NATIONAL ECOLOGICAL NETWORK HUNGARY

MIRES

NATIONAL ECOLOGICAL NETWORK NO. 3.

Preface

Mires had been used as shelter and natural defense or pitfalls for enemies. Nowadays people consider them as 'free areas' for investments e.g. creating future golf courses, shopping centers and hotels that are cheap to buy and can be sold later for extra profit. They are the mires… these particularly diverse, sensitive and therefore threatened wetland types everywhere in the world of whose only remnants (!) can be conserved in Hungary even if we know that this is a delicate issue. During consultation process in compilation of the text of Act on Nature Conservation, there had been many substantial and fairly interesting debates between experts how to define biogeographically mires understandable but at least in an acceptable manner to those responsible for wording the text of the Act. How can one name the differences clearly visible for scientific field between mires and marshes without having endless polemics with lawyers? Furthermore what are those peculiar characteristics that verify this distinguished attention?

According to the competent international scientific literature, one percent of the the World's surface is covered by mires. This figure is roughly the same that characterized coverage of mires in Hungary before water regulation (1,1%). What is the situation today in Europe and particularly in Hungary? Official nature conservation staff in Hungary – as a part of their activity of making inventories – have listed all mires and saline ponds of the country. The three-year long project resulted in unexpected sometimes even dramatic in a sense exciting data. This booklet provides basic conclusions and results of the survey.

The extent of European mires of has shrunk from its estimated 495 000 square km to the present 187 000 square km within a few decades. This means about 62% loss of this habitat. Unfortunately Hungary would win this 'competition'… The loss of mires is over than an estimated 97% in our country! As for paragraph 2 in Article 23 of Act on Nature Conservation, by virtue of the law, all mires are nationally protected in Hungary. This so-called ex lege protected status of mires is destined to provide enhanced protection for the existing fragments of mires and accompanied communities that are of outstanding value not only in biodiversity but also in historical, geographical, biogeographical regard. It is also in practice at international level that natural values, areas of exceptional value are given protection by virtue of law.

About one third of Hungarian mires are located already in protected areas: in national parks, landscape protection areas, nature reserves or locally protected areas designated by municipals. Thanks for the territorial protection, they still exist.

Considering the rapid and annoying loss of them, a new approach should have been chosen for conservation of mires that are small sized and in many times difficult to recognize. As a new and important instrument, the legislation had to be modified. Where it is possible, the next step is to restore former mires (Molinia meadows) or that had been degraded or whose water supply had been damaged.

There are altogether 13 different types of mires in Annex I of Habitat Directive (92/43/EEC) of the European Union that came into force in 1992 in countries of EU. All of them are core areas of the of EU's ecological network, namely Natura 2000 network.

The National Ecological Network series – published by the Authority for Nature Conservation of the Ministry of Environment and Water – aims at to show those natural or near natural habitats of great value in Hungary that are on the same time integral elements of the National Ecological Network. We would like more people to feel that nature cannot be over-used and unreasonable exploitation can have serious consequences later. The well known slogan of 'nature inherited from our fathers should be conserved for our grand children' is even seriously timely: damage on nature threatens our generations! If one doubts it, let him follow the story of mires…

In hilly Gömör Mohos is not a high peak,
There is no old castle on it, no noble games,
But an indigo blue mire on top with tussock,
That is my story is about.

(Mihály Tompa: Mohos)

Where did Istók Hany live?

There is no doubt that among other mystic phenomena like ignis fatuus, Istók Hany is a fairly famous legend of a mire-dwelling living creature, but there are many other well-known stories e.g. Zömök of Bereg. One thing is common in these stories passed on by oral tradition that they are all related to the specific habitats of mires. When one hear about mires, a ghost of mire may come to mind. Mires were always well-known to local people since there were several livings provided by these wetlands (e.g. different gatherers of mire dweller species). Mires not only provided subsistence but also their inaccessible world meant a safe shelter for communities escaped from enemies to islands in mires. Nowadays as an opposite situation, the population should conserve these areas from itself and from the general tendency of loss of habitats. But before going into details, let us explore what the term of 'mire' means?

