Census plot surface area, ha	Number of pairs	Population density, pairs/10 ha
1.	Forest park	30-Letiya Pobedy Park**	19.9	9	4.5
Average population density					4.5
2.	Cemetery	Vsesvyatskoe Cemetery	24.0	29	12.1
3.		Slavyanskoe Cemetery***	34.5	32	9.3
Average population density					10.4±1.4
4.	Recreational park	30-Letiya Pobedy Park**	19.8	9	4.5
5.		Gorodskoy Garden	13.3	5	3.8
6.		Chistyakovskaya Roshcha Park	49.0	11	2.2
7.		Kuban Park	9.6	0	0
Average population density					2.7±1.0
8.	Garden square	Trudovoy Slavy Square	1.9	0	0
9.		Festivalny Square	1.7	1	5.9
10.		Zhukova Square	2.5	1	4.0
11.		Druzhby Square	2.7	0	0
12.		Universitetsky Square	1.0	1	10.0
13.		Yekaterininsky Square	2.7	0	0
14.		Mariinsky Square	1.3	0	0
15.		Gagarinsky Boulevard	2.7	0	0
Average population density					1.8±1.3
16.	Small-house areas	Between Dlinnaya St., Kutuzova St., Golovatogo St., Bazovskaya St.	36.2	0	0
17.		Between Chapaeva St., Levanevskogo St., Dlinnaya St., Kommunarov St.	33.4	0	0
18.		Between Khimzavodskaya St., Koshevogo St., Zatonnaya St., Krasnodonskaya St.	19.9	0	0
Average population density					0
19.	Green residential areas with a predominance of 5-story housing blocks	Between Gagarina St., Atarbekova St., Gertsena St.	19.2	1	0.5
20.		Between Stavropolskaya St., Dimitrova St., 2-ya Pyatiletka St.	17.8	7	3.9
21.		Between Gagarina St., Vorovskogo St., Atarbekova St.	24.2	10	4.1
Average population density					2.9±1.2

* censuses of breeding pairs were conducted only once in one of the two years

** in 30-Letiya Pobedy Park, censuses were carried out separately in the recreational and forest-park parts, which were included in different habitat categories: "forest parks" and "recreational parks" respectively

*** censuses carried out on a part of the cemetery area

Results

Population density

The breeding of the Common Wood Pigeon was recorded in Krasnodar in all studied habitats, except the small-house areas. The highest population density was observed in the cemeteries (10.4 ± 1.4 pairs/10 ha, with the maximum value of 12.1 pairs/10 ha recorded for Vsesvyatskoe Cemetery). Lower population densities were observed in the forest park (4.5 pairs/10 ha), green residential areas (2.9 ± 1.2 pairs/10 ha) and recreational parks (2.7 ± 1.0 pairs/10 ha). The average population density of the Common Wood Pigeon in cemeteries exceeds the average population density in parks by 3.9 times. The maximum difference (factor of 5.5) between the population density values was noted for Vsesvyatskoe Cemetery and Chistyakovskaya Roshcha Park (Table 1).

Garden squares were less favored as breeding habitats. Of the eight squares studied, only three were occupied by only one pair of birds each (Table 1).

The censuses of breeding pairs of the Common Wood Pigeon in small-house areas are less complete than in other habitats due to the large area of this habitat in the city. The share of small-house areas is more than 80% of all residential areas in the city (Amendments to the General Plan 2020). Thus, rare breeding of birds in this habitat cannot be ruled out.

The average population density of the species in the city was 3.4 ± 0.8 pairs/10 ha.

The comparison of the Common Wood Pigeon population density between three habitats (parks, garden squares and green residential areas with a predominance of 5-story housing blocks) demonstrated the absence of significant differences ($H = 0.76$, $df = 2$; $p = 0.685$).

Nest placement

In the residential areas with a predominance of 5-story housing blocks, a total of 38 nests were found, which were built in trees and shrubs belonging to 13 taxa (Table 3). The majority of nests were located in ash (*Fraxinus excelsior*) (18.4% of the total number of nests found), linden (*Tilia* sp.) (15.8%), horse chestnut (*Aesculus hippocastanum*) (13.2%) and elm (*Ulmus* sp.) (13.2%) (Table 2) trees.

The Common Wood Pigeon nests in Krasnodar were located at a height of 5.5 to 15 m above the ground (mean $\pm$ SE: 9.6 ± 0.4 m).

