ASSESSMENT OF THE HABITATS IN SOME PASTURES FROM THE SOUTH-WEST FĂGĂRAȘ MOUNTAINS (ROMANIA)

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Abstract. In the mountainous regions of Romania, lands inherited by individual people are legally gathered together into associations for easier management, especially for grazing. These pastures have been grazed for centuries, according to some customs and regimes transmitted from generation to generation and strictly respected until the communist period, when all such customs were abandoned. Nowadays, there is an increased impact of grazing and changes in land use, together with changes in the Romanian legislation. In these private pastures from both alpine and subalpine areas, we inventoried *in situ* the plant species diversity, identified habitat-types and their characteristics, as well as their conservation status. Most of the pastures are overgrazed; the identified habitats are degraded forms of habitats of community interest (Annex 1 Habitats Directive) and have an unfavourable conservation status. The species composition is modified due to the dominance of some species that have low value as fodder and high vigour/productivity. The most important action required is to develop a pastoral management plan that should be implemented over future years to achieve restoration of the quality of the habitats present in these pastures.

Keywords: habitats, pastures, Făgăraș Mountains, Romania.

Rezumat. Evaluarea habitatelor în câteva pășuni din Sud-Vestul Masivului Făgăraș (România). În zonele montane, pământul moștenit de oamenii locului, este integrat în obștile de moșneni pentru un management mai facil, în special pentru pășunat. Pășunile au fost folosite de secole, după obiceiuri transmise din generație în generație, devenite legi nescrise și respectate cu strictețe până în perioada comunistă. În zilele noastre, impactul crescut al pășunatului și a schimbărilor în modul de folosință al terenurilor, impune schimbări în legislația românească. În unele pajiști private din zone alpine și subalpine, au fost inventariate *in situ* speciile de plante, s-au identificat tipurile de habitate, caracteristicile lor și statutul de conservare. Multe dintre pășuni sunt suprapășunate; habitatele identificate sunt forme degradate a unor habitate de interes comunitar (Anexa 1 Directiva Habitate) cu statut de conservare neadecvat-nefavorabil. Compoziția specifică este modificată din cauza dominanței unor specii cu valoare furajeră scăzută dar cu viabilitate puternică. Cea mai importantă acțiune care ar trebui întreprinsă este dezvoltarea unui amenajament pastoral care să fie respectat timp indelungat, ducînd astfel la restaurarea habitatelor care formează pășunile.

Cuvinte cheie: habitate, pășuni, Munții Făgăraș, România.

INTRODUCTION

Pastures are defined as permanent grasslands typically used for grazing, with a floral composition dominated by *Poaceae* and influenced by human activity (agricultural use or strong human disturbance) (KOSZTRA et al., 2019). Pastures also represent a type of farmland that is rich in public environmental goods and has positive environmental effects (BEAUFOY et al., 2011). A grassland is a multifunctional system with different utilities: fodder production, plant and animal biodiversity, soil erosion, water storage, maintaining groundwater quality, ensuring landscape quality, carbon storage, supplying soil with biologically fixed nitrogen, etc. (DRAGOMIR, 2017).

According to MARUȘCA et al. (2010), the main ecosystem functions performed by grasslands are:

1). Supporting services (habitat function) – for wild animals and the conservation of biodiversity of plant and animal species. The structural composition of grassland vegetation is very diverse, with very high biodiversity indices compared to many European countries; the populations of economically valuable species present a very high germplasm genetic pool of populations, Romania being considered a natural biological reservoir for genetic improvement of many agricultural species; there is a particularly rich nectar-producing and medicinal flora.

2). Provisioning services (economic function) – which refer to all related activities resulting from the usage of and economic outputs from grassland such as the processing of animal products, the collection of medicinal flora, beekeeping, etc. The grasslands provide the fodder requirements for at least 60 % of the bovine population and 80 % of the sheep population.

3). Provisioning services (source function) – grassland is a source of fertilisation of arable land (via manure, silage etc). Grassland is also a biomass source for the production of biofuels. The biomass produced but not completely exploited on natural grassland and on derelict land (due to inadequate management and the rapidly decline in livestock numbers) can be a very important source of biofuel.

4). Regulating services (ecological function) – soil protection against erosion and the preservation of the natural capital.

5). Regulating services (retention function) – grassland as a water retention system; grassland as a bio-fixed nitrogen (NFB) production source: the biologically fixed nitrogen (NFB) estimate is 30 kg/ha/year for permanent grassland and 80 kg/ha for temporary grassland; grassland as a source of CO_2 storage: the estimated amount of stored CO_2 (sequestration) is 4.7 t/ha/year for permanent grassland and 4.2 t/ha/year for temporary grassland.

6). Cultural services (the landscape function) – given by the diversity of plant species that enhance and beautify the environment. The functional structure of Romanian grassland has been deeply disturbed due to the aggressiveness of some invasive plant species that could replace high-value species.