Mires are defined scientifically. As long as mires have been known to human, their scientific studies have been in place. Although scientists have been familiar with the formation of mires and the specific flora or fauna of them comprehensive studies of them have just started in the 20th century. Initially geographers, botanists, zoologists started to investigate them.

Obviously there are as many definitions for mires as many aspects they have. It can be concluded in general that mires differ from other wetland types because of having peat formation. During this process structure of plant material is kept and it do not decompose in them. Peat formation is a fundamental characteristic of mires that can only take place in waterlogged conditions without oxygen present. The first step in coal development is peat formation. It is clear from above that in development of mires plant communities play an important role, therefore it is worth citing words of Ádám Boros about mires: 'Plant communities generating peat are called mires. Mires consequently plant associations and peat layer formed by plants underneath'.

It is important to distinguish between mires and marshes. One can read or heard mires and marsh as synonyms, however, there is no peat formation in marshes. Marshes and mires are therefore different and marshes can regularly dry up, decomposing plant detritus gathered. Water level in mires may hardly fluctuates. This is vital for creating waterlogged condition in order to make peat formation possible. Accumulation of organic material consequently can be observed in mires and in their soil types. Besides other fairly exciting facts (e.g. living creatures, romantic scenario of legends etc) it is already an interesting one in their development.

Mire types and their development

Definition of mires is not as clear in nature as above. It is the case especially when a site should be determined whether it is mire or marsh. In many cases only expert can judge on them. Unfortunately there are just a few clearly identifiable 'living' mires in Hungary, but there are several regulated, exploited, transformed, degraded, filled up mires or dried up fragments of mires of whose definition is fairly difficult.

Death is also part of the life cycle of mires as creation of them. In the initial stage of their development, when the mire bed is young with no sediments in it, accumulation of peat layer is a predominant process. Mires are flourishing in this phase till peat formation reaches its limits.

A delicate balance is maintained then between accumulation and decomposition of peat layer, influenced by water level of mires. Having a spongy structure, peat can absorb a quite large amount of water and can flexibly follow subtle fluctuation of water level as it can swell or shrink based

on water quantity. Permanent lack of water terminates peat formation. Drying up also means loss of peat. If this process become permanent, decomposition and chemical transformation starts with intense soil formation. The mire starts to deteriorate. Of course, the ecosystem of mires is also subject for change: plants strictly associated to water are replaced by other communities preferring drier environment.

After this short introduction, the types of mires are presented, how they are formed, what are the factors indispensable for their development.

Science of mires can be considered as a discipline between geology, geography, hidrology and botany, therefore mires can be classified according to their locations, morphology, vegetation, peat quality, structure, age, water supply and characteristics of soils. Based of these criteria, mires of the Carpathian Basin can be classified. Mires are associated to ponds (basins), rivers (oxbows, meanders), low, undulating surfaces (riverine plains) landslide areas of hilly and mountainous areas in Hungary. Their water supply is provided by soil water, stagnant water or infiltration. They produce sedge, reed furthermore moss and Sphagnum moss peat. They can be floating islands, rich fens, raised bogs, swamp woodlands or flushes. Based on characteristic of peat layer they can be calciferous, ferrous, acidic, neutral or alkaline. International literature divides mires into to groups based on morphology: lowland mires (this is characteristic for Hungary) and raised mires. And finally there are transitional and flushes.

Generally, raised bogs are considered to be as 'true mires'. This type provides the most specific characteristics of these habitats. Unfortunately this is the rarest of the many types in Hungary.

Mires are often classified according to their vegetation. It is however a rather difficult task with many potential pitfalls since there are examples for mire vegetations with no detectable peat formation. Another difficulty of it is that in cases of mires degraded or transformed up to certain extent that are sometimes secondary mires, identification of the mire is extremely difficult. In the following section vegetation types of mires are presented including those types having an ability for peat formation.