Main nest predators of the Common Wood Pigeon

Such nest predators of the Common Wood Pigeon as the Hooded Crow and Eurasian Magpie breed in Krasnodar. In general, their breeding density in the city is relatively low, with the Hooded Crow being the more numerous breeder. At the same time, the population density of both species in the small-house areas is very low. The breeding density of the Hooded Crow in the green residential areas with a predominance of 5-story housing blocks can reach 2.8 pairs/10 ha in some parts of the city (Table 3).

Table 2. Placement of Common Wood Pigeon nests in trees and shrubs in the green residential areas with a predominance of 5-story housing blocks in Krasnodar

2. táblázat Az örvös galamb fészkeinek elhelyezkedése a különböző fa- és cserjefajok alapján Krasznodar ötemeletes lakóépületeinek környezetében

Species of tree or shrub	Number of nests	%
Ash (<i>Fraxinus excelsior</i>)	7	18.4
Linden (<i>Tilia</i> sp.)	6	15.8
Horse chestnut (<i>Aesculus hippocastanum</i>)	5	13.2
Elm (<i>Ulmus</i> sp.)	5	13.2
Cherry plum (<i>Prunus cerasifera</i>)	2	5.3
Black locust (<i>Robinia pseudoacacia</i>)	1	2.6
Birch (<i>Betula</i> sp.)	1	2.6
Maple (<i>Acer</i> sp.)	1	2.6
Ash-leaved maple (<i>Acer negundo</i>)	1	2.6
Oriental plane (<i>Platanus orientalis</i>)	1	2.6
Pine (<i>Pinus</i> sp.)	1	2.6
Thuja (<i>Thuja</i> sp.)	1	2.6
Fruit tree (unidentified)	1	2.6
Unidentified tree	5	13.2

Table 3. Breeding density (nests/10 ha) of the Hooded Crow and Eurasian Magpie on census plots in Krasnodar, 2020

3. táblázat A dolmányos varjú és a szarka állománysűrűsége (fészkek száma/10 ha) Krasznodar területén 2020-ban

Habitat	Breeding density (min-max)		Average breeding density (mean±SE)	
	Hooded Crow	Eurasian Magpie	Hooded Crow	Eurasian Magpie
Small-house areas	0–1.2	0–0.3	0.4	0.1
Green residential areas with a predominance of 5-story housing blocks	0.4–2.8	0–0.8	1.4±0.5	0.2

Discussion

Population density

The Common Wood Pigeon population density varies markedly in the studied habitats of Krasnodar. The analysis conducted on the available literature data at our disposal (Biadun 1994, Dombrowski & Łuczak 1998, Kasprzykowski & Łuczak 2000, Tomiałojć 2007, Kopij 2010, Mošanský *et al.* 2014, Tomiałojć *et al.* 2020) revealed a number of patterns. A pairwise comparison (24 comparisons made) of Common Wood Pigeon population densities in the same year (in the event of absence of data for some year, data for the previous or subsequent year was used) in selected parks and cemeteries in 5 cities (Lublin, Legnica, Wrocław,

Siedlce, Košice) showed, that for slightly more than a half of the comparisons (54.2%) the population density is higher in parks (maximum difference by a factor of 5.3), for 37.5% it is higher in cemeteries (maximum difference by a factor of 8.4) and for 8.3% almost no difference was observed.

In Krasnodar, the Common Wood Pigeon population density is almost equal in the recreational parks and green residential areas with a predominance of 5-story housing blocks (*Table 1*). However, in three cities for which comparative data are available (Wrocław, Zielona Góra, Białystok), the population density of the Common Wood Pigeon is significantly higher in parks compared to the built-up area (Tomiałojć 2011, Bocheński *et al.* 2013, Zbyryt 2014, Kopij 2017, Tomiałojć *et al.* 2020). In particular, the Common Wood Pigeon population density in Białystok and Zielona Góra is higher in the parks than in the built-up area by a factor of 1.9 and 8, respectively (Bocheński *et al.* 2013, Zbyryt 2014).

Thus, the urban population of the Common Wood Pigeon in Krasnodar can be distinguished by a comparable population density in recreational parks and in green residential areas with a predominance of 5-story housing blocks.

The species was not observed in Krasnodar in the small-house areas during the research period. The information on breeding in small-house areas and the population density of the Common Wood Pigeon in this habitat in European urban areas is fragmentary. In Białystok, the population density in the small-house areas was 1 pair/10 ha (Zbyryt 2014). In Kaliningrad, 7.7% of all nests found were located in the small-house areas (Lykov 2009).