The ecosystem functions are called ecosystem services and represent flows of value to human societies as a result of the state and quantity of natural capital (***. SEP, 2015) or, in other words, the benefits that people obtain from ecosystems (***. MA, 2005). From an economic point of view, the flows of ecosystem services can be seen as the 'dividend' that society receives from natural capital (***. TEEB, 2010; BERNUÉS et al., 2015).

Plant species, depending on their optimum survival conditions, can be grouped in plant associations (phytocoenosis). A particular phytocoenosis has certain productivity and quality attributes as well as distinctive responses to management measures, and may occupy larger or smaller areas in grassland, depending on specific site conditions. Those pasture phytocoenoses that are similar in floristic composition, site conditions and agronomic characteristics (i.e. production, fodder quality, applied measures for improvement and usage, the direction of vegetation evolution depending on these measures, etc.) form a particular grassland habitat type (BĂRBULESCU & MOTCA, 1983; ȚUCRA et al., 1987). The protection and usage methodologies and the cultivation techniques of grasslands are specific to particular types of grassland and should not be applied uniformly to grasslands in general (MARUȘCA et al., 2010).

In recent years, along with the development of nature protection at the European level, Romania's entry into the European Union and the introduction of the Natura 2000 network, biodiversity conservation has increasingly focused on habitats of both national interest and European interest. DONIȚĂ et al. (2005) stipulate that the specific composition of flora and fauna, their ecological adaptations and their distribution as determined by these adaptations must be taken into account in the identification of habitats. Most habitats comprise one or more closely related plant associations (phytocoenosis). Exceptions exist in situations where there are several habitats within the same complex plant association. The structural complexity may arise from features such as exposed rocks in a grassland, other microtopographic variation or due to the growth form of the dominant species (or combinations of dominant species) creating fine-grain heterogeneity. The presence of two or more plant associations within a single habitat (e.g. peatland hummocks and pools) is also an exception. Habitat identification is achieved by identifying the phytocoenoses that characterise them, taking into account the typical (dominant) and ecological indicator species and the characteristics of the site (geographical location, altitude, relief, rock, soil, etc.).

Vegetation and habitat mapping often use a combination of different methods: on-the-ground surveys, satellite observations and statistical analysis (***. EEA, 2014). Studies by COLDEA et al. (2001) and CRISTEA et al. (2003) used 1: 25,000 maps and remote sensing images to identify grassland areas in Romania. Plant alliances were used as inventory units (size 0.5 ha). Areas smaller than 0.5 ha were inventoried only if they contained rare, endemic, threatened species, natural monuments or other particularly important features. Field trips (ground-truthing survey) were used to confirm the extent and composition of the units and sub-units.

The study of alpine and subalpine habitats (scrub and grasslands) by SÂRBU et al. (2020) showed that such habitats may be more sensitive to temperature and to moisture than the forests at lower altitudes. Most of the species surviving in these habitats are microthermophilic plants and are potentially sensitive to the warming and drought predicted by climate change.

Our own study sought to assess the extent, habitat type (and phytocoenoses) and present conservation quality of montane grasslands in part of the Făgăraș Massif. Our objective was to help local communities in managing their land for both productive grazing and for biodiversity conservation.

MATERIAL AND METHODS

In a broad geographical sense, the term Făgăraș Massif refers to the entire mountain complex belonging to the Meridionali Carpathians. The Făgăraș Massif dominates the Romanian Carpathians in terms of extent (2300 km^2) and height. The distinct geomorphologic characteristics of this massif include a sharp asymmetry between the northern and southern slopes (***. P. M., 2016) (Fig. 1). To the south, the Făgăraș Massif continues in a lower step formed by isolated mountains with very steep-sided valleys (***. P. M., 2016).

The Standard Data Forms available via the Environment Ministry and EEA and the Natura 2000 Viewer of the EEA (Fig. 2) show that ROSCI0122 Făgăraș Mountains is situated in the Alpine biogeographic region, with a total area of 198618 ha and altitude range of 347 m to 2526 m (***. EEA, 2014).

The Romanian legislation from 1921-1946 allowed private people to form communities (associations) for better management of their private land. During the period of communist rule, the land of these private owners was nationalised and managed by the state. After 1989 (LAW 1/2000), the right of private ownership of agricultural and forest land was restored and the land was given back to the private owners. The legislation permitted them to form communities (associations) according to the old legislation provided this did not contradict present Romanian legislation. The community was created in order to gain and allocate among the members the benefits obtained from grassland management e.g. through more efficient grazing. The pastures have been grazed for centuries, according to customs and traditions transmitted from generation to generation and strictly respected until the communist period, when all such customs were abandoned. In the present day, there is an increased impact of grazing and changes in land use, together with changes in the Romanian legislation.

Figure 1. Făgăraș Massif – general view (source: https://www.google.com/maps/)
The location of the studied area is demarcated in yellow.

