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Management models for grassland habitats

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Slovakia is endowed with an abundance of natural beauties, quite unique within Europe. Among them are our flowery meadows and pastures. Through this publication, we wish to make a contribution to their preservation and more effective conservation.

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Grasslands and their management

The grasslands of Slovakia are among the most important habitats of Central and Eastern Europe, due to their high species diversity. The meadows and pastures form a typical picture of the landscape, representing an inseparable part of its history. They contribute significantly to agricultural production, and provide places for recreation. In addition, pastures and meadows offer suitable conditions for the survival of rare species of plants and animals. Due to their natural richness, many localities have been included among the Special Areas of Conservation (SAC), either at national or European level (Natura 2000).

Over the last few years, considerable attention has been paid to the use of grassland habitats and their conservation in Slovakia. This is the result of international commitments which Slovakia, as a member of the European Union, is bound to follow in the field of nature conservation. However, it is also a consequence of the significant loss and degradation of rich-in-species grasslands in Slovakia. Most of the grasslands have been maintained, due to long-term extensive management. In the last few years, unfortunately, a marked degradation of a number of habitats, leading to a decrease in their biodiversity, has been witnessed. This is happening because the land is being abandoned, or used improperly. The area of grasslands keeps shrinking; and the farmers are leaving their lands, mainly those in remote mountain areas and in localities with adverse natural factors, such as bad accessibility or waterlogged soil. The consequence of insufficient management, or the complete abandonment, of grasslands is their total degradation, or even extinction.

A group of researchers and professionals have, therefore, decided to focus on this problem.

They have developed models which propose appropriate management measures for various types of grasslands. The measures have been designed under project "**SK 0115 Management models for grassland habitats**", implemented by the DAPHNE – Institute of Applied Ecology, in cooperation with the Botanic Institute of the Slovak Academy of Science (SAS). This project is a follow-up of a successful international project which was financed by the European Commission, and dealt similarly with 25 selected habitats at European level (http://ec.europa.eu/environment/nature/natura2000/management).

The lack of experimentally-verified recommendations for the management of individual types of habitats, which would constitute a sound basis for the more effective use of financial resources in the management of these habitats, is a serious problem. Field experiments, which focused on examining the influence of mowing, grazing and mulching on the species and vegetation structure of plant communities in selected territories of Slovakia, were an inherent part of the project.

A database of grasslands, which includes data from the Information system of meadows and mires of Slovakia, administered by DAPHNE, was completed. In its current form, it contains information on more than 20,000 grassland localities in Slovakia, covering a total area of 345,000 ha. An expert system was created as a superstructure of the database. This system helps to identify appropriate management models for individual localities. A number of research and popular-science articles have been published.

Management models were developed for 20 types of non-forest habitats occurring in Slovakia. In a number of cases, the models include several related habitats which have similar needs with regard to management and restoration. Each model offers complete information on the ecology of a particular habitat, its distribution in Slovakia, and its development trends and threats. In addition, it recommends measures for both active and restoring managements, and summarizes the ecological and management demands of specific species of fauna and flora. At the end, we provide examples of calculating the habitat management and restoration costs. The proposed procedures for management and restoration of a habitat's natural value provide information on the appropriate regime of mowing or extensive grazing for each habitat, all of which is based on the latest knowledge from research completed both in Slovakia and elsewhere in Europe.

Despite the exceptional importance of the grassland communities, neither the Legislative framework nor financial resources have so far provided sufficient tools for their preservation and conservation. One of the financial tools, which has a significant impact on the state of habitats in Slovakia, is the Agro-environmental programme, which is a part of the Rural development program (www.mpsr.sk). Under the latter, extensive forms of meadow and grassland management are financially compensated for. In addition, the programme defines the agricultural measures for seven ecological categories (type A – G). References to these types are to be found by each particular model. The models offered in this brochure serve as a superstructure to this programme, and they are very appropriate as a basis for planning the type of care in each particular locality, mainly in territories with high nature value, as well as in SAC (NATURA 2000).

The European Commission has defined meadows and pastures with minimal biodiversity as territories with "High Nature Value". Their total area is one of the indicators evaluated under the Rural development programme. This was one of the significant steps towards biodiversity conservation within the European agricultural policy, which indicates how the financial aid is to be allocated in future.

This brochure provides an overview of particular management models, as well as habitats included in them. Also, it gives a summary of appropriate management measures and provides information about the enlisting of habitats within both the network of Natura 2000 and the Habitat catalogue of in Slovakia. For more information about the project results, including the full text of models, go to www.daphne.sk/mm/.

1. Salt meadows

Daniel Dítě, Zuzana Melečková, Pavol Eliáš ml., Milan Janák

Habitats according to Habitat catalogue of Slovakia (Stanová & Valachovič 2002):

Sl1 Inland salt meadows (Natura 2000 code – 1340*) – alliances *Scorzonero-Juncion gerardii*, *Puccinellion limosae* and *Festucion pseudovinae*

Sl3 Pannonic salt steppes and salt marshes (Natura 2000 code – 1530*) – alliances *Salicornion prostratae* and *Cypero-Spergularion salinae*

Habitat description

Salt meadows develop in territories with an evaporative regime, i.e. in the driest and warmest regions of Slovakia. Many of the plant species growing in salt meadows are obligatory or facultative halophytes. Succulent and annual plants (e.g. *Camphorosma annua*,*Tripolium pannonicum*, *Artemisia santonicum* subsp. *patens*, *Spergularia media*, *S. salina*, *Chenopodium chenopodioides*), or assorted species of grass and monogerm plants, such as *Puccinellia* spp., *Crypsis aculeata* or *Bolboschoenus maritimus* agg., have adapted best to this environment, which can be toxic for many other species.

The greatest occurrence of saline soils is in the Podunajská nížina lowland, mainly in the region of Žitný ostrov. Their northern border reaches the city of Nitra. In Slovakia, there are two priority habitats of European importance bound to saline soils: inland salt meadows, and Pannonic salt steppes and salt marshes. The first habitat is represented by sub-halophyte communities of saline soils, with a stagnating level of ground water. They are mostly pioneer communities of salt pastures, both primary and secondary, and of periodically flooded depressions and salt grasslands. The vegetation of salt steppes is included in this habitat, too. The second habitat is represented by pioneer communities of the littoral zone of periodically groundwater-flooded ponds on solonchaks.

Plantago maritima

Management recommendations

In order to preserve the halophytic communities, it is necessary that they are regularly maintained. Otherwise natural succession will result in creating shrub formations, and ruderal species may begin to penetrate the community. The possibilities for restoration and preservation of the habitat are greatly influenced by external factors, such as the use of adjacent fields. For instance, negative changes in species structure can be noticed if the remaining areas with salt vegetation are surrounded by intensively used arable land. The vegetation of saline soils has traditionally been used mainly for grazing. Therefore, grazing and, to some extent, mowing, too, are among the recommended ways for the management of salt communities. Extensive grazing with a limited amount of stock per areal unit is recommended, because excessively intensive grazing leads to the hardening and, subsequently, degradation of the soil. The maximal recommended amount is one cow or 5 – 6 sheep per hectare. Mowing, mulching and stirring are recommended at localities where the cumulated biomass needs to be removed.

Enlistment in the Agro-environmental programme: Category D

Photo by V. Šefferová Stanová

The last grazed salt meadow in Slovakia – Siky by the village of Močenok. Although the water regime was impaired, it is the best preserved locality of saline vegetation in our country.

Photo by D. Dítě

Limonium gmelini is a Pannonic endemic species and, in Slovakia, it occurs in one locality only: between the villages of Kamenín and Kamenný most, at the northern border of its distribution.

Photo by D. Dítě

Lepidum perfoliatum is a rare species of Slovakian salt meadows, occurring in a few micro-localities only.

