Mieczysław GRZELAK[1], Eliza GAWEŁ[2], Magdalena JANYSZEK[3], Dorota WROŃSKA-PILAREK[4], Sławomir JANYSZEK[3], Maciej MURAWSKI[1], Sławomir RUNOWSKI[5], Agnieszka KNIOŁA[1]
Poznań University of Life Science
[1] Department of Grassland and Natural Landscape Sciences, [2] Department of Forage Crop Production,
[3] Department of Botany, [4] Faculty of Botany Forestry, [5] Faculty of Animal Breeding and Biology
ul. Wojska Polskiego 28, 60-637 Poznań, Poland
e-mail: grzelak@up.poznan.pl

NATURE AND FODDER VALUE OF GRASS-SEDGE COMMUNITIES IN THE NOTEĆ VALLEY IN THE NATURA 2000 AREA

Summary

Studies aiming at the evaluation of nature and fodder value of grass-sedge communities were conducted in the years 2009-2013 in the Natura 2000 area in the Noteć Leniwa and Bystra valley on meadows with varied moisture and trophic conditions. They showed that a significant effect on the formation of grass communities, their richness and floristic diversity, as well as nature and agricultural value is exerted by moisture conditions resulting from habitat mosaic and management intensity. Most analysed communities of considerable nature value have mediocre productivity value, providing yields (d.m.) of 1.6 - 14.6 t·ha^{-1}. Their fodder value score FVS ranged from 1.1 to 7.4, while the calculated floristic diversity (H') was varied and ranged from 1.2 to 4.2. Some of the communities are barren land.
***Key words**: biogens, habitat moisture content, floristic diversity, nature value*

WALORY PRZYRODNICZO-UŻYTKOWE ZBIOROWISK TRAWIASTO-TURZYCOWYCH W DOLINIE NOTECI NA OBSZARZE NATURA 2000

Streszczenie

Badania walorów przyrodniczych i użytkowych zbiorowisk trawiastych i szuwarowych przeprowadzone w latach 2009-2013, na obszarze Natura 2000 w dolinie Noteci Leniwej i Bystrej, na łąkach o zróżnicowanych warunkach wilgotnościowych i troficznych. Dotyczyły one walorów przyrodniczych i użytkowych. Wykazały one, że na wykształcanie się zbiorowisk trawiastych, ich bogactwo i różnorodność florystyczną, walory przyrodnicze oraz rolnicze, istotny wpływ ma przede wszystkim uwilgotnienie, które wynika z mozaikowatości siedlisk, i intensywność użytkowania. Większość cennych przyrodniczo zbiorowisk posiada mierną wartość gospodarczą i wartość użytkową Lwu wynosząca od 1,1 do 7,4, a niektóre są nieużytkami. Wyliczona różnorodność florystyczna (H') jest zróżnicowana i wynosi od 1,2 do 4,2, a uzyskiwane plony s.m. wynoszą od 1,6 do 14,6 t·ha^{-1}. Celem pracy była ocena walorów przyrodniczych i użytkowych zbiorowisk trawiasto-turzycowych dolinie Noteci na obszarze Natura 2000 na odcinku Białośliwie- Radolinek na obszarze Natura 2000.
Słowa kluczowe: biogeny, wilgotność siedlisk, różnorodność florystyczna, wartość przyrodnicza

1. Introduction

River valleys together with the surrounding plant communities constitute areas of considerable nature, productive and cultural value [14]. When preserved in the natural state they are ecosystems of the most complex structure and relatively rich biodiversity. Development of grassland communities, their richness and floristic diversity, nature and agricultural value are determined first of all by their moisture content, which results from their mosaic structure of habitats, their trophic levels and use intensity [4, 7, 10, 11, 15]. Thus the floristic composition of grassland communities and biodiversity are influenced both by the intensification and negligence of management. Many river valleys are locations of natural habitats and habitats for species of European importance, which are to be protected by the Natura 2000 ecological network [6, 20].

