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Species-rich Mountain Grasslands Through the Eyes of the Farmer: Flora, Species Composition, and Extensive Grassland Management

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ABSTRACT

Species-rich semi-natural grasslands are important components of European cultural landscapes. In Transylvania, Romania, they are managed by extensive land-use systems which, in turn, are maintained to this day through in-depth traditional ecological knowledge. Interdisciplinary approaches should help to better understand how these land-use systems operate, including their impact on vegetation, as well as help to solve a complex problem encountered in nature conservation, namely how to maintain such systems in the face of social and economic changes that often lead to either abandonment or intensification. The purpose of this paper is to explore the traditional local knowledge related to the flora and vegetation of species-rich hay meadows in the Gyimes/ Ghimeş region of the Eastern Carpathians, Romania.

First, 30 farmers were asked about 77 wild plant species of the grasslands, about their habitat preferences, and about the vegetation of the hay meadows and pastures, using structured indoor and field interviews and participatory observation. For a botanical description of grasslands, 30 4x4 m phytosociological relevés (quadrats) were made on both hay meadows and pastures.

We listed all together 85 wild plant species that were associated with meadows or pastures by the Gyimes people. The majority of constant and sub-constant species found in relevés of hay meadows and pastures were well known and often used by locals (wild edible, medicinal, poisonous plants and important forage and fodder plants). Interestingly, however, local people could list only a few of these plant species when they were asked to list species typical of meadows and pastures, i.e. an average 2.0 species names were given in a free listing. We conclude that Gyimes people do not use their detailed knowledge about habitat preferences of wild plant species to create abstract lists of "species composition per habitat".

In-depth knowledge of species and habitat preferences plays an important role in the lives of local communities. Gyimes people's knowledge extends to almost all key species of the flora of grasslands that provide important ecosystem services.

Extensive land-use practices contributed to a great extent to the development and maintenance of European cultural landscapes. A closer look at these systems would provide a framework to harmonise ethnographic and ecological research, as well as assist NGOs and governments in developing more site-specific, culturally more appropriate and thus more effective conservation strategies.

KEYWORDS

mountain hay meadows, grassland management, folk taxa and habitats, Gyimes/ Ghimeş

Introduction – the importance of hay meadows

The purpose of extensive management of European cultural landscapes is to enhance the benefits provided by nature, i.e. ecosystem services, and to ensure their continued availability and prevent their degradation. Land use of cultural landscapes has been developed for centuries and is built on in-depth traditional ecological knowledge that takes local conditions into account (including extremes) and thus ensures sustainable management of natural resources (Turner *et al.* 2000, Antrop 2005, Berkes 2008, Agnoletti 2014). Operation

of these land-use systems can be best understood through the lens of traditional and extensive management methods, and their impact on vegetation should be studied using interdisciplinary approaches derived from both ethnography and botany. The amalgamation of humanities and natural sciences assists in solving complex problems encountered in nature conservation, where solutions are promoted by uncovering the ecosystem services that are most important to the local community and by exploring the goals and motivations of that same community, including their intimate knowledge of nature (Mascia *et al.* 2003, Allendorf & Allendorf 2012).

Grasslands are a typical component of cultural landscapes. They are both natural and cultural assets, in that they are used to meet the summer (pastures) and the winter (hay meadows) feeding needs of the livestock. Hay meadows developed on the site of former forests are excellent indicators of social and economic change (Babai *et al.* 2015). Due to adverse social and economic impacts, these anthropogenic, yet sometimes very species-rich habitats, can be used as indicators of landscape abandonment or intensification (Fischer and Wipf 2002) that has often happened in a rapid or dramatic way (Cudlínová *et al.* 1999, MacDonald *et al.* 2000, Tasser & Tappeiner 2002, Palang *et al.* 2006, Veen *et al.* 2009, Pavlú *et al.* 2011, for Transylvania: Akeroyd & Page 2011, Demeter & Kelemen 2012, Hanspach *et al.* 2015). As a result of these changes the overwhelming majority of species-rich meadows were pushed back to marginal areas, mainly mountain ranges, where local communities still carry out extensive management and depend directly on biomass produced by the land they live on (Hartel *et al.* 2014).

In many parts of the mountain and hill ranges of Transylvania, Romania you can still find rural communities pursuing traditional land management of extensively managed species-rich meadows and pastures. There are still large areas of species-rich, dry, mesophilic, or poor mountain grazing land in many places in the North-eastern Carpathians (Maramureș) (Ivașcu and Rakosy 2016) and in several regions of the Eastern Carpathians (Csergő and Demeter 2012, Csergő *et al.* 2011, 2013), in Transylvanian Saxony (Baur *et al.* 2006, Akeroyd and Page 2006, 2011, Sutcliffe and Larkham 2011, Sutcliffe *et al.* 2015), on Mezőség (Szabó and Ruprecht 2001, Cremene *et al.* 2005, Dengler *et al.* 2012, Turtureanu *et al.* 2014), and Apuseni Mountains (Reif *et al.* 2008). These natural environments are suitable for livestock husbandry mainly, such as cattle and/ or sheep farming (dairy products and meat). However, due to the climatic conditions of the mountainous regions, with long winters, farmers must produce great amounts of winter hay fodder.

Careful management of hay meadows is of paramount importance for obtaining a large volume of quality hay (Meilleur 1986, Netting 1981, Niedrist *et al.* 2009, Glasenapp and Thornton 2011, Babai and Molnár 2014, Babai *et al.* 2014, 2015). Mountain communities are greatly dependent on the quantity and quality of the hay produced and have developed grassland management and husbandry to the highest standards (pl. Meilleur 1986, Babai and Molnár 2014).

For the development and maintenance of species richness on mountain hay meadows it is very important to document local and regional (e.g., Poschlod *et al.* 1998, Marini *et al.* 2008, Merunková *et al.* 2012), historical and cultural (e.g., Poschlod and Wallis de Vries 2002, Pärtel *et al.* 2007, Poschlod *et al.* 2008, Hájková *et al.* 2011) factors that influence patterns of land use (Poschlod *et al.* 1998, Turtureanu *et al.* 2014). These grasslands provide very important ecosystem services to the local community and the habitats provide a number of edible wild plants and medicinal herbs in addition to hay (Dénes *et al.* 2012, Babai *et al.* 2014).

The considerate and careful development of grasslands management that also sustains ecosystem services in the long run requires

extensive background knowledge on the part of local residents. Such traditional ecological knowledge includes knowledge of the names of grassland species, as well as their uses and habitat preferences. It also includes the valuation of each species as fodder, or issues related to population dynamics, including scarcity. The purpose of this paper is to explore the traditional local knowledge related to the flora and vegetation of hay meadows.

