

Letter to Editor

Changes of Meadow Flora Species in Area of Cedyński Landscape Park

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Abstract

The aim of this study was to investigate the dynamic state of meadow species (*Molinietalia*, *Arrhenatheretalia*) of vascular plants in the area of Cedyński Landscape Park and determine the most important factors of the changes. The floristic data were drawn up on the basis of field studies carried out in 1998-2003 and of source materials. Of 113 species of meadow plants found in the area of CLP 9.7% are extinct or lost while 26.5% are potentially threatened with extinction owing to a small number of stations. This concerns stenotopic species attached to a given type of habitat and to methods used in meadow cultivation. In the landscape of the Park the accessibility and common occurrence of open habitats of the type of roadsides, fallows, yards at homesteads and fences, land reclamation ditches and earth banks present the possibility of easy access for meadow species of fairly low ecological requirements. Some species of this group are equally frequently distributed in semi-natural, natural and anthropogenic habitats (26%), while the remaining ones (25%) are more frequent in transformed habitats. In respect to preferences for soil moisture the species occurring in fresh soils prevail.

Keywords: northwestern Poland, degradation, apophytization, anthropopression, vascular plants

Introduction

During the past 200 years the impact of people on the natural environment has grown more intensive. The effects of increasing urbanization and transport and of intensified agriculture and forest economy are manifested in the impoverished floristic composition and decreases in the area of biocenoses of natural and semi-natural character. However, anthropogenic habitats characterized by a different structure and species composition increase their acreage. Meadow communities of the *Molinio-Arrhenatheretea* class belong to impermanent ecosystems where the applied cultivation methods determine the composition and abundance of species. Extensive grazing; appropriate time and frequency of mowing; limited fertilization; and the proper level of ground waters condition the maintenance of abundant

species composition in different meadow communities [1, 2].

The aim of the studies was to show changes in the meadow species (*Molinietalia*, *Arrhenatheretalia*) of vascular plants in the area of Cedyński Landscape Park in the course of approximately the last 150 years, the present state and conditions of these species and the most important factors of the occurring changes.

Material and Methods

The floristic data were drawn up on the basis of field studies carried out in the years 1998-2003 and of source materials that were published from the mid-19th century. The research was realized using the cartogram method. In the investigated area 337 basic plots – squares 1 km in side length – were established and entered in so-called small

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Table 1. Number of meadows species occurring in the different types of habitats.

No.	Habitat	Presence of species	No.	Habitat	Presence of species
1	sides of rivers, lakes and small water bodies	65	19	Douglas fir monocultures	4
2	sides of drainage ditches and flood-relief canals	51	20	robinia forests	25
3	osiery	36	21	old ramparts	3
4	broadleaf forests >60 years	50	22	parks and cemeteries	20
5	broadleaf forests 20-60 years	52	23	former homesteads	20
6	mixed forests >60 years	22	24	by-cottage and by-fence areas	48
7	mixed forests 20-60 years	6	25	mid-field scrub and boundary strips	14
8	pine monocultures >60 years	30	26	ploughlands	21
9	pine monocultures 20-60 years	34	27	abandoned fields	56
10	xerothermophilous shrubs	32	28	field-pathsides	53
11	heathlands	7	29	forest unmetalled roadsides	58
12	flooded grasslands	42	30	metalled roadsides	57
13	meadows and pastures	81	31	roadsides in building areas	19
14	xerothermic, sandy and dry grasslands	45	32	roadside scarps	24
15	transitional and raised bogs	21	33	embankments	30
16	lowland bogs	47	34	gravel-pits and sand-pits	25
17	clearings	14	35	railways	30
18	greenwoods	42			

squares 10 km in side length which formed the cartogram network in accordance with the principles of the Distribution Atlas of Vascular Plants in Poland – ATPOL [3]. The basic plot is considered a locality. In each basic plot separate floristic records were carried out. Their number depended on habitat differentiation and on the kind and intensity of anthropogenic impact. The range of anthropogenic transformation of habitats was determined according to Sukkopp [4]. The investigation showed varying human impact, differentiated by four hemeroby degrees of habitats: oligohemerobic (insignificantly disturbed, e.g. peatlands, natural forests and water bodies), mesohemerobic (little disturbed, e.g. managed forest, grasslands); euhermerobic (strongly disturbed, e.g. ruderal and segetal vegetation, greenwoods), and polyhermerobic (totally disturbed, e.g. railways, metalled roads). Within basic fields a total of 1,822 floristic-ecological records were made, including various types of habitats of natural, semi-natural and anthropogenic character (Table 1). The size of record plots depended on type of habitat (forest communities – 100-300 m²; clearing, shrub, ruderal, segetal communities – 25-100 m²; meadows, pastures, xerothermic grasslands, heathlands, rushes – 10-50 m²; peatlands, sandy grasslands – up to 10 m²; communities of traded sites – up to 5 m²; strips of waterside vegetation 10-50 m; strips of shrub and hedges 30-50 m).

