

NATURAL AND UTILITY CHARACTERISTIC OF SUDETES GRASSLANDS USED IN EXTENSIVE BEEF CATTLE BREEDING

Summary

The paper presents phytosociological characteristic of grassland communities in farms situated in the Sudetes and extensive breeding beef cattle. Natural values (species richness and diversity index H') and utility value of the sward were estimated. Communities of the studied grasslands were ascribed to the class *Molinio-Arrhenatheretea* and the order *Arrhenatheretalia*. Two plant associations – *Arrhenatheretum elatioris* and *Lolio-Cynosuretum* and 3 communities with dominating species – *Poa pratensis-Festuca rubra*, *Agrostis capillaris* and *Holcus lanatus* were distinguished. *Lolio-Cynosuretum* association was found on pastures in all studied farms, other phytosociological units were noted on meadows or on grasslands used as both meadows and pastures. Plant communities were characterised by a high species richness (30 – 69 species in total). Grazed grasslands in the Middle Sudetes were populated by more species than meadows. The index of floristic diversity varied between 2.06 and 2.42 and its highest value was noted in *Holcus lanatus* community. Most (75%) of analysed grasslands had good utility value ($FVS > 6.0$). In all studied farms grazed grasslands had higher utility value of the sward.

Key words: pasture and meadow communities, natural value, utility value, the Sudetes

PRZYRODNICZO-UŻYTKOWA CHARAKTERYSTYKA SUDECKICH UŻYTKÓW ZIELONYCH WYKORZYSTYWANYCH W EKSTENSYWNYM CHOWIE BYDŁA MIĘSNEGO, NA TLE WARUNKÓW SIEDLISKOWYCH

Streszczenie

W pracy przedstawiono charakterystykę fitosocjologiczną zbiorowisk łąkowo-pastwiskowych wykorzystywanych w gospodarstwach położonych w Sudetach, prowadzących ekstensywny chów bydła mięsnego. Oceniono ich wartości przyrodnicze (bogactwo gatunkowe i wskaźnik różnorodności H') oraz wartość użytkową runi. Zbiorowiska badanych użytków zielonych zaklasyfikowano do klasy *Molinio-Arrhenatheretea* i rzędu *Arrhenatheretalia*. Wyróżniono 2 zespoły: *Arrhenatheretum elatioris* i *Lolio-Cynosuretum* oraz 3 zbiorowiska z gatunkiem dominującym – *Poa pratensis-Festuca rubra*, z *Agrostis capillaris* i *Holcus lanatus*. Zespół *Lolio-Cynosuretum* wyróżniono na użytkach zielonych wykorzystywanych pastwiskowo, we wszystkich badanych gospodarstwach, pozostałe jednostki fitosocjologiczne na łąkach użytkowanych kośnie lub kośno-pastwiskowo. Zbiorowiska te charakteryzują się zróżnicowanym bogactwem gatunkowym (30-69 gatunków ogółem). Użytki zielone wypasane, usytuowane w Sudetach Środkowych, cechuje większa liczba gatunków ogółem niż łąki. Wartości wskaźnika różnorodności florystycznej zawierają się w granicach 2,06-2,42, największą jego wartość stwierdzono w zbiorowisku *Holcus lanatus*. Większość (75% badanych użytków zielonych) charakteryzuje się dobrą wartością użytkową runi ($Lwu > 6,0$). We wszystkich badanych gospodarstwach użytki spasane wyróżniają się większą liczbą wartości użytkowej runi.

Słowa kluczowe: zbiorowiska łąkowo-pastwiskowe, wartości przyrodnicze, wartość użytkowa, Sudety

1. Introduction

Positive changes in agriculture have been observed during the last decade in mountain region of the Sudetes. Breeding ruminants is a direction that has gained importance [15]. The most important group of farm animals is cattle for which meadows and pastures are the basic food source. Grassland share in the structure of regional croplands exceeds 50% of the total area [23]. One of the important factors affecting botanical composition of grasslands and decisive for their biological and practical value is the way of utilization [11, 14, 21, 31]. Mowing followed by grazing is considered the best way of maintaining high diversity of these communities. Mowing alone inhibits the development of shrub and tree species and moderate grazing facilitates the spread of various species. Grazing enables spreading of plants of other species and promoting plants of higher requirements for light [24]. The impact of grazing animals on soil and vegetation (selective plant grazing, trampling and leaving faeces) may negatively affect floristic composition and diversity of the sward. The impact

depends, however, on the intensity of grazing and the way of pastoral management.

