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MEADOW COMMUNITIES WITH *CIRSIUM CANUM* (L.) ALL. IN THE WIELOPOLKA RIVER VALLEY IN THE STRZYŻÓW FOOTHILLS (WESTERN CARPATHIANS)

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ABSTRACT. The research was conducted in meadow communities with *Cirsium canum* in the Wielopolka River valley in the Strzyżów Foothills in 2012–2013. The common phytosociological Braun-Blanquet method was applied and 20 phytosociological relevés were taken in each of the managed and abandoned patches. The aim of the study was to investigate the distribution of the species and identify the floristic composition and habitat conditions in the phytocoenoses, as well as to compare mown and unmown patches in which the species occurs. It was observed that the management factor exerted a significant effect on the floristic composition of the communities with *Cirsium canum*. The managed patches exhibited a large proportion of species from fresh and wet meadows (*Molinio-Arrhenatheretea* class), whereas the abandoned patches were clearly dominated by species from wet meadows from the *Calthion* alliance and *Molinietalia* order.

KEY WORDS: *Cirsium canum*, *Calthion*, *Molinietalia*, management, species diversity, Ellenberg's indicators, Strzyżów Fooothills

INTRODUCTION

In the Polish flora, *Cirsium canum* represents the Pontic-Pannonian element reaching the northern boundary of its occurrence range (Zając & Zając 2009). The compact distribution range comprises central and eastern Europe. The species grows in northern Italy, Austria, the Czech Republic, Saxony, Poland, and Russia and reaches the Ural Mountains. Isolated localities of the species have been reported from Albania, the Caucasus, and Turkey (Meusel & Jäger 1992). In Poland, the species occurs mainly in the south of the country in the valleys of rivers and waterways. It has been frequently reported from the macroregions of the Silesia Lowland, Nida Basin, Kielce Upland, Western Polesie, Volhynian Polesie, Volhynian Upland, Sandomierz Basin, and Środkowobeskidzkie Foothills. Single and dispersed localities of the species have also been found in the western part of the Polish Lowland (Zając & Zając 2001).

Cirsium canum is a perennial plant reaching a height of 1.5 m. It is distinguished from other *Cirsium* species by oblong-lanceolate, grey-green, arachnoid hairy, dentate, and unevenly spinulose-bristled leaves. Purple-coloured flowers develop from June to September. The fruit is a pappus-bearing achene (Rutkowski 2004).

The species is a hemicryptophyte with high light and thermal requirements. It prefers wet, eutrophic, neutral, or alkaline soils. It grows on wet meadows, pastures, and in ditches and along water banks (Zarzycki et al. 2002, Rutkowski 2004).

Cirsium canum is classified by researchers into different taxonomic units within the *Molinio-Arrhenatheretea* class. As reported by Matuszkiewicz (2005), it represents species characteristic for the *Calthion* alliance of the *Molinietalia* order.

Preliminary field studies revealed quantitative and qualitative differences in the occurrence of the species within different meadow patches.

The aim of the study was to investigate the distribution of *C. canum* in the Wielopolka River valley in the Strzyżów Foothills (a rare species in this region) and identify the floristic composition and habitat conditions of phytocoenoses in which the species occurs. Another objective was to compare the floristic composition of mown and unmown stands.

STUDY AREA

According to the physical-geographical division of Poland (Kondracki 2011), the study area belongs to the Strzyżów Foothills mesoregion, Środkowobeskidzkie Foothills macroregion, and the Outer Western Carpathians Subprovince. In the geobotanical division, it belongs to the Western Carpathians Division and Foothills Region (Pawłowski 1977 b). A more detailed division proposed by Towpasz (1990) regards the study area as a separate Strzyżów-Dynów Foothills sub-region. Towpasz (1987, 1990) carried out research in the region and provided a report on the flora and geobotanical characteristics of the Strzyżów Foothills.

The study area covers the Wielopolka River valley, which stretches over a distance of ca. 20 km from Nawsie in the south to Ropczyce in the north. During heavy rainfall, the Wielopolka River valley is exposed to waterlogging; therefore, it mostly comprises grasslands with extensive forms of management, e.g. mowing or animal grazing, although wastelands and spontaneous riparian scrubs can also be found. The valley comprises the largest meadow and pasture complexes in the area of the Strzyżów Foothills, which have not been subjected to comprehensive phytosociological analyses so far. The meadow communities are dominated by fresh, wet, and sedge meadows; there are also rush communities.

MATERIALS AND METHODS

The investigations were conducted in the Wielopolka River valley in 2011–2013. In phytocoenoses comprising *C. canum*, 40 phytosociological relevés i.e. 20 relevés in mown and 20 in unmown stands were taken using the Braun-Blanquet method (Pawłowski 1977 a), and then they were compared in tables and analysed in detail. Phytosociological stability and the coverage coefficient were calculated for each relevé. The species names were given according to a checklist of vascular plants of Poland (Mirek et al. 2002). Phytosociological classification of the communities was taken from the guide of Matuszkiewicz (2005). The Shannon-Wiener index of diversity (H') was calculated as well (Krebs 2011). Using the phytoindication method developed by Ellenberg et al. (1992), the values of indicators of insolation, thermal conditions, soil moisture, reaction, and trophy were calculated.

