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NATURE VALUE, HABITAT CONDITIONS AND FODDER VALUE OF SELECTED ASSOCIATIONS IN SEMI-NATURAL MOIST MEADOWS IN THE NOTEĆ BYSTRA RIVER VALLEY

Summary

Floristic studies were conducted in two vegetation seasons, in 2013 and 2014. The object of analyses comprised selected phytocenoses of grass and tall sedge rushes classified to the class Phragmitetea, found in semi-natural meadows in the Noteć Bystra river valley. The selected plant associations are located at the town of Radolin, the Wielkopolskie province, the Czarnków-Trzcianka county, the Trzcianka commune. A total of 40 relevés for well-developed phytocenoses were prepared applying the 7-point scale according to Braun-Blanquet. As a result seven plant associations from two alliances (Phragmition and Magnocaricion) from the class Phragmitetea were identified. The recorded plant associations were characterised by considerable floristic diversity - 112 taxa belonging to 33 botanical families were identified, with the family Poaceae represented by the greatest number of species and found most commonly.
***Key words**: nature value, habitat conditions, fodder value, semi-natural moist meadows, biodiversity, the Noteć valley, Noteć Bystra*

WALORYZACJA PRZYRODNICZA, WARUNKI SIEDLISKOWE ORAZ WARTOŚĆ UŻYTKOWA WYBRANYCH ZESPOŁÓW ROŚLINNYCH SEMINATURALNYCH ŁĄK WILGOTNYCH W DOLINIE NOTECI BYSTREJ

Streszczenie

Badania florystyczne przeprowadzono w dwóch sezonach wegetacyjnych, w 2013 i 2014 roku. Obiekt badań stanowiły wybrane fitocenozy szuwarów trawiastych i wielkoturzycowych zaliczanych do klasy Phragmitetea, występujące na półnaturalnych łąkach usytuowanych w Dolinie Noteci Bystrej. Wybrane zespoły roślinne zlokalizowane są w miejscowości Radolin w województwie wielkopolskim - powiat czarnkowsko-trzcianecki, gmina Trzcianka. Stosując siedmiostopniową skalę metody Braun- Blanqueta wykonano 40 zdjęć fitosocjologicznych dobrze wykształconych płatów roślinności. Umożliwiło to wyróżnienie siedmiu zespołów roślinnych wchodzących w skład dwóch związków (Phragmition i Magnocaricion) z klasy Phragmitetea. Wyróżnione asocjacje roślinne cechowały się znaczną różnorodnością florystyczną. Sklasyfikowano 112 taksonów należących do 33 rodzin botanicznych, wśród których najliczniejszą w gatunki, a także najczęściej reprezentowaną była rodzina wiechlinowatych.
***Słowa kluczowe**: waloryzacja przyrodnicza, warunki siedliskowe, wartość użytkowa, półnaturalne łąki wilgotne, bioróżnorodność, dolina Noteci, Noteć Bystra*

1. Introduction

Considerable floristic diversity and abundant species richness are indispensable elements of permanent grasslands located in river valleys. This is promoted by abiotic factors, i.e. climate and soil conditions found in a given location and providing an area conducive to the occurrence of these species. Habitat conditions and human activity, particularly land use intensity, influence the mosaic character of the formed vegetation cover. Among habitat factors moisture content is definitely the most important. It affects not only the character, but also the rate of processes taking place in the soil, while it also directly contributes to changes in the habitat diversification and floristic composition of plant associations found in the area [5, 6, 7, 10, 11, 15].

Esthetic and landscape value in combination with historical and cultural value as well as productivity and land use also constitute aspects characterising river valleys [4, 9, 15]. We also need to mention here their protective function in relation to the avian fauna and small animals [8].

The Noteć river valley, including the rapids of this river, is classified to well-developed river valleys, with its diverse geomorphological structure considerably contributing to the variation in its habitat conditions. Plant associations discussed in this study are characteristic to habitats related with the numerous land depressions as well as river valleys and ice marginal valleys, in the vicinity of which stagnating and flowing watercourses are found [15]. Richness of the floristic cover in the agricultural landscape is connected with a marked dominance of meadows and pastures, which retain their form thanks to the application of grassland cultivation measures [8, 12, 15].