The aim of this study was to perform phytosociological characteristic of permanent grasslands, both mown and grazed, situated in farms in the Sudetes that extensively bred beef cattle in view of natural and utility values of grasslands.

2. Study area and methods

Floristic and phytosociological studies were carried out in the years 2012-2013 on permanent grasslands mown (once a season), mown and grazed or grazed in farms specializing in extensive beef cattle breeding. Animal stock in farms did not exceed 1.0 LU ha⁻¹ AL. Farms are situated in four localities: Dzikowiec, Boguszyn, Ścinawka Średnia and Trzebieszowice in the Kłodzko County. The county is located in south-west part of Poland in Dolnośląskie Province. According to physico-geographical division of Poland [7] it is situated in the Czech Massif province, the Sudetes and Sudetes Foothills subprovince and in two macrore-

gions: the Middle Sudetes and Eastern Sudetes. Table 1 presents characteristics of studied meadows and pastures in particular farms. Data on topographic and soil conditions (soil type and species) were obtained from database available in Lower Silesian Research Centre of the Institute of Technology and Life Sciences.

In each farm, the analyses of vegetation were performed on mown and grazed grasslands separately with the Braun-Blanquet method [16]. Phytosociological relevés (53) were made on 25 m² plots [2] in uniform plant patches. The number of relevés depended on the size of study site and plant diversity. Collected data were used to prepare phytosociological tables which contained results of analyses made according to classification procedure with the use of the Juice software [25]. Syntaxonomic affiliation of distinguished communities was determined after Matuszkiewicz [10]. Latin names of vascular plants were adopted after Mirek et al. [12]. The frequency of occurrence and abundance of each species are presented in synthetic phytosociological table (tab. 1).

Natural value of each study plot was estimated based on the total number of species, their mean number in a phytosociological relevé and on the diversity index H' [9]. Protected species were noted as well [22]. Utility value was estimated according to fodder value scores (FVS) with the Filipek's method [3]. Additionally, the numbers of nutritionally valuable species (FVS>6.0) was recorded. Vegetation structure was analysed with the division into basic plant functional groups: grasses, legumes and herbs and weeds.

3. Results and discussion

Phytosociological characteristic of grassland communities (tab. 2)

Analysed meadows and pastures were classified to anthropogenic grassland communities of the class *Molinio-Arrhenatheretea* and the order *Arrhenatheretalia*. These

communities are an important element of agricultural landscape of the Sudetes, which was also noted by other authors e.g. Kryszak et al. [8], Nadolna [13], Paszkiewicz-Jasińska [17], Żyszkowska and Paszkiewicz-Jasińska [30]. Five phytosociological units were distinguished within the order: 2 associations – *Arrhenatheretum elatioris* and *Lolio-Cynosuretum* and 3 communities with the dominating species – *Poa pratensis-Festuca rubra* with *Agrostis capillaris* and *Holcus lanatus*.

Arrhenatheretum elatioris

The association was distinguished on a mown meadow in Trzebieszowice based on the presence of *Arrhenatherum elatius* and other species characteristic for the alliance *Arrhenatherion: Galium mollugo, Tragopogon pratensis* and *Campanula patula*. The highest layer of the sward was formed by the oat grass together with *Dactylis glomerata* and *Trisetum flavescens* – the species characteristic for the order *Arrhenatheretalia*. A substantial share of lower grasses: *Agrostis capillaris*, *Festuca rubra* and *Holcus lanatus*, and dicotyledons – apart from the two mentioned above, also *Rumex acetosa* – were found in plant patches of the association.

