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THE SHARE OF XEROTHERMIC SPECIES IN VASCULAR FLORA OF THE CITY OF LUBLIN (POLAND)

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A b s t r a c t

The purpose of this study is to present the distribution and characteristics of xerothermic flora located within Lublin (51º08'-51º18'N and 22º27'-22º41E). The data on this flora have been derived from the literature and herbarium collections as well as they were collected during field research conducted in 2002-2009.

Family affiliation, life forms, geographical-historical groups, the degree of synanthropization of species and habitat, categories of threat are discussed in this paper. 107 xerothermic species belonging to 26 families and 70 genera were reported from the area of Lublin. The number constitutes 10% of the city's flora. The most numerous are plants from the classes *Festuco-Brometea* (70 species), *Trifolio-Geranietea sanguinei* (21) and *Rhamno-Prunetea* (16). All extinct species (8) belong to the class *Festuco-Brometea*. The analysis of the spectrum of life forms indicates that the biggest share in the flora of Lublin was observed in the group of hemicryptophytes (57 species) and phanerophytes (14). The native species (103) dominate over the group of alien ones (4 species). The group of xerothermic plants comprises 21 legally protected and endangered species. Xerothermic plants exhibit a mosaic distribution in the area of Lublin. The frequency (measured as the presence of a species in a study unit, one ATPOL square) ranged from 1 to 44 species. Two main features of the analyzed area seemed to be responsible for species distribution: the value of the Real Hemeroby Index (RIH) and the history of the flora.

Key words: xerothermic flora, urban flora, anthropopressure, Lublin city, eastern Poland

INTRODUCTION

A big city is an unusual phenomenon of culture, sociology, and economics, but also of flora and vegetation. The plant cover of a city is related to ecological and historical human activity. The flora of urban areas consist of two groups of species: hemerophobes – native or permanently naturalized alien species which are withdrawing from the given area under the influence of human activity, and hemerophiles – native species and a great part of archaeophytes and kenophytes spreading under the influence of human's activity showing permanent apophytic tendencies (J a c k o w i a k, 1990).

So far, data on xerothermic plants in Lublin and in the macroregion surrounding Lublin have been mainly published by F i j a ł k o w s k i (1954), F i j a ł k o w s k i and I z d e b s k i (1957) and I z d e b s k i (1958). The papers mentioned above describe stands of xerothermic plants in the NE part of Lublin (Rudnik district). The xerothermic patches investigated were classified into three syntaxa: the associations *Carex humilis-Inula ensifolia* and *Festuca vallesiaca-Erysimim crepidifolium* from the class *Festuco-Brometea*, and *Prunetum fruticosae* communities. The authors recorded 57 xerothermic species in the area of Rudnik. They emphasize a large admixture (14 species) of forest species from the class *Querco-Fagetea* in the shrub community with *Cerasus fruticosa*, which may indicate progressing succession. The communities were reported from steep slopes of loess gullies and the Bystrzyca River valley. The communities with *Carex humilis* and *Festuca vallesiaca* were found on slopes with a southerly aspect, whereas the shrub communities were found on the flat tops of the loess plateaus and slopes with a northern exposure. The analysis of the edaphic conditions demonstrated that both communities occured on $CaCO_3$-rich loess soils. The stands of xerothermic species and vegetation in Lublin city are usually found on loose loam calcareous soils rich in $CaCO_3$ (D e n i s o w et al. 2008).

Investigations of the flora and vascular plant communities of railway areas in the western part of the Lublin Upland (W r z e s i e ń and Ś w i ę s , 2006) showed that these areas are substitute habitats for xerothermic vegetation. The xerothermic flora comprised 54 species, including 27 from the class *Festuco--Brometea*, 13 from *Rhamno-Prunetea*, and 14 from the class *Trfolio-Geranietea sanguinei*. The authors described 11 xerothermic communities within the railway infrastructure of Lublin (railway stations, rails, embankments, rail edges); 4 communities were classified as *Festuco-Brometea*, 6 as *Trifolio-Geranietea sanguinei*, and 1 as the class *Rhamno-Prunetea*.

The aim of the study was to evaluate the role and share of the group of xerothermic species in the contemporary flora of the city of Lublin. The more specific goals can be formulated in the following way:

Analysis of the current spatial distribution of xerothermic species in the territory of Lublin.

Compilation of features of the investigated plant group (habitat preferences, geographical-historical status, life forms, response to the environmental changes in the Lublin area).

Comparison of the present share of this group of plants with the historical data.

MATERIALS AND METHODS

The characteristics of the study area

The city of Lublin, Poland, in its present administrative boundaries covers the area of 148 km^2 and is situated between 51°08' – 51°18' N and 22°27' – 22°41' E, having a population of 300,000 permanent residents. It is the capital of the Lublin province (S t o c h l a k , 1999). The city is located in the central-northern part of the macroregion of Lublin (Lublin-Lviv) Upland on the border of four macroregions: Nałęczów Plateau, Bełżyce Plain, Świdnik Plateau and Giełczewska Elevation (K o n d r a c k i , 2009) (Fig. 1.).

Fig. 1. Map of the city of Lublin, Poland, against the background of ATPOL grid (1 km x 1 km): 1 – administrative city boundaries; 2 – boundaries of physico-geographical macroregions of Lublin Upland: I – Nałęczów Plateau, II – Świdnik Plateau; III – Giełczewska Elevation, IV – Bełżyce Plain; 3 – rivers and water bodies; 4 – square of ATPOL grid (1km x 1km); some Quaternary sediments: 5 – loess cover; 6 – loess-like and clay covers.