2. Rocky Pannonic grasslands and dealpine *Sesleria*-grasslands

Monika Janišová, Milan Janák

Habitats according to Habitat catalogue of Slovakia (Stanová & Valachovič 2002):

Tr5 Rupicolous Pannonic grasslands (Natura 2000 – code 6190)
– alliances *Bromo pannonici-Festucion pallentis* and *Diantho lumnitzeri-Seslerion*

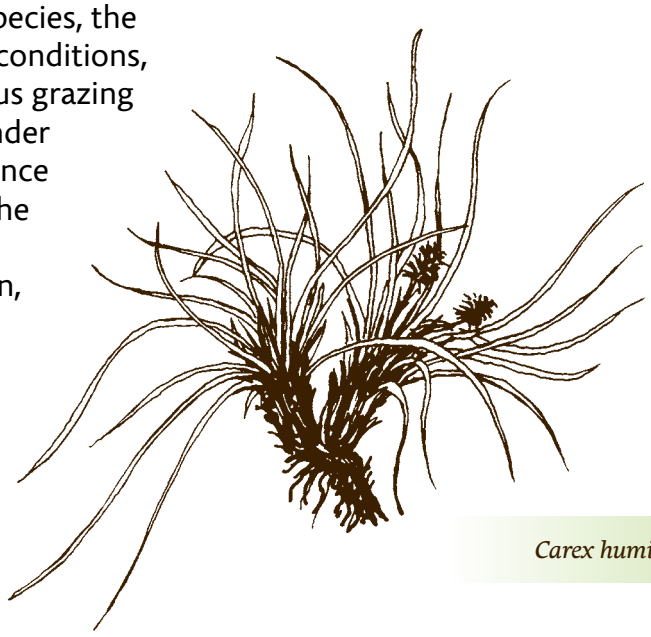
Habitat description

The habitat includes xerothermophilous Pannonic grasslands of the *Bromo pannonici-Festucion pallentis* alliance, and the dealpine *Sesleria*-dominated grasslands of the *Diantho lumnitzeri-Seslerion* alliance. The first of the above – mentioned grasslands inhabits mainly steep rocky slopes and karst fields with shallow soil on dolomite and limestone. This vegetation occurs in warm and sunny places at lower altitudes, in regions with low total annual precipitation, and a regular summer drought period. Dealpine *Sesleria*-grasslands inhabit cooler and wetter sites in the warm peri-Carpathian mountains. They are restricted to the northern slopes and inverse locations in narrow river valleys, and are of relict character. The geological bedrock is always built by dolomite or limestone, and soils are shallow to medium deep, with higher humus content.

Management recommendations

The main aim of the proposed management is to maintain the typical species composition and structure of these communities, as well as to preserve conditions for the occurrence of rare xerothermophilous plant and animal species. Appropriate management includes the regular removal of successional shrubs and trees, and the elimination of expansive species and occasional grazing by goats and other farm animals. An adequate area of plots and their interconnection are important prerequisites for their conservation. Restoration management is demanding and requires the sowing of target species, the preparation of appropriate habitat conditions, and their maintenance by continuous grazing and clearing of voluntary plants. Under certain conditions, fire and disturbance techniques can be used to restore the degraded habitats. Thanks to the disturbance of the closed vegetation, the seed germination of the target species is enhanced.

Enlistment in the Agro-environmental programme: Category A



Carex humilis

Photo by M. Janišová

Photo by M. Janišová

Succession in xerothermophilous grassland communities at the site Kňaží vrch (Tematínske vrchy Mts.). Until 2005, pine trees dispersed spontaneously from the adjacent plantation (figure left). View of the site in 2010 after the restoration activities of NGO Pre prírodu (figure right).

Photo by M. Janišová

Photo by M. Janišová

Carex humilis frequently dominates and determines the community structure in the vegetation of the Bromo pannonici-Festucion pallentis alliance. Among the subdominant species, Potentilla arenaria and Helianthemum ovatum (figure left) or Stipa eriocaulis (figure right) are very common.

3. Xerothermic grasslands

Daniela Dúbravková, Milan Janák

Habitats according to Habitat catalogue of Slovakia (Stanová & Valachovič 2002):

Tr1a and Tr1d Semi-natural dry grasslands and scrubland facies on calcareous substrates (Natura 2000 code – 6210) – alliances *Festucion valesiacae* and *Koelerio-Phleion phleoidis*

Tr2 Sub-Pannonic steppic grasslands (Natura 2000 code – 6240*) – alliance *Festucion valesiacae*

Tr3 Pannonic loess steppic grasslands (Natura 2000 code – 6250*) – alliance *Festucion valesiacae*

Habitat description

Semi-natural grasslands include rare, relatively rich-in-species, xerophilous and thermophilous vegetation types. They occur on nutrient-poor soils, and on calcareous, loess and volcanic bedrocks (*Festucion valesiacae*) and acid rocks (*Koelerio-Phleion phleoidis*). Their occurrence is limited to warm areas of Slovakia, mainly to the Subcarpathian mountains, which border on the Pannonic Basin. Plants well adapted to the summer drying of the substrate, as well as the rare continental, sub-Mediterranean and Pontic-Pannonic species of plants and insects, are all involved in forming the structure of the habitats. They are most often dominated by clumps of narrow-leaved caespitose grasses of the genera Stipa and Fescue.

Management recommendations

At present, most of the xerothermic locations have been abandoned. In the care of habitats, therefore, it is necessary to decrease the negative effects of the absence of management. At the abandoned locations, the volunteer trees inevitably have to be removed, and it is necessary to ensure that the sheep and goats can graze regularly between April and June. A flock of various species is more appropriate than a flock consisting of only one species. The recommended proportion of sheep to goats is 3:1. The sheep is a selective grazer and focuses on low vegetation, such as soft, non-flowering grasses which it grazes to a height of less than 3 cm, i.e. the biomass removal is consistent. Goats favour grazing on plants at a greater height, mainly on flowering grasses, but also on leaves and the bast fibre of woody plants, thus eliminating their growth. Mowing, including hay removal, mulching and burning, are less appropriate, although still acceptable, ways of management under certain circumstances. Mowing helps to eliminate mesophilous grass species, for example, false oat-grass (*Arrhentaherum elatius*) and wood small-reed (*Calamagrostis epigejos*), which spread mainly in abandoned localities and decrease their diversity.

Festuca valesiaca

Enlistment in the Agro-environmental programme: Category A

Photo by D. Dúbravková

Rich-in-species xerothermic vegetation of the association Festuco valesiacae-Stipetum capillatae on the hill of Plieška in the Zoborské vrchy range.

Photo by D. Dúbravková

Management of a protected area by sheep grazing on steppic habitats of the Festuco valesiacae-Stipetum capillatae association in the Hainburg hills, Lower Austria.

Photo by D. Dúbravková

Verbascum phoeniceum is among typical habitat types.

4. Sub-xerophilous meadows and pastures

Iveta Škodová, Ivana Jongepierová, Milan Janák

Habitats according to Habitat catalogue of Slovakia (Stanová & Valachovič 2002):

Tr1b a Tr1c Semi-natural dry grasslands and scrubland facies on calcareous substrates (Natura 2000 code – 6210, 6210*) – alliances *Bromion erecti* and *Cirsio-Brachypodion pinnati*

Habitat description

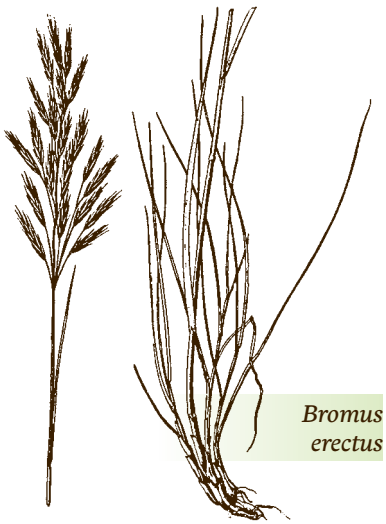
Sub-xerophilous meadows and pastures represent grasslands which are among the most rich-in-species habitats in West and Central Europe. They are dominated by several of grasses, especially upright brome (*Bromus erectus*) and tor-grass (*Brachypodium pinnatum*), and occur from the lowlands to sub-mountain zones, on variously oriented, moderate slopes, but also on steeper sunny slopes. These communities are very important, since several rare and endangered species, mainly from the *Orchidaceae* family, are to be found here. If a locality is rich in orchid occurrence, it is considered a priority habitat within the network of SAC – Natura 2000.

Management recommendations

The plant communities of this habitat were traditionally managed mainly as unfertilised, annually mown meadows, and where the animals grazed on the aftermath (alliance *Bromion erecti*) in the autumn. The production of biomass in this vegetation type is usually rather low. Only one spring grazing is recommended but, occasionally, autumn grazing of aftermath might be appropriate. Grazing by a mixed flock of sheep, goats and cattle is optimal, while the size of the flock should be directly proportional to the length of grazing time.

In addition to active management, restoration management is also very important for the habitat's preservation and maintenance, which includes the removal of voluntary woody plants, and subsequent regular mowing or extensive grazing.

