



Mires to visit

Mires that are located along marked pathways

1. Chalupská slač mire

Accessible from the green tourist path between Borová Lada and Svinná Lada (ca. 1 km) by a boardwalk.

A valley raised bog next to the Vydří stream with a picturesque pool and floating peaty islands. At the water's edge you can find the common sundew (*Drosera rotundifolia*) and the rare mud sedge (*Carex limosa*). You can also see places where peat was manually cut in the past and these are now overgrown by dwarf shrubs of northern bilberry (*Vaccinium uliginosum*), cranberry (*Oxycoccus palustris*), and dwarf heath shrubs.

2. Tříjezerní slač mire

Take the red tourist path from Modrava along Roklanský potok (brook) – Rybárna – to Tříjezerní slač mire.

A smaller, well-preserved mountain raised bog with several pools. A boardwalk takes you through stands of bog pine to a pool. Along the path you may see on the carpet of sphagnum moss, cotton-grass, bog rosemary (*Andromeda polifolia*), cranberry and common sundew. There are also growing mud sedge and runnoch-rush in the edge of bog pools. The Tříjezerní slač mire is part of a mire complex called Modrava mires.

3. Jezerní slač mire

This mire is located next to the road from Kvilda to Horská Kvilda on your left.

This peatbog had been hand-cut in places, signs of which can be seen as regular stripes of depressed areas. Along the boardwalk you can see the rare dwarf birch (*Betula nana*).



1

CAN WE FIND PIECES OF TUNDRA IN THE ŠUMAVA LANDSCAPE?

Vltava River Floodplain
Photo Zdenka Křenová

The Forgotten North

Mires are rather rare phenomena in a central European landscape and stand out in the surrounding landscape where they occur. But their relative rarity was not always the case. Towards the end of the **Last Glacial Period** (some nine thousands years ago) our landscape was somewhat similar to that of **arctic tundra**, with low dwarf shrubs and an occasional clump of dwarf birch and pine.

As the glaciers retreated the landscape character changed markedly with time – as a result of the rise in temperature and increase in humidity. The cold-loving plants of northern latitudes were eventually replaced by **wood-**

land vegetation. Nevertheless, in places **with less-suitable conditions**, some tundra communities got left behind and some have survived up to the present day. One such type of plant and animal community are **mires**.

In Šumava, mires serve as a reminder of the last glacial period and the species that have survived here from that period are referred to as **glacial relicts**. Due to their situation and relative small size mires are referred to as 'islands of the north'; islands left behind in the central European landscape since the time the glacial ice sheet retreated northwards.

2

WHAT IS PEAT?



Neither water nor land - how does a mire grow?

Šárecká slať mire
Photo Ivana Bufková



Restoration of Blatenská slať mire
Photo Ivana Bufková

A mire is a magical place lying on **the border** between two different worlds – **water and land**. One way to best appreciate this fact is to walk on the soft living carpet of sphagnum moss; a carpet that floats on a 'soft mud' several metres-thick which is nearly all water. The presence of water coming up to the mire surface can be felt at every step. Water is essential for mires. Mires only develop in places that are sufficiently wet throughout the year and where water accumulates.

Under waterlogged conditions, thus with a **low oxygen content**, dead plant material decomposes very slowly and over the years gradually accumulates. As a result a thick **layer of organic material** known as **peat** is formed. In this respect, mires are remarkable: they create for themselves the conditions that are suitable for their own development. Mires are usually restricted to cold, humid conditions with abundant rainfall.

How can everyone help to conserve mires?

Each of us can contribute to mire conservation. The important step is to **replace the use of peat in gardening by using suitable alternatives**. Such alternatives to peat are already on offer. Large areas of mires in the world are still destroyed due to peat extraction and the sale of peat as a gardening substrate. By exploiting mires in the world we lose some unique worlds of plants and animals that will never again return. At the same time, large amounts of carbon dioxide are released to the atmosphere as a result of exposing previously-buried

organic matter to decomposition and the water regime is also substantially affected. In **Šumava**, you can help by **participating in the mire restoration programme**. The National Park seeks volunteers to help with mire restoration. As a volunteer you can help directly: by contributing physical work directly connected to mire restoration. Register yourself to **Days For Mires** via the internet (www.npsumava.cz).



Mosses of mires

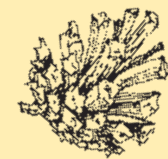


BOG GROOVE-MOSS
(*Aulacomnium palustre*)



INFLATED NOTCHWORT
(*Gymnocolea inflata*)

BOG PINE
(*Pinus rotundata*)



GROWTH HABIT, BRANCH, CONE

Mires of Šumava

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WHAT IS THE MAIN AIM IN MIRE RESTORATION?



Water 'lost and returned' - or a mire restored

Blocked drainage ditches at Černohorský močál
Photo Ivana Buřková

Many mires in Šumava have been influenced by human activities, especially by way of surface drainage. At present, a programme concerned with the **restoration of wetlands, including mires**, is being implemented in Šumava. This programme is focused on the conservation and restoration of degraded wetlands, including mires, and the restoration of a functioning water regime. Within this programme, **drainage ditches are being blocked** by the construction of small wooden dams and infilled by natural materials (peat, branches) in order to restore a high water table and support the growth of mire vegetation.