Material and methods

Study area

Botanical knowledge related to grasslands management was assessed in the Eastern Carpathians, among the Gyimes Csángó people (*Ceangăi din Ghimeş*), in the part of Gyimesközéplok (*Lunca de Jos*) called Hidegségpataka (*Valea Rece*) (Harghita county, Romania) (Figure 1, Table 1). The Gyimes Csángó people constitute an ethnic sub-group with about 14,000 members living in the valleys of the Tatros/ Trotuş and its tributaries. Their native tongue is Hungarian. Hidegségpataka is a community of 2,500 people. The Csángó culture, folklore (particularly dances and folk songs), religious life, dress, characteristic life-style and customs, which were all in use until recently, have preserved a number of archaic elements (see e.g., Ilyés 2007, Kallós 1960, Tánczos 1994, Pócs 2008). After the change of the political system in 1989, the local culture has been under transformation, i.e. it is increasingly dependent on market conditions and emigration has started. Preservation of the spoken language and the characteristic cultural traditions have strengthened local identity and ensured the expression of the community's national identity.

Fig. 1. The study area in the Eastern Carpathians, Romania (Map source: Babai & Molnár 2013)

The people in the Gyimes region (called Csángós) continue to practice a form of semi-subsistence farming system. Local farmers strive for self-sufficiency, producing an estimated three-quarter of the necessary food for their families (meat – beef and pork and dairy products). Animal husbandry and small-scale dairy production are the key sources of income in their local economy (Biró *et al.* 2011, Sólyom *et al.* 2011). There are only a few entrepreneurs in the community, who are farming on larger areas, owning 10-15 or at most 40 cattle, in comparison with an average of 2-3 cattle. They have recently started to keep beef cattle.

The only crop the Csángós produce in large quantities is potatoes, the surplus of which is sold at the market or exchanged for grapes, or vegetables (for more details, see Babai & Molnár 2013). Because of this type of mixed small-scale farming, local farmers have to be a lot in the natural environment (they spend approximately 210 days yearly outdoors), which enriches their ecological experiences and knowledge.

Since the '90s, legal and illegal logging in the area surrounding the settlement was an important revenue opportunity for the local small farms. Illegal logging however was forced back completely by the exhaustion of resources, the reduction of exploitable forests. Nowadays rural tourism is a new source of income not least due to the conscious effort to build the Gyimes "Millenial Border" into a Hungarian national symbol (Ilyés 2010), and to the Pentecost Csíksomlyó Pilgrimage becoming a national celebration for Hungarians all around the world.

Features	
Geographic data	
Location (central coordinates)	N 46.3722° – E 25.5724°
Region	Eastern Carpathians
Settlement structure	Scattered
Elevation above sea level	800-1500 m
Climate	Mountainous-boreal with a continental influence
Average yearly temperature	4-6 ºC (see Ilyés 2007)
Average yearly precipitation	800-1000 mm (see Ilyés 2007)
Proportion of main land-cover types in (1769-72; 1871-73; 1940; 2010)	Arable: no data (<2)/n.d. (<10)/n.d. (<10)/3% Grassland: 19/66/60/65% (see Babai 2014) Forest: 77/29/30/26% (see Babai 2014)
Minimum cover of forest in the last 250 years	30% in 1870 (see Sólyom et al. 2011)
Protected areas	Cheile Bicazului-Hăşmaş (Békás-pass – Nagyhagymás) National Park, ROSCI0323 Munţii Ciucului (Csíki havasok) Natura 2000 area
Societal data	
Human population in 1860/1961/2010	3600/14700/14000 (see Ilyés 2007)
Nationalities (2010)	Hungarian (99.8%), Romanian (0.1%), Roma (0.1%)
Dominant religion (2010)	Catholic
Economic data	
Average yearly income / person (2010)	1.610 EUR
Population managing meadows in 1960/2010	ca. 98/ca. 90%
Main area of meadows per family in 1960/2010	2.6/2.4 ha
Population working in animal husbandry in 1960/2010	ca. 98/ ca. 90%
Livestock unit per family in 1960/2010	ca. 5/ ca. 3

Table 1: Geographic, social and economic data of the study area (based on Babai et al. 2015).

This area falls within the Carpathian district of the Central European Floristic Region. The most common forest tree is spruce (*Picea abies*). The majority of the 641 vascular plant species we documented have Eurasian (29%), European (13%) and circumpolar (12%) distributions. Some of the typical endemic species are *Viola declinata*, *Campanula carpathica* and *Hepatica transylvanica* (Pálfalvi 1995, 2001, 2010, Nechita 2003, Babai 2014). A number of rarities, including endemic and relic species, find favourable living conditions here, like e.g., *Tozzia carpathica*, *Gentiana phlogifolia*, *Scabiosa lucida* subsp. *barbata* (Babai 2014).

Almost the entire area was formerly forested, and lies within the belt of spruce forests (*Hieracio rotundati-Piceetum*) between (600) 1200 – 1600 m. Beech forests (*Symphyto cordati-Fagetum*) also occur, but are very limited in extent.

Vegetation of the meadows dominating two thirds of the landscape consists mainly of mountain grasslands (*Festuco rubrae-Agrostetum capillaris*, *Anthoxantho-Agrostietum capillaries, Violo declinatae-Nardetum*) and the mesophilous, manured grasslands in the valleys (*Arrhenatheretum elatioris*). Weed flora of arable fields is considerably rich (as local farmers abstain from the use of any herbicides) (Babai 2014).

The locals and their traditional ecological knowledge

The Gyimes area was a political border zone of the Hungarian Kingdom, with no recorded intensive use before the eighteenth century (Ilyés 2007, Hofer 2009), which makes it one of the youngest cultural landscape in Europe. Early seventeenth century archival sources do not mention any permanent human populations in

the Gyimes area. And neither do late seventeenth century sources (Ilyés 2007). The first church was built only in 1782 close to the border (Ilyés 2007). The Gyimes area was covered with 75% forest in 1792. There were narrow stripes of grasslands and roads in the main valleys. Exploitation of timber resources in the area became possible only after the building of the railway in 1897. These data suggest that the area was settled comparatively late. Immigration from the west (Transylvania) and east (Moldova), and deforestation began only in the 18th century. The forested area was rapidly reduced in order to create pastures and hay meadows (Ilyés 2007). About 45% of the original forests were cut in the first half of the 19th century (Babai 2014). The pattern of the landscape was stabilized afterwards, and the resulting grassland-forest mosaic characterizes the landscape structure even today (Ilyés 2007).

