SEGETAL FLORA OF THE MIDDLE VISTULA RIVER VALLEY

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Abstract

The objective of the study was to describe the segetal flora of the Middle Vistula River Valley. A total of 367 species were recorded in spring and winter cereals, tuber crops, and stubble fields. Such floristic abundance may be due to the fact that the study area is located in the proximity of a river where semi-natural communities interact directly with communities inhabiting cultivated fields and that fields are fragmented and characterised by different habitats. There were more apophytes (62%) than anthropophytes (38%) in the flora studied. Meadow apophytes were the dominant native species (35%) and archeophytes were the dominant anthropophytes (69%). The analysis of the life spectrum revealed that there were more therophytes (50%) than hemicryptophytes (39%). What is more, non-perennial species constituted 56% and perennials 44% of the segetal flora established in the Middle Vistula River Valley. The large proportion of archeophytes (26%) may indicate that traditional farming predominated in the study area.

Key words: segetal plants, anthropophytes, apophytes, agrocnoses, Middle Vistula River Valley.

INTRODUCTION

Soil and climatic conditions as well as anthropogenic factors affect the flora that establishes in cultivated fields. Changes in the floristic composition and structure of the communities have been observed for many years. Anthropogenic factors have the greatest influence on changes in segetal flora. They include the following: high mineral fertilisation, organic manuring, withdrawal of some plants from cultivation, the application of herbicides, reduced crop rotations, and the introduction of more efficient methods of seed material cleaning. Due to these factors, on the one hand, the area inhabited by specialised components of segetal flora is shrinking and some of them are even disappearing [1–3]; on the other hand, some species are

increasing in number, their ranges are expanding, and they are penetrating new areas and habitats [4,5].

Studies on segetal flora have been conducted in Poland for a very long time. However, there are some regions where no such research has been attempted so far. The Middle Vistula River Valley is an example of such a region and Wójcik [6] is the only author who has reported some data for this area.

DESCRIPTION OF THE STUDY AREA

The Mesoregion of the Middle Vistula River Valley is located in east-central Poland. In physico-geographical terms, it has been classified by Kondracki [7] as a representative of the province of the Middle European Plain, sub-province of the Central Poland Lowlands, and macro-region of the Central Mazovian Lowland.

The Middle Vistula River Valley stretches from the Vistula gorge, runs through the Polish Uplands upstream of Puławy, and terminates at the valley's narrowing in Warsaw. The width of the valley is 10–12 km and its overall area is approximately 1350 km². This section of the Vistula is around 120 km long; the river flows close to the left side of the valley and is quite wide (up to 1 km). According to Woś [8], the Middle Vistula River Valley belongs to two climatic regions: the Central Mazovian Region and the Eastern Lesser Poland Region.

The Middle Vistula River Valley has slightly worse climatic conditions than the adjacent areas. It is located low relative to the riverbed, which, coupled with shallow groundwater table, contributes to higher variations in daily temperatures. Also, air humidity is higher, winds are stronger, and fogs occur on 60 days per year.

The study area is located on two terraces. Fragments of oxbows with many temporarily or permanently flooded hollows are located on the first terrace, whereas

the second terrace is composed mainly of sands with no water flows.

The persistence of groundwater depends on relative heights, geology and water level in the river. In the proximity of the valley, water is present at a depth of 3 to 5 m, whereas in the alluvial terrace groundwater occurs at a depth of 5 to 10 m.

MATERIALS AND METHODS

Fieldwork was carried out from 2003 to 2008 at 117 localities of the Middle Vistula River Valley (Fig. 1). Floristic and phytosociological observations were conducted in cereals, tuber crops, and stubble fields, using the widely approved Braun-Blanquet method; in addition, numerous floristic lists were compiled.

Fig 1. List of localities: 1 – Anielin, 2 – Antoniówka Świerżowska, 3 – Bączki, 4 – Borek, 5 – Borowa, 6 – Bożówka, 7 – Bronowice, 8 – Brzezinka, 9 – Brzeźce, 10 – Cieciszew, 11 – Chinów, 12 – Chmielew, 13 – Cyganówka, 14 – Czernidła, 15 – Dębowola, 16 – Dębówka, 17 – Długowola, 18 – Drahalica, 19 – Dziecinów, 20 – Gassy, 21 – Glinki, 22 – Głusiec, 23 – Gniewosów, 24 – Gołąb, 25 – Goźlin, 26 – Goźlin Górny, 27 – Gruszczycze, 28 – Grzybów, 29 – Holendry Kozienickie, 30 – Janików, 31 – Janów, 32 – Jaroszyn, 33 – Kawęczyn, 34 – Kępa Nadbrzeska, 35 – Kępa Wólczyńska, 36 – Kępice, 37 – Klonowa Wola, 38 – Kłoda, 39 – Kochów, 40 – Kobylnica, 41 – Konary, 42 – Kosumce, 43 – Kowala, 44 – Kozienice, 45 – Kraski Dolne, 46 – Kraski Nowe, 47 – Kurki, 48 – Łęka, 49 – Magnuszew, 50 – Majdan, 51 – Majdany Kozienickie, 52 – Mariańskie Porzeczce, 53 – Marynin, 54 – Mniszew, 55 – Moczydłów, 56 – Mozolice Duże, 57 – Mozolice Małe, 58 – Nadbrzeż, 59 – Nadwiślanka, 60 – Nieciecz, 61 – Opactwo, 62 – Opacz, 63 – Opatkowice, 64 – Ostrołęka, 65 – Ostrów (gm. Maciejowice), 66 – Ostrów (gm. Magnuszew), 67 – Ostrówek (gm. Karczew), 68 – Ostrówek (Warka), 69 – Otwock Wielki, 70 – Paprotnia, 71 – Pawłowice, 72 – Pasternik, 73 – Pęcław, 74 – Pilica, 75 – Piotrowice (gm. Stężycza), 76 – Piotrowice (gm. Karczew), 77 – Piwonin, 78 – Podole Nowe, 79 – Podole Stare, 80 – Podwierzbie, 81 – Potycz, 82 – Prażmów, 83 – Przewóz, 84 – Przewóz Stary, 85 – Przyłot, 86 – Radwanków Szlachecki, 87 – Regów Nowy, 88 – Regów Stary, 89 – Rososzka, 90 – Roznieszew, 91 – Ruda Tarnowska, 92 – Ryczywół, 93 – Samogoszcz, 94 – Skoki, 95 – Skurcza, 96 – Sobiektursk, 97 – Sobienie Biskupie, 98 – Sobienie Jeziory, 99 – Sobienie Kielczykowskie, 100 – Sobienie Szlacheckie, 101 – Stężycza, 102 – Szymanowice, 103 – Śmietanki, 104 – Śniadów, 105 – Turzyn Dworski, 106 – Warszawice, 107 – Wicie, 108 – Wilga, 109 – Wólka Gruszczyńska, 110 – Wólka Tarnowska, 111 – Wólka Turzyńska, 112 – Wróble Wargocin, 113 – Wysoczyn, 114 – Występ, 115 – Zakrzew, 116 – Zajezierze, 117 – Zbyczyn.