Up till now, about 500 ha of wetlands and mires have been restored. Restoration of the **industrially cut-over peatbog at Soumarský Most** has also been attempted. It involves raising the water table and creating suitable conditions such that the peat will be able to accumulate again. Drainage ditches have been blocked and small depressions that will retain some water have been made. In such depressions, conditions are ideal for wetland vegetation, including the sphagnum moss, to re-establish itself and thus begin the process of mire regeneration.

Mires of Šumava

3

WHY SPHAGNUM MOSSES NEVER DIE?



Which is the moss that never dies?

The spore capsules at the tips of Sphagnum moss
Photo Eva Mikulášková

Some plants have a greater ability for building mires than others. Foremost amongst all of these are the species of **sphagnum moss** - considered to be the **key species** of mires. Many species of *Sphagnum* are perfectly adapted to waterlogged conditions with very little nourishment. In such conditions they develop a high biomass that overwhelms all other organisms. An individual *Sphagnum* plant does not die because it is constantly growing from a bud at the tip of its stem while its lower parts are dying. The layers of dead Sphagnum beneath the living surface slowly accumulate, forming

more compacted layers known as **peat**. A *Sphagnum* plant can retain a huge amount of water in their leaves, thus keeping the mire environment continually wet. Waterlogged conditions and the unattractiveness of sphagnum moss to microbes result in the very slow decomposition rate of their dead bodies, thus the 'empire' of the sphagnum mire is steadily built up.



Mosses of mires

Species of *Sphagnum* mosses differ in their heads.

SHRUBS OF
(*Pinus x-pseudopumilio*)



GROWTH HABIT, BRANCH, CONE



RUSTY BOG-MOSS
(*Sphagnum fuscum*)



FEATHERY BOG-MOSS
(*Sphagnum cuspidatum*)



MAGELLANIC BOG-MOSS
(*Sphagnum magellanicum*)

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WHY THE NAME
'RAISED BOG'?



Raised bogs as extreme habitats

Rokytecká sláň mire
Photo Zdenka Krénová

Perhaps the best-known type of mire is the **raised bog**. Raised bogs are spectacular as their central mass rises above the surrounding ground level - the living Sphagnum carpet steadily grows upwards while the dead remains accumulate and produce deeper and deeper peat deposits below.

Beneath the living surface layer of raised bogs there are often several metres of deep peat deposits that have risen above the local groundwater table. Raised bogs are thus fed only by rainwater; furthermore, water that is

poor in nutrients. Mires typical for Šumava are **mountain raised bogs** with pools, bogs that have developed around mountain springs within the central part of Šumava at an altitude of about 1000 m asl. However, raised bogs are also found in the valleys of larger streams – along the rivers Křemelná and Vltava. These so-called **valley raised bogs** are devoid of pools and are overgrown by dwarf shrubs and stands of bog pine (*Pinus rotundata*).

Plants of bog pools



MUD SEDGE - (*Carex limosa*)



RUNNOCH-RUSH - (*Scheuchzeria palustris*)

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WHAT IS MOST
IMPORTANT FOR MIRES?



Why and how should we protect mires?

Marsh Felwort
Swertia perennis
Photo Eva Mikulášková

Mires play a very important role in the landscape. They support many rare and often endangered species of fauna and flora; many of these species are glacial relicts. Another important role for mires is their participation in the water regime within landscapes. Mires **retain water** in the landscape, help recharge the groundwater table and have a positive **impact on local climate** by contributing to short water cycles and local precipitation.

Mires require a **sufficient supply of water** and any kind of drainage badly affects them. Mires already degraded due to changes in their water

regime can be restored by **blocking old drainage ditches**. Mires can also be disturbed by an increased input of nutrients – so it is important to maintain a **low level of nutrients** in the environment. Eutrophication, i.e. an excessive input of nutrients, for example, from intensive agriculture or urban settlements nearby, needs to be prevented if mires are to be preserved. Intact primary mires should be left to their natural development. The preservation of mire meadows, require continuing management in terms of regular hand mowing, if their biodiversity is to be preserved.

Carnivorous plants of mires



COMMON BUTTERWORT
(*Pinguicula vulgaris*)



ENGLISH SUNDEW
(*Drosera anglica*)



ROUND-LEAVED SUNDEW
(*Drosera rotundifolia*)



LESSER BLADDERWORT
(*Utricularia minor*)

Mires of Šumava

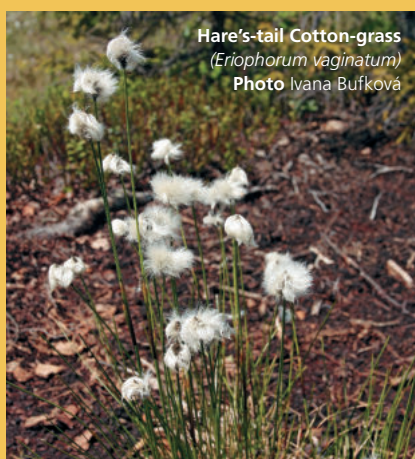
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WHY WAS PEAT EXTRACTED
IN THE PAST?