Community *Poa pratensis-Festuca rubra*

The community was noted on mown and grazed meadow in Dzikowiec based on the domination of *Festuca rubra* and the presence of *Poa pratensis*. Substantial contribution of other grasses: *Dactylis glomerata*, *Trisetum flavescens*, *Holcus lanatus*, *Festuca pratensis* and a smaller one of *Arrhenatherum elatius* and *Agrostis capillaris* was noted. Most frequent among dicotyledons were *Plantago lanceolata* and *Taraxacum officinale* and among legumes – *Trifolium repens*. Floristic composition of *Poa pratensis-Festuca rubra* indicates distinct impoverishment compared with the association *Arrhenatheretum elatioris*. The community is an indicator of extensive grassland management [10].

Table 1. Characteristics of meadows and pastures in studied farms

Tab. 1. Charakterystyka łąk i pastwisk w badanych gospodarstwach

Locality	Dzikowiec		Boguszyn		Ścinawka Średnia		Trzebieszowice	
Geographical region: macroregion mesoregion microregion	the Middle Sudetes Noworudzkie Depression Dzikowiec Prominence		the Middle Sudetes the Bardzkie Mts Eastern Ridge		the Middle Sudetes Ścinawka Depression Ścinawskie Hills		the Eastern Sudetes the Złote Mts	
Elevation a.s.l.	490-500	470-480	420-430	410-430	410-420	420-430	470-480	405-410
Exposition	SW slope	flat area	flat area	NW slope	NE slope	NE slope	S slope	flat area
Soil	light silty loam, brown leached soil	clayey silt, podzol soils	clayey silt, light silty loam, brown proper soil	light silty loam, brown proper soil	clayey silt, brown leached soil	clayey silt, brown leached soil	medium silty loam, brown proper soil	medium silty loam, brown proper soil
Management	meadow-pasture	pasture	meadow-pasture	pasture	meadow-pasture	pasture	meadow	pasture

Source: own studies / Źródło: badania własne

Table 2. Synthetic phytosociological table with distinguished grassland communities in studied farms
 Tab. 2. Syntetyczna tabela fitosocjologiczna dla wyróżnionych zbiorowisk zielonych, w badanych gospodarstwach