The first type is the reedbeds. They are fairly common everywhere in flowing or stagnant water. Reed (*Phragmites australis*) has strong creeping roots filled with lots of air called rhizomes. They can develop even on the surface of the water level. In addition, reed is able to make roots from every node reclining on ground, therefore there are frequently loose reed communities at the edges of reedbeds. Later gradually thicker and thicker floating sward is developed. Subsequently a net is formed from the rhizomes and other parts of reed enabling

absorbing plant detritus. On this surface other plant species can survive e.g. Cyperus Sedge (*Carex pseudocyperus*) and Marsh Fen (*Thelypteris palustris*). As peat formation proceeds, the floating sward becomes floating island on which later shrubs and trees can settle. Not only can floating islands develop in reedbeds but also in Bullrush (*Typhetum angustifoliae*) or other (*Glycerietum maximae)* communities.

Another type of mire vegetations is the tall sedge community composed of taller sedge species. After having reached a certain extent of sedimentation of the freshwater bodies, they are formed naturally, often along the edges of reedbeds. A more or less permanent water level (created by high winter water level) is inevitable in their development. The medium-tall vegetation type can be tussock-like or blanket-like. The previous is formed in a nutrient-rich environment that has more permanent water level. The predominant species of this spectacular habitat are Tufted Sedge *(Carex elata),* Fibrous Tussock Sedge *(Carex appropinquata)* and Greater Tussock Sedge *(Carex paniculata).* Among tussocks, dark brown colored open water patches can be seen that host another rare aquatic plant species. like Least Bur-reed (*Sparganium minimum*) and Bogbean (*Menyanthes trifoliata*). Soils of blanket like tall sedge community are more unpredictable in terms of water supply. When they are together with tussocks, they are restricted to its marginal zone. As predominant species, Lesser Pond

Photo 1: Floating island at Vaja with Thelypteris palustris

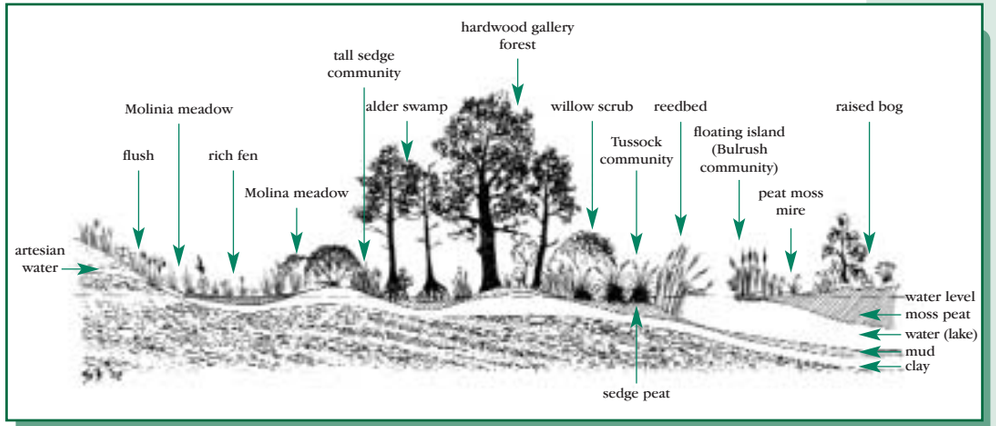

Figure 1: Mire types and their occurrences in a schematic figure

Sedge *(Carex acutiformis),* Bladder Sedge *(C. vesicaria),* Brown Sedge *(C. disticha)* and *C. gracilis* should be mentioned. Special attention should be given to the latter one since secondarily it occupies those mire habitats that are drying up. Also populations of *C. marsicus* should be taken into account as they form communities that are fairly similar in appearance to tall sedge meadows.

