

Structures of breeding bird communities in wooded and densely built-up areas in a city centre in SW Poland

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Abstract: Breeding bird community in the city centre of Brzeg was quantified by means of the simplified version of the territory mapping method. The centre consists two habitats: densely built-up area (c. 40 ha) and wooded belt (c. 26 ha) around the built-up area. In 2022, 46 breeding bird species were recorded in the city centre; 25 species in the built-up area and 36 in the wooded area. The group of dominants in Brzeg city centre was composed of *Apus apus*, *Columba livia*, *Sturnus vulgaris*, *Streptopelia decaocto*, and *Passer domesticus*. They comprised together 59.1% of all breeding pairs of all species recorded. The group of subdominant was composed of five species *Columba palumbus*, *Turdus merula*, *Cyanistes caeruleus*, *Sylvia atricapilla*, *Phylloscopus collybita* (together 15.9% of all breeding pairs). In wooded area the following species were dominants: *Sturnus vulgaris*, *Columba palumbus*, *Turdus merula*, *Cyanistes caeruleus* and *Sylvia atricapilla* (together 44.9%); while in built-up area: *Apus apus*, *Columba palumbus*, *Streptopelia decaocto* and *Passer domesticus*. Two species: *Apus apus* and *Columba livia* comprised 2/3 of all breeding pairs in the built-up area. Insectivores and granivores were the most numerous feeding guilds in the built-up area (58.3% and 39.3% respectively), whereas in the wooded area, the insectivores were much more numerous (75.0%) than the granivores (20.1%). In built up areas, most birds nested on buildings (79.8%), much less on trees or shrubs (15.6%), in tree holes (4.0%) and in herbaceous vegetation (0.2%). In the wooded area, most birds nested on trees/shrubs (52.8%) and in tree holes (37.3%).

Key words: urban ornithology, community ecology, population densities.

Introduction

Although bird communities are intensively studied in cities and towns throughout Europe (Dunn & Weston 2008; Magle et al. 2012; Luniak 2013, 2017), their central parts are neglected as study habitats. Although the centres are often much smaller than the remaining built-up areas within cities, in Central Europe, these comprise the oldest (established already in the Middle Ages) and the core area of the town. Their ecological setting should be therefore, an object of more intensive studied than these in any other parts of cities. However, it can be expected that city centres, as the oldest and the most densely built-up areas, are avoided by birds, animals and other organisms as feeding and breeding areas. Centres may however offer novel food resources, shelters and other environmental requisites to some species. It is therefore interesting to discern and monitor their adaptations to these environmental novelties.

Although studies on birds in urbanized environment were conducted in several towns in SW Poland (Tomiałoć 1970; Kopij 1995, 2010, 2011, 2013a, 2013b, 2014, 2017; Betleja et al. 2007; Kopij & Zaczek 2009; Kopij & Wolanin 2010; Tomiałoć et al. 2020), studies on whole avian communities in the strict city centres were conducted so far only in Nysa (Kopij 2006a), Wrocław (Kopij 2006b), and Bytom (Soska & Beuch 2016).

The presented study was conducted in a city centre composed of densely built-up areas and a tree belt encircling the centre. Such ecological setting provides an opportunity to investigate

the impact of wooded areas (in immediate vicinity) on breeding bird community in an old densely built-up area of a city centre, an environmental contrast poorly investigated in urban ornithology.

Study area

The study plot was situated in the city centre of Brzeg, in the Oder river valley, Opole Silesia, SW Poland. The study plot includes two habitats (Fig. 1): a densely built-up area (c. 40 ha) and wooded area (c. 24 ha). The densely-built up area comprises mainly 2-4-storeyed buildings from 19th century and block buildings from the second half of 20th century (Fig. 2). St. Nicolas Church, Elevation of Sain Cross Church, St. Peter & Paul Church, Piasts' Castel, city-hall and old water-mill are among the most impressive historical buildings. Some greenery na green areas are scarcely dispersed among buildings, usually in the form of avenues and rows. There is only one small park (2 ha), and two tree squares (c. 0.5 and 0.3 ha).