The main prerequisite for preserving these communities is the exclusion of fertilization. Mowing of the grasslands usually takes place at the beginning of July. However, the time of mowing needs to be chosen, bearing in mind the occurrence of rare and endangered species of plants and animals, especially some of the butterfly species. In the case that several species of interest, with differing phenological cycles, occur in the locality at the same time, mosaic mowing should be applied. Second mowing is recommended in places where there is an occurrence of the expansive species *Calamagrostis epigejos*.



Bromus erectus

Enlistment in the Agro-environmental programme:
Category A

Photo by I. Škodová

Association Polygalo majoris-Brachypodietum pinnati of the alliance Cirsio-Brachypodion pinnati at the Vrchná hora hill by the town of Stupava.

Photo by I. Jongepierová

Sheep grazing at the Drahy locality in the Protected Landscape Area Bíle Karpaty, the Czech Republic.

Photo by I. Jongepierová

Hay packing machine at the Javorůvky locality.

5. Alluvial meadows

Viera Šefferová Stanová, Ján Šeffer, Milan Janák

Habitats according to Habitat catalogue of Slovakia (Stanová & Valachovič 2002):

Lk8 *Alluvial meadows of river valleys of the Cnidion venosi alliance* (Natura 2000 code – 6440) – alliance *Cnidion venosi*

Lk7 Foxtail alluvial meadows (habitat of national importance) – allience *Alopecurion pratensis*

Habitat description

The habitat includes alluvial meadows with a natural flooding regime, belonging to the *Cnidion venosi* alliance. In Slovakia, the occurrence of the habitat is bound to the Pannonic region. The habitat includes meadows of the great lowland rivers which are regularly flooded; however, the dry continental climate causes them to dry in summer. The foxtail alluvial meadows of the *Alopecurion pratensis* alliance are also included in this group, and can be found from the lowlands to the foothill zones, in the alluvia of smaller rivers and streams. They are not as rare and rich-in-species as the previous type.

The species structure depends on the duration of the spring floods, the level of the underground water, the content of nutrients in the soil, and on the method of management. The flooded meadows provide a habitat and a significant source of food for a number of endangered bird species.

Cnidium dubium

Management recommendations

The alluvial meadows have formed as a result of both floods and wise utilisation by man. The species structure is negatively influenced by the lack of floods; however, excessive and long-term flooding of meadows has the same negative impact. These communities require regular management, i.e. they need to be mown once, or even twice, a year. Long-term flooding during the growing season, as well as insufficient mowing (including removing the biomass), can result in a rapid and negative change in the species structure of the meadows. Grazing as a way of management of alluvial meadows is not generally recommended. Therefore, should grazing take place, it is necessary to consider the time of the cattle's entrance to the locality, and also the length and intensity of grazing. Inappropriate grazing can result in degradation of the habitat's species structure and soils.

Enlistment in the Agro-environmental programme:
Category D, E

Photo by V. Šefferová Stanová

Flooded meadows of the Cnidion venosi alliance dominated by Clematis integrifolia at the Morava river.

Photo by V. Šefferová Stanová

Spring floods bring in a lot of nutrients which are very important for these meadows.

Photo by V. Šefferová Stanová

Clematis integrifolia and Inula brittanica (yellow flowers) belong to the typical species of flooded meadows.

6. Eolic sands

Viera Šefferová Stanová, Milan Valachovič, Milan Janák

Habitats according to Habitat catalogue of Slovakia (Stanová & Valachovič 2002):

Pi1 Pannonic inland dunes (Natura 2000 code – 2340*)
– alliance *Corynephorion canescentis*, partially *Festucion vaginatae*

Pi2 Xeric sand calcareous grasslands (Natura 2000 code – 6120*)
– alliance *Koelerion arenariae*

Tr4 Pannonic sand steppes (Natura 2000 code – 6260*)
– alliance *Festucion vaginatae*

Habitat description


Corynephorus canescens

The Pannonic grasslands on inland dunes and eolic sands, occurring in the Pannonic bio-geographical region, are amongst the most endangered types of habitats in Central Europe. The main ecological factors are the movement of sand dunes and natural wind erosion. Typical for this habitat are highly specialized animal and plant species. The plants tolerate the active transfer of sand, including their complete covering by sand. Sands are acid, neutral or alkaline, and poor in nutrients. The canopy and the species structure of the vegetation on sands change, depending on their placement, either on the tops of dunes or in small recesses between them. Sands in the Borská nížina lowland are a relatively widely-occurring habitat. In the Podunajská and Východoslovenská nížina lowlands, they cover only small areas, and are endangered by a lack of management.

Management recommendations

The Pannonic grasslands on sands can be left without management, if the ecological conditions allow both the movement of sand dunes and wind erosion. However, most of the sand dune systems were stabilized during the previous centuries. Management is, therefore, required for their preservation. An example of human intervention is the regular disturbance of the soil cover by military actions in the Military District of Záhorie, which helps to maintain these communities. Without appropriate management, natural succession starts, resulting in the growth of scrub and woody plant formations, or the invasion of expansive grasses and alien plant species. The sand dunes of Slovakia are endangered by the expansion of the black locust (*Robinia pseudoacacia*) and tree of heaven (*Ailanthus altissima*). The elimination of these species has to be carried out by combining mechanical and chemical interventions. The trees need to be removed late in summer, or at the beginning of autumn. This method is more effective if herbicides are applied to the stumps right after the trees are cut down. Clearing of voluntary woody plants needs to be periodically repeated, at least every 3 – 5 years, so that the expansion of alien species is halted, and natural forestation prevented.

Enlistment in the Agro-environmental programme: Category A, only habitat Tr4.

Photo by V. Šefferová Stanová

Priority habitat of the Pannonic grasslands on sands in the locality of Líščie diery. Association of Festucetum vaginatae, dominated by a species bound to grow on sands – Stipa borysthenica.

Photo by D. Dítě

Iris arenaria is a species of European importance, protected under the Habitats Directive. The population of this species occurs in Slovakia only in the complex of the Čenkovský les forest, at the northern border of its general distribution area.

Photo by Z. Vajda

The Black locust is amongst the invasive sand species. Its elimination requires combining mechanical and chemical interventions.

7. Lowland hay meadows

Iveta Škodová, Helena Ružičková, Milan Janák

Habitats according to Habitat catalogue of Slovakia (Stanová & Valachovič 2002):

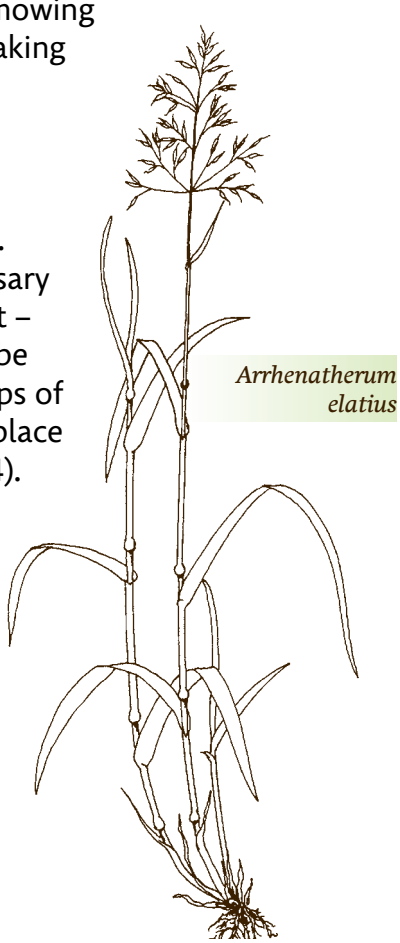
Lk1 Lowland hay meadows (Natura 2000 code – 6510)
– alliance *Arrhenatherion elatioris*

Habitat description

The communities of the mesophilous meadows constitute a wet, regularly mown, rarely grazed or unutilised vegetation cover on slightly humic, rich-in-minerals, mesic soils. They occur on various types of bedrock, from the lowlands (200 m a.s.l.) to the mountainous areas (1,050 m a.s.l.). They are mostly dominated by several species of tall grasses with high forage value, such as *Arrhenatherum elatius*, *Festuca rubra agg.*, *Agrostis capillaris*, *Trisetum flavescens,* along with dicotyledonous species. Since the ecological spectrum of their occurrence is relatively wide, their species structure is variable, being influenced not only by ecological factors, but also by management practice.