The city of Lublin is characterized by fairly specific climatic properties (Zinkiewicz and Warakomski, 1959; Kaszewski et al. 1995). The average annual air temperature is 7.9°C. The coldest month is January and the warmest one July, with their average air temperatures of 3.6°C and 18.6°C, respectively. The average annual precipitation is 556 mm. The highest amount of precipitation is recorded in July (ca. 77.0 mm), the lowest one in January (ca. 29.6 mm). The average annual insolation is 4.5 hours per day. Snow cover persists for 60-80 days per year. The average growing season in the Lublin area lasts 209 days (Stochlak, 1999).

Within the area of Lublin, the basic Quaternary substratum is composed of loess and loess-like and clay covers (Chałubińska and Wilgat, 1954). The former sediments predominate in the western part and the latter ones in the southern part of the city. The borderland between these covers is the Bystrzyca river valley in the general outline (Maruszczak, 1958; Harasimiuk and Henkiel, 1982).

Different soil types are found within the Lublin area (Turski et al. 1993). The prevalent types are clay-dusty and sandy-dusty brown and grey-brown soils. In the valleys of the river system, there is a mosaic of alluvial and black soils, sporadically marshy and peat soils. The soils within Lublin's densely built-up areas are usually highly anthropogenically degraded soils in respect of their physical and chemical properties. Most often these are soils of urban and industrial type with a different degree of pollution and contamination (Kukier, 1985; Turski et al. 1993). Highly productive soils of anthropogenic type predominate in the arable land widespread around the city's central part.

METHODS

The survey was carried out during the 2002-2008 growing seasons in Lublin city and its results were compared to historical literature data (Karo, 1883; Koporska, 1929; Fijałkowski, 1954, 1960, 1967; Święs and Wrzesień, 2002, 2003, 2004; Balana et. al. 2006; Rysiak, 2009; 2009a; Rysiak, et al. 2008, 2008a). The floristic material comprised data obtained during the present field study, from literature searches, and data from herbarium collections. Observations of the entire flora were made during the peak growing season. Species belonging to the classes *Festuco-Brometea, Trifolio-Geranietea sanguinei, Rhamno-Prunetea* and lower syntaxa of these classes (Matuszkiewicz, 2008) as well as species which find the optimum of their distribution in xerothermic communities (Zarzycki et al. 2002) were regarded as xerothermic species.

Habitat conditions and scale of species hemeroby were evaluated during the field research. Special attention was paid to the land use in the area (Table 1.). Regarding the scope and intensity of anthropopressure, it is divided into 4 degrees of hemeroby (Sukopp, 1972). The degree of hemeroby of a species was described on the basis of frequency of its occurrence and the value of RHI (Real Hemeroby Index) proposed by (Jackowiak, 1998), according to the following formula:

$$\text{RIH} = \text{(eu+poly species)} - \text{(oli+meso species)} \; / \boldsymbol{\Sigma} \text{ species in the study area}$$

Table 1.
Scale of hemeroby by Sukopp (1972), changed

Degree of hemeroby	Definition	Occurrence in the study area
oligohemerobic [oli I]	Little anthropogenic influence takes place, actual vegetation corresponds with natural vegetation	The best preserved patches of forests, meadows, xerothermic grasslands and water biotopes.
mesohemerobic [meso II]	Anthropogenic factors take place in a low to moderate degree. Semi-natural vegetation.	Biotopes of utilized forests, bushes, meadows pastures, grasslands, most of water and aquatic habitats.
euhemerobic [eu III]	Anthropogenic factors act constantly to a high degree. Ruderal and segetal plants, transformed semi-natural communities.	Field and garden habitats, fallow grounds, flower-beds, waste lands.
polyhemerobic [poly IV]	Influence of anthropogenic factors is constant and very strong. Vegetation has a high degree of specialization and pioneer character.	Inter-track spaces, railway areas, dumping sites hardened with gravel squares and roadsides, next to walls and slits in walls, sediment traps.

The species are listed in alphabetical order (Table 2) and their nomenclature follows Mirek et al. (2002). The description of each taxon includes its threat category after Mirek et al. (2006) for Poland and after Kucharczyk (2003) for the Lublin region. The categories of species protection are listed (Regulation… 2004). The affiliation of grassland species to individual ecological and geographical elements was determined according to Zając and Zając (1992) as well as Zając and Tokarska-Guzik, (1998), while life forms according to Z a r z y c k i et al. (2002).

The distribution of species was recorded using a grid of 1 x 1 km squares. These basic units were arranged in accordance with the ATPOL grid (Z a j ą c , 1978). The studied area covering the city of Lublin within its administrative boundaries consists of 4 “large” 10 x 10 km squares of the ATPOL grid and 188 squares of 1 x 1 km. 117 of them fit entirely in the area of Lublin and 66 are boundary squares (Fig. 1). The occurrence of a species in a square was regarded as its locality. To illustrate their frequencies of occurrence, the species were arranged in a series following frequency classes. Individual classes were identified relative to the total number of cartogram fields (Table 3).

RESULTS

107 xerothermic species belonging to 26 families and 70 genera were reported from the area of Lublin. The number constitutes 10% of the city’s flora. In turn, xerothermic species in other Polish cities constitute 5% in Warsaw (S u d n i k - W ó j c i k o w s k a , 1987), 7% (69 species) in Poznań (J a c k o w i a k , 1998), 6% in Łódź (W i t o s ł a w s k i , 2006) and 12.5% in Bydgoszcz (K o r c z y ń s k i , 2010).