Wooded areas comprise a tree belt (green belt) encircling the build-up area (Fig. 1). The belt was established in 19th century in the place of the former Prussian bulwark with a moat. Today it is covered with old tree stand resembling *Tilio-Carpinetum* forest, with admixture of *Alnus glutinosa* forest. The tree belt consists three parks (Fig. 1): Park on Oder River (4.6 ha), Park on the Moat (4.3 ha), Central Czajkowski Park (6 ha); and wooded areas between the Central Czjkowski Park and the Oder River (c. 4.5 ha), on the Oder river left bank (3.1 ha) and on an island Młynka Kępa (1.5 ha).



Fig. 1: Study area: Brzeg city centre (a – wooded areas, b – water, c – streets).



Fig. 2: View of the Brzeg city centre from the bird flight.

Methods

Studies were conducted in 2022. The simplified version of the territory mapping method was employed (Sutherland 1996). A series of four surveys (one in each month: April, May, June and July) of the entire study plot were conducted during which all breeding bird species were counted. This procedure conforms with other studies in larger urban areas (Luniak *et al.* 2001; Mitschke, Baumung 2001; Otto, Witt 2002; Kopij 2006a, 2006b; Betleja *et al.* 2007).

Birds were counted while walking slowly along all streets and paths. All records of birds showing breeding (e.g. transporting nesting material, constructing nests, feeding chicks etc.) or territorial (e.g. singing males) behaviour were plotted directly (without GPS) on a map 1: 1000, in the form of symbols. Special attention was paid to simultaneously singing males, as they were important in determining the number of occupied territories (Sutherland 1996). Attention was also paid to not count the same birds twice, as this could overestimate the number of territories.

The dominance is expressed as the percentage of the total number of pairs of a given species in relation to the total number of all pairs of all species recorded. Dominant species is defined as that comprising 5% and more of all pairs of all species recorded, while subdominant – that comprising 2-4.99%. Two ecological guilds, feeding (granivorous, insectivorous, omnivorous, vegetarian, carnivorous) and nesting (trees or shrubs, tree holes, buildings, herbaceous vegetation), were distinguished and analyzed.

The following indices were used to characterize the diversity and evenness of the communities:

1) Shannon's diversity index: $H' = -\sum p_i \ln p_i$

where: p_i is the proportion of breeding pairs belonging to the i th species

2) Simpson's diversity index: $D = ((\sum n(n-1))/N(N-1))$

where: n – total number of breeding pairs belonging to a given species, N – total number of breeding pairs of all species

3) Pielou's evenness index: $J' = (-\sum p_i \ln p_i) / \ln S$,

where p_i is the proportion of breeding pairs belonging to the i th species; S – total number of species. J' varies between 0 and 1. The less variation between species in a community, the higher J' is.

Two other indices were used to compare communities:

1) Community dominance index: $DI = (n_1 + n_2)/N$

where: n_1, n_2 —number of pairs of the two most abundant species and N —the total number of pairs of all species.

2) Sørensen's Coefficient: $I = 2C/A + B$

where: A—the number of bird species in one habitat, B—the number of bird species in another habitat, and C—the number of bird species common to both habitats.

Results and discussion

In 2022, 46 breeding bird species were recorded in the city centre of Brzeg; 25 species in the built-up area and 36 in the wooded area. The similarities indices and the evenness index were quite different in both habitats compared (Tab. 1). The Sørensen's Similarity Index between the two habitats was $I=0.49$.

In Nysa city centre, SW Poland, 34 breeding bird species were recorded; 30 species in built-up area and 26 species in tree belt encircling the city centre (Kopij 2006a). The built up area in Nysa centre was bigger (77 ha) and with more greenery than green areas than the built-up areas in Brzeg city centre, hence more species were recorded in Nysa. On the other hand, the green belt had a similar structure and surface in both towns, hence similar number of breeding bird species recorded. Also in a tree belt encircling the city centre of Koźle, SW Poland (c. 30 ha, mainly old oaks), similar number of breeding species ($n=31$) were recorded (Kopij 2019).