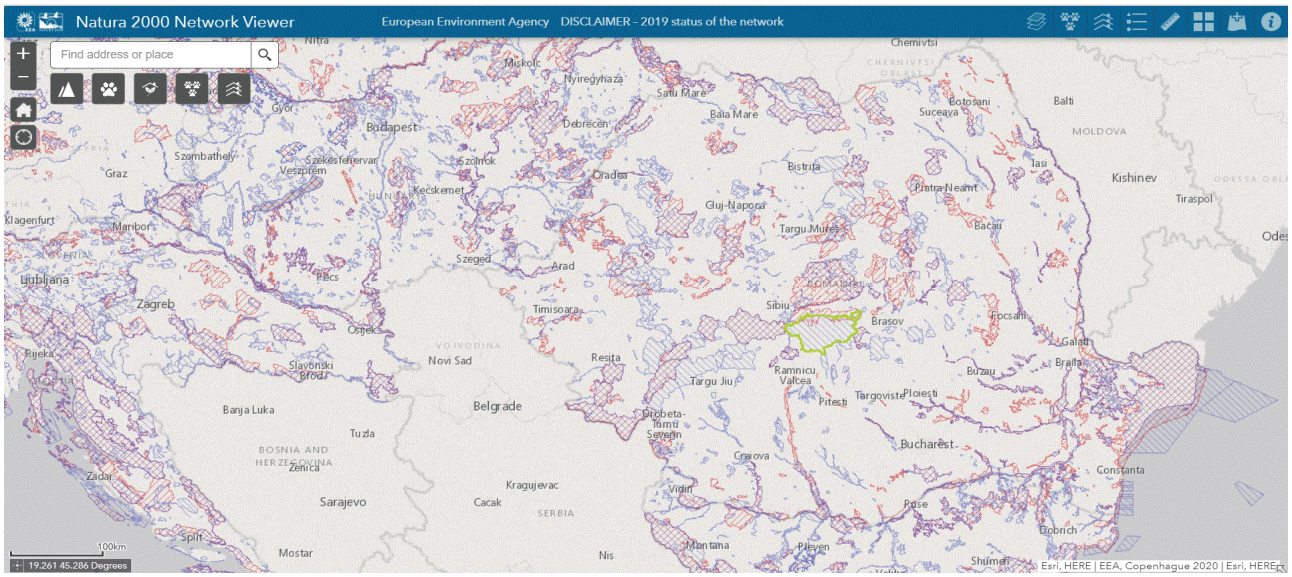

Figure 2. The location of ROSCI0122 Munții Făgăraș. After Natura 2000 Viewer of the European Environment Agency (https://natura2000.eea.europa.eu/).

The optimal duration of the grazing season is determined by days with daily temperatures equal or above 10^0C *i.e.* 40 days in the alpine area (2200-2400 m altitude) and 160 days at lower altitudes (600-800 m). In the mountains, grazing with sheep depends mainly on the duration of snow coverage, forcing the shepherds to graze their sheep at lower altitude (MARUȘCA, 2016a; b).

The study areas are situated in alpine and subalpine levels within the territory of four communities managing private grasslands (Table 1) used as grazing pastures for sheep. They extend over 6 mountains in the South-West region of the Făgăraș Massif (Fig. 3).

On the itinerary, we recorded the abundance-dominance (in %) of plant species in every investigated site. In every site, in accordance with its distribution area (Table 1) we established 10 x 10 m quadrats for characterizing the important areas, as is follow (Table 2): four quadrats in Vemeșoaia (Vem 1-4); three quadrats in Galbena (Galb 1-3); four quadrats in Budislavu (Bud 1-4), five quadrats in Sterminoasa (Ster 1-5) and four quadrats in Grohotișu (Groh 1-4). In every pasture, the private owners installed enclosures where grazing was banned.

The identified plant species were confirmed using CIOCÂRLAN (2009) and SÂRBU et al. (2013) and the ecological indices for every species included (following KOVÁCS, 1979). Identification of plant association and habitats followed CRISTEA et al. (2004), GAFTA & MOUNTFORD (2008) and SANDA et al., (2008). The statistical analysis of the data obtained after field inventory was performed using PAST program (HAMMER et al., 2001). One

Natura 2000 habitat might correspond to one or more Romanian habitats. Every Romanian habitat is described based on characteristic and identifying species (DONIȚĂ et al., 2005; GAFTA & MOUNTFORD, 2008).

In these private pastures from the alpine and subalpine areas we identified habitat types and characteristics, together with their conservation status (PĂCURAR & ROTAR, 2014; MIHĂILESCU et al., 2015).

Table 1. The extent of the study areas.

Community name	Local name	Area (ha)
Grohotișu	Grohotișu Mountain	164,62
Galbena and Vemeșoaia	Mountain Galbena and Mountain Vemeșoaia	331
Cîinenii Mici	Mountains Zănoaga, Prislop, Cocorîciu, Miclăușu	447,89
Sterminoasa and Budislavu	Mountain Sterminoasa and Mountain Budislavu	301,78

Within the Cîinenii Mici Community we studied only the Cocorîciu Mountain ridge (about 50 ha).