The research we have conducted since 2004 has showed that nearly half of the 641 vascular plant species found in the area so far (for the list of the flora, see Babai 2014), 48 % (309 species) are also known by the Gyimes population (Babai 2014, Molnár and Babai 2009). Most members of the local community know 75-80% of the folk taxa, while the specialists (e.g., the healers) know more than 90% of it. The average knowledge of plants is outstanding in the Gyimes community, in comparison with other communities studied (e.g. Péntek & Szabó 1985). Certainly, there are some members of the community who barely know the folk taxa. The traditional ecological knowledge is so significant in this village because the transmission of knowledge was not disrupted by the socialist transformation of the agriculture. While other regions of the country were significantly affected by the set up of socialist collective farms in the 1950s, there were no collective farms or only partly operational ones in the Csángó territory. Csángós owned their land (arable fields, pastures, meadows, and partly also the forests) even during the communism. The gradual change of lifestyle after 1989, however, hinders the traditional mechanisms of knowledge transfer; the young generations learn fewer and fewer species, habitat names and methods of use from their parents (Babai 2014). The Csángós' knowledge of plant species is based on extremely sophisticated morphological information, as they are even able to determine with certainty if and when a new species appeared in the region (Molnár & Babai 2009). Their knowledge of plants is based mainly on the information learned from their elders and their own experience. School education is not significant when it comes to plant knowledge, though the elders tell that they have learned something about plants in school too. This "formal" knowledge however covers only a few species. The most important external influence on their knowledge of species and the folk names was the 1990 Hungarian edition of Maria Treben's book *Health from God's Garden: Herbal Remedies for Glowing Health and Well-Being*, which is found in a great number of copies and is quite widespread and popular among the Csángós. This book however covers mainly the local knowledge of folk healing, but has a much smaller influence on the traditional ecological knowledge.

Csángós know not only the names and morphological traits of species but their habitat preferences as well. In the landscapes that they cultivate and are most familiar with, Gyimes individuals can distinguish between over 140 different habitats (Figure 6, Appendix 1-2) (Babai and Molnár 2013, Biró *et al.* 2014), which is the highest figure among communities worldwide assessed for such knowledge (cf. Johnson and Hunn 2010). Gyimes people build their classification of habitats on nine features: some abiotic (such as soil characteristics, hydrological, and geomorphologic features) and the others biotic (for instance, land use, dominant plant species, vegetation structure, successional stage, disturbance) that enable them to accurately

Fig. 2. The nearby hay meadows (*Arrhenatherum elatioris*) are dominated mainly by *Salvia pratensis* (lila) and *Tragopogon pratensis* (yellow). Photo credits: Ábel Molnár

identify the habitat needs of species important to them (Babai and Molnár 2009, 2013).

The Gyimes Csángó people distinguish between three different groups of grasslands: inner (nearby) and outer (distant) hay meadows (Figure 2, 3), the former derived frequently from fallow land (Table 2), and pastures (three subtypes; Table 3, Figure 4, 5). These main habitat types differ from each other in terms of management, and, therefore, in species composition as well (Babai 2014).

Table 2 Main hay meadow types in Gyimes (based on Babai & Molnár 2014)

	nearby hay meadows (Fig. 2)	distant hay meadows (Fig. 3)
location	near settlements, accessible mountain slopes to which manure can be carried	far from settlements, usually at higher altitudes
mode of use	mowed 2(3) times a year, grazed in late autumn	mowed once, grazed in autumn
dominant plants	Monocots	Dicots
typical plant species	*Trisetum flavescens, Agrostis tenuis, Anthoxanthum odoratum, Lolium perenne, Trifolium repens, Salvia pratensis, Tragopogon orientalis, Colchicum autumnale*	*Festuca rubra, Agrostis tenuis, Nardus stricta, Carlina acaulis, Veratrum album, Vaccinium myrtillus, Trifolium pannonicum, Traunsteinera globosa, Hipochoeris uniflora*
hay quantity	higher (grass height is ca. 1.0–1.5 m)	lower (grass height is ca. 0.4–0.5 m)
hay quality	fibrous (lower quality) + good second growth	leafy (better quality)
time of mowing	end of June-end of July + August	beginning of August-beginning of September
manuring	every 2–3 years	rarely (only around barns)
origin of the meadows	mostly from abandoned fields	mostly never ploughed, originated directly from forests

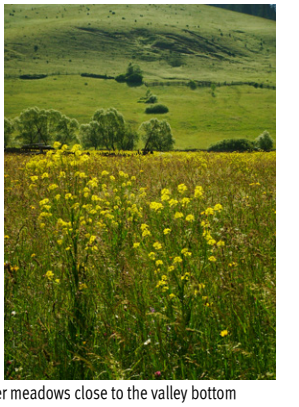
Fig. 3. Distant hay meadows (*Festuco rubrae-Agrostetum capillaris*) are species rich seminatural grasslands, dominated by colourful flowers, e.g. *Leucanthemum vulgare* (white), *Campanula rotundifolia* (lila). Photo credits: Daniel Babai

Pastures are sometimes overgrazed, downtrodden habitats, and are of three distinct types (Table 3).

The grassland management system of the Gyimes people takes into account the species and the habitats, as well the properties of the natural environment. Their system is extremely labour intensive as it involves mowing the hay by hand, while being extensive in its overall coverage area (Babai *et al*. 2014). Nevertheless, it is also capable of producing large amounts of quality hay from year to year. An important purpose of the management is – in addition to the obvious goal of producing hay – to eliminate the impact of

Figure 6 Most important grassland habitats in Gyimes (Eastern Carpathians) (Source: Babai & Molnár 2013)

a) ***Bennvaló kaszáló:*** inner meadow close to settlement *(Arrhenatheretum elatioris)*



b) ***Bennvaló kaszáló:*** inner meadows close to the valley bottom

c) ***Kinnvaló kaszáló:*** outer meadow in the mountains *(Anthoxantho-Agrostietum capillaris)*

d) ***Kinnvaló kaszáló:*** outer meadow *(Anthoxantho-Agrostietum capillaris)*

e) ***Hegyi kaszáló:*** outer hay meadows with scattered trees

f) ***Kaszáló s reglő:*** outer meadow and pasture separated by a wooden fence

g) ***Hegyi reglő:*** moutain pasture with a mountain farm

h) ***Johókosározott hely:*** place of present and former sheep corrals

Table 3 Types of pastures in Gyimes (based on Babai & Molnár 2014)

	nearby pastures (Fig. 4)	mountain pastures (Fig. 4)	sheep pastures (Fig. 5)
Location	on slopes near settlements	in the high mountains	on the plateaus of the highest mountains
Typical plant species	*Festuca rubra, Agrostis tenuis, Primula veris, Juniperus communis*	*Festuca rubra, Anthoxanthum odoratum, Juniperus communis, Leucanthemum vulgare,Trifolium montanum*	*Nardus stricta, Trifolium repens, Bellis perennis, Veratrum album Potentilla erecta*
Herder	absent	absent	present (hired shepherds)
Summer hut	absent	present	present
Mode of herding	owners drive animals every morning and evening to and from the pasture	each evening owners go to the pasture, spend the night there, and return home with milk	paid shepherds are on the spot day and night
Animals	cattle	cattle, horse	sheep (goat), cattle, horse
Night spent in	barn in the village	barn in the mountains	open corral
Use of products	mostly by the family, rarely surplus is sold	mostly by the family, surplus (milk and cheese) is sold	commercial (mainly cheese)