In the Noteć river valley we may still find vast sedge meadows, fens and partially shrub-covered flood meadows, which are primary refuges of various species from the Polish Red Book. For this reason in 2004 one of the obligations for Poland connected with the accession to the EU was to establish Natura 2000 areas. It is a network of protected areas aiming at the preservation of habitats as well as plant and animal species of particular value to the EU. In turn, in December 2009 the Ministry of Agriculture commissioned a preliminary concept for the establishment of High Nature Value (HNV) areas in rural areas of Poland and a monitoring programme designed for these areas. High Nature Value areas are these areas, on which farming activity is conducted, which character and performance contribute to the conservation of biodiversity, valuable species and habitats of the agricultural landscape. From the point of view of the European Union the greatest value is attributed to natural habitats, which existence is threatened in their natural range. They are characterized by high biodiversity. It results from the development of new ecological niches colonized by successive species, both native and alien, accidentally introduced a long time ago and established (archaeophytes). They also include rare species, having specific habitat requirements or exhibiting low competitiveness in relation to other species [4]. In Poland one of the methods to prevent loss of biodiversity is to implement an environmental management scheme [2, 5]. The primary aim of the scheme is to improve the quality of the natural environment, particularly maintenance and restoration of the original condition of the most valuable natural habitats. Management practices on permanent grassland are restricted and many bans are binding in all packages, covering meadows and pastures.

Habitats associated with river valleys are considered to be particularly threatened, especially by human activity. These areas are transformed to obtain water, generate energy, provide flood control or sewage discharge. Intensification of farming, negligence of use for hay or grazing, deforestation and urbanisation result in changes in vegetation cover. As a consequence the nature, economic and recreational value of river valleys is reduced. Thus extensive farming, with a high share of permanent grassland, is of paramount importance for the protection of the Natura 2000 areas [21].

The aim of this study was to assess nature and productive value of grass and sedge communities in the Noteć river valley, at the Białośliwie-Radolinek section, within the Natura 2000 area.

2. Materials and methods

Scientific analysis was performed on results of geobotanical studies conducted in the years 2009-2013 in the Noteć Leniwa and Bystra river valley at the Białośliwie-Radolinek section in the Wielkopolskie province, the Czarnków-Trzcianka county. A total of approx. 160 relevés prepared using the Braun-Blanquet [1] method were analysed. Distinguished syntaxa were identified and classified to the phytosociological system according to Matuszkiewicz [8]. Next meadow communities were subject to the valuation of their nature value, appraising individual nature values in a 10-point gradual scale: the mean value score, nature value and quality class (Table 1) according to Oświt [13] and based on the floristic diversity index according to Shannon-Wiener (H'). The moisture status of habitats was evaluated using the phytoindication method according to Klapp, as modified by Oświt [12]).

Table 1. Nature value index according to Oświt [13]
Tab. 1. Wskaźnik waloryzacji przyrodniczej według Oświta [13

Quality class	Determination of nature value	Range of mean index value
I A	medium low	<1,4
II	medium low	1,5 – 1,8
III	low	1,9 – 2,2
IV B	moderate	2,3 – 2,6
V	medium moderate	2,7 – 3,0
VI	moderately high	3,1 – 3,4
VII C	high	3,5 – 3,8
VIII	very high	3,9 – 4,2
IX D	outstanding	4,3 – 4,6
X	unique/exceptional	>4,6

A- Low value, B- moderate, C- high, D- outstanding

Fodder value of individual communities was estimated based. Dry matter yield was determined (drying at 105) and fodder value score FVS (Table 2) according to Filipek [3].

Table 2. Fodder value score FVS for individual communities [3]
Tab. 2. Wartości użytkowe Lwu dla poszczególnych zbiorowisk [3]

Numerical FVS value	Plant characteristics
10 – 9	very good fodder plants
8 – 7	good fodder plants
6 – 4	plants of medium fodder value
3 – 1	plants of low fodder value
0	species of no fodder value
(-3) – (-1)	poisonous species

3. Results and discussion

Species diversity of grassland ecosystems depends first of all on the variation in environmental conditions. In the case of river valley ecosystems the most significant factor distinguishing them from others is connected with horizontal water flow in the river channel. Individual plant species are not distributed randomly, but form characteristic clusters, differing in habitat conditions, nature and fodder value. A survey of the most important plant communities in the Noteć Bystra and Leniwa river valley does not indicate all potential associations and their groups. However, it provides a certain insight into the exceptional natural diversity of riparian areas. Distinguished syntaxa were identified and classified to the phytosociological system according to Matuszkiewicz [8].