The group of dominants in Brzeg city centre was composed of the Common Swift *Apus apus*, Rock Dove *Columba livia*, Common Starling *Sturnus vulgaris*, Collared Dove *Streptopelia decaocto*, and House Sparrow *Passer domesticus*. They comprised together 59.1% of all breeding pairs of all species recorded. The group of subdominants was composed of five species (Wood Pigeon *Columba palumbus*, Blackbird *Turdus merula*, Blue Tit *Cyanistes caeruleus*, Blackcap *Sylvia atricapilla*, Chiffchaff *Phylloscopus collybita*) and 15.9% of all breeding pairs. Each other species nested at a density lower than 2 pairs per 10 ha.

The following species were dominant in wooded area (green belt) of Brzeg city centre: Common Starling, Wood Pigeon, Blackbird, Blue Tit and Blackcap (together 44.9%); while in built-up area the dominant group comprised the Common Swift, Wood Pigeon, Collared Dove and House Sparrow (Tab. 2). Two species, the Common Swift and Rock Dove, composed together 2/3 of all breeding pairs in the built-up area. The species composition of the dominant group was therefore totally different in built-up and wooded area in the city centre (Tab. 1).

In the built-up area of Nysa city centre, the following species were distinguished as dominants: House Sparrow, Common Swift, House Martin *Delichon urbica*, Rock Dove, Rook *Corvus frugilegus*, Collared Dove and Jackdaw *Corvus monedula*. In the green (tree) belt of Nysa city centre, the dominant group was composed of the Rook, Collared Dove, Chaffinch *Fringilla coelebs*, Common Starling and Blackbird (Kopij 2006a). In the tree belt of Koźle city centre, the insectivores were much more numerous (75.0%) than the granivores (20.1%). Omnivores comprised 3.6%, while vegetarians 1.3% (Graph 1A).

In built up areas in Brzeg city centre, most birds nested on buildings (79.8%), much less on trees or shrubs (15.6.0%), in tree holes (4.0%) and only very few in herbaceous vegetation (0.2%). In the wooded area, most birds nested on trees/shrubs (52.8%) and in tree holes (37.3%) (Graph 1B).

Data on population densities of birds breeding in Brzeg city centre in the past are lacking for most bird species. In 2009, 13 breeding pairs of the Rook still nested in the city centre (G. Kopij). By the year 2022, they disappeared from the centre and from the city at large. In the wooded area, the Collared Flycatcher *Ficedula albicollis* and Stock Dove *Columba oenas* were not recorded as breeding species in the past (Dyrz et al. 1991), but in 2022, single pairs were recorded as breeding in the green belt. In the past the Common Kestrel *Falco tinnunculus*, Wood Pigeon and Fieldfare *Turdus pilaris* nested in Brzeg city centre in a much lower density than today.

Tab. 1: Characteristics of breeding bird community.

Parameter	Wooded area	Built-up area	Total
Number of species and breeding pairs			
Number of spp.	36	25	46
Number of pairs	312	503	815
Overall density	130	126	127
Dominance structure			
Dominance index	0.30	0.65	0.40
Number of dominant species	5	4	5
Percentage of dominants	44.9	80.4	59.1
Number of subdominant species	13	4	5
Percentage of subdominants	41.6	9.8	15.9
Diversity indices			
Shannon's Index (H')	3.10	1.91	2.83
Pielou's Index (J')	0.87	0.59	0.74
Simpson's Index (D)	0.94	0.74	0.88

Tab. 2: Breeding bird community in the city centre of Brzeg in 2022 N – number of breeding pairs, D – density (pairs/10 ha), %D – dominance (in percentage). Dominant species are given in the bold case.

