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ECOLOGICAL BASIS OF DEVELOPMENT OF MEADOW ECOSYSTEMS IN THE VALLEY OF THE SOUTHERN CANAL OF THE OBRA RIVER

Key words: meadows community, the Obra River Southern Canal valley, site, ecological factors, floristic diversity

S u m m a r y

In the course of long-term studies, the impact of site conditions – moisture condition and trophic factors – on meadow plant communities was assessed by determining their physiological structure and Shannon-Wiener floristic diversity index – H'. The obtained results were compared with the site and floristic investigations from 1994. In the case of the Obra River valley, it was moisture level and nitrogen content in the soil that exerted the most important influence on the development of meadow communities as indicated by the occurrence of unstable transitory forms. They differ from one another with regard to floristic diversity and a small proportion of characteristic species. Utilisation and its intensity, alongside site conditions, exert a modifying influence on the floristic composition of communities allowing random species to settle among them and to reduce their stability.

Introduction

The development of meadow-pasture communities is of anthropogenic nature. It is affected directly by human activities but, even more frequently, also by man's indirect actions affecting sites occupied by them [Barabasz 1997; Grynia 1996; Kryszak 2001; Kucharski 1999; Zarzycki 1999]. By altering the system of ecological conditions, these human multi-directional activities destroy the biocenotic equilibrium of meadow ecosystems and, consequently, lead to the formation of new communities.

In the case of meadow communities, especially changes in site moisture conditions result in significant vegetation transformations. They sometimes

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assume the character of degenerations and, at other times, regressions. In the course of these processes, phytocoenoses are characterised by a labile floristic composition. Grass communities, especially those situated on peat soils, are exposed to floristic transformations resulting from changes in site moisture conditions combined with peat degradation [Ilnicki 2004]. A good example of such changes is meadow communities in the region of the Obra River valley where, towards the end of the 18th century, land amelioration works were initiated which were later on abandoned. The neglect of amelioration facilities gradually led to, presumably, irreversible ecological and phytosociological changes in plant ecosystems.

The objective of long-term investigations is to assess the impact of site conditions – moisture level and trophic conditions – on the development of meadow communities in the Obra River valley and their floristic diversity.

Methods

The paper presents results of investigations carried out during the vegetation season 2004-2005 in the Obra River valley close to the Southern Canal (Przemęt – Perkowo). The analysis of the existing floristic condition was carried out on the basis of over 600 phytosociological relevés collected using the Braun-Blanquet method. The influence of site conditions: moisture levels (F) and trophic conditions assessed using the phyto-indication methods of Ellenberg [1992] and Oświt [1992] on plants was determined on the basis of the phytosociological structure of the indentified communities and the Shannon-Wiener floristic diversity index H' [Magurran 1996]. The obtained results were compared with the results of the site and floristic experiments from 1994.

Results and discussion

It was found that, at the present time, in the area of the Obra River Southern Canal "anthropogenic, semi-natural meadow and pasture communities from the *Molinio-Arrhenatheretea* class situated on non-swampy mineral and organic-mineral soils" were dominant. They were found to occupy nearly 80% of the area of the identified communities, of which syntaxons characteristic for sites with variable moisture levels from the *Molinietalia* order constituted almost 39%. Simultaneously, the floristic composition of many patches of communities of marshy sites of the *Phragmitetea* class exhibit transitory forms associated with the communities typical for variable moisture sites of the *Molinietalia* order. It can be assumed that in the near future their succession will move

towards communities of the *Molinio-Arrhenatheretea* class. On the other hand, it was found that areas occupied by the communities utilised for hay or as pastures with regulated water relationships from the *Arrhenatheretalia* order decreased by approximately 10% during the past 11 years (Table 1).

Table 1. Changes in the proportions of identified meadow communities in years 1994-2004 (%)

Plant community	Year 2005	Year 1994
With class *Phragmitetea*	21,3	15,3
With class *Scheuchzerio-Caricetea nigrae*	1,1	-
With class *Molinio-Arrhenatheretea*	77,6	84,7
- incl. order *Molinietalia*	38,5	27,5

The analysis of the floristic results and their comparison with the ecological results show that, primarily, the moisture level (the drop of the level of ground waters by about 0,5 m during the last 40 years) and site trophic conditions (N content in the soil) affected plant transformations of the meadow ecosystems in the Obra River Southern Canal (Table 2).