Its population density in most European urban areas is noticeably higher than the average population density in Krasnodar. But at the same time, the population density of the species in some locations was noticeably lower compared to Krasnodar (*Table 4*).

Thus, during the existence of the urban population of the species in Krasnodar, its population density reached relatively high values, however, in most other European urban areas this value has climbed even higher. This difference is apparently linked to a relatively recent formation of an urban population of the Common Wood Pigeon in Krasnodar compared to the urban populations in most other European urban areas, which have a longer history. Additionally, the population density of the Common Wood Pigeon may be determined by habitat structure, food source availability, weather factors and predation (Faragó *et al.* 2019).

Nest placement

The conditions for sheltering Common Wood Pigeon nests related to the structural features of trees are the main factor that determines the degree of predation pressure. This species tends to build nests in areas with dense foliage (Tomiałojć 1979).

Data on preferred nesting tree species in Krasnodar is comparable to the information published for other locations. Thus, in other cities for which data on the taxa of preferable nesting trees is available, the Common Wood Pigeon most often nested in linden trees: Minsk (53.5% of the total number of nests; Sakhvon & Kövér 2020), Liverpool (32%; Slater 2001), Legnica (26.4%; Tomiałojć 1979), Kaliningrad (19.8%; Lykov 2009), Galway, Ireland (19.5%; Ó hUallacháin 2014). In Debrecen, the linden is the second favored nesting tree after the common hackberry (*Celtis occidentalis*), with 15.3% of nests located in linden trees (Juhász & Varga 2019). In

Table 4. Comparative population density of the Common Wood Pigeon in European urban areas
4. táblázat Az örvös galamb állománysűrűsége más európai városok összehasonlításában