RESULTS

Cirsium canum is a rare species in the Wielopolka River valley. It occurs in four localities: Łączki Kucharskie, Niedźwiada, Borek Wielki, and Okonin. It grows in both managed and abandoned meadow phytocoenoses. In the mowed stands, it rarely exceeds the abundance values of 2–3 degrees and occurs single or in small clusters, whereas in abandoned stands it is often a dominant species growing in larger groups and achieving abundance values of 3–4. The mown stands (Table 1) comprised between 19 and 39 species per relevé, while 11–26 species were recorded in the unmown patches (Table 2). In total, 64 species, out of which 26 exhibited stability degree IV–V, were noted in the mown patches. The other group of phytocoenoses comprised 71 species, but a majority occurred sporadically and only five species exhibited a high degree of stability (IV–V). The Shannon-Wiener index of diversity calculated for both groups of phytocoenoses revealed considerable differences. It reached a value of 3.003 in the mown stands and 2.717 in the abandoned stands.

In the mown phytocoenoses, a high stability degree (V) is exhibited by *Cirsium rivulare* from the *Calthion* alliance, *Equisetum palustre* from the *Molinietalia* order, and *Ranunculus repens* and *Lysimachia nummularia* from the *Agropyro-Rumicion crispi* alliance. Stability degree V is also exhibited by species characteristic for the *Molinio-Arrhenatheretea* class: *Holcus lanatus, Ranunculus acris, Trifolium pratense, Plantago lanceolata,* and *Festuca pratensis*. Species from the *Arrhenatherion* association: *Galium mollugo*, and *Geranium pratense* and from the *Arrhenatheretalia* order: *Trifolium repens*, *Leucanthemum vulgare*, *Dactylis glomerata*, and *Heracleum sphondylium* are frequent and abundant species (stability degree IV). Other frequently occurring species included *Symphytum officinale* and *Anthoxanthum odoratum*, although they were not very abundant.

In the abandoned phytocoenoses, such a high degree of stability is achieved by *Deschampsia caespitosa* (V) and *Equisetum palustre* (IV) from the *Molinietalia* order, *Carex hirta* (V) from the *Agropyro-Rumicion crispi* alliance, and *Carex gracilis* (IV) from the *Phragmitetea* class. This community shows a high proportion of *Deschampsia caespitosa*, which is a co-dominant species together with *C. canum*. A higher abundance value is shown by rush species (*Carex gracilis*, *Phalaris arundinacea*). There are also species of the *Artemisietea* class, including taxa in the rank of invasive kenophytes (*Solidago gigantea*, *Impatiens glandulifera*). Particularly noteworthy is the occurrence of rare species for the region in this community, i.e. *Dactylorhiza majalis*, *Polygonum bistorta*, and *Sanguisorbia officinalis*.

Analysis of the share of species characteristic for the particular syntaxa revealed that the managed phytocoenoses exhibited a higher proportion of