The frequency classes were distinguished on the basis of intervals in the percentage of the number of locations of the given taxon in relation to the total number of plots (337) (Table 2). The ability of invading habitats of anthropogenic character was presented using the apophytization *Iap* indicator [5]:

$$Iap = \frac{\sum \text{of eu- and polyhermerobic localities}}{\sum \text{of all localities}}$$

The selection of meadow species for analysis was made on the basis of papers [6-8] and the author's observations. Characteristic species of the order *Molinietalia* and *Arrhenatheretalia* attached to moist and fresh meadows were selected. The nomenclature of species was given according to the work by Mirek et al. [9].

Results

On the basis of my own studies and on analysis of the source materials, 113 species of meadow plants were recorded in Cedyński Landscape Park. Of this number, eleven species are regarded as extinct or lost. Thirty other species are classified as rare or very rare in the park, e.g.

Table 2. Frequency of meadow species occurrence in Cedyňa Landscape Park according to recent records.

Frequency class	Frequency description	% of localities	Number of localities	Number of taxa	% of taxa
I	very rare	≤1.0	1-3	14	13.9
II	rare	1.1-3.0	4-10	16	15.8
III	fairly rare	3.1-6.0	11-20	12	11.9
IV	widespred	6.1-12.1	21-40	17	16.8
V	frequent	12.1-25.0	41-84	19	18.8
VI	very frequent	25.1-50.0	85-168	15	14.9
VII	common	50.1-100.0	169-337	8	7.9

Betonica officinalis, *Hieracium caespitosum*, *Taraxacum laevigatum*, *Campanula patula*, *Ophioglossum vulgatum*, *Galium boreale*, and *Polygonum bistorta*. Currently over 30% of species in the lowest frequency classes in the park – I and II (Table 2) – show a distinctly lower number of locations than in the past; e.g.: *Avenula pubescens*, *Leontodon hispidus*, *Crepis biennis*, *Linum catharticum*, *Rhinanthus serotinus*, *Briza media*, and *Polygala vulgaris*. It is possible that even these data are understated since no complete floristic reports concerning the park area in the past are available.

Meadow species occur in various types of habitats of semi-natural, natural and anthropogenic character (Fig. 1). In moist and fresh meadows and pastures the total number of 81 species of meadow plants was recorded. Small mid-forest meadows show a distinctly poorer species composition, 51 species having been noted there while in meadows outside the forest complexes – 74 species. A high number of meadow species was found along the banks of water courses and canals (a total of 69 species); in forest phytocenoses (a total of 72 species) chiefly in deciduous forests; and along the roads (a total of 76 species); fallows; near homesteads and at fences. The total number of 96 meadow species was noted in oligo- and mesohemerobic habitats, while 86 species occurred on eu- and polyhemerobic habitats.

Meadow species currently occurring in the investigated area show various apophytic tendencies (Fig. 1). 50 species chiefly or solely occur in semi-natural or natural habitats ($Iap < 0.33$), including *Achillea ptarmica*, *Lotus uliginosus*, *Polygonum bistorta*, and *Veronica longifolia*. 25 species occur decidedly more frequently in habitats of anthropogenic character ($Iap > 0.66$), including *Trifolium pratense*, *Trifolium repens*, *Leontodon autumnalis*, and *Galium mollugo*. 27 species were recorded equally often in not transformed and in anthropogenic habitats ($0.33 < Iap < 0.66$), including *Anthoxanthum odoratum*, *Poa trivialis*, *Knautia arvensis*, *Arrhenatherum elatius*, and *Stellaria graminea*.

Discussion

Of 113 species of meadow plants found in the area of CLP, 9.7% are extinct or lost. Evidently, this is not the full

list since formerly only fragmentary studies were carried out in the Park area. The data from the period between the wars and from early post-war years are particularly scarce. At that time *Euphorbia lucida* [10], *Inula salicina* [11], and *Tragopogon orientalis* [12] were recorded for the last time. Already in the late years of the 19th century the process of species recession was progressing owing to the development of agriculture and the enlargement of cultivated areas connected with the drainage of soils and the regulation of the Oder River. Within the system of jounkers' large estates, the productivity of agriculture constantly increased up to the end of World War II [13]. After the postwar period of the breakdown of the farm economy, the rapid development of agriculture, particularly of cattle and sheep breeding [14], continued from the 1960s.