The systematic layout follows Rutkowski [9] and species names follow Mirek et al. [10]. A multifaceted analysis of the flora was performed taking into account the geographical and historical affiliation of species, their persistence, biological type and frequency of occurrence. It was based on the works by the following authors: Rutkowski [9], Zając [11], Jackowiak [12], Korniak [13], and Rothmaler [14].

The incidence of species is based on the combined scale by Jasiewicz [15]: site = locality (1–3 sites – very rare, 4–9 sites – rare, 10–23 sites – rather rare, 24–46 sites – frequent, 47–69 – quite common, 70–93 – common, 94–117 sites – very common) (Table 1). The floristic lists also included crop self-seeders or crop plants running wild, both treated as ergasiophytes.

RESULTS

The flora that accompanies cereals and tuber crops and grows in stubble fields in the Middle Vistula River Valley encompasses 367 species of vascular

plants representing 45 botanic families and 201 genera (Table 1). The following families had the most species: Asteraceae, Poaceae, Fabaceae, Brassicaceae, Caryophyllaceae and Scrophulariaceae. Species of the most abundant families were mostly apophytes and anthropophytes, apart from Brassicaceae and Chenopodiaceae where anthropophytes dominated (Table 1).

When the frequency of occurrence of individual species in the study area was considered, very rare and rare species were the most frequent group (Table 1). There were 223 taxons in this group, which accounts for 60.3% of segetal species in the study area. The group was dominated by species representing natural and semi-natural communities, including: *Geranium pratense*, *Equisetum fluviatile*, *Calystegia sepium*, *Lychnis flos-cuculi*, *Lysimachia nummularia*, *Torylis japonica*, and *Eryngium planum*. Some species classified as very rare or rare are also rarely found in crop fields all over Poland, for example *Neslia paniculata*, *Camelina sativa*, *Camelina microcarpa* subsp. *sylvestris*, *Valerianella dentata*, *Valerianella rimosa*, *Sherardia arvensis*, and *Fumaria vaillantii*.

Table 1
Systematic list of species

S.n.	Species	Origin	Persistence	Life form	Frequency
Equisetaceae					
1.	<i>Equisetum sylvaticum</i> L.	Ał	W	G	very rare
2.	<i>E. arvense</i> L.	Ał	W	G	very common
3.	<i>E. fluviatile</i> L.	Anw	W	H	very rare
4.	<i>E. palustre</i> L.	Ał	W	G	rare
Cannabaceae					
5.	<i>Humulus lupulus</i>	Al	W	H	very rare
Urticaceae					
6.	<i>Urtica urens</i> L.	Ar	K	T	rare
7.	<i>U. dioica</i> L.	Al	W	G(H)	rare
Aristolochiaceae					
8.	<i>Aristolochia clematitis</i> L.	Ar	W	H	very rare
Polygonaceae					
9.	<i>Polygonum aviculare</i> L.	Anw	K	T	very common
10.	<i>P. heterophyllum</i> Lindm. Em.H Scholz	Anw	K	T	very rare
11.	<i>P. bistorta</i> L.	Ał	W	G	rare
12.	<i>P. amphibium</i> L.	Anw	W	G	rare
13.	<i>P. hydropiper</i> L.	Anw	K	T	frequent
14.	<i>P. mite</i> Schrank	Anw	K	T	very rare
15.	<i>P. minus</i> Huds	Anw	K	T	very rare
16.	<i>P. persicaria</i> L.	Anw	K	T	common
17.	<i>P. lapathifolium</i> L. subsp. <i>pallidum</i> /With/Fr.	Anw	K	T	common
18.	<i>P. lapathifolium</i> L. subsp. <i>lapathifolium</i>	Anw	K	T	common
19.	<i>Fallopia convolvulus</i> /L./ Á. Löve	Ar	K	T	very common
20.	<i>F. dumetorum</i> (L.) Holub	Al(Az)	K	T	very rare
21.	<i>Fagopyrum esculentum</i> Gillib	Er	K	T	very rare

22.	<i>Rumex acetosella</i> L.	Aps	W	G	quite common
23.	<i>R. acetosa</i> L.	Ał	W	H	very rare
24.	<i>R. obtusifolius</i> L.	Al	W	G	very rare
25.	<i>R. confertus</i> Willd.	Ał	W	H	rare
26.	<i>R. conglomeratus</i> Murray	Al	W	G	very rare
27.	<i>R. crispus</i> L.	Ał	W	G	rather rare
Chenopodiaceae					
28.	<i>Beta vulgaris</i> L.	Er	K	T	very rare
29.	<i>Chenopodium glaucum</i> L.	Anw	K	T	very rare
30.	<i>Ch. rubrum</i> L.	Anw	K	T	very rare
31.	<i>Ch. hybridum</i> L.	Ar	K	T	very rare
32.	<i>Ch. polyspermum</i> L.	Anw	K	T	rather rare
33.	<i>Ch. suecicum</i> Murr	Ar	K	T	very rare
34.	<i>Ch. strictum</i> Roth	Ep	K	T	very rare
35.	<i>Ch. album</i> L.	Anw	K	T	very common
36.	<i>Atriplex nitens</i> Schkuhr	Ar	K	T	very rare
37.	<i>A. tatarica</i> L.	Ef	K	T	very rare
38.	<i>A. patula</i> L.	Ar	K	T	rather rare
Amaranthaceae					
39.	<i>Amaranthus retroflexus</i> L.	Ep	K	T	quite common
40.	<i>A. lividus</i>	Ep	K	T	rather rare
Caryophyllaceae					
41.	<i>Arenaria serpyllifolia</i> L.	Aps	K	T	frequent
42.	<i>Stellaria nemorum</i> L.	Al	W	H	very rare
43.	<i>S. media</i> /L./ Vill.	Ał	K	T	very common
44.	<i>S. graminea</i> L.	Ał	W	H	rather rare
45.	<i>Cerastium arvense</i> L. s.s.	Aps	K	H	rare
46.	<i>C. holosteoides</i> Fr. em. Hyl.	Ał	K	H	frequent
47.	<i>C. semidecandrum</i> L.	Amk	K	T	very rare
48.	<i>Sagina procumbens</i> L.	Ał	W	H	rather rare
49.	<i>Scleranthus annuus</i> L.	Ar	K	T	quite common
50.	<i>S. perennis</i> L.	Aps	W	H	rare
51.	<i>Herniaria hirsuta</i> L.	Aps	K	T	rare
52.	<i>Spergula arvensis</i> L.	Ar	K	T	quite common
53.	<i>S. morisonii</i> Boreau	Aps	K	T	rather rare
54.	<i>Spergularia rubra</i> /L./J. Presl et C. Presl	Anw	K	T	frequent
55.	<i>Lychnis flos-cuculi</i> L.	Ał	W	H	very rare
56.	<i>Agrostemma githago</i> L.	Ar	K	T	frequent
57.	<i>Melandrium album</i> /Mill./ Garcke	Ał	K	T	quite common
58.	<i>M. noctiflorum</i> /L./ Fr.	Ar	K	T	frequent
59.	<i>Gypsophila muralis</i> L.	Anw	K	T	frequent
60.	<i>Saponaria officinalis</i> L.	Anw	W	G	rare
61.	<i>Silene vulgaris</i> /Moench/ Garcke	Amk	W	H	rare
Ranunculaceae					
62.	<i>Consolida regalis</i> Gray	Ar	K	T	frequent
63.	<i>Ranunculus flammula</i> L.	Anw	W	H	very rare
64.	<i>R. bulbosus</i> L.	Amk	W	H	rare
65.	<i>R. arvensis</i> L.	Ar	K	T	very rare
66.	<i>R. repens</i> L.	Ał	W	H	frequent
67.	<i>R. sardous</i> Crantz	Ał	W	H	rare
68.	<i>R. acris</i> L. S. STR.	Ał	W	H	very rare
69.	<i>Myosurus minimus</i> L.	Anw	K	T	rare

