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The share of nectariferous and polleniferous taxons in chosen patches of thermophilous grasslands of the Lublin Upland

[1]MAŁGORZATA WRZESIEŃ, [2]BOŻENA DENISOW

[1]Department of Geobotany, Institute of Biology, Maria Curie Skłodowska University,
19 Akademicka str., 20 033 Lublin, Poland
[2] Department of Botany, Agricultural University,
15 Akademicka Str., 20 950 Lublin, Poland

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Summary

The estimation of participation and density of forage species in several xerothermic communities of the Lublin Upland were carried out in 2004 and 2005.

Most plants species visited by bees are grouped in plots of the *Brachypodio-Teucrietum* and the *Adonido-Brachypodietum pinnati* communities. The nectariferous and polleniferous taxons are mostly perennials predominated by hemicryptophytes (79%), others are terophytes and geophytes (21%). Successive blooming of the nectariferous and polleniferous species in both associations ensures unbroken food flow from the early spring until the late summer and early autumn. Xerothermic swards make a valuable food potential to be important for the *Apoidea* before and after blooming of the main forage cultivated crops.

Key words: xerothermic associations, Lublin Upland, nectariferous and polleniferous plants

INTRODUCTION

Forage plants provide the pollinating apifauna the valuable food, nectar and pollen. The development of honey bee colonies and wild bees closely depends on the food resources in the nearby habitat. Increasing environmental degradation, the vast introduction of cultivated monocultures, general agricultural intensification and chemicalization with destruction of fields margins have had an adverse influence on the lack of nectariferous and polleniferous flora. The occurrence of food gaps is being negatively reflected on the condition of honey bees families and the considerable decline of bumblebees (*Bombus* Latr.), solitary bees (*Osmia* L., *Megachile* L., *Andrena* F.),

and other pollinators (Dylewska, 1995; Flaga, 2000; Jabłoński, 2000). The *Apoidea* most frequently settle down the xerothermic swards, which create favorable conditions for existence (Banaszak, 1993). The communities are characterized by an extraordinarily rich and variable floristic strip creating an important element of natural and semi-natural landscapes of the whole Lublin Upland. Along with the typically grassland plants, there are also meadow, forest and forest-brush species. The xerothermic phytocenoses most frequently develop on dry slopes, grazing lands, fallows, and even on slopes of railway embankments, and anti-errosion terraces. They cover different areas, depending on the humans activity.

The aim of the research carried out on some chosen xerothermic associations was to determine their richness in nectariferous and polleniferous species. Also, the time and length of blooming of the most frequently foraged taxons were studied.

MATERIAL AND METHODS

The field research was done in 2004-2005 on three sites: Stawska Góra near Chełm, Podzamcze near Bychawa and Pliszczyn near Lublin. Patches of communities belonging to the *Festuco-Brometea* class, *Festucetalia valesiace* order and the *Cirsio-Brachypodion pinnati* alliance, were analyzed. To a greater or lesser degree, they represent forms resembling the complexes of the *Adonido-Brachypodietum pinnati,* the *Brachypodio-Teucrietum* and the *Inuletum ensifoliae*. The plant communities were identified according to the commonly accepted Braun-Blanquet's method (Pawłowski, 1977).

The included phytosociological records show the species' coverage degrees in a 5-degree scale with an additional "+" marking of the species with the coverage degree lower than 10%. All the examined phytocenoses are described with the same range of syntaxonomic structure (Matuszkiewicz, 2001; Fijałkowski, 1964), and the terminology of vascular plants is based on Mirek et al. (2002).

The research determined the participation of nectariferous and polleniferous plants in the individual phytocenoses of species considered to be visited by different groups of *Apoidea* (*Apis mellifera*, *Bombus* sp., *Andrena*) or *Diptera*. The investigated patches were visited once a week. The seasonal blooming spectrum of most intensely foraged taxons was observed according to an assumption that the beginning of the blooming period was the moment when 10% of flowers bloomed, the full of the blooming period being the 70-80% of flowers, and the end with over 75% of the flowers came out of bloom (Jabłoński and Szklanowska, 1997). The spectrum is shown as averages on the basis from investigated species observed in all patches. Also, for those species their biological stability and the Raunkiaer's life form were quoted (Szafer, 1967; Zarzycki et al., 2002). The intensity of foraging were estimated as averages on the basis of 30 min observations concerning each species in every patches under consideration. *Apoidea* countings were made in full blooming period, during sunny weather and in most intensely forage hours (10.00-14.00 EET). The following range was applied for apifauna visits: week- 0-1·m^{2}; medium 2-4·m^{2}; good >5·m^{2}

Table 1
The communities *Festuco Brometea* class.