Jezerní slať mire
Photo Zdenka Křenová

History of peat extraction



Hare's-tail Cotton-grass
(*Eriophorum vaginatum*)
Photo Ivana Bufková

Peat in Šumava was mined from approximately the beginning of the 19th century, with its peak being the end of the 19th century. Peat was used mainly as **fuel** – for heating houses and also partly for glassmaking workshops. Furthermore, peat was used as **bedding** for animals. Peat was dug by hand using a special spade, then cut into blocks (bricks) and stacked in special formations to dry.

The hand-cutting of peat took place mostly close to the villages of Kvilda and Horská Kvilda, Prášíly, Borová Lada, Nové Hutě, and Strážný, or in the valley of the Upper Vltava River. Industrial peat cutting was performed on four sites, though only one of them – Soumarský Most – is located within the boundary of the National Park.

A RAISED BOG SPHAGNUM CARPET WITH DWARF SHRUBS

1. FORK MOSS
Dicranum sp.
2. RUSSOW'S BOG-MOSS
Sphagnum russowii
3. MAGELLANIC BOG-MOSS
Sphagnum magellanicum
4. COMMON HAIRCAP
Polytrichum commune
5. GLITTERING WOOD-MOSS
Hylocomium splendens
6. CRANBERRY
Oxycoccus palustris
7. RED-STEMMED FEATHER-MOSS
Pleurozium schreberi
8. CROWBERRY
Empetrum nigrum
9. NORTHERN BILBERRY
Vaccinium uliginosum
10. BOG ROSEMARY
Andromeda polifolia



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DO ORCHIDS GROW IN PEATY FORESTS?



Spruce mire in the locality Stará jímka
Photo Ivana Bufková



Waterlogged spruce forest Na Ztraceném
Photo Ivana Bufková

Unearthly corners of woodlands on peaty soils

Mires have many forms - some take on the form of a waterlogged forest - some a wet meadow. **Woodlands on peaty soils** also include some **waterlogged spruce forests** and these are probably the most abundant type of mire in Šumava. Often they surround raised bogs but are also widespread in surface depressions and along valley streams.

At first sight colourful carpets catch your eye: sphagnum moss along with other mosses intertwined with dwarf shrubs of bilberries, various grasses such as *Calamagrostis villosa*, sedges and bog cotton (cotton-grass). Spruce growing on the peaty soil are smaller, more twisted and further apart. Dark and moist waterlogged spruce forests with puddles of water and decaying tree trunks evoke memories of a mysterious woodland from a childhood fairy tale.

Spruce stands on peaty soils belong to some of the most stable of upper altitude spruce forest stands in Šumava. The recent bark beetle infestation is less devastating in spruce mires and waterlogged spruce stands; these thus form 'green islands' - stabilising elements - within the declined forest that surround them.

Moist-loving plants in spruce mires



BOTTLE SEDGE
(*Carex rostrata*)



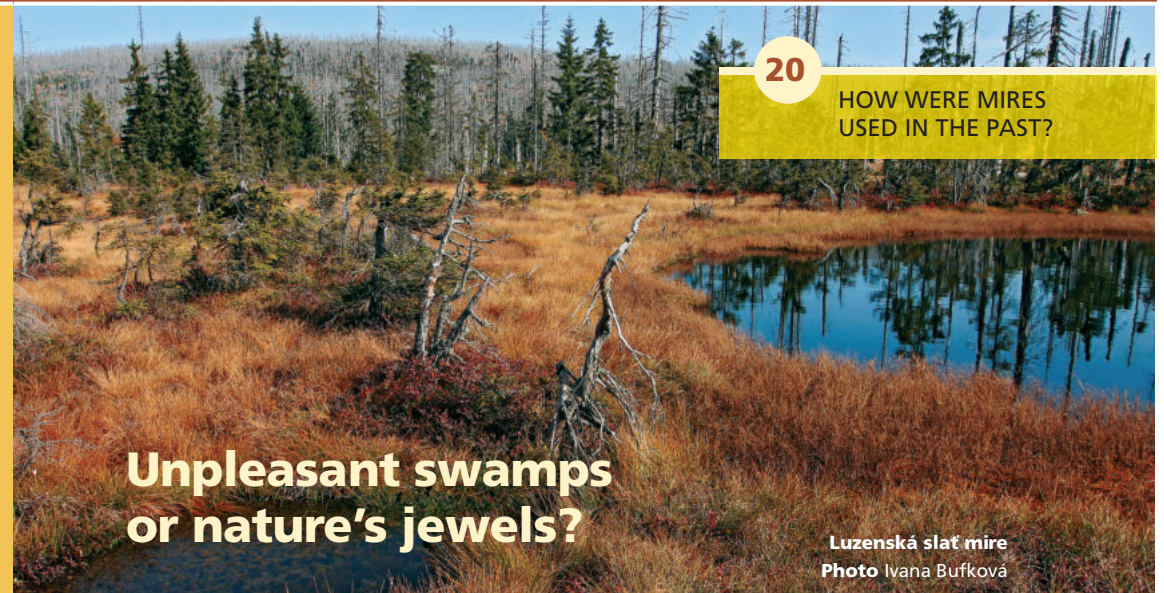
HEART-LEAVED TWAYBLADE
(*Listera cordata*)



STIFF CLUBMOSS
(*Lycopodium annotinum*)

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HOW WERE MIRES USED IN THE PAST?