Papaveraceae					
70.	<i>Papaver somniferum</i> L.	Er	K	T	very rare
71.	<i>P. argemone</i> L.	Ar	K	T	rather rare
72.	<i>P. dubium</i> L.	Ar	K	T	rather rare
73.	<i>P. rhoeas</i> L.	Ar	K	T	common
74.	<i>Chelidonium majus</i> L.	Al	W	H	rare
Fumariaceae					
75.	<i>Corydalis solida</i> Sm.	Al	W	G	very rare
76.	<i>Fumaria officinalis</i> L.	Ar	K	T	rather rare
77.	<i>F. vullantii</i> Loisel	Ar	K	T	very rare
Brassicaceae					
78.	<i>Sisymbrium officinale</i> /L./ Scop.	Ar	K	T	rather rare
79.	<i>S. loeselii</i> L.	Ep	K	H	rare
80.	<i>Descurainia sophia</i> /L./ Webb. ex Prantl.	Ar	K	T	rather rare
81.	<i>Arabidopsis thaliana</i> /L./ Heynh.	Aps	K	T	frequent
82.	<i>Erysimum cheiranthoides</i> L.	Ar	K	T	frequent
83.	<i>Rorippa palustris</i> /L./ Besser	Anw	K	T	frequent
84.	<i>R. sylvestris</i> /L./ Besser	Anw	W	H	quite common
85.	<i>R. austriaca</i> /Crantz/ Besser	Kn	W	H	rather rare
86.	<i>R. amphibia</i> /L./ Besser	Anw	W	G	rare
87.	<i>Armoracia rusticana</i> P.Gaertn., B. Mey. et Scherb.	Ar	W	G	rare
88.	<i>Cardaminopsis arenosa</i> (L.) Hayek	Aps	K	T	rather rare
89.	<i>Alyssum alyssoides</i> (L.) L.	Amk	K	T	very rare
90.	<i>Berteroa incana</i> /L./ DC	Amk	K	T	rare
91.	<i>Erophila verna</i> /L./ Chevall.	Aps	K	T	rather rare
92.	<i>Camelina microcarpa</i> subsp. <i>sylvestris</i> (Wallr.) Hiitonen	Amk	K	T	rare
93.	<i>C. sativa</i> (L.) Crantz	Ar	K	T	very rare
94.	<i>Neslia paniculata</i> (L.) Desv.	Ar	K	T	very rare
95.	<i>Capsella bursa-pastoris</i> /L./ Medik.	Ar	K	T	very common
96.	<i>Teesdalea nudicaulis</i> /L./ R. Br.	Aps	K	T	rather rare
97.	<i>Thlaspi arvense</i> L.	Ar	K	T	frequent
98.	<i>Lepidium ruderalis</i> L.	Ar	K	T	rare
99.	<i>Brassica napus</i> L. subsp. <i>napus</i>	Er	K	T	very rare
100.	<i>B. rapa</i> L. subsp. <i>oleifera</i>	Er	K	T	very rare
101.	<i>Sinapis arvensis</i> L.	Ar	K	T	rather rare
102.	<i>S. alba</i> L.	Er	K	T	rare
103.	<i>Raphanus raphanistrum</i> L.	Ar	K	T	quite common
Crassulaceae					
104.	<i>Sedum maximum</i> /L./ Hoffm.	Amk	W	G	very rare
105.	<i>S. acre</i> L.	Amk	W	H	very rare
Rosaceae					
106.	<i>Filipendula ulmaria</i> (L.) Maxim.	Al	W	H	very rare
107.	<i>Rubus caesius</i> L.	Al	W	Ch	rare
108.	<i>Sanguisorba officinalis</i> L.	Al	W	H	very rare
109.	<i>Geum urbanum</i> L.	Al	W	H	rare
110.	<i>Potentilla anserina</i> L.	Al	W	H	frequent
111.	<i>P. reptans</i> L.	Al	W	H	rare
112.	<i>P. norvegica</i> L.	Anw	K	T	rare
113.	<i>P. arenaria</i> Borkh.	Amk	W	H	very rare
114.	<i>P. collina</i> Wibel s.s.	Anw	W	H	very rare

115.	<i>P. argentea</i> L.s.s	Amk	W	H	rare
116.	<i>Alchemilla monticola</i> Opiz	Al	W	H	very rare
117.	<i>Aphanes arvensis</i> L.	Ar	K	T	very rare
Fabaceae					
118.	<i>Lupinus luteus</i> L.	Er	K	T	rare
119.	<i>Galega officinalis</i> L.	Ef	W	H	very rare
120.	<i>Astragalus glycyphyllos</i> L.	Al	W	H	very rare
121.	<i>Vicia sepium</i> L.	Al	W	H	very rare
122.	<i>V. sativa</i> L.	Ar	K	T	rather rare
123.	<i>V. angustifolia</i> L.	Ar	K	T	common
124.	<i>V. hirsuta</i> /L./ S. F. Gray.	Ar	K	T	very common
125.	<i>V. tetrasperma</i> /L./ Schreb.	Ar	K	T	common
126.	<i>V. villosa</i> Roth	Ar	K	T	quite common
127.	<i>V. cracca</i> L.	Al	W	H	frequent
128.	<i>Lathyrus pratensis</i> L.	Al	W	H	rare
129.	<i>L. tuberosus</i> L.	Ar	W	G	quite common
130.	<i>Pisum sativum</i> L.	Er	K	T	rare
131.	<i>P. sativum</i> L. subsp. <i>arvense</i> (L.) Asch&Graebn.	Er	K	T	rare
132.	<i>Melilotus alba</i> L.	Amk	K	T	very rare
133.	<i>M. officinalis</i> (L.) Pall.	Al	K	T	rare
134.	<i>Medicago sativa</i> L. S. STR.	Er	W	H	very rare
135.	<i>M. falcata</i> L.	Amk	W	H	rare
136.	<i>M. lupulina</i> L.	Amk	K	T	frequent
137.	<i>Trifolium dubium</i> Sibth.	Al	K	T	rare
138.	<i>T. campestre</i> Schreb.	Al	K	T	rare
139.	<i>T. repens</i> L.	Al	W	H	common
140.	<i>T. hybridum</i> L.	Al	W	H	rare
141.	<i>T. rubens</i> L.	Aps	W	H	very rare
142.	<i>T. medium</i> L.	Az	W	H	very rare
143.	<i>T. pratense</i> L.	Al	K	T	frequent
144.	<i>T. arvense</i> L.	Aps	K	T	rather rare
145.	<i>Lotus corniculatus</i> L.	Al	K	H	rather rare
146.	<i>Ornithopus sativus</i> Brot.	Er	K	T	very rare
Oxalidaceae					
147.	<i>Oxalis fontana</i> Bunge	Ep	W	H	common
148.	<i>O. acetosella</i> L.	Al	W	G	rare
Geraniaceae					
149.	<i>Geranium pratense</i> L.	Al	W	H	rare
150.	<i>G. dissectum</i> L.	Ar	K	T	very rare
151.	<i>G. pusillum</i> Burm. f. ex L.	Ar	K	T	frequent
152.	<i>Erodium cicutarium</i> /L./ L' Hér.	Ar	K	T	frequent
Linaceae					
153.	<i>Linum usitatissimum</i> L.	Er	K	T	very rare
154.	<i>Radiola linoides</i> Rothm.	Anw	K	T	rare
Euphorbiaceae					
155.	<i>Euphorbia helioscopia</i> L.	Ar	K	T	common
156.	<i>E. palustris</i> L.	Anw	W	H	very rare
157.	<i>E. exigua</i> L.	Ar	K	T	rather rare
158.	<i>E. peplus</i> L.	Ar	K	T	rare
159.	<i>E. cyparissias</i> L.	Amk	W	G	rare