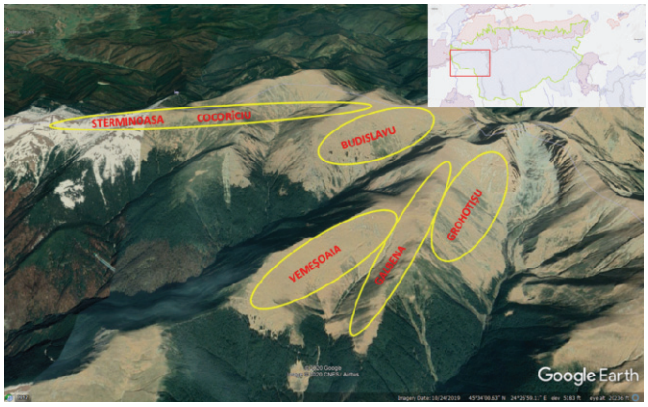

Figure 3. Location of study areas (original).

Table 2. Characteristics of the plots' locations.

Site	Vem 1	Vem 2	Vem 3	Vem 4	Galb 1	Galb 2	Galb 3	Bud 1	Bud 2	Bud 3	Bud 4	Coc 1	Coc 2	Ster 1	Ster 2	Ster 3	Ster 4	Ster 5	Groh 1	Groh 2	Groh 3	Groh 4
Altitude(m)	1747	1887	2043	1933	2054	2050	1710	2090	2068	2098	2073	1919	1918	1740	1749	1750	1752	1755	1746	1747	1821	1868
Aspect	S-SE	S	S	SE	W	SW	W-SW	SW	SW	SW	SW	S	S	W	W	W	W	W	E	E	E-SE	S-SE
Slope(°)	20	20	15	15	15	15	15	20	30	20	30	15	15	15	15	15	15	15	25	25	20	25

Legend: Vem – Vemeșoaia; Galb – Galbena; Bud – Budislavu; Coc – Cocorîciu; Ster – Sterminoasa; Groh – Grohotișu.

The conservation status of habitat types (MIHĂILESCU et al., 2015; 2020) was evaluated taking into account the following parameters: area, extent, structure and functions (including typical species – species that regularly appear in the habitat type), future prospects, pressures and threats. The results of the evaluation of conservation status parameters are expressed in four categories (and four colour codes -"traffic light method"): favourable (FV) – green, unfavourable/inadequate (U1) – orange, unfavourable/bad (U2) – red, and unknown (XX) – grey.

RESULTS AND DISCUSSION

In the Făgăraș Mountains, where permanent grasslands are present (ȚUCRA et al., 1987; MARUȘCA et al., 2014) the ecological zonation of grasslands may be defined as follows: 1.) Alpine level - present in high mountains, above 2000 m altitude in the north and 2100 to 2200 m altitude in the south, with the annual mean temperature from – 1.5 to -2.5°C, mean annual rainfall of 1300 – 1400 mm. 2). Subalpine level (of mountain pine) - present in high mountains, at altitudes 1700 (1800) m – 2100 (2200) m, with mean annual temperatures of 0.5 and – 1.5°C and mean annual rainfall above 1200 mm.

The Natura 2000 grassland habitats present in the ROSCI0122 site (Făgăraș Mountains) are: 6150 Siliceous alpine and boreal grasslands (0.1% of site); 6230*[1] Species-rich *Nardus* grasslands (0.01%); 6520 Mountain hay meadows (10%); 6410 *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*) (0.001%); and 6170 Alpine and subalpine calcareous grasslands (1%) (***. EEA, 2019).

ONETE et al. (2020) demonstrated that the natural and anthropogenic grasslands from the alpine and subalpine zones of the mountains of the South-West Făgăraș Massif were of very poor to medium quality in terms of use as pastures for grazing with sheep. The pastures are overgrazed and this can lead to a vicious circle of management. Thus, the decreasing quality of pastures reduces the quality of livestock products and then, in order to maintain their income, the local people increase the number of grazing animals thus further degrading pasture quality. The investigated pastures have become more uniform through decreased plant species diversity and increased dominance of some non-forage species as well as an increase in the distribution and density of some toxic species (Fig. 4).

The most species-rich grasslands occurred within enclosures where the grazing was prevented (Vemeșoaia 2 – Vem 2, Budislavu 1 - Bud 1 and Sterminoasa 1 – Ster 1). In contrast, the lowest number of species appeared in the areas where the dominant species was *Deschampsia cespitosa* (L.) P. Beauv. forming thick and tall clumps and not allowing other species to survive.

[1] Asterisk (*) indicates a priority habitat according to the Habitats Directive

Analysis of the database of the biological traits of the recorded species highlights the fact that the plant species from these investigated pastures are characteristic of grasslands with closed (compact) vegetation without open soil for regeneration. The life cycle of these species is adapted to the conditions of high mountains where the vegetation season is short because of late snow melting, strong wind, etc. The reproduction type is predominantly vegetative and sexual, and all species are clonal. Pollination takes place mainly through wind (anemophily) and insects (entomophily). Seed dispersal is achieved by wind (anemochory) and animals (ento- and endozoochory). The flowering time is predominantly in June, July and August. The life form of the species is predominantly hemicryptophyte.