Locality	Dzikowiec		Boguszyn		Ścinawka Średnia		Trzebieiszowice	
Management	meadow-pasture community	pasture	meadow-pasture community with	pasture	meadow-pasture community with	pasture	meadow	pasture
Phytosociological unit	<i>Festuca rubra</i>	<i>Lolium-Cynosuretum</i>	<i>Agrostis capillaris</i>	<i>Lolium-Cynosuretum</i>	<i>Holcus lanatus</i>	<i>Lolium-Cynosuretum</i>	<i>Arrhenatherum elatioris</i>	<i>Lolium-Cynosuretum</i>
Number of relevés	3	6	10	11	4	5	6	8
Ch.Ass. <i>Arrhenatherum elatioris</i>								
<i>Arrhenatherum elatius</i> (L.) P. Beauv. ex J. Presl & C. Presl	2 ¹	2 ⁺¹	3 ⁺¹		2 ⁺¹	2 ⁺¹	6 ¹⁻²	
D.com. <i>Poa pratensis - Festuca rubra</i>								
<i>Poa pratensis</i> L.	2 ¹ 3 ⁺³	1 ² 1 ⁺	2 ⁺	11 ¹⁻²	4 ¹	1 ¹ 4 ⁺²	3 ⁺¹ 6 ⁻³⁻³	7 ¹ 3 ⁺³
<i>Festuca rubra</i> L.								
D.com. with <i>Agrostis capillaris</i>								
<i>Agrostis capillaris</i> L.	2 ²	5 ⁺¹	10 ⁺⁴	11 ²⁻³	2 ⁺		6 ⁻³⁻³	4 ¹
D.com. with <i>Holcus lanatus</i>								
<i>Holcus lanatus</i> L.	3 ¹⁻²	1 ⁺	8 ⁺¹	10 ¹⁻²	4 ²⁻³	5 ¹⁻²	6 ¹⁻²	8 ¹
Ch.Ass <i>Lolium-Cynosuretum</i>								
<i>Trifolium repens</i> L.	3 ⁺¹	4 ²	10 ⁻²	11 ⁺³	4 ¹⁻²	5 ⁺³	1 ⁺	8 ²⁻³
<i>Lolium perenne</i> L.		5 ³⁻⁴	7 ⁺¹	8 ²⁻²	3 ⁺¹	1 ⁺		
<i>Leontodon autumnalis</i> L.	1 ²	4 ⁺¹		5 ⁺¹				
Ch.All. <i>Arrhenatheron</i>								
<i>Campanula patula</i> L.		4 ⁺	5 ⁺⁴	3 ⁺		1 ⁺	3 ⁺	1 ⁺
<i>Galium mollugo</i> L.			7 ⁺	6 ⁺		1 ⁺	6 ²	1 ⁺
<i>Crepis biennis</i> L.	1 ¹		9 ⁺¹	9 ⁻¹	2 ⁺	3 ⁺		4 ⁺¹
<i>Knautia arvensis</i> (L.) J. M. Coult		5 ¹		2 ⁺				
<i>Tragopogon pratensis</i> L.	1 ¹			1 ⁺			5 ⁺¹	2 ⁺
Ch.All. <i>Cynosurion</i>								
<i>Cynosurus cristatus</i> L.	1 ⁺			1 ⁺		3 ¹⁻²		5 ⁺¹
Ch.O. <i>Arrhenatheretalia</i>								
<i>Achillea millefolium</i> L.	1 ⁺	6 ⁺²		8 ⁺¹		5 ¹	2 ⁺¹	4 ⁺¹
<i>Dactylis glomerata</i> L.	3 ¹	3 ¹	2 ⁺	3 ⁻¹	4 ⁻¹	5 ¹	6 ¹	8 ¹⁻²
<i>Trisetum flavescens</i> (L.) P. Beauv.	3 ⁺²	1 ¹			4 ¹	5 ⁺¹	2 ⁻¹	
<i>Lotus corniculatus</i> L.		6 ⁺¹		4 ⁺		3 ⁺¹	1 ⁺	
<i>Heracleum sphonabulum</i> L.	1 ⁺	2 ⁻¹		3 ⁻¹				7 ⁺¹
<i>Leucanthemum vulgare</i> Lam.	1 ⁺	2 ⁺¹		4 ⁺			1 ¹	1 ⁺
<i>Taraxacum officinale</i> F. H. Wigg.	2 ¹⁻²	4 ⁺¹	7 ⁺³	7 ⁺	4 ⁺²	5 ⁺¹	2 ⁺	8 ¹⁻²
<i>Trifolium dubium</i> Sibth.			1 ⁺	6 ⁻¹		4 ⁺¹		2 ⁻¹
<i>Daucus carota</i> L.		5 ⁺¹		3 ⁺				
<i>Pimpinella major</i> (L.) Huds.								
Ch.Cl. <i>Molinio-Arrhenatheretea</i>								
<i>Festuca pratensis</i> Huds.	3 ¹	3 ⁺¹	1 ⁺	1 ⁺	2 ⁺	3 ⁺²	1 ¹	6 ¹⁻³
<i>Rhinanthus minor</i> L.			2 ⁺					
<i>Ranunculus acris</i> L.	2 ⁺¹	1 ⁺		2 ⁺	4 ⁺¹	1 ⁺	1 ⁺	2 ⁺
<i>Lathyrus pratensis</i> L.	2 ⁺¹	1 ⁺	1 ⁺		1 ⁺		1 ⁺	4 ⁺
<i>Rumex acetosa</i> L.	3 ⁺	2 ⁺		1 ⁺	4 ⁻¹	2 ¹	5 ⁺¹	
<i>Plantago lanceolata</i> L.	3 ¹	5 ⁺¹	2 ⁺	7 ⁻²	4 ⁺	2 ⁺¹	1 ⁺	
<i>Centaurea jacea</i> L.	2 ⁺	1 ⁺	8 ⁺²	1 ⁺				