As mentioned above, numerous patches of communities developed as transitory forms, which is indicated by their phytosociological structure. The analysis of this structure allows indicating the future of the currently occurring meadow communities. It is interesting to note reduced proportions of species characteristic for the *Phragmitetea* class in communities of this class. One of such examples is patches of *Caricetum ripariae* occurring in marshy sites. During the years 1994-2005, the proportion of these species in the floristic composition of these patches declined by about 50%. No significant changes were observed in the species composition of the *Phalaridetum arundinaceae* association, which can be the result of its wide ecological scale.

At present, communities of the *Molinio-Arrhenatheretea* class appear to present more stable forms, although in some of their patches we can notice settlement or significant proportions of species characteristic for segetal and ruderal nitrophylic sites of the *Artemisietea* and *Stellarietea* classes (Table 3).

Table 2. Effect of changes in site conditions on the development of selected meadow communities

Moisture						N[**/]		Plant community
Ground water level (m)		According to Oświt		F[*/]				
1994	2005	1994	2005	1994	2005	1994	2005	
0,0-0,2	0,3-0,6	8,9	7,6	8,9	7,6	4,3	3,9	*Caricetum ripariae*
0,1-0,3	0,7-1,1	6,0	7,8	6,3	7,8	4,9	5,7	*Phalaridetum arundinaceae*
0,3-0,6	0,5-0,9	4,6	6,3	5,5	6,1	3,8	4,6	*Potentillo-Festucetum arundinaceae*
0,6-1,6	0,9-1,3	6,1	6,2	6,2	6,2	3,9	3,4	With *Deschampsia caespitosa*
0,9-1,3	1,0-1,5	5,7	6,5	5,8	5,8	5,7	5,5	*Alopecuretum pratensis*
1,2-1,6	1,5-1,9	4,6	5,2	4,9	5,0	4,8	5,2	*Arrhenatheretum elatioris*
1,0-1,5	1,3-1,7	5,0	6,2	4,9	5,0	5,4	4,3	*Lolio-Cynosuretum*

[*] F – moisture index [Ellenberg 1996], [**/] N – content of soil nitrogen index [Ellenberg 1996]

Table 3. Phytosociological structure of selected meadow communities

Plant community	Proportion of species characteristic for (%):								
	Phragmitetea		*Molinio-Arrhenatheretea*			*Artemisietea*	*Stellarietea*	*Scuechzerio-Caricetea nigrae*	Other class
			Total		*Molinietalia*				
	Year								
	1994	2005	1994	2005	2005	2005	2005	2005	2005
Caricetum ripariae	28,1	14,9	25,0	39,4	13,8	7,4	6,4	2,1	29,8
Phalaridetum arundinaceae	14,9	14,8	48,9	40,6	13,9	6,9	8,9	4,0	24,8
Potentillo-Festucetum arundinaceae	6,3	10,7	46,3	62,7	13,3	8,0	12,0	4,0	2,6
Com. with *Deschampsia caespitosa*	9,9	10,1	50,5	43,5	11,6	5,8	12,3	3,6	24,7

Alopecuretum pratensis	8,0	14,5	48,3	44,9	4,3	5,8	8,7	4,3	21,8
Arrhenatheretum elatioris	4,8	9,7	49,0	50,5	10,7	5,4	9,7	-	24,7
Lolio-Cynosuretum	2,3	3,7	58,4	70,4	-	7,4	3,7	-	14,8

The effect of site conditions, mainly moisture level, on the development of these communities is confirmed by the phytosociological structure of some communities. Their wide ecological scale with regard to moisture levels allows them to develop transitional patches which can be classified to lower phytosociological units in accordance with the gradient of declining moisture level. This is exemplified by *Phalaridetum arundinaceae, Deschampsia acaespitosa* community and *Arrhenatheretum elatioris* syntaxons (Table 4).

Table 4. Impact of moisture levels (F) on phytosociological variability of selected syntaxons

Wariant of association	F	Proportion of species characteristic for (%):				*H’
		Phragmitetea	*Molinio-Arrhenatheretea*		Other class	
			Total	*Molinietalia*		
Phalaridetum arundinacea						
Dry	4,9-5,2	8,8	60,8	17,4	30,4	3,04
Medium humid	5,3-6,5	13,5	44,9	14,6	41,6	3,98
Humid	6,6-7,8	20,7	46,6	17,2	32,7	3,88
Wet	7,9-8,6	45,0	15,0	10,0	40,0	2,86
Community with *Deschampsia caespitosa*						
Dry	4,1-5,2	5,7	47,7	7,9	46,6	3,69
Medium humid	5,3-6,5	11,4	43,1	10,6	45,5	4,00
humid	6,6-7,3	18,7	50,0	12,5	31,3	3,74
Arrhenatheretum elatioris						
Dry	4,0-5,2	6,7	54,1	6,7	39,2	3,82
Medium humid	5,3-6,4	11,3	52,1	9,9	36,6	3,62