Population density, pairs/10 ha	City/town, country (year, habitat, location)	Source
More than 100	Legnica , Poland (2003–2004, down-town Central Park)	Tomiałojć 2007
50–99	Ślupsk , Poland (1990–1997, urban parks); Legnica , Poland (1966–1967, 1972, down-town Central Park); Wrocław , Poland (1970–1973, Słowacki Park)	Górski <i>et al.</i> 1998, Tomiałojć 2007, Tomiałojć <i>et al.</i> 2020
40–49	London , Great Britain (1974, St James's Park); Zielona Góra , Poland (parks)	Tomiałojć 1978, Bocheński <i>et al.</i> 2013
30–39	Legnica , Poland (2006, cemetery)	Jędro <i>et al.</i> 2008
20–29	Ślupsk , Poland (1985–1989, urban parks); Legnica , Poland (2004–2005, cemetery); Wrocław , Poland (2009, 2013, Południowy Park; 2007, Botanic Garden)	Górski <i>et al.</i> 1998, Jędro <i>et al.</i> 2008, Kopij & Zendwalewicz 2009, Kopij 2010, Tomiałojć <i>et al.</i> 2020
10–19	London , Great Britain (1974, Kensington Gardens); Wrocław , Poland (2009–2010, Szczytnicki Park; 2008–2010, Słowacki Park; 2013, Botanic Garden); Warsaw , Poland (2015, Krasińskich Garden); Mezőhegyes , Hungary (2022)	Tomiałojć 1978, Tomiałojć 2011, Luniak & Węgrzynowicz 2019, Tomiałojć <i>et al.</i> 2020, Csathó & Bozó 2022
8–9.9	Ślupsk , Poland (1974–1977, 1990–1997, suburban parks); Siedlce , Poland (1999, cemetery at Cmentarna str.)	Górski <i>et al.</i> 1998, Kasprzykowski & Łuczak 2000
6–7.9	Lublin , Poland (1988–1990, Akademicki Park; 1989–1991, Botanic Garden; 1989–1991, area planted with trees in Czechów); Ślupsk , Poland (1985–1989, suburban parks); Liverpool, Great Britain (1996–1998, Sefton park); Legnica , Poland (1965, Peripheral park); Košice , Slovakia (2011–2012, Cemetery of St. Rozália)	Biadun 1994, Górski <i>et al.</i> 1998, Slater 2001, Tomiałojć 2007, Mośański <i>et al.</i> 2014
4–5.9	Lublin , Poland (1988–1990, Park "Saski Garden"); Legnica , Poland (2007, Peripheral park); Wrocław , Poland (2011, Biskupiński Park; 2008, Osobovitskoe Cemetery; 2016, city center); Zielona Góra , Poland (housing estates); Warsaw , Poland (2000, cemetery-mausoleum of Soviet soldiers, estate near the street Dombrowsky; 2004–2005, 2014, Skaryszewski Park); Battonya , Hungary (2022)	Biadun 1994, Luniak <i>et al.</i> 2001, Tomiałojć 2007, Bocheński <i>et al.</i> 2013, Luniak & Węgrzynowicz 2019, Tomiałojć <i>et al.</i> 2020, Csathó & Bozó 2022
2–3.9	Lublin , Poland (1982–1984, Lipowa Str. Cemetery; 1987–1989, Unicka Str. Cemetery; 1987–1990, Bronowicki Park; 1988–1990, Majdanek Cemetery, Kalinowszczyzna Cemetery); Ślupsk , Poland (1974–1977, urban parks); Siedlce , Poland (1985, Main Siedlce Park; 1984, 1986, Wild Siedlce Park; 1998, cemetery at Cmentarna str.; 1985–1986, 1998–1999, cemetery at Janowska str.); Kaliningrad , Russia (2008–2010); Kraków , Poland (2012, Rakowice Cemetery); Košice , Slovakia (2011–2012, park in Barca); Białystok , Poland (2013, parks); Wrocław , Poland (2017, block-buildings area); Warsaw , Poland (2006, 2013, Żeromskiego Park; 2013, Krasińskich Garden); Końskie , Poland (2016–2017, multi-family housing plot)	Biadun 1994, Górski <i>et al.</i> 1998, Dombrowski & Łuczak 1998, Kasprzykowski & Łuczak 2000, Astafieva <i>et al.</i> 2011, Albrycht & Ciach 2013, Mośański <i>et al.</i> 2014, Zbyryt 2014, Kopij 2017, Luniak & Węgrzynowicz 2019, Dębowski 2020
1–1.9	Lublin , Poland (1982–1984, Ludowy Park); Siedlce , Poland (1984, 1986, Main Siedlce Park; 1985–1986, cemetery at Cmentarna str.); Dijon , France (1980–1984, Parc des Sports); Košice , Slovakia (2011–2012, Public Cemetery); Białystok , Poland (2013, city centre, old block of flats area, detached houses estate); Warsaw , Poland (2004, 2017, Żeromskiego Park; 2013, Kępa Potocka Park)	Biadun 1994, Dombrowski & Łuczak 1998, Tomiałojć 1998, Kasprzykowski & Łuczak 2000, Mośański <i>et al.</i> 2014, Zbyryt 2014, Luniak & Węgrzynowicz 2019
less than 1	Dijon , France (1980, Parc de La Colombiere); Warsaw , Poland (late 1980s, Łazienki Park, Rakowiec, Wierzbno districts; 2006, Kępa Potocka Park); Košice , Slovakia (2011–2012, park on the Komenského street); Wrocław , Poland (2017, industry area); Białystok , Poland (2013, modern block of flats area, industrial areas, suburban rural area)	Tomiałojć 1998, Luniak <i>et al.</i> 2001, Mośański <i>et al.</i> 2014, Kopij 2017, Zbyryt 2014, Luniak & Węgrzynowicz 2019

Minsk and Legnica, the Common Wood Pigeon, in addition to linden, also preferred to build nests on Horse Chestnut (18.4% and 18.3% respectively) (Tomiałojć 1979, Sakhvon & Kövér 2020). In other urban areas, the Common Ash and Elm species were also used by the Common Wood Pigeon for nesting, however, the number of nests in trees of these taxa was insignificant (Tomiałojć 1979, Ó hUallacháin 2014). In Kaliningrad and Minsk, Common Wood Pigeon nests were not found in elm trees (Lykov 2009, Sakhvon & Kövér 2020).

