

## USEFUL PLANTS IN GRASSLAND COMMUNITIES OF RIVER VALLEYS IN WIELKOPOLSKA

### Summary

Variety of habitats covered by grassland communities and intensity of cultivation are the main factors which influence the diversity of their floral composition which reflects in the cultivation value of green growth. Basis for this paper was composed of 200 phytosociological relevés completed with Braun-Blanquet's method in the years 2011-2015 in river valleys of Wielkopolska. The paper covers 10 communities from *Molinio-Arrhenatheretea* class. Detailed analyses of species composition of the communities were conducted in terms of cultivated plants whose share strongly conditions their destiny i.e. their economic significance expressed in a fodder value of meadow sward, apian usefulness, energetic value or as a base of herbal material. Moreover, habitat conditions were determined with the method of phytoindication. According to the analyses, most of utilization possibilities are found in communities developed in dryer, valley meadow-based habitats, whose meadow sward contains a lot of species of the highest fodder value, numerous herbs which positively influence fauna and people, and when blooming – provide pollen and nectar for *Apidae* and moreover – a lot of grasses of high heat of combustion. The aim of the research was to assess grassland communities from *Molinio-Arrhenatheretea* class which covers river valleys in Wielkopolska, in terms of presence of valuable herbs, cultivated and energetic plants.

**Key words:** grassland communities, fodder value of green growth, cultivated groups of grassland plants, melliferous plants, energetic plants

## ROŚLINY UŻYTKOWE W ZBIOROWISKACH ŁĄKOWYCH DOLIN RZECZNYCH WIELKOPOLSKI

### Streszczenie

Różnorodność siedlisk zajmowanych przez zbiorowiska łąkowe oraz intensywność gospodarowania to główne czynniki mające wpływ na zróżnicowanie ich składu florystycznego, którego wyrazem jest wartość użytkowa runi. Bazę do pracy stanowiło 200 zdjęć fitosocjologicznych wykonanych, metodą Braun-Blanqueta, w latach 2011-2015, w dolinach rzecznych Wielkopolski. W pracy uwzględniono 10 zbiorowisk roślinnych należących do klasy *Molinio-Arrhenatheretea*. Dokonano szczegółowych analiz składu gatunkowego zbiorowisk pod względem grup użytkowych roślin, których udział w głównym stopniu decyduje o ich przeznaczeniu, tj. znaczeniu gospodarczym wyrażonym wartością paszową runi, znaczeniu jako pożytku pszczelego, znaczeniu energetycznym, czy jako baza surowców zielarskich. Określono także warunki siedliskowe metodą fitoindykacji. Analizy wykazały, że najczęściej możliwości wykorzystania dają zbiorowiska wykształcone w siedliskach suchszych – grądowych, w których runi notowano wiele gatunków o najwyższej przydatności pastewnej, wiele ziół pozytywnie wpływających na zwierzęta, czy organizm ludzki, a w momencie kwitnienia dostarczających pyłku i nektaru dla pszczołowatych, a ponadto wiele traw o wysokim ciepłe spalania. Celem badań była ocena zbiorowisk łąkowych z klasy *Molinio-Arrhenatheretea*, porastających doliny rzeczne Wielkopolski, pod kątem występowania w nich cennych ziół, roślin użytkowych i energetycznych.

**Słowa kluczowe:** zbiorowiska łąkowe, wartość gospodarcza runi, grupy użytkowe roślin łąkowych, rośliny miododajne, rośliny energetyczne

### 1. Introduction

Maintenance of grassland-pasture communities rich in species is possible due to mowing at least once in a vegetation season. A long term and one-direction management, however, has led to major deformations in primary natural systems and therefore – to changes in phytosociological structure of grasslands and pastures [1]. When compared to European grasslands, Polish ones show high biodiversity. One can encounter about 400 species of vascular plants here, which amounts for 1/6 of vascular flora in our country [2]. Utilization attractiveness of a grassland depends mostly on the species which form the green growth of a community. This is especially important in the production of fodder for ruminants. For many years a production function of grasslands has been very important, and matters