2. Material and methods

The material for this study was provided by relevés prepared using the classical Braun-Blanquet method [1]. Relevés were established on well-developed phytocenoses; as a result, selected plant associations could be easily classified to the phytosociological system [12]. Based on the analysis of the species composition, including the botanical structure of plants in the sward (%), total number of species as well as the diversity index (H') according to Shannon-Wiener [5] floristic diversity of selected plant associations

was identified. Additionally, using the nature valuation method of wetlands and valuation classes the nature value index L_{wal} was calculated [14]. Moreover, using phytoindication indexes habitat conditions were determined, considering soil factors including moisture content (F), soil reaction (R) and soil nitrogen content (N) [2]. Using fodder value score FVS [3] the fodder value was estimated for selected plant associations. Botanical nomenclature was adopted after Mirek et al. [13].

Identified associations:

- Class: *Phragmitetea* R. Tx. & Preising 1942
  - Order: *Phragmitetalia* Koch 1926
    - Alliance: *Phragmition* Koch 1926
      - ***Phragmitetum australis* (Gams 1927) Schmale 1939**
      - ***Typhetum latifoliae* Soó 1927**
      - ***Glycerietum maximae* Hueck 1931**
    - Alliance: *Magnocaricion* Koch 1926
      - ***Caricetum acutiformis* Sauer 1937**
      - ***Caricetum gracilis* (Graebn. et Hueck 1931) R. Tx. 1937**
      - ***Cariccetum vulpinae* Nowiński 1928**
      - ***Phalaridetum arundinaceae* (Koch 1926 *n.n.)* Lib. 1931**

2.1. Floristic studies

Field studies were conducted in the years 2013-2014 in Radolin located in the Noteć Bystra river valley, the Trzcianka commune, the Czarnków-Trzcianka county, the Wielkopolskie province. A total of 40 relevés were prepared for well-developed vegetation, thanks to which 7 plant associations were recorded (Table 1), identifying 112 taxa from 33 botanical families. The characteristic species for each of the described plant formations had a high cover index (D) and stability index (S), *Phragmitetum australis* ($S=V^{4-5}$, D=6964.29), *Typha latifolia* ($S=5^{3-4}$, D=5000), *Glyceria maxima* ($S=V^{4-5}$, D=7750), *Carex acutiformis* ($S=V^{3-5}$, D=5750), *Carex gracilis* ($S=V^{3-4}$, D=4821), *Carex vulpinae* ($S=V^{2-4}$, D=5350) and *Phalaris arundinacea* ($S=V^{3}$, D=3750). The highest number of species in a relevé was recorded in the association *Caricetum acutiformis* - 50, while it was lowest (20) in the association *Typhetum latifoliae*. In turn, the highest number of botanical families (22) were recorded in the association *Caricetum vulpinae*, Analysed phytocenoses were characterised by a low floristic diversity. For the identified plant associations the highest calculated Shannon-Wiener index H' = 1.645 was recorded for *Caricetum acutiformis*.

The highest nature value index for the species composition of individual plant associations was recorded for the association *Glycerietum maximae* and it amounted to L_{wal}=3.7 (value class VII C), which indicates high nature value (Table 2). The lowest index value was found for the association of reed canary grass (*Phalaridetum arundinaceae*) - L_{wal}=2.8 (class V B - medium moderate nature value). We need to stress the fact that all the communities found in the investigated area had mean value index L_{wal}= 6.3, assigning it to class IX D, with outstanding nature value. In relation to floristic diversity, particularly H' and L_{wal}, similar results for *Caricetum gracilis* and *Phalaridetum arundinacea* were reported by Murawski et al. [15], while for *Caricetum acutiformis* and *Caricetum vulpinae* - by Grzelak et al. [6].

2.2. Habitat conditions

Habitat conditions for the analysed plant associations were determined using phytoindication indexes (Table 3).

Table 1. Floristic diversification of identified plant communities
Tab. 1. Zróżnicowanie florystyczne wyróżnionych zbiorowisk roślinnych

Identified plant association	Species (number)			% share of crop plants in the sward				H'
	Total	Mean for relevé	Botanical families	Grasses	Sedges	Legumes	Herbs and weeds	
Phragmitetum australis	26	8	17	15	8	-	77	1.3
Typhetum latifoliae	20	9	14	10	10	-	80	1.3
Glycerietum maximae	33	12	14	27	21	-	52	1.5
Caricetum acutiformis	50	19	19	22	14	6	58	1.6
Caricetum gracilis	33	13	13	30	6	12	52	1.5
Caricetum vulpinae	41	18	22	17	15	5	63	1.6
Phalaridetum arundinaceae	39	13	17	33	5	8	54	1.5

Source: the authors' study / Źródło: opracowanie własne

Table 2. Nature value index for selected plant associations based on identified plant species and plant communities according to Oświt [16]
Tab. 2. Wskaźnik waloryzacji przyrodniczej wybranych asocjacji roślinnych na podstawie występujących gatunków roślin oraz zbiorowisk roślinnych wg Oświta [16]