Smaller sedge and Cypressus species form lowland peat moss mires and communities of open water patches among tussocks. They are generally characterized by highly-developed moss layer, forming an intact moss cover. Their habitat has permanent water level and nutrient-poor environment. The most representative of them is peat moss mires with the predominant Sphagnum species.

Principally they are glacial relicts therefore quite vulnerable. The majority of them were damaged in Hungary because of large scale water regulation measures. Characteristic species are Common Sedge *(Carex nigra),* Slender Sedge *(C. lasiocarpa),* Bottle Sedge *(C. rostrata)* or Star Sedge *(C. echinata).* Among others, Common Cottongrass

Photo 2: Tussock sedge communities in Danube-Tisza Intersection

Photo 3: Tufted sedge carpet

(*Eriophorum angustifolium*) is often seen here. Raised bogs that are typical in the boreal life zone, are special type of them. Nevertheless they occur in mountainous, hilly and even in lower elevations. Raised bogs are characterized by thick Sphagnum moss layer that raises over the surrounding area with peat material. Even 'peat moss tussocks' can be observed in them. It is a rich habitat in rare and characteristic plant species like Round-leaved Sundew (*Drosera rotundifolia*) hat ensnare insects by sticky leaves, the small Cranberry (*Vaccinium oxycoccos*) and Hare's tail

Photo 4: Raised bog of Bereg with Cottongrass species

Photo 5: Peat moss, the denominator species of raised bogs

Cottongrass (*Eriophorum vaginatum*). These are all typical species in the boreal region, but in Hungary they are glacial relict species.

Calcareous rich fens occur on meadow-mire soils rich in Calcium ions. This type is usually wet in the beginning of vegetation period and they occur mainly in lowlands and at the feet of hills. There is no doubt that they are the most beautiful mires and the majority of mire dweller plant species are restricted to this type. There are smaller of medium sized Sedge species like Large Yellow Sedge (*C. davalliana*), *C. flava* and

Photo 6: Rounded leaved Sundew with its insect digester sticky leaves

Photo 7: The Bog Rosemary is a rare species of raised bogs

C. hostiana forming basically the sward of this type. Besides these, the peculiar Black Bog-rush (*Schoenus nigricans*), or *Sesleria uliginosa* blooming in spring should be also mentioned. The dark green color of it is decorated by carpets of different flowers including rare orchids, moreover Marsh Gentian, Lilium and Dianthus species. As a species of outstanding nature conservation value, the Birdseye Primrose (*Primula farinosa*), a strictly protected relict species of calcareous rich fens should be mentioned. The species is part of the logo of Balaton Uplands National Park.

In the following vegetation types of 'mires' are described where no peat

Photo 8: Hare's tail Cottongrass

Photo 9: Rich fen with dozens of Orchids in Danube-Tisza Interfluvial

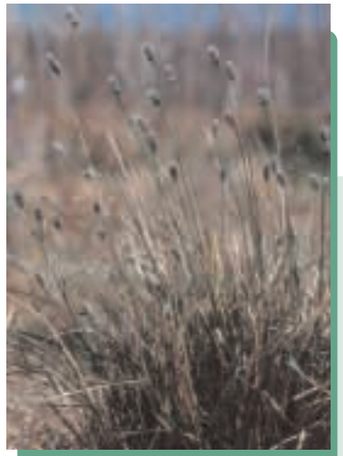

Photo 10: Sesleria uliginosa is a rare species of our mires

formation is associated with their development. This can be explained with characteristics of water supply. Flushes – as this name tells us – are fed by clean and cold water of springs coming through the structure of the mire whilst water becomes saturated with oxygen. As peat formation needs conditions without oxygen, no 'classic' peat layer can be observed in majority of this type. They are frequently small and extremely vulnerable. They occur in hilly areas rich in springs, associated to woodland vegetation, sedge communities or tall herb communities. Typical species of them include Wood Club-rush *(Scirpus sylvaticus),* Cottongrass species *(Eriophorum ssp.),* Large Bitter-crest *(Cardamine amara),* Alternate-leaved Golden-saxifrage *(Chrysospermium alternifolium).* Below the loose sward vegetation, an intact and dense moss layer covers the ground.