Table 1. Occurrence of *Cirsium canum* in managed meadow communities

Succesive number of relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Constancy	Cover coefficient
Number of relevé in the field	13	84	86	89	127	128	129	130	131	132	133	134	135	136	137	138	139	141	142	143		
Date (day)	20	9	9	9	21	21	21	21	21	21	21	21	21	21	22	22	22	22	22	22		
Date (month)	5	8	8	8	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5		
Date (year)	2012	2012	2012	2012	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013		
Herb layer cover (%)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
Management	mII	mI	mI	mI	mII	mII	mII	mII	mI	mII	mII	mII	mII	mII	mII	mII	mII	mII	mII	mII		
Number of species	26	19	19	22	28	38	29	35	31	36	28	30	29	36	31	35	39	34	28	35		
Cirsium canum	1.2	+.2	+.2	2.2	1.3	1.2	3.4	1.2	3.3	3.3	4.5	1.2	2.3	1.2	2.3	3.4	+.2	2.3	2.3	+	V	1,660
ChAll. *Calthion*																						
Cirsium rivulare	3.3	2.2	2.2	+	1.3	1.2	1.2	2.2	1.2	+	.	1.2	2.3	+	1.2	2.3	1.2	1.2	3.3	3.3	V	1,207
Trifolium hybridum	+	2.2	.	+	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	117
Cirsium oleraceum	.	.	+	.	.	.	.	+.2	.	.	3.4	.	.	.	.	.	.	.	.	.	I	192
ChO. *Molinietalia*																						
Equisetum palustre	1.1	+	.	.	+	1.1	1.1	1.1	1.1	+	+	2.1	+	+	+	+	.	+	+	+	V	240
Angelica sylvestris	+	.	.	.	.	.	.	+	+	+	+	+	+	.	.	r	.	r	.	+	III	25
Lychnis flos-cuculi	+	+	.	.	.	.	.	+	+	+	.	.	.	+	r	r	.	.	r	+	III	25
Deschampsia caespitosa	.	.	.	1.2	.	+	+	.	.	.	+	.	+	.	.	+	+	.	.	+	II	42
Filipendula ulmaria	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1.3	.	I	30
Lythrum salicaria	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	2
ChAll. *Arrhenatherion*																						
Galium mollugo	+	.	.	+	+	+	.	.	+	+	1.2	+	+	+	+	+	+	+	+	+	IV	62
Geranium pratense	+	+	1.2	+	1.2	+	.	.	.	.	+	.	+	+	1.2	1.2	1.2	3.3	+	+	IV	335
Crepis biennis	.	.	.	+	+	.	.	.	.	+	.	.	.	+	.	+	+	.	.	.	II	15
Arrhenatherum elatius	.	1.2	1.2	2.2	.	.	.	.	.	.	.	.	+	.	.	.	+.2	.	.	.	II	142
ChO. *Arrhenatheretalia elatioris*																						
Trifolium repens	+	.	.	+	+	+	1.2	1.2	2.2	2.2	.	2.2	.	2.2	1.2	+	+	1.2	+	1.2	IV	492
Leucanthemum vulgare	.	.	.	.	1.2	+	+	1.2	1.2	1.2	.	1.2	.	2.2	+	+	1.2	+	.	+	IV	252
Dactylis glomerata	.	.	.	.	1.2	2.2	.	+	+	+	.	+	+	+	+	+	+	1.2	+	.	IV	162
Heracleum sphondylium	+	.	+	.	.	.	+	.	+	+	+	+	+	.	+	.	+	+	+	+	IV	32
Taraxacum officinale	.	.	.	1.2	.	+	1.2	.	.	+	+	.	.	+	2.2	1.2	+	1.2	.	1.2	III	225
Lotus corniculatus	.	.	.	.	.	1.3	.	+	+.2	+	.	+	.	+	+	+	+	+	+	.	III	50
Pimpinella major	.	.	+	.	+	+	.	.	.	+	.	+	.	+	+	.	1.2	+	.	+	III	47
Achillea millefolium	.	.	.	.	+	.	+	+	+	+	.	+	.	+	.	.	+	+	.	+	III	25
Bellis perennis	.	.	.	.	.	.	+	+	+	+	.	+	.	+	+	+	+	r	.	.	III	25
Bromus hordeaceus	.	.	.	.	+	.	+	.	.	.	.	+	.	+	.	.	+	.	.	+	II	15
Carum carvi	.	.	.	.	+	.	.	+	.	+	.	+	.	.	.	.	.	.	.	.	I	10
Trifolium dubium	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	I	2
ChO. *Trifolio fragiferae-Agrostietalia stoloniferae*																						
Ranunculus repens	1.2	1.2	+	+	1.2	+	.	1.2	+	+	+	+	+	+	2.2	1.2	+	2.2	1.2	1.2	V	375
Lysimachia nummularia	+	+	+	+	.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	V	47
Carex hirta	+	.	.	+	.	+	+	+	+	+	+	+	+	.	.	+	.	.	+	+	IV	32
Mentha longifolia	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	2
Potentilla reptans	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	I	2
ChCl. *Molinio-Arrhenatheretea*																						
Holcus lanatus	3.2	+	+	.	3.3	3.3	3.3	3.3	2.2	2.2	1.2	2.2	2.2	3.2	3.3	3.3	2.2	1.2	1.2	2.2	V	2,105
Ranunculus acris	3.3	+	.	+	1.2	1.2	.	1.2	2.2	2.2	1.2	2.2	+	1.2	2.2	2.2	1.2	2.2	2.2	2.2	V	1,045
Trifolium pratense	1.2	.	.	3.2	1.2	+	1.2	1.2	+	1.2	+	2.2	+	1.2	2.2	1.2	+	2.2	+	1.2	V	665
Plantago lanceolata	.	+	+	2.2	+	+	+	+	+	+	+	+	+	1.2	1.2	+	+	+	.	+	V	175
Festuca pratensis	1.2	.	.	.	2.2	2.2	3.3	3.3	3.3	3.3	1.2	2.2	3.2	2.2	2.2	2.2	3.2	2.2	1.2	2.2	V	1,900
Alopecurus pratensis	2.2	.	.	.	2.2	+	1.2	+	1.2	+	+	.	2.2	+	2.2	2.2	+	1.2	2.2	1.2	IV	640
Lathyrus pratensis	2.3	1.2	3.2	+	1.2	1.2	.	+	+	+	+	+	2.2	.	+	+	.	+	2.2	.	IV	547
Poa pratensis	.	.	.	.	+	+	+	1.2	1.2	1.2	+	1.2	1.2	1.2	+	+	+	+	1.2	+	IV	197
Rumex acetosa	1.2	+	.	.	.	.	+	+	+	+	+	.	+	+	+	+	+	+	+	+	IV	60
Cerastium holosteoides	.	.	.	.	+	+	+	+	+	+	.	+	+	+	+	+	+	+	r	+	IV	37
Alchemilla pastoralis	.	.	.	.	+	+	+	+	+	+	.	.	.	+	+	+	+	+	+	r	IV	32
Centaurea jacea	.	+	.	+	.	+.2	.	+	+	.	.	+	.	.	.	.	1.2	1.2	.	.	II	65
Festuca rubra	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	+	+	.	I	10

