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CHANGES IN THE LOCATION OF MAGPIE *PICA PICA* NESTS IN THE AGRICULTURAL LANDSCAPE OF WESTERN POLAND

ABSTRACT

In recent decades, rapid changes have been observed in the species composition of woody and shrubby vegetation of rural areas in western Poland. Deciduous species, including fruit tree and shrub species, are being replaced by coniferous species, changing the potential nesting habitats of many bird species. The aim of this study was to check whether progressive changes in the species composition and age structure of trees and shrubs in agricultural areas affect the abundance of Magpies and their choice of nesting sites. The study was conducted in the agricultural landscape in two study plots near Kożuchów (district K – 100 km^2) and Żagań (district Z – 110 km^2) in the southern part of Lubuskie Province in the years 1999 and 2016. During field inspections carried out in the 3rd decade of April, occupied Magpie nests were searched for and the species of the tree or shrub and the height of the nest location above the ground were noted. There were no significant differences in the number of nesting pairs between the years in the surveyed plots. In 1999, 53 nests (density = 0.53 p/km^2) were found in plot K and 34 nests (density = 0.31 p/km^2) in plot Z. In contrast, in 2016 49 (0.49 p/km^2) and 37 (0.34 p/km^2) nests were recorded, respectively. At the same time, there was a clear change in the type of trees used by Magpies as nesting sites. In 1999, on both plots, Magpies nested exclusively in deciduous trees or shrubs (10 species), while in 2016, the number of species increased to 15, and the proportion of coniferous trees or shrubs to all trees colonized by Magpies was 49.0% on plot K and 29.7% on plot Z. In addition, the height of the location of nests above the ground was significantly higher in 1999 ($\bar{x}$ = 15.4 m) than in 2016 ($\bar{x}$ = 7.5 m). The results of the study indicate changes in the type of nesting habitat of Magpies over two decades as a result of the planting of ornamental vegetation, mainly spruce trees. At the same time, the birds resigned from nesting in tall trees, choosing lower spruce trees, which structure provides more security for nesting than deciduous trees.

Key words: Magie Pica pica, agricultural landscape, Western Poland, nesting sites changes.

INTRODUCTION

In recent decades, changes have been observed within rural areas, related to the modernization of buildings, and transformation of rural areas, including changes in the species composition of woody and shrubby vegetation (Rosin et al. 2016, Switek et al. 2017, Rosin et al. 2020, 2021). In the case of vegetation, the transformations involve the abandonment of deciduous species, including fruit trees and shrubs, in favor of coniferous species. Such changes are not indifferent to rural fauna, including birds. In most cases, the impact is negative (Rosin et al. 2020, 2021), but changes in habitat structure can also be beneficial for rural fauna (e.g., Rosin et al. 2017).

The Magpie as a synanthropic species is a frequent object of study mainly in urban environments and much less frequently in agricultural landscapes. Magpie populations in such areas are strongly associated with human settlements (Bochenski et al. 2001, Orlowski 2005, Przybycin 2005). However, in some regions, such as in central-eastern Poland near Siedlce, the vast majority of nests were located at a considerable distance from buildings (Kasprzykowski & Olton 2008). Nesting of Magpies within rural buildings is associated with the choice of tree species on which their nests are built. The aim of this study was to examine whether changes in the species composition and age structure of trees and shrubs in agricultural areas of western Poland over two decades have affected the abundance and density of magpies and the choice of their nest sites.

STUDY AREA AND METHODS

The study was conducted in an agricultural landscape in the southern part of Lubuskie Voivodeship in the districts of Żagań and Nowa Sól (Fig. 1). Two study plots were selected near Kożuchów (plot K – 100 km²) and Żagań (plot Z – 110 km²). In area K, 10 villages were located in whole or in part. The area was open, and forests and larger wooded areas occupied only 15% of the study area. Within plot Z, 14 localities were located wholly or partially, and forests and larger wooded areas occupied 22% of the area. Most of the largest villages in both plots were characterized by buildings located on both sides of the main roads ("street" type villages).