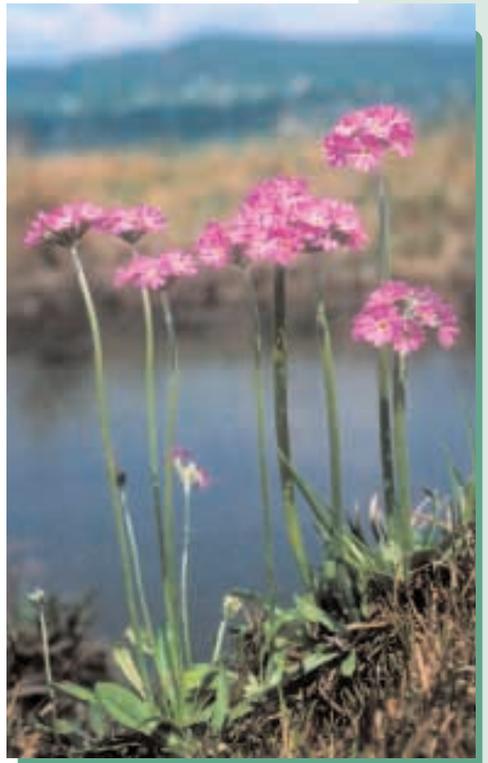

Photo 11: The Birdseye Primrose is the rarest among Hungarian Primroses

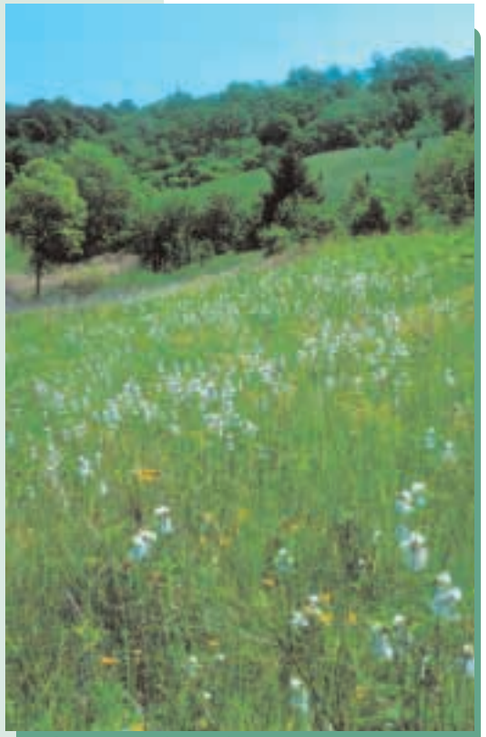

Photo 12: Flushes with Cottongrass in Heves-Borsod Hills

It is certainly worth to describe the hidden aquatic vegetation in brown colored open water bodies called 'semlyék' of mires. First of all those 'predator' plant species should be mentioned that digest. They are Lesser Bladderwort *(Utricularia minor), Utricularia bremii* and *Aldrovanda vesiculosa*. Due to their rareness, communities of them are also fairly rare and have limited extent in Hungary.

Finally wooded mires called as swamps should also be mentioned that have wooded upper layer in their structure. This group consists of swamp woodlands and willow scrubs. For wooded vegetations, conditions provided by mires are usually not appropriate since they are not able to keep pace with the development of the mire. Therefore trees often invade this habitat in final stages of its development. It is slightly different in willow scrubs that can survive larger water level changes due to their additional roots. Swamps are basically taller high forests, characterized by trees having 'feet' formed by wide net of supporting roots at their base. These are examples for adaptation to the changing water level. This thick base always provides wet conditions for bark and detritus

Photo 13: Eriphorum latifolium

Photo 14: Aldrovanda vesiculosa is one of the insect trapper and digester species of Hungary