The class *Festuco-Brometea* is represented in Lublin by 70 species, whereas *Rhamno-Prunetea* and *Trifolio-Geranietea sanguinei* are represented by 16 and 21 species, respectively. The field study did not verify the localities of 8 species. The alphabetical list of the xerothermic flora, including data sources and information about the threat and protection category, are included in Table 2. The analysis of the spectrum of life forms indicates that the groups of hemicryptophytes (57 species) and phanerophytes (14 species) have the largest share in the flora of Lublin, while among the historical-geographical groups, native species (103) are predominant over antropophytes (4 species). The most interesting group of xerothermic plants comprises 21 species, including 6 legally protected and 15 endangered species at the regional and national level.

Table 2.
Alphabetical list of xerothermic species of vascular plants in Lublin, Poland

A	B	C		D	E (%)				F	G	H
	Cl. *FESTUCO-BROMETEA*	**P**	**H**		**I**	**II**	**III**	**IV**			
1	*Achillea pannonica*	+	.	+	28.6	50	14.3	7.1	.	V	V
2	*Acinos arvensis*	+	.	+	22.6	0	16.1	48.4	I		
3	*Adonis vernalis*	+	.	+	100	0	0	0	I	V	V, TP
4	*Agrimonia eupatoria*	+	.	+	22.2	13.1	26.3	38.4	III		
5	*Ajuga genevensis*	.	.	+	22.7	59.1	4,5	13.6	II	CR	CR
6	*Allium oleraceum*	.	.	+	44.8	17.2	20.7	17.2	.		
7	*Anthemis tinctoria*	+	.	+	12.5	0	50	37.5	I		
8	*Anthyllis vulneraria*	+	.	+	2.6	3.2	19.4	54.8	I, IV		
9	*Arabis hirsuta*	+	.	+	33.3	0	25	41.7	I		
10	*Artemisia campestris*	+	.	+	22.2	15.6	17.8	44.4	I		
11	*Asparagus officinalis*	+	.	+	20	21.2	29.4	29.4	I		
12	*Astragalus danicus*	+	.	.	.	.	.	.	I	EN	
13	*Brachypodium pinnatum*	+	.	+	45	20	5	30	I, II		
14	*Bromus inermis*	+	.	+	17.3	15.4	32.7	34.6	I, II, III		
15	*Campanula glomerata*	.	.	+	66.7	0	16.7	16.7	.		
16	*C. sibirica*	+	.	+	50	31.8	9.1	9.1	I		TP
17	*Carex caryophyllea*	.	.	+	66.7	8.3	0	25	.		
18	*C. michelii*	+	.	+	100	0	0	0	.		
19	*C. praecox*	+	.	+	0	0	58.3	41.7	I		V
20	*Carlina vulgaris*	.	.	+	50	50	0	0	.		
21	*Centaurea scabiosa*	+	.	+	7.9	36.8	18,4	36.8	.		
22	*C. stoebe*	.	.	+	14	26	12	48	.		
23	*Cerastium pumilum*	+	.	+	0	0	100	0	I		V
24	*Cirsium acaule*	.	.	+	0	100	0	0	.		

25	*Crepis praemorsa*	+	.	.	.	.	.	.	I, II	V	
26	*Dianthus carthusianorum*	.	.	+	57.9	36.8	0	5.3	I, II		
27	*Elymus hispidus*	+	.	+	14.3	42.9	0	42.9	I, IV		LR
28	*Erigeron acris*	+	.	+	17,1	18.6	38.6	25.7	III, IV		
29	*Euphorbia cyparissias*	+	.	+	23.9	22.2	22.2	31.6	II, III		
30	*Festuca rupicola*	.	.	+	11.1	11.1	22.2	55.6	I		EN
31	*F. trachyphylla*	+	.	+	20	20	40	20	I		
32	*F. valesiaca*	.	.	+	100	0	0	0	.		
33	*Filipendula vulgaris*	+	.	+	40.9	36.4	18.2	4.5	.		
34	*Galium album*	.	.	+	0	0	100	0	.		
35	*Helianthemum nummularium*	+	.	+	0	100	0	0	.		
36	*Hieracium bauhinii*	+	.	+	27.1	18.6	20.3	33.9	.		
37	*Jovibarba sobolifera*	.	.	+	100	0	0	0	.		EN, TP
38	*Koeleria glauca*	.	.	+	100	0	0	0	.		
39	*K. macrantha*	.	.	+	25	37.5	0	37.5	II	V	V
40	*Linum flavum*	+	.	.					.	E	
41	*Myosotis ramosissima*	.	.	+	29.4	23.5	41.2	5.9	I	V	V
42	*Onobrychis viciifolia*	.	.	+	100	0	0	0	.		
43	*Orobanche lutea*	+	.	+	100	0	0	0	III		TP
44	*Phleum phleoides*	+	.	+	100	0	0	0	.		LR
45	*Plantago media*	+	.	+	27.9	13.2	27.9	30.9	II, III		
46	*Poa bulbosa*	.	.	+	0	100	0	0	.	DD	
47	*P. compressa*	.	.	+	18.8	13.4	28.9	38.9	.		
48	*Polygala comosa*	+	.	+	42.9	28.6	0	28.6	.		
49	*Potentilla arenaria*	+	.	+	28	32	22	18	I, II, III		
50	*P. heptaphylla*	+	.	+	20	20	0	60	I, II		
51	*P. recta*	+	.	+	14.3	19	28.6	38.1	.		
52	*Ranunculus bulbosus*	+	.	+	25	26.4	15.3	33.3	.		
53	*Salvia nemorosa*	.	.	+	0	100	0	0	IV	EN	
54	*S. pratensis*	+	.	+	38.6	25	15.9	20.5	I		
55	*S. verticillata*	+	.	+	23.3	23.3	2.9	50.5	I		
56	*Scabiosa ochroleuca*	+	.	+	54.2	8.3	20.8	16.7	I		
57	*Scorzonera purpurea*	+	+	.	.	.	.	.	.	EN	R
58	*Seseli annuum*	+	.	+	0	50	0	50	III		
59	*Silene dichotoma*	+	.	.	.	.	.	.	II		
60	*Stachys germanica*	.	+	.	.	.	.	.	I, II		
61	*S. recta*	+	.	+	37.5	43.8	9.4	9.4	I		
62	*Teucrium chamaedrys*	+	.	+	100	0	0	0	I	C	V
63	*Thalictrum minus*	+	.	+	45.7	23.9	8.7	21.7	I	V	V
64	*T. simplex*	.	.	+	100	0	0	0	.	V	V
65	*Thesium linophyllum*	+	+	.	.	.	.	.	I, III	V	
66	*Verbascum phoeniceum*	.	.	+	50	27.8	16.7	5.6	.		
67	*Veronica austriaca*	.	.	+	44.4	11.1	44.4	0	I, II	V	V
68	*V. spicata*	+	.	+	48.1	18.5	14.8	18.5	I		
69	*Vincetoxicum hirundinaria*	+	.	+	29	29	6.5	35.5	.		
70	*Viola rupestris*	+	+	.	.	.	.	.	I		
	CL. *RHAMNO-PRUNETEA*										
71	*Berberis vulgaris*	.	.	.	32.1	25	14.3	28.6	.		
72	*Cerasus fruticosa*	+	.	+	79.3	17.2	0	34	I, II	CR	V, TP
73	*Clematis vitalba*	+	.	+	6.1	18.2	45.5	30.3	III		

