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THE ROLE OF USEFUL PLANTS IN MOUNTAIN MEADOW-PASTURE COMMUNITIES FROM *MOLINIO-ARHENATHERETEA* CLASS

Summary

The aim of this study was to analyze the species composition of seven communities of mountain grasslands selected in the Kłodzko County, with regard to the presence of useful plants, whose share largely determines the possibilities of their use, mainly as a fodder for ruminants, as a natural place for obtaining pollen and nectar for Apidae, as well as the base of medicinal, edible or of potential culinary importance plants. The analysis was based on 221 phytosociological relevés completed with Braun-Blanquet's method in the years 2009-2013. Results of the research show that the majority of distinguished communities was characterized by a good utility value number of the sward (UVN=6.1-7.2), with the exception of *Angelico-Cirsietum oleracei* association (UVN=3.8), significant share of plant species valuable for fodder, plants with medicinal properties, edible for humans and melliferous plants (providing pollen and nectar).

Key words: mountain meadow-pasture communities, Kłodzko County, edible plants for humans, medicinal plants, melliferous plants (providing pollen and nectar), utility value

ROLA ROŚLIN UŻYTKOWYCH W GÓRSKICH ZBIOROWISKACH ŁĄKOWO- PASTWISKOWYCH Z KLASY *MOLINIO-ARHENATHERETEA*

Streszczenie

Celem pracy była analiza składu gatunkowego siedmiu zbiorowisk górskich użytków zielonych wyróżnionych w powiecie kłodzkim, pod kątem obecności roślin użytkowych, których udział w znacznym stopniu decyduje o możliwościach ich wykorzystania, głównie jako źródła paszy dla zwierząt przeżuwających, jako naturalnego miejsca pozyskiwania pyłków pszczoł i nektaru dla owadów z rodziny pszczołowatych, a także bazy roślin leczniczych oraz jadalnych lub o potencjalnym znaczeniu kulinarnym. Bazę do przeprowadzonej analizy stanowiło 221 zdjęć fitosocjologicznych wykonanych metodą Braun-Blanqueta w latach 2009-2013. Z przeprowadzonych badań wynika, że większość wyróżnionych zbiorowisk charakteryzowała się dobrą wartością użytkową runi (Lwu=6,1-7,2), z wyjątkiem zespołu *Angelico-Cirsietum oleracei* (Lwu=3,8), znacznym udziałem gatunków roślin wartościowych paszowo, roślin o właściwościach leczniczych, jadalnych dla ludzi oraz roślin pożytkowych (pyłkodajnych i nektarodajnych).

Słowa kluczowe: górskie zbiorowiska łąkowo-pastwiskowe, powiat kłodzki, rośliny jadalne dla ludzi, rośliny lecznicze, rośliny pożytkowe (pyłkodajne i nektarodajne), wartość użytkowa

1. Introduction

The current functions of permanent grassland, especially in mountain and foothill areas, play an important role in shaping the sustainable development of the entire region [13]. Formerly, grasslands, as one of the components in the structure of agricultural land, were considered only as a supplier of green biomass for production purposes. They were to provide feed for ruminants, both in fresh form during grazing of animals and in the form of silage or hay obtained from the meadows farmed by mowing. This is due to the fact that still 20-30 years ago, the livestock population in Poland, especially cattle and sheep, was several times greater than at present. Hence, the demand for green biomass was enormous, also because the area of grassland in relation to arable land was much smaller than at present.

In the 1990s, significant structural and utility changes began in Polish agriculture as a result of socio-political

transformation. This also caused the economic downturn resulting in a reduction in agricultural production, with the effect of a decline in the livestock population and a reduction in the area of arable land. So far, intensively used arable land was slowly undergoing self-sodding or deliberately (especially after Poland's accession to the European Union) was transformed by farmers into extensive meadows, often only for the purpose of obtaining direct or structural subsidies [12].

The above conditions caused a significant extensification of management on permanent grasslands, which led to a change in their species composition [4, 23]. It is particularly noticeable in mountain areas where structural changes were characterized by greater dynamics and scope than in other regions of our country. In poorly used meadows (often mowed only once) and extensively used pastures (small density of animal population), the produced grass biomass is generally characterized by a higher biological value. Spe-

cies diversity increases, emerge valuable plant species, often of high medicinal values [2, 32, 35], as well as edible species for humans. Meadows with high biodiversity also become an area for the development of many animal species and a specific "pasture" for *Apidae* [3, 10]. Bee pasture is a collection of all plant species located within the flight range of bees and supplying them with benefits, ie pollen and nectar, sometimes also honeydew. Such species are called melliferous plants or depending on the provided kind of benefit - pollen or nectar species. Colloquially we call them honey plants, although they do not provide honey. Their flowers give off a certain amount of sweet nectar, attracting insects in this way, for which it is mainly energy food [11]. The high species richness of permanent grasslands gives the possibility of their multidirectional use.

