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## **CHANGES IN THE BREEDING POPULATION OF THE ROOK *CORVUS FRUGILEGUS* IN GORZÓW WIELKOPOLSKI IN THE YEARS 2001-2025**

### **ABSTRAKT**

Gorzów Wielkopolski (Lubusz Voivodeship, western Poland) has for many years constituted an important stronghold of the Rook *Corvus frugilegus* population in the Lubusz Land. This study analyses changes in population size, spatial distribution, and the structure of breeding colonies of the Rook within the city limits in 2021-2025. Over the survey period, breeding colonies were recorded at 16 sites, with the number of active colonies in individual years ranging from 12 to 5. On average, the size of Rook colonies ranged from 48 nests (Me = 11) in 2021 to 132 (Me = 143) in 2008. Most were concentrated in the central part of the city, at a short distance from the valley of the Warta River and its tributary, the Kłodawka (in close proximity to foraging areas).

The Gorzów Wielkopolski population reached its maximum size in 2006 (849 nests; 9.9 pairs/km<sup>2</sup>), after which a systematic decline began, leading to a minimum recorded in 2025 (338 nests; 3.9 pairs/km<sup>2</sup>). Over the last two decades, the population decreased by as much as 60.2%, at an average rate of 4.7% per year. These figures are alarming. Analysis of the results indicates that the pronounced reduction in the number of breeding pairs was primarily driven by anthropogenic factors, including disturbance of birds, removal of nests, felling and pollarding of trees within colonies, progressive suburbanisation, and a reduction of foraging resources caused by changes in the use of agricultural land around the city. It is evident that additional factors may also be involved and further investigation is needed.

The obtained results are consistent with the nationwide trend of a significant decline in the Rook population in Poland and underscore the need for the development of conservation and educational programmes, not only at the local level.

**Key words:** Rook *Corvus frugilegus*, corvids, distribution, decrease of abundance, Lubusz Voivodeship, Lubusz Land

## INTRODUCTION

Studies on the Rook *Corvus frugilegus* population from the Lubusz Voivodeship in western Poland are relatively scarce. The literature also lacks long-term observations from this area spanning several decades, which would allow the identification of actual population trends beyond short-term fluctuations.

Publications from the 1980s and the early 21st century regarding the distribution of Rook breeding colonies in the Lubusz Land indicate that the species inhabits exclusively urban habitats in this region (Jermaczek 1995, Jerzak & Piekarski 2001, 2005). According to estimates provided by these authors, the Rook population during this period was relatively stable, reaching a maximum of 1,344 pairs in 1987, with a slight decline in subsequent years, reaching 1,125 pairs in 2004 (Jerzak & Piekarski 2005).

Recent studies indicate an alarming declining trend in the breeding populations of the Rook across various regions of Poland. In 2001, the species was included in the Polish nationwide research programme, the Monitoring of Flagship Bird Species (MFGP), which has confirmed a pronounced decrease in its abundance for more than a decade. Between 2010 and 2017, the decline in the Polish breeding population was estimated at approx. 40% (Wardecki et al. 2021). Currently, due to the rapid nationwide decrease in numbers (ca. 57%), the Rook has been classified as Vulnerable (VU) according to IUCN criteria and included in the Polish Red List of Birds (Wilk et al. 2020). Despite this decline, Poland still supports the fourth largest population of this species within the European Union (Beuch et al. 2024). Across Europe, a decrease in Rook abundance has been observed since the 1990s, primarily as a result of changes in land-use structure and human persecution (Marchant & Gregory 1999, Orłowski & Czapulak 2007, Wylegała et al. 2013). At the beginning of the 21st century, a similar trend of agricultural changes unfavorable to birds also emerged in Poland.

In the Lubusz Voivodeship, the largest Rook breeding colonies have been recorded in Gorzów Wielkopolski (Jermaczek 1995, Jerzak & Piekarski 2005), one of the two main urban centres of this region of western Poland. The aim of this study is to present data on the abundance, distribution, and trends in the Rook population over the past 25 years (2001-2025) in Gorzów Wielkopolski.