Unpleasant swamps or nature's jewels?

Luzenská slat mire
Photo Ivana Bufková

Mires have attracted interest since time immemorial. In the early days it was, however, a rather different interest than that shown today. Early settlers considered mires as infertile land, difficult to access and cross, and thus only a further complication to their difficult lives. Much effort was expended in trying to make some use of them - to harvest peat or to use the mires for agriculture or forestry production. Many mires thus suffered some form of drainage, which brought about their degradation. Further degradation would then follow as a result of wood logging, peat extraction, intensive meadow cultivation, intensive grazing or road construction.

The 20th century saw a change in our perception of mires. Nowadays, they are no longer considered purely as objects for utilization; instead, the first efforts to preserve them have occurred. Thus in the 1930s, the first mire nature reserves were declared. Nevertheless, between the 1960s and 1980s, the growing intensification of agriculture and forestry put new pressures on mires, including those in Šumava. The designation of the Šumava National Park in 1991 finally declared that mires are nature's jewels - and stressed their importance in maintaining a functioning water regime within the landscape. The majority of mires have been included in the first zone of the National Park.

Endangered animals of mires

NORTHERN BIRCH MOUSE
(*Sicista betulina*)



BLACK GROUSE
(*Tetrao tetrix*)



Mires of Šumava

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WHICH ARCHIVE CAN BE USED TO RECONSTRUCT HOW NATURE APPEARED A LONG TIME IN THE PAST?

Are we able to understand the ancient testimony of the peat archive?

Peat layers under the mire surface
Photo Ivana Buřková

Mires are interesting not only for their living surface but also for the many secrets they keep deep underneath. The slowly growing peat layers of a mire contain many plant remains, such as pollen grains, from the ancient past of the mire's surroundings. Thanks to its strong outer layer, **pollen** is extremely resistant and can be preserved unchanged in the peat for thousands of years. This is also thanks to the humic acids present in the peat having conservative properties.

The **age of the peat layers** can be determined using **radioactive carbon**. The shape of

the pollen is specific to each species, thus we are able to reveal the vegetation structure of the mire and its surroundings as it once looked in the distant past.

The peat layers serve as a useful archive, similar to chronicles, providing evidence of the past; from the peat archive we can learn about the vegetation composition since the beginning of a peatbog's development. We can thus follow **nature's development** since the **last ice age**.

The science that studies the pollen preserved in peat is called palynology.

The pollen of some trees



NORWAY SPRUCE



ALDER



SPHAGNUM MOSS CARPET WITH VARIOUS PLANTS ON MIRE MEADOWS

- | | |
|--|---|
| 1. COMMON SEDGE
<i>Carex nigra</i> | 8. WARNSTORF'S BOG-MOSS
<i>Sphagnum warnstorffii</i> |
| 2. WESTERN MARSH ORCHID
<i>Dactylorhiza majalis</i> | 9. YELLOW STARRY FEATHER-MOSS
<i>Campylium stellatum</i> |
| 3. CARNATION SEDGE
<i>Carex panicea</i> | 10. RINGLESS HOOK-MOSS
<i>Warnstorfia exannulata</i> |
| 4. COMMON HAIRCAP
<i>Polytrichum commune</i> | 11. POINTED SPEAR-MOSS
<i>Calliergonella cuspidata</i> |
| 5. LOUSEWORT
<i>Pedicularis sylvatica</i> | 12. GREASEWORT
<i>Aneura pinguis</i> |
| 6. COMMON BUTTERWORT
<i>Pinguicula vulgaris</i> | 13. COW-HORN BOG-MOSS
<i>Sphagnum denticulatum</i> |
| 7. RIGID BOG-MOSS
<i>Sphagnum teres</i> | |



Mires of Šumava

Mires of Šumava

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WHAT IS THERE A SHORTAGE OF IN PEATBOGS?



Harsh conditions or who will survive?

Bog pool overgrown by vegetation in the bog Javoří slat
Photo Ivana Bufková

Life in a mire is certainly no holiday. Plants and animals live and reproduce here under extremely harsh conditions. They have to withstand permanent **waterlogging and low temperatures**, as well as **high temperature differences and nutrient shortages**. Plants adapted to life in a mire are usually smaller compared to the vegetation in the immediate surroundings. During evolution, plants in waterlogged conditions have had to learn to **transport oxygen to their roots** awashed in water and in some other way to **obtain nutrients** other than by photosynthesis. Some plants grow in dense tufts to get above the level of permanent water floor-

ding, while others have developed special spongy tissue with air spaces (aerenchym) which allow the diffusion of oxygen through the stems to the roots. The roots of heaths and heathers (the heath family – *Ericaceae*) live in symbiosis with special bacteria that are able to fix air nitrogen and thus improve poor soil nutrition for plant growth. Another adaptation - this time to withstand the competition for space with the constantly expanding Sphagnum - is the trailing character of, for example, the cranberry (*Oxycoccus palustris*). Its trailing character enables the plant to grow through the dense carpet of *Sphagnum*.