Phytosociological classification of distinguished communities

Rush and salt sedge meadow communities

1. Class: *Phragmitetea* R. Tx. et Prsg 1949

Communities of grassland, tall sedge rushes
O.: *Phragmitetalia* Koch 1926
Riparian reeds
All.: *Phragmition* Koch 1926
A group of riparian reeds with *Magnocaricion* species
Low rush communities in shallow standing waters (up to 0.5 m)
Ass.: *Eleocharietetum palustris* Šennikow 1919
Ass.: *Equisetum fluviatilis S*teffen 1931
Tall rush communities in deeper waters
Ass.: *Phragmitetum australis* (Gams 1927) Schmale 1939
Ass.: *Typhetum angustifoliae* (Allorge 1922) Soó 1927
Riparian reeds with variable water levels
Ass.: *Glycerietum maximae* Hueck 1931
Tall sedge rushes
All.: *Magnocaricion* Koch 1926
Communities of tall (up to 1.5 m) sedges forming tufts or with thick runners not forming a sward
Ass.: *Caricetum riparie* Soó 1928
Ass.: *Caricetum acutiformis* Sauer 1937
Communities of sedge meadows, at least partially anthropogenic
Ass: *Caricetum distichae* (Nowiński 1928) Jonas 1933
Ass: *Caricetum gracilis* (Graebn. et Hueck 1931) R. Tx. 1937
Floodplain non-peat sedge rushes or grassland rushes
Ass.: *Phalaridetum arundinaceae* (Koch 1926 n.n.) Lib. 1931
Ass.: *Caricetum vulpinae* Nowiński 1928

Semi-natural and anthropogenic grassland and meadow sward communities:

2. Class: *Molinio-Arrhenatheretea* R.Tx. 1937

Low swards in periodically flooded or waterlogged locations
O.: *Trifolio fragiferae-Agrostietalia stoloniferae* R.Tx.1970
Floodplain swards
All.: *Agropyro-Rumicion crispi* Nordh.1940 em.R.Tx.1950
Low, but dense moist swards with significant grazing
Ass.: *Ranunculo-Alopecuretum geniculati* R.Tx.1937
Communities relatively highly resistance to short-term drying
Ass.: *Potentillo-Festucetum arundinaceae* (R.Tx.1933) Nordh. 1940
com. with *Agropyron repens*

Permanent or periodically moist, fertile hay meadows
O.: *Molinietalia caeruleae* W. Koch 1926
Anthropogenic or semi-natural herb communities along watercourses
All.: *Filipendulion ulmariae* SEGAL 1966
Communities found on slightly dried fens, no longer used as hay meadows
Ass.: *Lythro-Filipenduletum ulmariae* Hadač et. all. 1997
com. *Filipendula ulmariae*
At least semi-natural herb communities composed of tall herbaceous perennials
All.: *Calthion palustris* R.Tx. 1936 em. Oberd. 1957
Group of eutrophic moist meadows
Ass.: *Angelico-Cirsietum oleracei* R. Tx. 1937 em. Oberd. 1967
Group of wet, marshy meadows
Ass. *Scirpetum sylvatici* Ralski 1931
Group of wet, marshy meadows
com. *Deschampsia caespitosa* (= *Deschampsietum caespitosae* Horvatić 1930)
Comminities of intensively managed meadows, with spontaneous species composition
All.: *Alopecurion pratensis* Pass. 1964
Communities with the dominant meadow foxtail, the so-called foxtail meadow
Ass.: *Alopecuretum pratensis* (Regel 1925) Steffen 1931
Communities of fertile meadows on fresh mineral soils
O.: *Arrhenatheretalia elatioris* Pawł. 1928
Hornbeam-oak forest meadows, double- and multi-swath
All.: *Arrhenatherion elatioris* (Br.-Bl. 1925) Koch 1926
Ass. *Arrhenatheretum elatioris* Br.-Bl. ex Scherr. 1925
com. *Poa pratensis-Festuca rubra* Fijałk. 1962
Fertile lowland and mountain pastures
All.: *Cynosurion* R.Tx. 1947
Ass. *Lolio-Cynosuretum* R.Tx. 1937