Nests of the Common Wood Pigeon in the green residential areas with a predominance of 5-story housing blocks in Krasnodar were on average located higher (9.6 m) than ones in the residential areas of Debrecen (7.2 m) (Juhász & Varga 2019), parks and residential areas of Minsk (7.1 m) (Sakhvon & Kövér 2020), in the university area in Galway (6.0 m) (Ó hUallacháin 2014) and in the residential areas of Kaliningrad (5.4 m) (Lykov 2009). In Słowacki Park in Wrocław, the average nest height above the ground of 9.9 m is comparable to our figures obtained in Krasnodar. In other Polish parks (Szczynicki Park in Wrocław and City Park in Legnica), the average height of nests of the Common Wood Pigeon was greater (10.9 and 14.3 m respectively) than in Krasnodar (Tomiałojć 1979). According to Tomiałojć (1979), the height of Common Wood Pigeon nests above the ground depends on the degree of predation by the Hooded Crow. When the level of predation by the Hooded Crow is high, the Common Wood Pigeon places its nests lower above the ground (Tomiałojć 1979). Common Wood Pigeon nests in Debrecen, Minsk, Galway and Kaliningrad may be placed lower due to higher degrees of predation by crows in these cities compared to Krasnodar. In addition, an important factor influencing the height of nest placement is the height of trees.

Main nest predators of the Common Wood Pigeon

The main nest predators include the Hooded Crow and, to a lesser extent, the Eurasian Magpie (Tomiałojć 1979, Górski *et al.* 1998, Faragó *et al.* 2019, Varga & Juhász 2020). The high numbers of the Hooded Crows are regarded by Tomiałojć (1979) as one of the factors that complicate the colonization of the urban environment by the Common Wood Pigeon. Therefore, the breeding Hooded Crow and Eurasian Magpie have an impact on the population of the Common Wood Pigeon in Krasnodar. However, taking into account the low density of both corvid species in Krasnodar, their impact on the Common Wood Pigeon is not so significant compared to urban areas where the population density of those species is significantly higher. It should be noted that in some urban areas, the breeding success of the Common Wood Pigeon can decrease by up to 3–7% due to predation pressure (Tomiałojć 2021).

Thus, the predation pressure in Krasnodar is deemed to be in general insignificant. In the green residential areas with a predominance of 5-story housing blocks, the total breeding density of the main nest predators (Hooded Crow, Eurasian Magpie) is much lower than the population density of the Common Wood Pigeon.

Food supply assessment

Breeding urban populations of the Common Wood Pigeon are characterized by long-distance foraging movements to nearby farmland, where the birds receive additional food,

supplementing the food found in the urban area itself (Tomiałojć 1976, Jędro *et al.* 2008, Bendjoudi *et al.* 2015). During the breeding period, Common Wood Pigeon can make regular foraging movements over distances of up to 15 km or more (Tomiałojć 1976). Food supply provided by cultivated crops with different sowing dates, vegetation periods and, consequently, different harvesting dates partially complements the food source (Faragó *et al.* 2019).

No special studies have been carried out on the foraging movements of the Common Wood Pigeon to the farmland in the suburbs of Krasnodar. However, taking into account the importance of farmland for bird nutrition, it is necessary to provide a summary about this food source and of the state of agriculture in the areas around Krasnodar.

The Common Wood Pigeon feeds on a variety of plant foods, including weed seeds, shrub berries, seeds of crops (e.g. pea, sunflower, wheat, barley, corn, rice) ripening or lost during the harvest and seeds sown. It also eats green parts of herbaceous plants, tree fruits, soft shoots and pine seeds. Sometimes the species eats earthworms and snails (Faragó *et al.* 2019).

Analysis of data provided on the analytics platform “Unified Center for Remote Satellite Monitoring of the Agro-Industrial Complex of Krasnodar Krai” showed the following

