

Flower-rich Meadows in the Krkonoše Mountains (Giant Mountains)

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The Krkonoše Mountains are a mountain range situated in North-Eastern Bohemia alongside the Czech-Polish border. They are part of the High Sudeten Mountain complex and famous for extremely high landscape and species diversity in four altitudinal belts, from sub-montane to alpine ones.

Even though not very high (the highest point Sněžka reaching 1,602 m a.s.l.), the mountains appear as an ecological island of arctic and alpine ecosystems whose counterparts are found many hundreds of kilometers further to the south and to the north.

The extraordinary natural values - high species diversity of flora (1,250 taxa of vascular plants, endemic and glacial relicts) and fauna (more than 150 breeding bird species) - are found in the following habitats: alpine tundra, subarctic peat-bogs, glacial corries, mountain spruce forests, mixed beech-spruce forests, sub-alpine meadows and flower-rich mountain meadows.

These values of the region have been exceptionally well protected as a national park on the Czech side since 1963. In 1992, the entire area was declared a bilateral biosphere reserve, representing Central European highlands

The area has been cultivated by men for many centuries. Since the 16th century the mountains were settled first by foresters and later farmers. Vast areas of the mountainous forests have been cut and on the deforested areas mountain meadows have been created. They were managed by traditional cultivating methods: mowing; extensive grazing of the cows, sheep and horses; organic and mineral fertilization; and irrigation. The result of these activities was the heterogeneous mountain landscape and species-rich meadows. Such meadows were in biological contact with the ecosystems above the timber-line and with the lowland ecosystems and on these meadows grew the

grass and forb species coming from both sides.

The peak-period of development old farming occurred from the 18th century up to the 1950s. After the Second World War most of the inhabitants were resettled to Germany, and former farming activities were abandoned. This has been meaning many problems and changes in land use. The 1960s, 1970s, and 1980s brought the biggest threat by very intensive agriculture with overmanuring and high concentrations of cattle on pastures.

After the changes in Eastern Europe in 1989 agricultural activities decreased substantially and many mountain meadows were abandoned and became overgrown with trees and shrubs.

The main problem caused by harvesting of the meadows is the use of grass or hay (burning, mulching).

The most important plant communities and their diagnostic species on flower-rich mountain meadows in the Giant Mountains:

- **Nardion.** Primary and secondary flowery nardetum in supramontane, sub-alpine, and alpine belts.
Substitute community of Vaccinio-Piceetalia:
Gentiana asclepiadea, Hieracium alpinum, Homogyne alpina, Hypochoeris uniflora, Luzula sudetica, Phleum alpinum, Potentilla aurea, Pulsatilla alba, Rhinanthus alpinus, Solidago virgaurea, Thesium alpinum.
- **Nardo-Agrostion tenuis.** Species-rich meadows with Nardus stricta, substitute community of spruce and beech forests. Typical is the combination of mountain and lowland species:
Arnica montana, Briza media, Crepis conyzifolia, Crepis succisifolia, cam-

panula bohemica, Campanula rotundifolia, Carex pilulifera, Galium saxatile, Gymnadenia conopsea, Hieracium iseranum, Luzula luzuloides, Omalotheca sylvatica, Phleum alpinum, Pleurozium schreberi, potentilla aurea, Silene vulgaris, Veronica officinalis, Viola lutea subsp. Sudetica.

- **Nardo-Caricion rigidae.** Closed alpine grassland with Nardus stricta:
Agrostis rupestris, Carex bigelowii, Festuca airoides, Luzula sudetica, polytrichum strictum, Baeothryon cespitosum, Diphasiastrum alpinum, Huperzia selago.
- **Polygono-Trisetion.** Middle herb, rarely tall herb meadow communities in mountain belt, substitute community of spruce and beech forests:
Cardaminopsis halleri, cirsium heterophyllum, Crepis succisifolia, Geranium sylvaticum, Melandrium rubrum, Phleum alpinum, Phyteuma spicatum, poa chaixii, Polygonum bistorta, potentilla aurea.
- **Violion caninae.** Oligotrophic meadows on the acid substrate, substitute community of oak, beech, fir, and spruce forests:
Campanula rotundifolia, Carex pallens, Galium pumilum, Pedicularis sylvatica, Pimpinella saxifraga, polygala vulgaris, Sieglingia decumbens, Thymus pulegioides, Viola canina
- **Calthion.** Grasslands communities on humid localities:
Chaerophyllum hirsutum, Geranium sylvaticum, Cardaminopsis halleri, Crepis paludosa
- **Arrhenaterion.** Tall and middle herb communities, substitute community of hornbeam and beech forests:
Arrhenaterum elatius, Campanula patula, Carum carvi, Crepis biennis, Galium mollugo, Knautia arvensis, Tragopogon orientalis, Trifolium dubius.

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- **Cynosurion.** Short and middle herb communities, regular grazing or mowing:
Bellis perennis, Cynosurus cristatus, Lolium perenne, Phleum pratense, Poa annua, Poa pratensis, Prunella vulgaris, Trifolium repens.
- **Genistion.** Species-poor communities with heather:
Calluna vulgaris, Deschampsia flexuosa, Vaccinium myrtillus, Vaccinium vitis-idaea, Potentilla erecta, Nardus stricta, Pleurozium schreberi, Solidago virgaurea, Melampyrum pratense, Arnica montana.