Management recommendations

The most rich-in-species vegetation can be found in long-term traditionally managed locations. Traditional management is a combination of mowing once or twice a year, with occasional extensive grazing taking place in localities with a high biomass production. These meadows can be fertilised by small amounts of manure, especially if they are mown two-three times a year. An important principle to follow is to leave the hay dry on the site, so that the organisms inhabiting it can get away. In the case of agriculturally unused meadows, it is necessary to maintain at least the rotating method of management – mowing, grazing and fallow. Oat-grass meadows should be mown in this cycle every three years. For individual groups of animals, it is very important that gradual mowing takes place on smaller areas, at time intervals of several weeks (3 – 4).



Arrhenatherum elatius

Extensive grazing by cattle or sheep is the most appropriate for larger areas. Based on experimental observations, a short period of grazing is recommended (max. 4 weeks). Even more appropriate is the rotation of grazing and mowing. Sometimes it is recommended that fertilisation and mowing be substituted by mulching (leaving the mown biomass on the site). This method is the most suitable for grasslands with a low biomass production.

Enlistment in the Agro-environmental programme: Category B

Photo by I. Škodová

Vegetation of the Ranunculo bulbosi-Arrhenatheretum elatioris in the Drietomská dolina valley, Biele Karpaty mountain.

Photo by I. Škodová

Association of Anthoxantho-Agrostietum tenuis in the Drietomská dolina valley, Biele Karpaty mountain.

Photo by L. Halada

Vegetation of Pastinaco-Arrhenatheretum elatioris near the village of Pavčina Lehota, region of Liptov.

8. Mountain hay meadows

Katarína Hegedüšová, Helena Ružičková, Milan Janák

Habitats according to Habitat catalogue of Slovakia (Stanová & Valachovič 2002):

Lk2 Mountain hay meadows (Natura 2000 code – 6520)
– alliance *Polygono-Trisetion*

Habitat description

Mountain hay meadows include species-rich mesophilous montane meadows on medium-deep to deep nutrient-rich soils in sub-mountainous, mountainous and sub-alpine mountain zones. These typical semi-natural grasslands are dominated by medium-tall grasses and broad-leaved herbs, with the occurrence of the species of Alpic tall-herb communities. They occur at higher altitudes, with long-term snow cover.

Management recommendations

The most effective way of maintaining the species structure of mountain hay meadows is the combination of mowing once a year with subsequent grazing. Grazing, however, should not be done by large flocks; instead, smaller groups of cattle should graze the vegetation for a brief time here at the beginning of the growing season, and then after the first or second mowing (the autumn grazing of fresh grass). Long-term grazing is recommended in the case of mountain meadows which are found in what are officially denoted forest soil areas. Mulching twice a year, while leaving the biomass on the site, is the preferred way of maintaining the meadows, especially where the hay has no use. This method is, above all, appropriate for application in vegetation with a lower biomass production, occurring at lower altitudes. Decomposition of a large volume of biomass at a higher altitude, with frequent rains, is slower, which leads to decreases in light-demanding species and predomination of nitrophilous species in the species composition. In cases where the meadows are only mown, it is appropriate to fertilize them.

Trisetum flavescens

Enlistment in the Agro-environmental programme: Category C

Photo by K. Hegedüšová

Mountain hay meadows in the locality of the Krivánska Malá Fatra range.

Photo by K. Hegedüšová

Lilium bulbiferum is a typical representative of mountain hay meadows.

Photo by K. Hegedüšová

Donovaly in the Nízke Tatry mountain range: grazing as one of the possible management procedures.

9. Mesophilous pastures

Eva Uhliarová, Jana Smatanová, Monika Janišová, Milan Janák

Habitats according to Habitat catalogue of Slovakia (Stanová & Valachovič 2002):

Lk3 Mesophilous pastures (habitat of national importance) – alliance *Cynosurion cristati*

Habitat description

The habitat involves nutritive pastures dominated by *Cynosurus cristatus*, *Lolium perenne* or *Festuca pseudovina* ordered within the *Cynosurion cristati* alliance. In Slovakia, they are distributed mainly at lower and middle altitudes (up to 700 a.s.l.). Their formation is conditioned by frequent disturbance by grazing and trampling, leading to mechanical damage of plants. These communities occur on fresh soils, rich in nutrients, which support fast regeneration of the vegetation. They are dominated by low and light-demanding species, forming a dense turf that covers the soil surface, even after the stand is grazed or mown. Manuring or side-dressing by mineral fertilizers plays an important role in the formation of these communities. In regions with a drier climate, the habitat is restricted to the grazed alluvia of streams and rivers.

Management recommendations

The management measures should maintain the typical species composition, as well as the stand structure, and should prevent the spread of weeds. The use of herbicides, and the sowing of non-native species, grasses and legumes cultivars, is not appropriate. Season-wide or year-long continuous stocking, or rotational grazing, are recommended. In far-removed sites, this can be replaced by strip grazing, accompanied by gentle hurdling. Among the farm animals, cattle, sheep, goats and mixed herds are the most appropriate. Horses and European bison can also be used for grazing. Regarding the treatment measures, spring dragging and regular mowing of the ungrazed biomass are important, as they restrict the growth and spread of pasture weeds. To conserve the invertebrates, it is recommended to keep a certain area of the pasture without management, at least during the growing season. In the case of strip grazing, combined with hurdling, it is important to pay attention to correct hurdling techniques, especially to maintaining the minimum size of enclosures and their frequent shifts.

Cynosurus cristatus

Enlistment in the Agro-environmental programme: Category B

Photo by M. Janišová

Intensive pasture on the south-facing slope of Turkov vrch hill near Hrochoť (Poľana Mts.).

Photo by M. Janišová

Pastures of the Lolio perennis-Cynosuretum cristati association in Zázrivá (Malá Fatra Mts.). A detailed view of the stand before the start of spring grazing.

Photo by M. Janišová

The structure of the permanent pasture is typical for its thick turf layer covering the soil surface even after intensive grazing or mowing.

10. Purple moorgrass meadows

Viera Šefferová Stanová, Helena Ružičková, Milan Janák

Habitats according to Habitat catalogue of Slovakia (Stanová & Valachovič 2002):

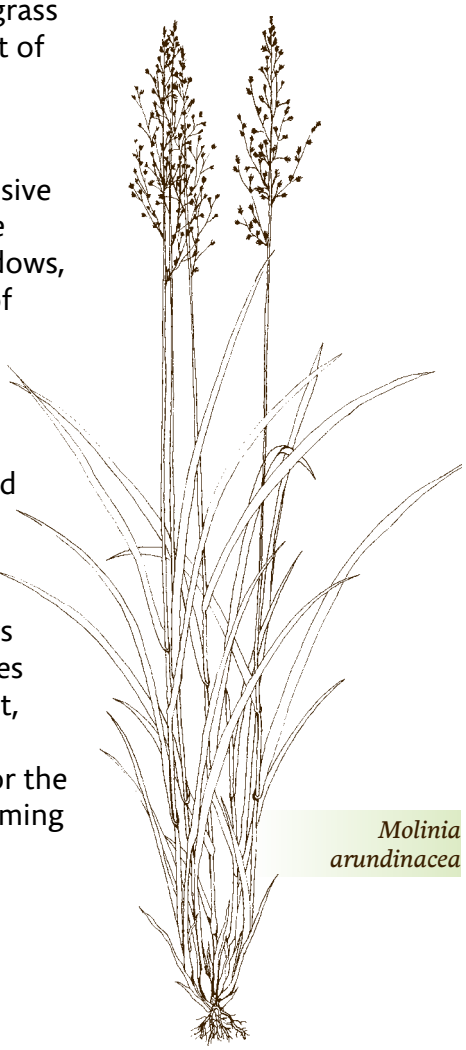
Lk4 Molinia meadows on calcareous, peaty or clayey-silt-laden soils (Natura 2000 code – 6410) – alliance *Molinion*

Habitat description

The purple moorgrass meadows with dominance of *Molinia caerulea* and *M. arundinacea* are amongst the most endangered vegetation types in Central Europe. They grow on mineralized fen soils, ranging from alkaline to acid character. Here, fluctuation of the underground water level is typical throughout the year; there are no surface floods, and these areas dry to a greater depth during summer. For the rest of the year, the underground water is to be found close to the soil surface. The purple moorgrass meadows are rich-in-species communities, with an occurrence of mesophilous meadow species, in combination with species growing in fens. These meadows are in full bloom in late summer and early autumn. A number of protected and endangered species grow here. The purple moorgrass meadows are quite exceptional in Slovakia, since most of the localities have been drained and ploughed.