Successive number of releve	1	2	3	4	5	6
Date	28.06.04	15.07.05	27.05.04	20.05.05	18.05.04	12.05.05
Area of releve m^2	125	100	100	50	40	60
Cover of layer C %	90	90	90	90	80	80
Cover of layer B %	10	'	+	+	-	-
Number of species	37	33	38	46	46	41
Number of forage species	17	13	18	22	22	21
1	2	3	5	6	7	8
I. Ch.All. *Cirsio-Brachypodion pinnati*						
Inula ensifolia	4	2	.	.	.	.
Aster amellus	+	+	+	2	.	.
Carex michelii	+	1	.	.	.	.
Cirsium pannonicum	1	+	.	.	.	.
Melampyrum arvense	.	.	+	+	.	.
Ranunculus bulbosus	.	.	+	+	+	+
Carlina onopordifolia	.	.	1	+	.	.
Seseli annuum	.	.	.	.	+	+
Carex praecox	.	.	.	.	+	+
II. Ch.O. *Festucetalia valesiaceae*						
Salvia verticillata	+	+	1	.	.	.
Potentilla arenaria	+	+	.	.	1	1
Scabiosa ochroleuca	+	+	+	+	.	+
Thesium linophyllon	+	+	+	+	+	.
Campanula sibirica	.	+	1	+	+	+
Adonis vernalis	.	.	.	.	4	3
Achillea pannonica	.	.	+	+	.	.
Astragalus onobrychis	.	.	+	+	.	.
Campanula glomerata	.	.	.	+	+	.
Asparagus officinalis	.	.	.	.	+	+
Verbascum phoeniceum	.	.	.	.	+	+
Hieracium bauhinii	.	.	.	.	+	+
III. Ch.Cl. *Festuco-Brometea*						
Brachypodium pinnatum	+	4	3	4	2	2
Centaurea scabiosa	+	+	+	+	.	+
Teucrium chamaedrys	+	1	1	1	.	.
Euphorbia cyparissias	+	+	+	+	.	1
Asperula cynanchica	+	+	+	+	.	.
Plantago media	+	+	.	.	+	+
Stachys recta	+	.	+	.	.	.
Onobrychis viciifolia	.	.	+	+	+	.
Carlina vulgaris	.	.	+	+	.	.
Anthyllis vulneraria	.	.	+	+	+	+
Filipendula vulgaris				+	+	
Phleum phleoides	.	.	.	+	+	+
Veronica spicata	.	.	.	+	+	+
Acinos arvensis	.	.	.	+	+	+
Bromus inermis	.	.	.	.	1	1
Dianthus carthusianorum	.	.	.	.	+	+
Allium oleraceum	.	.	.	.	+	+

cd. table 1

	1	2	3	4	5	6
Centaurea stoebe	.	.	.	.	+	+
Artemisia campestris	.	.	.	.	+	+
Accompanying with						
IV. Cl. *Rhamno-prunetea*						
Prunus spinosa b	+	.	+	+	.	.
Rosa canina	+	+	.	.	.	.
Cornus sanguinea b	+	.	.	.	.	.
Cerasus fruticosa b	.	+	.	+	.	.
V. Cl. *Trifolio-Geranietea sanguinei*						
Peucedanum cervaria	1	1	.	.	.	.
Geranium sanguineum	1	+	.	.	.	.
Anemone sylvestris	+	+	2	+	.	.
Coronilla varia	+	+	.	.	+	+
Galium mollugo	+	+	+	+	+	+
Leucanthemum vulgare	+	+	.	.	.	.
Anthericum ramosum	+	1	.	+	+	+
Clinopodium vulgare	+	.	.	.	+	.
Galium verum	+	.	+	.	+	+
Agrimonia eupatoria	+	.	+	.	+	+
Medicago falcata	+	.	.	+	1	+
Origanum vulgare	+	.	+	+	.	1
Trifolium medium	.	.	.	+	+	+
Fragaria viridis	.	.	.	+	+	.
VII. Cl. *Molinio-Arrhenatheretea*						
Lotus corniculatus	+	+	.	.	+	.
Linum catharticum	+	+	1	+	.	.
Leontodon autumnalis	+	+	+	.	+	.
Festuca rubra	+	.	.	.	.	+
Plantago lanceolata		+	+	+	+	
Achillea millefolium	.	+	+	+	+	+
Dactylis glomerata	.	+	.	.	+	+
VIII. Others						
Salvia pratensis	+	+	+	+	.	.
Hypericum perforatum	+	.	.	.	+	+
Polygala vulgaris	+	+	+	+	.	.
Elymus repens	.	+	.	.	+	+
Pimpinella saxifraga			+	+		
Chamaecytisus ratisbonensis	.	.	+	+	1	1
Cerinthe minor	.	.	+	+	+	.
Juniperus communis b	.	.	+	+	.	.
Prunella vulgaris	.	.	+	+	.	.
Valeriana officinalis	.	.	+	+	.	.
Primula officinalis	.	.	+	1	.	.
Cruciata glabra	.	.	+	+	.	.
Euphorbia esula	.	.	.	+	+	+
Berteroa incana				+	+	+
Thymus serpyllum	.	.	.	.	+	+
Sisymbrium loeselli	.	.	.	.	+	+