Special protection of the meadow species and biotopes

The most endangered plant species with limited populations are protected "ex-situ" in a tiny botanical garden (a "gene-bank" of the National Park Administration). Seeds of endangered species are collected from wild plants, cultivated "ex-situ" and raised seedlings are planted at places of their origin or at field gene-pool sites managed by the Administration of the National Park. As special field gene-pool sites the most valuable botanical localities were chosen. The care of these localities includes regular per year mowing, making hay and grass mass clearing, grazing, reconstruction of the drainage furrows, removing of undesirable tree-self-sowing, liquidation of invasive plant species, simple heap composting, etc.

The vegetation is formed by the peatbogs plant communities, mesotrophic meadows and springs, the communities of alders and willows. More than 150 taxa of vascular plant species grow there. It was declared a small protected area and basic field gene-pool site. It serves for active preservation of its rich plant communities and for transfers and rescue cultivation of wetland plants from the Giant mountains region, especially the endangered orchid species whose ecological characteristic are studied there too.

The KRNAP Administration ensures the annual management of these meadows (mowing, harvesting, water management suitable from the ecological point of view, etc.).

Dominants of the different types on abandoned meadows:

A. Eutrofic or eutroficated meadows with high production:

Urtica dioica, Chaerophyllum aromaticum, dactylis gomerata, Rumex alpinus, Myrrhis odorata, senecio fuchsii, Galeopsis tetrahit, Imperatoria ostruthium.

B. Mezo- and oligotrofic meadows with low production:

Holcus mollis, Hypericum maculatum, Silene vulgaris, Senecio Fuchsii, Deschampsia caespitosa, Rumex alpinus, Bistorta major, Sorbus, Acer, Betula.

Significant botanical localities in the Krkonoše National Park:

Objective: conservation of the most valuable biotopes, flora and fauna species of the Krkonoše NP

Area: 100 hectares

Types: flower-rich mountain meadows, xerotherm meadows, swamp meadows, heatherland, peatbog, lowbo, etc.

Location: I., II., III. zone of NP

Financed by: Programme for Landscape management from the Ministry of the Environment

Cost: 30,000 US\$

e.g. **Slunečná strán** - area: 10 hectares.

Recreational function of grasslands

Since the beginning of the 20th century, the number of visitors of the Krkonoše National Park grew enormously. In the late 1980s between eight and ten million people visited this region. The mountain meadows play an important role, mainly in winter tourism, because most of them became increasingly used for skiing.

Monitoring of and research on the mountain meadows

Since the 1970s, the Botanical Institute of the Czech Academy of Sciences has been carrying out long-term research on and monitoring of the mountain grasslands.

The studies are headed to the plant communities classification, their dynamism, processes on the abandoned meadows and methods of recreation and restoration.

The **reaction of species diversity** to different management conditions under different nutrient regimes:

1. mowing low diversity, oligotrofic process low-productive soil
2. mowing and fertilization .. diversity growing
3. no mowing diversity declining, succession

1. mowing diversity declining, oligotrofic process low-middle productive
2. mowing and fertilization .. maintenance or growing of soil diversity
3. no mowing diversity declining

1. mowing diversity growing middle-high
2. mowing and fertilization .. maintaining or declining of productive bio-diversity soil
3. no mowing diversity declining

1. mowing slow growing diversity high productive soil
2. mowing and fertilization .. maintenance or declining of biodiversity
3. no mowing degradation, diversity declining

Source: Grasslands of the Krkonoše Mountains: Plantcommunities and their Dynamics, *Opera Corcontica* 33, 1996

Processes on abandoned meadows, dynamism of the production of the meadows:

Nardo-Agrostion

oligotrophic, low biodiversity *no mowing* **forest**

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no mowing, fertilization

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mowing, no fertilization

Nardo-Agrostion

mesotrophic, high biodiversity *mowing, fertilization* **Polygono-Trisetion**
mezo-oligotrophic

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no mowing, no fertilization

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Dominance of *Nardus stricta*, *Luzula luzuloides*, *Poa chaixii*, *Deschampsia flexuosa*, *Polygonum bistorta*, *Hypericum maculatum*, *Deschampsia cespitosa*,

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dominance of *Holcus mollis*

Source: Grasslands of the Krokonoše Mountains: Plantcommunities and their dynamics, *Opera Corcontic* 33, 1996

on of flower-rich mountain meadows. E.g., two years ago, a project was started to study the influence of long-term mulching on mountain meadows. Particularly, studies are made by university students and the staff of the Administration of the National Park.

The results of this research are used to propose concrete management methods aiming at the field gene-pool sites. E.g., this year, a project was started focussing

on the application of composting of grassland biomass for the fertilisation of meadows.

Subvention policy and the position of the Ministry of the Environment and the Ministry of Agriculture

Important help for mountain agriculture has been and still is the Program for

Landscape Management by the Ministry of Environment.

The fund supported, for example, regular management methods of meadows and pastures, and special protecting methods..

The second financial support comes from the Ministry of Agriculture. The funds are used to improve the care of mountain meadows: under the same conditions 100 US\$ per hectare of harvested meadows.

Nevertheless, it is often difficult to satisfy the demands of both ministries. For instance, subsidies from the Ministry of Agriculture are often used for maintenance by mulching, which clashes with nature conservation demands and does not seem to be a good solution.

Mountain agriculture in the Giant Mountains

Examples:

Farma HUCUL s.r.o., Vítkovice v Krkonoších

Ecological horse breeding (90, Hucul race), 300 hectares (meadows, pastures), agri-tourism.

Horská farma Sosna, Vlašské boudy

900 m -1,100 m a.s.l., ecological cattle breeding (7, special Czech breed), 13 hectares of pasture, sale of selfmade milk products.

Horská farma Waldmann, Paseky n. Jizerou

Ecological sheep breeding (beef sheep breed Ramney), 20 hectares of pastures, agri-tourism.

