

GEOBOTANICAL AND ECONOMIC VALUATION OF MEADOW AND PASTURE COMMUNITIES AND THEIR USE

Summary

The study area covered communities of inundated meadows mainly from the class *Phragmitetea*, from the *Magnocaricion* and *Phragmition* alliances, located in the Noteć Bystra valley. Plant associations were evaluated in terms of their floristic diversity, Ellenberg's phytosociological indexes: moisture content (F), soil nitrogen content (N), soil reaction (R), as well as yielding and fodder value. The calculated floristic diversity (H') of communities ranges from 1.22 to 3.8, which results from their limited use and high groundwater levels, with dry matter yields ranging from 4.1 to 12.7 t ha⁻¹, and FVS ranging from 0.4 to 7.6.

Key words: water edge communities, relevé mean

GEOBOTANICZNA I GOSPODARCZA OCENA EKOLOGICZNYCH ZBIOROWISK ŁĄKOWO-PASTWISKOWYCH I ICH WYKORZYSTANIE

Summary

Obszar badań obejmował zbiorowiska łąk zalewanych głównie z klasy *Phragmitetea*, ze związku *Magnocaricion* i *Phragmition*, usytuowane w dolinie Noteci Bystrej. Asocjacje roślinne zostały ocenione pod względem różnorodności florystycznej, wskaźników fitoindykacyjnych według Ellenberga: wilgotności (F), zawartości azotu w glebie (N), odczynu gleby (R) oraz plonowania i liczby wartości użytkowej. Wyliczona różnorodność florystyczna (H') zbiorowisk wynosi od 1,22 do 3,8, co jest wynikiem ograniczonego użytkowania i wysokiego poziomu wód gruntowych, a plony s.m. wynoszą od 4,1 do 12,7 t ha⁻¹, natomiast wartość Lwu wynosi od 0,4 do 7,6.

Słowa kluczowe: zbiorowiska przywodne, średnio w zestawieniu

1. Introduction

Intensity of use and habitat conditions are the factors which have a tremendous effect on floristic diversity of plant communities, including meadow and pasture [5, 7, 8]. The territory of Poland is characterised by high biodiversity of communities, represented by over 350 plant species, which significantly interact forming multifaceted systems of interrelations, which may be referred to as "life community". Identification and assessment of its nature value and productivity as well as valuation of a habitat in terms of the diversity of plant and animal organisms, morphological land forms, type of soil and waters require information on all its components: flora, fauna and biotope [12, 14].

Some communities as a result of excessive moisture contents in the area are classified as wasteland despite their relatively good economic value [6, 13]. However, they serve many positive functions in the natural environment [1, 6, 9] and provide living and breeding grounds for many animal species, particularly avifauna [1]. Due to their high natural character they are of great aesthetic and nature value.

Diversity of species found in balanced associations is of considerable practical importance, as high proportions of grasses, sedges, papilionaceous plants and herbs in the sward of a meadow or pasture positively affect the quality of hay and products formed after its processing. Moreover, such a variation in the species composition ensures optimal utilisation of the habitat by meadow and pasture communities [5, 6].

The aim of the study was to conduct a multi-faceted geobotanical and economic evaluation of ecological meadow and pasture communities from the classes *Phragmitetea* and *Molinio-Arrhenatheretea* found in the Noteć valley.

2. Material and methods

2.1. Floristic analyses

Floristic analyses were conducted in the period from 2010 to 2013 in the Noteć Bystra valley in the Radolin-Radolinek section. A total of 91 relevés were prepared applying the conventional method by Braun-Blanquet [2] in plots of 20 m² (5 x 4 m) for the *Typhetum latifoliae* and *Caricetum vulpinae* associations and in plots of 100 m² (10 x 10 m) for greater single-species aggregations: *Phragmitetum australis* and *Phalaridetum arundinaceae*. Species were identified based on the nomenclature of the key "Polish plants" and "Vascular Plant of Poland a checklist" [11]. The plant community was classified using a syntaxonomic system according to Matuszkiewicz [10].