160.	<i>E. lucida</i> Waldst. & Kit.	Anw	W	H	very rare
161.	<i>E. esula</i> L.	Amk	K	H	rather rare
Balsaminaceae					
162.	<i>Impatiens parviflora</i> DC.	Er	K	T	very rare
Malvaceae					
163.	<i>Malva pusilla</i> Sm.	Ar	K	H	very rare
164.	<i>M. neglecta</i> Wallr.	Ar	K	H	rather rare
165.	<i>M. sylvestris</i> L.	Ar	K	H	rare
Clusiaceae					
166.	<i>Hypericum humifusum</i> L.	Aps	W	T (H)	rather rare
167.	<i>H. perforatum</i> L.	Ał	W	H	rather rare
Violaceae					
168.	<i>Viola arvensis</i> Murray	Ar	K	T	very common
169.	<i>V. tricolor</i> L. S. STR.	Aps	K	T	rare
Lythraceae					
170.	<i>Lythrum salicaria</i> L.	Ał	W	H	very rare
171.	<i>Peplis portula</i> L.	Anw	K	T	rare
Onagraceae					
172.	<i>Oenothera biennis</i> L. S. STR.	Aps	K	T	rare
173.	<i>Chamaenerion angustifolium</i> (L.) Scop.	Az	W	H	very rare
174.	<i>Epilobium parviflorum</i>	Anw	W	H	rather rare
175.	<i>E. roseum</i> Schreb.	Anw	W	H	rare
Apiaceae					
176.	<i>Eryngium planum</i> L.	Aps	W	H	very rare
177.	<i>Anthriscus sylvestris</i> (L.) Hoffm.	Al	W	H	very rare
178.	<i>Pimpinella saxifraga</i> L.	Amk	W	H	rather rare
179.	<i>Aegopodium podagraria</i> L.	Amk	W	H	rare
180.	<i>Aethusa cynapium</i> L.	Ar	K	T	frequent
181.	<i>Anethum graveolens</i> L.	Er	K	T	very rare
182.	<i>Falcaria vulgaris</i> Bernh	Amk	W	H	rare
183.	<i>Carum carvi</i> L.	Ał	K	T	very rare
184.	<i>Pastinaca sativa</i> L. s.s.	Ał	K	H	rare
185.	<i>Heracleum sphondylium</i> L. S.STR.	Ał	W	H	very rare
186.	<i>H. sibiricum</i> L.	Ał	W	H	very rare
187.	<i>Torilis japonica</i> (Hout.) DC.	Az	K	T	very rare
188.	<i>Daucus carota</i> L.	Ar	K	T	frequent
Primulaceae					
189.	<i>Lysimachia nummularia</i> L.	Ał	W	G	rare
190.	<i>L. vulgaris</i> L.	Ał	W	G	rare
191.	<i>Centunculus minimus</i> L.	Ar	K	T	rare
192.	<i>Anagallis arvensis</i> L.	Ar	K	T	common
Plumbaginaceae					
193.	<i>Armeria maritima</i> (Mill.) Willd.	Aps	W	H	very rare
Gentianaceae					
194.	<i>Centaurium pulchellum</i> (Sw.) Druce	Ał	K	T	rather rare
Rubiaceae					
195.	<i>Sherardia arvensis</i> L.	Al	K	T	rare
196.	<i>Galium palustre</i> L.	Anw	W	H	very rare
197.	<i>G. aparine</i> L.	Al	K	T	common
198.	<i>G. spurium</i> L.	Ar	K	T	rare

199.	<i>G. odoratum</i> (L.) Scop.	Al	W	H	very rare
200.	<i>G. verum</i> L.	Al	W	G	rare
201.	<i>G. mollugo</i> L.	Al	W	G	rare
Convolvulaceae					
202.	<i>Cuscuta campestris</i> Yuncker	Ep	K	T	very rare
203.	<i>Calystegia sepium</i> L.	Az	W	H	very rare
204.	<i>Convolvulus arvensis</i> L.	Amk	W	G	very common
Hydrophyllaceae					
205.	<i>Phacelia tanacetifolia</i> Benth	Er	K	T	very rare
Boraginaceae					
206.	<i>Lithospermum arvense</i> L.	Ar	K	T	rather rare
207.	<i>Echium vulgare</i> L.	Amk	K	H	rare
208.	<i>Symphytum officinale</i> L.	Anw(l)	W	G	frequent
209.	<i>Anchusa officinalis</i> L.	Amk	K	H	rare
210.	<i>A. arvensis</i> (L.) M. Bieb.	Ar	K	T	frequent
211.	<i>Myosotis arvensis</i> (L.) Hill.	Ar	K	T	very common
212.	<i>M. stricta</i> Link ex Roem. i Schult	Aps	K	T	rather rare
Lamiaceae					
213.	<i>Ajuga reptans</i> L.	Az	W	H	very rare
214.	<i>Galeopsis ladanum</i> L.	Ar	K	T	very rare
215.	<i>G. speciosa</i> Mill.	Al	K	T	very rare
216.	<i>G. pubescens</i> Besser	Al	K	T	rather rare
217.	<i>G. tetrahit</i> L.	Al	K	T	frequent
218.	<i>G. bifida</i> Boenn.	Al	K	T	rare
219.	<i>Lamium album</i> L.	Ar	K	T	very rare
220.	<i>L. amplexicaule</i> L.	Ar	K	T	quite common
221.	<i>L. purpureum</i> L.	Ar	K	T	quite common
222.	<i>Leonurus cardiaca</i> L.	Ar	W	H	very rare
223.	<i>Ballota nigra</i> L.	Ar	W	H	rare
224.	<i>Stachys annua</i> L.	Ar	K	T	rare
225.	<i>S. palustris</i> L.	Anw	W	G	quite common
226.	<i>Glechoma hederacea</i> L.	Al	W	H	frequent
227.	<i>Prunella vulgaris</i> L.	Al	W	H	rare
228.	<i>Thymus serpyllum</i> L. Emend. Fr.	Aps	W	H	very rare
229.	<i>Lycopus europeus</i> L.	Anw	W	H	very rare
230.	<i>Mentha arvensis</i> L.	Anw	W	H	quite common
231.	<i>Elsholtzia ciliata</i> (Thunb.) Hyl.	Ep	K	T	very rare
Solanaceae					
232.	<i>Solanum nigrum</i> L. em. Mill.	Ar	K	T	frequent
233.	<i>Datura stramonium</i> L.	Ep	K	T	very rare
Scrophulariaceae					
234.	<i>Verbascum thapsus</i>	Amk	K	T	very rare
235.	<i>V. nigrum</i> L.	Al	K	H	very rare
236.	<i>Scrophularia nodosa</i> L.	Al	W	H	rare
237.	<i>Chaenorhinum minus</i> (L.) Lange	Amk	K	T	frequent
238.	<i>Linaria vulgaris</i> (L.) Mill.	Aps	W	G	rather rare
239.	<i>Kickxia elatine</i> (L.) Dumort.	Ar	K	T	rather rare
240.	<i>Veronica spicata</i> L.	Amk	W	H	very rare
241.	<i>V. serpyllifolia</i> L.	Al	W	H	rare
242.	<i>V. triphyllos</i> L.	Ar	K	T	rather rare