Fig. 4. *Festuca rubra*-dominated pasture in Gyimes. Photo credits: Dániel Babai

Fig. 5. *Nardus stricta*-dominated pasture (*Violo declinatae-Nardetum*) on the flat top of the highest mountains in Gyimes. Photo credits: Ábel Molnár

natural and artificial disturbances, such as trampling or dry frost, to the extent possible (Babai and Molnár 2014). The various steps (e.g. mowing, parcel-rotation, application of hayseed, selective weeding of native poisonous plants, manuring, drainage of spring fens) all have an impact on the species composition of the resulting grassland (Table 4, for more details, see Babai and Molnár 2014, Babai *et al.* 2015).

Methods

Thirty Gyimes Csángó farmers were asked about the wild plant species of the landscape. Identification of the species and association thereof with their local names was accomplished with the help of field interviews and participatory observation, while the more detailed information about species was obtained using structured interviews.

A total of 30 structured interviews were done, involving questions about 150 species, including 77 grassland species. Respondents included 17 males and 13 females, with an average age of 56.3 years (the youngest being 12, the oldest 87 years old). We chose interviewees using the snowball-method. Interviews were recorded with a voice recorder and later transcribed. The next step was to summarize habitats specified by the 30 respondents for each plant species and folk taxon, respectively, and the occurrences of each main habitat category were calculated. It was then determined which habitat type is connected by Gyimes people most frequently with one folk taxon or another.

Components of traditional grassland management

1. Spring cleaning of hay meadows (collecting twigs, litter – raking)
2. Levelling ant hills
3. Levelling mole hills
4. Burning of collected twigs, leaves etc.
5. Control of native meadow weeds (*Veratrum album, Colchicum autumnale, Helleborus purpurascens, Pteridium aquilinum*)
6. Pushing back the forest edge (cutting trees, bushes, tall-herb species in edges)
7. Haymaking
8. Starting date of the first mowing: second half of June (traditionally: 24 June)
9. Starting date of the second mowing (traditionally: the beginning of August)
10. Manual hay mowing
11. Manual hay gathering
12. Parcel rotation (mowing order changed annually)
13. Aftermath grazing
14. Second aftermath grazing
15. Manuring (on inner meadows that were once arable fields)
16. Levelling of manure (raking)
17. Oversowing with hayseed
18. Oversowing with *Onobrychis viciifolia*
19. Elimination of moss-dominated patches (burning, tearing up with pitch-fork, manuring)
20. Drainage of spring fens
21. Fence maintenance
22. Solitary trees left on meadows
23. Burning (*Spiraea chamaedryfolia*, *Nardus stricta* and mossy patches)

Table 4: Elements of extensive (traditional) grassland management in Gyimes region (based on Babai et al. 2015)

The interviews were repeated a few years later with 11 respondents chosen from the group of the first research stage. This time we asked the questions the other way around, namely we asked them to list all the wild plant species for each important habitat type (free listing) (e.g., "What kind of grasses/ flowers etc. can be found in the inner hay meadows or pastures?").

For a botanical description of Gyimes grasslands, 4x4 m phytosociological relevés (quadrats) were conducted of both hay meadows and pastures (17 and 13 relevés, respectively), in an attempt to provide representative samples. Constancy and average abundance values of each vascular plant species were determined as percentages using synthetic tables drawing on the phytosociological surveys.

Results

Thirty-nine per cent of the 77 folk taxa (documented in the first interview round) well known by Gyimes people were associated explicitly with grasslands, mainly with hay meadows (58 species) and to a lesser extent specifically with pastures (19 species). The species of grasslands and in particular of hay meadows was well known by them. All constant species (8) and the majority of sub-constant species (7/ 11) found in relevés of hay meadows are known to Gyimes people (Table 5). In the case of pastures, Gyimes people know two thirds of the constant species (6/ 9) and nearly half of the sub-constant species (6/ 13) (Table 5), and only a lesser part of the more frequently found species is not known (Table 6). The flora of differently managed habitat types is overlapping, but it is more or less separated in the minds of local farmers. There are, however, common plant species

Table 5: Folk plant taxa of hay meadows and pastures – species mostly associated with hay meadows and pastures by the Gyimes people (›20%), and the constancy and average abundance values of these species in the phytosociological relevés. Explanation of the columns: K: constancy, which shows which percentage of the given species is present in the vegetation relevés, on a five-point scale: I: 0–20, II: 21–40, III: 41–60, IV: 61–80, V: 81–100. A–D: abundance, which shows the average cover by the given species in the vegetation relevés.

