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The breeding avifauna of the parks and cemeteries of Lublin (SE Poland)

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Abstract 10 urban green areas (123.5 ha) were studied in the years 1982–1991 in the city of Lublin (SE Poland). Counts in each area were made in at least three consecutive years. A combined variant of the mapping method was applied. A total of 93 species were reported from the areas studied, and 50 of these were found to breed. In individual areas the number of breeding species varied from 17 to 39. *Columba palumbus*, *Pica pica*, *Oriolus oriolus*, *Parus major* and *Fringilla coelebs* were found breeding in all areas. 23 species were dominants, making up over 5% of a total population. Included most often (at least in 5 areas) among these dominants were *Streptopelia decaocto*, *Sturnus vulgaris*, *Hippolais icterina* and *Carduelis chloris*. The density of breeding pairs varied from 46.5 per 10 ha (in a cemetery on the periphery) to 238.5 per 10 ha (in a small park in the city). Of the total number of breeding pairs in all areas, some 54% were of species nesting in the tree canopy and a height of more than 1.5 m in shrubs and bushes. In contrast, hole-nesting species were poorly represented (30% of breeding pairs). Characteristic of the parks and cemeteries of Lublin were the high densities of *Streptopelia decaocto* and *Hippolais icterina*. When set against the communities inhabiting the green space of other cities and towns, the avifauna of Lublin's parks and cemeteries is distinguished by its species-richness. Moreover, several species have appeared in recent years or have increased considerably in numbers.

Key words: bird communities, urban birds, Lublin, urban parks

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INTRODUCTION

In Poland, a relatively large number of studies have been devoted to urban avifauna. However, in spite of this, there are still few which present the results of quantitative studies carried out on material that is sufficiently representative. Towns and cities like Legnica (Tomiałojć 1970), Słupsk (Górski 1982), Warsaw (Luniak 1980, 1981, Nowicki 1992) and Poznań (Mizera 1988) are exceptions, but most other work refers to one or more selected areas or to single species, or else comprises nothing more than contributions to urban avifauna. The earlier monographs – published before the 1970s – present only the qualitative composition of avifauna and treat the issue of abundance in a rather general way. The avifauna of Poland's urban green areas has been described in a holistic way by Luniak (1983).

The birds of Lublin have been the subject of several studies (Riabinin 1959, 1973, 1986, Riabinin & Olearnik 1985a, 1985b) which considered species composition and changes in the avifauna in recent decades. The data included within them do not provide a point of

reference for the results which were obtained by contemporary quantitative methods. The work presented here is based on several year-long counts of the breeding avifauna carried out in Lublin's cemeteries and in all of the city's more important parks. The results obtained for the Lipowa Street Cemetery have been described in a separate publication (Biaduń 1989).

STUDY AREA AND METHODS

With a population of 352 thousand (1991), Lublin (51°13'N, 22°34'E) is Poland's largest city east of the Vistula River. It has an administrative area of 147.55 km² and lies in the South Polish Upland belt, on either side of a small river Bystrzyca. Urban green space covers only 1062 ha of the city, and this gives a low index of 30.1 m² per inhabitant. Not considered in this study were Dąbrowa and Stary Gaj – two forest complexes covering several hundred hectares and lying within the administrative boundaries of the city on its southern and south-western edges. More precise data on the natural characteristics of Lublin have been given by Stochlak (1993).

Table 1. Characteristics of study areas.

Surroundings: B – built up areas, T – communication routes, W – planted with trees, O – open areas.

Degree of tree cover: “+” – <25%, “++” – 25–50%, “+++” – >50%.

Tree age: I – <30 years, II – 30–50, III – >50 years.

Undergrowth: “+” – <5% of the area, “++” – >5%, “+++” – large undergrowth assemblages.

Herb layer: n – natural amongst trees, P – cultivated extensive, p – cultivated amongst trees.

Presence of people: “+” – limited, “++” – moderate, “+++” – very considerable.

[Tabela 1. Charakterystyka badanych terenów.

Otoczenie: B – zabudowa, T – trasy komunikacyjne, W – zadrzewienia, O – tereny odkryte.

Stopień zadrzewienia: “+” – <25%, “++” – 25–50%, “+++” – >50%.

Wiek drzewostanu: I – do 30 lat, II – 30–50 lat, III – 50 lat.

Krzewy: “+” – poniżej 5% terenu, “++” – powyżej 5%, “+++” – zwarte, duże kępy krzewów.

Runo: n – naturalne płyty wśród drzew, P – rozległe pielęgnowane powierzchnie, p – pielęgnowane wśród drzew. Obecność ludzi:

“+” – niewielka, “++” – średnia, “+++” – bardzo duża.]

Name and symbol of area	Area size – ha	Surroundings	Degree of tree cover	Tree stand age	Undergrowth	Herb layer	Presence of people
Ludowy Park (PL)	30.1	BTO	+	II	+	P	+
Lipowa Str. Cemetery (CL)	18.4	BT	+++	III	+	n	+++
Botanic Garden (OB)	18.0	BTWO	+	III	+++	P	+
Majdanek Cemetery (CM)	16.4	O	+	I	+	P	+
Saski Garden (OS)	12.9	BT	+++	III	+	p	+++
Unicka Str. Cemetery (CU)	11.0	BTO	+++	III	+	n	+
Wooded area in Czechów (LC)	6.0	TO	+++	I	+++	n	+
Akademicki Park (PA)	5.5	BT	+++	II	+	p	+++
Kalinowszczyzna Cemetery (CK)	2.7	BO	+	III	+	n	+
Bronowicki Park (PB)	2.5	BT	+	III	+	p	+++

The study extended to all Lublin's cemeteries as well as to the most important concentrations of taller greenery of a park-like character. Covering a total of 123.5 ha, these areas (Fig. 1, Table 1) included the four cemeteries, four typical parks, the Botanic Garden and a small complex planted with trees. While areas LC, OB and CM are situated on the periphery, the other areas can be regarded as typical city areas. Areas CL, OB, OS, CK and PB have old, fully mature stands of trees, while the cemetery in Majdanek (CM) and the area planted with trees in Czechów (LC) are characterized by trees of the age class 30 years or less.