Species diversity

In the river valley shrub and forest associations develop in areas not utilised agriculturally. In turn, in the riparian areas typically rush vegetation develops, depending first of all on the type of management use, followed by the groundwater level and frequency of flooding. They are tall sedge rushes: *Caricetum ripariae, Caricetum acutiformis, Caricetum gracilis, Caricetum vulpinae*) and in the so-called ecotone zone they are exceptionally diverse riparian reed rushes, overgrowing ox-bow lakes, bodies of stagnant waters and riparian areas: *Phragmitetum australis, Typhetum angustifoliae, Glycerietum maximae* (Table 3), as well as herb communities at forest edges. Tall sedge communities are characterised by a high percentage share of sedges and Cyperaceae in the association of true fox sedge amounting to 48.71%, up to 69.80% in the association of lesser pond sedge, with Fabaceae being absent or found in low numbers, and a considerable share of grasses, but always lower than the share of herbs and weeds. In turn, reed and narrowleaf cattail rushes are associations of standing or slow-flowing waters with a slight share of sedges, absence of Fabaceae and the dominance of reed and cattail.

In locations with higher moisture contents apart from sedge rushes, fen vegetation may be found: *Eleocharietetum palustris, Equisetetum fluviatilis* and *Caricetum distichae* with a diverse floristic composition (Table 3). Meadow vegetation in the valley includes frequently found moist meadows *Angelico-Cirsietum oleracei,* wet marshy meadows *Scirpetum silvatici* or the community with *Deschampsia caespitosa,* as well as communities of flood-plain meadows *Ranunculo-Alopecuretum geniculati* and *Potentillo-Festucetum arundinaceae*. Among meadow vegetation in the Noteć valley *Alopecuretum pratensis* is a frequently found community, along with the association *Angelico-Cirsietum oleracei,* as well as herb communities of tall herbacous perennials *Lythro-Filipenduletum ulmariae* and the community with *Filipendula almaria*. Hornbean-oak forest habitats are overgrown with specific and typically very rich vegetation connected with the community of fresh meadows: *Arrhenatheretum elatioris,* while pasture communities are represented by a typical community of such habitats, i.e. *Lolio-Cynosuretum*.

In the opinion of Szoszkiewicz and Szoszkiewicz nature value of phytocenoses is determined by the presence of valuable rare, threatened and vanishing species rather than the biodiversity index. In the analysed communities the greatest floristic diversity was observed in the association *Arrhenatheretum elatioris* (H'= 4.2), *Alopecuretum pratensis* (H'= 3.9), while it was lowest in the association *Typhetum angustitifoliae* and *Lythro-Filipenduletum ulmariae* (H'= 1.2). Such a low biodiversity index may have resulted from the progressing changes in habitat moisture contents, reducing the natural character of plant communities.

Nature values

Analysed communities varied in terms of nature value (Table 4). The mean value score was 3.8 and 3.7 in the community *Angelico-Cirsietum oleracei* and *Typhetum angustifoliae* of quality class VIIC, which in terms of the classification according to Oświt [13] means that they are communities of high nature value. Low nature value and a low quality class were calculated for *Glycerietum maximae* – 1.9 and for the community with *Agropyron repens* – 2.1. The other distinguished communities have moderate nature value and quality class IVB. Some of them form relatively monotonous aggregations of one species, as in the case of the community with *Phalaris arundinacea*. Others include communities of low structural variation, with hydrophilic vegetation with aquatic and rush species, but also communities composed of many species. Vegetation of these communities is frequently naturally developed from various classes [5]. Due to the natural or semi-natural character of habitats these communities are distinguished by the richness of their flora and fauna, although some phytocenoses are characterised by a poor species composition and variation, being found in the form of practically single-species clusters of only limited number number of species. An exception in this respect is found for the community of marsh horsetail *Equisetum fluviatile*, as it was observed by Żukowski and Jackowiak [22].