Therefore, the aim of the study was to analyze the species composition of distinguished meadow and pasture communities from the *Molinio-Arrhenatheretea* class, located in the Kłodzko County, with regard to the presence of useful plants, whose share largely determines the possibilities of their use as a source of fodder for ruminant animals, places of acquisition of pollen and nectar for *Apidae*, as well as medicinal, edible or of potential culinary importance plants.

2. Study area, materials and methods

Field research was carried out on meadows and pastures located in the Kłodzko County. It is one of counties located in the Sudety Mountain Range, which extends mainly in the south-western Poland and northern Czech Republic, also with a small patch in Germany. Detailed description of the Kłodzko County was presented by Paszkiewicz-Jasińska and Helis [24].

The vegetation research was carried out using the Braun-Blanquet [27] method in the years 2009-2013. Phytosociological relevés (total of 221) conducted on meadows and pastures used extensively were the basis of these studies. The above-mentioned paper [24] presents the phytosociological affiliation of grassland communities and their exact characteristics. There were distinguished seven plant communities belonging to *Molinio-Arrhenatheretea* class, five meadow communities: *Arrhenatheretum elatioris* group, *Poa pratensis-Festuca rubra* community, community with *Agrostis capillaris-Festuca rubra*, community with *Trisetum flavescens*, *Angelico-Cirsietum oleracei*

group and two pasture communities: *Lolio-Cynosuretum* group and *Festuco-Cynosuretum* group.

In this work, the analysis of the species composition of each of the distinguished plant communities was carried out. On this basis, there were specified:

- the number of species in total and in individual utility (functional) groups, broken down into: grasses, *Fabaceae*, herbs and weeds, as well as the proportion of plants from the *Cyperaceae*, *Juncaceae* and *Equisetaceae* family, seedlings of trees and shrubs and the share of plant species valuable for fodder (with a very good and good fodder value - UVN > 6) - the division was based on Filipek [6],
- utility value of sward expressed in the fodder value scores (UVN) in accordance with the point method proposed by Filipek [6],
- share of medicinal and poisonous species - health properties of species were adopted according to Rutkowski's method [29],
- share of edible species or of potential culinary importance - based on the research by Łuczaj [20] and Szot-Radziejewska [30],
- share of melliferous plant species (providing pollen and nectar) according to studies by Kottowski [11] and Lipiński [18].

Latin names of vascular plants are given after Mirek et al. [22].

3. Results and discussion

Meadow-pasture communities covered by the study is characterized by a diverse number of vascular plant species from 34 to 150 (Table 1). On most of them (approx. 90%), more than 40 species were recorded in total. According to Kostuch [15], this allows it to be considered as a community of grasslands with a great diversity. Among the distinguished communities, the greatest species richness was characteristic to the pasture association of *Lolio-Cynosuretum*, while the lowest to *Angelico-Cirsietum oleracei* used by mowing. However, the great species richness does not determine the fodder value of sward. Its properties as feed for animals are affected by such factors as: the amount of digestible energy, the content and quality of protein, the content of minerals and vitamins, the palatability of feed (desire to collect), the lack of harmful substances. These properties are determined by the fodder value of individual species and utility groups of plants in the sward.

Table 1. Utilization characteristics of distinguished meadow-pasture communities

Tab. 1. Charakterystyka użytkowa wyróżnionych zbiorowisk łąkowo-pastwiskowych

Plant community	Number of species						Share of plant species valuable for fodder (%)
	total	edible plants	medicinal plants	toxic plants	medicinal and toxic plants	melliferous plants (providing pollen and nectar)	
<i>Arrhenatheretum elatioris</i>	83	35	25	5	3	17	21.7
Community <i>Poa pratensis-Festuca rubra</i>	98	38	28	5	1	24	19.4
Community with <i>Agrostis capillaris-Festuca rubra</i>	120	39	32	5	2	21	15.8
Community with <i>Trisetum flavescens</i>	45	22	11	3	0	11	33.3
<i>Angelico-Cirsietum oleracei</i>	34	9	8	2	0	7	23.5
<i>Lolio-Cynosuretum</i>	150	52	52	9	3	25	13.3
<i>Festuco-Cynosuretum</i>	81	35	26	3	0	18	21.0