Management recommendations

The purple moorgrass meadows are adapted to extensive methods of management. They should be mown once a year, and at a later time than the mesophilous meadows, because their growing season is delayed. At the end of summer, the soils dry, making these localities accessible. It is recommended that these meadows are mown by light mechanisms, adjusted to wetland conditions, with double tyres to avoid soil compaction. The hay should be collected and removed from the locality after mowing. Fertilization and grazing are not recommended. Should grazing be considered, it must be very extensive and take place in autumn. At high nutrient inflow, the meadows are overgrown by reed. Currently, most of the localities are without any management. When mowing is absent, the meadows are overgrown by shrub willows and voluntary woody plants. Their removal is necessary for the restoration of this habitat, but this is very time-consuming and expensive.



Molinia arundinacea

Enlistment in the Agro-environmental programme: Category F

Photo by V. Šefferová Stanová

Photo by V. Šefferová Stanová

The purple moorgrass meadows in the National Nature Reserve Abrod represent the largest preserved complex of these meadows in Slovakia. Meadows of this type should be mown once a year, at a later time.

Photo by V. Šefferová Stanová

Orchids of the Dactylorhiza genus are found in abundance in the purple moorgrass meadows.

Photo by V. Šefferová Stanová

Dianthus superbus is a typical species of purple moorgrass meadows.

11. Tall-herb communities on wet grasslands

Dobromil Galvánek, Richard Hrivnák, Milan Janák

Habitats according to Habitat catalogue of Slovakia (Stanová & Valachovič 2002):

Lk5 Tall-herb communities on wet grasslands (NATURA 2000 code – 6430) – sub-alliance *Filipendulenion*

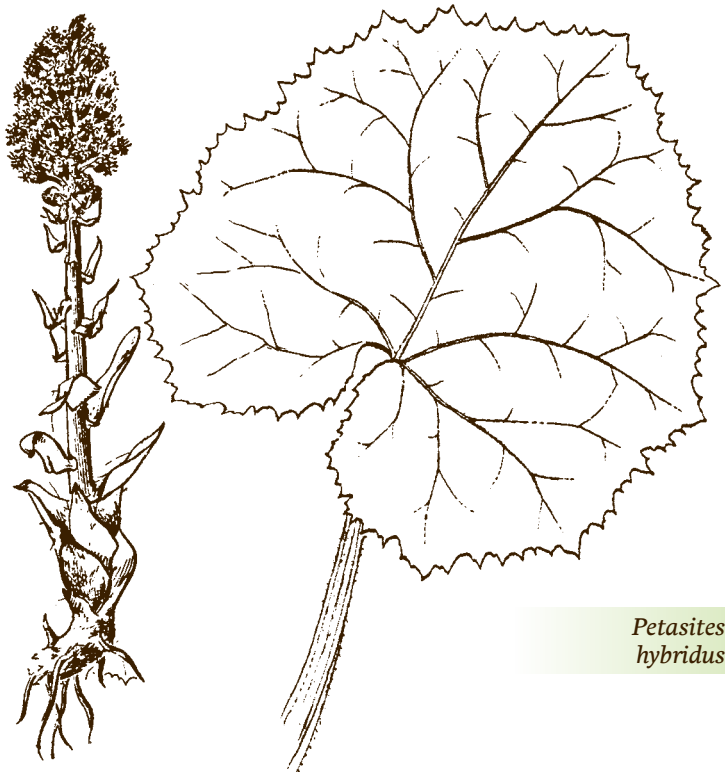
Habitat description

The habitat is represented by communities dominated by large broad-leaved strong competitors, such as *Filipendula ulmaria, Lysimachia vulgaris,* and *Mentha longifolia.* It occurs in the alluvia of streams or smaller rivers, and in the surroundings of springs, water reservoirs and mires, from the uplands to mountain areas. This type of vegetation requires sufficient soil moisture throughout the year, some fluctuation of water table in the soil, sufficient nutrient content in the soil and irregular management practices, including no management intervention. The communities are medium species-rich; the species composition is variable, with a dominance of one or two forb species. Species richness and species composition depend on both local ecological conditions and management intensity.

Management recommendations

Ideal management is irregular mowing once in 3-5 years. This blocks the encroachment of shrubs, and does not suppress the dominant forbs typical for the habitat. More frequent mowing may lead to changes in the species composition towards communities of the *Calthenion* sub-alliance. Grazing is not very suitable for this type of vegetation. The animals are not able to consume tall herbs, and they may even disturb the soil cover. Irregular mulching, approximately once in 5 years, is also suitable for the maintenance of this vegetation. No kind of additional fertilizing is necessary.

Enlistment in the Agro-environmental programme: Category F



Petasites hybridus

Photo by K. Ujházy

Alluvium of a small stream near the village of Strelníky. Grasslands with the dominance of Scirpus sylvaticus change to tall-herb communities with Mentha longifolia and Filipendula ulmaria after abandonment.

Photo by K. Ujházy

Typical species are Filipendula ulmaria, Urtica dioica and Lysimachia vulgaris.

Photo by K. Ujházy

Unmown stands of Filipendulenion sub-alliance along the stream in the Bystrá dolina Valley (town of Hriňová).

12. Sub-mountain and mountain grasslands

Dobromil Galvánek, Karol Ujházy, Milan Janák

Habitats according to Habitat catalogue of Slovakia (Stanová & Valachovič 2002):

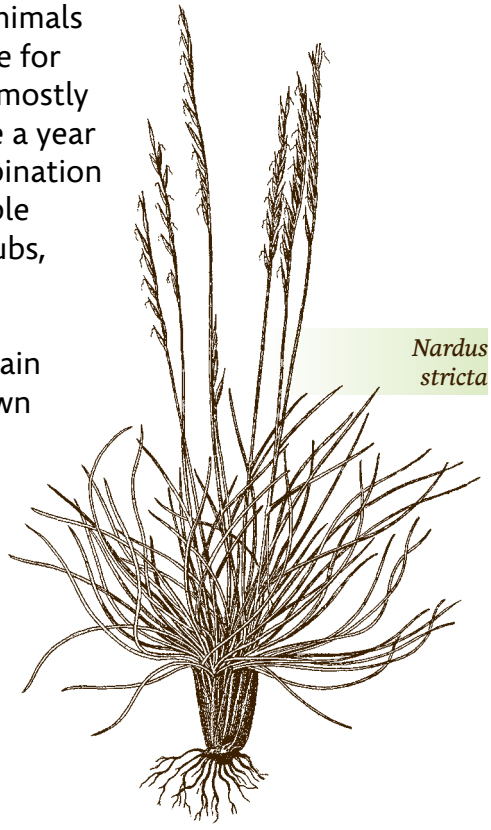
Tr8b Flower-rich high-mountain and mountain Nardus grasslands on siliceous substrate (NATURA 2000 code – 6230*) – alliances *Violion caninae*, *Nardo-Agrostion tenuis*

Habitat description

The Nardus grasslands are short-grass grassland habitats occurring on poor soils. They are dominated by lower grasses, such as *Nardus stricta, Festuca rubra, Agrostis capillaris*, but several forbs may occur as well and, due to that fact, the stands are in full bloom at the height of the flowering season. They are different from other grassland types because of their position along the ecological gradient of nutrient content in soils. They occur at the poorest oligotrophic localities, where soils are poor in nutrients. We may find this habitat from the uplands to the sub-alpine vegetation belt in the most of the mountainous areas of Slovakia, and on different substrates. This is the dominant type of grassland vegetation on the flysch rocks of northern Slovakia, in the Slovenské Rudohorie Mts. and in some volcanic mountains (Poľana).

Management recommendations

The most appropriate way of management is extensive grazing. All traditionally-used domestic grazing animals (cattle, sheep, horses, and even goats) are suitable for grazing on the Nardus grasslands. The sheep are mostly used in mountainous areas. Regular mowing once a year with biomass removal is also appropriate. A combination of mowing and grazing is ideal. Mulching is suitable only as a restoration measure, to remove the shrubs, but repetition is not recommended for a number of subsequent years. Limited organic fertilizing is acceptable, and even necessary, in order to maintain species richness, if the Nardus grasslands are mown only. It is not suitable to use mineral fertilizers or liming. If possible, it is not advisable to apply sheep-folding to the Nardus grasslands.



Nardus stricta

Enlistment in the Agro-environmental programme: Category B

Photo by K. Ujházy

Springtime with the species Genista pilosa on the grazed Nardus grasslands on the edge of Poľana Mts. near the village of Povrazník.