of yielding, boosting the quality of green growth, and fodder's preservation have been a subject of numerous studies [3, 4, 5]. Good species composition of green growth influences nourishing value of milk (especially due to micro- and macroelements and vitamins), enhances the quality of meat and also boosts a general health condition of animals [6, 7]. A determinant of species quality of grassland communities is attractiveness for ruminants, as well as for insects which eagerly make use of green fodder and litter's quality used as an alternative for a traditional straw. Higher share of melliferous species in grassland green growth allows for their use for *Apidae* to produce one of the most valuable types of honey [8, 9]. Presence of herbs makes them a "natural drug store", and high share of *Carex* allows for them being used as an energetic material [10, 11, 12]. Species composition of grassland communities is condi-

tioned by two factors. One of them is anthropoppression understood as utilization i.e. mowing, graze, fertilization, rolling etc. The other one, which is especially important, is habitat and mainly soil's moisturization, its type, reaction and content of bio genes.

The aim of the research was to analyze grassland communities from *Molinio-Arrhenatheretea* class which covered river valleys in Wielkopolska, in terms of presence of valuable herbs, cultivated and energetic plants.

## 2. Materials and methods

Basis for this paper was composed of 200 phytosociological relevés completed with Braun-Blanquet's method in the years 2011-2015 in river valleys of Wielkopolska (Obra, Warta, Noteć). The paper covers 10 communities (in each case randomly selected 20 relevés from a much wider database of Institute of Ecosystems' Biodiversity at the Department of Grassland and Landscape Sciences, University of Life Sciences in Poznań) from *Molinio-Arrhenatheretea* class, i.e. community *Agrostis stolonifera-Potentilla anserina* (com. *A.s.-P.a.*), *Potentillo-Festucetum arundinaceae* (*P-F.a.*), *Alopecuretum pratensis* (*Al.pr.*), community with *Holcus lanatus* (com. with *Hol.lan.*), *Molinietum caeruleae* (*Mol.caer.*), community *Deschampsia caespitosa* (com. *D.c.*), *Arrhenatheretum elatioris* (*Arrh.el.*), community *Poa pratensis-Festuca rubra* (com. *P.pr.-F.r.*), *Lolio-Cynosuretum* (*L-C*), community with *Antoxanthum odoratum* (com. with *Antox.odo.*).

Species composition was analyzed in terms of:

- utilization value i.e. number of cultivated plants – in accordance with Szoszkiewicz's division [13] - on the basis of cover indice and number of special in floral composition and fodder value of meadow sward calculated with Novak's pattern [14]:

$$E = \frac{\sum D_{sr} \cdot FV}{n}$$

E – evaluation of grassland quality

$D_{sr}$  – average cover index [%],

where:

$$D_{sr} = \frac{D \cdot 100\%}{n}$$

D – cover index [%]

n – number of relevés in a community

FV – forage value of a species.

Table 1. Evaluation of the grassland quality (E) and the scale of forage value (F) of plant species

Tab. 1. Wartość użytkowa runi oraz gatunków

E	Grassland	FV	Plant species
90 – 100	Most valuable	7 – 8	Most valuable
70 – 90	Highly valuable	6 – 5	Highly valuable
50 – 70	Valuable	4 – 6	Less valuable
25 – 50	Less valuable	2 – 4	Least valuable
15 – 25	Least valuable	1 – 2	Worthless
0 – 15	Deleterious - Worthless	0 – 1	Deleterious
< 0	Toxic	0 – (-1)	Slightly toxic
		(-1) – (-3)	Toxic
		(-3) – (-4)	Highly toxic to death causing

Source: own study on the basis of [14]

Źródło: opracowanie własne na podstawie [14]

- attractiveness for Apidae [15],
- share of healing and poisonous herbs [16],
- share of energetic grasses – based on the known values of the energy of each species [10, 11, 12] – was calculated share of these species in the sward.