Table 3. Natural and utility characteristic of grassland communities in studied farms

Tab. 3. Przyrodnicza i użytkowa charakterystyka wyróżnionych zbiorowisk użytków zielonych, w badanych gospodarstwach

Locality	Dzikowiec		Boguszyn		Ścinawka Średnia		Trzebieszowice	
Phytosociological units	community <i>Poa pratensis-Festuca rubra</i>	<i>Lolio-Cynosuretum</i>	community with <i>Agrostis capillaris</i>	<i>Lolio-Cynosuretum</i>	community with <i>Holcus lanatus</i>	<i>Lolio-Cynosuretum</i>	<i>Arrhenatheretum elatioris</i>	<i>Lolio-Cynosuretum</i>
Number of species including	41	64	67	69	30	48	43	39
Mean number of species in a relevé	23	27	23	22	19	22	19	19
<i>H'</i> index	2.39	2.14	2.06	2.19	2.42	2.39	2.06	2.30
FVS	7.1	7.6	5.5	6.4	6.5	7.1	5.4	7.6
The structure of plant functional groups (in %):								
grasses	31.7	18.7	19.4	15.9	36.7	33.3	25.6	30.8
legumes	12.2	12.5	13.4	10.2	13.3	14.6	11.6	17.9
herbs and weeds	56.1	68.8	67.2	73.9	50.0	52.1	62.8	51.3
Number of nutritionally valuable species	14	14	16	12	13	15	13	10

Source: own studies / Źródło: badania własne

communities is the presence of rare and protected species. Only one strictly protected species – *Carlina acaulis* – was found on grazed grassland in Dzikowiec. Similar results of studies on communities of the order *Arrhenatheretalia* in the Sudetes were obtained by Nadolna [13], Kryszak et al. [8], Paszkiewicz-Jasińska and Nadolna [19], Źyszkowska [29].

Analysed grasslands showed different utility value of the sward ranging from mean to good (FVS from 5.4 to 7.6). Similar variability was reported by Kryszak et al. [8] and Paszkiewicz-Jasińska and Nadolna [18]. Sward of most of grasslands (75%) was estimated as good (FVS >6.0). These were mainly the grasslands used in farms as pasture and meadow like the communities *Poa pratensis-Festuca rubra* in Dzikowiec and *Holcus lanatus* – in Ścinawka Średnia. According to Duuren [1], meadows with a big share of the Yorkshire fog are important for fodder production especially in sites with limited fertilisation.

The number of nutritionally valuable species in the sward varied from 10 to 16. The highest number of these species was found in *Agrostis capillaris* community in Boguszyn. The species were, however, characterised by a low frequency and small abundance. Coverage by valuable species is more important for utility value of the sward than the number of species, which was confirmed in studies by Paszkiewicz and Nadolna [18]. The lowest number of species of very good and good fodder value was found on meadow in Trzebieszowice. The share of species in particular utility groups of analysed communities was differentiated. Grasses which are decisive for the efficiency and fodder value of grasslands are the most important group of plants. The share of grasses in analysed communities varied from 15.9 to 36.7%, which agrees with studies performed by other authors in the Sudetes [6, 18]. The greatest share of grasses was found on mown (*Holcus lanatus* community) and grazed grasslands in Ścinawka Średnia, the smallest – on pasture in Boguszyn. Legumes, due to the content of protein, vitamins and mineral substance, are an important component of grassland sward. This group was least numerous, the share of legume species varied from 10.2% on pasture in Boguszyn to 17.9% on grazed grassland in Trzebieszowice. In all analysed communities the most numerous were herb and weed species whose share ranged from 50 to

68.8%. Their highest contribution was noted on pasture in Boguszyn and the lowest – on meadow in Ścinawka Średnia (*Holcus lanatus* community). Studies by Grynia and Kryszak [6] and Paszkiewicz-Jasińska and Nadolna [18] indicate that meadows in the Sudetes are mostly multi-species herb meadows. Herbs, due to lower fibre content and higher content of macro- and microelements compared with grasses, are an important component of sward and many of them have medicinal properties [26, 27].