Swards of certain communities at a decreasing anthropopressure are characterised by a greater nature value, which was reported by Grzelak and Bocian [4] and Grzelak et al. [5]. They may be sources for the collection of medicinal plants and may be used by honey bees as a source of nectar [9, 16] while they also have potential value for recreation and tourism thanks to their specific microclimate and natural landscape value [18, 19].

Economic and fodder value

The distinguished communities in the Noteć Bystra and Leniwa valley vary not only in terms of their nature value, but also economic and fodder value. As a result of excessive moisture content of most habitats in the analysed

area a majority of communities of high nature value have poor or mediocre sward value, while it is good only occasionally (Table 5). Communities developed under habitat conditions optimal for them and with sustainable management produce high yields. These include the high-yielding community with dominant *Phragmites australis, Phalaris arundinacea, Glyceria maxima* and *Alopecurus pratensis,* producing 8.4-14.0, 7.0-11.0, 6.4-9.8 and 5.6-7.8 ($t \cdot ha^{-1}$), respectively. A high, although slightly lower yielding is recorded for meadow and rush vegetation. These communities according to the fodder value score FVS (16) as a rule have low fodder value. The associations *Arrhenatheretum elatioris* and *Lolio-Cynosuretum* with FVS=7.4 and the association *Alopecuretum pratensis* with FVS=6.1 are exceptions in this respect.

Moisture content conditions of analysed communities, characterised by the phytoindication method using plant indicators, exhibit a highly mosaic character of moisture content conditions, ranging from dry (com. *Poa pratensis-Festuca rubra* – moisture index=4.8) to strongly moist and wet, marshy and even aquatic in the case of *Typhetum angustifoliae* – moisture index=8.3.

Table 3. Floristic diversity of distinguished communities
Tab. 3. Zróżnicowanie florystyczne wyróżnionych zbiorowisk

Community	Number of species		Percentage proportion of the remaining species			
	Total	Mean in fotos	Grasses	Fabaceae	*Carex* and sedges	Herbs and weeds
Rushes of standing or slowly flowing waters						
Phragmitetum australis	15	7	29,11	-	8,33	70,56
Typhetum angustifoliae	6	4	16,67	-	11,11	72,22
Rush and meadow vegetation						
Caricetum ripariae	14	8	12,72	-	65,96	21,32
Caricetum acutiformis	17	8	9,80	-	69,80	20,4
Caricetum gracilis	24	17	20,43	2,52	54,87	32,18
Caricetum vulpinae	21	11	19,59	1,88	48,71	29,82
Rush and meadow vegetation						
Phalaridetum arundinaceae	32	19	52,58	3,23	6,45	37,74
Glycerietum maximae	18	7	47,27	-	11,21	41,52
Sedge beds						
Eleocharietetum palustris	26	16	21,87	13,84	9,77	54,52
Equisetetum fluviatilis	17	9	26,82	7,83	18,86	46,49
Caricetum distichae	17	8	20,02	13,63	13,63	52,70
Low swards on periodically flooded soils						
Ranunculo-Alopecuretum geniculati	24	10	56,00	8,00	12,00	24,00
Potentillo-Festucetum arundinaceae	25	9	19,80	10,90	4,90	35,60
com.with *Agropyron repens*	22	11	28,82	9,80	2,39	57,99
Tall herb communities						
Lythro-Filipenduletum ulmariae	32	16	10,00	5,88	11,76	12,36
com.with *Filipendula ulmaria*	29	14	15,22	3,05	10,08	71,65
Anthropogenic meadows in moist or wet habitats						
Angelico-Cirsietum oleracei	44	21	26,67	4,44	4,44	64,45
Wet marshy meadows						
Scirpetum silvatici	18	11	13,33	6,67	6,67	73,33
com.with *Deschampsia caespitosa*	28	16	22,92	8,33	2,08	66,67
Intensively managed, periodically flooded meadow						
Alopecuretum pratensis	31	22	20,59	14,71	11,76	59,94
Lowland hay meadow						
Arrhenatheretum elatioris	36	15	26,18	14,06	2,08	57,68
com.with *Poa pratensis-Festuca rubra*	27	19	26,23	9,84	3,28	60,65
Fertile pastures						
Lolio-Cynosuretum	32	22	34,29	8,57	5,71	51,43