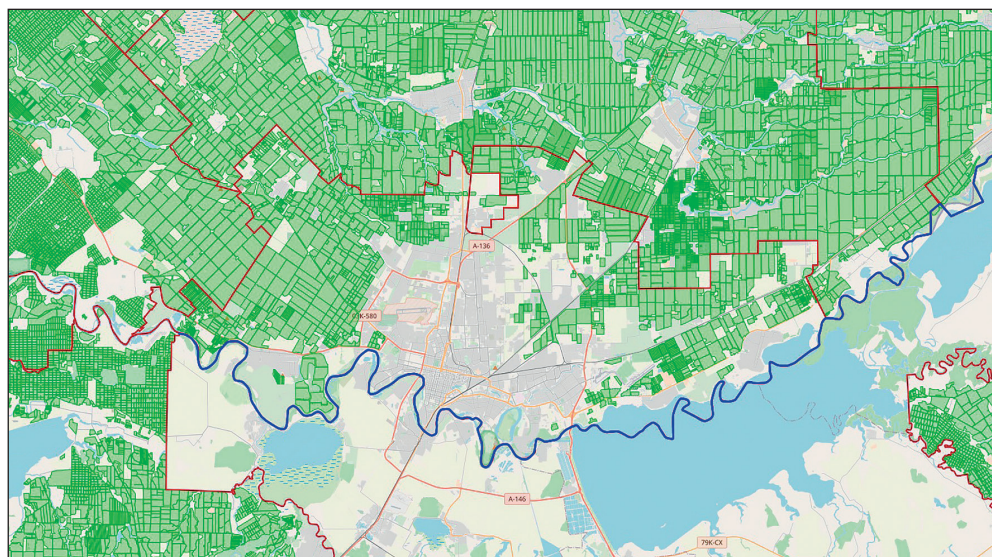


Figure 2. Distribution of farmland in Krasnodar and the surrounding area (indicated in green on the map). For the territory of the Republic of Adygea, farmland is not shown. The boundaries of the municipal districts of the Krasnodar Krai are indicated by a red line, the border between the Krasnodar Krai and the Republic of Adygea is indicated by blue.

Source: website of the analytics platform “Unified Center for Remote Satellite Monitoring of the Agro-Industrial Complex of Krasnodar Krai” https://maps.krasnodar.ru/agrofields_pub/regions/23

2. ábra A mezőgazdasági területek kiterjedése Krasznodarban és a környező területeken (a térképen zöld színnel jelölve). Adigeföld területén nincsenek jelölve ezek a területek. A közigazgatási kerületek határait Krasznodarszk vidékén piros vonal jelöli, míg Adigeföld határát kék vonal mutatja

patterns. The agricultural lands where the birds breeding in Krasnodar can move for feeding are located both within the city itself and in the territories of Krasnodar Krai adjacent to the city (*Figure 2*) (Website of the analytics platform “Unified Center for Remote Satellite Monitoring of the Agro-Industrial Complex of Krasnodar Krai” (https://maps.krasnodar.ru/agrofields_pub/regions/23)). Farmland is also present in the nearby Republic of Adygea in Takhtamukaisky Municipal District (Official website of the state executive bodies of the Republic of Adygea (<http://www.adygheya.ru/about/information/selskoe-khozyaystvo/?ysclid=Irs3vp2qya806799149>)). Takhtamukaisky Municipal District adjoins the southern part of Krasnodar. The minimum distance between the conventional city center and the nearest farmland landscapes located in Krasnodar is 6–9 km.

Agricultural lands occupy a significant part of Krasnodar (36%). The total cultivated area within the city was 282 km² in 2018 (Amendments to the General Plan 2020).

In 2023, the most widely cultivated crops in Krasnodar Krai were wheat (44% of the total cultivated area in the region), sunflower (13%) and corn (11%; Website of the Krasnodar Krai and Adygea Republic Office of the Federal State Statistics Service. (https://23.rosstat.gov.ru/agriculture_kk)), while in the Adygea Republic, they comprised wheat (40% of the total cultivated area in the region), corn (8%) and rapeseed (6%; Website of the Krasnodar Krai and Adygea Republic Office of the Federal State Statistics Service. (https://23.rosstat.gov.ru/agriculture_ra)). In Takhtamukaisky Municipal District of the Republic of Adygea that adjoins Krasnodar, rice, sunflower and wheat have the largest share (Adygea Today news agency website (<https://adigeatoday.ru/news/38464.html?ysclid=Irs4m3senl72428284>)). The crops specified for Krasnodar Krai and the Adygea Republic can be used by Common Wood Pigeon as food.

Thus, an assessment of the food supply of the Common Wood Pigeon showed the presence of vast areas of agricultural crops in the city and its surroundings that can be used by birds as food. As noted by Tomiałojć (1976), the location of the city in a river valley among fertile soils with developed agriculture in the form of cultivated field lands is one of the conditions conducive to the formation of a stable urban population of the Common Wood Pigeon.

Assessment of the colonization of urban areas by the Common Wood Pigeon

Using the stages of synanthropization specified by Tomiałojć (1976), the urban population of the Common Wood Pigeon in Krasnodar can be conditionally classified as one of the synanthropization stage 3: breeding in urban parks with a high density, as well as regular breeding in residential areas (on the streets). The studied population, however, seems to not reach the last synanthropization stage 4, when the species breeds at a high density in urban parks, as well as in residential areas, and individual pairs start to build nests on man-made structures.

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