Scientific name	Local Hungarian name	Official Romanian name	Hay meadows Locals	Hay meadows K	Hay meadows A-D	Pastures Locals	Pastures K	Pastures A-D
Tragopogon pratensis	bakceka	ţâţa caprei	100	IV	1,1	17	I	0,1
Leucanthemum vulgare	papvirág	mărgăritǎ	100	V	3,7	64	IV	3,3
Colchicum autumnale	varjúhagyma	brânduşă de toamnă	96	V	2,2	19	-	-
Primula veris, P. elatior	kukukkvirág	ciuboţica cucului si ţâţa vacii	96	IV	1,5	71	IV	0,9
Veratrum album	ászpa	strigoaie	95	I	0,1	82	I	0,1
Gymnadenia conopsea, Dactylorhiza maculata	bergőburján	limba-cucului, poroinic	94	II	0,3	39	II	0,1
Carlina acaulis	bábakonty	turtă	92	III	1,3	32	III	0,8
Salvia pratensis	bárányláb	salvie de câmp	88	III	1,4	8	-	-
Poaceae	imola	iarbă înaltă	88	V	42	48	V	37
Helleborus purpurascens	eszpenz	spânz	86	-	-	62	II	0,2
Carum carvi	köménymag	chimen	85	IV	0,8	22	III	0,2
Galanthus nivalis	hóvirág	ghiocei	85	-	-	65	-	-
Geranium pratense	szentjánosvirág	ciocul berzei / greghetin	83	III	0,2	25	-	-
Laserpitium latifolium	kecskekapor	smeoaică	82	II	2,0	41	-	-
Campanula spp.	harangvirág	clopoţei	81	V	1,0	29	III	0,1
Trifolium spp.	vadhere	trifoi	81	V	9,6	35	V	2,1
Lotus corniculatus	szarvaskeret	ghizdei mărunt	80	IV	1,0	0	V	2,1
Bunias orientalis	borsos lenkő	brăbin	79	-	-	4	-	-
Rhinanthus spp.	csengőkóró	clocotici	77	IV	1,3	23	II	0,3
Nepeta nuda	dobronika	cătuşnică	77	I	0,9	0	-	-
Myosotis spp.	kéknefelejcs	nu-mă-uita	76	III	0,3	29	-	-
Hypericum perforatum	vérburján	pojarniţă	75	I	0,1	33	I	0,1
Viola tricolor	vadárvácska	trei fraţi pătaţi	74	I	0,1	47	II	0,1
Viola spp.	ibolya	viorele	73	I	0,1	58	IV	0,4
Origanum vulgare	ezerjófű	sovârv / dost	73	-	-	45	I	0,1
Vaccinium vitis-idaea	ménisora	merişor de munte	71	-	-	48	-	-
Alchemilla spp.	zsanika	creţişoare	71	V	2,9	71	IV	7,2
Capsella bursa-pastoris	pásztortáska	traista ciobanului	70	I	0,1	50	-	-
Trollius europaeus	pünkösdi rózsa	bulbuci	70	I	2,0	15	-	-
Pyrus pyraster	vadkörte	păr pădureţ	69	-	-	31	-	-
Achillea spp.	pulykafű, cickafark	coada-şoricelului	68	IV	1,1	26	V	1,0
Carduus spp, Cirsium spp.	szamárcsipke	ciulin, crăpuşnic	68	I	0,1	64	-	-
Pteridium aquilinum	ördögborda	ferigă de câmp	67	-	-	67	II	0,5

Scientific name	Local Hungarian name	Official Romanian name	Hay meadows Locals	Hay meadows K	Hay meadows A-D	Pastures Locals	Pastures K	Pastures A-D
Salix caprea	rakottya	salcie căprască, Iovă	67	-	-	29	-	-
Gentiana cruciata	epefű	ochincea	65	-	-	52	II	0,2
Nardus stricta	szőrcse	ţăpoşică	64	I	0,7	64	II	9,2
Picea abies	veres fenyő	brad roşu	64	I	0,1	64	IV	2,5
Vicia spp.	vadborsó	măzăriche	64	III	0,2	27	I	0,1
Streptopus amplexifolius	nyúleper	ouşor	63	-	-	21	-	-
Vaccinium uliginosum	takonykokojza	afin-vânăt	63	-	-	25	-	-
Lycopodium clavatum	serkefű, kígyómoha	pedicuţă	61	-	-	6	-	-
Sorbus aucuparia	kórus	scoruş de munte	61	-	-	57	-	-
Aconitum moldavicum	papucsvirág	omag	60	-	-	40	-	-
Brachypodium pinnatum, Deschampsia caespitosa, Dactylis glomerata	zablevelű fű	obsigă	59	V	6,1	18	I	0,1
Gentiana asclepiadae	gyertyánfű	lumânărica pământului	57	I	0,1	62	I	0,1
Ribes petraeum	borfüge	păltior	54	-	-	31	-	-
Betula pendula	nyír, nyírfa	mesteacăn	54	-	-	38	-	-
Parnassia palustris	torokgyék	şopârlaiţă albă	53	I	0,1	32	I	0,1
Rumex alpinus, Rumex sp.	lósósdi	ştevia stânelor	52	II	0,4	44	I	0,1
Rosa canina agg.	hecselli	măceş	50	I	0,3	85	I	0,2
Acer pseudoplatanus	jáhorfa	paltin de munte	50	-	-	30	-	-
Taraxacum officinale	lánclapi	păpădie	50	IV	1,1	23	III	0,1
Corylus avellana	magyarófa	alun	48	-	-	40	-	-
Euphorbia amygdaloides	árior	alior	45	I	0,1	36	-	-
Antennaria dioica	mezei gyapárdi	parpian	45	-	-	40	III	0,3
Botrichyum lunaria	tüdőfű	limba cucului	44	II	0,2	11	-	-
Fraxinus excelsior	kőrösfa	frasin	43	-	-	0	-	-
Juniperus communis	borsika	ienupăr	42	I	0,1	96	III	3,2
Populus tremula	nyárfa	plop termurător	41	-	-	32	-	-
Thymus spp.	vadcsombor	cimbrişor	41	II	0,4	77	IV	2,3
Urtica dioica	csihány	urzică mare	41	-	-	41	-	-
Ribes uva-crispa	szőrösfüge	agriş	40	-	-	44	I	0,1
Onobrychis viciifolia	bartacin	sparţetă	38	I	0,1	4	I	1,4
Convolvulus arvensis	vad fuszujkavirág	volbură	38	-	-	10	-	-
Fagus sylvatica	bükk	fag	37	-	-	33	-	-
Pinus sylvestris	lúcs	pin	35			24	I	0,1

Scientific name	Local Hungarian name	Official Romanian name	Hay meadows Locals	Hay meadows K	Hay meadows A-D	Pastures Locals	Pastures K	Pastures A-D
Scrophularia nodosa	reszfugburján	buberic	33	-	-	33	-	-
Vaccinium myrtillus	fekete kokojza	afin	32	-	-	52	I	3,1
Spiraea chamaedryfolia	gyüngyemény	cununiţă	32	-	-	9	-	-
Lamium album	árvacsihány	urzică moartă	31	-	-	19	-	-
Ribes alpinum	leánkafüge	coacăz de munte	30	-	-	35	-	-
Chelidomium majus	fökönburján	rostopască	29	-	-	7	-	-
Malva spp.	papsajt	nalbă mărunţă	29	-	-	0	-	-
Plantago lanceolata, P. major	útilapi	pătlagină	29	V	1,1	19	V	5,4
Polypodium vulgare	kőméz, édesgyüker	iarbă dulce	27	-	-	0	-	-
Mentha spp.	menta	izmă	27	-	-	9	-	-
Galium aparine	ragadvány	turiţă	27	III	1,0	27	II	0,1
Fragaria viridis	tokoseper	fragi de câmp	26	-	-	48	IV	1,0
Agrimonia eupatoria	apróbojtorján	turliţă mare	25	-	-	17	I	0,1
Potentilla anserina	libapimpó	coada racului	24	I	0,1	6	-	-
Abies alba	fehér fenyő	brad	23	-	-	27	I	0,1
Matricaria chamomilla	kamilla	muşeţel prost	23	-	-	8	-	-
Fragaria vesca	berkeeper	fragi de pădure	22	II	0,1	30	II	0,1
Symphytum officinale	fekete nadály	tătăneasă	22	-	-	7	-	-
Crataegus monogyna	istengyümölcse	păducel	22	-	-	30	-	-