Photo by K. Ujházy

A detailed photo of a locality with the Campanulo-Dianthetum association in the village of Bratkovica, where forbs vegetation is maintained, due to grazing.

Photo by K. Ujházy

Extensive grazing is the most appropriate management on the Nardus grasslands.

13. Tall sedges

Richard Hrivnák, Kateřina Šumberová, Helena Oťaheľová, Petra Hájková, Milan Janák

Habitats according to Habitat catalogue of Slovakia (Stanová & Valachovič 2002):

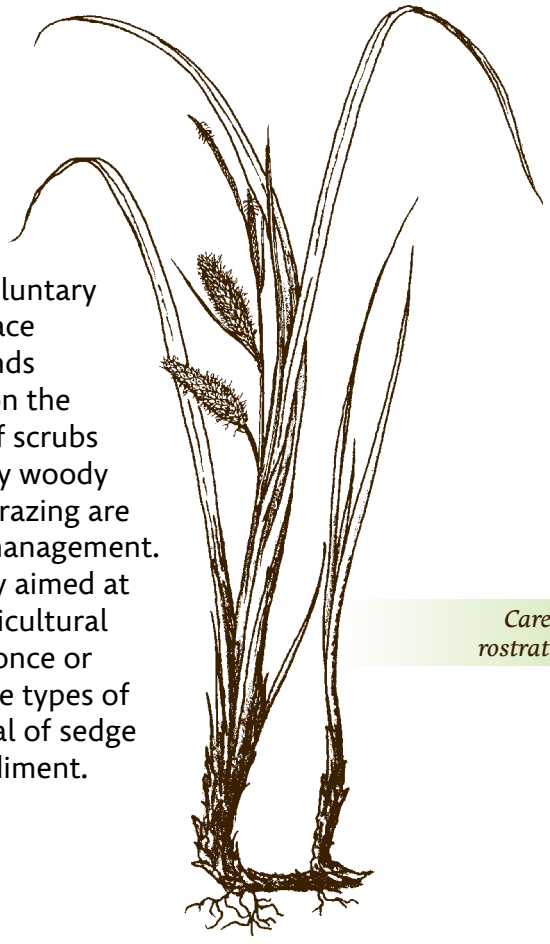
Lk10 Vegetation of tall sedges (habitat of national importance) – alliances *Magno-Caricion elatae*, *Magno-Caricion gracilis*

Habitat description

The vegetation is dominated by the creeping and tussock-forming species of the *Carex* genus, as well as by some species of tall plants. Almost permanently present are the wetland species, frequently hydrophytes and, occasionally, hygrophilous and mire species. The vegetation cover is poor in species. The amount and duration of floods and the fluctuation of the water regime over the year, as well as some other environmental factors (e.g. content of nutrients in the substratum), are all prerequisites in the creation and existence of this habitat. The vegetation of these communities settles in specific habitats which are affected by the surface water for at least part of the year. Typical are oxbow lakes, and flooded depressions in river and creek alluvia, as well as secondary habitats (water reservoirs, rock pits). The habitats are confined to lowlands and hilly areas; more occasionally, they occur in the sub-mountainous zone and, exceptionally rarely, in the mountainous vegetation zone.

Management recommendations

Normally, non-intervention management is beneficial for the vegetation of this habitat; optimally, it is left to develop spontaneously. However, mowing is used in order to remove the accumulated biomass and suppress the ruderal and invasive species. In addition, it prevents overgrowth caused by voluntary woody plants. Mowing should usually take place every two years; however, its frequency depends on environmental conditions, and especially on the purpose for which it is carried out. Removal of scrubs and trees is required wherever these voluntary woody plants occur. The burning of vegetation and grazing are among the less commonly used methods of management. The restoration type of management is mainly aimed at restoring the disturbed water regime. The agricultural use of the habitat, which consists of mowing once or twice a year, is beneficial for the more valuable types of vegetation. Less frequently used is the removal of sedge tussocks, together with the substratum or sediment.



Carex rostrata

Enlistment in the Agro-environmental programme: Category D

Photo by R. Hrivnák

Tall sedges vegetation covers, Bobrov záliv bay of the Orava Water Reservoir, near the Polish border.

Photo by R. Hrivnák

Caricetum rostratae in the litoral of the Jamské pleso lake.

Photo by R. Hrivnák

Vegetation covers of the Galio palustris-Caricetum repariae association, by the village of Vrbovka.

14. Fens

Viera Šefferová Stanová, Daniel Dítě, Milan Janák

Habitats according to Habitat catalogue of Slovakia (Stanová & Valachovič 2002):

Ra3 Transition mires and quaking bogs (Natura 2000 code – 7140)
– alliances *Caricion fuscae* and *Sphagno recurvi-Caricion canescentis*

Ra6 Alkaline fens (Natura 2000 code – 7230)
– alliances *Caricion davallianae* and *Sphagno warnstorfiani-Tomenthypnion*

Habitat description

The mires are a significant and striking natural phenomenon. They are terrestrial ecosystems, occurring on permanently, or long-term, water-logged habitats, where the primary biotic production outweighs the decomposition, and the dead organic matter accumulates in the substratum here. The fens can be dissected, based on several criteria, into a number of types. The floristic structure of the communities is influenced by three main ecological gradients: (i) the content of nutrients in the water, which is influenced by the bedrock; (ii) the content of organic particles in the sediments, which is related to the gradient of the progressing succession; (iii) the level of the underground water on the site, which is determined by climatic and hydrological conditions, and the character of the mezzo – and micro-relief on each individual site. There are two basic types of fens: fens with a high alkaline amount (calcareous fens or rich fens), and poor fens with low alkaline amount.

Carex davalliana

Management recommendations

The hydrological systems, which used to supply the fens with water, were able to create stable conditions over the centuries without human intervention for non-forest vegetation. Due to drainage, however, many fens have changed to low-production meadows over the last few centuries. These meadows cannot be preserved without implementing regular management.
A significant part of the fens is maintained by so-called conservation management, which focuses on the preservation of the biodiversity value of areas. Mowing is a traditional way of fen meadows management, and it supports their species richness. At present, the fens are mown by light, usually small, mechanisms which are well-adjusted to the environment. Grazing is recommended as an alternative to mowing, mainly in abandoned localities; however, in that case, a decrease in species richness can be expected. Restoration management includes cutting the voluntary woody plants, mulching the abandoned meadows for a maximum of two consecutive years, and/or restoration of the water regime.

Enlistment in the Agro-environmental programme: Category F

Photo by V. Šefferová Stanová

Alkaline fens at the locality of the Belianske lúky meadows. Very rare are the pioneer communities of the fen pools.

Photo by T. Dražil

An example of a light tractor with wide tyres, adjusted for wetland conditions. In densely overgrown terrain, it is capable of mulching about 1 hectare of fen meadows per day.

Photo by V. Šefferová Stanová

Menyanthes trifoliata is among the typical species of fens.

15. Alpine and subalpine calcareous grasslands

Ján Kliment, Jozef Šibík, Ivan Jarolímek, Milan Janák

Habitats according to Habitat catalogue of Slovakia (Stanová & Valachovič 2002):

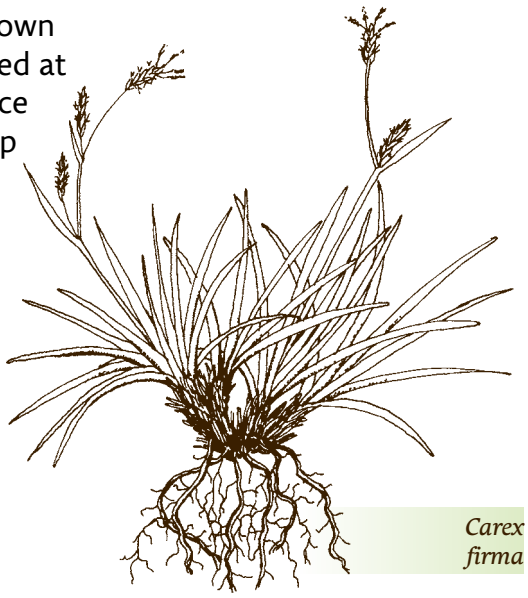
Al3 Alpine and subalpine calcareous grasslands (Natura 2000 code – 6170) – alliances *Caricion firmae*, *Astero alpini-Seslerion calcariae* and *Seslerion tatrae*

Habitat description

The alpine and subalpine calcareous grasslands are a unique and noticeable habitat, with high aesthetic, scientific and biodiversity value. In syntaxonomy, these habitats are included in two classes: *Elyno-Seslerietea* Br.-Bl. 1948 and *Carici rupestris-Kobresietea bellardii* Ohba 1974. The communities of this habitat are of interest, due to the presence of an abundance of phytogeographically important (endemic, arctic-alpine), rare and endangered species. Most of the alpine and subalpine calcareous grasslands (growing on alkaline bedrock) are relic types of vegetation, with a long-term stable floristic structure, with only local changes, due to natural factors. They are mostly small-scale or mosaic phytocenosis, the relic nature of which becomes represented (along with close links to environmental conditions), due to the fact that they occur in limited areas.