Table 2. The energy value of some species of grasses and sedges

Tab. 2. Wartość energetyczna niektórych gatunków traw i turzyc

No	Plant species	Energy value (MJ·kg <sup>-1</sup> s.m.–DM)
Grasses		
1	<i>Arrhenatherum elatius</i>	15,8
2	<i>Calamagrostis epigejos</i>	17,9
3	<i>Dactylis glomerata</i>	18
4	<i>Deschampsia caespitosa</i>	16,9
5	<i>Festuca arundinacea</i>	16,1
6	<i>Holcus lanatus</i>	13,8
7	<i>Phalaris arundinacea</i>	18,2
8	<i>Phragmites australis</i>	18,1
	Average	16,9
Sedges		
9	<i>Carex acutiformis</i>	18,7
10	<i>Carex disticha</i>	17,3
11	<i>Carex flava</i>	17,8
12	<i>Carex gracilis</i>	17,2
13	<i>Carex riparia</i>	16
	Average	17,4

Source: on the basis of [10, 11, 12]

Źródło: na podstawie [10, 11, 12]

Background for the analysis constituted habitat conditions determined with a phytoindicative method [17]. For the analyzed phytocenoses values of moisturization (F) and content of nitrogen (N) were calculated.

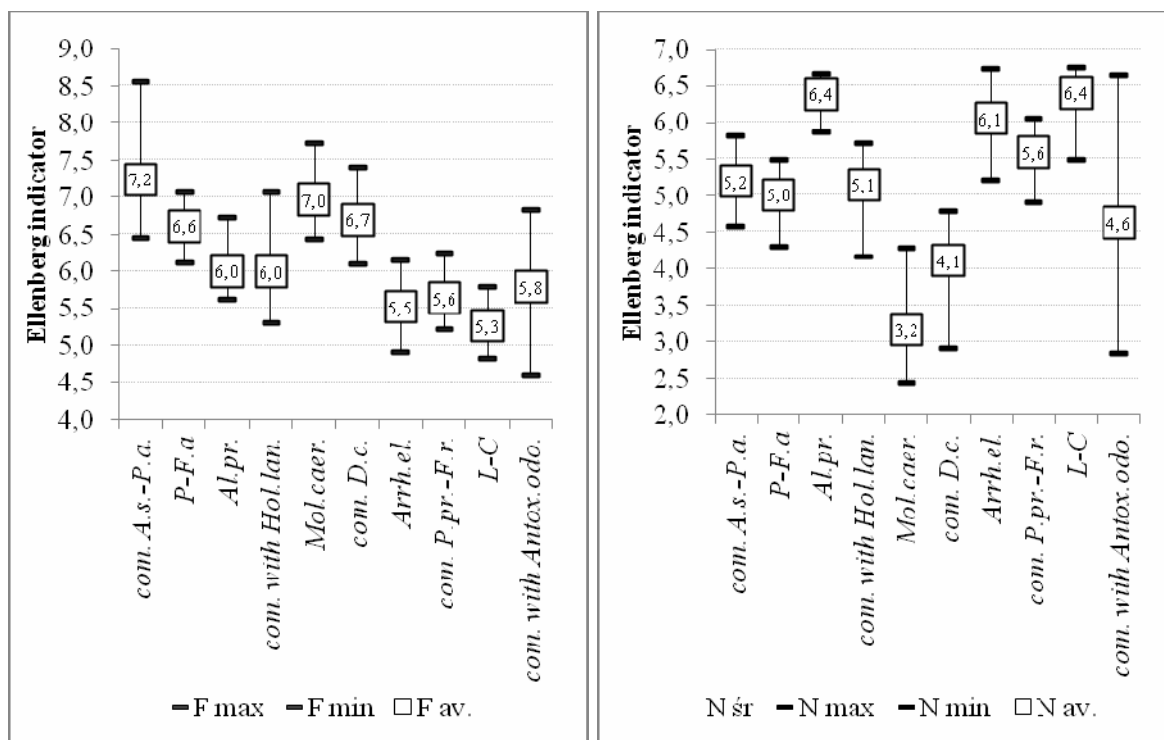
## 3. Results and Discussion

Basic role of grasslands is providing high-quality fodder for the ruminants. Grasslands in Wielkopolska are mainly located at the bottom of river valleys. Diversity of habitats which they cover (Fig. 1) and intensity of utilization are the main factors which influence the variety of their floral composition which is visible in the value of green growth.