Table 1. cont.

Succesive number of relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Constancy	Cover coefficient
Number of relevé in the field	13	84	86	89	127	128	129	130	131	132	133	134	135	136	137	138	139	141	142	143		
(day)	20	9	9	9	21	21	21	21	21	21	21	21	21	21	22	22	22	22	22	22		
Date (month)	5	8	8	8	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5		
(year)	2012	2012	2012	2012	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013		
Herb layer cover (%)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
Management	mII	mI	mI	mI	mII	mII	mII	mII	mI	mII	mII	mII	mII	mII	mII	mII	mII	mII	mII	mII		
Number of species	26	19	19	22	28	38	29	35	31	36	28	30	29	36	31	35	39	34	28	35		
Phleum pratense	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	7
Plantago major	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	I	5
Poa trivialis	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	I	5
Juncus tenuis	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	I	2
Leontodon hispidus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	I	2
ChCl. *Artemisietea* vulgaris																						
Glechoma hederacea	.	+	.	.	.	+	+	.	+	+	+	.	+	+	+	+	+	+	.	+	IV	32
Galium aparine	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	I	7
ChCl. *Phragmitetea*																						
Phalaris arundinacea	.	.	+	+	.	.	.	+	.	+	+	.	.	.	.	+	+	.	.	.	II	17
Carex gracilis	+	3.3	2.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	I	280
Carex vulpina	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	I	5
Others																						
Symphytum officinale	+	+.2	+	+	+	+	+.2	+.2	.	.	1.2	+.2	+	+	+	+	+	.	1.2	+	V	87
Anthoxanthum odoratum	.	.	.	.	.	1.1	+	1.2	+	+	+	+	+	1.1	.	+	+	+	+	+	IV	102
Polygonum amphibium	+	.	.	.	+	+	+	.	+	+	.	+	+	.	+	+	+	+	.	.	III	30
Ajuga reptans	.	.	.	.	r	+	.	.	.	+	.	.	.	+	r	.	+	.	.	r	II	17
Ranunculus auricomus	.	.	.	.	.	.	.	.	.	.	+	.	+	+	.	1.2	+	.	.	+	II	37
Luzula campestris	.	.	.	.	+	+	.	+	.	.	.	.	.	+	.	.	r	.	.	.	II	12
Lolium multiflorum	.	.	1.2	2.2	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	I	115
Briza media	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	I	5
Anemone nemorosa	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	2
Ficaria verna	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	I	2
Vicia sepium	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	2

Explanations:
Management: mII – twice movn meadow, mI – once movn meadow.

Table 2. Occurrence of *Cirsium canum* in abandoned meadow communities

Succesive number of relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Constancy	Cover coefficient
Number of relevé in the field	61	88	148	149	151	209	210	211	212	214	232	233	234	235	236	237	238	239	240	241		
(day)	6	9	22	22	22	29	29	29	29	29	19	19	19	19	19	19	19	19	19	19		
Date (month)	8	8	5	5	5	7	7	7	7	7	8	8	8	8	8	8	8	8	8	8		
(year)	2012	2012	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013		
Herb layer cover (%)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
Management	-	-	2011	2011	2011	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Number of species	11	13	25	23	23	14	13	21	20	16	24	26	26	16	19	22	20	16	21	20		
Cirsium canum	4.4	3.3	+.3	1.2	+	2.3	2.2	3.3	3.2	1.2	3.3	2.3	2.3	5.5	4.4	2.3	4.4	1.2	1.2	2.2	V	2,755
ChAll. *Calthion*																						
Cirsium rivulare	+	+	2.2	2.3	1.2	.	+	1.2	+.2	+.2	.	.	.	.	+.2	.	.	.	.	.	III	240
Polygonum bistorta	.	.	.	.	.	.	.	.	.	.	+	+	+	+	+	+	1.2	1.2	1.2	1.2	III	115
Epilobium palustre	.	.	.	.	.	.	.	.	.	+	.	+	1.1	+	+	+	.	2.2	1.2	1.2	III	175
Caltha palustris	.	.	2.2	1.2	2.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	200
Scirpus sylvaticus	.	.	.	.	+	+	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	I	30
Dactylorhiza majalis	.	.	+	r	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	7

Table 2. cont.