Cotton-grasses



COMMON COTTON-GRASS (*Eriophorum angustifolium*)



TUFTED BULRUSH, DEERGRASS (*Trichophorum cespitosum*)



HARE'S-TAIL COTTON-GRASS (*Eriophorum vaginatum*)

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WHY DO LIZARDS NOT LAY THEIR EGGS IN MIRES?



Can we find large animals in Šumava mires?

Black grouse *Tetrao tetrix*
Photo Josef Hlásek

Large animals that can be considered as being confined only to mires are not found in the Šumava Mts. We can meet some vertebrate species in mire habitats, of course, but all of them are usually able to live also outside mires. For example, on the sphagnum moss carpet we can spot the viviparous or common lizard (*Zootoca vivipara*). The name of this species is derived from its ability to give birth to live young, an adaptation to a cool climate. Often also found in mires is the adder (*Vipera berus*) – a species that enjoys humidity as well as basking in the sun on the open surface of mires. Among bird species we can sight in mires are

black grouses (*Tetrao tetrix*). These gallinaceous birds can find here both enough proper food and shelters from predators. Another birds, inconspicuous meadow pipits (*Anthus pratensis*), usually catch small flying insects in mires, especially craneflies. Bog margins and its surroundings are often resorted by large and majestic capercaillies (*Tetrao urogallus*). Quite rare small mammal, northern birch mouse (*Sicista betulina*), is also living in surrounding of peat bogs and on mire meadows.



Males of black grouse mating



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WHICH PREDATORS INHABIT THE WATERS OF BOG POOLS?



Rokytecké slatě mire
Photo Alois Pavlíčko

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WHY DO SUNDEWS FEED ON INSECTS?



Why do carnivorous plants like mires?

Common sundew
(*Drosera rotundifolia*)
Photo Marek Drha

Who is lurking in the dark waters of mire lakes?

The dark waters of peaty pools and lakes look at first sight devoid of life. However, if we look closer we can detect the movements of small creatures that inhabit these pools. For example, we can find here 'boat-shaped' water bugs of the genus *Notonecta*, called backswimmers, and *Corixa* that feed on small aquatic animals. Another interesting creature is the predatory fly *Hydrophorus signiferus* that can be seen quickly running on the water surface and is observed mostly in autumn. In pools also live the larvae of cold-loving northern

mosquitoes of the genus *Aedes* and *Theobaldia*. They often fall prey to the larvae (nymphs) of dragonflies and damselflies that both belong to the most fearsome predators of these pools and lakes. Pools even hide much tinier organisms that are invisible to the human eye. These are, for instance, the microscopic algae of *Desmidiaceae*, which gained their name thanks to the most remarkable variable shape of their bodies.



Plant carnivory is another excellent adaptation to the lack of nutrients. Amongst the best-known carnivorous plants of mires are **sundews**. Their leaves are covered with long sticky hairs (tentacles) which curve inwards to trap unwary insects. At the end of each hair is a drop of nectar-like glue, red in colour, that glitters in the sun, such that the leaves look like small jewels. When an insect is captured, the shorter tentacles towards the base of the leaf secrete enzymes to dissolve and digest the insect. Another carnivorous species is the **common butterwort** (*Pinguicula vulgaris*). Its succu-

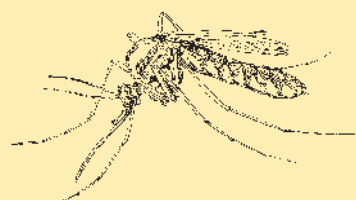
lent bright green leaves, all in a rosette against the ground, take in nutrients and moisture from the ground through the lower side of their leaves. The glandular upper surface of the leaves secrete a mucilage on which insects are trapped. Less known amongst the carnivorous plants are **bladderworts**. They can be found on mires in small puddles of water, where they trap exiguous both aquatic and soil invertebrates into a specialised bladder. On Šumava mires there rarely occurs an endangered species: lesser bladderwort (*Utricularia minor*).

Mosquitoes of mires

Leaf of the sundew catching a fly



MOSQUITO OF THE GENUS *Aedes* AND ITS LARVA



MOSQUITO OF THE GENUS *THEOBALDIA*



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WHICH PLANTS INDICATE WET SITES?



Bog rosemary
Andromeda polifolia
Photo Ivana Bufková



Northern bilberry
(Vaccinium uliginosum)
Photo Ivana Bufková



Rannoch rush
(Scheuchzeria palustris)
Photo Ivana Bufková

Plants of mires



STAR SEDGE
(Carex echinata)



BOG SEDGE
(Carex paupercula)



COMMON HEATHER
(Calluna vulgaris)

What other plants can we find in mires?