## STUDY AREA

Gorzów Wielkopolski is located in north-western Poland, in the northern part of the Lubusz Voivodeship, and covers an area of approx. 86 km<sup>2</sup>. It is classified as a medium-sized city. According to Statistics Poland (GUS 2025), the population of Gorzów Wlkp. in 2024 amounted to just under 115,000 inhabitants and showed a declining trend.

According to the physico-geographical regionalization of Kondracki (2013), the area of the city is situated at the boundary of two morphogenetically distinct units. The northern part lies within the macroregion of the South Pomeranian Lakeland,

mesoregion Gorzów Plain. The southern part, in turn, is located within the western section of the Toruń–Eberswalde Ice-Marginal Valley macroregion, mesoregion Gorzów Basin. The ice-marginal valley is traversed by the River Warta, which divides the city into two parts: the left-bank and right-bank sections. The left-bank part has a lowland character and comprises a flat floodplain terrace. In contrast, the right-bank part of the city is situated within the northern escarpment of the ice-marginal valley, characterized by strongly undulating terrain with elevations of up to 82 m a.s.l. The majority of Rook colonies were located in the southern part of the city, within the river ice-marginal valley.

An analysis of land-use structure in Gorzów Wlkp. indicates that built-up and urbanized areas occupy approx. 36% of the city's administrative area, whereas agricultural and green areas (meadows, forests, and arable land) constitute the majority of its territory. Within the city boundaries, there is also a network of urban green spaces (parks and green areas) with a total area of approx. 342.7 ha, representing about 4% of the city area (UM Gorzów Wielkopolski 2016). The high proportion of agricultural land and forests within the administrative boundaries of the city results from the incorporation, in the 1970s, of surrounding villages and parts of rural settlements, which have retained their rural character to the present and have become districts of the city. These areas provide favorable foraging habitats for birds, including the Rook.

Despite the relatively small area occupied by urban green spaces, Gorzów Wlkp. is characterized by a relatively well-developed network of city parks. Importantly, these urban parks contain trees of older age classes (50-150 years), including plane trees *Platanus × acerifolia*, oaks *Quercus* spp., limes *Tilia* spp., maples *Acer* spp., hornbeams *Carpinus betulus*, and ashes *Fraxinus* sp., located both along avenues and in the central parts of the parks (UM Gorzów Wielkopolski 2016). These mature trees play a significant ecological role by providing habitats for colonial birds, including the Rook. In combination with access to open areas (meadows, pastures, fields, lawns), the presence of older trees in parks promotes the formation of breeding colonies and makes Gorzów Wlkp. an attractive environment for corvid species in the urban landscape.

## METHODS

Field studies were conducted between 2001 and 2025 and encompassed the area within the administrative boundaries of Gorzów Wielkopolski (study area: 86 km<sup>2</sup>). Rook colonies were surveyed annually during the third decade of April. Each year, all wooded areas throughout the city were also inspected to identify potential new colonies.

The location of each colony was mapped onto the city plan, and its position, GPS coordinates, and microhabitat were recorded. A breeding colony was defined as the presence of a minimum of 3 nests. Separate colonies were considered as clusters of nests located more than 250 m apart. Within each Rook colony, the number of nests per tree was recorded, the average height of nest placement was determined, and the

tree species or genus hosting the nests was identified. It was assumed that one nest corresponds to a single breeding pair.

The mean annual percentage decline of the Rook population was calculated using an exponential model describing changes in population size over time, as recommended in the methodology of the State Environmental Monitoring Programme (GIOŚ 2025):

$$\lambda = (N_T / N_0)^{1/T}; r = (\lambda - 1) \times 100\%$$

where:  $\lambda$  – the coefficient of population growth/decline,  $N_T$  – the value of the parameter after T years from the beginning of the measurement series, T – the number of years elapsed since the first year of measurements,  $N_0$  – the value of the parameter in the first year of measurements, r – the mean annual percentage decline.