Source: own studies / Źródło: opracowanie własne

Grasses, mainly fodder grasses, often called noble ones are the most important group determining the efficiency and value of fodder. The number of species from the group of grasses in individual communities was varied and it amounted from 6 to 22 species in meadow communities, while in pasture communities - 19 and 23 species (Table 2). Their share in the sward of the researched plant communities ranged from 15% in the *Lolio-Cynosuretum* association to 31% in the community with *Trisetum flavescens*. Fodder grasses were an important element in the sward of the studied communities, their number in individual plant communities was 3 to 9 species, and their share in the species composition ranged from 5 to 13%. Most species of valuable grasses were recorded in the *Agrostis capillaris-Festuca rubra* community. It is a community of transitional nature [25]. The species with good and very good fodder value (FVS>6) recorded in the studied communities are: *Arrhenatherum elatius*, *Festuca pratensis*, *Alopecurus pratensis*, *Dactylis glomerata*, *Trisetum flavescens*, *Lolium perenne*, *Poa pratensis* and *Phleum pratense*. A greater share of fodder grass species was characteristic to meadow than pasture communities.

Fabaceae are the second important plant group in the sward affecting the quality of fodder - due to the high content of primarily protein, vitamins and minerals. In the studied plant communities, this group of plants belonged to the least numerous, which is confirmed by research conducted in the Sudetes by Paszkiewicz-Jasińska and Steinhoff-Wrzeńniewska [26] as well as Grynja and Kryszak [8]. The number of species from the group of *Fabaceae* plants ranged from 3 species in the *Angelico-Cirsietum oleracei* association to 12 species in the *Lolio-Cynosuretum* association, and their share in the sward of distinguished plant communities ranged from 8 to about 13% (Table 2). In the group of *Fabaceae* a considerable number of species with good and very good fodder value (3-8 species) were noted. The share of these species in the sward of the distinguished communities ranged from 5 to 11%. In the *Angelico-Cirsietum oleracea* association, all 3 recorded species from the group of *Fabaceae* are valuable fodder species (Lwu>6), these are: *Lathyrus pratensis*, *Vicia sepium* and *Lotus uliginosus*. Additionally to the first two aforementioned species, *Trifolium pratense*, *Trifolium repens* and *Lotus corniculatus* occurred most often in other plant communities.

Species of the remaining dicotyledonous plants - herbs and weeds were the most numerous group in the species composition (Table 2). Their number in the sward of the studied plant communities was very diverse, from 20 to 107 species, they constituted 53-71% of the share. Research conducted in the Sudetes on grasslands by Grynja and Kryszak [8], Paszkiewicz-Jasińska and Steinhoff-Wrzeńniewska [26] indicate that the majority of mountain meadows are multi-species herbal meadows where herbs account for over 50%. In all plant communities the following species composition was most abundant: *Alchemilla monticola*, *Achillea millefolium*, *Plantago lanceolata*, *Taraxacum officinale*, *Leucanthemum vulgare*, *Heracleum sphondylium*. According to many authors among others Kozłowski and Swędrzyński [16], meadows with herbs provide valuable green fodder, which is attractive in terms of taste, and its direct use for feeding provides full coverage of the need for most nutrients. Trzaskoś et al. [31], Falkowski et al. [5] emphasize that herbs not only improve biological properties, but often combine the feeding, therapeutic and dietary properties, due to the content of macro and micronutrients, vitamins (B1, B2, C, PP), flavonoids, organic acids and other biologically active substances. The demand for herbs as plant therapies is usually small but variable over time. Animals' demand for herbs increases with various ailments, while grazing they instinctively choose those species that are necessary for them [14]. According to Radkowski [28], some herbs, such as *Carum carvi* or *Alchemilla monticola*, improve the production effects and have a positive effect on health of animals. According to Filipek [6], these species have good fodder properties, provided that their share in the sward does not exceed 5% of coverage. In the distinguished meadow-pasture communities, among the herb species with good fodder properties (UVN=7-8), four species were recorded: *Alchemilla monticola*, *Leontodon autumnalis*, *Plantago lanceolata* and *Carum carvi*. Their number ranged from 2 to 4. Percentage share of species valuable for fodder in most plant communities did not exceed 6%, with the exception of the community with *Trisetum flavescens*. Despite the fact that the most species (107) of herbs and weeds were noted in the *Lolio-Cynosuretum* association, the share of valuable species was small - it amounted to about 3% (4 species).

