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EVALUATION OF MOUNTAIN PASTURES QUALITY FORMING THE LANDSCAPE ARCHETYPE IN WESTERN CARPATHIANS

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Abstract

The research of pastures influenced by Carpathian sheep milk farming as a typical archetype was conducted in study areas of the mountain even subalpine landscape in the forest zone of the Western Carpathians in the Slovak Republic. We have chosen 28 areas that have been effected by mountain sheep farming since the period of the Wallachian colonization. The research works were under way from 1998 to 2016. The pastures of observation were from 615 to 1 421 meters above sea level (m a.s.l.) in the areas of 1 398 ha in total that was of various exposition and inclination, from flat surface to steep hillsides with 28° slope. The studied pastures ranged from the species-rich to species-poor, from *Festuca-Agrostis* grasslands through *Nardo-Agrostion* tenuis alliance to *Nardion*. The number of plant species (from 18 to 48, average 33 at 1 m^2) shows a rather varied composition of grasslands. There were only two study sites with higher dominance of *Festuca rubra* (51 % and 64 %) recorded. The quality of grassland depends on the floristic composition (cover in %) and forage value of the particular species. Evaluation of the grassland quality (E_{GQ}) reached the average value 57.5 in the scale from 0 to 100. Value varied from least valuable grasslands with 40.1 points in two study plots to valuable grasslands with 69.4 points. Relations between selected environmental factors were analysed by means of redundancy analysis (RDA). Among the significant factors of environment, the impact on data set variability was the strongest by altitude (18.1 %), then by total precipitation in the vegetation period (5.6 %) and grassland quality E_{GQ} (5.2 %).

Keywords: grassland, pastures, evaluation of the grassland quality, landscape archetype

INTRODUCTION

The Western Carpathians represent the northern part of the Carpathian mountain range with the highest altitude of the Carpathian arc where the highest peaks exceed 2 600 m a.s.l. The highest point of arc and at the same time of the whole Carpathians is the Gerlachovský štít with altitude 2 600 m a.s.l. The length of 400 km of the total 1 450 km of Carpathians belongs to the Western Carpathians.

The major part lies in Slovakia but the outer flysch zone extends to the territory of Poland and Czech Republic. Geological boundaries are between the towns Michalovce, Bardejov and Nowy Sącz. Through the colonization wave of Wallachian Rusyns (in historical written sources *Valachi seu Rutheni*) to unsettled mountainous areas in the Eastern Carpathians and then in the 14th century in the Western Carpathians the mountain farming associated with Wallachian sheep farms and dairy products made from sheep milk in shepherd's hut were spreading. Walachians was getting to these areas mainly due to landlords, property owners who hired them. The settling down had the advantages because the settlers paid taxes and benefits in kind to the property owners. Colonization under the Wallachian law has influenced culturally almost 70 % of the area in Slovakia (Ratkoš, 1980; Novák *et al.* 2013; Novák, 2018).

Under the influence of the mountain sheep milk farming, except in the (sub)alpine grasslands of the northern and southern hillsides of Carpathians, and after the deforestation, the grasslands have been changing, and in various modifications some of them were preserved by regular using till today (Kráľovičová and Herianová, 2009; Janišová and Uhliarová *et al.*, 2010; Novák *et al.* 2013; Novák, 2018). With an increasing number of population and number of sheep in 16th and 17th century the mountain farming in Western Carpathians began to develop intensively. Due to the greater number of sheep the shepherds had to expand the areas by burning off and cutting down of trees by which they created land with open spaces for grazing with substantially segmented, i.e. mosaic structure (Novák *et al.*, 2013). The aim of the Wallachian way of mountain farming was to provide enough grazing for sheep shelter to be able to remain in one stand as long as possible, though by moving the sheepfolds at the same time the pastures were fertilized and thus their botanic structure and forage value improved. During the reign of Marie Theresa, the grazing in forests began to be reduced by so called Theresian regulation because the excessive grazing, mainly by goats, damaged the forest natural regeneration of trees (Novák, 2011).