Akademicki Park (PA) is the only area with nest-boxes – for Starling and tits. Breeding opportunities for hole-nesting birds are provided in four other areas by lamps (at PL) or cemetery shrines (at CL, CU and CM). None of the areas have bodies of water, with the exception of OS, which has a small artificial pond for park swans.

The study employed a combined variant of mapping method (Tomiałojć 1980a, 1980b) supplemented by specific modifications by the author. Efforts were made to locate all the nests of species occurring at high

density or having a specific biology. This related mainly to *Streptopelia decaocto*, *Columba palumbus*, *Corvus monedula*, *Pica pica*, *Sturnus vulgaris*, *Passer domesticus*, *P. montanus* and *Turdus pilaris*. In principal this was the basis for the estimation of the population sizes of these species, though with the remarks of Tomiałojć (1974) taken into consideration.

The counts (10–13 each breeding season) were carried out in the early hours of the morning, though were extended into late morning in exceptional circumstances. On average, the counts took ca 100 minutes per 10 ha, with extreme values of 60 minutes and 160 minutes. In individual cases up to 30 minutes were devoted to the penetration of 1 ha. These variations resulted from differences in the studied environments, and were also connected with the degree of advancement of the breeding season. The research was carried out between the last third of March and the first days of July.

Sorensen's Index (QS) and Renkonen's Index (Re) in the version applied by Glowaciński (1975), were used to estimate the similarity of the species composition of, and numerical dominance in, particular communities.

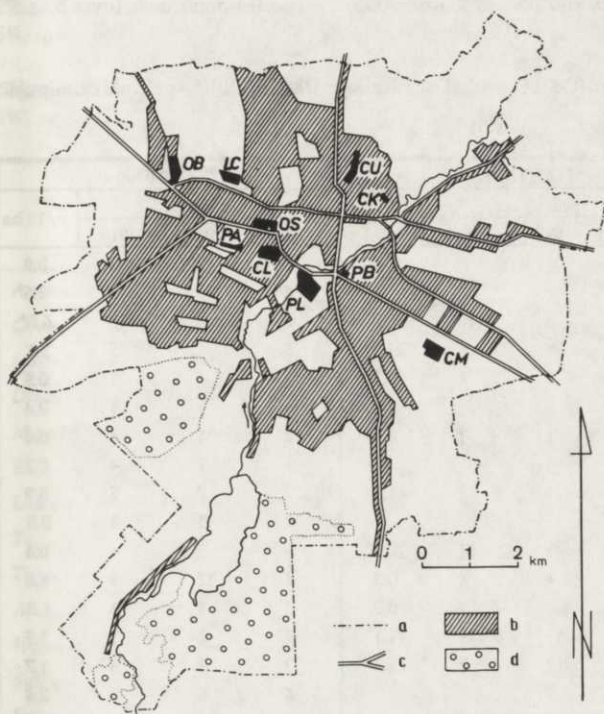


Fig. 1. Distribution of study areas within the municipal boundaries (a) of Lublin, b – built-up areas, c – main streets, d – wooded areas. Symbols of areas – see Tab. 1.

[Ryc. 1. Rozmieszczenie badanych terenów na obszarze administracyjnym Lublina: a – granice administracyjne miasta, b – zabudowa miejska, c – główne ulice, d – lasy. Symbole powierzchni patrz Tab. 1.]

RESULTS

Tables 2–5 present the results of the research carried out. A total of 50 breeding species were recorded in the course of counts made in the areas studied. In particular areas, the number ranged from 17 (in the planted group of trees in Czechów) to 39 (in the Botanic Garden). Categorized as migratory or accidental were a further 43 species observed in the breeding season, of which three – *Dendrocopos minor*, *Turdus philomelos* and *Asio otus* – went on to breed in the study areas after the study period had ended. The required positive opinions from the Polish Avifaunistic Commission were obtained in the case of two species: *Dendrocopos syriacus* and *Phylloscopus trochiloides*, considered to be breeding.

As many as 23 of the breeding species were recorded as dominants in particular areas, but only 4 – *Streptopelia decaocto*, *Sturnus vulgaris*, *Hippolais icterina*

and *Carduelis chloris* – were amongst the dominants at least five times.

A totally different form was taken by the frequency of occurrence of individual species in the areas studied (Table 6). *Columba palumbus*, *Pica pica*, *Oriolus oriolus*, *Parus major* and *Fringilla coelebs* nested in all areas and twenty other species were present in breeding communities five or more times. Sporadic breeding (irregularly and in single areas) was reported for *Dendrocopos major*, *Jynx torquilla*, *Corvus corone*, *Motacilla alba*, *Phoenicurus phoenicurus*, *Pyrrhula pyrrhula* and several other species.

Densities of breeding pairs ranged from 46.5 per 10 ha in the cemetery on the edge of the city (CM) to 238.5 per 10 ha in the smallest area studied – Bronowicki Park (PB). Even higher values were attained in isolated cases, e.g. 285.2 in 1990 in Kalinowszczyzna Cemetery (CK).

The highest densities of breeding pairs were noted for *Streptopelia decaocto* (Tab. 6) in central areas of the city: values varied from 21.7 to 58.0 per 10 ha. A characteristic feature was the high density of *Hippolais icterina*, which appeared among the dominants 6 times. Also worthy of note in the communities studied was the considerable numerical representation of *Phylloscopus collybita*, *Carduelis carduelis* and *Oriolus oriolus*. *Carduelis chloris*, *Turdus merula* and *T. pilaris* also had very large populations in some areas. A marked expansion was noted in the 1980s for the last of these species, as well as for *Columba palumbus*.

QS and Re Indices calculated for the same areas but in different years showed that the communities compared were virtually identical in 63 cases out of 72 (QS>80%, Re>70%). This attests to the considerable stability of the breeding populations in even the smallest areas.