Fieldwork was conducted in 1999 and 2016. During one-time inspections of the surveyed plots conducted in the 3rd decade of April, active nests of Magpies were searched for. For all occupied nests, the species of tree or shrub and the height of the nest location above the ground were determined.

The percentages and averages presented in the paper are given along with 95% confidence intervals (CL). A generalized linear mixed model (GLMM) with a Gamma distribution and a log link function with year as a fixed factor and study plot as a random
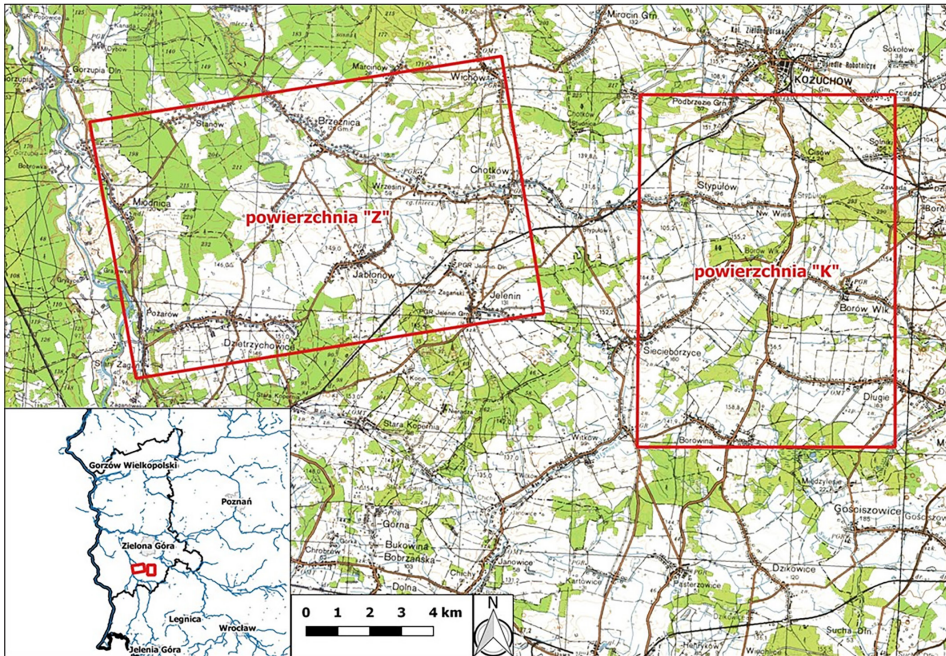
Fig. 1. Two study plots

effect was used to analyze differences in the height of nest location above the ground between the years. All calculations were performed using IBM SPSS Statistics for Windows, version 24.0 (IBM Corp. 2020).

RESULTS

In 1999, 53 nests (density 0.53 p/km^2) in the area K and 35 nests (0.32 p/km^2) in the area Z were found. In contrast, in 2016, it was 49 (0.49 p/km^2) and 37 nests (0.34 p/km^2), respectively. There were no significant differences in the number of breeding pairs between the years in the study plots (chi-square = 0.19, df = 1, p = 0.663). Over the years there was a clear change in the type of trees used by Magpies as nesting sites (chi-square = 44.83, df = 1, p < 0.001). In 1999, all nests (n = 88, 100%) were located in deciduous trees, while in 2016 only 59.3% (n = 51) were already located in this type of tree, of which 51.0% (n = 25) in the K plot and 70.3% (n = 26) in the Z plot. In 1999, in both plots, Magpies nested exclusively on 10 species of deciduous trees or shrubs, while in 2016 the number of species increased to 15 and also coniferous trees and shrubs were used by Magpies (Table 1). Among coniferous species, spruce *Picea* sp. was the most frequently used by Magpies (85.7% of coniferous species cases, n = 30; Table 1). Simultaneously, nests were located higher above the ground in 2009 than in 2016 (GLMM, $F_{1,\ 172}$ = 159.27, p < 0.001, Fig. 2).