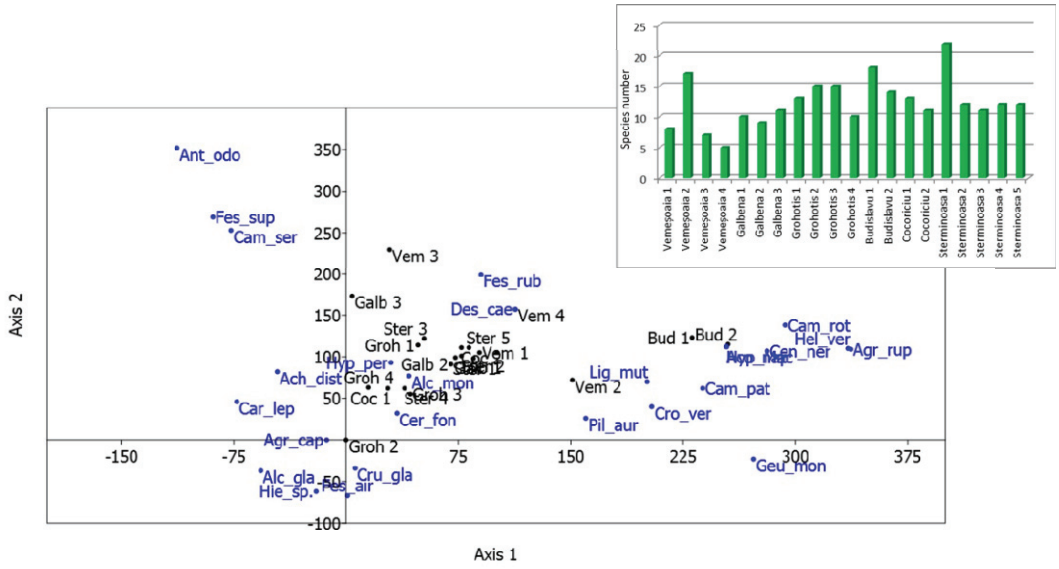

Figure 4. DCA (Detrended Canonical analysis) – characteristic species/plot in subdivisions of the study areas.

Within the Făgăraş Massif, some species are widespread, occurring on all the mountains investigated, whilst other appeared to be confined to one or only a few inventoried plots from the same mountain. For instance, *Nardus stricta*, which is indicative and characteristic of the NATURA 2000 priority habitat 6230* Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and submontane areas, in Continental Europe), is present on all six investigated pastures but in different proportions (Table 3). In contrast, another characteristic species, *Viola declinata*, is rare in some areas and apparently absent (or overlooked due to overgrazing) in other areas.

Table 3. Species recorded on the 6 Mountains and their range of % coverage.

Species	**Vem**	**Galb**	**Groh**	**Bud**	**Coc**	**Ster**
Achillea stricta Gremli			0-5			0-2
Aconitum napellus L. ssp. *fissurae* (Nyár.) W. Setz.	0-3					
Agrostis capillaris L.	6-10	10-25	20-60		15-35	10-30
Agrostis rupestris All.				4-5		
Agrostis stolonifera L.						
Alchemilla glabra Neygenf.					2-10	
Alchemilla monticola Opiz						2-7
Anthoxanthum odoratum L.	0-5	0-5				
Avenula versicolor (Vill.) M.Laínz				2		
Campanula abietina Griseb.		0-3		0-2	1-2	0-2
Campanula rotundifolia L. ssp. *polymorpha* (Witašek) Tacik				1-5		0-5
Campanula serrata (Kit. ex Schult.) Hendrych	0-3	0-2	0-2		0-2	
Carex leporina L.						0-5
Centaurea nervosa Willd. ssp. *nervosa*	0-5			1		
Cerastium fontanum Baumg. ssp. *fontanum*			0-3		0-3	0-5
Crocus vernus (L.) Hill ssp. *vernus*	0-4		0-2			0-1
Cruciata glabra (L.) Ehrend.		0-1	0-2			0-3
Deschampsia cespitosa (L.) P.Beauv.	5-30	5-30	0-20	3	10-40	5-35
Festuca rubra L.	5-10	5-10	0-20	1-5	2-14	5-20
Festuca supina Schur	0-5		0-8			0-5
Geum montanum L.	0-3		0-5	1-2		
Hypericum maculatum Crantz	0-3					
Hypericum perforatum L.		0-2				0-2
Ligusticum mutellina (L.) Crantz	2-3	0-3	0-2	1	0-2	0-5
Luzula multiflora (Retz.) Lej.			0-6			
Nardus stricta L.	30-60	15-30	0-15	2-3	10	0-20
Phleum alpinum L. ssp. *alpinum*				5-20		