Explanation: a annual, b biennial, p perennial, s shrub, Ch chamephytes, H hemicryptophytes, T terophytes, G geophytes

Table 2
The ecological featuers of forage species and visual estimation of apifauna visits.

Species	Life span	Life forms	Intensity of insect's visits of		
			Apis mellifera L.	*Bombus* sp.	*Solitary bees*
Adonis vernalis	p	H	medium	good	good
Agrimonia eupatoria	p	H	good	weak	medium
Allium oleraceum	p	G	weak	weak	good
Anemone sylvestris	p	H	good	medium	good
Anthyllis vulneraria	p	H	weak	medium	weak
Aster amellus	p	H	good	good	good
Astragalus cicer	p	H	weak	good	eak
Astragalus onobrychis	p	H	weak	good	weak
Berteroa incana	a,p	T/H	good	weak	v. good
Campanula sibirica	b	H	good	weak	good
Centaurea stoebe	b	H	v. good	v. good	medium
Centaurea scabiosa	p	H	v. good	v. good	medium
Chamaecytisus ratisbonensis	s	Ch	weak	good	weak
Dianthus carthusianorum	p	Ch	medium	weak	medium
Euphorbia cyparissias	p	G/H	weak	weak	good
Euphorbia esula	p	H	weak	weak	medium
Filipendula vulgaris	p	H	weak	weak	medium
Fragaria viridis	p	H	medium	weak	medium
Galium verum	p	H	good	weak	medium
Inula ensifolia	p	H	good	good	medium
Lotus corniculatus	p	H	weak	good	weak
Medicago falcata	p	H	good	good	weak
Melampyrum arvense	a	T	weak	good	weak
Onobrychis viciifolia	p	H	weak	good	weak
Origanum vulgare	p	H	v. good	medium	good
Pimpinella saxifraga	p	H	weak	weak	good
Potentilla arenaria	p	H	good	weak	good
Ranunculus bulbosus	p	G	weak	weak	medium
Salvia pratensis	p	H	good	good	good
Salvia verticillata	p	H	good	good	medium
Scabiosa ochroleuca	p	H	good	good	medium
Stachys recta	p	H	good	weak	good
Teucrium chamaedrys	p	Ch	good	weak	good
Thymus serphyllum	p	Ch	good	weak	good
Trifolium medium	p	H	v. good	good	good
Verbascum phoeniceum	b	H	good	good	good
Veronica spicata	p	H	weak	weak	good