To forecast population changes over the study period, an exponential decay model was applied, described by the following formula:

$$N_T = N_0 \times (1 - r)^T$$

where:  $N_T$  – predicted population size after T years,  $N_0$  – population at the start of the period, r – annual rate of decline, T – number of years.

## RESULTS

### Population status

Between 2001 and 2025, Rook colonies were recorded in 16 locations within the city of Gorzów Wlkp. (Tab. 1). Their numbers fluctuated over the years but remained relatively stable at 6-8 colonies during the period 2006-2020 (Fig. 3). In 2003, the highest number of colonies was recorded - 12, whereas the lowest number was observed in 2025 – only 5.

The distribution of most breeding colonies (approx. 60-75% in individual years) was concentrated mainly in the central part of the city, characterized by the presence of old tenement buildings and mature greenery (tree-lined avenues and clusters of older trees). This choice of breeding sites was likely determined both by the availability of suitable nesting trees (primarily old plane trees) and by the short distance to the Kłodawka and Warta rivers (up to 0.5 km). The Warta River valley provides favourable foraging habitats, such as flood terraces, meadows, and pastures. Two relatively large colonies (up to 227 nests) were located in the southern districts of Gorzów Wlkp. with a rural character, surrounded by agricultural land (Gorzów-Zieleniec and Gorzów-Karnin). No breeding birds were recorded within housing estates characterized by modern buildings and young tree plantings.

The distribution of Rook colonies within the administrative boundaries of Gorzów Wlkp. over a 25-year period is shown in Figs. 1-2. Figure 2 presents the situation in 2025 and illustrates the scale of the decline in the number of colonies during the study period.

The size of Rook colonies varied considerably, ranging from 3 to 344 nests. Throughout the study period, small colonies containing up to 20 nests were the most numerous (9). The numbers of five colonies in peak years fell within the ranges of 21-50 and

51-230 nests, whereas the largest colonies, exceeding 300 nests in some years, were recorded at only two locations.

Tab. 1. Nesting localities of Rooks in Gorzów Wielkopolski in the years 2001-2025 and their periods of activity

No.	Location of colony	Active period	Number of years
1	Śródmieście / Park Wiosny Ludów	2001-2025	25
2	Teatralna Str.	2001-2025	25
3	Warszawska Str. / rondo	2001-2025	25
4	Chrobrego Str. / Łokietka Str.*	2001-2003	3
5	Walczaka Str./ church	2001-2005	5
6	Koniawska Str.	2001-2004	4
7	Kobylogórska Str. / SP4	2001	1
8	Grobła Str.	2001-2005	5
9	Walczaka Str./ hospital-park / ZSZ*	2001-2021	21
10	district Gorzów-Zieleniec**	2001-2025	25
11	district Gorzów-Karnin**	2001-2025	25
12	Słowackiego Str. / Grunwaldzki Square	2003-2007; 2009-2022	19
13	Walczaka Str. / Kopernik's Park	2003	1
14	11 Listopada Str. / ul. Słoneczna Str.	2014; 2016-2019	5
15	Bracka Str. / church	2021-2024	4
16	Wawrzyniaka Str. / park	2021-2023	3

\* Two colonies in close proximity were merged into a single colony. In earlier publications, they were treated as separate (Jerzak & Piekarski 2001, 2005).

\*\* In earlier publications (Jerzak & Piekarski 2001, 2005), these peripheral districts of Gorzów Wlkp. were treated as separate localities.

The number of Rook pairs in individual years, including all breeding colonies, is shown in Tab. 2 and Fig. 4. The highest population within the city was recorded in 2006 – 849 nests (mean density 9.9 pairs/km<sup>2</sup>). Since then, the breeding population has steadily declined, reaching a minimum of 338 nests in 2025 (mean density 3.9 pairs/km<sup>2</sup>). The mean colony size ranged from 48 nests (Me = 11) in 2021 to 132 nests (Me = 143) in 2008.