The plants best adapted to the harsh conditions of mires are typically members of the sedge and heath families. Wet and waterlogged parts of mires are occupied by plants of the sedge family – sedges, club-rushes and cotton-grasses. The bog pools are regularly inhabited by mud sedge (*Carex limosa*) or rannoch rush (*Scheuchzeria palustris*). Moist flat lawns are home to deergrass (*Trichophorum cespitosum*); the hummocks are host to hare's-tail cotton-grass (*Eriophorum vaginatum*). On sedge peaty meadows we often find bottle sedge (*Carex rostrata*) and star sedge (*Carex echinata*).

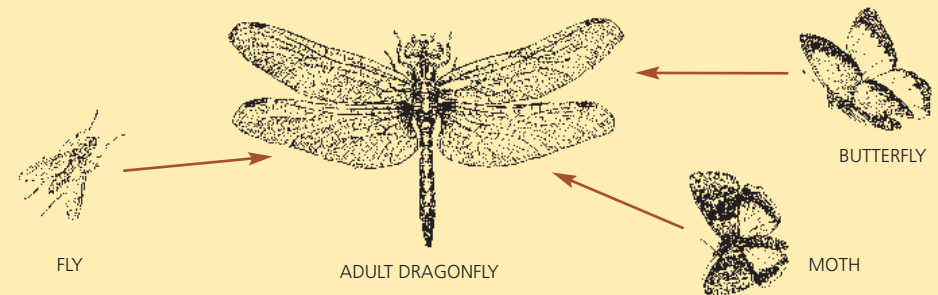
Plants of the **heath family**, by contrast, prefer drier sites. Common on raised bogs is northern bilberry (*Vaccinium uliginosum*), while on wetter Sphagnum moss carpet can be also found cranberry (*Oxycoccus palustris*) or bog rosemary (*Andromeda polifolia*). Less common is black crowberry (*Empetrum nigrum*). Very rare, occurring only on one site in Šumava, is cross-leaved heath (*Erica tetralix*). The well-known common heather (*Calluna vulgaris*) occurs mainly on valley-raised bogs or on mires where the water regime has in some way been modified. Nevertheless, it also occurs frequently on dry sites away from mires.

Why are moths active in mires even in daylight?

In the cold environment of mires where the night temperatures may fall below zero even in summer, many invertebrates try to warm up in the sun. Butterflies warming up in the sun would not surprise anyone, but in mires even moths adopt a similar lifestyle, though usually considered as creatures of the night. Hence, in Šumava mires, you can observe moth species, such as rosy marsh moth (*Coenophylla subrosea*), *Xestia rhaetica* or light knot grass (*Acronicta menyanthidis*), even during the daytime. The daytime activity of moths is also common in the harsh and cold climates of northern Europe or in high mountains. It is another example of the adaptation of small creatures to the inhospitable conditions in mires.

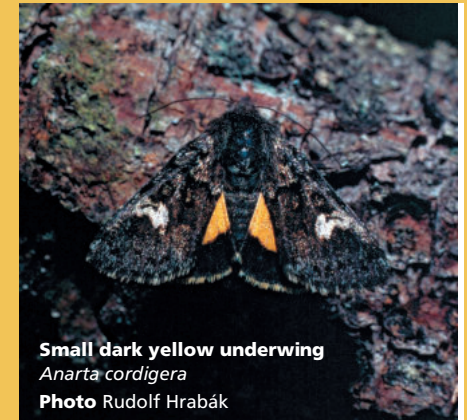


Food of an adult dragonfly



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ARE MOTHS SEEN ON MIRES DURING THE DAYTIME?



Small dark yellow underwing
Anarta cordigera
Photo Rudolf Hrabák



Moth
Xestia rhaetica
Photo Rudolf Hrabák

BUTTERFLY

MOTH

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ARE DRAGONFLIES PREDATORS OR HERBIVORES?



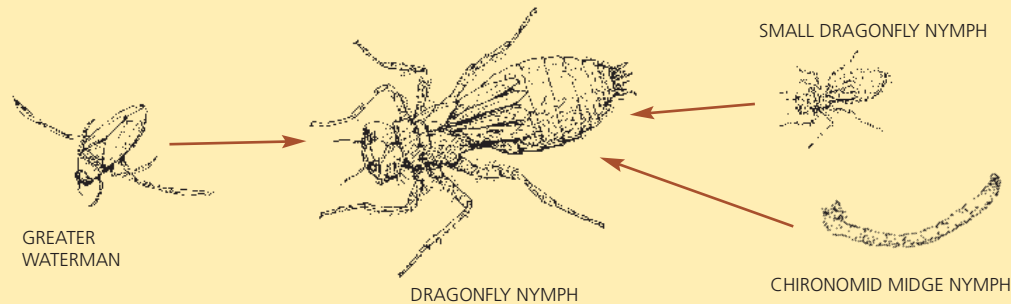
Dragonfly of the genus *Leucorhinia* sp.
Photo Ivana Buřková

Flying jewels

Whilst 'creepy-crawlies' are mostly inconspicuous and often left unnoticed, flying insects often attract our attention. Amongst the flying insects of mires are found some real jewels. Most striking are many **butterflies**, amongst the most common being, for example, the moorland clouded yellow (*Colias palaeno*) or cranberry fritillary (*Boloria aquilonaris*). Equally attractive are the glittering **dragonflies and damselflies**; the rustling of their wings as they swoop menacingly about can

often be heard near mire pools. Adult dragonflies capture their prey in the air and are able to take on even a careless butterfly. Equally rapacious are their carnivorous nymphs that feed in the mire pools. Frequently observed in mires are the dragonflies **sub-arctic hawker** *Aeshna subarctica*, **azure hawker** *Aeshna caerulea* and **alpine emerald** *Somatochlora alpestris*. All three species live exclusively in mires and mainly in mountain raised bogs.