Succesive number of relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Constancy	Cover coefficient
Number of relevé in the field	61	88	148	149	151	209	210	211	212	214	232	233	234	235	236	237	238	239	240	241		
(day)	6	9	22	22	22	29	29	29	29	29	19	19	19	19	19	19	19	19	19	19		
Date (month)	8	8	5	5	5	7	7	7	7	7	8	8	8	8	8	8	8	8	8	8		
(year)	2012	2012	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013		
Herb layer cover (%)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
Management	-	-	2011	2011	2011	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Number of species	11	13	25	23	23	14	13	21	20	16	24	26	26	16	19	22	20	16	21	20		
Myosotis palustris	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	5
Juncus effusus	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	I	2
ChO. *Molinietalia*																						
Deschampsia caespitosa	+	3.3	.	+	+.2	2.3	2.2	3.3	3.3	.	3.3	3.3	2.3	2.3	2.3	3.3	1.3	2.3	+.2	1.2	V	1,710
Equisetum palustre	1.1	.	.	+	+	.	.	+	+	+	1.1	1.1	.	1.1	1.1	1.1	1.1	+	+	1.1	IV	217
Lythrum salicaria	.	.	.	+	.	.	.	.	.	.	+	.	+	+	+	+	+	+	2.2	3.2	III	295
Filipendula ulmaria	.	.	1.2	+.2	2.2	2	+	+	+	.	.	+	.	.	+	.	.	.	1.2	.	III	240
Selinum carvifolia	.	.	.	.	.	.	.	.	.	.	+	+	.	+	+	+	+	.	.	.	III	15
Lychnis flos-cuculi	.	.	+	+	+	.	.	.	.	.	+	+	+	.	.	.	.	.	1.2	+	II	42
Sanguisorbia officinalis	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	1.2	1.2	I	55
Angelica sylvestris	.	+	+	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	I	10
Cirsium palustre	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	I	2
Lotus uliginosus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	I	2
Lysimachia vulgaris	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	I	2
Valeriana officinalis	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	I	2
ChAll. *Arrhenatherion*																						
Geranium pratense	1.2	.	.	.	+	.	+	+	+	2.2	1.2	+	+	+	.	.	.	.	.	.	III	155
Galium mollugo	.	.	+	.	.	.	.	.	.	.	+	+	+	+	+	+	1.2	+	.	+	III	47
Arrhenatherum elatius	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	I	5
Crepis biennis	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	5
ChO. *Arrhenatheretalia elatioris*																						
Achillea millefolium	.	.	.	.	.	.	.	+	.	+	1.2	+	1.2	.	.	+	+	.	+	.	II	65
Dactylis glomerata	+	+	.	.	.	+	.	.	+	.	+	1.2	1.2	.	.	.	.	.	.	.	II	62
Heracleum sphondylium	.	.	.	.	+	.	.	+	.	.	.	.	+	.	.	.	.	+	.	+	II	12
Daucus carota	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	I	5
Bromus hordeaceus	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	2
Taraxacum officinale	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	2
ChO. *Trifolio fragiferae-Agrostietalia stoloniferae*																						
Carex hirta	.	1.2	.	+	+	.	1.2	1.2	2.2	1.2	2.2	1.2	1.2	+	2.2	2.2	2.2	1.2	+	1.2	V	647
Rumex crispus	+	.	+.2	.	.	.	.	.	.	.	+	+	+	.	.	+	+	.	+	+	III	22
Ranunculus repens	.	.	+	+	.	.	.	.	.	.	+	+	+	.	+	.	.	.	+	+	II	20
Lysimachia nummularia	.	.	+	+	+	.	.	+	.	.	.	.	.	+	1.1	.	.	+	.	.	II	40
Mentha longifolia	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	I	7
Elymus repens	.	.	.	.	.	.	+	.	.	1.2	.	.	.	.	.	.	.	.	.	.	I	27
Juncus inflexus	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.	.	.	I	2
ChCl. *Molinio-Arrhenatheretea*																						
Holcus lanatus	.	.	1.2	.	+	.	.	+	+	.	1.2	2.2	2.2	.	1.2	1.2	1.2	2.2	.	.	III	332
Lathyrus pratensis	.	.	1.2	1.2	1.2	+	+	+	+	.	+	2.2	+	.	.	+	.	.	.	.	III	180
Plantago lanceolata	.	.	+	+	.	+	.	.	.	.	+	+	.	.	.	.	.	+	+	+	II	20
Alopecurus pratensis	.	.	2.2	1.2	1.2	+	+	1.2	1.2	.	.	.	.	.	.	.	.	.	.	.	II	192
Festuca rubra	.	.	+.2	.	+	.	.	.	.	.	+	1.2	1.2	.	.	+.2	.	.	.	.	II	60
Poa pratensis	.	+	1.2	1.2	.	.	.	1.2	+	.	.	.	.	.	.	.	.	.	.	.	II	80
Centaurea jacea	+	+	.	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	II	12
Rumex acetosa	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	7
Alchemilla pastoralis	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	5
Cerastium holosteoides	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	I	5
Prunella vulgaris	.	.	.	.	+	.	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.	I	5
Ranunculus acris	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	5
Festuca pratensis	.	.	3.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	187

Table 2. cont.