Among the analysed habitat factors, floral composition is the strongest determinant of soil's moisturization and content of nitrogen, which was also emphasized inter alia by Grzywna and Urban [18]. Plants which form the analysed grassland communities allows for their classification as fresh and partly moisturized. Higher amplitude in terms of habitats are visible in *Agrostis stolonifera-Potentilla anserina* and communities from *Antoxanthum odoratum* (Fig. 1). In terms of content of nitrogen in the soil, calculated indices vary more both between phytocenoses and within them (Fig. 1). Habitats which are poor in nitrogen occupie parts of communiteis of various moisturization from *Molinietalia* (*Molinietum caeruleae*, *Deschampsia caespitosa* community), whereas far larger content of nitrogen was found in *Alopecuretum pratensis* and *Lolio-Cynosuretum*. Habitat diversity is visible the richness of species (Tab. 3), which determines utilization values of the analysed grassland communities.

The largest species richness among the studied communities was found in degraded and variously moisturized grasslands with *Deschampsia caespitosa* and *Holcus lanatus*. However, large species variety does not result in high utilization value of green growth (Tab. 3). Among all the groups of plants, this value is mainly conditioned by cultivated grasses and *Fabaceae* [19]. However, it is also influenced by herbs, which is emphasized inter alia by Szoszkiewicz [20], Wylupek [21], or Grzegorzczak and Alberski [22]. Trzaskoś [23] observed a positive impact of herbs on the content of magnesium in hay, and according to

Kozłowski [24] as well as Falkowski et al. [25], *Fabaceae*, herbs and weeds are much richer in calcium than grasses. According to Trąba [26], grasslands which are rich in these species provide more phosphorus, magnesium and sodium. Kozłowski [24] observed a bit higher concentration of sugar in *Fabaceae* when compared to grasses. Grynia and her team [27] put emphasis on the fact that very often chemical composition of multi-species and extensively utilized grasslands and pastures is more beneficial than the composition of grasslands popularly thought of as the most valuable as fodder.



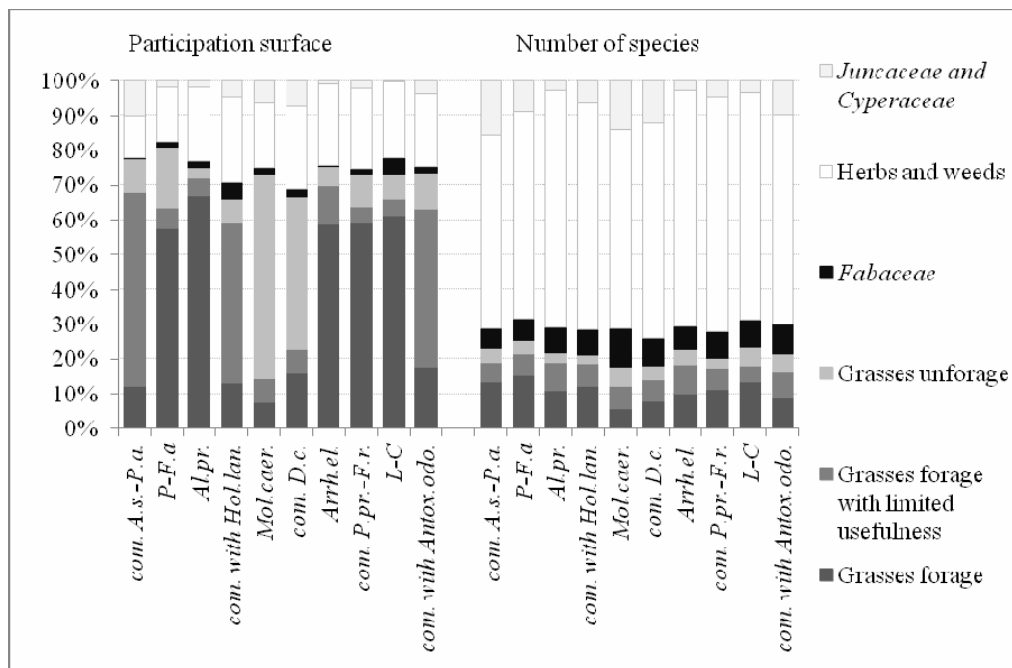
Source: own work / Źródło: opracowanie własne

Fig. 1. Diversity of habitat conditions within the analysed grassland communities from *Molinio-Arrhenatheretea* class  
Rys. 1. Zróżnicowanie warunków siedliskowych w obrębie analizowanych zbiorowisk łąkowych z klasy *Molinio-Arrhenatheretea*