Species	Wooded areas (c.24 ha)			Built-up areas (c.40 ha)			Total (c.64 ha)		
	N	D	%D	N	D	%D	N	D	%D
<i>Apus apus</i>	0	0.0	0.0	230	57.5	45.7	230	35.9	28.2
<i>Columba livia</i>	0	0.0	0.0	97	24.3	19.3	97	15.2	11.9
<i>Sturnus vulgaris</i>	47	19.6	15.1	17	4.3	3.4	64	10.0	7.9
<i>Streptopelia decaocto</i>	14	5.8	4.5	36	9.0	7.2	50	7.8	6.1
<i>Passer domesticus</i>	0	0.0	0.0	41	10.3	8.2	41	6.4	5.0
<i>Columba palumbus</i>	30	12.5	9.6	10	2.5	2.0	40	6.3	4.9
<i>Turdus merula</i>	27	11.3	8.7	8	2.0	1.6	35	5.5	4.3
<i>Cyanistes caeruleus</i>	19	7.9	6.1	1	0.3	0.2	20	3.1	2.5
<i>Sylvia atricapilla</i>	17	7.1	5.4	0	0.0	0.0	17	2.7	2.1
<i>Phylloscopus collybita</i>	15	6.3	4.8	2	0.5	0.4	17	2.7	2.1
<i>Carduelis chloris</i>	7	2.9	2.2	8	2.0	1.6	15	2.3	1.8
<i>Serinus serinus</i>	11	4.6	3.5	4	1.0	0.8	15	2.3	1.8
<i>Phoenicurus ochroros</i>	0	0.0	0.0	12	3.0	2.4	12	1.9	1.5
<i>Fringilla coelebs</i>	12	5.0	3.8	0	0.0	0.0	12	1.9	1.5
<i>Parus major</i>	12	5.0	3.8	0	0.0	0.0	12	1.9	1.5
<i>Hippolais icterina</i>	11	4.6	3.5	0	0.0	0.0	11	1.7	1.3
<i>Corvus monedula</i>	0	0.0	0.0	10	2.5	2.0	10	1.6	1.2
<i>Carduelis carduelis</i>	8	3.3	2.6	2	0.5	0.4	10	1.6	1.2

<i>Passer montanus</i>	9	3.8	2.9	1	0.3	0.2	10	1.6	1.2
<i>Turdus pilaris</i>	7	2.9	2.2	2	0.5	0.4	9	1.4	1.1
<i>Corvus cornix</i>	8	3.3	2.6	1	0.3	0.2	9	1.4	1.1
<i>Delichon urbica</i>	0	0.0	0.0	8	2.0	1.6	8	1.3	1.0
<i>Sitta europaea</i>	8	3.3	2.6	0	0.0	0.0	8	1.3	1.0
<i>Muscicapa striata</i>	8	3.3	2.6	0	0.0	0.0	8	1.3	1.0
<i>Luscinia megarhynchos</i>	5	2.1	1.6	0	0.0	0.0	5	0.8	0.6
<i>Falco tinnunculus</i>	0	0.0	0.0	5	1.3	1.0	5	0.8	0.6
<i>Phoenicurus phoenicurus</i>	3	1.3	1.0	1	0.3	0.2	4	0.6	0.5
<i>Dendrocopos major</i>	4	1.7	1.3	0	0.0	0.0	4	0.6	0.5
<i>Oriolus oriolus</i>	4	1.7	1.3	0	0.0	0.0	4	0.6	0.5
<i>Anas platyrhynchos</i>	4	1.7	1.3	0	0.0	0.0	4	0.6	0.5
<i>Turdus philomelos</i>	3	1.3	1.0	0	0.0	0.0	3	0.5	0.4
<i>Picus viridis</i>	3	1.3	1.0	0	0.0	0.0	3	0.5	0.4
<i>Curruca curruca</i>	0	0.0	0.0	3	0.8	0.6	3	0.5	0.4
<i>Phylloscopus trochilus</i>	3	1.3	1.0	0	0.0	0.0	3	0.5	0.4
<i>Motacilla alba</i>	2	0.8	0.6	1	0.3	0.2	3	0.5	0.4
<i>Acrocephalus palustris</i>	1	0.4	0.3	1	0.3	0.2	2	0.3	0.2
<i>Coccothraustes coccothraustes</i>	2	0.8	0.6	0	0.0	0.0	2	0.3	0.2
<i>Aegithalos caudatus</i>	2	0.8	0.6	0	0.0	0.0	2	0.3	0.2
<i>Columba oenas</i>	1	0.4	0.3	0	0.0	0.0	1	0.2	0.1
<i>Curruca communis</i>	1	0.4	0.3	0	0.0	0.0	1	0.2	0.1
<i>Phylloscopus sibilatrix</i>	1	0.4	0.3	0	0.0	0.0	1	0.2	0.1
<i>Pica pica</i>	0	0.0	0.0	1	0.3	0.2	1	0.2	0.1
<i>Cuculus canorus</i>	1	0.4	0.3	0	0.0	0.0	1	0.2	0.1
<i>Motacilla cinerea</i>	0	0.0	0.0	1	0.3	0.2	1	0.2	0.1
<i>Ficedula albicollis</i>	1	0.4	0.3	0	0.0	0.0	1	0.2	0.1
<i>Certhia brachydactyla</i>	1	0.4	0.3	0	0.0	0.0	1	0.2	0.1
Total	312	130.1	100	503	126.4	100	815	128.1	100