Identified plant association	Mean value index	Value class	Nature value
Phragmitetum australis	3.3	VI B	Moderately high
Typhetum latifoliae	3.5	VII C	high
Glycerietum maximae	3.7	VII C	high
Caricetum acutiformis	3.2	VI B	Moderately high
Caricetum gracilis	2.9	V B	Medium moderate
Caricetum vulpinae	3.6	VII C	high
Phalaridetum arundinaceae	2.8	V B	Medium moderate
Plant communities jointly	6.3	IX D	outstanding

Source: the authors' study / Źródło: opracowanie własne

Table 3. Habitat conditions for identified plant communities
Tab. 3. Warunki siedliskowe wyróżnionych zbiorowiska

Identified plant communities	Phytoindicator values according to Ellenberg and Leuschner [2]					
	F		R		N	
	value	intensity	value	intensity	value	intensity
Phragmitetum australis	9.73	Habitats located along water bodies	6.67	Neutral and weakly neutral	6.69	high
Typhetum latifoliae	9.41	Habitats located along water bodies	5.8	Weakly acid and neutral	7.6	high
Glycerietum maximae	9.78	Habitats located along water bodies	7.23	Neutral and weakly neutral	8.41	very high
Caricetum acutiformis	8.05	Wet	5.66	Weakly acid and neutral	4.88	moderate
Caricetum gracilis	8.27	Wet	5.21	Weakly acid and neutral	4.63	moderate
Caricetum vulpinae	8.26	Wet	1.51	Very acid	5.07	moderate
Phalaridetum arundinaceae	7.75	Fresh and moist	5.86	Weakly acid and neutral	6.35	high

Source: the authors' study / Źródło: opracowanie własne

In the case of the factor referring to moisture content, its intensity may be presented in terms of three groups: habitats located along water bodies with F=9.41-9.78 (the highest value, *Glycerietum maximae*), very wet with F=8.05-8.27 and fresh and partly moist F=7.75 (*Phalaridetum arundinaceae*). When comparing soil acidity, the investigated plant associations may also be divided into 3 groups: highly acid (R=1.51) - *Caricetum vulpinae*, weakly acid and neutral at R=5.21-5.86 (*Phalaridetum arundinaceae*) as well as neutral and weakly neutral at R=6.67-7.23 (*Glycerietum maximae*). When investigating soil trophic levels the intensity of the factor was also divided into three groups: moderate intensity N=4.63-5.07 (*Caricetum vulpinae*), high F=6.35-7.6 (*Typhetum latifoliae*) and very high F=8.41 - *Glycerietum maximae*. Similar results for *Caricetum gracilis* and *Phalaridetum arundinacea* were obtained by Murawski et al. [15].

2.3. Fodder value

Fodder value of swards in individual plant associations is presented in Table 4. The lowest value was recorded for the rushes of *Phragmitetum australis* and *Caricetum acutiformis* FVS= 1.11. The highest number of economically valuable species (13) was reported in the plant association *Phalaridetum arundinaceae*, which was characterised by good sward value FVS= 6.32. Mediocre value at FVS= 4.54 was also observed (*Glycerietum maximae*).

Table 4. Fodder value score of identified plant communities
Tab.4. Wartość użytkowa wyróżnionych zbiorowisk roślinnych

Identified plant communities	Number of valuable species	Fodder value	
		*FVS	value
Phragmitetum australis	2	1.11	poor
Typhetum latifoliae	1	1.22	poor
Glycerietum maximae	4	4.54	mediocre
Caricetum acutiformis	11	1.11	poor
Caricetum gracilis	11	1.92	poor
Caricetum vulpinae	6	1.51	poor
Phalaridetum arundinaceae	13	6.32	poor

*FVS – fodder value score index [3]

Source: the authors' study / Źródło: opracowanie własne

3. Conclusions

1. The calculated floristic diversity (H') varied, with the highest value of the index H'=1.6 recorded for the association *Caricetum acutiformis*, while the lowest H'=1.3 - for the association *Typhetum latifoliae* 2, which is a consequence of progressing changes in habitat moisture contents.
2. The highest mean value index L_{wal}=3.7 was recorded for the plant association *Glycerietum maximae*, while the lowest L_{wal}=2.8 - for the plant association *Phalaridetum arundinaceae*. The mean value index for the identified plant communities (L_{wal}= 6.3) assigns them to class IX D, characterised by outstanding nature value.
3. Thanks to the application of indicator values according to Ellenberg and Leuschner it may be stated that the identified plant associations represent considerable diversity in terms of their habitat conditions.
4. The economic and fodder value of the investigated meadow plant associations depends mainly on habitat conditions and their varied land use. The highest fodder value FVS=6.3 was recorded for the association *Phalaridetum arundinacea*, while the lowest value was reported for the plant associations *Phragmitetum australis* and *Caricetum acutiformis* with FVS= 1.1.