Table 1. Summary of types and species of trees and shrubs used by Magpies as nesting sites in the agricultural landscape of western Poland in 1999 and 2016. K – area of Kożuchów, Z – area of Żagań; coniferous trees – bold font

| Species	K 1999	K 2016	Total (%)	Z 1999	Z 2016	Total (%)
Alnus glutinosa	9	2	11 (10.8)	6	8	14 (19.4)
Fruit tree	2	4	6 (5.9)	0	11	11 (15.3)
Fraxinus excelsior	0	1	1 (1.0)	0	0	0 (0.0)
Juglans regia	0	1	1 (1.0)	0	0	0 (0.0)
Larix sp.	**0**	**1**	**1 (1.0)**	**0**	**0**	**0 (0.0)**
Unmarked	1	1	2 (2.0)	2	0	2 (2.8)
Picea sp.	**0**	**21**	**21 (20.6)**	**0**	**9**	**9 (12.5)**
Pinus sylvestris	**0**	**1**	**1 (1.0)**	**0**	**2**	**2 (2.8)**
Populus sp.	17	2	19 (18.6)	13	4	17 (23.6)
Prunus spinosa	1	1	2 (2.0)	0	0	0 (0.0)
Pseudotsuga sp.	**0**	**1**	**1 (1.0)**	**0**	**0**	**0 (0.0)**
Qercus sp.	5	7	12 (11.8)	6	0	6 (8.3)
Rosa sp.	1	1	2 (2.0)	0	0	0 (0.0)
Salix sp.	12	5	17 (16.7)	6	2	8 (11.1)
Tilia sp.	5	0	5 (4.9)	2	1	3 (4.2)
Total	53	49	102 (100.0)	35	37	72 (100.0)
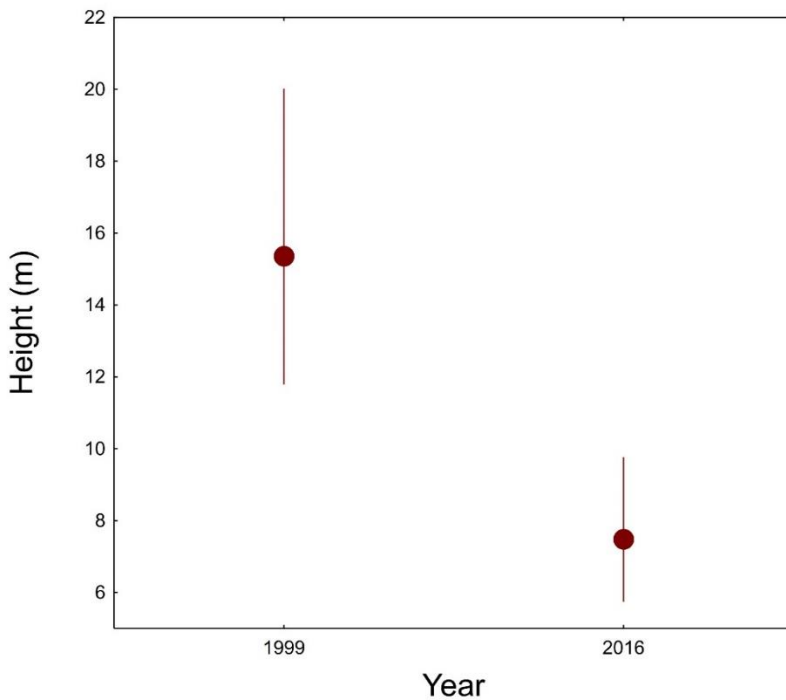
Figure 2. The height of the nests above the ground in the years 1999 and 2016