The grass covers influenced by mountain farming are significant landscape elements and they form historical landscape structures. Huba (2004) characterizes the historical landscape structure as a material immovable part of the cultural inheritance. This fact is significant not only from the ecological but also from the cultural, historical, aesthetical and landscape point of view. Those are the areas with preserved traditional way of using. The value of these localities follows mainly from the low degree of intensification, the high landscape diversity, the preserved traditional way of folk, technical and other constructions, the preserved form of agricultural use with forest complexes and folk architecture, and from the significant social value of the area (Hrnčiarová, 2010).

The pastures secondarily created in Carpathians represent the varied grass and herbaceous associations of plants intended for nutrition of farm animals. In Slovakia, they are the natural inheritance (natural renewable resource) with an irreplaceable gene pool, and many of them are classified among the areas of national or European importance (Natura, 2000). As significant landscape elements, the pastures make grasslands as secondary ecosystem which requires a human intervention. Long-term using of pastures at the same stands classifies them as the landscape archetype (Novák, 2008, 2011) representing historical landscape structures being formed over a long period which are the result of historical changes, socio-economic conditions and natural factors of environment (Izakovičová and Miklós, 2016). They are the actual part of the landscape; they accentuate the horizontal layout of spatial structures (composition of mosaics in the landscape after deforestation). Their characteristic feature is a relatively long-term stability of the historical secondary structure of the agricultural land and a relatively long-term invariability of the basic pattern composition. Those may be wiped off or accentuated by the processes related to leaving the landscape or changes of its use. The changes result in creation of various geometrical patterns, layouts of landscape elements and their compositions (Hreško and Petrovič *et al.*, 2015). According to Pauditšová and Reháčková (2009), there is a need to know the past of the country, and to evaluate it not only from the viewpoint of its antropogenous use but also from the socio-historical point of view, and to know its current condition.

Hreško and Petluš (2015) state that removing the original beech, fir-beech, fir-spruce and spruce forests by burning off in order to gain the pasture areas is connected with preserving the typical historical elements and structures of mountain archetype of the agricultural land. In the extensive farming of the original Wallachian sheep stock the grass covers with high natural value were preserved. By regular using (grazing) those landscape elements not only stabilize but their biodiversity and landscape character are preserved. The pastures impacted by mountain farming, which remain still in existence, create the archetype of mountain landscape that will perish if the exploitation of its grass ecosystem stops and if it will be left; by means of natural succession it will become the forest association again. After being left some of the pastures became or are becoming overgrown with forest; there are only some indications of the former mountain farming or they are only traces of the past pasturage in the form of toponyms (Novák, 2008a, b; Novák *et al.*, 2013; Novák, 2018).

The objective of this article is to evaluate the archetype of mountain landscape from the viewpoint of quality of grasslands and for the nutrition of the animals at the pastures on the basis of the botanical composition and nutritive value of the plant species. The issue of grassland evaluation according to its floristic composition by means of various ranges of values was dealt with by many authors in the past, such as De Vries *et al.* (1942), Ellenberg (1952), Klapp *et al.* (1953), Regal (1967), Stählin (1971), Šostarič-Pisačič and Kovačevič (1974), Jurko (1990) and Novák (2004).

MATERIAL AND METHODS

Study Area

Pastures affected by mountain sheep farming in connection with Wallachian colonization in the past were selected from the research „Inventory of agriculturally used grassland in the Western Carpathians in Slovakia" which was carried out during the years 1998–2016. The altitudes of the studied pastures (28 study sites) are between 615 and 1 421 meters. Total study area of 1 398 hectares was surveyed with different exposure and slope from lowland locations to 28º (Tab. I).

Some of the preserved pastures from the times of the Wallachian colonization influenced by mountain farming in Slovakia are the deforested mountain chains and grasslands of Oravské Beskydy, Oravská Magura, Chočské vrchy, Malá Fatra and Veľká Fatra, Nízke Tatry, Spišská Magura, Čergov, Revúcka vrchovina, etc. The major part is included in the national parks, protected landscape areas and protected bird areas. The Western Carpathians represent a landscape archetype of high importance that was formed by the processes which were situated mostly at a great distance from settlements. In the forest area those pastures were called „grúň" (as unforested mountainsides) and „poľana" (as grassy clearings), a bit higher there were so called „hoľa" (as grassy areas of ridges) from the 15th century infenced by Carpathian mountain milk sheep farming and above the upper forest boundary the pastures formed a part of (sub)alpine meadows and they were named after the mountain tops and chains of mountains, such as Črchľa, Grúň, Grapa, Košarisko, Kýčera, Magura, Minčol, Poľana, Príslop, Sihla, Solisko, etc. These names are the tracks from the past in the form of toponyms which were preserved till today and we can always find them in both historical and current topographical maps (Novák, 2018).