Floristic diversity was calculated by analysing the species composition, i.e. the botanical structure (in %), total number of species found in the community, mean number of species in a relevé and the calculated Shannon-Weiner's diversity index:

$$H' = -\sum (p_i \times \log p_i),$$

where:

H' – Shannon–Wiener's index,

Σ – the number of all species in the community,

p_i – the number of occurrences of a species in relevés.

2.2. Analyses of habitat conditions

The study included the following edaphic factors according to:

– Ellenberg [3] – moisture content (F), soil reaction (R) and nitrogen content in soil (N) assessed in the 9- and 12-point scales (the latter comprises only moisture conditions – F).

2.3. Evaluation of economic value

– Dry matter yield in t·ha⁻¹,
– valuation of fodder value score FVS according to Filippek [4] (tab.1).

Table 1. Sward classification in terms of economic usefulness [4]

Tab. 1. Klasyfikacja runi pod względem przydatności gospodarczej [4]

Uvn / Lwu	Sward / Ruń
8.1 - 10	very good / bardzo dobra
6.1 - 8.0	good / dobra
3.1 - 6.0	mediocre / mierna
< 3.0	poor / uboga

3. Results and discussion

Phytosociological association

- ❖ Class: *Phragmitetea* R. Tx. & Preising 1942
 - Order: *Phragmitetalia* Koch 1926
 - Alliance: *Phragmition* Koch 1926
 - *Phragmitetum australis* (Gams 1927) Schmale 1939
 - *Typhetum latifoliae* Soó 1927
 - Alliance: *Magnocaricion* Koch 1926
 - *Caricetum gracilis* (Graebn. & Hueck 1931) R. Tx. 1937
 - *Caricetum vulpinae* Nowiński 1928
 - *Phalaridetum arundinaceae* (Koch 1926 n.n.) Libb. 1931
- ❖ Class: *Molinio-Arrhenatheretea* R. Tx. 1937
 - Order: *Molinetalia caeruleae* W. Koch 1926

- Alliance: *Calthion palustris* R. Tx. 1936 em. Oberd. 1957
- *Angelico-Cirsietum oleracei* R. Tx. 1937 em. Oberd. 1967
- community *Dechampsia caespitosa* (= *Deschampsietum caespitosae* Horvatić 1930)
- Alliance: *Alopecurion pratensis* Pass. 1964
- *Alopecuretum pratensis* (Regel 1925) Steffen 1931
- Order: *Arrhenatheretalia* Pawł. 1928
- Alliance: *Arrhenatherion elatioris* (Br.-Bl. 1925) Koch 1926
- community *Poa pratensis*- *Festuca rubra* Fijałk.

The greatest number of total species occurrences in a relevé was recorded in the association *Phalaridetum arundinaceae* (62) and in the community *Poa pratensis*-*Festuca rubra* (61), while the association *Caricetum vulpinae* and the community *Dechampsia caespitosa* with 19 species predominated in terms of the mean number of occurrences in the relevé (tab.2). The highest percentage share of grasses was observed in the association *Caricetum gracilis* (30.43%), while it was lowest in the association *Phragmitetum australis* (11.11%). Plants from the family Fabaceae were not found in the associations from the alliance *Phragmition*, while their greatest share was recorded in the community *Poa pratensis*-*Festuca rubra* (9.84%). Sedges and Cyperaceae accounted for the greatest percentage share in the association *Caricetum vulpinae* (14.71%), while they were less abundant in the community *Dechampsia caespitosa* (2.08%). Herbs and weeds constituted the greatest proportion in the association of *Phragmitetum australis* (80.56%), while the lowest share was recorded in the association *Caricetum gracilis* (52.18%). The greatest floristic diversity was observed in the association *Alopecuretum pratensis* ($H' = 3.8$), while it was lowest in the association *Typhetum latifoliae* ($H' = 1.2$). Similar results of the analyses were reported by Grzelak et al. [7].