* H’ – Diversity indicator according to Shannon-Wienner

Utilisation as well as its intensity can, together with site conditions, exert a modifying influence on the floristic composition of plant communities and can also contribute to the development of transitory forms. At the moment, majority of the communities occurring in the Obra River valley exhibit instability and undergo continuous changes which are caused by the competition between spe-

cies in changing conditions of site and utilisation. This is especially true with regard to the communities of the fresh sites of the *Molinio-Arrhenatheretea* class undergoing more intensive utilisation which are more open to the settlement of accidental species reducing their stability. On the other hand, syntaxons of the marshy sites of the *Phragmitetea* class less available to utilisation exhibit greater stability. This is confirmed by the proportion of species with the 5th or 6th degree of stability which makes up nearly 28% of species (Table 5).

Table 5. Distribution of the degree of species stability of selected meadow communities

Plant community	Constancy degree (%)				
	V	IV	III	II	I
Phragmitetea class					
Oenantho-Rorripetum	27,8	27,8	-	44,4	-
Caricetum ripariae	1,1	3,2	4,3	20,2	71,2
Caricetum gracilis	1,0	4,2	7,3	21,8	65,7
Phalaridetum arundinaceae	1,0	1,0	10,8	11,8	75,4
Molinio-Arrhenatheretea class					
Potentillo-Festucetum arundinaceae	3,1	5,2	6,2	12,5	73,0
Community with Deschampsia caespitosa	1,4	4,3	6,5	7,2	74,8
Alopecuretum pratensis	6,1	9,1	10,6	10,6	63,6
Arrhenatheretum elatioris	5,4	4,3	7,5	8,6	74,2
Lolio-Cynosuretum	18,5	33,3	-	48,2	-

A positive consequence of site variability is the possibility of developing transitional communities of greater floristic diversity than natural communities [Biderman 1990, Michalik 1990, Zarzycki 1999]. Apart from the moisture level, the effect of soil nitrogen and, especially, phosphorus contents as well as the soil reaction on the development of plant communities and their diversity becomes apparent [Janssens et al. 1997; Zarzycki 1999]. This is confirmed by the calculated values of the Shannon-Wiener index (H') which reveal differences between variants in relation to the moisture level (Table 4). The long-term investigations conducted in the Obra River valley show that site variability is the direct cause of the development of lower phytosociological units of greater floristic diversity, especially in the case of marshy sites [Kryszak et al. 2006].

Conclusions

1. Moisture levels and trophic factors were the main factors which influenced the development in the Obra River Southern Canal of meadow communities, as confirmed by the occurrence of unstable transitional forms.
2. The transitory forms of plant communities differ from one another with regard to floristic diversity and a small proportion of their own characteristic species.
3. Utilisation as well as its intensity, together with site conditions, can exert a modifying influence on the floristic composition of communities allowing the settlement of accidental species which reduce their stability.

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EKOLOGICZNE PODSTAWY WYKSZTAŁCANIA EKOSYSTEMÓW ŁĄKOWYCH W DOLINIE KANAŁU POŁUDNIOWEGO OBRY

Słowa kluczowe*:* zbiorowiska łąkowe, dolina Kanału Południowego Obry, siedlisko, czynniki ekologiczne, zróżnicowanie florystyczne

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

W trakcie badań oceniono wpływ warunków siedliskowych: uwilgotnienia i trofizmu na roślinność zbiorowisk łąkowych poprzez określenie ich struktury fitosocjologicznej oraz wskaźnika różnorodności florystycznej Shannona-Wienera – H'. Otrzymane wyniki odniesiono do badań siedliskowych i florystycznych z roku 1994. W dolinie Obry przede wszystkim uwilgotnienie oraz zawartość azotu w glebie wpłynęły na wykształcenie zbiorowisk łąkowych o czym świadczy występowanie niestabilnych form przejściowych. Różnią się one między sobą różnorodnością florystyczną oraz niewielkim udziałem gatunków charakterystycznych. Użytkowanie oraz jego intensywność obok warunków siedliskowych wpływa modyfikująco na skład florystyczny zbiorowisk, umożliwiając wkraczanie gatunkom przypadkowym obniżającym ich stabilność.