Table 3. Utilization characteristics of grassland communities from *Molinio-Arrhenatheretea* class  
Tab. 3. Charakterystyka użytkowa zbiorowisk łąkowych z klasy *Molinio-Arrhenatheretea*

Plant community	Number of species				Participation of species in the meadow sward [participation surface in %]		Evaluation of the grassland quality - E [14]
	total	average in phytosociological relevé	providing pollen and nectar for <i>Apidae</i>	energetic	providing pollen and nectar for <i>Apidae</i>	energetic	
com. <i>Agrostis stolonifera-Potentilla anserina</i>	90	13.3	33	9	6.7	18.2	43.07
<i>Potentillo-Festucetum arundinaceae</i>	79	16.8	34	8	9.1	<b>67.4</b>	34.58
<i>Alopecuretum pratensis</i>	110	24.2	49	9	12.6	11.8	45.55
com. with <i>Holcus lanatus</i>	<b>123</b>	22.6	49	10	<b>20.1</b>	15.0	37.07
<i>Molinietum caeruleae</i>	107	19.2	43	6	9.3	6.4	26.02
com. <i>Deschampsia caespitosa</i>	<b>127</b>	24.9	56	9	11.8	<b>48.0</b>	32.02
<i>Arrhenatheretum elatioris</i>	119	<b>25.8</b>	56	8	15.8	<b>50.7</b>	<b>53.90</b>
com. <i>Poa pratensis-Festuca rubra</i>	114	<b>29.2</b>	56	8	<b>16.8</b>	14.7	<b>50.08</b>
<i>Lolio-Cynosuretum</i>	89	23.6	44	7	<b>20.3</b>	5.8	<b>54.85</b>
com. with <i>Antoxanthum odoratum</i>	103	18.8	43	8	13.8	17.4	39.26

Source: own work / Źródło: opracowanie własne



Source: own work / Źródło: opracowanie własne

Fig. 2. Utilization group of plants in grassland communities from *Molinio-Arrhenatheretea* class

Rys. 2. Grupy użytkowe roślin w zbiorowiskach łąkowych z klasy *Molinio-Arrhenatheretea*

Therefore, in terms of fodder values of green growth, it is not the richness in species that primarily decides about the value, but variability and “quality” of species which compose it. Communities with the domination of fodder grasses (mainly communities from *Arrhenatheretalia*, i.e. *Arrhenatheretum elatioris*, com. *Poa pratensis-Festuca rubra* or *Lolio-Cynosuretum*, Fig. 2) – possess the highest utilization value of green growth (indice E – Tab. 3). Simultaneously, these are communities formed in optimally moisturized habitats which are rich in nitrogen. Their floral composition contains no more than few percent of species from *Juncus* and *Carex* which are undesired in grazing animals farm, whereas herbs and weeds are numerous at the same time. This group occupies about 25% of vegetation patch and about 65% of floral composition. It is formed of plants which boost digestibility, are antiseptic and a variety and micro- and macroelements such as *Achillea millefolium*, *Taraxacum officinale*, *Mentha arvensis*, *Plantago lanceolata*, *Carum carvi*, *Daucus carota* or *Urtica dioica*. Many of these plants have been used in phytotherapy and herbalism for years.

Among the analyzed communities, there were also ones whose green growth was composed of numerous species useless in terms of fodder – hard to digest or poisonous: mainly “hard” tuft grasses, *Juncaceae*, *Cyperaceae*, *Ranunculaceae* or horsetails, which was visible in a low value of E indices. Communities of the lowest utilization value of green growth are *Molinietum caeruleae* (E=26.02) and *Deschampsia caespitosa* (E=32.02).

Fodder grasses influence mainly the fodder value of green growth, but it is the richness in Dicotyledon species (*Fabaceae*, herbs and weeds) that decides about the possibility of using grasslands as source for *Apidae*. Rich floral grasslands are irreplaceable in that matter – they provide bees with pollen – the only source of proteins, mineral soils and vitamins, as well as nectar and honeydew – basic sources of carbohydrates [8, 15, 28]. According to Kołowski [29], demand of one *Apidae* family for their vital needs is 30 kg of

pollen and 90 kg of honey and all the necessary products come from plants – even honeydew, which is obtained from aphids’ excrements originates from vegetal juice. Nowadays, in the time of intensification of grassland management and awareness of a need to maintain multi-species grasslands in the landscape, they again draw attention as an interesting source of *Apidae* utility. It is used not only by *Apis mellifera* but also many other wild bees and bumblebees whose role as pollinators is magnificent. According to Banaszak [30], permanent meadows are a fodder basis for most of them; they are also often places of brood nests.