Succesive number of relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Constancy	Cover coefficient
Number of relevé in the field	61	88	148	149	151	209	210	211	212	214	232	233	234	235	236	237	238	239	240	241		
Date (day)	6	9	22	22	22	29	29	29	29	29	19	19	19	19	19	19	19	19	19	19		
Date (month)	8	8	5	5	5	7	7	7	7	7	8	8	8	8	8	8	8	8	8	8		
Date (year)	2012	2012	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013		
Herb layer cover (%)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
Management	-	-	2011	2011	2011	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Number of species	11	13	25	23	23	14	13	21	20	16	24	26	26	16	19	22	20	16	21	20		
Phleum pratense	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	+	.	.	.	.	I	7
Poa trivialis	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	I	2
Trifolium pratense	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	2
ChCl. *Artemisietea vulgaris*																						
Cirsium arvense	.	.	.	.	.	.	.	.	.	.	+	.	1.1	+	.	1.2	+	+	+	1.2	II	87
Galium aparine	.	+	.	.	.	.	1.2	+	1.2	+	.	.	.	.	.	.	+	.	+	1.2	II	87
Solidago gigantea	.	.	.	.	.	.	.	+.2	.	.	.	+	+	+	.	+	+	.	.	+	II	17
Glechoma hederacea	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	+	+	.	.	.	I	10
Impatiens glandulifera	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	I	7
Artemisia vulgaris	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	I	5
Calystegia sepium	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	I	5
ChCl. *Phragmitetea*																						
Carex gracilis	.	2.2	+	3.2	3.3	4.2	3.2	2.2	1.2	2.2	+	+	.	.	.	+	1.2	3.2	2.2	.	IV	1,473
Phalaris arundinacea	3.2	1.2	.	1.2	.	1.2	2.2	1.2	2.2	3.2	.	.	.	.	.	.	.	.	.	.	II	650
Carex vulpina	.	.	+	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	5
Phragmites australis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	I	2
Others																						
Symphytum officinale	+	.	.	.	.	+	.	+	+	1.2	+	+	+	+	+	.	+	.	.	+	III	52
Geum rivale	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	+	+	+	.	.	I	32
Mentha arvensis	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	I	5
Alnus glutinosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	I	5
Urtica dioica	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	I	5
Ajuga reptans	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	2
Veronica chamaedrys	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	I	2

Explanations:
Management: 2011 – unmoving from 2011 year.

Table 3. Comparison of the floristic composition of (managed and abandoned) meadow communities with *Cirsium canum* in the Wielopolka River valley

Management	1		2	
Number of relevés	20		20	
Total numer of species	65		72	
Mean number of species in 1 relevé	30		19	
Shannon-Wiener index (H')	3.003		2.717	
Cirsium canum	V	1,660	V	2,755
Ch. *Molinietalia* (incl. ***Calthion****)				
*Cirsium rivulare**	V	1,207	III	240
Equisetum palustre	V	240	IV	217
Angelica sylvestris	III	25	I	10
Lychnis flos-cuculi	III	25	II	42
Deschampsia caespitosa	II	42	V	1,710
Filipendula ulmaria	I	30	III	240
Lythrum salicaria	I	2	III	295

Table 3. cont.