Evaluation of the Grassland on the Study Sites

On each area there four square–shaped plots (1 m^2) were established. Before and one week after the cutting we made phytosociological analysis through the area divided by nylon fiber into the squares (100 × 100 mm). We specified the percentage of coverage (D – dominance) for different species and floristic groups. Nomenclature of vascular plants followed Marhold and Hindák (1998). The floristic analyses included the method of reduced cover (D in %), the evaluation of the coverage of dominant weed species on the study area (Klapp, 1965; Novák, 2004). In order to assess the pastures we have chosen the Evaluation of the grassland quality (E_{GQ}) which proceeds from the floristic composition and forage values of the individual plant species (Novák, 2004). The Evaluation of the grassland quality ($E_{GQ} = \Sigma D.FV/8$) based on cover in % (D in %) and forage value of individual plant species (FV) was recorded according to Novák (2004).

Data Analysis

As the gradient length in Detrended Correspondence Analysis (DCA) was short (2.896 and 1.106 for the first two axes), the Redundancy Analysis (RDA) within direct gradient analysis was applied which is included in the program Canoco 4.5 (Ter Braak and Šmilauer, 2002). Species data were log-transformed. For values of environmental

I: *Environmental factors on the study sites*

N	Locality, Mts.	Name of pasture	Area (ha)	Alt. (m a.s.l.)	Gb.	pH in KCl	Exp.	Sl. (°)	R. pgs (mm)	T. pgs (°C)
1	Bajerovce	Beskyd	100	700	f	5.5	NW	5–12	600	11
2	Braväcovo	Patráška	36	750	p	5.1	S	3–6	495	13
3	Bobrov	Breziny	60	615	fs	6.6	–	–	493	12.5
4	Mýto pod Ďumbierom	Pohansko	30	730	p	5.2	S	12	495	13
5	Hruštín	Grúň	140	750	f	4.8	NW	3–15	493	12.5
6	Jarabina	Poľanky	10	760	f	5.2	SW	6–25	500	13
7	Kamienka	Pod duby	61	600	f	5.2	NE	7–8	500	13
8	Litmanová	Košariská	75	750	f	5.2	SE	8	500	13
9	Námestovo	Poľany	40	720	f	5.4	S	3–6	493	12.5
10	Nižná Boca	Salašky	50	900	gd	4.7	SE	7	800	9
11	Mútne	Magurka	55	788	fs	5.1	NE	1–8	493	12.5
12	Oščadnica	Kýčera	43	660	f	5.2	NE	15	550	12.5
13	Oravská Magura	Minčol	110	1 394	sb	5.3	SE	25–28	1 100	7
14	Revúcka vrchovina	Príslop	50	1 120	gd	4.4	SE	12	900	8
15	Rabča	Grapa	18	700	f	6.8	W	4–14	493	12.5
16	Brezovica	Črchličky	30	700	fs	6.3	NW	11	495	12.5
17	Suchá Hora	Beskyd	25	850	f	6.0	W	4	493	12.5
18	Oravský Biely Potok	Čieťaž	10	650	f	5.7	NW	8	493	12.5
19	Makov	Kršlisko	18	780	f	4.9	W	16	650	11
20	Krušetnica	Sihly	20	725	fs	5.4	N	0–19	493	12.5
21	Zuberec	Ivanov	80	820	fs	5.9	NW	4–16	493	12.5
22	Čergov-Livov	Košarisko	50	710	sb	6.1	SE	12	900	9
23	Veľká Fatra	Pod Ploskou	140	1 240	sb	6.3	NW	5–10	1 000	9
24	Malá Fatra	Strungový príslop	60	1 150	dv	6	N	15	1 000	10
25	Nízke Tatry	Kečka	150	1 140	sb	6.5	W	10	1 000	8
26	Chočské vrchy	Stredná poľana	30	1 248	sb	5.8	SE	5	1 000	8
27	Nízke Tatry	Pod Košariskami	50	1 421	gd	4.5	S	8	1 100	7
28	Spišská Magura	Magurské sedlo	120	949	f	5.3	S	12	900	9