The number of nests per individual tree usually ranged from 1 to 36 (averaging from 4.8 in 2007 to 6.7 in 2024). In two colonies located in the southern, rural parts of the city, the number of nests on a single tree (plane tree) reached as many as 71 (Gorzów-Karnin in 2002) and 106 (Gorzów-Zieleniec in 2008 and 2012) in peak years. Notably, in the most recent period (2022-2025), when the number of Rook colonies declined sharply, the mean number of nests per tree reached its highest values (6.2-6.7).

During the study period, Rooks most frequently selected the following tree species for nesting: plane tree (mean 48.2%), maple (mean 13.5%), hornbeam (mean 12.9%), and lime (mean 10.5%). In urban tree stands of Gorzów Wlkp, especially in parks, mature plane trees make up a large proportion. Owing to their large size and spreading crowns, this species was the most frequently selected for nesting by birds.

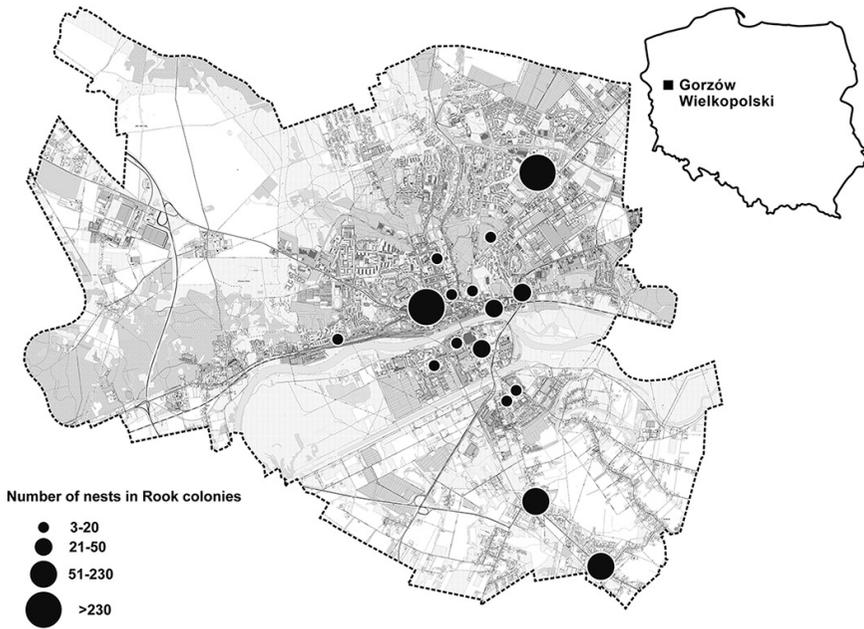


Fig. 1. Distribution and size of Rook colonies in Gorzów Wielkopolski between 2001 and 2025



Fig. 2. Distribution and size of Rook colonies in Gorzów Wielkopolski in 2025

Tab. 2. Number of Rook nests in the city of Gorzów Wielkopolski in the years 2001–2025

No.	Location of colony	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
1	Śródmieście / Park Wiosny Ludów	170	183	224	175	156	168	158	221	250	325	318	307	344	289	273	303	285	278	259	237	238	228	219	216	223
2	Teatralna Str.	10	9	7	10	13	16	10	7	5	9	15	16	16	24	23	16	12	7	11	10	20	28	28	21	11
3	Warszawska Str. / rondo	37	43	40	32	40	40	27	19	26	32	34	25	24	23	20	24	17	17	32	13	10	11	16	8	8
4	Chrobrego Str. / Łokietka Str.	17	14	5																						
5	Walczaka Str. / church	6	10	7	5	4																				
6	Koniawska Str.	5	5	5	3																					
7	Kobylogórska Str. / SP4	3																								
8	Grobła Str.	36	35	32	24	27																				
9	Walczaka Str. / hospital-park / ZSZ	269	318	206	235	240	311	180	254	199	222	130	181	166	118	114	108	46	38	30	14	11				
10	district Gorzów-Ziele-niec	85	108	126	132	164	207	180	227	215	153	132	129	117	117	143	118	135	125	79	88	112	106	77	60	69
11	district Gorzów-Karmin	110	111	90	79	81	96	54	65	38	34	22	18	14	8	14	16	24	20	37	22	30	39	30	29	27
12	Słowackiego Plac Grun-waldzki			15	17	5	11	3		13	8	10	13	14	14	6	3	8	4	5	5	4	3			
13	Walczaka Str. / Kopernik's Park			6																						
14	11 Listopada Str. Słoneczna Str.													5		10	16	10	15							
15	Bracka Str. / church																					6	8	7	5	
16	Wawrzyniaka Str. / park																					3	3	3		
RAZEM:		748	836	763	712	730	849	612	793	746	783	661	689	598	598	593	598	543	499	468	389	434	426	380	339	338