Scientific name	Romanian name	Konstancia	Abundancia	Hay meadow / Pasture
Centaurea pseudophrygia	slăvoc	IV	2,2	H
Cruciata glabra	ţăţoi	IV / V	0,2/ 0,4	H / P
Prunella vulgaris	Busuioc de câmp	IV / V	1,4 / 1,4	H / P
Ranunculus polyanthemos	Gălbenele	IV / IV	0,6 / 0,8	H / P
Hieracium pilosella	Vulturică	V	2,1	P
Euphrasia spp.	silur	IV	0,2	P
Leontodon hispidus	Potcapul călugărului	IV	1,4	P
Linum catharticum	Ineaţă	IV	0,1	P
Polygala vulgaris	Şopârliţă	IV	0,2	P
Veronica officinalis	Ventrilică	IV	0,5	P

Table 6 Constant (V) and subconstant (IV) species in phytosociological relevés, not known by the Csángó people

which are not associated with pastures only because livestock grazing eliminates them and hence they cannot bear flowers (for instance, *Tragopogon pratensis*: "it is manly on hay meadows, 'cause the animals graze it off on the pasture and cannot grow there.")

The differences found between the species compositions pertaining to the two types of hay meadows, i.e. the outer and inner meadows, were not striking in terms of the habitats of each plant species (in other words, plant species were not often associated with outer or inner meadows specifically, only the main type of land use was specified). Nonetheless, Gyimes people perceive the differences arising from

the variations in altitude relative to the sea level: "there are kinds of plants on the outer meadows in the mountains which are not all found here in the inner meadows"; "there is fewer herb species (dicotyledons) in the inner meadows than in the outer ones. Where the dung is added, there will be none. They will die off." Still a consequence of manuring is that "on rich places [inner meadows] there are more imola-s [tall grasses] growing on the meadow, while on poorer places [outer meadow] there is more lapis [leafy], zsanika (*Alchemilla*). There is imola as well, but it just doesn't grow so high." So manured inner meadows are dominated primarily by *Poaceae* species, while non-manured mountain meadows are dominated by mono and dicot spectacular flowering species.

We listed 85 wild plant species that were associated with meadows or pastures by Gyimes people (Table 5). At the top of the list there are abundant and frequently seen local hay meadow species, well known and used by locals, edible wild and medicinal plants, and poisonous plants. Species associated mostly with meadows included *Tragopogon pratensis* and *Leucanthemum vulgare* present on inner (100%) and outer (100%) hay meadows, respectively, although the latter was not uncommon on inner meadows, either. *Colchicum autumnale* (96%) is a particularly poisonous species, a specialist of inner meadows, while *Primula*-species used as medicinal herbs (96%) were frequently found on both inner and outer hay meadows. *Veratrum album* (95%) and orchid-species associated with outer hay meadows (94%) and the edible medicinal herb *Carlina acaulis* (92%) were also often mentioned, albeit a little less common.

Grasses dominating the grasslands (*Poaceae*) were assigned by Gyimes people in 88% of their answers to hay meadows.

It was interesting that *Streptopus amplexifolius* found in forest edges and spruce forests was assigned to hay meadows. The fruit of this species (*rabbit berry*) is not consumed fresh, but rather gets caught in the hay, only to be "found" in winter during feeding: "these red berries would grow [ripen] in the barn, in the hay." One reason why this plant is thought to come from hay meadows could be that the fruit ripens in the hay: "it is no good in summer, I have eaten it then too but not much, but in winter it gets into the hay, it ripens there, and then you can eat it."

The typical pasture species, according to Gyimes people, were the following: *Juniperus communis* (96%) and *Rosa canina* (85%). Both shrubs fall regularly victim to the clearing of the pastures. Beside the poisonous *Veratrum album* (82 %) mentioned earlier in relation to hay meadows, *Alchemilla* species (71%) play a really important role in the species composition of pastures: "zsanika is a milky thing, you know, and if there is a lot of it in the pasture, the cow would also give much milk."

They also identified economically useless grass species (*Nardus stricta*) (64 %) and species not eaten by animals but used instead for medicinal purposes (such as *Gentiana asclepiadea* – 62%, *G. cruciata* – 52%). The latter ones were collected by the Gyimes people in great quantities to treat gastrointestinal problems. Other species used to treat animals were also listed (*Helleborus purpurascens* – 62%), which were thinned selectively on hay meadows: "early on… there is a hay meadow out there, where there is a lot of it (*Helleborus*), when it grows high it must be cut with the scythe 'cause it grows high, the cattle would never eat it. Not even the hay." Due to their fruits' being edible, the typical species of alpine pastures and *Nardus* grasslands, cranberry and blueberry species (*Vaccinium myrtillus* – 52%, *Vaccinium vitis-idaeus* – 48%), were associated with pastures by many.

These days pastures are increasingly undergrazed, hence the overgrowing of *Picea abies* (64%) which covers abandoned grasslands with thick regrowth within a few years.

The Gyimes people knew the habitat preferences of wild plant species quite well. On the contrary, they could only mention a few of the numerous species associated with a specific type of habitat when required to produce a free listing. All in all, a list of the typical species of a given habitat was requested in 68 cases. A mere 2.0 species names were provided on average. 22% of the answers did not contain any actual species ("all kinds" or "I wouldn't know"). 22% of all answers contained only one species, and only 36% of them mentioned at least three (but not more than 7 species). Only the most knowledgeable respondents could list 6–7 species. The longest lists were given for plough land (3.7), meadows, and pastures (3.0). The number of species listed in any one answer may be low, yet overall the number of species mentioned was high. We asked 22 questions about meadows and pastures, and we received a total of 66 species from our respondents (Fig. 7 and 8).