Management recommendations

The alpine and subalpine calcareous communities mostly do not need active management in order to preserve them in a good condition. The only exceptions are cases where it is required to preserve or restore the traditional management methods (regular mowing, extensive grazing by an appropriate number of sheep or cattle). These traditional forms of management have a positive impact on the species biodiversity of some of these grasslands. Management is required also when man-made negative changes in the species structure need to be eliminated. An example is cutting down the mountain pines which were unwisely planted at localities which had been naturally treeless since the glacial era (snow and avalanche fields, steep rocks, etc.). The preservation of a favourable state of habitats can mostly be sufficiently ensured by so-called passive management, which includes the prevention of the negative influences of anthropogenic factors, and activities on the habitat. An important prerequisite for prevention is the mapping of (potentially) endangered habitats, followed by monitoring in selected localities.



Carex firma

Enlistment in the Agro-environmental programme: Category G

Photo by J. Šibík

Alpine calcareous grasslands are a unique habitat which has a significant role, not only in preserving the biodiversity but they have an inestimable aesthetic value, too. The Havran mountain in the Belianske Tatry range.

Photo by J. Šibík

Aster alpinus and Anthylis vulneraria subsp. alpestris, species typical for the communities of the Astero alpini-Seslerion calcariae alliance. Krivánska Malá Fatra mountain range.

Photo by J. Šibík

Access by cableway, as well as insufficient monitoring by the nature conservation authorities, has an influence on the increase of erosion in the sensitive alpine environment of the National Nature Reserve Chleb.

16. Neutrophilous to acidophilous (sub)alpine grasslands

Jozef Šibík, Ján Kliment, Ivan Jarolímek, Milan Janák

Habitats according to Habitat catalogue of Slovakia (Stanová & Valachovič 2002):

Al1 Siliceous alpine and boreal grasslands (Natura 2000 code – 6150) – alliances *Juncion trifidi* and *Festucion versicoloris*

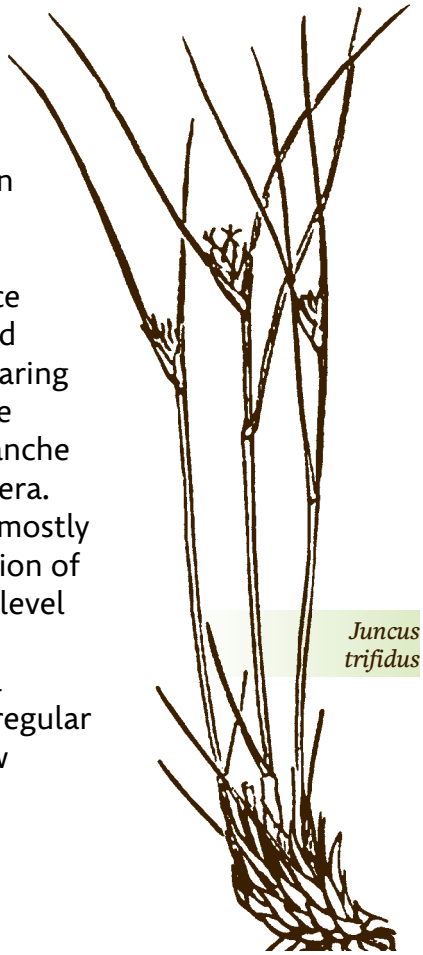
Tr8a Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas and submountain areas in continental Europe (Natura 2000 code – 6230*) – alliance *Nardion strictae*

Habitat description

Alpine grasslands on acid to slightly nitrophilous substratum represent a group of vegetation communities which are limited in their occurrence to high mountains. From the group of habitats of European importance, acidophilous grasslands of the alpine zone, along with the Nardus grasslands of the alpine zone, are included in this habitat. In addition to these two vegetation types, the small-scale islands of the vegetation occurring on the stabilized mylonite debris and terraces of the broken rock cliffs are to be included into this habitat group (alliance *Festucion versicoloris* Krajina 1933, class *Carici rupestris-Kobresietea* Ohba 1978).

Management recommendations

In order to preserve the alpine communities with their typical vegetation, not only on the acid substratum, most of them do not require active management. It is only important in certain cases when the species structure of the communities depends on a traditional method of management, i.e. regular mowing or extensive grazing. Management interference is required when negative changes caused by man need to be eliminated. The interference may include the clearing of mountain pines or spruce (occasionally larch). These territories, for example, the ends and bottoms of avalanche troughs, have been naturally treeless since the glacial era. Preserving the species diversity in this type of habitat mostly requires human impact regulation, such as the regulation of the number of tourists in selected areas with a higher level of erosion (the mylonite zones of the Tatry Mountain, the Belianske Tatry mountain range, etc.), the maximal limitation of movement beyond the tourist trails, the regular renovation of these trails, and restrictions to both new construction activities and the development of tourist attractions.



Juncus trifidus

Enlistment in the Agro-environmental programme: Category G

Photo by J. Šibík

Bright rusty-red colouration of the dominant species Juncus trifidus, and other grasses, is typical for late summer and autumn in these habitats. The Furkotská dolina valley in the Vysoké Tatry mountain range.

Photo by J. Šibík

Pulsatilla vernalis, a critically endangered species, is limited in occurrence to the mylonite zones of the Vysoké and Západné Tatry mountain ranges, growing in the communities of the Festucion versicoloris alliance.

Photo by J. Šibík

In spring, the communities of the acidophilous grasslands are enriched by conspicuously flowering species of higher plants, e.g. Primula minima.

17. Inland salt meadows

Daniel Ditě, Tomáš Dražil, Milan Janák

Habitats according to Habitat catalogue of Slovakia (Stanová & Valachovič 2002):

Sl2 Inland salt meadows (Natura 2000 code – 1340*)
– alliance *Caricion davallianae*

Habitat description

The Carpathian inland salt meadows are mainly small-scale habitats. The vegetation is characterized by the occurrence of the plant community *Glauco-Trichophoretum pumili* (Šmarda 1961) (Vicherek 1973), included in the *Caricion davallianae* alliance. In addition to species typically growing on alkaline fens (for example, *Epipactis palustris*, *Pedicularis palustris*, *Primula farinosa* or *Pinguicula vulgaris*), plants requiring a high salt content in the soil substratum can be found in this vegetation. The habitat occurs around springs with highly mineralized water, containing a significant percentage of dissolved salts which have a strong impact on the soil chemistry around the spring. Due to salt precipitation on the surface, sinter is created, which forms travertine piles or shields in some places over time. This priority habitat is very rare, limited in occurrence only to the northern locations of the inner-Carpathian basins. The vegetation is typical for the common occurrence of obligate halophytes, with species typical for highly alkaline fens. At a number of localities, the habitat can be found as a part of a mosaic consisting of fen vegetation and/or (in the case of the existence of travertine piles or shields) xerothermic vegetation growing on the eroding sinter.

Management recommendations

The preserved halophyte vegetation covers of this habitat type, which are in a favourable state, do not need any active management. Typical is their significantly low-scale occurrence, mainly of a spot-like character (for example, typically occurring around a mineral spring). Active interference, however, is often required in the adjoining habitats (fens, xerothermic and mezophilic meadows), which are the source of the invasion of competitively strong species into this salt meadow habitat. Considering the very small area of all the existing habitats, the most appropriate method of management is hand mowing, followed by biomass removal beyond the localities of interest. Since these habitats are extremely sensitive, the most suitable solution is hand mowing with brushcutters (occasionally by special light mechanisms which do not cause soil surface compaction). Grazing is a less appropriate way of management in the case of this habitat.

Pedicularis palustris

Enlistment in the Agro-environmental programme: Category F

Photo by D. Dítě

The initial stages of vegetation of inland salt meadows on the accumulating sinter. Sivá brada, north-east slope of the travertine pile.

Photo by D. Dítě

Glaux maritima is a critically endangered species of our flora.