Table 2. Utility groups of plants and the utility value number (UVN) of distinguished meadow-pasture communities
Tab. 2. Grupy użytkowe roślin oraz wartość użytkowa (Lwu) wyróżnionych zbiorowisk łąkowo-pastwiskowych

Plant community	Number of species							Seedlings of trees and shrubs	UVN
	grasses		<i>Fabaceae</i>		herbs and weeds		<i>Cyperaceae</i> , <i>Juncaceae</i> and <i>Equisetaceae</i>		
	total	valuable for fodder	total	valuable for fodder	total	valuable for fodder			
<i>Arrhenatheretum elatioris</i>	17	8	11	8	47	2	2	6	6.6
Community <i>Poa pratensis-Festuca rubra</i>	19	8	10	7	64	4	2	3	6.6
Community with <i>Agrostis capillaris-Festuca rubra</i>	22	9	11	7	77	3	0	10	6.1
Community with <i>Trisetum flavescens</i>	14	6	6	5	24	4	0	1	6.8
<i>Angelico-Cirsietum oleracei</i>	6	3	3	3	20	2	5	0	3.8
<i>Lolio-Cynosuretum</i>	23	8	12	8	107	4	2	6	7.2
<i>Festuco-Cynosuretum</i>	19	7	8	6	50	4	1	3	6.5

Source: own studies / Źródło: opracowanie własne

In the botanical composition there were few species of plants from the *Cyperaceae*, *Juncaceae* and *Equisetaceae* family - which have no fodder value. In addition, species with poisonous properties are noted among *Equisetaceae*. In two communities, no species belonging to the abovementioned families were found, and in the remaining communities their number ranged from 1 to 7 (Table 2). Most species were recorded in the *Angelico-Cirsietum oleracei* association, in which their share was significant and amounted to almost 21%. According to studies carried out on meadows by Wasilewski [33], with the increasing habitat moisture, the share of species of low utility value increases as well. The occurrence of *Scirpus sylvaticus* (from the *Cyperaceae* family), *Juncus conglomeratus*, *Juncus effusus* (from the *Juncaceae* family), *Luzula luzuloides*, *Luzula campestris* (from the *Equisetaceae* family) was recorded, among others, in the studied communities. In meadow-pasture communities, tree seedlings (including *Salix* sp. *Acer* sp., *Sorbus* sp.) and young trees and shrubs (*Rubus* sp., *Rosa* sp.) were also found, and their share in the species composition of the communities was small (Table 2), somewhat larger than in meadow communities distinguished in the Walbrzych County by Paszkiewicz-Jasińska and Steinhoff-Wrzeźniewska [26].

The meadow-pasture communities distinguished in the studied area were characterized by a little utility value of sward. The utility value number (UVN) of sward of most plant communities varied from 6.1 to 7.2, which indicates its good properties (Table 2). Similar results regarding the utility value number of sward were obtained by other authors conducting research in the Sudetes: Kryszak et al. [17] for the *Arrhenatheretum elatioris* association and the *Lolio-Cynosuretum* association, Paszkiewicz-Jasińska and Steinhoff-Wrzeźniewska [26] for the *Arrhenatheretum elatioris* association, the *Poa pratensis-Festuca rubra* community and the community with *Trisetum flavescens*. In our own research, only the sward of *Angelico-Cirsietum oleracei* should be considered as mediocre (UVN=3.8). This community belongs to the eutrophic wet meadows, characterized by a low utility value of sward, but quite a large natural value, which is confirmed by Grzelak et al. [9]. The fodder value scores of the *Angelico-Cirsietum oleracei* sward obtained by the abovementioned author and his team was UVN=3.5, which is close to the value obtained in own research. The species composition of the *Angelico-Cirsietum oleracei*, distinguished in the own research, comprised the poisonous species - *Ranunculus acris* and *Ranunculus repens*. The presence of species with poisonous properties reduces the utility value of grasslands

Grasslands are not only a source of animal feed, but also the place of occurrence of edible species for humans, used for food purposes. In the past, especially during periods of starvation or shortage of food, people used wild edible plants, sometimes as the only available food [19, 30]. According to Łuczaj [21], during the last 200 years in Poland, about 150 species of wild plants were used as food, which is about 5% of flora. Currently, eating "wild products" has become fashionable, it is an expression of a healthy lifestyle and a return to nature (Table 1). In the examined meadow-pasture communities, 9 to 52 edible species or species of potential culinary significance were recorded. Most species were recorded in the *Lolio-Cynosuretum* association, which constitutes 35% of the species composition, and least in the *Angelico-Cirsietum oleracei* association.