74	*Cornus sanguinea*	.	.	+	27.8	15.2	27.8	29.1	.	
75	*Cotoneaster integerrimus*	.	.	+	0	0	50	50	.	
76	*Crataegus leavigata*	.	.	+	66.7	33.3	0	0	.	
77	*C. monogyna*	.	.	+	27	16.2	27	29.7	.	
78	*C. riphidophylla*	.	.	+	0	100	0	0	.	
79	*Prunus spinosa*	.	.	+	16.1	30.6	17.7	35.5	.	
80	*Rhamnus catharticus*	+	.	+	23.1	53.8	0	23.1	.	
81	*Rosa canina*	+	.	+	31.6	18.4	21.1	28.9	.	
82	*R. dumalis*	.	.	+	33.3	27.8	27.8	11.1	.	
83	*R. glauca*	.	.	+	0	0	100	0	.	
84	*R. rubiginosa*	+	.	+	0	100	0	0	.	
85	*R. spinosissima*	+	.	+	100	0	0	0	.	
86	*R. tomentosa*	.	.	+	0	50	0	50	.	V
	CL. *TRIFOLIO-GERANIETEA SANGUINEI*									
87	*Anemone sylvestris*	.	.	+	40	40	20	0	I	TP
88	*Anthericum ramosum*	+	.	+	60	0	20	20	.	
89	*Astragalus cicer*	+	.	+	10.6	13.6	36.4	39.4	I, IV	
90	*A. glycyphyllos*	+	.	+	14.9	17.9	32.8	34.3	.	
91	*Campanula bononiensis*	+	.	+	69.2	7.7	0	23.1	.	TP
92	*C. rapunculoides*	.	.	+	27	19.1	27.8	26.1	.	
93	*Clematis recta*	.	.	+	0	50	25	25	.	
94	*Clinopodium vulgare*	.	.	+	41.7	23.3	10	25	.	
95	*Coronilla varia*	.	.	+	14.5	24.2	22.6	38.7	.	
96	*Fragaria viridis*	.	.	+	100	0	0	0	I	
97	*Galium verum*	+	.	+	19	15.5	32.1	33.3	I, III	
98	*Geranium sanguineum*	.	.	+	50	15	20	15	III	
99	*Lathyrus sylvestris*	+	.	+	47.8	8.7	8.7	34.8	.	
100	*Medicago falcata*	.	.	+	25.3	14.1	26.3	34.3	.	
101	*Origanum vulgare*	+	.	+	38.3	8.3	15	38.3	I, III	
102	*Silene nutans*	+	.	+	50	50	0	0	.	
103	*Trifolium alpestre*	.	.	+	45.5	18.2	18.2	18.2	.	
104	*T. medium*	+	.	+	25.3	14.3	29.7	30.8	.	
105	*Veronica teucrium*	+	.	+	71.4	28.6	0	0	.	
106	*Vicia tenuifolia*	.	.	+	0	0	42.9	57.1	.	
107	*Viola hirta*	.	.	+	100	0	0	0	.	

Explanations: **A** – number; **B** – species; **C** – historical data (**P –** papers, **H –** herbarium); **D** – current data; **E** – percentage share according to the degree of habitat hemeroby for the recorded flora (for abbreviations see Tab. 1), **F** – degree of hemeroby in historical records (for abbreviations see Tab. 1); **G** – local "Red list"; **H** – national "Red List" and legal protection of species: EN– endangered species, CR – critically endangered species, DD – data deficient species, LR – lower risk species, TP – total legal protection, V – vulnerable species.