N – the pasture number, Mts. – mountain, Alt. – altitude, Gb. – geological base, Exp. – exposure, Sl. – slope; R. pgs – average total rainfall per year measured by precipitometer, T. pgs – temperature per growing season, f – flysch, fs – flysch schists, p – paragneisses, gd – granodiorites, sb – marlstones schists, dv – dolomites and limestones

variables square root transformation was used. All studied environmental factors were tested by the Monte Carlo permutation test with unrestricted permutations (499 permutations, $P \leq 0.05$). Finally, the pure effect (where the percentage variance is explained by the variable, while the remaining significant variables were used as co-variables) was calculated (Ter Braak and Prentice, 1988). Pure variance is expressed as percentage of total inertia. Marginal effect is percentage variance. The conditional effect of a variable is given by the additional variance explained by the variable at the time it was included in the forward selection. Correlations among the environmental variables were evaluated by Spearman correlation test in Statistica 7 (Statsoft, 2005).

RESULTS AND DISCUSSION

The studied pastures are the archetype of the mountain even (sub)alpine landscape which represents the historical and a long-term basis formed structure of the open landscape of the Western Carpathians in the forest zone. This zone has been influenced by the human activity after deforestation, in particular, from the period of the Walachian colonization associated with the Carpathian sheep milk farming. These changes survived in the course of the historical development from the 15th century until the present time. They are grass vegetations (pastures) which are being regularly used by the extensive grazing. Also, the secondary grassy uplands rank among them.

The pastures in colder submountain areas with higher altitude and rainfall range between the species-poor and species-rich scale of grasslands. Floristically species-poor grasslands tend to be more valuable in term of forage feeding; forage value is supported by highly valuable grasses into the growth phase of flowering, in particular *Dactylis glomerata, Festuca pratensis, Phleum pratense, Poa pratensis* but also less valuable species *Festuca rubra,* highly valuable leguminous species *Trifolium repens, Trifolium pratense,* possibly valuable species *Lotus corniculatus* and other valuable herbaceous species *Achillea millefolium, Alchemilla* spp., *Plantago lanceolata, Taraxacum officinale* etc. According to the forage value, in the species-rich grassland the higher percentage of least valuable even to toxic plant species occurs. Forage grassland quality is decreased through grasses *Agrostis* spp., *Nardus stricta, Poa chaixii* and herbaceous species *Carex* spp., *Cruciata glabra*, *Hypericum maculatum, Leucanthemum vulgare*, *Luzula campestris*, *Potentilla erecta, Veronica officinalis* etc. (Fig. 2). Some of the mentioned species occur at species-poor habitats according to Stanová and Valachovič (2002).

In the submountain and mountain areas of Western Carpathian with *Festuca-Agrostis* grasslands as typical mountain sheep farmed pastures the dominance of grasses is represented by species *Festuca rubra* and *Agrostis capillaris*. Bărbos (2006) in Eastern Carpathian in Romania (Maramureş) states a similar plant association *Festuco rubrae-Agrostietum capillaris* Horv. (1951). Typical flora consists of the most widespread herbs, for instance *Leucanthemum vulgare, Campanula patula, Ranunculus acris, Leontodon hispidus, Alchemilla* spp., *Plantago lanceolata, Achillea millefolium* and other, legumes *Trifolium repens*, *Trifolium pratense* and other. They also occur in the characteristic form of *Anthoxantho-Agrostietum* association. It differs from other types of *Arrhenatherion* alliance through the great occurrence of extensive pasture indicators (*Briza media, Lotus corniculatus, Thymus pulegioides, Luzula campestris, Cruciata glabra*) and oligotrophic species (*Viola canina, Polygala vulgaris, Carex pallescens, Nardus stricta*).