Discussion

In order to develop and maintain ecosystem services, a thorough knowledge of both the managed habitats and their species is needed. In-depth knowledge of species composition and habitat preferences which play an important role in the lives of local communities is well documented worldwide (cf. Fleck and Harder 2000, Shepard *et al.* 2001, Johnson and Hunn 2010). Gyimes people know and name approximately half of the local flora (Babai 2014). Their knowledge extends to all important and common species (Molnár and Babai 2009, Babai 2014). They are also familiar with the species and vegetation of meadows and pastures as habitats providing important ecosystem services. Almost all key species living here, which play an important role in determining the

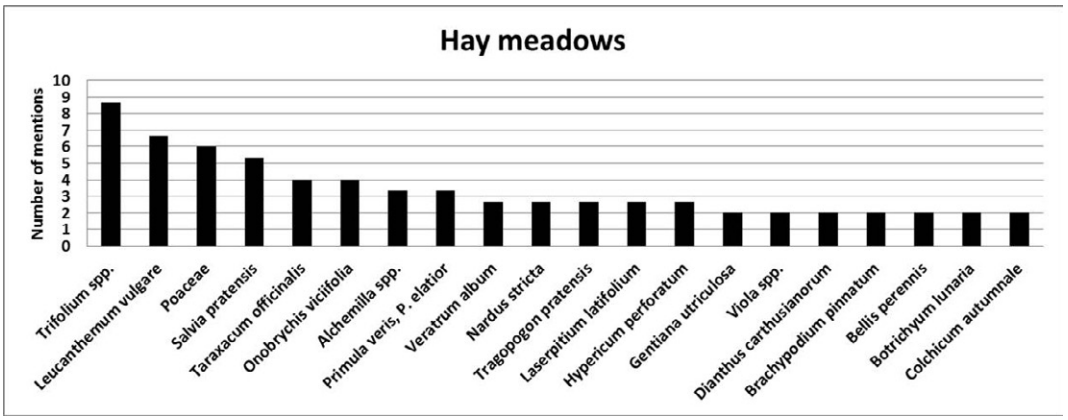


Figure 7 The most often listed species of hay meadows (The interview questions was: Which kind of grasses / flowers etc. can be found on the inner hay meadows?)

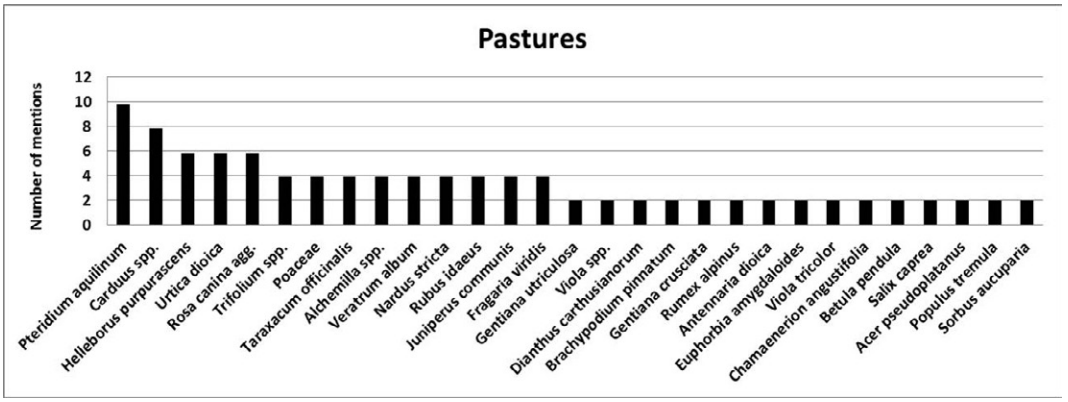


Figure 8 The most often listed species of pastures (see interview question in the caption of Fig. 7).

quality of the hay, are known and identified (Table 5). A substantial part of these species is also used as edible or medicinal plants (e.g., *Tragopogon pratensis*, *Salvia pratensis*, *Carlina acaulis*, *Primula* spp.) (Kóczián *et al.* 1975, 1976, Rab *et al.* 1981, Rab 1982, Babai *et al.* 2014).

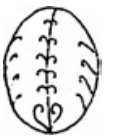
Intimate knowledge of hay meadows and their species composition used to be widespread in other mountain communities throughout Europe (Netting 1981, Meilleur 1986, Rab 2001). The time for hay cutting, picking out poisonous and therefore selectively thinning species, removing undesirable (mainly thorny) species from the pasture, all these required a thorough knowledge of livestock behaviour, as well as of grassland species and population dynamics processes (cf. Paládi-Kovács 1979, Meilleur 1986).

Species knowledge is clearly focused on useful plant species (such as *Salvia pratensis*, *Tragopogon pratensis*, *Onobrychis viciifolia*) (cf. Hunn 1982), and species assigned to a given habitat were primarily indicators of good quality feed. In Maramureş county hay quality is predominantly determined by the geomorphologic features of the hay meadow it is collected from (terrain type, sun exposure, structure and dominant species). The only species mentioned with respect to hay is clover (clovery hay) (Ivaşcu and Rakosy 2016). In Gyimes there are other species, however, deemed to be worthless from the ecological perspective, or poisonous species, which are also salient in the vegetation of the grassland habitats. Although deprived of economic value, *Nardus stricta* was associated in 64% of the answers with both meadows and pastures, while in relevés it appeared with a constancy value of I and II. Familiarity with certain poisonous species was a lot more intensive than their relative abundance on hay meadows, because these were species weeded from the fields by the locals in springtime to avoid getting them into the hay in larger quantities. Such species included for instance *Helleborus purpurascens*, *Veratrum album* and *Colchicum autumnale*. This was once a typical activity in the traditional grassland management of the Alps, where farmers also thinned *Veratrum*, *Gentiana lutea* and *Colchicum* (Meilleur 1986, Winter *et al.* 2011).

Grassland management in the Gyimes is practiced at the habitat level (Babai and Molnár 2014), involving an intimate background knowledge of the species of hay meadows and pastures (Babai *et al.* 2014). Interestingly, however, while they could say to what habitat each species belonged (Babai and Molnár 2013), they could only list the species composition of each well known habitats to a limited extent (Babai and Molnár 2009).

For place names (toponyms) containing plant names, where the geographic terms are named after the dominant plant species (e.g., *kokojzás*, meaning having *Vaccinium*), Rab (2001) suggests that these are in reality vernacular names for plant communities: "we clearly regard kokojzás (blueberry field) as the name for a vernacular plant community, at least on the timberline and above. A typical situation occurred: both local villagers and academics gave the plant community the same name, independent from each other, and using different actual terms." Péntek and Szabó (1985) put it in a similar way: "geographic names indicating plant communities, groups of communities, and ecological units deserve undivided attention."