Xerothermic plants exhibit a mosaic distribution in the area of Lublin. They occur in nearly all the study units, although with varied density (Figs 2-4). The highest share within the city area was recorded for the representatives of the class *Festuco-Brometea*, which were noted in 154 study units covering 82% of the study area. Large concentrations of representatives of this class comprising 13-30 species were recorded in as many as 34 squares, while in the other squares there were from 1 to 6 species. Plants from the classes *Rhamno-Prunetea* and *Trifolio-Geranietea sanguinei* were found in 112 (60%) and 135 (72%) study units, respectively. The lowest quantitative and qualitative proportion in the xerothermic flora of Lublin was observed among the species in the *Rhamno-Prunetea* class. They did not form dense clusters and only 5-6 species were found in 4 study units. Compared to the aforementioned plants, the representatives of the class *Trifolio-Geranietea sanguinei* exhibited a medium quantitative and qualitative proportion. Their localities containing 9-12 species were only recorded in 15 ATPOL squares.

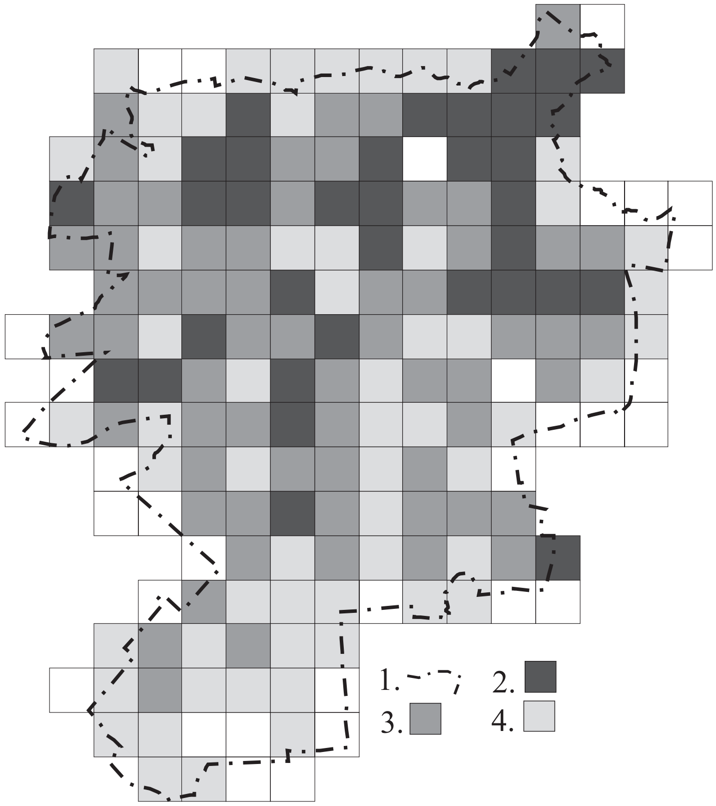

Fig. 2. Distribution of the species from the *Festuco-Brometea* class within the area of Lublin, Poland: 1 – city limits; 2 – 13-30 species in the square; 3 – 6-12 species in the square; 4 – 1-5 species in the square.

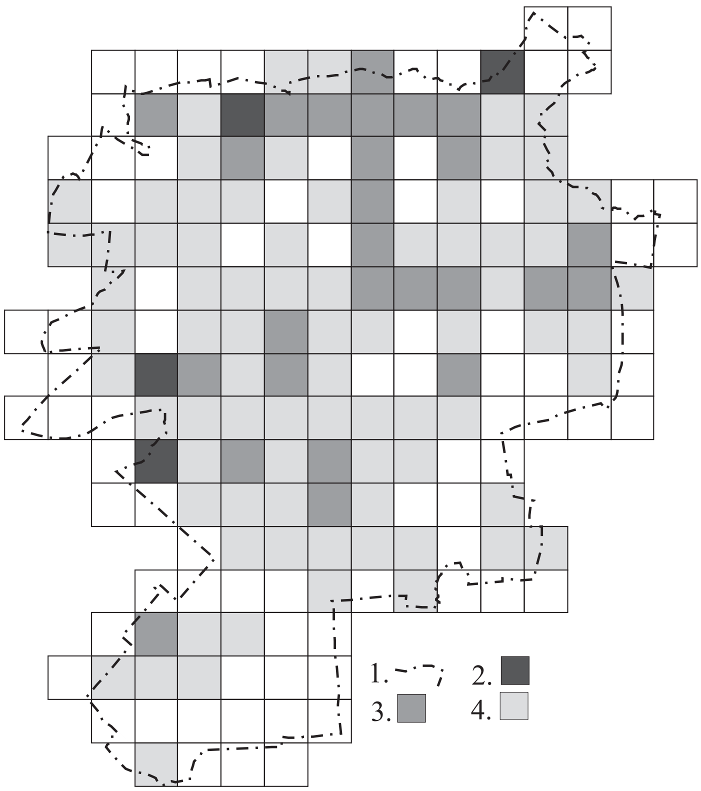

Fig. 3. Distribution of species from the *Rhamno-Prunetea* class within the area of Lublin, Poland: 1 – city limits; 2 – 5-6 species in the square; 3 – 3-4 species in the square; 4 – 1-2 species in the square.