Comparison of breeding communities in particular areas revealed that, out of 45 cases, 8 communities showed identical species composition with QS>80%, and a further 22 showed clear similarity, with QS values of 60–80%. Identical breeding groupings occurred in five of the areas studied (PB, OS, CK, CU and CL). Values for QS obtained in comparisons between them varied from 76.6 (PB:CU) to 85.7% (OS:CL and PB:CK). The breeding population of LC was distinguished by a species composition markedly different from that noted elsewhere (similarities were only found for comparisons LC:PA (68%) and LC:OB (61%).

Table 2. Breeding birds of Lipowa Str. Cemetery (CL), Saski Garden (OS) and Botanic Garden (OB). * – species-dominants (over 5%), ** – without *Corvus frugilegus*.

[Tabela 2. Ptaki lęgowe Cmentarza przy ul. Lipowej (CL), Ogrodu Saskiego (OS) i Ogrodu Botanicznego UMCS (OB). * – gatunki dominujące (ponad 5%), ** – bez gawrona.]

Species	CL (18.4 ha)				OS (12.9 ha)				OB (18.0 ha)			
	pairs			p/10 ha	pairs			p/10 ha	pairs			p/10 ha
	'82	'83	'84		'88	'89	'90		'89	'90	'91	
<i>Perdix perdix</i>									1	2	2	0.9
<i>Phasianus colchicus</i>									6	5	3	2.6
<i>Columba palumbus</i>	1	3	7	2.0	6	6	10	5.7	8	8	18	6.3*
<i>Streptopelia decaocto</i>	107	103	104	56.9*	32	26	26	21.7*	6	6	5	3.1
<i>Strix aluco</i>					-	1	1	0.5	1	1	1	0.5
<i>Jynx torquilla</i>									+	1	1	0.4
<i>Picus viridis</i>					-	1	1	0.5	1	1	+	0.4
<i>Dendrocopos syriacus</i>									+	1	+	0.2
<i>Erithacus rubecula</i>	1	2	+	0.5	2	1	2	1.3	7	7	7	3.9
<i>Luscinia luscinia</i>									1	1	1	0.5
<i>Turdus merula</i>	33	28	25	15.6*	26	23	32	20.9*	+	2	+	0.4
<i>Turdus pilaris</i>	5	4	3	2.2	+	+	1	0.3	4	12	9	4.6
<i>Acrocephalus palustris</i>					-	+	1	0.3	3	4	3	1.8
<i>Hippolais icterina</i>	26	19	20	11.8*	15	15	13	11.1	4	2	3	1.7
<i>Sylvia curruca</i>	1	1	1	0.5	1	2	2	1.3	3	3	3	1.7
<i>Sylvia communis</i>									4	6	3	2.4
<i>Sylvia borin</i>									1	1	1	0.5
<i>Sylvia atricapilla</i>	3	4	2	1.6	6	9	7	5.7	5	5	5	2.8
<i>Phylloscopus sibilatrix</i>	1	+	+	0.2	+	1	+	0.3	1	1	+	0.4
<i>Phylloscopus collybita</i>	1	2	1	0.7	2	2	2	1.5	5	5	5	2.8
<i>Phylloscopus trochilus</i>	+	1	+	0.2					8	4	4	3.0
<i>Muscicapa striata</i>	6	6	9	3.8	6	5	4	3.9	+	+	2	0.4
<i>Parus montanus</i>									1	+	1	0.4
<i>Parus caeruleus</i>	5	8	8	3.8	5	9	11	6.5	6	5	7	3.3
<i>Parus major</i>	4	6	3	2.3	8	8	13	7.7	6	6	7	3.5
<i>Sitta europaea</i>	-	+	1	0.2	2	2	3	1.8	+	1	1	0.4
<i>Certhia brachydactyla</i>	1	1	2	0.7								
<i>Oriolus oriolus</i>	2	2	3	1.2	2	2	2	1.5	2	1	2	0.9
<i>Pica pica</i>	1	1	1	0.5	2	2	2	1.5	7	8	10	4.6
<i>Corvus monedula</i>	3	7	5	2.7	46	43	41	33.6*	21	29	20	13.0*
<i>Corvus frugilegus</i>					172	149	118					
<i>Corvus corone</i>									1	1	1	0.5
<i>Sturnus vulgaris</i>	32	23	25	14.5*	54	43	58	40.0*	20	28	21	12.8*
<i>Passer domesticus</i>	+	1	1	0.4	3	3	1	1.8				
<i>Passer montanus</i>	9	15	16	7.2	9	8	13	7.7	3	6	8	3.1
<i>Fringilla coelebs</i>	10	11	15	6.5	16	11	14	10.6*	3	8	8	3.5
<i>Serinus serinus</i>	8	12	10	5.4	4	4	6	3.6	3	2	2	1.3
<i>Carduelis chloris</i>	18	13	17	8.7*	8	9	14	8.0	5	10	8	4.3
<i>Carduelis carduelis</i>	9	13	8	5.4	3	4	7	3.6	4	2	4	1.8
<i>Carduelis cannabina</i>									+	3	3	1.1
<i>Pyrrhula pyrrhula</i>	-	1	-	0.2								
<i>Coccothraustes coccothr.</i>					+	+	1	0.3	1	1	+	0.4
<i>Emberiza citrinella</i>									3	6	3.5	2.3
Total sp.	23	25	23	27	23	26	28	29	33	37	34	39
Pairs (p/10 ha)	287	287	287	(156.0)	258**	240**	288**	(203.1**)	155	195	182.5	(98.6)
			QS	Re			QS	Re			QS	Re
		1982:'83	91.7	88.1		1988:'89	93.9	92.5		1989:'90	91.4	81.9
		1983:'84	91.7	91.5		1989:'90	92.6	88.4		1990:'91	90.1	83.6
		1982:'84	91.3	88.4		1988:'90	90.2	87.4		1989:'91	89.5	80.4

Table 3. Breeding birds of Ludowy Park (PL), Akademicki Park (PA) and Area planted with trees in Czechów (LC). Species-dominants (over 5%) marked by asterisk.