Although there are indeed geographic names and vegetation types which might indicate local recognition of plant communities (in the Gyimes region, for instance, *bárányláb-bakcekás hay meadow* = hay meadow dominated by *Salvia pratensis* and *Tragopogon pratensis*, while *sátés* = a wet habitat dominated by *Carex* species), we argue that the actual underlying cause is mainly the presence of the dominant species included in the name as well. Such names are not associated with a list of other species that characterize the habitat in question (Molnár and Babai 2009).



In our view, the Gyimes people – just like Hortobágy herdsmen (Molnár & Hoffmann 2011) – do not regard habitat types as having a fixed, repetitive species composition. As for the list of species specific to a habitat, it was constantly felt that this question required a completely new synthesis from the informants. Nevertheless, there are examples of local communities that identify vegetation communities, although admittedly this information is not codified, but diffuse, and not readily cited, for example, as diagnostic species (e.g. Wola region, Papua New Guinea, see Sillitoe 1998). We conclude that Gyimes people do not use their detailed knowledge about habitat preferences of wild plant species to create abstract lists of "species composition per habitat."

Traditional ecological knowledge concerning the recognition of species and habitats provides background information that can assist in the appropriate management and long-term sustenance of the community's natural resources. Traditional ecological knowledge has provided for centuries the stability of the socio-ecological system, while contemporary unfavourable socio-economic changes preclude the extensive farming based on this knowledge (MacDonald *et al*. 2000). The European Union's agri-environmental funds are beneficial to some extent, but they do not solve the problems of the system, and the result is the ongoing, slow loss of traditional farming. Rural tourism as a source of increasing revenues might be one solution, which, in addition to national symbols, could focus also on the natural and cultural values of the landscape, including the traditional ecological knowledge needed for their creation and maintenance. This however requires precisely the maintenance of traditional farming – for the sake of the cultural landscape – which, regardless of the growing recognition of its biodiversity and cultural importance, is increasingly difficult to sustain economically.

The local community still has the knowledge needed for the maintenance of the sustainable traditional land-use system, which is also beneficial from a nature conservation perspective. The problem is that this system is still in use because of economic constraints (there are no other forms of livelihood in the region), there being a huge gap between the work input and the size of the expected revenues. The agri-environmental funds are almost the sole source of income, and they are not sufficient to finance small-scale farms.

Extensive land-use practices contributed to a great extent to the development and maintenance of the cultural landscapes rich in natural and cultural values on this continent, therefore the study of this knowledge also carries an important nature conservation message (Berkes *et al.* 2000, Calvo-Iglesias *et al.* 2006, Fischer *et al.* 2008, Molnár *et al.* 2008, Gugić 2009, Loos *et al.* 2014). Familiarity with the ecological knowledge and land-use practices of the local communities maintaining these habitats, along with the socio-ecological systems, provides valuable help in the sustenance and preservation of the species-rich hay meadows of Transylvania, which are studied more and more intensively these days (e.g., Jones *et al.* 2010, Knowles 2011, Hanspach *et al.* 2014, Turtureanu *et al.* 2014, Dorresteijn *et al.* 2015, Loos *et al.* 2015, Sutcliffe *et al.* 2015). There is also a great need for a comparative analysis of the land-use practices and related traditional ecological knowledge of these lands and ethnic groups, because cultural traditions affect different levels of diversity (Fischer *et al.* 2008) (for instance, Apuseni Mountains, Maramureș, Făgăraș, a comparison of the Romanian, Hungarian and Saxon ways of using the land) (for a Swedish-Romanian example, see Dahlström *et al.* 2013).

These investigations could provide excellent grounds to harmonise ethnographic and ecological research, since joint study of species-rich habitats and of the human communities managing them lays the foundations to the complex

knowledge leading to messages assisting in the development of effective conservation strategies.

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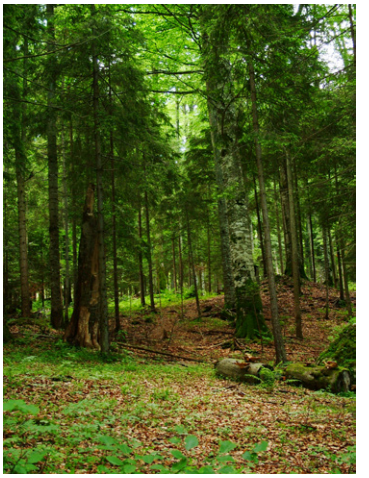
APPENDIX 1. Most important forest habitats in Gyimes region (Eastern Carpathians) (Source: Babai & Molnár 2013)

a) ***Őreg erdő:*** old spruce forest without logging or grazing *(Hieracio rotundati-Piceetum)*

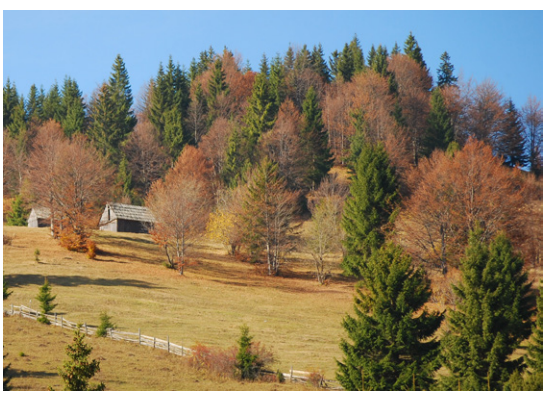
b) ***Fenyőerdő, gyéres erdő:*** grazed, open spruce forest *(Hieracio rotundati-Piceetum)*



c) ***Fenyőerdő, gyakor erdő:*** mixed spruce forest *(Fagus sylvatica* in a *Hieracio rotundati-Piceetum)*

d) ***Bezseny:*** young, dense spruce forest *(Hieracio rotundati-Piceetum)*

e) ***Vész:*** clear-cut area *(Rubetum idaei)*



f) ***Bükkős:*** beech forest (*Symphyto cordati-Fagetum*)

g) ***Nyíres:*** pioneer forest-stand dominated by *Betula* pendula

APPENDIX 2. Wet and stony habitats in Gyimes (Eastern Carpathians) (Source: Babai & Molnár 2013)

a) ***Patak mente:*** stream and its shore *(Salix trees, Alnetum incanae)*

b) ***Porondos hely:*** young and old stream banks with gravel deposits *(Myricarietum germanicae)*

c) ***Kőves hely:*** rock grassland at high elevation

d) ***Szikla, kőpócok:*** cliffs and rocks

e) ***Kert mellyéke:*** tall herb vegetation along fences

f) ***Selymék:*** rich fens in the valley bottom *(Eriophoretum latifolii)*

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IV. Hay on Display