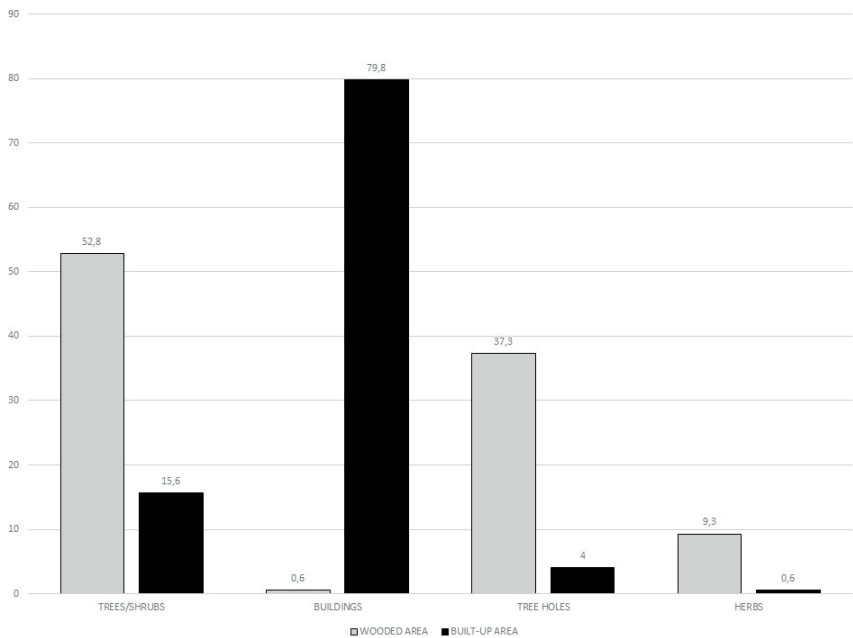
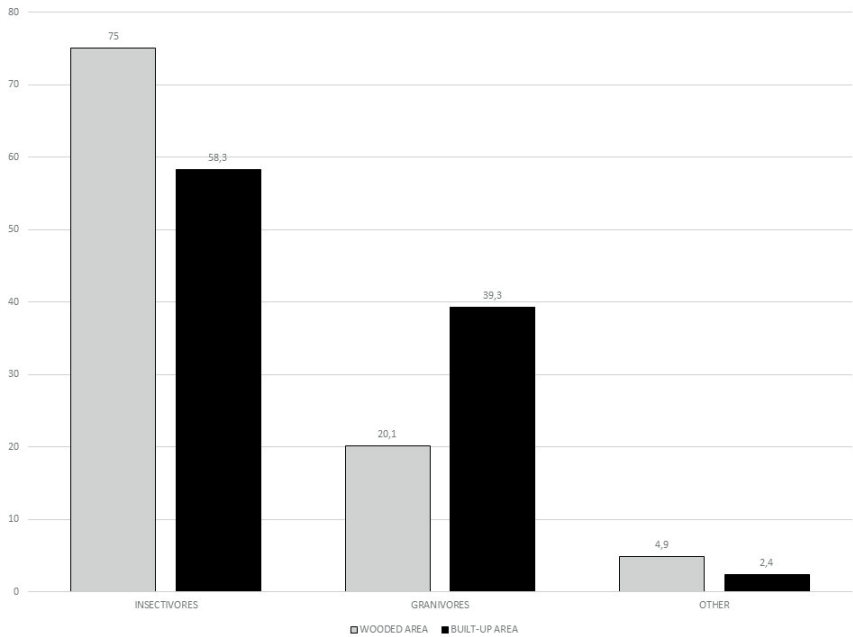
Tab. 3: Dominant bird species (recorded as such at least in one city) and their densities in wooded areas (green belt) in selected city centres in SW Poland. D – density (pairs per 10 ha), %D – dominance (in percentage).