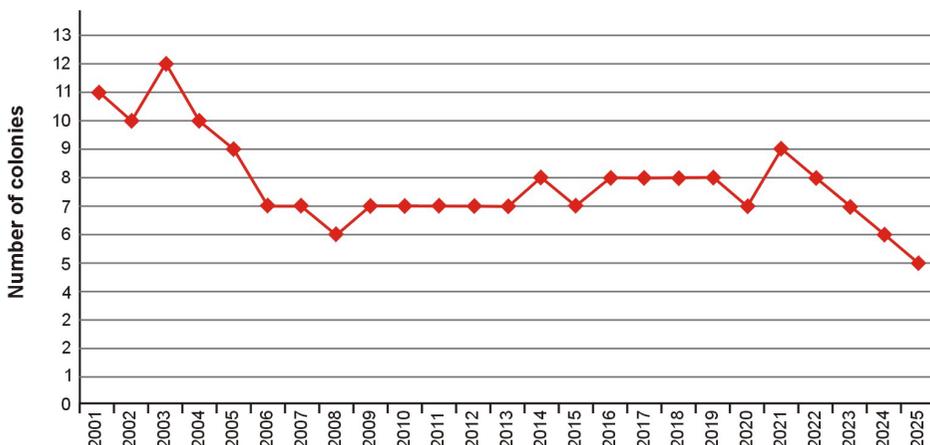


Fig. 3. Changes in the number of Rook colonies recorded in Gorzów Wielkopolski in the years 2001-2025

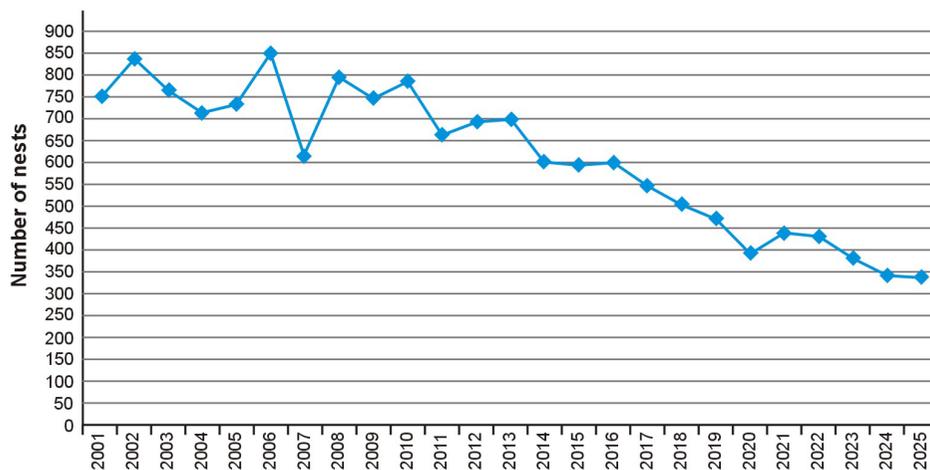


Fig. 4. Dynamics of breeding pair numbers of Rooks in Gorzów Wielkopolski in the years 2001-2025

### Declining trend of the Gorzów Wielkopolski population

Over the past two decades, the breeding population of Rook in the city of Gorzów Wlkp. has declined significantly. Since reaching its peak in 2006 (849 pairs), the population has decreased by 60.2%. Data presented in the tables and figures indicate a continuous decline in the number of Rooks in Gorzów Wlkp. since 2007. The mean annual decrease in the breeding population, calculated using an **exponential model**, amounted to approx. 4.7%.