Among edible taxa, there were recorded the following species: *Dactylis glomerata*, *Trifolium pratense*, *Leontodon hispidus* and *Taraxacum officinale*. Young blades of *Dactylis glomerata* in the past were consumed by children due to the sweet taste. Dried *Trifolium pratense* powdered flowers were added to the bread during the famine in Ireland. Tea can be made from inflorescences of this species, while wine and syrup can be prepared from flowers of *Leontodon hispidus* [20]. Some of the plant species recorded in the studied communities are also willingly used for culinary purposes today. *Taraxacum officinale* is an example of such a species. Due to the content of many vitamins and mineral salts, as well as low calorific value, flower petals and young leaves of this species are used for making syrup, wine, tinctures, soups, dietary salads and even cocktails.

Grassland communities are also the place of occurrence of plant species with medicinal properties used in the pharmaceutical industry for the production of plant medicines, in folk medicine, as well as in the cosmetics industry. According to Gawęda and Ralski [7], herbs found in semi-natural meadow communities have better healing properties for humans and animals than those cultivated on field plantations in pure sowing. In composition of distinguished plant communities, from 2 to 52 healing species were recorded, the richest in these species was the *Lolio-Cynosuretum* association, and the poorest *Angelico-Cirsietum oleracei* association (Table 1). The most common species with medicinal properties were: *Taraxacum officinale*, *Plantago lanceolata*, *Achillea millefolium*, *Alchemilla monticola*, *Crepis biennia*. Some of the medicinal species have both poisonous properties and are used in homeopathy [1]. Such species include: *Tanacetum vulgare*, *Colchicum autumnale*, *Artemisia vulgaris* and *Senecio jacobaea*.

Rich floristic mountain grasslands, with a large share of herbs, weeds and *Fabaceae*, are a natural place for obtaining pollen and nectar for *Apidae*, as well as a place of development for predatory insects that are allies of the farmer in protecting crops against pests and some invertebrates, e.g. butterflies, including those threatened with extinction in Poland and Europe [3]. More important for insects for obtaining pollen and nectar are meadows than pastures. They are the place of occurrence of many species of melliferous plants (providing pollen and nectar), blooming from April to August. On the other hand, pastures, on which plants are constantly bitten and do not bloom, are less important for *Apidae*. They may be important when there grow such species, omitted by animals, as *Geranium pratense* or *Cirsium* sp. and also when they are divided into quarters or used extensively (low stocking density of animals). The attractiveness of meadow-pasture communities for *Apidae* increases when they are overgrown with bushes and trees, among which willow is of great importance [18].

In the distinguished meadow-pasture communities, from 7 to 25 species of melliferous plants (providing pollen and nectar) were recorded (Table 1). Their largest share was found in the *Poa pratensis-Festuca rubra* community and community with *Trisetum flavescens* (24%), the least occurred in the *Lolio-Cynosuretum* association (less than 17%). The species with good and medium beekeeping values, listed most frequently in the distinguished communities include: *Taraxacum officinale*, *Trifolium pratense*, *Trifolium repens*, *Vicia cracca*. Of these species, the yellow-flowering *Taraxacum officinale* appears the earliest, which is eagerly spotted by bees mainly for valuable pollen [11].

Many authors point out that in Poland many grassland species are used for the production of commercial honey, because honey obtained from multi-species plant communities is more valuable than honey obtained from only one species, such as rapeseed honey [34].

4. Conclusion

1. Meadow-pasture communities from the *Molinio-Arhenatheretea* class in the Sudetes are multi-species plant communities that give the possibility of using them in many ways.

2. The most important utility group of plants, affecting for the fodder value of meadow-pasture communities, were grasses and *Fabaceae*, with a high share of species that are valuable for forage (UVN > 6). The share of grasses with very good and good fodder value in the sward of distinguished plant communities ranged from 5 to 13%, and *Fabaceae* from 5 to 11%. The largest share of species valuable for forage was characteristic to the community with *Trisetum flavescens*.

3. The most numerous group amongst assessed communities was herbs and weeds, in this group only a few species of good fodder value were recorded (from 2 to 5 species), while numerous species of melliferous plants (providing pollen and nectar) as well as plants with medicinal properties and plants edible for humans were noted. The least number of species with mentioned properties was recorded in the *Angelico-Cirsietum oleracei* association.

4. Most of the plant communities (90%) distinguished in the studied area were characterized by a good fodder value scores of the sward (FVS ranged from 6.1 to 7.2), only the sward of the *Angelico-Cirsietum oleracei* association was characterized by a mediocre utility value number.

5. Floristically rich meadow-pasture communities, containing in their composition plant species with various functional properties, deserve their preservation in the agricultural landscape of the Sudetes for utilitarian reasons.

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