Source: own work / Źródło: opracowanie własne

Table 4. Nature values of identified plant communities
Tab. 4. Wartość przyrodnicza wyróżnionych zbiorowisk roślinnych

Nature value number (Nvn)				
Community	Mean value score	Natural qualities	Quality class	*H’
Rushes of standing or slowly flowing waters				
Phragmitetum australis	3,3	Moderately high	VIC	1,5
Typhetum angustifoliae	3,7	High	VIIC	1,2
Rush and meadow vegetation				
Caricetum ripariae	2,6	Moderate	IVB	1,3
Caricetum acutiformis	2,3	Moderate	IVB	2,1
Caricetum gracilis	2,3	Moderate	IVB	1,5
Caricetum vulpinae	2,4	Moderate	IVB	1,6

Cont. Table 4

Nature value number (Nvn)				
Community	Mean value score	Natural qualities	Quality class	*H’
Flooded rush and meadow vegetation				
Phalaridetum arundinaceae	3,2	Moderately high	VI C	3,4
Glycerietum maximae	1,9	Low	IIIB	1,5
Sedge beds				
Eleocharietetum palustris	3,4	Moderately high	VIC	2,8
Equisetetum fluviatilis	3,3	Moderately high	VIC	2,7
Caricetum distichae	2,4	Moderate	IVB	1,4
Low swards on periodically flooded soils				
Ranunculo-Alopecuretum geniculati	2,1	Low	IIIB	1,4
Potentillo-Festucetum	2,4	Moderate	IVB	2,1
com.with *Agropyron repens*	2,1	Low	IIIB	1,9
Tall herb communities				
Lythro-Filipenduletum ulmariae	2,6	Moderate	IVB	1,2
z com.with *Filipendula ulmaria*	2,4	Moderate	IVB	1,5
Anthropogenic meadows in moist or wet habitats				
Angelico-Cirsietum oleracei	3,8	High	VIIC	2,6
Wet marshy meadows				
Scirpetum silvatici	2,3	Moderate	IVB	1,4
com.with *Deschampsia caespitosa*	2,4	Moderate	IVB	1,7
Intensively managed, periodically flooded meadow				
Alopecuretum pratensis	3,6	High	VIIC	3,9
Lowland hay meadow				
Arrhenatheretum elatioris	3,4	High	VIIC	4,2
com.with *Poa pratensis-Festuca rubra*	2,4	Moderate	IVB	2,8
Fertile pastures				
Lolio-Cynosuretum	2,6	Moderate	IVB	3,6

*H’–Shannon-Wiener floristic diversity index

Source: own work / Źródło: opracowanie własne

Table 5. Moisture content variability of syntaxonomic units and yield and fodder value score of identified plant communities
Tab. 5. Zróżnicowanie wilgotnościowe jednostek syntaksonomicznych oraz plon i wartość użytkowa wyróżnionych zbiorowisk