Table 2. Floristic diversity of featured communities

Tab. 2. Zróżnicowanie florystyczne wyróżnionych zbiorowisk

Association / Zespół Community / Zbiorowisko	Total number of species Gatunki ogółem	Mean in relevé Średnio w zestawieniu	Percentage share in association Procentowy udział w zespole				H'
			Poaceae Trawy	Fabaceae Bobowate	Sedges Turzyce i turzycowate	Herbs and weeds Zioła i chwasty	
Alliance / Związek: Phragmition							
Phragmitetum australis	36	8	11.11	-	8.33	80.56	1.4
Typhetum latifoliae	18	11	16.67	-	11.11	72.22	1.2
Alliance / Związek: Magnocaricion							
Caricetum gracilis	46	17	30.43	6.52	10.87	52.18	2.1
Caricetum vulpinae	34	19	20.59	5.88	14.71	58.82	1.5
Phalaridetum arundinaceae	62	14	22.58	3.23	6.45	67.74	2.9
Alliance / Związek: Calthion palustris							
Angelico-Cirsietum oleracei	45	17	26.67	4.44	4.44	64.45	2.6
zb. Dechampsia caespitosa	48	19	22.92	8.33	2.08	66.67	1.7
Alliance / Związek: Alopecurion pratensis							
Alopecuretum pratensis	45	7	26.67	8.89	4.44	60.0	3.8
Alliance / Związek: Arrhenatherion elatioris							
community Poa pratensis- Festuca rubra	61	15	26.23	9.84	3.28	60.65	2.7

Source: Authors' own research / Źródło: badania własne

Table 3. Habitat conditions of selected communities
Tab. 3. Warunki siedliskowe wyróżnionych zbiorowisk

Association / Zespół Community / Zbiorowisko	Wskaźniki fitoindykacyjne Phytoindication indexes					
	Soil moisture index (Ellenberg) – F Wskaźnik wilgotności gleby (Ellenberg) – F		Soil nitrogen index – N Wskaźnik zaw. azotu w glebie – N		Soil reaction – R Wskaźnik odczynu gleby – R	
	*W -V	**N-I	*W -V	**N-I	*W -V	**N-I
<i>Phragmitetum australis</i>	9.81	water edge przywodne	6.84	damp wilgotne	6.74	medium acidic śr. kwaśny
<i>Typhetum latifoliae</i>	9.98	water edge przywodne	7.78	damp wilgotne	6.89	medium acidic śr. kwaśny
<i>Caricetum gracilis</i>	6.7	wet / wilgotne	4.94	high / duża	3.94	acidic / kwaśny
<i>Caricetum vulpinae</i>	8.14	very wet bardzo wilgotne	4.63	moderate umiarkow.	2.19	very acidic b. kwaśny
<i>Phalaridetum arundinaceae</i>	9.2	water edge przywodne	6.6	high / duża	5.68	medium acidic śr. kwaśny
<i>Angelico-Cirsietum oleracei</i>	6.52	wet / wilgotne	4.4	moderate umiarkow.	6.07	medium acidic śr. kwaśny
zb. <i>Dechampsia caespitosa</i>	5.0	fresh / świeże	2.27	very low bardzo mała	2.18	very acidic b. kwaśny
<i>Alopecuretum pratensis</i>	6.54	wet / wilgotne	6.55	high / duża	5.69	medium acidic śr. kwaśny
zb. <i>Poa pratensis-Festuca rubra</i>	3.72	partly fresh częściowo świeże	3.46	mała low	2.16	very acidic b. kwaśny

according to Ellenberg [3] / według Ellenberga [3]

**** Intensity of factor Natężenie czynnika / *** Value Wartość

Table 4. Yield and use value in selected plant communities
Tab. 4. Plony oraz wartość użytkowa wyróżnionych zbiorowisk roślinnych