On the high-elevation pastures in the forest zone – secondary grasslands and on the natural grasslands above the timberline within *Nardo-Agrostion tenuis* alliance of *Nardetea strictae* plant community, various combinations of plant species occur. These pastures are characterised by shorter growing season, prolonged snow cover and higher rainfall. They mostly occur above 900 m a.s.l., in areas with colder climate they descend even lower. The limit occurrence is at the bottom of subalpine zone in which the change fluently to the alpine communities of *Nardion* alliance. They occur in different bedrocks, especially silicate, but also on mineral richer or alkaline volcanic and carbonate rocks because at higher altitudes due to the wet and cold climate the soil surfaces decalcified, vinegary and the raw acidic humus accumulates. The characteristic grasses are *Nardus stricta*, *Agrostis capillaris*, *Anthoxanthum odoratum*, herbs *Potentilla erecta*, *Alchemilla* spp., *Leontodon hispidus*, *Luzula sylvatica* and other. On the ruderalised sites mainly *Rumex obtusifolius, Rumex alpinus, Urtica dioica, Carduus personata* and other. At the alpine grasslands there could be also tall grass, relatively species-poor communities with dominance of *Deschampsia cespitosa* but also *Avenula planiculmis*. They have grown on the site of the original mountain spruce, fir and beech forests, and partly perhaps after grubbing mountain pine scrub. They were mostly used as extensive pasture and after sheep farming on eutrophic sites they had been changing to *Poion alpinae* alliance. After depletion of nutrients over the years, they once again changed to the acidified and oligotrophic *Nardus* communities. In the species composition acidophytes and oligotrophic species have significant dominance.

In underused grasslands gradually prevail *Hypericum maculatum, Vaccinium myrtillus, Calamagrostis arundinacea*, *Calamagrostis vilosa* and on the most acidic *Vaccinium* and *Calluna* shrubs.

In terms of nature protection the plant species protected at national level included in Red list occurred in the study area – *Campanula serrata, Crocus heuffelianus, Dactylorhiza majalis*, *Dactylorhiza maculata, Gentiana punctata, Gymnadenia conopsea, Orchis morio*, *Trollius altissimus*, etc. and Western Carpathian endemic species *Soldanella carpatica* which occurs only in Slovakia. Species-rich *Nardus* grasslands on siliceous substrates in mountain areas with the alliances *Nardion strictae* and *Nardo-Agrostion tenuis* are the habitats included in the Natura 2000 network according to Stanová and Valachovič (2002). After the deforestation of *Pinus mugo* scrub also secondary oligotrophic short species–rich swards could develop (Kliment, Valachovič *et al.*, 2007).

These are the habitats with natural and culturally-historical values. As the old, traditionally cultivated, particularly grazed by sheep non-forest habitats they are also the national heritage. Their occurrence is reducing these days, therefore it is necessary to protect them.

The number of plant species on the study plots varied between 18 and 50 species at 1 m² (average 32.8) suggesting relatively rich composition of grasslands. Only in two study plots we noticed significant dominance of species Festuca rubra (51 % and 64 %). The quality of grassland depends on the floristic composition (cover in %) and forage value of the particular species. Average value of the grassland quality (E_{GQ}) in the scale from 0 to 100 was 57.5 points, quality varied from least valuable grasslands with 40.1 points in two study plots to valuable grasslands with 69.4 points (Tab. II).

As the gradient length in DCA was short (1.923 and 1.518 for the first two axes), RDA within direct gradient analysis was applied which is

II: *Number of plant species at 1 m² on the study sites and Evaluation of the grassland quality (E_{GQ})*