If the current trend persists, further population decline can be expected, particularly in smaller colonies. Using an exponential decay model, projections were made for the Rook population in Gorzów Wlkp. over the next 10 and 20 years. According to these projections, assuming an annual decrease of 4.7%, the population is expected to decline to approx. 206 pairs by 2035 and to 126 pairs by 2045.

## DISCUSSION

Data on the population of the Rook in the Lubusz Land, including Gorzów Wielkopolski, are scarce. In the late 1980s, 570-600 breeding pairs were reported from Gorzów (Jermaczek et al. 1992, 1995), which was the highest figure among localities in the region. In 2004, a total of 1,757 nests were recorded throughout the Lubusz Voivodeship, all of them located exclusively within urban areas (Jerzak & Piekarski 2005). In that year, 712 nests were found in Gorzów (Tab. 2), which accounted for over 40% of the regional population. In 2006, the maximum number of nests within the city was recorded – 849, which remains the highest value observed to date. No breeding of the species was recorded in Zielona Góra County (Hordowski 2009) and Zielona Góra city, another major urban center in the region (unpublished). These data indicate that Gorzów Wlkp. constitutes an important stronghold of the species in the analysed region. As reported by Hordowski (2009, after Jerzak & Piekarski 2005), the highest number of nests recorded on a single tree in Poland (88) was observed at this site. The studied tree (a plane tree) is located in the Gorzów–Zieleniec colony. During subsequent surveys, a record number of nests was documented on the same plane tree, reaching 106 in 2008 and 2012. Over time, the number of nests per tree gradually declined, reaching 66 in 2025.

A significant decline in the Rook population in Poland over recent decades has been reported by numerous authors (Kuźniak et al. 2005, Hordowski 2009, Adamiak 2010, Neubauer et al. 2011, Tobółka et al. 2011, Wylegała et al. 2013, Zbyryt et al. 2013, Jerzak et al. 2017, Zbyryt et al. 2018, Wachecki 2021, Dylík et al. 2024) and has intensified markedly in the last two decades (Chylarecki et al. 2018, Wilk et al. 2020). According to the Polish Red List of Birds, the national population has decreased by 57% (Wilk et al. 2020). Countrywide, Rook abundance declined on average by 4% per year between 2001 and 2020, with an acceleration after 2008 (Chylarecki et al. 2018, Wilk et al. 2020). In eastern Poland, the population decline reached 10% per year, which was twice the rate observed in western regions (Chylarecki et al. 2018). The magnitude of the population decline observed (4-10% per year) qualifies as substantial or strong in the long-term perspective.

The Rook population in Gorzów Wlkp. has declined by 60.2% over the past 20 years, reflecting the nationwide decreasing trend, with an average annual reduction of 4.7%. Predictive simulations for the city of Gorzów Wlkp. indicate that, over the next two decades, the population may decrease to approx. 126 breeding pairs.

Comparing these data with the decline in the Rook population from nearby Strzelce Krajeńskie (Gorzów Wlkp. County), where a 56.4% decrease in abundance occurred over the past 24 years at an average rate of 3.6% per year (R. Piekarski, unpublished), the Gorzów Wlkp. population exhibits a concerning trend, indicating an urgent need for conservation measures.

### **Causes of population decline**

There may be multiple causes underlying the decline of the Rook population, some of which remain unexplained. Anthropogenic factors undoubtedly play a significant role, as Rooks in urban areas are considered a conflict species (Zbyryt et al. 2013). The attitude of the Gorzów Wlkp. community toward these birds is predominantly negative, particularly among residents of tenement buildings close to the breeding colony, or in the area of the hospital complex. The main problems include contamination by droppings in streets, parking areas and pedestrian alleys, as well as noise and odor. In rural areas (Gorzów–Karnin), occasional killing of nestlings fallen from nests by local residents has been reported. In the case of colonies located near churches and on cemetery grounds, a significant problem is the contamination of the area with bird droppings.