[Tabela 3. Ptaki lęgowe Parku Ludowego (PL), Parku Akademickiego (PA) i Zadrzewień na Czechowie (LC). Gatunki dominujące (ponad 5%) oznaczono gwiazdką.]

Species	PL (30.1 ha)				PA (5.5 ha)				LC (6.0 ha)				
	pairs			p/10 ha	pairs			p/10 ha	pairs			p/10 ha	
	'82	'83	'84		'88	'89	'90		'89	'90	'91		
<i>Anas platyrhynchos</i>	+	+	2	0.2									
<i>Columba palumbus</i>	1	4	6	1.2	2	2	6	6.1	2	4	6	6.7*	
<i>Streptopelia decaocto</i>	65	81	99	27.1*	12	12	13	22.4*					
<i>Dendrocopos major</i>	-	1	-	0.1									
<i>Motacilla flava</i>	1	+	+	0.1									
<i>Erethacus rubecula</i>					1	1	1	1.8	2	5	3	5.5*	
<i>Luscinia luscinia</i>	2	2	6	1.1	1	+	-	0.6	3	2	1	3.3*	
<i>Turdus merula</i>	9	11	16	4.0	1	2	8	6.7					
<i>Turdus pilaris</i>	18	13	13	4.9	4	7	12	13.9*					
<i>Acrocephalus palustris</i>	11	4	5	2.2					2	1	-	1.7	
<i>Hippolais icterina</i>	12	13	15	4.4	6	8	5	11.5*	+	+	1	0.5	
<i>Sylvia curruca</i>	2	3	1	0.7	2	1	1	2.4	+	+	1	0.5	
<i>Sylvia communis</i>	+	1	1	0.2	-	1	-	0.6					
<i>Sylvia borin</i>	+	1	2	0.3	+	1	-	0.6	1	2	+	1.7	
<i>Sylvia atricapilla</i>	6	6	11	2.5	4	5	5	8.5*	3	4	2	5.0*	
<i>Phylloscopus sibilatrix</i>	1	+	+	0.1					2	1	1	2.2	
<i>Phylloscopus collybita</i>					4	4	2	6.1	7	4	5	8.9*	
<i>Phylloscopus trochilus</i>					+	+	1	0.6	1	1	1	1.7	
<i>Muscicapa striata</i>	3	3	3	1.0	2	2	1	3.0					
<i>Parus montanus</i>									1	1	-	1.1	
<i>Parus caeruleus</i>	4	5	5	1.5	2	2	2	3.6	0.5	0.5	0.5	0.8	
<i>Parus major</i>	7	7	5	2.1	2	2	3	4.2	3	3	2	4.4*	
<i>Certhia brachydactyla</i>	1	1	1	0.3									
<i>Oriolus oriolus</i>	2	3	4	1.0	1	1	2	2.4	1	2	1	2.2	
<i>Pica pica</i>	4	4	4	1.3	2	1	2	3.0	3	2	4	5.0*	
<i>Sturnus vulgaris</i>	3	4	7	1.5	8	10	8	15.8*					
<i>Passer domesticus</i>	97	86	94	30.7*									
<i>Passer montanus</i>	17	17	18	5.8*									
<i>Fringilla coelebs</i>	6	10	14	3.3	3	6	4	7.9*	+	2	1	1.7	
<i>Serinus serinus</i>	7	10	9	2.9	+	1	2	1.8					
<i>Carduelis chloris</i>	17	17	19	5.9*	4	5	5	8.5*					
<i>Carduelis carduelis</i>	6	6	8	2.2	1	2	2	3.0					
<i>Coccothraustes coccothr.</i>					1	1	1	1.8					
Total sp.	24	25	25	28	20	22	21	24	14	15	14	17	
Pairs (p/10 ha)	302	313	368	(108.9)	63	77	86	(137.0)	31.5	34.5	29.5	(53.1)	
			QS	Re			QS	Re			QS	Re	
	1982:'83		89.8	88.0	1988:'89		90.5	86.8	1989:'90		96.5	73.4	
	1983:'84		96.0	92.2	1989:'90		93.0	78.9	1990:'91		82.6	70.2	
	1982:'84		89.8	85.2	1988:'90		92.7	75.6	1989:'91		78.6	67.4	

Table 4. Breeding birds of Unicka Str. Cemetery (CL) and Majdanek Cemetery (CM). Species-dominants (over 5%) marked by asterisk.

[Tabela 4. Ptaki legowe Cmentarza przy ul. Unickiej (CL) i Cmentarza na Majdanku (CM). Gatunki dominujące (ponad 5%) oznaczono gwiazdka.]

Species	CU (11.0 ha)				CM (16.4 ha)			
	pairs			p/10 ha	pairs			p/10 ha
	'87	'88	'89		'88	'89	'90	
<i>Phasianus colchicus</i>					2	+	+	0.4
<i>Columba palumbus</i>	2	3	2	2.1	4	4	8	3.2*
<i>Streptopelia decaocto</i>	8	12	12	9.7*	5	6	8	3.9*
<i>Dendrocopos syriacus</i>	1	+	1	0.6				
<i>Motacilla flava</i>					1	2	1	0.8
<i>Motacilla alba</i>					+	+	1	0.2
<i>Erithacus rubecula</i>	+	1	+	0.3	+	2	1	0.6
<i>Oenanthe oenanthe</i>					8	8	5	4.3*
<i>Turdus merula</i>	+	1	1	0.6				
<i>Turdus pilaris</i>	-	-	1	0.3				
<i>Acrocephalus palustris</i>	2	1	+	0.9	3	2	2	1.4
<i>Hippolais icterina</i>	4	7	3	4.2*				
<i>Sylvia curruca</i>	1	1	2	1.2	2	2	+	0.8
<i>Sylvia communis</i>					7	7	5	3.9*
<i>Sylvia borin</i>	+	+	1	0.3				
<i>Sylvia atricapilla</i>	1	2	1	1.2				
<i>Phylloscopus trochiloides</i>	-	1	+	0.3				
<i>Muscicapa striata</i>	+	1	+	0.3				
<i>Parus caeruleus</i>	1	+	1	0.6				
<i>Parus major</i>	+	4	2	1.8	1	1	1	0.6
<i>Oriolus oriolus</i>	3	3	1	2.1	1	1	+	0.4
<i>Pica pica</i>	1	4	4	2.7	6	11	10	5.5*
<i>Corvus monedula</i>	2	1	5	2.4	1	1	4	1.2
<i>Sturnus vulgaris</i>	1	1	+	0.6				
<i>Passer domesticus</i>	6	19	12	11.2*	17	22	32	14.4*
<i>Passer montanus</i>	-	3	2	1.5				
<i>Fringilla coelebs</i>	2	3	1	1.8	+	1	1	0.4
<i>Serinus serinus</i>	2	5	6	3.9*				
<i>Carduelis chloris</i>	5	13	15	10.0*	2	3	4	1.8
<i>Carduelis carduelis</i>	1	1	+	0.6				
<i>Carduelis cannabina</i>					4	4	4	2.4*
<i>Emberiza citrinella</i>					1	-	+	0.2
Total sp.	17	21	19	25	16	16	15	19
Pairs (p/10 ha)	43	87	73	(61.5)	65	77	87	(46.5)
			QS	Re			QS	Re
	1987:'88		78.9	72.0	1988:'89		84.8	86.6
	1988:'89		75.0	75.1	1989:'90		87.5	81.0
	1987:'89		77.8	69.5	1988:'90		77.4	74.2