243.	<i>V. arvensis</i> L.	Ar	K	T	common
344.	<i>V. verna</i> L.	Amk	K	T	rather rare
245.	<i>V. dillenii</i> Cranz.	Aps	K	T	rather rare
246.	<i>V. hederifolia</i> L. s.s.	Ar	K	T	rare
247.	<i>V. persica</i> Poir.	Ep	K	T	common
248.	<i>V. agrestis</i> L.	Ar	K	T	frequent
249.	<i>V. polita</i> Fr.	Ar	K	T	frequent
250.	<i>V. opaca</i> Fr.	Ar	K	T	rather rare
251.	<i>V. anagallis-aquatica</i> L.	Anw	W	Hy	very rare
252.	<i>V. chamaedrys</i> L. S. STR.	Ał	W	H	rare
253.	<i>Odontites serotina</i> (Lam.) Rchb.	Ał	K	T	very rare
254.	<i>Rhinanthus serotinus</i> /Schönh./ Oborný	Ar	K	T	rare
Plantaginaceae					
255.	<i>Plantago media</i> L.	Ał	W	H	rare
256.	<i>P. major</i> L.	Al	W	H	common
257.	<i>P. intermedia</i> Gilib.	Anw	W	H	quite common
258.	<i>P. lanceolata</i> L.	Ał	W	H	frequent
Valerianaceae					
259.	<i>Valerianella rimosa</i> Bastard	Ar	K	T	very rare
260.	<i>V. dentata</i> (L.) Pollich	Ar	K	T	rare
Dipsacaceae					
261.	<i>Knautia arvensis</i> /L./ J.M. Coult.	Ał	W	H	rare
Campanulaceae					
262.	<i>Campanula patula</i> Griseb.	Ał	W	H	very rare
263.	<i>C. rapunculoides</i> L.	Amk	W	G	rare
264.	<i>Jasione montana</i> L.	Aps	K	H	very rare
Asteraceae					
265.	<i>Solidago virgaurea</i> L.	Al	W	H	rare
266.	<i>S. gigantea</i> Aiton	Ep	W	H	rare
267.	<i>S. canadensis</i> L.	Ep	W	H	rare
268.	<i>Bellis perennis</i> L.	Ał	W	H	very rare
269.	<i>Erigeron acris</i> L.	Ep	K	H	rare
270.	<i>E. annuus</i> (L.) Pers.	Ep	K	H	frequent
271.	<i>Conyza canadensis</i> (L.) Cronquist	Ep	K	T	common
272.	<i>Filago minima</i> (Sm.) Pers.	Aps	K	T	rare
273.	<i>Gnaphalium sylvaticum</i> L.	Al	W	H	rather rare
274.	<i>G. uliginosum</i> L.	Anw	K	T	quite common
275.	<i>Helichrysum arenarium</i> /L./ Moench	Aps	W	H	very rare
276.	<i>Bidens frondosa</i> L.	Kn	K	T	rare
277.	<i>B. tripartita</i> L.	Anw	K	T	rather rare
278.	<i>Iva xantifolia</i> Nutt.	Ep	K	T	very rare
279.	<i>Galinsoga parviflora</i> Cav.	Ep	K	T	common
280.	<i>G. ciliata</i> /Raf./S.F. Blake	Ep	K	T	quite common
281.	<i>Anthemis cotula</i> L.	Ar	K	T	very rare
282.	<i>A. arvensis</i> L.	Ar	K	T	quite common
283.	<i>A. nobilis</i> L.	Ef	K	T	very rare
284.	<i>Achillea millefolium</i> L.	Ał	W	H	common
285.	<i>Matricaria maritima</i> subsp <i>inodora</i> Schule-Bip.	Ar	K	T	very common
286.	<i>Chamomilla recutita</i> (L.) Rauschert	Ar	K	T	rare
287.	<i>Ch. suaveolens</i> /Pursh/ Rydb.	Ep	K	T	frequent