Community	Mean moisture index (l.w.)*	Moisture content site types	Yield (DM ha^{-1})	FVS**	Value of sward
Rushes of standing or slowly flowing waters					
Phragmitetum australis	7,6	strongly moist	8,4-14,6	1,1	a poor
Typhetum angustifoliae	9,3	aquatic	-	2,0	
Rush and meadow vegetation					
Caricetum ripariae	9,1	swampy	4,0-5,8	1,8	poor
Caricetum acutiformis	8,2	swampy, periodically driedried drying	5,4-8,8	1,7	poor
Caricetum gracilis	7,9	swampy, periodically dried	5,2-8,5	2,5	poor
Caricetum vulpinae	7,9	swampy, periodically dry-ing	3,4-4,4	1,9	poor
Flooded rush and meadow vegetation					
Phalaridetum arundinaceae	7,2	strongly moist and wet	7,0-11,0	6,8	good
Glycerietum maximae	8,5	swampy, periodically dried	6,4-9-8	2,8	poor
Sedge beds					
Eleocharietetum palustris	6,8	strongly moist	4,7	2,2	poor
Equisetetum fluviatilis	7,1	wet	2,8	1,6	poor
Caricetum distichae	7,3	wet	4,2-6,8	1,8	poor
Low swards on periodically flooded soils					
Ranunculo-Alopecuretum geniculati	6,4	moist, drying	2,1	3,8	mediocre
Potentillo-Festucetum	7,2	moderately moist	2,3	4,6	
com.with *Agropyron repens*	6,1	moist drying	2,4-4,2	2.9	poor
Tall herb communities					
Lythro-Filipenduletum ulmariae	5,6	moderately moist	1,6	3,3	mediocre
com.with *Filipendula ulmaria*	6,5	moist, drying		2,7	Poor

Cont. Table 5

Community	Mean moisture index (l.w.)*	Moisture content site types	Yield (DM ha^{-1})	FVS**	Value of sward
Anthropogenic meadows in moist or wet habitats					
Angelico-Cirsietum oleracei	6,9	moderately high	4,9	3,5	mediocre
Wet marshy meadows					
Scirpetum silvatici	7,7	wet	4,8	3,1	mediocre
com.with *Deschampsia caespitosa*	6,5	moist, drying	2,1	1,9	poor
Intensively managed, periodically flooded meadow					
Alopecuretum pratensis	5,6	fresh	5,6-7,9	6,1	good
Lowland hay meadow					
Arrhenatheretum elatioris	5,4	fresh	4,4- 7,5	7,4	good
com.with *Poa pratensis-Festuca rubra*	4,8	dry	2,8- 3,6	5,3	mediocre
Fertile pastures					
Lolio-Cynosuretum	5,5	fresh	5,8- 6,2	7,4	good

Moisture content scores are referred to in this study as: l.w. (MCN*)
** FVS – fodder value score index according to [3]

Source: own work / Źródło: opracowanie własne

4. Conclusions

1. Grassland and rush communities found in the Noteć Leniwa and Bystra valley represent diverse nature value, forming valuable ecosystems of high landscape value.
2. The formation of grassland communities, their richness and floristic diversity, nature and agricultural value are influenced first of all by their moisture content, resulting from the mosaic character of these habitats and intensity of use.
3. As a result of excessive moisture content of most habitats in the analysed area most of the communities of high nature value have mediocre economic and fodder value, while some of them are barren.
4. The calculated floristic diversity (H') varies, ranging from 1.2 to 4.2, which results from the progressing changes in moisture content of habitats reducing the natural character of these plant communities.
5. Economic and fodder value in analysed meadows depends mainly on the conditions and varied use, as indicated by produced yields of dry matter (from 1.6 to 14.6 $t \cdot ha^{-1}$) and FVS ranging from 1.1 to 7.4.