In terms of *Apidae* utility, this role may be attributed mainly to *Holcus lanatus*, com. *Poa pratensis-Festuca rubra* or *Lolio-Cynosuretum*, whose green growth is composed of almost 20% of utility plants (Tab. 3). Richness of melliferous plants in the analysed communities is significant. Among 247 species, 97 (ca. 40%) are pollen and nectar species. Abundance of *Apidae* fodder may be found there especially in spring, when grasslands are dominated by yellow *Taraxacum officinale* which provides significant amounts of pollen and nectar [28]. Also species from *Cirsium* and *Armeria maritima* are very popular especially among bumblebees. Melliferous properties are characteristic to *Fabaceae* and grassland herbs which are very numerous in the green growth of *Molinio-Arrhenatheretea* communities. Very popular and frequent ones among nectar species are: *Achillea millefolium*, *Galium mollugo*, *Leontodon autumnalis*, *Taraxacum officinale*, *Trifolium repens*, *Lathyrus pratensis*, *Lychnis flos-cuculi*, *Potentilla anserina*, *Cirsium arvense*. In Poland, what is emphasized by Wyrwa and Wilkaniec [31] as well as Kaczmarek and Kozłowski [8], a lot of grasslands are used in the production of trade honey as honey obtained from multi-species plant communities is much more attractive than popular rapeseed honey. Another alternative for the utilization of grasslands, is their fuel usefulness. In the times of extensive exploitation of non-renewable resources, more and more emphasis is put on energy obtained from renewable sources.

Biomass which comes mainly from arable lands and grasslands is one of these alternatives. It is the most profitable in extensively used areas and in communities formed of species of little fodder values e.g. due to little attention to their proper functioning, inter alia, lack of fertilization. In such a case, especially two groups of plants are useful – sedges and grasses, whose average fuel value oscillates around 17 MJ/kg for grasses and around 17,5 MJ/kg for sedges (Table 3), which places them between coal (22,5 MJ/kg) and wood (15,6 MJ/kg) [12, 32]. It does not differ from traditional sources, so it may serve as their alternative. In Polish conditions meadow sward sward of *sedges* is mostly used as fuel biomass, however, grassland communities from *Molinio-Arrhenatheretea* class may also be used for such purposes. In the analysed communities, there were 13 species characterized by fast and significant growth of biomass (Table 2) – and therefore useful as energetic fuel. They mostly compose green growth of *Potentillo-Festucetum arundinaceae* (67,4% share in energetic species), *Deschampsia caespitosa* (40,8%) and *Arrhenatheretum elatioris* (50,7%) communities.

To sum up, it may be ascertained that grassland communities from *Molinio-Arrhenatheretea* class have got a large utilization potential. However, they need to be utilized in a proper manner in order to obtain the most demanded crops.

#### 4. Conclusions

1. Grassland communities from *Molinio-Arrhenatheretea* class may be utilized on various ways. Communities which presented:

- the highest value of fodder were *Lolio-Cynosuretum*, *Arrhenatheretum elatioris* and *Poa pratensis-Festuca rubra*.
- rich and diverse benefits for Apidae: *Lolio-Cynosuretum*, *Holcus lanatus* and *Poa pratensis-Festuca rubra*.
- richness of species of herbs and weeds used in herbalism and phytotherapy: *Arrhenatheretum elatioris* and *Holcus lanatus*
- high energetic value: *Potentillo-Festucetum arundinaceae*, *Deschampsia caespitosa* and *Arrhenatheretum elatioris*.

2. Possibility of more diverse use of species were observed in the meadow sward of *Arrhenatheretalia* communities formed in dryer – meadow valley habitats than these of *Molinietalia*, or *Trifolio fragiferae-Agrostietalia stoloniferae*, which cover more moisturized areas.

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