288.	<i>Tanacetum vulgare</i> L.	Al(nw)	W	H	quite common
289.	<i>Leucanthemum vulgare</i> Lam. S. STR	Al†	W	H	very rare
290.	<i>Artemisia absinthium</i> L.	Ar	W	H	rare
291.	<i>A. vulgaris</i> L.	Al(nw)	W	H	common
292.	<i>A. annua</i> L.	Ef	K	T	very rare
293.	<i>A. campestris</i> L.	Aps	W	H	rare
294.	<i>Tussilago farfara</i> L.	Anw	W	G	rare
295.	<i>Senecio vulgaris</i> L.	Ar	K	T (H)	quite common
296.	<i>S. vernalis</i> Waldst. et Kit.	Ar	K	T (H)	rare
297.	<i>S. jacobea</i> L.	Al	W	H	very rare
298.	<i>Arctium tomentosum</i> Hill.	Al	K	H	rare
299.	<i>A. lappa</i> L.	Al	K	H	rare
300.	<i>A. minus</i> /Hill/ Bernh.	Ar	K	H	very rare
301.	<i>Carduus acanthoides</i> L.	Ar	K	H	very rare
302.	<i>C. crispus</i> L.	Ep	K	H	very rare
303.	<i>Cirsium vulgare</i> (Savi) Ten.	Al†	W	H	very rare
304.	<i>C. arvense</i> /L./ Scop.	Al	W	G	very common
305.	<i>Centaurea cyanus</i> L.	Ar	K	T	very common
306.	<i>C. scabiosa</i> L.	Amk	W	H	very rare
307.	<i>C. stoebe</i> L.	Amk	K	H	very rare
308.	<i>C. jacea</i> L.	Al†	W	H	rare
309.	<i>Cichorium intybus</i> L.	Ar	W	G	rather rare
310.	<i>Arnoseris minima</i> /L./ Schweigg. & Körte	Aps	K	T	frequent
311.	<i>Hypochoeris radicata</i> L.	Al†	W	H	rare
312.	<i>H. glabra</i> L.	Aps	K	T	rare
313.	<i>Leontodon autumnalis</i> L.	Al†	W	H	rather rare
314.	<i>Tragopogon pratensis</i> L. S. STR	Al†	W	H	very rare
315.	<i>Sonchus oleraceus</i> L.	Ar	K	T (H)	quite common
316.	<i>S. asper</i> /L./ Hill.	Ar	K	T	common
317.	<i>S. arvensis</i> L.	Anw	W	H	common
318.	<i>Lactuca serriola</i> L.	Ar	K	H	rare
319.	<i>Taraxacum</i> sp. F.H. Wigg. coll.	Al†	W	H	quite common
320.	<i>Lapsana communis</i> L.	Al	K	T (H)	quite common
321.	<i>Crepis tectorum</i> L.	Aps	K	T	rather rare
322.	<i>C. capillaris</i> (L.) Wallr.	Al†	K	T	rare
323.	<i>Hieracium pilosella</i> L.	Aps	W	H	rather rare
324.	<i>H. umbellatum</i> L.	Al†	W	H	very rare
Liliaceae					
325.	<i>Allium vineale</i> L.	Amk	W	G	rare
326.	<i>Gagea pratensis</i> (Pers.) Dumort	Al†	W	G	rare
Juncaceae					
327.	<i>Juncus capitatus</i> Weigel.	Anw	K	T	rare
328.	<i>J. bufonius</i> L.	Anw	K	T	frequent
329.	<i>Luzula campestris</i> /L./ DC.	Al†	W	H	very rare
Poaceae					
330.	<i>Festuca pratensis</i> Huds.	Al†	W	H	rare
331.	<i>F. rubra</i> L. s.s	Al†	W	H	very rare
332.	<i>F. ovina</i> L.	Aps	W	H	very rare
333.	<i>Lolium perenne</i> L.	Al†	W	H	rather rare
334.	<i>L. multiflorum</i> Lam.	Ep	K	H	very rare

335.	<i>Poa annua</i> L.	Al	K	T	quite common
336.	<i>P. pratensis</i> L.	Al	W	H	very rare
337.	<i>P. palustris</i> L.	Anw	W	H	very rare
338.	<i>Dactylis glomerata</i> L.	Al	W	H	rare
339.	<i>Apera spica-venti</i> (L.) P. Beauv.	Ar	K	T	common
340.	<i>Briza media</i> L.	Al	W	H	very rare
341.	<i>Bromus tectorum</i> L.	Ar	K	T	very rare
342.	<i>B. sterilis</i> L.	Ar	K	T	very rare
343.	<i>B. inermis</i> Leyss.	Amk	W	H	rare
344.	<i>B. secalinus</i> L.	Ar	K	T	frequent
345.	<i>B. hordeaceus</i> L.	Al	W	H	rare
346.	<i>Elymus repens</i> /L./ Gould.	Anw	W	G	common
347.	<i>E. hispidus</i> (Opiz) Melderis	Ef	W	G	very rare
348.	<i>Avena fatua</i> L.	Ar	K	T	quite common
349.	<i>A. strigosa</i> L.	Ar	K	T	rather rare
350.	<i>Arrhenantherum alatum</i> (L.) P. Baur. ex J. Presl & C. Presl	Al	W	H	very rare
351.	<i>Anthoxanthum aristatum</i> Boiss.	Ep	K	T	frequent
352.	<i>Holcus lanatus</i> L.	Al	W	H	rare
353.	<i>H. mollis</i> L.	Al	W	H	very rare
354.	<i>Corynephorus canescens</i> (L.) P. Beauv.	Aps	W	H	very rare
355.	<i>Agrostis capillaris</i> L.	Al	W	H	rare
356.	<i>A. stolonifera</i> L.	Anw	W	H	rather rare
357.	<i>Phleum pratense</i> L.	Al	W	H	rather rare
358.	<i>Alopecurus geniculatus</i> L.	Anw	W	H	rare
359.	<i>A. pratensis</i> L.	Al	W	G	very rare
360.	<i>Phragmites australis</i> /Cav./ Trin. ex Steud.	Anw	W	G	frequent
361.	<i>Nardus stricta</i> L.	Aps	W	H	very rare
362.	<i>Echinochloa crus-galli</i> (L.) P. Beauv.	Ar	K	T	common
363.	<i>Digitaria ischaemum</i> (Scheb.) H. L. Mühl.	Ar	K	T	rather rare
364.	<i>D. sanguinalis</i> (L.) Scop.	Ar	K	T	rare
365.	<i>Setaria pumila</i> (Poir) Roem.Schult.	Ar	K	T	common
366.	<i>S. viridis</i> (L.) P. Beauv.	Ar	K	T	frequent

Cyperaceae

367.	<i>Carex hirta</i> L.	Al	W	G	rare
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Explanations: Ar – archeophytes, Ep – epicephytes, Er – ergasiophytes, A – apophytes: l – meadows, nw – waterside, ps – psammophilous grassland, mk – xerothermic grassland, l – forest, z – shrub; K – short-lived, W – perennial, T – therophytes, H – hemicryptophytes, G – geophytes, Ch – chamaephytes,

Common species are the least numerous group. Only 13 species were found in cereals, tuber crops, and stubble fields of the Middle Vistula River Valley, that is, 3.5% of the segetal flora. These species are as follows: *Equisetum arvense*, *Fallopia convolvulus*, *Polygonum aviculare*, *Chenopodium album*, *Stellaria media*, *Viola arvensis*, *Convolvulus arvensis*, *Myosotis arvensis*, *Matricaria maritima* subsp. *inodora*, and *Centaurea cyanus*. It is worth noticing that the following taxons: *Bromus secalinus*, *Melandrium noctiflorum*, *Consolida regalis*, *Aethusa cynapium*, *Chaenorhinum minus*, *Veronica agrestis*, *Veronica polita* and *Agrostemma githago*, are sporadic species

in many regions of Poland, whereas in the study area they are frequently found. The group of quite common species was made up of 6 taxons established on soils which are wet and excessively wet due to a high level of groundwater. They include the following: *Stachys palustris*, *Mentha arvensis*, *Rorippa sylvestris*, *Plantago intermedia*, *Gnaphalium uliginosum*, and *Polygonum amphibium*.

The analysis of taxons in terms of their geographical and historical classification revealed 227 (62%) of native species and 140 (38%) species which were newcomers during different historical periods (Fig. 2).

Fig. 2. Percentage proportion of geographical and historical groups in the segetal flora of the mesoregion of the Middle Vistula River Valley.

The apophytes were dominated by meadow apophytes – 78 species (35%), followed by waterside apophytes and apophytes established in excessively wet habitats – 48 species (21%) (Fig. 3). These groups were present in more than half of all the native species, as they became established close to meadow communities and in close proximity to the river contributing to the growth and development of moisture-loving species, deep-rooting plants in particular. The following taxons were less abundant: forest and bush taxons (39 species – 17%), sandy, sandy grassland and dune taxons (32 species – 14%), and xerothermic grassland taxons (30 species – 13%).