Species	Brzeg (24 ha)		Nysa (15 ha)		Kozle (30 ha)		Wrocław (28ha)	
	2022		2005		2018		2004	
	D	%D	D	%D	D	%D	D	%D
<i>Sturnus vulgaris</i>	19.6	15.1	8.7	8.8	18.3	16.6	15	17.1
<i>Turdus merula</i>	11.3	8.7	5.3	5.4	12.3	11.1	3.2	3.7
<i>Fringilla coelebs</i>	5	3.8	10	10.1	11.3	10.2	4.3	4.9
<i>Columba palumbus</i>	12.5	9.6	3.3	3.4	5	4.5	3.9	4.5
<i>Cyanistes caeruleus</i>	7.9	6.1	2.7	2.7	4.3	3.9	8.6	9.8
<i>Parus major</i>	5	3.8	4	4.1	6.7	6	6.4	7.3
<i>Sylvia atricapilla</i>	7.1	5.4	4.7	4.7	8	7.2	2.1	2.4
<i>Passer montanus</i>	3.8	2.9	3.3	3.4	6.7	6	5	5.7
<i>Corvus frugilegus</i>	0	0	17.3	17.6	0	0	0	0
<i>Passer domesticus</i>	0	0	0	0	0	0	16.1	18.4
<i>Streptopelia decaocto</i>	5.8	4.5	5.3	5.4	0	0	1.8	2
Number of all species	36		25		31		24	

Tab. 4: Dominant bird species (recorded as such at least in one city) in densely built-up areas in selected city centres in SW Poland. D – density (pairs per 10 ha), %D – dominance (in percentage).

Species	Brzeg (40 ha)		Nysa (77 ha)		Wrocław (110 ha)	
	2022		2005		2004	
	D	%D	D	%D	D	%D
<i>Apus apus</i>	57.5	45.7	24.0	18.0	90	8.2
<i>Columba livia</i>	24.3	19.3	15.6	11.7	26.4	51.2
<i>Streptopelia decaocto</i>	9.0	7.2	8.4	6.3	3.0	5.8
<i>Passer domesticus</i>	10.3	8.2	29.9	18.0	10.0	19.4
<i>Corvus frugilegus</i>	0.0	0.0	9.9	7.4	0.0	0.0
<i>Corvus monedula</i>	2.5	2.0	7.4	5.5	0.0	0.0
<i>Delichon urbica</i>	2.1	1.6	18.1	13.5	0.0	0.0
Number of all species	25		30		12	

Graph 1: Proportion (in percentage) of main feeding (A) and nesting guilds (B) in wooded and built-up area.