Prey of a dragonfly nymph

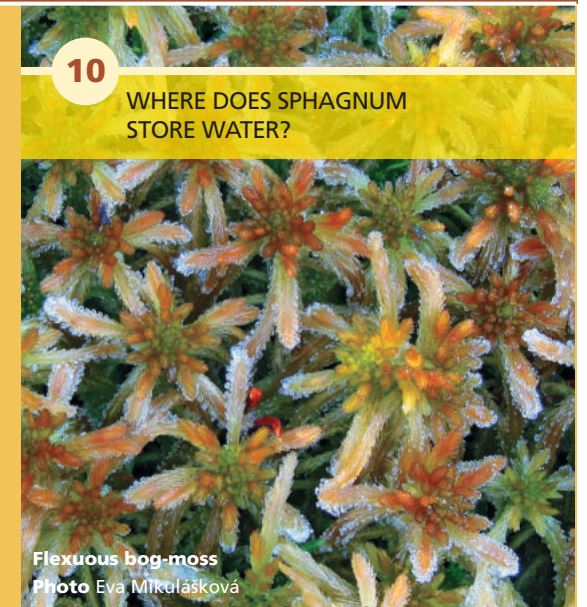


When crawling on knees is necessary

Mosses are the most abundant type of plants on mires. Perfectly **adapted to the harsh conditions**, a high number of species also occur here too. Harsh conditions such as permanent water-logging, but also drying-out of mire surfaces in summer, summer overheating and winter frosts, and sudden changes in temperatures, all these put a stress on the plants and require specific adaptations. The **ever-green stems** of mosses grow all year round, protecting themselves from the changing conditions by the various pigments in their cells, changing colours from yellow to red and black. Mosses are **not able to actively control the water content** in their cells. Nevertheless, they have developed a strategy of **keeping large quantities of water** amongst their stems. Forming dense mats, water rises due to capillary forces and is retained between the leaves, main stems and their side branches. The cells of mosses are also able to survive being completely dried-out. **Sphagnum mosses** have one further adaptation: each leaf contains two types of cells – small green ones that maintain photosynthesis and large empty cells that serve as mini water reservoirs. In this way they can store huge quantities of water.

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WHERE DOES SPHAGNUM STORE WATER?



Flexuous bog-moss
Photo Eva Mikulášková

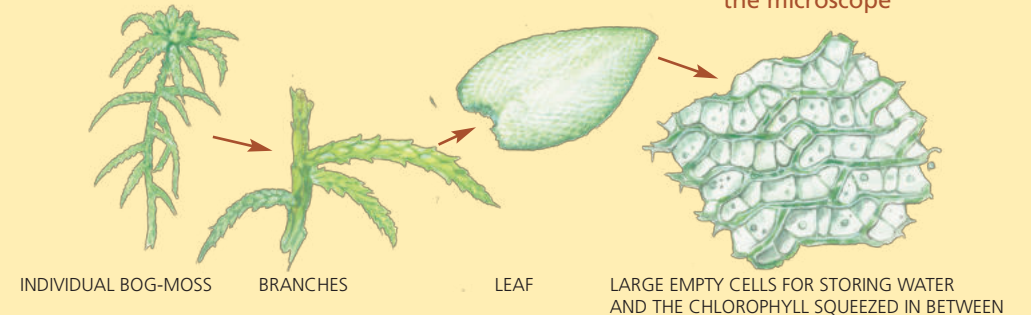


Russow's bog-moss
Photo Eva Mikulášková



Feathery bog-moss
Photo Eva Mikulášková

Sphagnum moss under the microscope



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HOW WOULD YOU DEFINE A HUMMOCK AND A HOLLOW?

Every moss has its niche or - why the mire surface is rugged.

Diverse surface of a mire
Photo Alois Pavlíčko

The actual topography of the mire surface is highly important for mosses. On an undulating, 'bumpy' surface, for example, we can find different habitats that suit different species. **Hummocks** ('bumps') are drier than their surroundings and thus suitable for the growth of *Sphagnum rubellum*, rusty bog-moss (*Sphagnum fuscum*), along with strict haircap (*Polytrichum strictum*). These species have slower decomposition rates than others and as a result form 'hillocks' – the hummocks. By contrast, the little depressions (**hollows**) and small pools in between are inhabited by feathery bog-moss (*Sphagnum cuspidatum*). This species does not need a firm ground and can create extensive mats providing it has enough light. In winter it freezes along with the water in the ice. Flat areas

in between hummocks and hollows are overgrown by flexuous bog-moss (*Sphagnum flexuosum*), along with the black liverwort inflated notchwort (*Gymnocolea inflata*). **On less-acid, peaty meadows, richer in nutrients**, grow many sensitive and endangered moss species. Unfortunately for these rare mosses, the equilibrium or dynamic stability of these sites can be easily disturbed. Should drainage, the input of nutrients, or the absence of mowing occur, then they are gradually outcompeted by other more aggressive species.