Fig. 3. Percentage proportion of apophytes in the segetal flora of the mesoregion of the Middle Vistula River Valley

Common apophytes in the study area were as follows, e.g.: *Sonchus arvensis*, *Plantago intermedia*, *Rorippa sylvestris*, *Stachys palustris*, *Mentha arvensis*, *Equisetum arvense*, and *Elymus repens*. Rare apophytes included the following: *Gagea pratensis*,

Juncus capitatus, *Radiola linoides*, *Peplis portula*, *Sherardia arvensis*, *Galeopsis speciosa*, *Hypericum humifusum*, and *Ranunculus sardous*. The above-mentioned species are rare in Poland and are classified as threatened species.

The anthropophytes were dominated by archeophytes – 97 species (69%) (Fig. 4). Epecophytes and ergasiophytes were much less frequent – 23 and 15 species, respectively (16 and 11%). Moreover, 5 ephemeroxytes were found (4%). The following archeophytes were the most common: *Scleranthus annuus*, *Papaver rhoeas*, *Lathyrus tuberosus*, *Euphorbia helioscopia*, *Anagallis arvensis*, *Myosotis arvensis*, *Lamium amplexicaule*, *Lamium purpureum*, *Sonchus arvensis*, *Sonchus oleraceus*, and *Sonchus asper*.

Fig. 4. Percentage proportion of individual groups of anthropophytes in the segetal flora of the Middle Vistula River Valley.

Rare and very rare archeophytes included: *Centunculus minimus*, *Fumaria vaillantii*, *Aphanes arvensis*, *Geranium dissectum*, *Valerianella dentata*, *Valerianella rimosa*, *Neslia paniculata*, and *Camelina sativa*. The aforementioned species are also rarely encountered in other regions in Poland. The following epecophytes were found: *Amaranthus retroflexus*, *Oxalis fontana*, *Rorippa austriaca*, *Cuscuta campestris*, *Iva xantifolia*, *Bidens frondosa*, *Elsholtzia ciliata*, *Anthoxanthum aristatum*, and others.

The analysis of the biological spectrum of the segetal flora showed that therophytes were the dominant life forms. The segetal flora included 185 therophytes (50%), 143 hemicryptophytes (39%), 37 geophytes (10%), 1 hydrophyte (0.5%), and 1 chamaephyte (0.5%) (Fig. 5). When the biological types of native species were analysed, it was found that hemicryptophytes were the dominant life form (54%). Therophytes were dominant anthropophytes (83%).

Fig. 5. Percentage proportion of forms in the segetal flora of the Middle Vistula River Valley.

Non-perennial (short-lived) species were more abundant than perennials. Of the 370 flora species in the study area, 206 taxons were non-perennials (56%)

and 161 taxons were perennials (44%) (Fig. 6). Moreover, perennial apophytes and non-perennial anthropophytes were more abundant (65 and 90%, respectively).

Fig. 6. Percentage proportion life of species in the segetal flora of the Middle Vistula River Valley.

DISCUSSION

Segetal flora is becoming more and more impoverished mainly due to increasing intensification of agricultural production, particularly in western and central Europe [2,3,16–21].

The segetal flora in the Middle Vistula River Valley is very abundant. A total of 367 vascular species were found in cereals, tuber crops, and stubble fields. The flora in the study area seems to be much more abundant than in Mazovia [6], the Mazovian Landscape Park [22] or the Kampinos National Park

[23]. When compared with the rest of Poland, the study area has fewer species than the area of the Przeborsko-Małopolskie Range – 393 species [24] and the Piotrków Plain – 374 species [25].

Such floristic abundance was due to the fact that the study area is located along the banks of the Vistula River. A wide variety of habitats are found there, the dominant ones being fertile alluvial soils as well as acid and dry habitats. Also, the fields are fragmented and cultivated in quite a traditional way.

The analysis of the segetal flora demonstrated that apophytes were more numerous than anthropophytes. Such findings have been reported for other regions in Poland [6,13,22,25–27]. The opposite has been reported only for the Vistula delta area (Żuławy Wiślane) has [28]. According to Dąbkowska and Sygulska [29], the fact that native species dominate over newcomers from different historical periods is indicative of a small effect of human pressure and slight transformation of segetal flora. Over 58% archeophytes of 165 taxons occurring in Poland [30] were found in the study area. Such a high share of this group of species in the flora of the Middle Vistula River Valley may be indicative of the dominance of traditional farming in the area. It has been reported in European literature that this group of species is receding due to the application of herbicides, the use of certified seeds for sowing, the abandonment of certain cultivation practices, the exclusion from cultivation of poor quality fields with infertile acid soils and oligotrophic carbonate-rich habitats, and changing the ways in which fields are used [2,17,31]. Under Polish conditions, the fragmentation of fields may be an additional factor as it contributes to less competition with native species. In recent years, agrocenoses have also been affected by the increasing proportion of foreign invasive species which may threaten the native flora [32–35]. The epiphytes that had a special influence on the composition and structure of communities in the study area included the following: *Oxalis fontana*, *Veronica persica*, *Conyza canadensis*, *Galinsoga parviflora*, and *Anthoxanthum aristatum*.

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REFERENCES

1. Kornaś J. Chwasty polne rozprzestrzeniane z materiałem siewnym. Specjalizacja ekologiczna i procesy wymierania. Zesz Nauk AR Krakow. 1987; 19: 23–36.
2. Stehlik I, Caspersen JP, Wirth L, Holderegger R. Floral free fall in the Swiss lowlands: environmental determinants of local plant extinction in a peri-urban landscape. J Ecol. 2007; 95(4): 734–744. <http://dx.doi.org/10.1111/j.1365-2745.2007.01246.x>
3. Skrajna T, Gozdowski B, Ługowska M. The transformations of field communities with *Illecebrum verticillatum* L. (Caryophyllaceae) on the borderlands of its European range (central-eastern Poland). Pol J Ecol. 2014; 62(1): 3–15.
4. Warcholińska AU, Siciński JT. Ekspansja *Anthoxanthum aristatum* Boiss. w środkowej Polsce. Zesz Nauk Akad Tech Roln Bydg. 1996; 196(38): 183–192.
5. Tokarska-Guzik B. The establishment and spread of alien plant species (Kenophytes) in the flora of Poland. Pr Nauk Uniw Śląskiego. 2005; 2372: 1–192.
6. Wójcik Z. Udział apofitów i antropofitów w zbiorowiskach segetalnych Mazowsza. Mat Zakł Fitosoc Stos UW. 1968; 25: 109–122.
7. Kondracki J. Geografia regionalna Polski. PWN. Warszawa: 2002; 3: 11–194
8. Woś A. Klimat Polski. Warsaw: Polish Scientific Publishers PWN; 1999.
9. Rutkowski L. Klucz do oznaczania roślin naczyniowych Polski niżowej. Warsaw: Polish Scientific Publishers PWN; 1998.
10. Mirek Z, Piękoś-Mirkowa H, Zając A, Zając M, editors. Flowering plants and pteridophytes of Poland – a checklist. Cracow: W. Szafer Institute of Botany, Polish Academy of Sciences; 2002. (Biodiversity of Poland; vol 1).
11. Zając A. Pochodzenie archeofitów występujących w Polsce. Rozpr Hab UJ Kraków. 1979; 29: 5–213.
12. Jackowiak B. Antropogeniczne przemiany flory roślin naczyniowych Poznania. Wyd Nauk UAM Pozn. Biol. 1990; 42: 1–232.
13. Korniak T. Flora segetalna północno-wschodniej Polski, i jej przestrzenne zróżnicowanie i współczesne przemiany. Acta Acad Agric Tech Olst Agric. 1992; 53(A suppl): 5–76.
14. Rothmaler W. Exkursionsflora von Deutschland. G. Fischer Verlag; Jena. 2000; 3: 1–734.
15. Jasiewicz A. Rośliny naczyniowe Bieszczadów Zachodnich. Mongr Bot. 1965; 20: 1–340
16. Pyšek P, Jarošík V, Kropáč Z, Chytrý M, Wild J, Tichý L. Effects of abiotic factors on species richness and cover in Central European weed communities. Agric Ecosyst Env. 2005; 109(1–2): 1–8. <http://dx.doi.org/10.1016/j.agee.2005.02.018>
17. Meyer S, Wesche K, Krause B, Leuschner C. Dramatic losses of specialist arable plants in Central Germany since the 1950s/60s – a cross-regional analysis. Divers Distrib. 2013; 19(9): 1175–1187. <http://dx.doi.org/10.1111/ddi.12102>
18. Storkey J, Meyer S, Still KS, Leuschner C. The impact of agricultural intensification and land-use change on the European arable flora. Proc R Soc B.