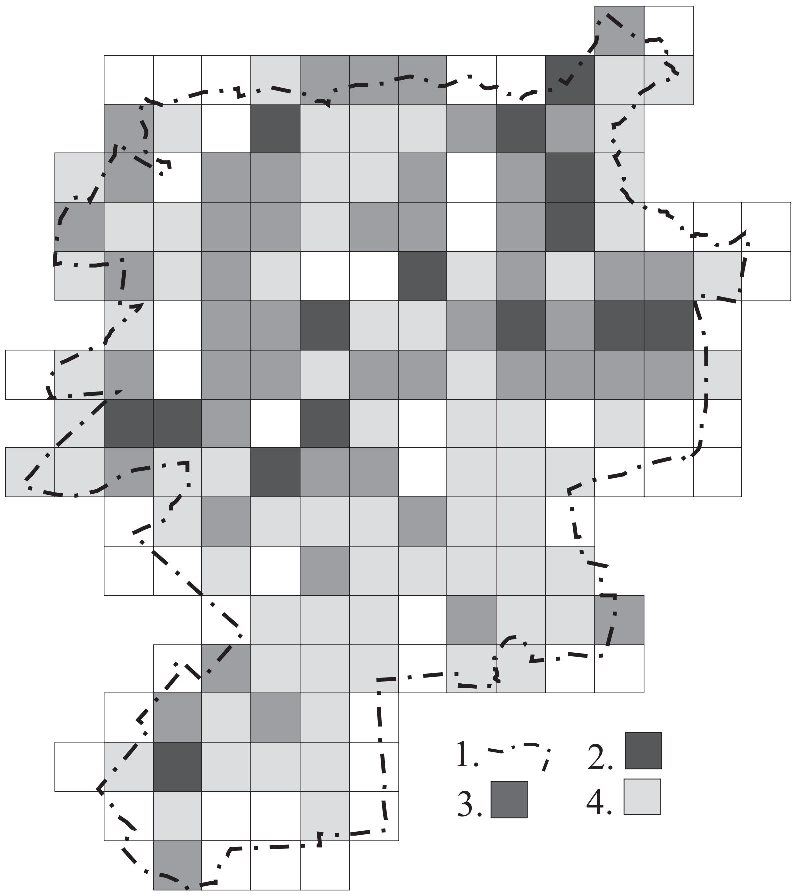

Fig. 4. Distribution of species from the *Trifolio-Geranietea sanguinei* class within the area of Lublin, Poland: 1 – city limits; 2 – 9-12 species in the square; 3 – 5-8 species in the square; 4 – 1-4 species in the square.

The frequency (measured as the presence of a species in a study unit, one ATPOL square) ranged from 1 to 44 species within the study area. The proportion of squares with the presence of the analyzed species varied among the different habitats in the Lublin area. Two main features of the analyzed area seemed to be responsible for species distribution: the value of the Real Hemeroby Index (RIH) and the history of the flora. Grassland species were much more abundant in the NE and N districts of the Lublin city area. They are concentrated mainly in places close to sources of propagules, which are located in the patches of grasslands characterised in the historical papers. The main factor which slows down the process of colonization and distribution in the studied area is the increasing Real Hemeroby Index (RIH) (Fig. 5). The value of RIH in Lublin on the ATPOL grid varied between 0.11 and 0.48. Xerothermic species were less frequent in the squares with maximum values of RIH.

A large group of xerothermic species (more than 60%) at present consists of very rare and rare species in the Lublin city area (Table 3). As few as 6 species can be regarded as wide-spread and very common. These are: *Verbascum phlomoides* (185 localities), *Bromus inermis* (172), *Plantago media* (141), *Medicago falcata* (139) *Coronilla varia* (122), and *Asparagus officinalis* (98 localities).