Management	1		2	
Number of relevés	20		20	
Total numer of species	65		72	
Mean number of species in 1 relevé	30		19	
Shannon-Wiener index (H')	3.003		2.717	
*Polygonum bistorta**			III	115
*Epilobium palustre**			III	175
Selinum carvifolia			III	15
*Caltha palustris**			I	200
Sanguisorbia officinalis			I	55
*Scirpus sylvaticus**			I	30
*Dactylorhiza majalis**			I	7
*Myosotis palustris**			I	5
Cirsium palustre			I	2
Lotus uliginosus			I	2
Lysimachia vulgaris			I	2
Valeriana officinalis			I	2
*Juncus effusus**			I	2
*Trifolium hybridum**	I	117		
*Cirsium oleraceum**	I	192		
Ch. *Arrhenatheretalia* (incl. ***Arrhenatherion****)				
Trifolium repens	IV	492		
Leucanthemum vulgare	IV	252		
Lotus corniculatus	III	50		
Pimpinella major	III	47		
Bellis perennis	III	25		
*Geranium pratense**	IV	335	III	155
Dactylis glomerata	IV	162	II	62
*Galium mollugo**	IV	62	III	47
Heracleum sphondylium	IV	32	II	12
Taraxacum officinale	III	225	I	2
Achillea millefolium	III	25	II	65
*Arrhenatherum elatius**	II	142	I	5
Bromus hordeaceus	II	15	I	2
*Crepis biennis**	II	15	I	5
Carum carvi	I	10		
Trifolium dubium	I	2		
Daucus carota			I	5
Ch. *Trifolio fragiferae-Agrostietalia stoloniferae*				
Ranunculus repens	V	375	II	20
Lysimachia nummularia	V	47	II	40
Carex hirta	IV	32	V	647
Rumex crispus			III	22
Elymus repens			I	27
Mentha longifolia	I	2	I	7
Potentilla reptans	I	2		
Juncus inflexus			I	2
Ch. *Molinio-Arrhenatheretea*				
Holcus lanatus	V	2,105	III	332
Ranunculus acris	V	1,045	I	5
Trifolium pratense	V	665	I	2
Plantago lanceolata	V	175	II	20

Table 3. cont.

Management	1		2	
Number of relevés	20		20	
Total numer of species	65		72	
Mean number of species in 1 relevé	30		19	
Shannon-Wiener index (H')	3.003		2.717	
Festuca pratensis	V	1,900	I	187
Alopecurus pratensis	IV	640	II	192
Lathyrus pratensis	IV	547	III	180
Poa pratensis	IV	197	II	80
Rumex acetosa	IV	60	I	7
Cerastium holosteoides	IV	37	I	5
Alchemilla pastoralis	IV	32	I	5
Centaurea jacea	II	65	II	12
Festuca rubra	I	10	II	60
Phleum pratense	I	7	I	7
Poa trivialis	I	5	I	2
Plantago major	I	5		
Juncus tenuis	I	2		
Leontodon hispidus	I	2		
Prunella vulgaris			I	5
Ch. *Artemisietea vulgaris*				
Glechoma hederacea	IV	32	I	10
Galium aparine	I	7	II	87
Cirsium arvense			II	87
Solidago gigantea			II	17
Impatiens glandulifera			I	7
Artemisia vulgaris			I	5
Calystegia sepium			I	5
Ch. *Phragmitetea*				
Carex gracilis	I	280	IV	1,472
Phalaris arundinacea	II	17	II	650
Carex vulpina	I	5	I	5
Phragmites australis			I	2
Others				
Anthoxanthum odoratum	IV	102		
Polygonum amphibium	III	30		
Ranunculus auricomus	II	37		
Luzula campestris	II	12		
Lolium multiflorum	I	115		
Briza media	I	5		
Anemone nemorosa	I	2		
Ficaria verna	I	2		
Vicia sepium	I	2		
Symphytum officinale	V	87	III	52
Ajuga reptans	II	17	I	2
Geum rivale			I	32
Mentha arvensis			I	5
Alnus glutinosa			I	5
Urtica dioica			I	5
Veronica chamaedrys			I	2

Explanations:
Management: 1 – managed, 2 – abandoned.

Table 4. Mean Ellenberg's indication values of L, T, F, R and N indices in the studied communities

Specification	L	T	F	R	N
Community with *C. canum* (managed)	7.4	5.9	6.3	6.9	5.6
Community with *C. canum* (abandoned)	7.1	5.8	7.4	6.5	4.6

Explanations: L – solar radiation, T – temperature radiation, F – soil moisture, R – soil reaction, N – soil nitrogen content.

species from the *Arrhenatheretalia* order and *Molinio-Arrhenatheretea* class, whereas the abandoned phytocoenoses had a higher share of species from the *Calthion* alliance *Molinietalia* order, and *Artemisietea* and *Phragmitetea* classes (Table 3).

The mean values of Ellenberg's environmental indicators show that both groups of phytocoenoses occupied well-insolated, moderately warm habitats with neutral or slightly acidic reaction of soils (Table 4). The mown phytocoenoses covered fresh and moderately moist soils, whereas the unmowed phytocoenoses grew on wet and highly wet soils. Analysis of the nitrogen level indicator revealed that the unmown stands were found at the border of poor or moderately poor habitats. In turn, the managed patches exhibited considerably higher substrate fertility between mesotrophic and eutrophic habitats.

DISCUSSION

According to the generally adopted classification of plant communities proposed by Matuszkiewicz (2005), *C. canum* is regarded to be characteristic for the *Calthion* alliance. Fijałkowski & Chojnacka-Fijałkowska (1990) also classify the species into the group of wet meadows. The authors described the *Cirsietum cani* association in the Lublin region, which exhibited dominance of species characteristic for the *Molinietalia* order. Kotańska & Towpasz (2007) analysed phytocoenoses with *C. canum* on the Proszowice Plateau, and classified this species into the *Arrhenatherion* alliance and *Arrhenatheretalia elatioris* order after calculating the systematic value of species groups (Pawłowski 1977 a). Meadow communities with *C. canum* were similarly classified by Vicherek (1962), who investigated the occurrence thereof in Moravia.