4. Conclusions

1. Plant communities found on studied meadows and pastures in the Sudetes used in extensive beef cattle breeding belong to the class *Molinio-Arrhenatheretea* and the order *Arrhenatheretalia*.
2. Species richness of analysed communities is diversified and encompasses 30 to 69 species in total. In farms of the Middle Sudetes grazed grasslands have more species than mown and grazed grasslands.
3. Species diversity index *H'* varied from 2.06 to 2.42. Its highest value was recorded in *Holcus lanatus* community used as meadow and pasture.
4. The presence of one strictly protected species – *Carlina acaulis* – was noted on a grazed grassland.
5. Most (75%) analysed grasslands had good utility value of the sward (FVS >6.0). Pastures in all studied farms had better utility value.

5. References

- [1] Duuren L. Bakker J.P., Fresco L.F.M.: From intensively agricultural practices to hay-making without fertilization. *Vegetatio*, 1981, 46-47: 241-258.
- [2] Faliński J. B.: Przewodnik do długoterminowych badań ekologicznych. Warszawa, Wydaw. Nauk. PWN, 2001, 688 ss.
- [3] Filipek J.: Projekt klasyfikacji roślin łąkowych i pastwiskowych na podstawie liczb wartości użytkowej. *Postępy Nauk Rolniczych*, 1973, 4: 59-68.
- [4] Fitter A.H.: Influence of soil heterogeneity on the coexistence of grassland species. *Journal of Ecology*, 1982, 70, 139-148.
- [5] Grynia M., Kryszak A.: Ocena geobotaniczna zbiorowisk łąkowych Obniżenia Dusznickiego oraz Gór Bystrzyckich. Ze-