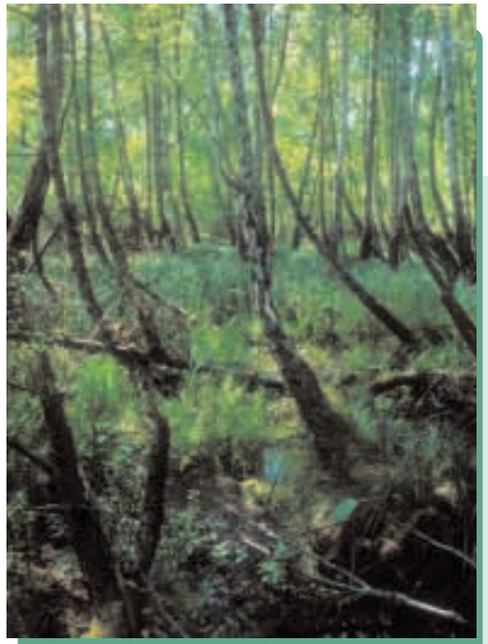

Photo 15: Birch swamp in Nyírség

dweller species. In Hungarian swamps, alder (*Alnus glutinosa*) forms mixed communities with Narrow-leaved Ash (*Fraxinus angustifolia ssp. hungarica*) and another ash (*Fraxinus excelsior*) species. The previous is typical in swamps of Great Plain, the latter in mountainous areas. The dark water under the canopy host aquatic species. One of the most attractive ones is Water Violet (*Hottonia palustris*) that often creates pink colored carpet in the undergrowths. On the feet of trees ferns live like Marsh Fen (*Thelypteris palustris*), Narrow Buckler-fen (*Dryopteris carthusiana*), furthermore other species like Elongated Sedge *(Carex elongate)*. After alder swamp community, gallery forest is formed during succession, if water level drops.

Willow and poplar scrubs are created at the edges of mire ponds, rarely in floating surface, or by reforestation of lowland or peat moss mires. Willow scrub species like Grey Willow (*Salix cinerea*) creating semicircular patches are usually in mosaic pattern with remnants of Molinia meadows and tussocks. Even denser vegetation of them can also be formed where shorter tree species can settle. In birch mire woodlands even high forests composed of lower trees is formed. Besides Grey Willow, Eared Willow (*Salix aurita*) and Bay Willow (*Salix pentandra*) can also be

Photo 16: Marsh Fen is a typical fern in mires

mentioned. Among trees, birch should be mentioned. In the sward layer, a characteristic species, the *Calamagrostris canescens* may also be mentioned that can settle on tussocks or form tussocks themselves. Also light green Cyperus Sedge *(Carex pseudocyperus)* and Marsh Fen are typical species. In acid moss layer poor in Calcium, Sphagnum species can be predominant. A rare relict species of floating islands or mires with proper water supply is Marsh Cinquefoil *(Comarum palustre)*. Another rare species are Globeflower (*Trollius europeaus*), or Ligularia sibirica, a formerly extinct and re-introduced species. Finally Molinia meadows are described. They are discussed in the end since they can not be considered as 'living mires' without peat formation and with a process in which decomposition of peat is predominant in their drying-up soil. Nevertheless they should also be conserved because on one hand they frequently occupy dry marginal zones around mires and on the other hand they host internationally threatened or relict species of Hungary. As their names define, they are grasslands in the same time often predominated by Purple Moor-grass *(Molinia coerulea agg.),* Carnation Sedge *(Carex panicea)* and Glaucous Sedge *(Carex flacca)*. In their flowery swards there are many orchid species, but obviously the species of outstanding nature conservation value include Marsh Gentian *(Gentiana pneumonanthe), Allium suavolens, Gladiolus palustris* or the poisonous large White Hellebore *(Veratrum album)*. The list of important plant species can be even longer covering many pages.