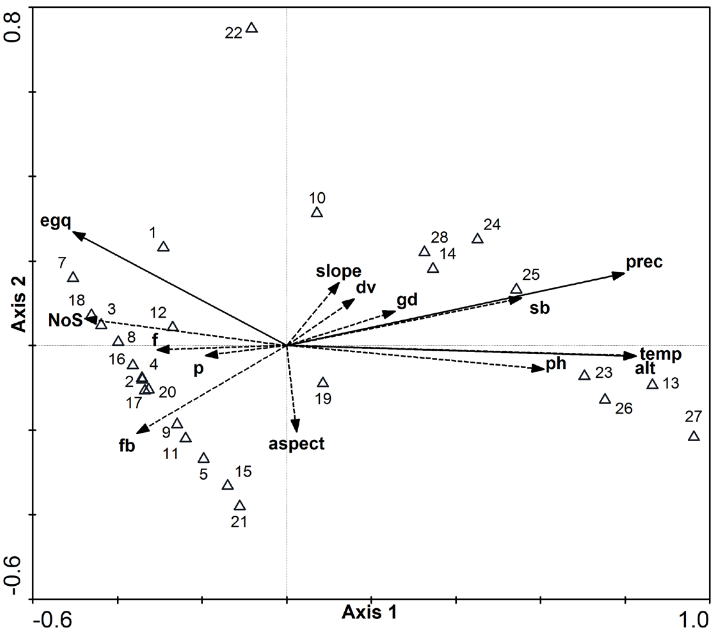
N	Nps	E_{GQ}	N	Nps	E_{GQ}	N	Nps	E_{GQ}
1	48	63.9	11	36	58.5	21	39	52.6
2	31	62.9	12	41	59.8	22	23	67.9
3	34	58.8	13	50	48.5	23	30	51.8
4	35	61.5	14	44	62.8	24	31	61.6
5	38	53.5	15	38	47.4	25	32	58.8
6	48	40.1	16	23	60.7	26	24	47.8
7	44	62.6	17	18	69.4	27	22	44,9
8	28	67.4	18	30	63.2	28	30	55.7
9	36	55.3	19	34	49.1			
10	42	64.9	20	**35**	**59.8**	**Ø**	**32.8**	**57.5**

N – the pasture number, Nps – number of plant species, EGQ – Evaluation of the grassland quality

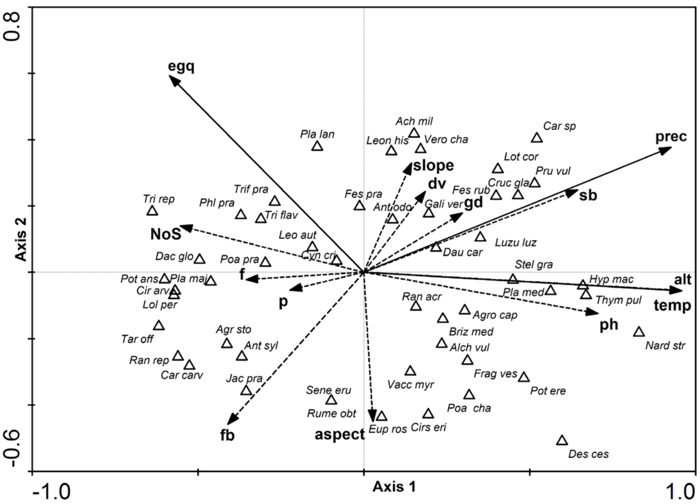
III: *Redundancy analysis (RDA): variance explained by individual environmental variables.*

	Marginal effects	Conditional effects	Pure effect
Altitude	**0.181****	**0.181****	**0.052***
Precipitation	**0.174****	**0.056****	**0.056***
Temperature	0.165**	0.023n.s.	x
EGQ	**0.098****	**0.052****	**0.052***
sb	0.096**	0.014n.s.	x
NoS	0.077**	0.034n.s.	x
fs	0.077*	0.044n.s.	x
f	0.052n.s.	0.023n.s.	x
aspect	0.045n.s.	0.037n.s.	x
slope	0.042n.s.	0.033n.s.	x
pH	0.041n.s.	0.042n.s.	x
gd	0.040n.s.	0.014n.s.	x
p	0.037n.s.	0.037n.s.	x
dv	0.024n.s.	0.020n.s.	x

NoS – Number of species, EGQ – Evaluation of the grassland quality, alt – altitude, prec – precipitation, temp – temperature, ph – pH, f – flysch, fs – flysch schists, p – paragneisses, gd – granodiorites, sb – marlstones schists, dv – dolomites and limestones n.s. – not significant, ** – significant at p ≤ 0.01, * significant at p ≤ 0.05



1: *Redundancy analysis (RDA) with significant variables chosen by method of forward selection in Canoco 4.5 (solid line) (Ter Braak and Šmilauer, 2002). Insignificant variables with dashed line are only supplementary.*
1 – 28 pasture, NoS – number of species, egq – Evaluation of the grassland quality (E_{GQ}), alt – altitude, prec – precipitation, temp – temperature, ph – pH, f – flysch, fs – flysch schists, p – paragneisses, gd – granodiorites, sb – marlstones schists, dv – dolomites and limestones