Association / Community Zespół roślinny / Zbiorowisko roślinne	Yield (t DM ha ⁻¹) Plony sm w t ha ⁻¹	FVS / Lwu	Number of species of eco- nomic value / Ilość gat. war- tościowych gospodarczo
<i>Phragmitetum australis</i>	12.7	1.4	1
<i>Typhetum latifoliae</i>	-	2.0	0
<i>Caricetum gracilis</i>	6.7	4.3	10
<i>Caricetum vulpinae</i>	5.7	0.4	2
<i>Phalaridetum arundinaceae</i>	7.4	4.7	1
<i>Angelico-Cirsietum oleracei</i>	5.2	4.5	3
zb. <i>Dechampsia caespitosa</i>	4.1	2.2	4
<i>Alopecuretum pratensis</i>	6.3	7.6	7
community <i>Poa pratensis-Festuca rubra</i>	5.7	4.7	2

FVS – fodder value score index according to Filipek [4] / * Lwu – liczba wartości użytkowej runi wg Filipka [4]

Habitat conditions in the investigated communities were evaluated based on 3 soil conditions: (F – moisture content, N – nitrogen resources, R – acidity) are varied (table 3).

In terms of the moisture content index F the communities may be divided into 5 groups. The first group comprises water edge plants from the association (*Typhetum latifoliae*, *Phragmitetum australis*, *Phalaridetum arundinaceae*). The second group is characterised as very moist – the association *Caricetum vulpinae*. The third group is composed of communities with the moist index value: *Caricetum gracilis*, *Alopecuretum pratensis* and *Angelico-Cirsietum oleracei*, the fresh community group (IV) comprises the community *Deschampsia caespitosa*, while (V) – partly fresh – the community *Poa pratensis-Festuca rubra*.

In terms of soil nitrogen resources (tab. 3) higher values (7.78 and 6.84) were recorded in the communities connected with the aquatic environment, i.e. *Typhetum latifoliae* and *Phragmitetum australis*, whereas the lowest N reserves and the lowest intensity were observed in the communities *Deschampsia caespitosa* (2.27) and *Poa pratensis-Festuca rubra* (3.46). When analysing soil reaction R they were divided into 3 groups: strongly acidic (0.18 – 2.16), acidic

and medium acidic with pH values ranging from 5.68 to 6.89.

Table 4 presents yields and fodder value of the analysed communities. The listed plant associations indicate considerable variability both in terms of their productivity and fodder value score. The association providing the highest yields of dry matter per 1 ha is *Phragmitetum australis* 12.7 t ha⁻¹, while the lowest yields of 4.1 t ha⁻¹ were recorded in the community *Deschampsia caespitosa*. In terms of its quality sward may be divided into 3 groups: poor with FVS <3.0, mediocre with FVS = 3.1- 6.0 and good with FVS = 6.1 – 8.0. The above mentioned communities also varied in the number of species of economic value. The highest number, i.e. as many of 10 species of economic value, was recorded in the association *Caricetum gracilis*.

1. In the analysed area the greatest area is covered by communities of inundated meadows, mainly from the class *Phragmitetum*, alliances *Magnocaricion* and *Phragmitetum*: *Phalaridetum arundinaceae*, *Caricetum gracilis*, *Caricetum vulpinae* as well as *Phragmitetum australis* and *Typhetum latifoliae*.

2. Smaller areas are covered by communities from the class *Molinio-Arrhenatheretea* from the alliances *Calthion palustris*, *Alopecurion pratensis* and *Arrhenatherion elatioris*: *Angelico-Cirsietum oleracei*, community *Deschampsia caespitosa*, *Alopecuretum pratensis* and community *Poa pratensis-Festuca rubra*.
3. The calculated floristic diversity index (H') varies, ranging from 1.22 to 3.8, which results from limited use and high groundwater levels.
4. Economic and fodder value of analysed meadows depends mainly on the local conditions and varied use, as evidenced by the dry matter yields (ranging from 4.1 to 12.7 t ha⁻¹) and FVS (from 0.4 to 7.6).

4. References

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