Over the past 25 years in Gorzów Wlkp., the disappearance or substantial reduction of Rook colonies has been documented due to the following factors: disturbance, felling of nest-bearing trees, topping of trees with nests in cemeteries, and the successive removal of nests outside the breeding season. Such practices have been frequently reported in the literature (Zbyryt et al. 2013, Wachecki 2021, Pawlak 2022, Dylík et al. 2024).

A letter obtained under the access to public information procedure, issued by the Regional Directorate for Environmental Protection in Gorzów (RDOŚ, WOIS.402.149.2025.JM), indicates that over the past 15 years only a single derogation decision for scaring Rooks has been issued. The authorization was justified by a “conflict arising from Rook breeding sites located along the main park avenues, in the area of the summer garden adjacent to the restaurant, and near the playgrounds within the Wiosny Ludów Park in the center of Gorzów Wielkopolski.” Fortunately, the colony was not significantly affected.

For reasons unknown but easily anticipated (systematic removal of nests outside the breeding season), one of the largest colonies, located in a park within the hospital complex and the ZDZ school grounds on Walczaka Street, disappeared over a five-year period. Similar situations were observed on church grounds and in areas frequently visited by city residents (e.g., tenement buildings and the pedestrian street adjacent to the music school on Chrobrego and Łokietka Streets). According to the authors of this paper, at least 5-6 colonies have thus vanished from the Gorzów Wlkp. landscape, and two others have been significantly reduced. The few smallest colonies probably disappeared naturally, a phenomenon that has also been observed by other authors (Józefik 1976, Wachecki 2021).

Analyses of average colony sizes in Gorzów Wlkp. and the mean number of nests per tree indicate that after the disappearance of smaller colonies, some birds were incorporated into the remaining larger colonies (Jerzak & Piekarski 2005, Jerzak et al. 2017). This pattern is further evidenced by the fact that in 2003 a greater number of breeding colonies (12) was associated with a lower total number of nests (732) than in 2006, when only 7 breeding colonies were recorded in the city, yet they encompassed as many as 849 nests. No clear phenomenon of small colony formation in the vicinity of a large colony following its fragmentation, as reported by Wachecki (2021) and Pawlak (2022), was observed.

Beyond bird scaring and nest removal, significant causes of population decline should be sought in changes in agricultural land use in the vicinity of Gorzów Wlkp. Rooks exploit foraging grounds both within the urbanized part of the city and on its outskirts, located in close proximity to breeding colonies. Within the urban area, these comprise green urban spaces, accounting for approx. 2.4% of Gorzów's surface area (excluding parks), whereas on the periphery they include grasslands, pastures, and arable land. Unfortunately, the availability of agricultural areas for birds has steadily declined in recent years. According to data from the Gorzów Wielkopolski City Office (2016), in 2015 green areas and arable land covered approx. 48% of the city's area. However, part of these lands was earmarked for development, which subsequently reduced their suitability for birds. Similar causes of Rook population reduction, particularly in western Poland, have been previously reported by other authors (Orłowski & Czapulak 2007, Wylegała et al. 2013, Zbyryt et al. 2013, Zbyryt et al. 2018, Dylík et al. 2024).

The environmental protection program for Gorzów Wlkp. (2020/2021) highlighted weaknesses related to the development of green areas, including ongoing suburbanization and highly specialized agriculture (e.g., large-scale rapeseed and maize cultivation, chemical intensification, and the loss of alternative habitats). Agriculturally used areas are expected to decrease as urban development projects are implemented. Such trends indicate a further contraction of the food base in the city's surroundings.

In summary, it can be stated that the widespread perception of the Rook as a conflict species, causing nuisance to urban residents, has led to actions aimed at substantially reducing its population in the city. This is facilitated by Polish legal acts which, since 2014, have classified the Rook as a partially protected species in urban environments. The contraction of the food base around the city further intensifies the decline in their numbers. Over the past 20 years, the Rook population in Gorzów Wlkp. has decreased by 60.2% (an annual decline of approx. 4.7%), which is alarming and calls for consideration of a species conservation strategy, as well as public environmental education.

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