Photo by T. Dražil

Habitat management – the most sensitive areas around the springs need to be hand-mown (locality of Baldovce).

18. Raised bogs

Viera Šefferová Stanová, Daniel Dítě, Milan Janák

Habitats according to Habitat catalogue of Slovakia (Stanová & Valachovič 2002):

Ra1 Active raised bogs (Natura 2000 code – 7110*) – alliances *Oxycocco-Empetrion hermaphroditi*, *Sphagnion medii* and *Sphagnion cuspidati*

Ra2 Degraded raised bogs (still capable of natural regeneration) (Natura 2000 code – 7120) – alliance *Sphagnion medii*

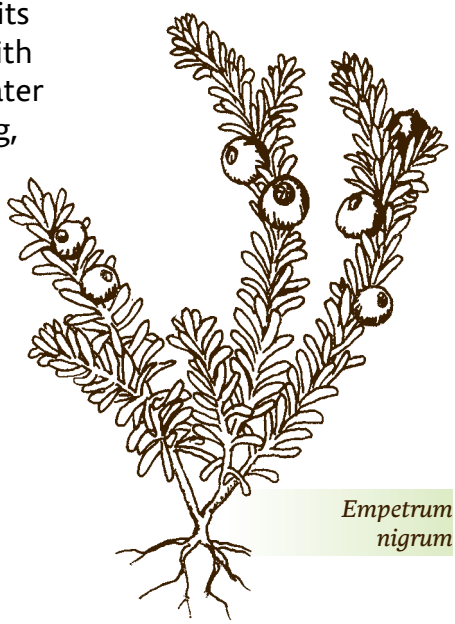
Habitat description

A raised bog is a special type of mire, and generally one of the most extreme habitats. Since the rainwater is the only source of nutrients, the environment is very acid and extremely nutrient-poor. These factors are significantly reflected in the species structure of the vegetation, which consists of only a few plant species, adjusted to extreme life conditions. Under conditions of limited oxygen inflow, dead organic remnants at various levels of decay accumulate here, leading to peat formation, consisting mainly of sphagnum mosses. Raised bogs are, by nature, rare in Slovakia, because this is the southern-most border of their occurrence within Europe.

Management recommendations

Raised bogs are without doubt amongst the most endangered types of bogs. Many of them have been totally destroyed by peat excavation; in other cases, their water regime has been damaged by peat mining or other activities. If we wish to try to restore the water regime, it is necessary to understand the hydrological conditions of the raised bogs. The underground water level can be increased by blocking up the drainage canals, e.g. by filling them up with appropriate material (dry peat is ideal), or by building various types of weirs which can be made from wood, plastic or other materials. The water level in the locality can be increased by implementing suitable measures in its surroundings; for example, creating a buffer zone with wetland vegetation above the bog, which retains water and allows its regular flowage. When restoring a bog, the technique of uncovering the upper soil level is used, too. In this way the dry peat level, with a higher content of nutrients, is removed, and also the underground water can reach the surface.

Agricultural use of the habitat is not supported by the agro-environmental programme.



Empetrum nigrum

Photo by V. Šefferová Stanová

Raised bogs are typical for their hummocks, created by bryophytes, and depressions between them, called hollows. A typical species of a raised bog is Eriophorum vaginatum, with its white hairy inflorescences.

Photo by V. Šefferová Stanová

The Klin Reserve in the Orava region. The white scrub in the background is the critically endangered species Ledum palustre.

Photo by V. Šefferová Stanová

Draining threatens the bogs most. Drainage canal at the raised bog Suchá hora.

19. Wet grasslands of sub-mountain and mountain areas

Dobromil Galvánek, Richard Hrivnák, Milan Janák

Habitats according to Habitat catalogue of Slovakia (Stanová & Valachovič 2002):

Lk6 Wet grasslands of sub-mountain and mountain areas (habitat of national importance) – sub-alliance *Calthenion*

Habitat description

The habitat is represented by mown wet meadows, occurring in stream and small river alluvia, surrounded by springs, on the edge of open water bodies and mires with optimal conditions in areas stretching from the uplands to the mountain vegetation belt. Conditions for their existence include: sufficient soil moisture throughout the year, some fluctuation of the water table in the soil profile, and regular management, mostly mowing. The communities of this type of habitat are medium species-rich, with a variable species composition, dominated by hygrophilous grassland species, such as *Caltha palustris, Lychnis flos-cuculi, Myosotis palustris* agg., *Poa trivialis, Scirpus sylvaticus.* The vegetation of the habitat is usually medium high or high, with several layers. In addition to vascular plants, bryophytes occur regularly.

Lychnis flos-cuculi

Management recommendations

The most suitable management is regular yearly mowing, with biomass removal; mowing twice a year is ideal. Light machinery should be used, since this does not cause soil compaction, or any other disturbance. Hand mowing is the most appropriate; however, this is not feasible in most cases, due to the high costs involved. Grazing is less suitable, but nonetheless preferable to abandonment. Mulching can be used in localities overgrown by trees and shrubs, but it should not be applied in the same area for more than two years in succession. There are no suitable fertilizers for this vegetation type.

Enlistment in the Agro-environmental programme: Category F

Photo by K. Ujházy

Vegetation dominated by the species Cirsium rivulare in the Podpoľanie region (surroundings of the town of Hriňová).

Photo by K. Ujházy

Scirpus-dominated meadow with Holcus lanatus in full flower, before first mowing (town of Hriňová, SE part of the Podpoľanie region).

Photo by R. Watzka

Springtime with a typical species Caltha palustris in the Vlkolínske lúky meadows (Veľká Fatra mountain range).

20. Montane tall-herb alluvia

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Habitats according to Habitat catalogue of Slovakia (Stanová & Valachovič 2002):

Al5 Hygrophilous tall herb fringe communities of plains and of the montane to alpine belts (Natura 2000 code – 6430) – sub-alliances *Adenostylenion alliariae* and *Delphinenion elati*

Al6 Tall herb communities of mountain alluvia on silicate bedrock (habitat of national importance) – alliances *Calamagrostion villosae* and *Trisetion fusci*

Al7 Tall herb communities of wet rock troughs on carbonate bedrock (habitat of national importance) – alliance *Festucion carpaticae*

Al8 Mountain tall herb communities on drier and warmer slopes (habitat of national importance) – alliances *Calamagrostion arundinaceae* and partially *Calamagrostion variae*

Habitat description

The montane tall-herb alluvia include natural non-forest communities of tall herbs and grasses, with a centre of occurrence in the sub-alpine zone. These communities are dominated by medium-tall to tall grass species (*Calamagrostis arundinacea*, *C. varia*, *C. villosa*, *Deschampsia cespitosa*, *Festuca carpatica*, *Trisetum fuscum*, rarely also *Dactylis glomerata*), broad-leaved herbs (*Aconitum firmum*, *Adenostyles alliariae*, *Cicerbita alpina*, *Delphinium elatum*, *Doronicum austriacum*) and ferns (*Athyrium distentifolium*, *Dryopteris filix-mas*). The tall-herb alluvia develop in places where avalanches, creeping snow, or the accumulation of a large amount of snow, hinder forest development.

Management recommendations

Regular management is not necessary in this type of habitat. With certain community types, however, traditional forms of management, such as mowing and extensive grazing, contribute to the preservation of their species richness. Management interventions are important, particularly in cases when these areas were forested or otherwise damaged by measures with a negative influence (e.g. the felling of mountain pine) in the past. Montane tall-herb alluvia require preventive management, which can ensure their protection mainly against inadequate human interventions, leading to the degradation of communities, and soil erosion. Preventive management includes, above all, following the visiting rules in protected territories, maintaining the hiking trails, limiting inappropriate forest plantings and last, but not least, avoiding any further building of recreation facilities in these rare habitats.

Enlistment in the Agro-environmental programme:
Category G (habitat Al6)

Cicerbita alpina

Photo by J. Šibík

Tall-herb alluvia in the Vysoké Tatry mountain range form a mosaic of subalpine deciduous shrubs dominated by Salix helvetica. The Hlinská dolina valley in the Vysoké Tatry mountain range.

Photo by J. Šibík

At flowering time, the communities dominated by the specie Adenostyles alliaria are spectacular in their appearance and colours. The Hlinská dolina valley in the Vsoké Tatry mountain range.

Photo by J. Šibík

Aconitum firmum subsp. firmum, a typical representative of the Carpathian endemic species in these habitats. The Velická dolina valley in the Vysoké Tatry mountain range.

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