Pilosella aurantiaca (L.) F.W.Schultz & Sch.Bip. ssp. *aurantiaca*	0-3		2-3			0-1
Plantago gentianoides Sibth. et Sm.				0-2		0-4
Poa annua L.	0-40				0-10	0-15
Poa *chaixii* Vill.			0-5			
Poa media Schur	0-5	0-5		50--60	0-3	0-15
Potentilla ternata K. Koch	0-3	3-5	0-10	1-2	0-2	0-5
Ranunculus oreophilus M. Bieb.				2-3		0-3
Rumex acetosella L.						0-5
Rumex alpinus L.			0-2	1-2	0-3	0-3
Scorzonera rosea Waldst. et Kit.			0-2			0-22
Soldanella major (Neilr.) Vierh.	0-3		0-2			
Taraxacum officinale Weber ex F.H.Wigg.					2-3	0-10
Thymus pulegioides L.			0-10			
Trifolium pratense L.						0-10
Trifolium repens L.	0-3	0-7	2-8	0-3	5-10	0-10
Urtica dioica L.					0-4	0-2
Vaccinium myrtillus L.	3-10	0-7	0-5			
Veratrum album L.	0-5	0-10				
Veronica chamaedrys L.						0-2
Veronica serpyllifolia L.			0-2	0-1		
Viola declinata Waldst. & Kit.	2-3	0-5				
Total vegetation cover (%)	86-90	88-95	100	98-100	100	100

Grasslands dominated by *Nardus stricta* are well developed over large areas. The vegetation structure of densely tufted *Nardus* individuals restricts the development of other species. The ecological factors that contribute to the development and spread of *Nardus* are increased soil acidity and decreased soil fertility, combined with climate, relief and grazing intensity (PUȘCARU-SOROCEANU et al., 1963).

On the six pastures, our vegetation survey started from 1700 m altitude and extended to 2000 m altitude. Within this zone, the dominant plant association is *Violo declinatae –Nardetum* Simon 1966 (Syn.: *Nardetum strictae montanum* Resmeriţă et Csürös 1963, *Nardetum strictae alpinum* Buia et al. 1962, *Nardetum alpigenum austro – carpaticum* Borza 1959) (SÂRBU et al., 2004; SANDA et al., 2008). This phytocoenosis corresponds to Romanian habitat R3609 South-East Carpathian grasslands with mat-grass (*Nardus stricta*) and *Viola declinata*. Over large areas of the Făgăraș Massif study area, the habitat was degraded, due to medium to high grazing impact (Photo 1), which in some places transformed the grassland to an anthropogenic habitat dominated by tufted hair-grass (*Deschampsia cespitosa)* (Photo 2).

Within this habitat the shrub layer is scarce and dominated by *Vaccinium myrtillus* and *Bruckenthalia spiculifolia*. The characteristic species include *Viola declinata, Nardus stricta, Scorzonera rosea* and *Poa media,* while other important species are *Agrostis capillaris*, *Pilosella aurantiaca, Campanula serrata, Ligusticum mutellina, Alchemilla sp.* and *Hypericum maculatum.*

Photo. 1. Habitat R3609 on rocky substrate (1870 m altitude) (original).

Photo. 2. Overgrazed R3609 (1755 m altitude) (original).

MARUȘCA et al. (2014) included within the Series NARDUS STRICTA those grasslands from the subalpine level (of mountain pine) on high mountains. These grasslands belong to the type of oligotrophic pastures on acidic and nutrient-poor soils from sub-alpine to alpine levels on all the high mountainous massifs of Romania, occupying many tens of hectares at altitudes between 1200 and 1800 m (COLDEA et al., 2001).

The Romanian habitat R3609 corresponds to the NATURA 2000 habitat 6230* (Table 3) and the conservation value of the habitat is moderate, despite the habitat being priority at the European level (DONIȚĂ et al., 2005).

Grasslands of tufted hair-grass are an anthropogenic modified habitat dominated by *Deschampsia cespitosa* and are well developed from the lowlands up to the lower part of the alpine level. The *D. cespitosa* grasslands are very close ecologically and are successional to grasslands of *Festuca rubra* s.l.; they are included within the same formation (PUȘCARU-SOROCEANU, 1963). The indicative and characteristic species is *Deschampsia cespitosa with* 80–95(100) % coverage (Photo 3). This grassland is a degraded form of habitat 6230* (i.e. R3609). Habitat R3609 contains some species with fodder value, but, being grazed, their extent is small and short, protected by *D. cespitosa,* and thus inaccessible for grazing animals. *Deschampsia cespitosa* has negligible fodder value for animals, but sometimes is still grazed because the other species with fodder value are overgrazed.