4. References

[1] Braun-Blanquet J.: Pflanzensoziologie. Wien: Springer Verl. 1954.
[2] Ellenberg H., Leuschner C.: Vegetation Mitteleuropas mit den Alpen in ökologischer, dynamischer und historischer Sicht. 6. Aufl. Eugen Ulmer, Stuttgart, Germany, 2010.
[3] Filipek J.: Projekt klasyfikacji roślin łąkowych i pastwiskowych na podstawie liczb wartości użytkowej. Post. Nauk Roln., 1973, 4: 59-68.
[4] Gajewski P., Grzelak M., Kaczmarek Z., Glina B., Mocek A., Rybczyński P., Tylman O.: Geobotanical conditions of grassland habitats in the Samica Leszczyńska valley. Journal of Research and Applications in Agricultural Engineering, 2016, 61 (3): 101-104.
[5] Gajewski P, Kaczmarek Z., Owczarzak W., Glina B., Grzelak M., Murawski M.: Floral and habitat diversity of ecological grasslands in the Bystra Noteć Valley. Journal of Research and Applications in Agricultural Engineering, 2015, 60 (3): 47-51.
[6] Grzelak M., Gaweł E., Janyszek M., Wrońska-Pilarek D., Janyszek S., Murawski M., Runowski S., Knioła A.: Nature and fodder value of grass-sedge communities in the Noteć

valley in the Natura 2000 area. Journal of Research and Applications in Agricultural Engineering, 2017, 62 (3): 135-140.
[7] Grzelak M., Gaweł E., Mackiewicz D., Murawski M., Knioła A.: Floristic and habitat analyses and natural value of the association *Potentillo-Festucetum arundinaceae* (R.Tx. 1933). Nordh. 1940. Journal of Research and Applications in Agricultural Engineering, 2016, 61 (3): 173-175.
[8] Grzelak M., Murawski M., Knioła A.: Geobotanical and economic valuation of meadow and pasture communities and their use. Journal of Research and Applications in Agricultural Engineering, 2014, 59 (3): 76-79.
[9] Kaczmarek Z., Gajewski P., Mocek A., Grzelak M., Knioła A., Glina B.: Geobotanical conditions of ecological grasslands on light river alluvial soils. Journal of Research and Applications in Agricultural Engineering, 2015, 60 (3): 131-135.
[10] Kaczmarek Z., Grzelak M., Gajewski P.: Warunki siedliskowe oraz różnorodność florystyczna ekologicznych siedlisk przyrodniczych w Dolinie Noteci. Journal of Research and Applications in Agricultural Engineering, 2010, 55 (3): 142-146.
[11] Kaczmarek Z., Grzelak M., Gaweł E., Gajewski P., Janyszek M., Glina B.: The diversity of *Scirpetum silvatici* Ralski 1931 association as a result of influence of variable habitat conditions. Journal of Research and Applications in Agricultural Engineering, 2017, 62 (3): 158-162.
[12] Kryszak A., Grynia M.: Zbiorowiska trawiaste siedlisk nadmiernie uwilgotnionych w dolinach rzecznych. Łąkarstwo w Polsce, 2005, 8: 97-106.
[13] Matuszkiewicz W.: Przewodnik do oznaczania zbiorowisk roślinnych Polski. PWN Warszawa, 2014.
[14] Mirek Z., Piekoś-Mirkowa H., Zając A., Zając M.: Vascular plants of Poland. A checklist. Krytyczna lista roślin naczyniowych Polski. Pol. Bot. Stud. Guideb. Ser. 15, 1-303. W. Szafer Institute of Botany, Polish Acad. of Scien., Kraków, 2002.
[15] Murawski M., Grzelak M., Gajewski P., Kaczmarek Z., Runowski S., Zalas M.: Habitat evaluation, habitat conditions and utility value of selected plant associations in seminatural moist meadows in the Noteć Leniwa river valley. Journal of Research and Applications in Agricultural Engineering, 2017, 62 (4): 29-32.
[16] Oświt J.: Metoda przyrodniczej waloryzacji mokradeł i wyniki jej zastosowania w wybranych obiektach. Falenty: IMUZ, 2000, 23: 3-32.

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