DISCUSSION

Over the past decades, an increase in Magpie abundance has been reported in urban areas, with a decrease within agroecosystems (Gregory & Marchant 1995, Górski 1997, Siriwardena et al. 1998, Chiron et al. 2008, Tomiałojć 2009, Gedeon et al. 2014). This phenomenon may be related to changes in environmental quality resulting from increased intensity of agricultural land use (Orlowski 2005). However, such a trend has not occurred everywhere, e.g., no changes have been recorded in central and eastern Poland over 30 years (Dombrowski 1997, Kasprzykowski & Olton 2008). In the case of the present study, there were no changes in the density of nesting pairs in the two study plots over the two decades. Most of the nests in the compared periods were located exclusively within human settlements, and only a few pairs of Magpies were found away from them. The recorded densities are comparable to those obtained in Poland's agricultural landscape, but they are closer to the lower values. The breeding densities of Magpies in Poland's agricultural landscape range from 0.2-1.0 p/km^2 near Siedlce (Dombrowski 1997), through 0.3-0.7 p/km^2 in the Lubuska region (Jerzak 1995, Dombrowski 1997), 0.8-1.0 p/km^2 near Szczecin and 0.9-1.1 p/km^2 near Białystok (Dombrowski 1997) to 2.1-3.0 p/km^2 near Tarnowskie Góry (Dombrowski 1997). These differences are due to the characteristics of the studied areas, i.e., the type of biotope (e.g., arable land, river valleys), forest cover, and buildings (Dombrowski 1997, Jerzak 2002, Jerzak 2005, Przybycin 2005, Kasprzykowski & Olton 2008). Analyses of breeding densities in agricultural landscapes have shown that in western Poland this parameter is higher than in eastern Poland (on average 1.2 p/km^2 and 0.6 p/km^2 respectively; Dombrowski 1997).

During the first survey period, all nests were located on deciduous trees. This result was in line with trends in the selection of nests in the surveyed plots in Poland from the last decades of the 20th century. Many studies describing the location of Magpie nests in different types of habitats indicate that in most cases the species chose deciduous trees and in urban environments preferred poplars, where the proportion of which could be up to 65% (Jerzak 2005). Research in recent years shows that in some urban and suburban zones, the share of coniferous species as nest trees is increasing (Lesinski 1998, Dulisz 2005, Zbyryt & Banach 2014, Jokimäki et al. 2017, Ciebiera et al. 2021). Some symptoms of this phenomenon were noticeable at the turn of the 20th and 21st centuries, also in plots in the agricultural landscape, when Magpie nests were found to appear on coniferous trees (Przybycin 2005, Wojciechowski et al. 2005, Kasprzykowski & Olton 2008). In the region of České Budějovice (southern Czech Republic) at the end of the second decade of the 21st century, it was shown that 10.1% of Magpie nests were built on coniferous trees, and the same tree species were found to be used with similar frequency in urban and agricultural areas (Šálek et al. 2020). Previously, nesting of Magpies in coniferous trees was rarely recorded (Jerzak 1988). The results of the present study indicate a progressive preference for coniferous tree choices, related

to the prevailing mode for this type of trees, followed by their increasing availability because they are fast-growing species The increase in the proportion of conifers as nesting sites for Magpies is explained by several factors: evergreen tree species with an unchanging crown (they do not lose their leaves in winter), which makes nests less visible in early spring and thus less accessible to predators, and provides an opportunity for earlier initiation of breeding (Antonov & Antanasova 2022, Jokimäki et al. 2017, Ciebiera et al. 2021).

The height of nest placement above the ground in human-inhabited areas may depend on the human and other mammals on Magpies pressure (Lesiński 1998, Jerzak 2002). However, differences in the height of nest locations above the ground in both urban and rural habitats may also be due to differences in the species composition of trees growing in the areas in question. Such conclusions were made based on a study near Siedlce (Kasprzykowski & Olton 2008). This factor is also confirmed by the present study, which noted a decrease in the height of nest locations above ground due to a change in the choice of nest trees, resulting from the planting of coniferous species. Magpies in the second study period were more likely to choose coniferous trees than in the first period, at the expense of nest placement height. Dense, inaccessible coniferous trees, although lower than the deciduous species chosen earlier, provided a safer nesting location. Within a dozen years or so, coniferous trees planted near buildings reached sufficient height to allow Magpies to build nests in them. With dense, safe trees, the height of the nest location no longer matters. Confirmation of this phenomenon is provided by the results of a study conducted in central and eastern Poland (Kasprzykowski & Olton 2008) showing a large proportion of nests located on willows that form osiers. The authors describe such sites as a specific habitat dominated by low and widely branched shrubs. There, Magpies built their nests deep within, rather than at the top of, clumps of willows, i.e. in places that were difficult to access. Such observations indicate that Magpies are highly plastic in choosing safe nesting sites.