- szyty *Problemowe Postępów Nauk Rolniczych*, 1996, 442: 97-104.
- [6] Grynia M., Kryszak A.: Wartość gospodarcza sudeckich łąk w okolicy Karpacza. *Poznańskie Towarzystwo Przyjaciół Nauk*, Wydział Nauk Rolniczych i Leśnych, 1999, 87: 27-31.
- [7] Kondracki J.: *Geografia fizyczna Polski*. Warszawa, Wydaw. Nauk. PWN, 2000, 468 pp.
- [8] Kryszak A., Kryszak J., Strychalska A.: Natural and use value of meadow communities of mountain and lowland regions. *Grassland Science in Europe*, 2011, 16: 490-492.
- [9] Magurran A.E.: *Ecological diversity and measurement*. Chapman and Hall. Cambridge, 1996, 179 pp.
- [10] Matuszkiewicz W.: *Przewodnik do oznaczania zbiorowisk roślinnych Polski*. Warszawa, Wydawnictwo Naukowe PWN, 2007, 537 pp.
- [11] Metera E., Sakowski T., Słoniewski K., Romanowicz B.: Grazing as a tool to maintain biodiversity of grassland - a review *Animal Science Papers and Reports*, Institute of Genetics and Animal Breeding, Jastrzębiec, Poland, 2010, 28(4): 315-334.
- [12] Mirek Z., Piękoś-Mirkowa H., Zając M.: Flowering plants and Pteridophytes of Poland – a checklist. – W. Szafer Institute of Botany, Polish Academy of Sciences, Kraków, 2002, 442 pp.
- [13] Nadolna L.: Wartości przyrodnicze sudeckich użytków zielonych o zróżnicowanym sposobie użytkowania na tle warunków siedliskowych i fizjograficznych. *Woda Środowisko Obszary Wiejskie*, 2012, 10, 4(32): 307-318.
- [14] Nadolna L.: Znaczenie sudeckich pastwisk w ochronie różnorodności florystycznej i wartości użytkowej. *Inżynieria Ekologiczna*, 2013, 33: 77-85.
- [15] Nadolna L., Żyszkowska M.: Characteristics of grassland in the Polish Sudetes in view of fodder production potential and grassland protection. *Journal of Water and Land Development*, 2011: 15, 29-40.
- [16] Pawłowski B.: Skład i budowa zbiorowisk roślinnych oraz metody ich badania. W: *Szata roślinna Polski*. T. 1. W. Szafer, K. Zarzycki (red.), Warszawa, PWN, 1972, 237-269.
- [17] Paszkiewicz-Jasińska A.: Walory krajobrazowe i wartość przyrodnicza zbiorowisk łąkowych obszaru Natura 2000 „Ostoja Nietoperzy Gór Sowich”. *Inżynieria Ekologiczna*, 2013, 33: 96-103.
- [18] Paszkiewicz-Jasińska A., Nadolna L.: Wartość użytkowa sudeckich użytków zielonych w gospodarstwach prowadzących działalność w systemie rolnictwa ekologicznego. *J. Res. Appl. Agric. Engng*, 2013, vol. 58 (3).
- [19] Paszkiewicz-Jasińska A., Nadolna L.: Zbiorowiska łąkowe w powiecie wałbrzyskim – możliwości ich ochrony w ramach pakietów przyrodniczych programu rolnośrodowiskowego. *Woda Środowisko Obszary Wiejskie*, 2013, 13, 1(41): 115-128.
- [20] Pławska-Olejniczak J., Żywiczka A.: Wpływ wypasu koników polskich i szkockiego bydła górskiego na florę naczyniową ekstensywnie użytkowanych łąk Skoszewskich. *Łąkarstwo w Polsce*, 2009, 12: 131-140.
- [21] Rogalski M., Wieczorek A., Kardyńska S., Płatek K.: Wpływ pasących się zwierząt na bioróżnorodność florystyczną runi. *Zeszyty Problemowe Postępów Nauk Rolniczych*, 2001, 478: 65-70.
- [22] Rozporządzenie Ministra Środowiska z dnia 5.01.2012 r. w sprawie ochrony gatunkowej roślin. *Dz. U.* 2012. Nr 0 poz. 81.
- [23] Spis rolny 2010 r.: http://www.stat.gov.pl/bdl/app/dane_cechter.dims?p_id=369893&p_token=419949581#
- [24] Sarateanu V., Moisuc A., Butnariu M., Cotuna O.: Plant biodiversity and pastoral value of two permanent grasslands from Tarcului Mountains (Caras-Severin County, western Romania), *Proceedings of 15th Meeting of the FAO-CIHEAM Mountain Pasture Network*, 2009: 113-114.
- [25] Tichý L.: Juice, software for vegetation classification. *Journal of Vegetation Science*, 2002, vol. 13: 451-453.
- [26] Trąba Cz.: Zawartość niektórych makroelementów i mikroelementów w runi zbiorowisk łąkowych o dużym udziale roślin dwuliściennych. *Zeszyty Problemowe Postępów Nauk Rolniczych*, 1997, 453: 331-337.
- [27] Trzaskoś M.: Rola ziół w runi trwałych użytków zielonych. *Zeszyty Problemowe Postępów Nauk Rolniczych*, 1997, 453: 339-348.
- [28] Żyszkowska M.: Różnorodność gatunkowa użytkowanych i nieużytkowanych łąk w dolinie rzeki górskiej - Bystrzycy Dusznickiej. *Woda Środowisko Obszary Wiejskie*, 2004, 4, 2b(12): 161-174.
- [29] Żyszkowska M.: Chronione gatunki roślin i siedliska użytków zielonych w dolinie rzeki górskiej - Bystrzycy Dusznickiej. *Woda Środowisko Obszary Wiejskie*, 2006, 6, 2(18): 387-396.
- [30] Żyszkowska M., Paszkiewicz-Jasińska A.: An assessment of the natural value of selected meadow-pasture communities in the Middle Sudetes region. *Journal of Water and Land Development*, 2011, 15: 53-64.
- [31] Żyszkowska M., Nadolna L., Paszkiewicz-Jasińska A.: Charakterystyka zbiorowisk użytków zielonych Gór Suchych (Sudety) pod kątem zróżnicowanego gospodarowania. *Acta Botanica Silesiaca*, 2011, 6: 115-124.