- | | |
|--|---|
| 1. FEATHERY BOG-MOSS
<i>Sphagnum cuspidatum</i> | 8. SPHAGNUM MOSS
<i>Sphagnum rubellum</i> |
| 2. FLOATING HOOK-MOSS
<i>Wamstoria fluitans</i> | 9. RUSTY BOG-MOSS
<i>Sphagnum fuscum</i> |
| 3. DEERGRASS
<i>Trichophorum caespitosum</i> | 10. FORK-MOSS
<i>Dicranum sp.</i> |
| 4. INFLATED NOTCHWORT
<i>Gymnocolea inflata</i> | 11. RED-STEMMED FEATHER-MOSS
<i>Pleurozium schreberi</i> |
| 5. MAGELLANIC BOG-MOSS
<i>Sphagnum magellanicum</i> | 12. GLITTERING WOOD-MOSS
<i>Hylocomium splendens</i> |
| 6. ANOMALOUS FLAPWORT
<i>Mylia anomala</i> | |
| 7. STRICT HAIRCAP
<i>Polytrichum strictum</i> | |



Hunters inconspicuous in a jungle of mosses

Amongst the permanent inhabitants of mires are also several small **invertebrate predators**. And amongst these is one of the most important and well-known beetles of mires – the **ground beetle *Carabus menetriesii***. As with other species of beetles that inhabit mires, this is also a cold-loving species. Thus it hunts mainly during the night and hibernates during the warmest summer months. It feeds on worms, snails, insect larvae and spiders. During the winter time the adult beetles stay deep in the *Sphagnum* carpet and hibernate. Šumava mires also host some smaller ground beetles, such as some from the *Carabus* genus, the most striking amongst these being ***Agonum ericeti***, found on sunny sites of open mires. Among the much-feared 'hunters' of mires are several species of **spiders**, such as ***Pardosa sphagnicola*** or ***Arctosa alpigena***. Spiders of the family *Pisauridae* hunt near water, sometimes even on the water surface itself.

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HOW DO GROUND BEETLES SPEND THEIR WINTER?

Ground beetle
Carabus menetriesii



Spider
Pardosa sphagnicola

Development of a parasitic fly of the genus *Apanteles*



CATERPILLAR OF A MOORLAND – APANTELES LAYING EGGS – APANTELES LARVAE EATING THE CATERPILLAR – ADULT APANTELES CLOUDED YELLOW

HAND-CUTTING OF PEAT IN THE 19TH CENTURY



Trailer for peat transport

FLOWERS OF TYPICAL BOG DWARF SHRUBS



NORTHERN BILLBERRY



BOG ROSEMARY



CROWBERRY



CRANBERRY

PLANTS OF INTACT MIRES

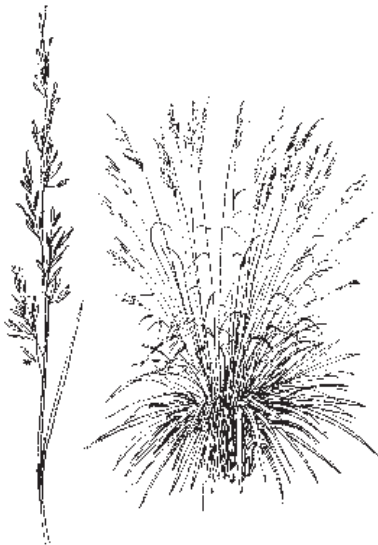


BOGBEAN
(*Menyanthes trifoliata*)



MUD SEDGE
(*Carex limosa*)

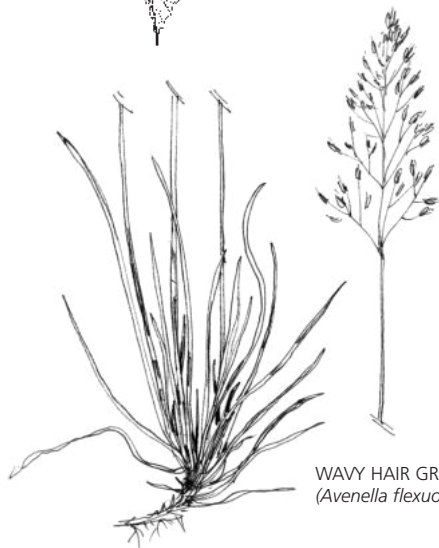
PLANTS OF DRAINED MIRES



PURPLE MOOR GRASS
(*Molinia caerulea*)



BIRCH
(*Betula pubescens*)



WAVY HAIR GRASS
(*Avenella flexuosa*)

FLOWERS OF DWARF SHRUBS



COWBERRY



BILBERRY