More floristic data come from the '60s and '70s and particularly from the '90s. *Cardamine parviflora*, *Leontodon taraxacoides* [15], *Crepis capillaris*, *Serratula tinctoria* [16], *Gratiola officinalis* [17], *Rhinanthus minor*, *Sanguisorba officinalis* [18], and *Senecio aquaticus* [19] were recorded for the last time in that period. In the 1990s, of the past century with the collapse of large state farms and decreasing productivity of animal breeding, the grasslands were abandoned. No mowing and grazing were continued and the process of natural succession began resulting in the transformation of meadows into tall herb communities with bushes and trees overgrowing them. The increase in the

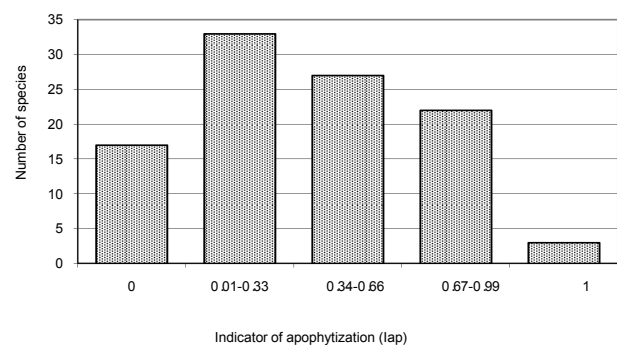


Fig. 1. Frequency of meadows species in groups with different Iap indicator of the apophytization coefficient (calculated for the current flora of the CLP).

cover of trees after the end of grazing is very detrimental to richness of grassland plants [20]. Inadequate ditches and drainage installations brought about the expansion of rush species, chiefly reeds. This process brought about changes in the qualitative and quantitative composition of meadow communities and impoverishment of their species composition. Nowadays similar processes are commonly observed in Poland and in Europe [21, 22]. Among the receding plants in the area of CLP the species of moist meadows of the order Molinietales, like *Selinum carvifolia*, *Lathyrus palustris*, *Scutellaria hastifolia*, *Trollius europaeus*, *Ophioglossum vulgatum*, *Polygonum bistorta*, and *Galium boreale*, prevail. Currently they appear on a few localities whose number is lower in comparison with historical data.

At present, 26.5% of meadow species are potentially threatened with extinction owing to the small number of stations. Species occurring in single stations are particularly threatened by random factors or economic activity. Here *Gratiola officinalis* [17] can be quoted as an example, since its only station in the park was destroyed during the great flood of 1997. Other valuable species such as *Juncus subnodulosus* and *Dactylorhiza majalis* are currently threatened by large fishponds built in river valleys.

A large group of meadow species (49%) currently occurring in the Park area was chiefly recorded in semi-natural and natural habitats (Fig. 1). These species prefer moist and wet habitats (Fig. 2 A) and just this factor considerably limits their capacity for growth in habitats transformed by man such as road sides or fallows that commonly occur in the Park area. Depending on species, they can be rarely found along the ditches or in the lower moist parts of earthen banks. With respect to spreading, these species belong to the low frequency classes, e.g. *Avenula pubescens*, *Dactylorhiza majalis*, and *Leontodon hispidus*. On the other hand, species widely distributed in the park (frequency class VI) are also encountered here: *Deschampsia caespitosa*, *Lysimachia vulgaris*, *Myosotis palustris*, *Lythrum salicaria*, *Juncus effusus*, and *Symphytum officinale*. These species are connected with habitats of natural

or semi-natural character. But unlike species of the low frequency classes, they can occur in diverse plant communities. They are found along the river banks and natural water courses, small reservoirs and wetlands, and peat bogs frequently occurring in the Oder River valley and in vast forest complexes, particularly in Piaskowa Forest.