In conclusion, the study did not show any changes in the density of nesting pairs of Magpies in the study plots, while there were clear changes in the type of nesting habitat of the studied species over the two decades, resulting from the planting of ornamental vegetation, mainly in the form of spruce trees. At the same time, birds gave up nesting in tall trees, choosing lower spruce trees, whose structure provides greater safety for nesting and greater protection against predators and weather conditions than deciduous trees.

REFERENCES

Antonov A., Atanasova D. 2022. Nest-Site Selection in the Magpie *Pica pica* in a High-Density Urban Population of Sofia (Bulgaria). Acta Ornith. 37: 55-66.

Bocheński M., Jerzak L., Czechowski P. 2001. Long-term dynamics of magpie *Pica pica* abundance in Zielona Góra. In: Biodiversity and ecology of animal populations in urbanized environments, Eds. P. Indykiewicz, T. Barczak, G. Kaczorowski, Nice, Bydgoszcz, pp. 244-249.

Chiron F., Alexandre L., Julliard R. 2008. Effects of landscape urbanization on magpie accupancy dynamics in France. Landscape Ecology 23: 527-538.

Ciebiera O., Czechowski P., Morelli F., Piekarski R., Bocheński M., Chachulska-Serweta J., Jerzak L. 2021 Selection of Urbanized Areas by Magpie *Pica pica* in a Medium Size City in Poland. Animals 11, 6: 1-8.

Dulisz B. 2005. Spatial structure, nest location, and densities of the Magpie *Pica pica* in two types of urban development in the city of Olsztyn (NE Poland). In: Corvids of Poland, Eds. L. Jerzak, B.P. Kavanagh, P. Tryjanowski, Bogucki Wyd. Nauk, Poznań, pp. 267-286.

Dombrowski A. 1997. The abundance of breeding populations of Magpies *Pica pica* in various types of agricultural landscape in Poland. Acta Ornithol. 32: 25-32.

Gedeon K., Grüneberg C., Mitschke A., Sudfeldt C., Eikhorst W., Fischer S., Flade M., Frick S., Geiersberger I., Koop B., Kramer M., Krüger T., Roth N., Ryslavy T., Stübing S., Sudmann S.R., Steffens R., Vökler F., Witt K. 2014. Atlas Deutscher Brutvogelarten. Atlas of German Breeding Birds. Stifung Vogelmonitoring Deutschland und Dachverband Avifaunisten, Münster.

Górski W. 1997. Urban and rural populations of the magpie Pica pica in the Koszalin region, NW Poland. Acta Ornithol. 32: 51-59.

Gregory R.D., Marchant J.H. 1995. Population trends of Jays, Magpies, Jackdaws and Carion Crows in the United Kingdom. Bird Study 43: 28-37.

IBM Corp. Released, IBM SPSS Statistics for Windows, Version 27.0, IBM Corp, Armonk, NY, 2020.

Jerzak L. 1995. Breeding ecology of on urban Magpie *Pica pica* population in Zielona Góra (SW Poland). Acta Ornithol. 29: 123-133.

Jerzak L. 2005. *Pica pica* magpie in Poland – a review of research. In: Corvids of Poland, Eds. L. Jerzak, B.P. Kavanagh, P. Tryjanowski, Bogucki Wyd. Nauk., Poznań, pp. 35-51.