Table 5. Breeding birds of Kalinowszczyzna Cemetery (CK) and Bronowicki Park (PB). Species-dominants (over 5%) marked by asterisk.

[Tabela 5. Ptaki lęgowe Cmentarza na Kalinowszczyźnie (CK) i Parku Bronowickiego (PB). Gatunki dominujące (ponad 5%) oznaczono gwiazdką.]

Species	CK (2.7 ha)				PB (2.5 ha)				
	pairs			p/10 ha	pairs				p/10 ha
	'88	'89	'90		'87	'88	'89	'90	
<i>Columba palumbus</i>	1	1	1	3.7	1	1	1	+	3.0
<i>Streptopelia decaocto</i>	15	12	20	58.0*	11	13	11	13	48.0*
<i>Strix aluco</i>					-	+	1	1	2.0
<i>Erithacus rubecula</i>					1	1	1	+	3.0
<i>Phoenicurus phoenicurus</i>					-	-	1	1	2.0
<i>Turdus merula</i>	+	1	1	2.5	2	2	1	1	6.0
<i>Turdus pilaris</i>	-	6	3	11.1*	-	+	+	1	1.0
<i>Hippolais icterina</i>	4	4	3.5	14.2*	7	6	6	4	23.0*
<i>Sylvia curruca</i>	0.5	1	1	3.1					
<i>Sylvia atricapilla</i>					1	1	+	+	2.0
<i>Muscicapa striata</i>	1	1	1	3.7	1	3	1	2	7.0
<i>Parus caeruleus</i>	1	1	2	4.9	1	2	2	2	7.0
<i>Parus major</i>	1	1	1	3.7	1	3	3	3.5	10.5
<i>Oriolus oriolus</i>	1	1	1	3.7	1	1	1	+	3.0
<i>Pica pica</i>	1	2	2	6.2	+	1	3	1	5.0
<i>Corvus monedula</i>	+	1	2	3.7					
<i>Corvus frugilegus</i>	-	2	-	2.5	6	7	6	6	25.0*
<i>Sturnus vulgaris</i>	5	5	6	19.7*	3	8	8	9	28.0*
<i>Passer domesticus</i>	+	1	4	6.2	5	5	4	10	24.0*
<i>Passer montanus</i>	9	5	7	25.9*	1	-	2	1	4.0
<i>Fringilla coelebs</i>	+	1	1.5	3.1	3	2	1	4	10.0
<i>Serinus serinus</i>	1	1	5	8.6	3	4	2	2	11.0
<i>Carduelis chloris</i>	3	5	8	19.7*	2	2	1	5	10.0
<i>Carduelis carduelis</i>	3	5	7	18.5*	1	1	1	1	4.0
Total sp.	14	20	19	20	18	18	20	18	22
Pairs (p/10 ha)	46.5	57	77	(222.8)	51	63	57	67.5	(238.5)
			QS	Re			QS	Re	
	1988:'89		82.3	70.7	1987:'88		94.4	84.5	
	1989:'90		97.4	82.5	1988:'89		89.5	86.2	
	1988:'90		84.8	72.8	1989:'90		89.5	81.0	
					1987:'89		89.5	77.0	
					1987:'90		77.8	73.0	
					1988:'90		77.8	79.3	

Table 6. Frequency of occurrence and highest density recorded of some species. Symbols of areas – see Tab. 1.

[Tabela 6. Częstość występowania i najwyższe stwierdzone zagęszczenie wybranych gatunków. Symbole powierzchni – patrz Tab. 1.]

Species	Frequency		Highest density		
	as dominant	total	p/10ha	area	year
<i>Streptopelia decaocto</i>	8	9	74.1	CK	1990
<i>Sturnus vulgaris</i>	6	8	45.0	OS	1990
<i>Hippolais icterina</i>	6	9	28.0	PB	1987
<i>Carduelis chloris</i>	5	9	29.6	CK	1990
<i>Passer domesticus</i>	4	7	40.0	PB	1990
<i>Columba palumbus</i>	3	10	10.0	OB	1991
<i>Turdus merula</i>	2	8	24.8	OS	1990
<i>Turdus pilaris</i>	2	8	21.8	PA	1990
<i>Fringilla coelebs</i>	2	10	16.0	PB	1990
<i>Corvus monedula</i>	2	6	35.6	OS	1988
<i>Passer montanus</i>	2	7	33.3	CK	1988
<i>Sylvia atricapilla</i>	2	8	9.1	PA	1990
<i>Pica pica</i>	2	10	6.7	CM	1989
<i>Carduelis carduelis</i>	1	8	25.9	CK	1990
<i>Serinus serinus</i>	1	8	16.0	PB	1988
<i>Parus major</i>	1	10	14.0	PB	1990
<i>Phylloscopus collybita</i>	1	5	7.3	PA	1988

In addition, the avifauna of CM was found to be totally distinct from that of all the other areas (QS:43.9–54.5).