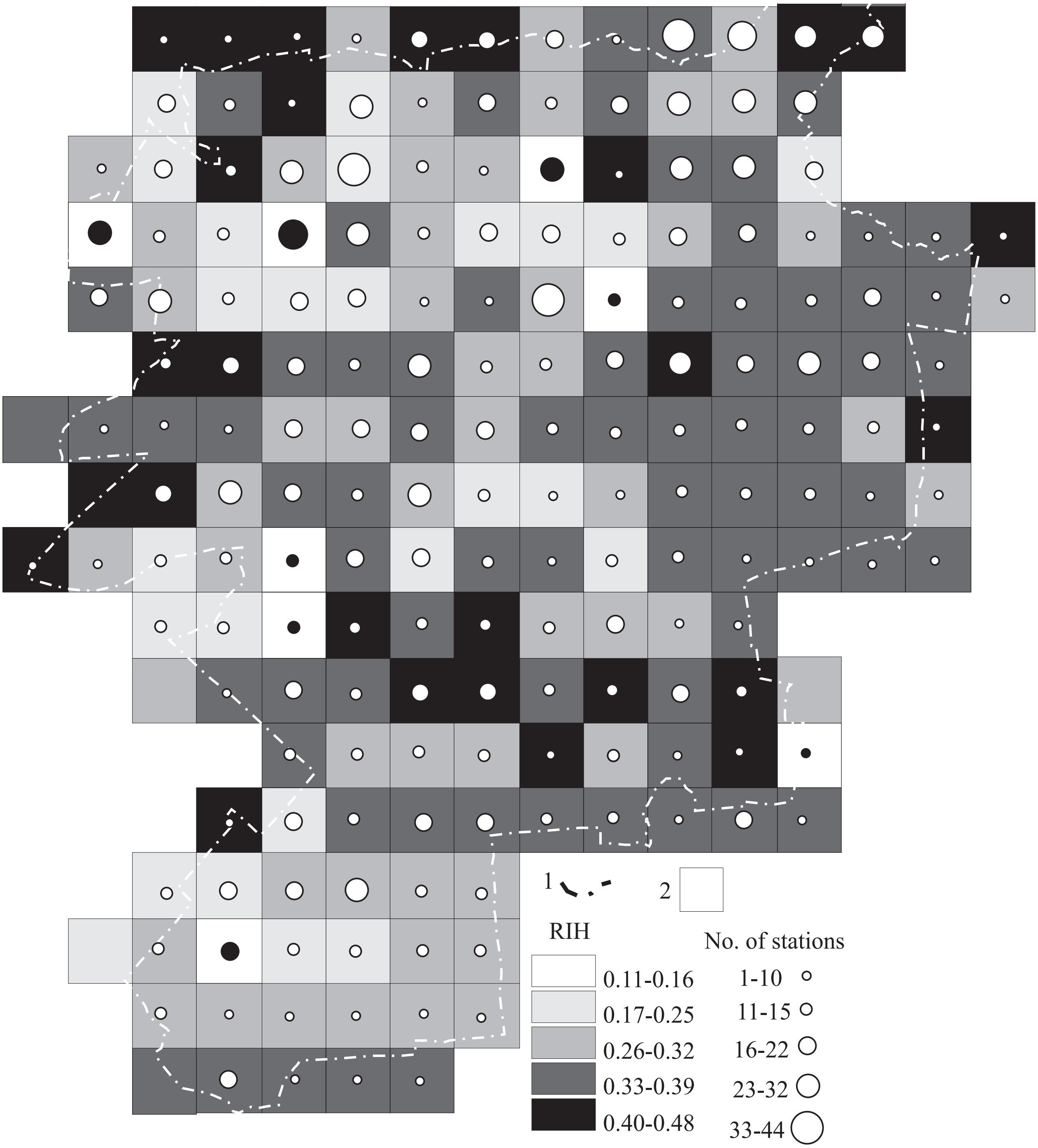

Fig. 5. Distribution of xerothermic species in the area of Lublin on the ATPOL grid square and RIH values: 1 –city limits; 2 – ATPOL grid square (1km x 1km).

In some cases, anthropogenic habitats are the important sites of those species. For example, *Carex praecox, Campanula sibirica, C. bononiensis, Elymus hispidus, Festuca rupicola* and other (Fig. 6) occurred in olygo- and meso- and polyhemerobic habitats. For some other species, anthropogenic habitats have a significant share in habitat spectrum, e.g. *Agrimonia eupatoria*, *Anthemis tinctoria*, *Arenaria serpyllifolia*, *Arabis hirsuta*, *Astragalus cicer* (Fig. 7).

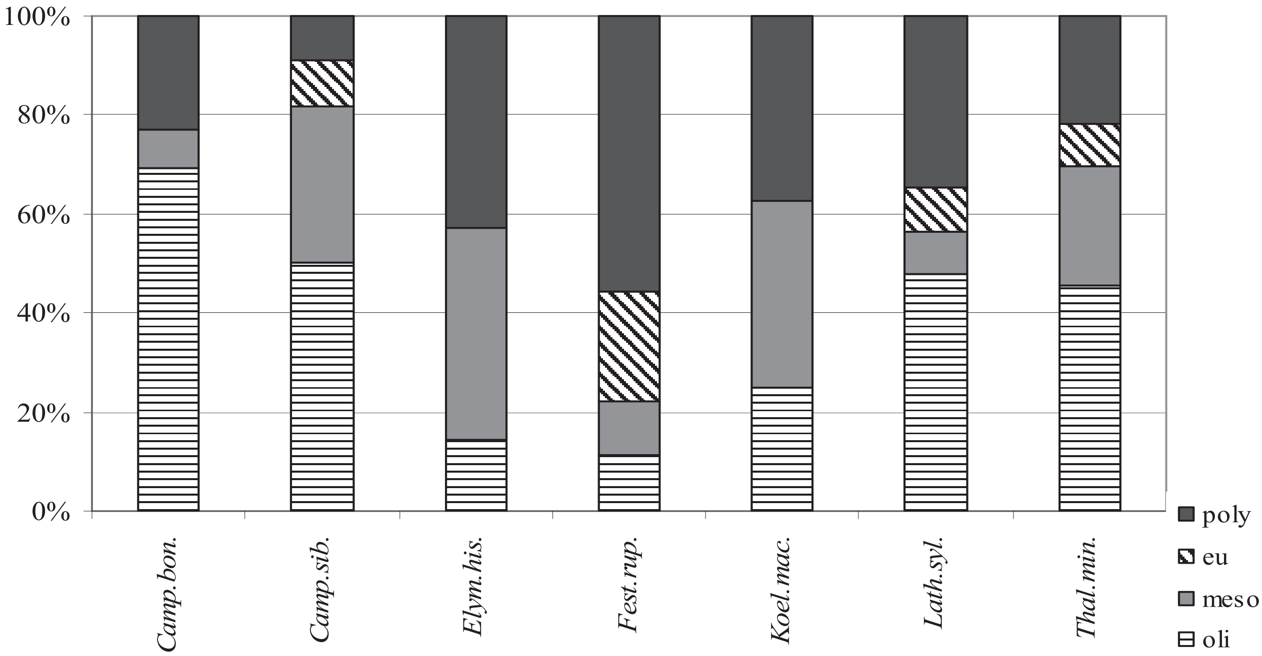

Fig. 6. Share of protected xerothermic species in habitats of different degrees of hemeroby (for explanation of abbreviations see Table 1). *Camp.bon.–Campanula bononiensis, Camp.sib.–Campanula sibirica, Elym.his.–Elymus hispidus, Fest.rup.–Festuca rupicola*, *Koel.mac.–Koeleria macrantha, Lath.syl.–Lathyrus sylvestris, Thal.min.–Thalictrum minus.*