- 2012; 279(1732): 1421–1429. <http://dx.doi.org/10.1098/rspb.2011.1686>
19. Májeková J, Zaliberová M, Šibík J, Klimová K. Changes in segetal vegetation in the Borská nížina Lowland (Slovakia) over 50 years. *Biologia (Bratisl)*. 2010; 65(3): 465–478. <http://dx.doi.org/10.2478/s11756-010-0035-5>
 20. Skrzyczyńska J, Ługowska M. Rzadkie gatunki segetalne wschodniej części Doliny Środkowej Wisły. *Fragm Flor Geobot Pol*. 2006; 13(1): 11–15.
 21. Szczęśniak E, Dajdok Z, Kącki Z. Metodyka oceny zagrożenia i kategoryzacja zagrożonych archeofitów na przykładzie Dolnego Śląska. *Acta Bot Siles*. 2011; 1: 9–28.
 22. Skrajna T, Skrzyczyńska J, Ługowska M. The segetal flora of the Mazowiecki Landscape Park. *Plant Breed Seed Sci*. 2010; 61: 93–104. <http://dx.doi.org/10.2478/v10129-010-0016-4>
 23. Bomanowska A. Wybrane cechy flory segetalnej Kampinowskiego Parku Narodowego. *Pam Puł*. 2006; 143: 27–35.
 24. Wnuk Z. Flora segetalna Pasma Przedborsko-Małoskiego i przyległych terenów. *Acta Univ Lodz*. 1978; 11(20): 183–255.
 25. Warcholińska AU. Flora segetalna Równiny Piotrkowskiej (Mezoregion Nizin Środkowopolskich). *Zesz Nauk UŁ Ser II*. 1976; 8: 63–95.
 26. Skrzyczyńska J. Studia nad florą i zbiorowiskami Wysoczyzny Siedleckiej *Rozpr. hab.* 1994; 39: 1–145
 27. Skrzyczyńska J, Rzymowska Z. The segetal flora of the Bug river geomorphological territories in Podlasie region. *Acta Agrobot*. 2001; 54(1): 115–135. <http://dx.doi.org/10.5586/aa.2001.011>
 28. Hołdyński C. Flora segetalna, zróżnicowanie florystyczno-ekologiczne i przemiany szaty roślinnej pól uprawnych w aktualnych warunkach agroekologicznych Żuław Wiślanych. *Acta Acad Agric Tech Olst Agric*. 1991; 51(403): 1–50.
 29. Dąbkowska T, Sygulska P. Variations in weed flora and the degree of its transformation in ecological and extensive conventional cereal crops in selected habitats of the Beskid Wyspowy Mountains. *Acta Agrobot*. 2013; 66(2): 123–136. <http://dx.doi.org/10.5586/aa.2013.029>
 30. Zając M, Zając A, Tokarska-Guzik B. Extinct and endangered archaeophytes and the dynamics of their diversity in Poland. *Biodiv Res Conserv*. 2010; 13: 17–24. <http://dx.doi.org/10.2478/v10119-009-0004-4>
 31. Preston CD, Pearman DA, Hall AR. Archaeophytes in Britain. *Bot J Linn Soc*. 2004; 145(3): 257–294. <http://dx.doi.org/10.1111/j.1095-8339.2004.00284.x>
 32. Lososova Z, Simonova D. Changes during the 20th century in species composition of synanthropic vegetation in Moravia (Czech Republic). *Preslia*. 2008; 80: 291–305.
 33. Pál R. Invasive plants threaten segetal weed vegetation of south Hungary. *Weed Technol*. 2004; 18: 1314–1318. [http://dx.doi.org/10.1614/0890-037X\(2004\)018\[1314:IPTS WV\]2.0.CO;2](http://dx.doi.org/10.1614/0890-037X(2004)018[1314:IPTS WV]2.0.CO;2)
 34. Pinke G, Pal R, Király G, Szendrődi V, Esterházy A. The occurrence and habitat conditions of *Anthoxanthum puelii* Lecoq; Lamotte and other Atlantic-Mediterranean weed species in Hungary. *J Plant Prot*. 2006; 22: 587–596.
 35. Tokarska-Guzik B, Węgrzynek B, Urbisz A, Urbisz A, Nowak T, Bzdęga K. Alien vascular plants in the Silesian Upland of Poland: distribution, patterns, impacts and threats. *Biodiv Res Conserv*. 2011; 19: 33–54. <http://dx.doi.org/10.2478/v10119-010-0019-x>

Flora segetalna Doliny Środkowej Wisły

Streszczenie

Celem pracy była charakterystyka flory segetalnej Doliny Środkowej Wisły. W uprawach zbóż jarych i ozimych, w uprawach okopowych oraz na ścierniskach zbożowych zarejestrowano 367 gatunków. Na tak duże bogactwo florystyczne miało wpływ usytuowanie terenu badań w bliskim sąsiedztwie z rzeką, bezpośredni kontakt półnaturalnych zbiorowisk z polami uprawnymi, a także drobnopowierzchniowy rozkład pól z dużym zróżnicowaniem siedlisk. W analizowanej florze odnotowano przewagę apofitów (62%) nad antropofitami (38%). Wśród gatunków rodzimych dominowały apofity łąkowe (35%), natomiast w grupie antropofitów archeofity (69%). Analiza spektrum życiowego wykazała przewagę terofitów (50%) nad hemikryptofitami (39%). We florze segetalnej Doliny Środkowej Wisły gatunki krótkotrwale stanowiły 56%, a wieloletnie 44%. Duży udział archeofitów (26%) wśród wszystkich zarejestrowanych gatunków może świadczyć o zachowaniu tradycyjnych form gospodarowania na tym terenie.

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