The Renkonen Index revealed near-identical communities in only one comparison – CK:CL (72.3%). However, great similarity of the dominants in communities was shown in the next 19 comparisons. In terms of quantitative dominance in the avifauna, the breeding bird communities of tree-planted areas in Lublin were best typified by Akademicki Park (PA), whose community showed clear similarity ($Re > 50\%$) in 7 cases out of 9. Although similar to most of the others where species composition was concerned, the breeding community of the Botanic Garden (OB) was of a different character in relation to dominance. Comparisons revealed only two similar communities (PA and OS). The breeding populations of the Majdanek cemetery (CM) and the area of planted trees in Czechów (LC) were also found to be distinct communities where quantitative dominance was concerned ($Re: 13–49\%$).

Breeding communities were also analyzed in relation to the nesting site and the height at which nests were situated (Table 6). Over half of the avifauna studied was found to be composed of birds which nest in the crowns of trees or in bushes at a height of over 1.5 m. In fact, on average, this ecological group com-

prised 54% of breeding pairs, which belonged to 16 species. Of the individual areas studied, CL had the highest values for the proportion of breeding pairs in this group (77%). However, with 14 each, the Botanic Garden (OB) and Saski Garden (OS) had a greater number of species of this type. Then again, where the density of breeding pairs from this group was concerned, it was the Bronowicki Park (PB) and the Kalinowszczyzna Cemetery (CK) which gave distinctly higher values than those elsewhere (156.0 and 155.5 pairs per 10 ha respectively). This group was least well-represented in areas CM and LC.

15 species were grouped as hole-nesting birds, and the number in individual areas varied from 3 (in LC, PA and CM) to 11 (in OB). The highest percentage representation for this group among the total number of breeding pairs was reported from the Saski Garden (OS) – 49 %, the Botanic Garden (OB) – 39% and Ludowy Park (PL) – 39%. Percentages were considerably lower in other areas nearer the city centre which were typical of those planted with trees. On average, hole-nesting birds accounted for as little as 30% of breeding populations.

As many as 19 species nested either on the ground or in bushes at heights of up to 1.5 m. On average, birds

Table 7. Number of species (n), density of breeding pairs (p/10 ha) and percentage representation (%) of particular ecological groups in the study areas: T – tree and shrub-nesters (at heights above 1.5 m), H – hole-nesters, G – ground- and shrub-nesters (below 1.5 m). Symbols of areas – see Tab. 1.

[Tabela 7. Ilość gatunków (n), zagęszczenie par lęgowych (par/10 ha) i procentowy udział (%) poszczególnych grup ekologicznych na badanych terenach: T – drzewa i krzewy (powyżej 1.5 m), H – dziuplaki, G – ziemia i krzewy (wys. do 1.5 m). Symbole powierzchni – patrz Tab. 1.]

Area	T			H			G		
	n	p/10 ha	%	n	p/10 ha	%	n	p/10 ha	%
PL	12	59.2	54.3	7	42.0	38.6	9	7.4	6.8
CL	13	120.2	77.2	8	31.8	20.3	6	3.7	2.3
OB	14	33.8	34.5	11	38.0	38.7	14	26.7	27.0
CM	6	15.2	32.8	3	16.2	34.9	10	15.0	32.2
OS	14	90.1	44.4	9	99.9	49.1	6	10.4	5.0
CU	12	38.3	62.5	7	18.7	30.5	6	4.2	7.0
LC	5	16.1	30.3	3	6.4	12.1	9	30.5	57.4
PA	13	92.0	67.3	3	23.6	17.2	8	21.2	15.3
CK	13	155.5	69.9	6	64.1	28.8	1	3.1	1.4
PB	13	156.0	65.2	7	77.5	32.4	2	5.0	2.0

in this group comprised 16% of breeding populations and nested at densities ranging from several pairs per 10 ha in PB, CK, CL and CU to 26.7 in OB, and 30.5 in LC. The greatest numbers of species from this group were also reported in the last two areas, which had 14 and 10 species respectively.

DISCUSSION

The avifauna of the parks and cemeteries of Lublin was found to include 50 species which were breeding and 43 other species which were noted in the breeding season. This compares with the 66 species which Luniak (1981) reported nesting in the areas of urban green space in Warsaw – a city four times the size of Lublin. However, later studies by Nowicki (1992) excluded Warsaw's forest parks, considered only typical park habitats, and reported from these as few as 37 breeding species plus 7 probably breeding. While work by Mizera (1988) in Poznań Sołacz district gave a number of species very similar to that in the present study, comparisons with other Polish cities show Lublin to be richer. Ferens (1957) reported 40 breeding species in the urban green space of Kraków, Okule-

wicz (1971) 35 in Olsztyn, Tranda *et al.* (1983) 37 in Łódź and Górski (1982) 38 species in Słupsk. Finally, 34 breeding species have been revealed in the latest studies carried out by Zalewski & Przystalski (1993) in 9 areas of urban green space in Toruń.

In the light of this, it would appear that the breeding avifauna of Lublin's urban green space is relatively rich in species. Of the areas studied, the Botanic Garden (OB) stands out in particular. The reported total of 39 breeding species makes this area of urban green space Poland's joint-richest in this respect (see Luniak 1983, Tomiałojć 1970, Tomiałojć & Profus 1977). Contributing to this richness are the Garden's peripheral location, the exceptional richness of its habitats, the lack of dogs and cats and the controlled presence of people. In addition, however, the smallest groupings of green space studied – Bronowicki Park (PB) and the Kalinowszczyzna cemetery (CK) – are also seen in a very favourable light. The respective figures reported (22 and 20 breeding species) are quite clearly above the upper limit given for Polish examples of this type of environment by Luniak (1983).