5. References

[1] Braun-Blanquet J.: Pflanzensoziologie. 2 Aufl. – Springer Verl., Wien, 1951.
[2] Dembek W.: Dylematy związane z ochroną terenów otwartych w dolinach rzecznych. In: Dembek W. (ed.) Aktualne problemy ochrony mokradeł. Woda Środowisko Obszary Wiejskie, 2002, 4: 82-92.
[3] Filipek J.: Problems in the classification of meadow and pasture plants based on usefulness value numbers. Postępy Nauk Rolniczych, 1973, 4: 59-68.
[4] Grzelak M., Bocian T.: Zróżnicowanie geobotaniczne zbiorowisk seminaturalnych doliny Noteci Bystrej oraz ich rola w krajobrazie. Annales Universitatis Mariae Curie-Skłodowska, LXI, 2006: 257-266.
[5] Grzelak M., Gaweł E., Janyszek M., Diatta J.B., Gajewski P.: The effect of biotope and land use on floristic variation, nature and economic value of marsh sedge rushes. Journal of Food, Agriculture and Environment, 2014, 12 (2): 1205-1212.
[6] Kałamucka W.: Zagospodarowanie turystyczne dolin rzecznych w obszarach chronionych województwa lubelskiego. Problemy Ekologii Krajobrazu XXV, 2009: 105-115.
[7] Kotowski W.: Wartości przyrodnicze fitocenoz siedlisk rolniczych w dolinach rzecznych. In: Dembek W. (ed.): Aktualne problemy ochrony mokradeł. Walory przyrodnicze mokradeł, a ich zrównoważone wykorzystanie. Woda Środowisko Obszary Wiejskie, 2002, 4: 43-61.
[8] Matuszkiewicz W.: Przewodnik do oznaczania zbiorowisk roślinnych Polski. PWN, Warszawa, 2013.
[9] Mosek B.: Walory krajobrazowe użytków zielonych w dolinach rzecznych Lubelszczyzny. Annales Universitatis Mariae Curie–Skłodowska, 1995, 50 (52): 277-280.
[10] Naiman J.R., Décamps H., Pollock M.: The role of riparian corridors in maintaining regional biodiversity. Ecological Applications, 1993, 3 (2): 209-212.
[11] Nawrocki P.: Walory przyrodnicze dolin rzecznych. In: Mioduszewski W. (ed.): Woda w krajobrazie rolniczym. Woda Środowisko Obszary Wiejskie, 2006, 18: 80-88.
[12] Oświt J.: Identification of moisture conditions using plant indexes (phytoindication). Bibloteczka Wiadomości IMUZ, 1992, 79: 39-67.
[13] Oświt J.: Metoda przyrodniczej waloryzacji mokradeł i wyniki jej zastosowania w wybranych obiektach. Falenty. IMUZ, 2000: 3-32.
[14] Ratyńska H., Szwed W.: Charakterystyka i znaczenie biocenotyczne użytków zielonych w dolinie Warty w parkach krajobrazowych środkowej Polski. Proceedings of the Scientific Conference on „The role of grassland and tree plantings in protection of agricultural environment", Kraków-Jaworki, 1999: 287-299.
[15] Riis T., Biggs B.J.F.: Hydrologic and hydraulic control of macrophyte establishment and performance in streams. Limnology and Oceanography, 2003, 48: 1488-1497.
[16] Sawicki B.: Rola paszowa, krajobrazowa oraz turystyczna trwałych użytków zielonych w Kozłowieckim Parku Krajobrazowym. Annales Universitatis Mariae Curie–Skłodowska, 2006, 61: 361-367.
[17] Szoszkiewicz K., Szoszkiewicz J.: Ocena różnorodności gatunkowej pratacenoz na przykładzie wybranych zbiorowisk. Poznańskie Towarzystwo Przyjaciół Nauk Wydział Nauk Rolniczych i Leśnych, 1998, 85: 47-51.
[18] Trąba C.: Florystyczne i krajobrazowe walory łąk w dolinach rzecznych Kotliny Zamojskiej. Folia Universitatis Agriculturae Stetinensis, 1999, 197 (75): 321-324.
[19] Trzaskoś M., Czyż H., Kitczak T.: Skład florystyczny i walory przyrodnicze łąk śródleśnych na tle warunków wodnych. Roczniki AR Poznań CCCX-LII, Melioacja, Inżynieria Środowiska, 2002, 23: 477-484.
[20] Van Duren I.C., Schneider S.: Nutrient limitation in three wet grassland communities on peat soils after long-term restoration management. In: Van Duren, I.C. (ed.). Nutrient limitations in drained and rewetted fen meadows. University of Groningen, 2000: 75-87.
[21] Wasilewski Z.: Stan obecny i kierunki gospodarowania na użytkach zielonych zgodnie z wymogami wspólnej polityki rolnej. Woda Środowisko Obszary Wiejskie, 2009, 9(2): 169-184.
[22] Żukowski W., Jackowiak B.: Ginące i zagrożone rośliny Pomorza Zachodniego i Wielkopolski. Bogucki Wydawnictwo Naukowe, Poznań 1995.