Although grasslands dominated by *Nardus stricta* or, to a lesser degree, *Deschampsia cespitosa* are the most extensive in the Făgăraș Massif study area, other types occur locally. In enclosures installed by private owners (Photo 4) the species recorded form the Association *Festuco rubrae –Agrostetum capillaris* Horvat 1951, which is referred to the habitat R3803 South-East Carpathian grasslands with *Agrostis capillaris* and *Festuca rubra* by DONIȚĂ et al. (2005). The description of this habitat by COLDEA et al. (2001) states that the habitat is present in hilly and mountainous regions, on the lower slopes of mountainsides with Southern and Eastern aspect. In the enclosures, the dominant species are *Agrostis capillaris* and *Festuca rubra*, which are characteristic and indicative of the habitat R3803. Other important species were *Campanula abietina, C. serrata, Ligusticum mutellina, Potentilla ternata* and *Trifolium repens*, whilst the total vegetation coverage was 100% (i.e. closed vegetation).

Photo 3. Anthropogenic degraded habitat of tufted hair-grass (1933 m altitude) (original).

Photo 4. Ungrazed vegetation in enclosure (1748 m altitude) (original).

The species-rich *Nardus* grassland (R3609) locally forms a mosaic with dwarf juniper scrub *Campanulo abietinae–Juniperetum* Simon 1966 (Syn.: *Juniperetum nanae* Soó 1928, *Juniperetum sibiricae* Raţiu 1965, *Vaccinio-Juniperetum communis* Kovács 1979, *Junipereto-Vaccinietum* Puşcaru et al. 1956 n.n.) (Photo 5). This low scrub is referred to the Romanian habitat R3108 South-East Carpathian scrubs of dwarf (*Juniperus sibirica*) and corresponds to the Natura 2000 habitat 4060 Alpine and boreal shrubs. On more exposed windy slopes, *Rhododendro myrtifolii–Vaccinietum* Borza (1955) 1959 em. Boşcaiu 1971 develops (Syn.: *Rhodoretum kotschyi* auct. rom., *Rhodoreto-Juncetum trifidi* Resmeriţă 1974 – *saxifragetosum panniculatae* Horeanu et Viţalariu 1991). This vegetation type equates to R3104 South-East Carpathians scrub with rhododendron (*Rhododendron myrtifolium*) and blueberry bush (*Vaccinium myrtillus*) and with the Natura 2000 habitat 4060 Alpine and Boreal heaths (Photo 6).

Photo 5. Mosaic of R3609 with *Juniperus sibirica* (1788 - 1886 m altitude) (original).

Photo 6. R3609 transition to R3108 (1950-1850 m altitude) (original).

On Budislavu Mountain, grazed pastures are present at altitudes above 2000 m, where the dominant plant community is *Poëtum mediae* Csürös et al. 1956, a plant association that is included within Romanian habitat R3610 South-East Carpathians grasslands with *Poa media* (Table 4). The main indicative and characteristic species is *Poa media* (DONIȚĂ et al., 2005) together with other important species (Table 3): *Phleum alpinum* ssp. *alpinum, Potentilla ternata, Ranunculus oreophilus, Thymus pulegioides* and *Trifolium repens.*

On Grohotișu (Photo 7) and Budislavu (Photo 8) Mountains, there are areas where the sheepfold was set for a while and where the plant association *Poëtum supinae* (Oberd. 1957) Brun-Holl 1962 emend. Gutte 1969 is well developed. The vegetation association represents the advanced phase of depletion of organic deposits (SANDA et al., 2008). This plant association is placed within the Romanian habitat R8707 South-East Carpathian communities with *Poa supina*. The upper layer of the vegetation is dominated by tall *Rumex alpinus* (indicative species) with *Veratrum album, Urtica dioica, Heracleum palmatum, Scrophularia nodosa* and *Polygonum bistorta* (characteristic species). Underneath, the lower layer of vegetation is represented by *Poa supina* (indicative and characteristic species), *Alchemilla hybrida, Trifolium pratense, T. repens* and *Geranium sylvaticum*. The soils are very rich in decomposing organic matter (DONIȚĂ et al., 2005). A major conservation problem arising from the development of this habitat is that, once established on the former sheepfold, both *Rumex alpinus* or *Urtica dioica* can invade cliff ecosystems (rocky habitats) that might provide a refuge for important (national and/or community interest) plant and animal species.

Photo 7. R8707 on small area (0.5 ha) in Grohotișu with *Rumex alpinus* dominant (1747 m altitude) (original).

Photo 8. R8707 on small area (1 ha) in Budislavu with *Urtica dioica* dominant (2050 m altitude) (original).

The pastures on the six investigated mountains were well developed and included the priority Natura 2000 habitat 6230* Species-rich *Nardus* grasslands, in siliceous substrates in mountain areas (and submontane areas, in Continental Europe). This habitat was well-distributed over large parts of all six investigated mountains. According to MIHĂILESCU et al. (2015), this habitat from the Alpine bioregion of Romania has favourable conservation status but unknown future prospects. It is specified in Annexes 1 and 2 of the EU Habitats Directive, adopted in Romania as OUG 57/2007 (Law 49/2011), as having a priority community interest, being a natural habitat in danger at European level and for which the European Community has a particular responsibility.