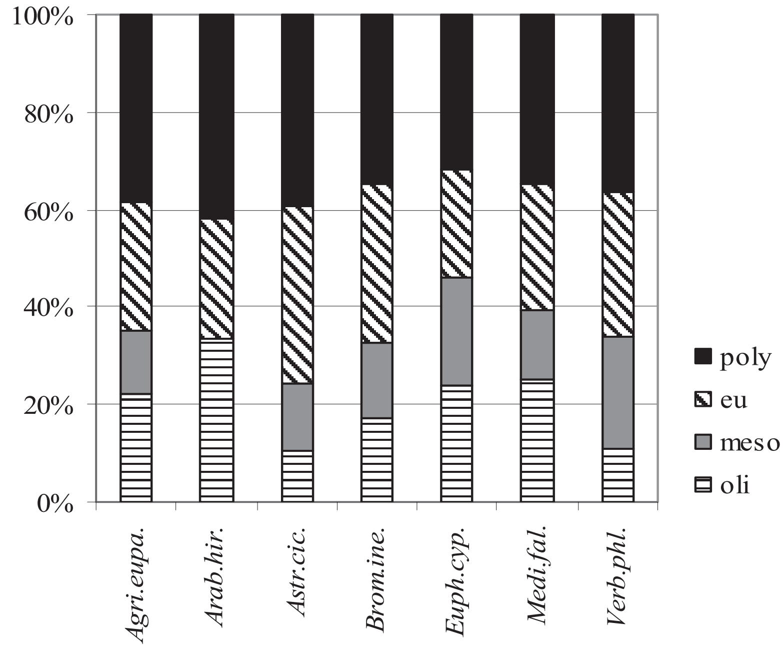

Fig. 7. Share of common xerothermic species in habitats of different degrees of hemeroby (for explanation of abbreviations see Table 1). *Agri.eupa.–Agrimonia eupatoria*, *Arab.hir.–Arabis hirsuta*, *Astr.cic.–Astragalus cicer*, *Brom.ine.–Bormus inermis*, *Euph.cyp.–Euphorbia cyparisias*, *Medi.fal.–Medicago falcata*, *Verb.pho.–Verbascyum phoeniceum.*

Table 3.
Frequency of xerothermic plant species occurring in the area of Lublin city

Frequency	Frequency class	% of cartogram fields	No. of localities	No. of species	Share (%)
Not found (extinct)	–	0	0	8	7.6
Very rare	I	0.1-4.0	1-7	29	27.6
Rare	II	4.1-12.0	8-22	36	34.3
Frequent	III	12.1-25.0	23-47	13	12.4
Common	IV	25.1-50.0	48-94	13	12.4
Very common	V	50.1-75.0	95-140	3	2.8
Abundant	VI	75.1-100.0	141-188	3	2.8

DISCUSSION

The uneven distribution of the xerothermic species reported for the particular phytosociological classes may have a diverse background. Grassland species with a broader ecological spectrum spread from the "centres" of their occurrence in the city towards anthropogenic substitute habitats: railways, road edges and embankments, loess slopes, and lawns. The most interesting patches of xerothermic vegetation within Lublin are located in Rudnik, where they were already described in the 50's of the 20th century (Fijałkowski, 1954; Izdebski, 1957; Fijałkowski and Izdebski, 1957), as well as in Lipnik (Balana et al. 2006) and in "Górki Czechowskie" (Balana et al. 2004). The shrub vegetation in the Lublin area is merely the remnant of midfield shelterbelts or fringe communities. Its insignificant share in the Lublin flora results from the lack of suitable habitats, which have been converted into cultivation areas or arranged greenery.

In comparison to the historical data, the xerothermic flora of Lublin has lost 8 valuable species and the share of the other species has declined substantially. The causes of disappearance of xerothermic vegetation in the Lubelszczyzna region include large-scale mechanized farming, afforestation, and natural succession of trees (Fijałkowski, 1988). Within the city boundaries, the causes include the increasing use of land for housing development, recreation, and transportation.

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Udział gatunków kserotermicznych we florze roślin naczyniowych Lublina, Polska

Streszczenie

Przedmiotem pracy jest prezentacja rozmieszczenia i charakterystyka flory kserotermicznej zlokalizowanej na terenie Lublina w jego granicach administracyjnych.

Dane na temat badanej flory zostały zaczerpnięte z literatury, notowań zielnikowych oraz zebrane podczas badań terenowych prowadzonych w latach 2002-2009. Charakterystyka flory zawiera następujące dane: przynależność do rodziny, formę życiową, skalę synantropizacji gatunku i siedliska, kategorie zagrożenia i ochronę gatunkową. Na terenie Lublina opisano 107 gatunków roślin kserotermicznych należących do 26 rodzin i 70 rodzajów. Stanowi to 10% flory miasta. Najliczniej reprezentowane były taksony z klasy *Festuco-Brometea* (70), liczba gatunków w klasie *Trifolio-Geranietea sanguinei* wynosiła 21, natomiast w *Rhamno-Prunetea* 16. Ośmiu gatunków wcześniej notowanych nie odnaleziono podczas badań terenowych, należały one do klasy *Festuco-Brometea.* W spektrum form życiowych dominują hemikryptofity (57 gatunków) i fanerofity (14), pod względem grup geograficzno-historycznych gatunki rodzime (103) zdecydowanie dominują nad obcymi (4). Wśród gatunków kserotermicznych Lublina opisano 21 roślin chronionych i zagrożonych. Rozmieszczenie gatunków na terenie miasta jest mozaikowe. Frekwencja, mierzona obecnością gatunku w podstawowym polu badawczym, waha się od 1 do 44. Analiza rozmieszczenia i danych historycznych wskazuje dwie przyczyny takiego stanu: zmienna wartość RIH w poszczególnych polach badawczych oraz historia flory danego obszaru. Gatunki kserotermiczne na terenie miasta koncentrują w miejscach najmniej antropogenicznie przekształconych oraz w pobliżu płatów roślinności kserotermicznej opisywanych od początku XX wieku.