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## 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<sup>-1</sup>. 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 mozaikowości 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<sup>-1</sup>. Celem pracy była ocena walorów przyrodniczych i użytkowych zbiorowisk trawiasto-turzycowych doliny 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.: *Phragmiton* Koch 1926

A group of riparian reeds with *Magnocaricion* species

Low rush communities in shallow standing waters (up to 0.5 m)

Ass.: *Eleocharietum palustris* Šennikow 1919

Ass.: *Equisetum fluviatilis* Steffen 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 ripariae* 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 crispis* Nordh.1940 em.R.Tx.1950

Low, but dense moist swards with significant grazing

Ass.: *Danunculo-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)

Communities 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 sylvatici* or the community with *Deschampsia caespitosa*, as well as communities of floodplain

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

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

Cont. of Table 4

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

\*H<sup>7</sup> – 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 <sup>-1</sup> ) | FVS** | Value of sward |
|---|-----------------------------|-----------------------------|------------------------------|-------|----------------|
| Rushes of standing or slowly flowing waters |                             |                             |                              |       |                |
| <i>Phragmitetum australis</i>               | 7,6                         | strongly moist              | 8,4-14,6                     | 1,1   | a poor         |
| <i>Typhetum angustifoliae</i>               | 9,3                         | aquatic                     | -                            | 2,0   |                |
| Rush and meadow vegetation                  |                             |                             |                              |       |                |
| <i>Caricetum ripariae</i>                   | 9,1                         | swampy                      | 4,0-5,8                      | 1,8   | poor           |
| <i>Caricetum acutiformis</i>                | 8,2                         | swampy, periodically dried  | 5,4-8,8                      | 1,7   | poor           |
| <i>Caricetum gracilis</i>                   | 7,9                         | swampy, periodically dried  | 5,2-8,5                      | 2,5   | poor           |
| <i>Caricetum vulpinae</i>                   | 7,9                         | swampy, periodically drying | 3,4-4,4                      | 1,9   | poor           |
| Flooded rush and meadow vegetation          |                             |                             |                              |       |                |
| <i>Phalaridetum arundinaceae</i>            | 7,2                         | strongly moist and wet      | 7,0-11,0                     | 6,8   | good           |
| <i>Glycerietum maximae</i>                  | 8,5                         | swampy, periodically dried  | 6,4-9-8                      | 2,8   | poor           |
| Sedge beds                                  |                             |                             |                              |       |                |
| <i>Eleocharietetum palustris</i>            | 6,8                         | strongly moist              | 4,7                          | 2,2   | poor           |
| <i>Equisetetum fluviatilis</i>              | 7,1                         | wet                         | 2,8                          | 1,6   | poor           |
| <i>Caricetum distichae</i>                  | 7,3                         | wet                         | 4,2-6,8                      | 1,8   | poor           |
| Low swards on periodically flooded soils    |                             |                             |                              |       |                |
| <i>Ranunculo-Alopecuretum geniculati</i>    | 6,4                         | moist, drying               | 2,1                          | 3,8   | mediocre       |
| <i>Potentillo-Festucetum</i>                | 7,2                         | moderately moist            | 2,3                          | 4,6   |                |
| com.with <i>Agropyron repens</i>            | 6,1                         | moist drying                | 2,4-4,2                      | 2,9   | poor           |
| Tall herb communities                       |                             |                             |                              |       |                |
| <i>Lythro-Filipenduletum ulmariae</i>       | 5,6                         | moderately moist            | 1,6                          | 3,3   | mediocre       |
| com.with <i>Filipendula ulmaria</i>         | 6,5                         | moist, drying               |                              | 2,7   | Poor           |

Cont. of Table 5

| Community  | Mean moisture index (l.w.)* | Moisture content site types | Yield (DM ha <sup>-1</sup> ) | FVS** | Value of sward |
|--|-----------------------------|-----------------------------|------------------------------|-------|----------------|
| Anthropogenic meadows in moist or wet habitats   |                             |                             |                              |       |                |
| <i>Angelico-Cirsietum oleracei</i>               | 6,9                         | moderately high             | 4,9                          | 3,5   | mediocre       |
| Wet marshy meadows                               |                             |                             |                              |       |                |
| <i>Scirpetum silvatici</i>                       | 7,7                         | wet                         | 4,8                          | 3,1   | mediocre       |
| com. with <i>Deschampsia caespitosa</i>          | 6,5                         | moist, drying               | 2,1                          | 1,9   | poor           |
| Intensively managed, periodically flooded meadow |                             |                             |                              |       |                |
| <i>Alopecuretum pratensis</i>                    | 5,6                         | fresh                       | 5,6-7,9                      | 6,1   | good           |
| Lowland hay meadow                               |                             |                             |                              |       |                |
| <i>Arrhenatheretum elatioris</i>                 | 5,4                         | fresh                       | 4,4- 7,5                     | 7,4   | good           |
| com. with <i>Poa pratensis-Festuca rubra</i>     | 4,8                         | dry                         | 2,8- 3,6                     | 5,3   | mediocre       |
| Fertile pastures                                 |                             |                             |                              |       |                |
| <i>Lolio-Cynosuretum</i>                         | 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 ha<sup>-1</sup>) and FVS ranging from 1.1 to 7.4.

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