Jerzak L. 2022. Synurbation of the magpie *Pica pica* in Eurasia. Editorial Board of Scientific and Technical Publishers, Zielona Góra, p. 114.

Jokimäki J., Suhonen J., Vuorisalo T., Kövér L., Kaisanlahti-Jokimäki M.-L. 2017. Urbanization and nest-site selection of the Black-billed Magpie (*Pica pica*) populations in two Finnish cities: From a persecuted species to an urban exploiter – Landsc. Urban Plan. 157: 577-585.

Kasprzykowski Z., Olton M. 2008. Nesting of magpie *Pica pica* in urban environment and agricultural landscape of central and eastern Poland. Not. Orn. 49: 29-38.

Lesinski G. 1998. Population development of magpie *Pica pica* in peripheral and suburban Warsaw in 1983-1998.Kulon 3: 185-193.

Orłowski G. 2005. Magpie *Pica pica* nest sites in farmland in vicinity of Wrocław city (SW Poland). In: Corvids of Poland, Eds. L. Jerzak, B.P. Kavanagh, P. Tryjanowski, Bogucki Wyd. Nauk., Poznań, pp. 509-515.

Przybycin M. 2005. Nesting magpies *Pica pica* in the landscape mosaic of eastern Wielkopolska. In: Corvids of Poland, Eds. L. Jerzak, B.P. Kavanagh, P. Tryjanowski, Bogucki Wyd. Nauk., Poznań, pp. 501-507.

Rosin Z.M., Hiron M., Żmihorski M., Szymański P., Tobółka M., Pärt T. 2020. Reduced biodiversity in modernized villages: A conflict between sustainable development goals. Journal of Applied Ecology 57, 3: 467-475.

Rosin Z.M., Lesicki A., Kwiecinski Z., Skórka P., Tryjanowski P. 2017. Land snails benefit from humanalterations in rural landscapes and habitats. Ecosphere 8 (7): e01874. 10.1002/ecs2.1874.

Rosin Z.M., Pärt T., Low M., Kotowska D., Tobółka M., Szymanski P., Hiron M. 2021. Village modernization may contribute more to farmland bird declines than agricultural intensification. Conservation Letters, 14: e12843, doi.org/10.1111/conl.12843.

Rosin Z.M., Skóra P., Pärt T., Żmihorski M., Ekner-Grzyb A., Kwiecinski Z., Tryjanowski P. 2016. Villages and their old farmsteads are hot-spots of bird diversity in agricultural landscapes. Journal of Applied Ecology 53: 1363-1372.

Šálek M., Grill S., Riegert J. 2020. Nest-site selection of an avian urban explorer, the Eurasian magpie *Pica pica*, across the urban-rural gradient. Journal of Vertebrate Biology 70, 1: 20086.

Siriwardena G.M., Baillie S., Buckland S., Fewster R., Marchant J., Wilson J. 1998. Trends in the abundance of farmland birds: a quantitative comparison of smoothed Common Birds Census indices. J. Appl. Ecol. 35: 24-43.

Świtek S., Jankowiak Ł., Rosin Z.M., Sawinska Z, Steppa R., V. Takacs V., Zbyryt A., Tryjanowski P. 2017. How to maintain a high level of biodiversity in agricultural areas in Poland? Identification of key research problems. Rural and agricultural 4: 115-138.

Tomiałojć L. 2009. Decline in the number of midland corvidae in southwestern Poland. Chrońmy Przyrodę Ojczystą 65, 6: 415-422.

Wojciechowski Z., Janiszewski T., Włodarczyk R. 2005. Changes in distribution of nests of the Magpie *Pica pica* in the initial period of its synurbization near the city of Łódź (central Poland). In: Corvids of Poland, Eds. L. Jerzak, B.P. Kavanagh, P. Tryjanowski, Bogucki Wyd. Nauk., Poznań, pp. 251-266.

Zbyryt A., Banach J. 2014. Abundance, density and characteristics of breeding sites of magpie *Pica pica* in Białystok – Ornis Pol. 55, 2: 105-114.