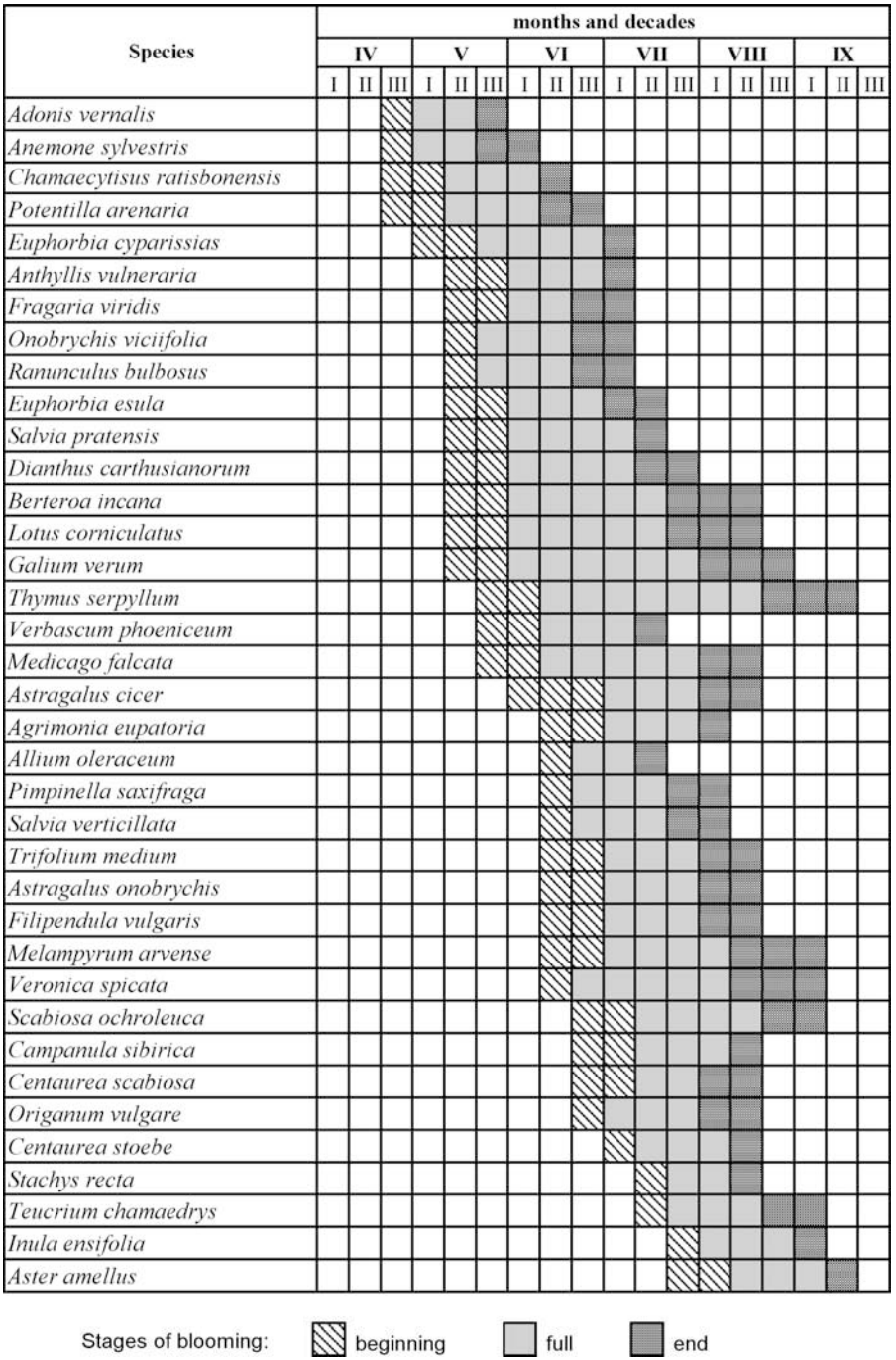

Fig. 1. The blooming spectrum of nectariferous and polleniferous species in investigated xerotermic patches (averages from years of studies).

RESULTS

The phytosociological records taken allowed the distinction of three basic associations and degree of nectariferous and polleniferous species' coverage. The blooming phases along with the description of their life span and life form are shown (Table 1, 2, Fig 1, records 1-6).

Inuletum ensifoliae (Table 1, records 1-2)

This association is connected with eroded chalky slops of different inclination. The patches are clearly predominated by *Inula ensifoliae* (up to 80% of the coverage), which is associated by typical xerothermic taxons such as *Aster amellus* and *Cirsium pannonicum.* The nectariferous and polleniferous plants, e.g. *Anthericum ramosum, Campanula glomerata, Euphorbia cyparisias, Galium verum, Peucedanum cervaria Potentilla arenaria, Teucrium chamaedrys*, etc. which are present do not reach high degrees of coverage. The hard core of this association is formed by the species blooming at the mid and late summer or early autumn, and there is a lack of typical harbingers of spring, present in the other two associations.

Brachypodio-Teucrietum (Table 1, records 3-4)

The association is characterized by the highest floral variability and a great share of species with coverage achieving 10%. The appearance of *Brachypodio-Teucrietum* patches changes quite considerably in different phenological periods, which results from the seasonal growth and blooming of individual species which create the herbaceous layer. In the early spring its colour comes from *Anemone sylvestris, Chamaecytisus ratisbonensis, Euphorbia cyparisias, Potentilla arenaria* and *Primula officinalis*. Then *Cerinthe minor, Campanula sibirica, Centaurea scabiosa, Hieracium bauhinii, Melampyrum arvense, Onobrychis viciaefolia, Origanum vulgare, Ranunculus bulbosus, Pimpinella saxifraga, Salvia verticillata, Thesium linophyllum, Valeriana officinalis* join in the flowering. The majority of these plants form dense clumps in which there are individual plants of *Agrimonia eupatoria, Centaurea stoebe, Dianthus carthusianorum, Scabiosa ochroleuca,* the species frequently visited by entomofauna. Despite the typical xerothermic species, a constant and quantitatively considerable additives are the heliophytes of the edge communities of the *Trifolio-Geranietea sanguinei* class. In total 20 plant species visited by bees has been found in observed association. The association can be very important as a potential pollen and nectar resource providing *Apoidea* with food, continually from early spring until the mid summer.