References

- Betleja J., Cempulik P., Chrul Z., Grochowski T., Ostański M., Schneider G., & Szlama D. (2007): Atlas ptaków lęgowych Gliwic, rozmieszczenie i liczebność w latach 1988-1990. – *Roczniki Muzeum Górnośląskiego (Przyroda)* 17: 1-158.
- Czapulak A. & Beetleja J. (2002): Liczebność i rozmieszczenie kolonii lęgowych gawrona *Corvus frugilegus* na Śląsku w latach 90. XX wieku. – *Ptaki Śląska* 14: 5-25.
- Dyrce A., Grabiński W., Stawarczyk T. & Witkowski J. (1991): *Ptaki Śląska – monografia faunistyczna*. Uniwersytet Wrocławski, Wrocław.
- Dunn A. M. & Weston M. A. (2008): Review of terrestrial bird atlases of the world and their application. – *Emu* 108: 42–67.
- Jerzak L., Szurlej-Kiełńska A., Beuch S., Frankiewicz J., Kołodziejczyk P. & Matacz L. (2017): Rozmieszczenie i liczebność kolonii lęgowych gawrona *Corvus frugilegus* na Śląsku w latach 2013–2014. – *Ptaki Śląska* 24: 75-88.
- Kopij G. (1995): Ptaki miasta Prudnika. – *Przyroda Śląska Opolskiego* 1: 12-17.
- (2006a): Zespół ptaków lęgowych centrum Nysy. – *Przegląd Przyrodniczy* 17: 79-86.
- (2006b): Zespół ptaków lęgowych centrum Wrocławia. – *Acta Societatis Poponorum, Biologia* 5: 3-12.
- (2010): Awifauna lęgowa miasta Korfańców na Śląsku Opolskim. – *Naukowe UP we Wrocławiu, Biologia i Hodowla Zwierząt* 61: 63-79.
- (2011): Awifauna lęgowa miasta Grodkowa. – *Przyroda Śląska Opolskiego* 17: 22-30.
- (2013a): Ptaki lęgowe Prudnika w 2010 r. – *Przyroda Śląska Opolskiego* 19: 15-26.
- (2013b): Ptaki lęgowe Głogówka. – *Przyroda Śląska Opolskiego* 19: 26-29.
- (2014): Ptaki lęgowe Głucholaz i okolicznych wiosek. – *Przyroda Śląska Opolskiego* 20: 13-24.
- (2017): Ptaki lęgowe miasta Głubczyce w 2017 r. – *Przyroda Śląska Opolskiego* 23: 1-8.
- (2019): Ptaki lęgowe miasta Koźle w 2018 roku. – *Przyroda Śląska Opolskiego* 25: 10-21.
- (2020): Ptaki lęgowe miasta Krapkowice. – *Przyroda Śląska Opolskiego* 25: 22-34.
- Kopij G. & Wolanin J. (2010): Awifauna lęgowa Nysy. – *Przyroda Śląska Opolskiego* 16: 1-21.
- Kopij G. & Zaczek K. (2009): Awifauna lęgowa Otmuchowa. – *Przyroda Śląska Opolskiego* 15: 35-44.
- Luniak M. (2013): Kartograficzne atlasy awifauny miast w Europie – przegląd badań. – *Ornis Polonica* 54: 40–49.
- (2017): Urban ornithological atlases in Europe: a review. In: Murgui E., Hedblom H. (eds.). *Ecology and conservation of birds in urban environments*. Springer, Heidelberg; p. 209-223.
- Luniak M., Kozłowski P., Nowicki W. & Plit J. (2001): *Ptaki Warszawy 1962-2000*. IGiPZ PAN, Warszawa.
- Magle S. B., Hunt V. M., Vernon M. & Crooks K. R. (2012): *Urban Wildlife Research: Past, Present, and Future*. – *Biological Conservation* 155: 23–32.
- Mitschke A. & Baumung S. (2001): Brutvogel-Atlas Hamburg. – *Hamburger Avifaunistische Beiträge* 31: 1-344.
- Otto W. & Witt K. (2002): Verbreitung und Bestand Berliner Brutvögel. – *Berliner Ornithologische Bericht*. 12, Sonderheft.
- Sutherland W. J. (1996): *Ecological Census Techniques: a handbook*. Cambridge University Press Cambridge (U.K.).
- Tomiałojć L. (1970): Badania ilościowe nad synantropijną awifauną Legnicy i okolic. – *Acta Ornithologica* 12: 293-392.
- Tomiałojć L., Orłowski G., Czapulak A. & Jakubiec Z. (2020): *Ptaki Wrocławia w okresie 200 lat. PTPP „pro Natura”*, Wrocław.

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