2: *Redundancy analysis (RDA) with significant variables chosen by method of forward selection in Canoco 4.5 (solid line) (TerBraak and Šmilauer, 2002). Insignificant variables with dashed line are only supplementary.*
Agro cap – Agrostis capillaris, Agr sto – Agrostis stolonifera, Achi mil – Achillea millefolium, Alch vul – Alchemilla vulgaris, Ant syl – Anthriscus sylvestris, Ant odo – Anthoxanthum odoratum, Car carv – Carum carvi, Car sp – Carlina spp., Briz med – Briza media, Cir arv – Cirsium arvense, Cirs eri – Cirsium eriophorum, Cruc gla – Cruciata glabra, Cyn cr – Cynosurus cristatus, Dact glo – Dactylis glomerata, Dau car – Daucus carota, Des cae – Deschampsia cespitosa, Eup ros – Euphrasia rostkoviana, Fest pra – Festuca pratensis, Fest rub – Festuca rubra, Frag ves – Fragaria vesca, Gali ver – Galium verum, Hyp mac – Hypericum maculatum, Jac pra – Jacea pratensis, Leon his – Leontodon hispidus, Lol per – Lolium perenne, Lot cor – Lotus corniculatus, Luzu luz – Luzula luzuloides, Nard str – Nardus stricta, Phl pra – Phleum pratense, Pla lan – Plantago lanceolata, Pla mai – Plantago major, Pla med – Plantago media, Poa cha – Poa chaixii, Pot ans – Potentilla anserina, Pot ere – Potentilla erecta, Pru vul – Prunella vulgaris, Ran acr – Ranunculus acris, Ran rep – Ranunculus repens, Rume obt – Rumex obtusifolius, Sene eru – Senecio erucifolius, Stel gra – Stellaria graminea, Tar off – Taraxacum officinale, Thym pul – Thymus pulegioides, Tri fla – Trisetum flavescens, Tri pra – Trifolium pratense, Tri rep – Trifolium repens, Vacc myr – Vaccinium myrtillus, Vero cha – Veronica chamaedrys

included in the program Canoco 4.5 (Ter Braak and Šmilauer, 2002). Environmental factors were log-transformed. All studied environmental factors were tested by the Monte Carlo permutation test with unrestricted permutations (499 permutations, $P \leq 0.05$). Pure variance is expressed as percentage of total inertia. Marginal effect is percentage variance. The conditional effect of a variable is given by the additional variance explained by the variable at the time it was included in the forward selection.

The relationship between selected environmental factors was analysed using redundancy analysis. The first RDA axis explained 21.5 % variance of the species data and 35.8 % of the species-environment relationship, which means that 35.8 % of the variability of our dataset caused by the selected environmental factors was reflected by the first canonical axis. All 5 environmental variables together explained 60 % of the variability of the species composition. The 3 factors altitude, precipitation and E_{GQ} that were significant in the Monte Carlo permutation test explained 28.9 % of the whole variability. Of all significant environmental factors, altitude had the strongest effect on the variability of our data set (18.1 %). E_{GQ} explain 5.2 % and precipitation 5.6 % of the variability (Tab. III, Fig. 1, Fig. 2).

CONCLUSION

By the anthropic pressure to the forest area in the landscape and by using the pasture covers a secondary landscape structure was and is created. The mountain up to (sub)alpine pastures, influenced by mountain farming over a long period, with horizontal layout of historical landscape structures, which are preserved by using till today, form the landscape archetype of Western Carpathians. After evaluation of the grassland quality (E_{GQ}) in the scale from 0 to 100, from the viewpoint of the animal nutrition they represent low-value grasslands in average (57.5). They present a natural renewable resource and the natural inheritance with irreplaceable gene pool. Since the pastures used on the long-term basis are not a subject of special legislative protection there is an irrecoverable loss impending due to abandonment and subsequent rapid forest succession. From the period of the development of Carpathian mountain sheep milk farming, the areas of the grass vegetation have been regularly grazed. Nowadays, most of them situated in the national parks, often in the territories with the strict earth protection. After the gradual slump of grazing, and abandonment of these areas, their generic composition has been changed in favour of the tall-growing grasses, predominantly more competitive efficient tall grasses, e.g. *Deschampsia cespitosa and Avenula planiculmis.*

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