Comparisons were made between the species composition in the urban green space of Lublin, and that of other cities. The greatest similarity (QS = 80.8%) was found for the comparison with Warsaw (using data from Nowicki 1992). This attests to the identical nature of the groupings in the two cities. In addition, QS values of 76–77% revealed a clear similarity between the avifauna found in Lublin's urban green space and that in similar situations in Poznań (Mizera 1988), Łódź (Tranda *et al.* 1983) and Toruń (Strawiński 1963, Zalewski & Przystalski 1993). On the other hand, QS values were lower for comparisons with Słupsk (73%, Górski 1982), Koszalin (69%, Górski & Górski 1979) and Hungarian cities (62–72%, Bozsko 1985).

Reference to the literature shows the densities reported in this study to be typical for such environments in Poland (Górski 1982, Górski & Górski 1979, Luniak 1983, Nowicki 1992). There was also marked interdependence between the size of an area and its ecological character. The densities reported from Bronowicki Park (PB), the Saski Garden (OS) and the Kalinowszczyzna Cemetery (CK) are amongst the highest reported from cities (Bozsko & Papp 1980, Gnielka 1981, Górski 1982, Luniak 1983, Mizera 1988, Ravussin & Mellina 1979, Tomiałojć & Profus 1977). However, as the likes of Mizera (1988) have emphasised

zed, there is a certain likelihood that results from small areas (such as PB and CK) may be overestimated.

High nesting densities were reached by many of the species making up the core avifauna of Lublin's urban green space. This was particularly the case with *Streptopelia decaocto*, which has only been found at higher densities in Słupsk (Górski 1982). Similarly, at up to 29.6 pairs per 10 ha, the reported densities of *Carduelis chloris* were the highest noted for European cities (Mroczkiewicz 1962, Tomiałojć 1970). Very much characteristic of the areas of Lublin studied was the high level of representation of *Hippolais icterina*, *Turdus pilaris* and *Acrocephalus palustris*, which are rare in cities, if they occur at all (Bozsko 1985, Górski 1982, Luniak 1990, Ptaszyk 1991). *Pica pica* and *Phylloscopus collybita* are common throughout the city and their populations are stable: a fact confirmed in subsequent work by the author. Finally, the expansion of *Columba palumbus* in the largest areas is also worthy of note.

Species nesting in trees, and in bushes at heights of over 1.5 m, were dominant in breeding populations. Partly underlying this were the exceptionally high densities of *Streptopelia decaocto*, which (with the exception of LC) constituted 8.3–36.5% of breeding groupings and which run counter to statements concerning the avoidance by this species of larger areas of trees (see Brożek 1978, Graczyk & Chewiński 1966). The considerable representation of *Streptopelia decaocto* in the breeding population may explain similar results obtained by Czyż & Królikowski (1990) in studies on the birds of Częstochowa's city centre parks, and by Górski (1982) for the avifauna of a similar park in Słupsk. In general, it would seem that a high percentage representation of tree-nesting birds is particularly characteristic of the breeding communities of typical cemeteries (Brożek 1978, Górski 1982, Mroczkiewicz 1975, Nowicki 1983).

In the bird communities studied, the relatively limited representation of hole-nesting species is a reflection of the lack of nest-boxes (except in PA) and of the general scarcity of other breeding places for members of this ecological group. Only areas OS and OB were different in this respect. In several other areas, the more marked presence of hole-nesting birds was mainly the result of nesting in lamps (in PL) or in the nooks and crevices of buildings (in CU and CM). As a consequence, no confirmation is given to statements by Luniak (1983) and Mizera (1988) concerning the

decisive role of hole-nesting birds in the breeding community.

Populations in three areas (OS, LC and CM) had a relatively greater proportion of birds building nests on the ground or in low bushes. In all probability this resulted from the peripheral locations of these areas, the relatively limited presence of man and the rather rich undergrowth. In this regard, the Botanic Garden (OB) is a particular illustration as only in the City Park in Pruszków has a higher number of species from this group been observed (Truszkowski 1963). The same number of such species has been noted on one other occasion – by Tomiałojć (1970) in a cemetery on the periphery of Legnica.

At this point, it is perhaps important to note the difficulties experienced in producing an unequivocal classification of species into the three ecological groups discussed. This is particularly the case when consideration is given to the breeding plasticity of species such as *Erithacus rubecula*, *Muscicapa striata*, *Turdus merula* or *Corvus monedula*. Górski (1982) and Tomiałojć (1970) are among those who have drawn attention to these problems.

Comparison with the old data from Riabinin (1959) reveals that many breeding species have appeared in Lublin. In the years 1951–1956, the city's urban green space is reported to have had around 40 breeding species. *Lanius collurio*, *Parus palustris*, *Cuculus canorus* and *Streptopelia turtur* are among those breeding then but not reported to do so at present. In contrast, ten to twenty new species have been reported after thirty years. These include dominants, such as *Turdus pilaris*, *T. merula* and *Pica pica*, as well as *Dendrocopos syriacus* – which has also appeared as its geographical range continues to extend northwards (Ciosek & Tomiałojć 1982). Considerable increases in population are indicated for *Streptopelia decaocto* and *Columba palumbus*. Overall, these changes reflect the continuing synurbization of birds – a phenomenon typical of European cities (Górski 1982, Luniak 1981, 1990).

The breeding avifauna of Lublin's urban green areas is typical in terms of its species composition, but stands out against other Polish cities when it comes to species richness, and the clearly-marked presence of birds that are rare elsewhere. In addition, comparison with past years attests to the synurbization and increase of many other species.

CONCLUSIONS

1. The avifauna of Lublin's parks and cemeteries was found to include fifty breeding species – a fact distinguishing it from other cities where species richness is concerned.
2. The densities of breeding pairs were typical of habitats of this type, or were in some cases, amongst the highest reported in Poland.
3. High densities of *Streptopelia decaocto* and *Hippolais icterina* were characteristic of the breeding species of the areas studied.
4. Breeding communities in Lublin's parks and cemeteries had a predominance of birds which nested in trees and bushes. In comparison to other cities, hole-nesting birds were poorly-represented.
5. The research attested to the synurbization of a large number of species, and to a clear increase in the populations of many others in the last several decades. On the other hand, *Lanius collurio*, *Parus palustris*, *Cuculus canorus* and *Streptopelia turtur* are no longer listed as breeding species.