Of the remaining 23 species reaching the highest frequency classes VI and VII (22.8% of meadow species) in the park area (Table 2), nine species are more often found in anthropogenic habitats than in semi-natural or natural ones (*Achillea millefolium*, *Bromus hordeaceus*, *Cerastium holosteoides*, *Dactylis glomerata*, *Galium mollugo* L. s. l., *Heracleum sibiricum*, *Plantago lanceolata*, *Taraxacum officinale*, and *Trifolium repens*); eight species occur equally frequently in both types of habitats (*Anthoxanthum odoratum*, *Arrhenatherum elatius*, *Knautia arvensis*, *Poa pratensis*, *Poa trivialis*, *Rumex acetosa*, *Veronica chamaedrys*, and *Vicia cracca*).

Economic activity has contributed to the formation of new habitats which were dominated by divergent species of foreign and native origin. Meadow species form a large proportion of apophytes [23, 24]. Similarly, in the investigated area numerous meadow species show apophytic tendencies. Some species of this group are equally frequently distributed in semi-natural, natural and anthropogenic habitats (26%) while the remaining ones (25%) are more frequent in transformed habitats (Fig. 1). In respect to preferences for soil moisture, the species occurring in fresh soils prevail among them (Fig. 2 B, C). The remaining small group of species of slightly higher moisture requirements (wet habitats) most frequently occur in anthropogenic habitats of a higher moisture content, e.g. *Achillea salicifolia* invades the roadsides that pass along wet fields and meadows and also occur in water-saturated bottoms of gravel-pits.

Among the habitats of a particularly rich composition of meadow species are the usually regularly mown herbaceous roadsides [25]. The eurytopic meadow species of the order Arrhenatheretalia such as *Dactylis glomerata*, *Daucus carota*, *Trifolium dubium*, *Bromus hordeaceus*,

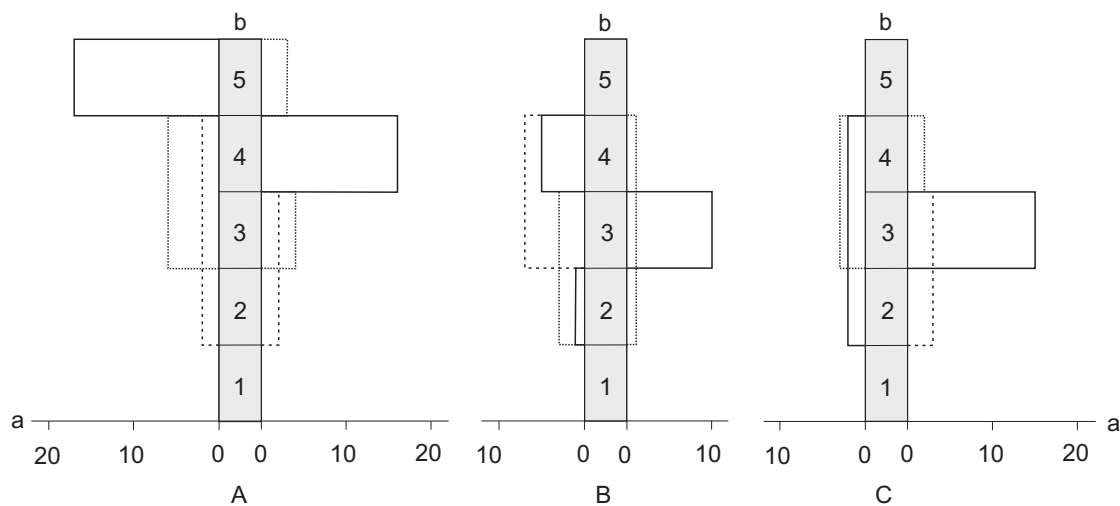


Fig. 2. Ranges of soil moisture value in group of meadows species were distinguished on the basis of the apophytization coefficient Iap: A – $I_{ap} \leq 0.33$; B – $0.33 \leq I_{ap} \leq 0.66$; C – $I_{ap} > 0.66$ (a – number of species, b – soil moisture value).

Achillea millefolium, *Pastinaca sativa*, and *Leucanthemum vulgare* are most abundantly represented here (Table 1). They are characterized by lower water requirements and hence they decidedly better accommodate in usually slightly drier, drained habitats in comparison with characteristic species attached to meadows of the Molinietales, order. Grassland plants use road corridors for dispersal [26], but road verges are dominated by common species [27]. In the landscape of the Park the accessibility and common occurrence of open habitats of the type of roadsides, fallows, yards at homesteads and fences, land reclamation ditches and earthen banks present the possibility of easy access for meadow species of fairly low ecological requirements. Owing to the apophytic tendencies observed in them, they also can spread in parts of the Park where no habitats of semi-natural and natural types most characteristic for them occur.

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