The main pressure (with a clear impact) upon the habitat is overgrazing, but some other general factors (climate changes and pollution) also affect the vegetation. The future prospects for the habitat are not good if the grazing impact increases further. If the private owners continue to apply the current management regime (grazing with the same number of sheep over years) in the mountains, that might keep the habitat in the present state. Other environmental factors also affect these grasslands. Most importantly, in the early 21st century, climate change is obvious in the mountainous regions, resulting in long periods of drought and elevated temperatures or long periods of heavy rain and low temperatures, or dry during winter and snow lying late in the spring. For the Făgăraș Massif study area and based upon the species and habitats present together with their extent (Tables 3 and 4) we can use the "traffic lights method" to show that the conservation status of the habitat is unfavourable/inadequate (U1) – orange (Table 5).

Table 5. The conservation status of Natura 2000 habitat 6230* Species-rich *Nardus* grasslands, in siliceous substrates in mountain areas.

Parameters	**Conservation status**	**Observations**
Area	U1	The grazing impact is constant or increasing
Extent of habitat	U1	Might decrease due to transformation of the habitat
Structure and function (Typical species)	U1	The populations of the typical plant species might decrease or the species might disappear
Future prospects (taking into account the above parameters)	U1	Not good as long as impact factors are stable or increase
Evaluation of the conservation status	U1	

The observations made in the ungrazed enclosures within subalpine pastures (1710 m in Galbena, 1867 m in Grohotișu, 1887 m in Vemeșoaia, 1919 m in Cococîciu) showed that the dominant species are *Agrostis capillaris* and *Festuca rubra* s.l.. We therefore infer that, prior to intensive grazing, these pastures that are now dominated by invasive *Nardus stricta* were originally *Agrostis capillaris* grasslands. Earlier studies (PUȘCARU-SOROCEANU et al., 1963; ANGHEL et al., 1967; IVAN & DONIȚĂ, 1975) showed that *Nardus stricta* grows on podzol soil (sandy or clay soil, poor in calcium, acidic, low natural fertility) at lower altitude, but on more fertile and humid soils at higher altitude. Higher altitude mat-grass grasslands differ from those from lower altitude in having some alpine accompanying species (*e.g. Festuca supina, Agrostis rupestris, Ligusticum mutellina*, etc.). Despite this fact, the alpine mat-grass grasslands are quite poor in truly alpine species and instead richer in montane (subalpine *etc*) species (*Ranunculus montanus, Stellaria graminea,* etc.). The mat-grass grasslands cover large areas of high Romanian Mountains (MOTCĂ et al., 1994). The dominant species *Nardus stricta* has a high ecological plasticity, being tolerant of a range of humidity and temperature conditions, and thus able to grow at different altitudes (300-2200 m). Mat-grass grasslands originated from other grasslands typical of the spruce-forest level (*Festuca rubra*) and juniper tree level (*Festuca ovina* s.l.) (PUȘCARU-SOROCEANU et al., 1963; MOTCĂ et al., 1994). They represent semi-natural plant associations in a disclimax (disturbance climax) stage within the true climax of the subalpine zone where the spruce and juniper has been clear-cut (BOȘCAIU, 1971). Where the cleared forest is subject to further intensified grazing, the mat-grass communities are gradually replaced by *Deschampsia cespitosa* grasslands, especially where the soils are moist and the drainage impeded.

CONCLUSIONS

Pastures belonging to four private communities spread over 6 mountains in the South-West Făgăraș Massif and extending over alpine and subalpine level have been grazed for centuries. We surveyed these pastures and recognised seven habitats i.e. degraded forms of two European interest habitats and five Romanian interest habitats.

The main direct impact factor on these grasslands is overgrazing with sheep, but there are also general impact factors (climate changes and pollution). The conservation status of the European interest pasture habitat in the Făgăraș Massif is unfavourable/inadequate (U1). However, in terms of habitat extent and distribution, we could not discriminate between true European interest habitat and habitat (grassland) derived secondarily from grasslands typical of the alpine and subalpine levels.

Comparing the study area with alpine and subalpine levels of the South-West Făgăraș Massif, pastures in the latter region occupy large areas, but the relief and ecological conditions are more varied. For example, the angles of the slopes are steeper, the soils are thinner, skeletal and less fertile, prone to drought or with excess moisture. The local climate (microclimate) varies, leading to a high diversity of plant species, high heterogeneity and uneven distribution of component habitats (phytocoenoses) as well as fodder production and quality.

There was considerable evidence in this study that unregulated and intensifying grazing with sheep has limited the biodiversity value of the massif. The rational usage of these pastures, the implementation of appropriate improvement, maintenance and use, can only be done in accordance with real knowledge of existing vegetation, soil and climate conditions, natural and anthropogenic environmental factors that affect them.

Because of overgrazing, the *Nardus* grasslands of the South-West Făgăraș Massif are at present too degraded and species-poor to deserve classification as a Natura 2000 priority habitat 6230*. However, a well-designed management plan collaborating with the local private communities could restore these pastures to the quality of a Natura 2000 habitat.

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