The results of the study conducted in the meadow communities with *C. canum* in the Wielopolka River valley indicate that the species is difficult to classify into a specific syntaxonomic unit. An additional difficulty is posed by the form of management of the investigated phytocoenoses. In the mowed patches, a high proportion is constituted by fresh meadow species, which are characterised by a greater number and species coverage than wet meadow species. A high share and stability degree are exhibited by species characteristic for the *Molinio-Arrhenatheretea* class. This is undoubtedly related to regular mowing and, probably, fertilisation and sowing, which have an effect on species diversity. Therefore, the mown phytocoenoses with the share of *C. canum* represent an intermediate community between the *Calthion* and *Arrhenatherion* alliances.

The abandoned phytocoenoses are clearly dominated by species from the *Calthion* alliance and *Molinietalia* order. In contrast, species of fresh meadows have an insignificant share, which is related to abandonment of mowing. The domination of *Deschampsia caespitosa*, a species that develops intensively on abandoned meadows, is evident. Authors from other Polish regions (Kompała-Bąba & Bąba 2007, Kryszak et al. 2007) report that *D. caespitosa* is able to colonise habitats with adverse conditions (flooding, periodic drying, insufficient fertilisation) and cessation of mowing leads to development of phytocoenoses dominated by this species. The phytocoenoses analysed are additionally accompanied by species from the *Phragmitetea* class. Particularly intensive development of *Carex gracilis* and, locally, *Phalaris arundinacea*, which have the role of dominating species, can be noted. Phytocoenoses with a high share of these species are characterised by poor floristic composition. Similarly, as reported by Kotańska (unpublished data) from the Proszowice Plateau, abandonment of mowing in patches with *C. canum* promotes overgrowth by *Phalaris arundinacea* and *Phragmites australis*.

Unmown phytocoenoses comprise species from the *Artemisietea* class. Kryszak et al. (2007) reported emergence of species from the *Artemisietea vulgaris*, *Agropyretea intermedio-repentis*, and *Stellarietea media* classes on unmown and ungrazed grasslands. In turn, Barabasz-Krasny (2002, 2011) noted that abandonment of management of former meadow and pasture areas in the Przemyśl Foothills led to eutrophication of habitats and formation of phytocoenoses dominated by herb species and herb-shrub communities.

Analysis of the diversity degree based on the Shannon-Wiener index revealed that the mown stands were characterised by a high species diversity (H' = 3.003). Despite the higher total number of species in the community, the abandoned phytocoenoses exhibit a lower diversity index (H' = 2.717). This is related to the species coverage and the number of species. In the mown patches, a considerable number of species are characterised by a high abundance value and stability degree IV–V. In turn, the abandoned patches are dominated by sporadically occurring species with an insignificant impact on the structure of the phytocoenoses. Similar results were obtained by authors from other regions of Poland who observed a significant decline

in species diversity in abandoned communities (Barabasz-Krasny 2002, Kryszak et al. 2007).

The values of Ellenberg's ecological indicators for temperature and light are similar in both communities. In contrast, the moisture indicator is higher in the abandoned phytocoenoses. This is associated with the increased share of wet habitat species, whose occurrence may be due to the higher moisture of the substrate or subsequent humidification thereof. In turn, the mown patches are characterised by a lower acidity and higher substrate fertility, which may be related to the commonly applied mineral fertilisation of the meadow grasslands.

CONCLUSIONS

1. *Cirsium canum* is a rare species in the Wielopolka River valley in the Strzyżów Foothills. It grows in managed and abandoned meadow phytocoenoses.
2. In the study area, *C. canum* grows on neutral or slightly acidic soils. The species prefers moist habitats and less frequently wetlands or periodically waterlogged habitats. It occurs in insolated, warm, or moderately warm meadow sites.
3. The managed patches exhibit a clear share of species characteristic for wet and fresh meadows, which is related to the regular mowing thereof. In the abandoned patches, the proportion of fresh meadow species (*Arrhenatheretalia*) is negligible. They are evidently dominated by species from the *Calthion* alliance and *Molinietalia* order.
4. Regular mowing, fertilisation, and sowing of arable meadow grasslands inhabited by *C. canum* increase the species richness in these phytocoenoses towards communities from the *Arrhenatherion* alliance and *Arrhenatheretalia* order. There is a large share of species from the *Molinio-Arrhenatheretea* class, which achieve a high abundance value, and therefore they cannot be clearly classified into a specific association.
5. The floristic composition of the meadow communities with *C. canum* is clearly influenced by the management, which determines the trend of vegetation development of these phytocoenoses.

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