Translated from Polish by dr. James Richards.

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STRESZCZENIE

[Awifauna lęgowa parków i cmentarzy Lublina]

Praca przedstawia wyniki kilkuletnich liczeń awifauny lęgowej prowadzonych na cmentarzach i we wszystkich ważniejszych parkach Lublina. Łączny obszar objęty badaniami wyniósł 123.5 ha. Rozmieszczenie i charakterystykę badanych powierzchni przedstawiono na ryc. 1 i w tabeli 1.

W badaniach stosowano kombinowaną odmianę metody kartograficznej (Tomiałojć 1980a, 1980b) uzupełniając ją własnymi modyfikacjami.

W przypadku gatunków o dużym zagęszczeniu bądź specyficznej biologii starano się zlokalizować wszystkie gniazda. Liczenia (10–13 w każdym sezonie lęgowym) prowadzono we wczesnych godzinach rannych. Ich tempo wynosiło średnio ok. 100 min/10 ha. Podobieństwo składu gatunkowego i dominacji ilościowej poszczególnych zespołów oceniano wykorzystując wskaźniki Sorensena (QS) i Renkonena (Re) w wersji zastosowanej przez Głowacińskiego (1975).

W trakcie liczeń stwierdzono na badanych terenach łącznie 50 gatunków lęgowych (tab. 2–5). Ich ilość na poszczególnych powierzchniach wahała się od 17 (LC) do 39 (OB). Dalsze 43 gatunki obserwowane w sezonie lęgowym zaliczono do przelotnych lub zalatujących. 23 gatunki wystąpiły na poszczególnych powierzchniach w charakterze dominantów. Cztery z nich – *Streptopelia decaocto*, *Sturnus vulgaris*, *Hippolais icterina* i *Carduelis chloris* – znalazły się wśród nich co najmniej pięciokrotnie. Na wszystkich terenach gniazdowały *Columba palumbus*, *Pica pica*, *Oriolus oriolus*, *Parus major* i *Fringilla coelebs*.

Pięć i więcej razy odnotowano w składzie zespołów lęgowych obecność kolejnych 20 gatunków. Zagęszczenie par lęgowych wahało się od wartości 46.5 na peryferyjnie położonym cmentarzu (CM) do 238.5/10 ha w najmniejszym z badanych – Parku Bro-

nowickim (PB). Najwyższe zagęszczenie par lęgowych odnotowano dla *Streptopelia decaocto*.

Uwagę zwraca znaczący udział w badanych zespołach *Hippolais icterina*, *Phylloscopus collybita*, *Carduelis carduelis* i *Oriolus oriolus*. Bardzo wysoką liczebność na niektórych powierzchniach osiągnęły *Carduelis chloris*, *Turdus merula* i *T. pilaris* (tab. 6).

Wskaźniki QS i Re obliczone dla tych samych powierzchni w różnych latach badań wykazały znaczną stabilność populacji lęgowych. Porównania zespołów lęgowych poszczególnych terenów ujawniły, że na pięciu z nich (PB, OS, CK, CU i CL) występują identyczne pod względem składu gatunkowego ugrupowania. Jeśli chodzi o charakter dominacji ilościowej, najbardziej typowa okazała się awifauna Parku Akademickiego (w 7 porównaniach na 9 wskaźnik Renkonena przekroczył 50%). Awifauna badanych terenów w przeszło połowie składała się z ptaków wijących gniazda w koronach drzew i krzewów na wysokości ponad 1.5 m. (16 gat., 54% par lęgowych). Dziuplaki, do których zaliczono 15 gatunków, stanowiły zaledwie 30% populacji. Ptaki gniazdujące na ziemi i krzewach do wys. 1.5 m reprezentowane były natomiast aż przez 19 gatunków, których udział w populacji lęgowej wyniósł średnio 16%.

Na tle innych miast polskich awifauna lęgowa zieleni miejskiej Lublina wyróżnia się bogactwem gatunków. Dotyczy to nawet najmniejszych badanych powierzchni (PB, CK), gdzie odnotowano ilość gatunków wyraźnie przekraczającą górny pułap podawanych przez Luniaka (1983) dla tego typu środowisk. QS wykazał identyczność (81%) ugrupowań lęgowych Lublina i Warszawy (Nowicki 1992) i wyraźne podobieństwo do badanej awifauny Poznania (wg Mizery 1988), Łodzi (Tranda *et al.* 1983) i Torunia (Strawiński 1963, Zalewski i Przystalski 1993).

Zagęszczenie odnotowane na badanych powierzchniach jest typowe dla tego typu środowisk w Polsce. Wartości odnotowane dla PB, OS i CK plasują się w grupie najwyższych notowanych dla miast (Luniak 1983). Wiele gatunków, m.in. *Streptopelia decaocto*, *Carduelis chloris*, *Hippolais icterina* i *Turdus pilaris*, tworzących trzon awifauny zieleni miejskiej Lublina osiągnęło wysokie zagęszczenie. Miało to decydujący wpływ na znaczny udział w badanych zespołach gatunków gniazdujących na drzewach i krzewach powyżej 1.5 m. Nie znalazł więc potwierdzenia podkreślany przez Luniaka (1983) i Mizere (1988) decydu-

jący wpływ udziału dziuplaków w zespołach lęgowych zasiedlających zielen miejską. W porównaniu z dawnymi danymi Riabinina (1959) wykazano synurbizację kilku gatunków, np. *Turdus merula*, *T. pilaris*, *Pica pica* i *Dendrocopos syriacus*, oraz wzrost liczebności wielu innych – m.in. *Streptopelia decaocto* i *Columba*

palumbus. Z listy gatunków lęgowych zniknęły natomiast *Lanius collurio*, *Parus palustris*, *Cuculus canorus* i *Streptopelia turtur*.

Redaktor pracy: prof. Maciej Luniak

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