Adonido-Brachypodietum pinnati (Table 1, records 5-6)

The phytosociological records taken on the intrafield slopes grown by herbaceous vegetation in Pliszczyn near Lublin distinguish the phytocenosis which was also classified as the *Festuco vallesiaceae-Erysimum crepidifolium* (I z d e b s k i ,

1958). According to Matuszkiewicz (2002), it can constitute the impoverished form of the *Thalictro-Salvietum*, devoid of many rare but characteristic species or the *Brachypodio-Teucrietum* distinguished by Fijałkowski (1969). Apart from the small surface of the escarpment, the density of its flora within the analyzed patch was considerable. In the early spring, it takes the form of a yellow carpet predominated with *Adonis vernalis* (up to 60% of the cover), *Potentilla arenaria* and *Chamaecytisus ratisbonensis.* At the full pick of spring, the violet and blue of the flowers of *Verbascum phoeniceum, Salvia pratensis, Campanula sibirica, Plantago media* start ruling over the patch. In the summer, apart from dense clumps of *Medicago falcata, Galium verum* and *Trifolium montanum*, there are some smaller amounts of *Dianthus carthusianorum, Centaurea stoebe, Scabiosa ochroleuca.* Later, the slopes start turning brown with shedding *Bromus inermis* and *Elymus repens*. Similarly, as in the *Brachypodio-Teucrietum,* in spite of the typical xerothermic species, there are some representatives of the *Molinio-Arrhenatheretea* and the *Trifolio-Geranietea sanguinei* classes. A total of 23 forage plants species was observed, which is 50% of the herbaceous vegetation, on average.

CONCLUSIONS

1. The greatest participation of the nectariferous and polleniferous species is located in the patches of *Brachypodio-Teucrietum* and the *Adonido-Brachypodietum pinnati.* Both associations are distinguished with a great floral variability and with a considerable density of taxons blooming in the early spring seasonal aspect.

2. Adonis vernalis, Anemone sylvestris, Chamaecytisus ratisbonensis, Centaurea scabiosa, Origanum vulgare, Potentilla arenaria, Salvia verticillata, Teucrium chamaedrys were found among the foraged species located in the xerothermic associations of the studied area. These species form a great coverage and are most intensely visited by bees.

3. The successive phenology of blooming of plant species which constitute the xerothermic swards provides *Apoidea* with unbroken food flow throughout the whole vegetation season, in the period between the early spring to the late summer and early autumn.

4. Perennials constitute 77% of a forage flora. Among them the hemicryptophytes predominate (79%), others are terophytes and geophytes (in total 21%). Such an arrangement confirms the stability and relative persistence of the xerothermic grasslands.

5. The patches of xerothermic associations should be protected not only because of the floral richness and the presence of the rare species but also the presence of nectariferous and polleniferous taxons. The herbaceous xerothermic vegetation supply the *Apoidea* with food in the critical periods of shortage of nectar and pollen before and after blooming of the main cultivated crop food providers.

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Udział roślin pożytkowych w wybranych płatach muraw kserotermicznych Wyżyny Lubelskiej

S t r e s z c z e n i e

Badania dotyczące obecności roślin pożytkowych w kilku zbiorowiskach muraw ciepłolubnych Wyżyny Lubelskiej prowadzono w sezonach wegetacyjnych 2004-2005.

Najwięcej gatunków oblatywanych przez pszczołowate grupuje się w fitocenozach *Brachypodio-Teucrietum* i *Adonido-Brachypodietum pinnati.* W większości są to rośliny wieloletnie, wśród których zdecydowanie przeważają hemikryptofity (79%). Pozostałe gatunki to terofity i geofity (łącznie 21%). Sukcesywne kwitnienie gatunków pożytkowych w obu zespołach zapewnia ciągłość taśmy pokarmowej od wczesnej wiosny do późnego lata, a nawet wczesnej jesieni. Asocjacje muraw kserotermicznych stanowią cenny rezerwuar pokarmu, który może być wykorzystywany przez *Apoidea* przed i po kwitnieniu pożytkowych roślin uprawnych.