In meeting zones of Molinia meadows,

Photo 17: Willow scrubs have peculiar appearance because of spheroid bushes of Grey Willow

Photo 18: Bay Willow is a rarity of willow scrubs and birch swamps

Photo 19: Comarum palustre is a plant species of willow scrubs and open water communities of raised bogs

Photo 20: Globe Flower is an alpine rarity of Hungarian rich fens

Photo 21: Ligularia sibirica has became extinct from Hungary

Photo 22: Molinia meadows with Hemerocallis lilo-asphodelus at Bakonyalja

Photo 23: Loose-flowered Orchid

swamps, willow scrubs and gallery forests there is a narrow edge, where tall grass communities occur, from whose strong tall stems they can be identified even in winter. In this vegetation type Meadowsweet (*Filipendula ulmaria*) can form even 2 m tall communities. There are many typical marshland species besides Crane's-bill (*Geranium palustre*) in this plant association e.g. the large protected Siberian Iris (*Iris sibirica*).

It is clear from above that mires have fairly diverse vegetation. In addition different types can be very close to each other forming a mosaic pattern, enriching the ecosystems of these habitats.

Photo 24: Marsh Gentian is an autumn flower in rich fens

Photo 25: Horned Ophrys is one of the most beautiful orchids imitating insects

Photo 26: Tall Grass communities along Ipoly valley

Photo 27: A poisonous species of rich fens is the large White False Helleborine

Photo 28: Unique pattern of outer petals makes Siberian Iris exotic

Dogfish, Root Vole and their fellows

Fauna of Hungarian mires are not as well known as flora of them at all. Animals of mires always have special requirements to the environment since they are restricted to the characteristic, cool and wet microclimate of this habitat type. Sometimes their host plant or prey species live in mires.

Many of them are considered as glacial relict species. After the glacial period, movements in the fauna of Hungarian mires were slightly different than those of in large vegetation zones of the Carpathian Basin. Isolated in cooler mires, species preferring cooler could survive the warming up climate of the area. The majority of them are invertebrates. Examples for them may include *Leucorrhina pectoralis*, and two moth species Large Ear *(Amphipoea lucens)* and *Arytrura musculus.* These species have larger ranges of distribution in northern latitudes. Nevertheless they exist only in larger mires in Hungary.

There are also some species restricted to mires without being a glacial relict. They occur is specific habitats that they prefer in many sites of temperate zone of Europe and Eurasia. One of them is the False Ringlet (*Coenonimpha oedippus*), a globally threatened species close to extinction from Europe. There is only one site of this species that prefers sedge dominated marginal zones of alder swamps.

Molinia meadows with Burnet species are home to the rare Dusky Large Blue (*Maculinea nausithus*). Though Scarce Large Blue (*Maculinea teleius*) has also the same host plant species, it is a common species in Hungary. There is a third species of Large Blues, the Alcon Blue (*Maculinea alcon*), hosted by fen meadows with Marsh Gentian (*Gentiana pneumonanthe*). An eco-type of this species *Maculinea alcon alcon* is threatened by extinction at European level. An interesting feature of the Large Blues species is that newborn young larva of them are quite similar to the ant, therefore the ants collect them in their nests. Here they feed on larva of ants. Geranium Argus (*Aricia eumedon*) is a characteristic species of mires rich in Crane's-bill species. Only a few sites are known of the species, mainly in northern Hungary, in tall herb communities along brooks. Violet Copper (*Lycaena helle*) is an extinct species that was a typical species before water regulation of rivers or mires. This is the smallest but in the same time the most beautiful species of this genus in the Carpathian Basin. It is a spectacular view when they are feeding on pink flowers of Bistort (*Polygonum bistorta*) with their iridescent coloring in the May sunshine. Unfortunately this species can only be found in Transsylvania and in a few sites in Szatmári-síkság. On the other hand, *Lycaena dispar rutila* has probably the strongholds in Hungary among European countries. By the 1850s, it became extinct in Great Britain, and there are is a scattered population of it in Western Europe of the species. In tussocks and in tall sedge communities there are fortunately strong populations in Hungary. It has generally

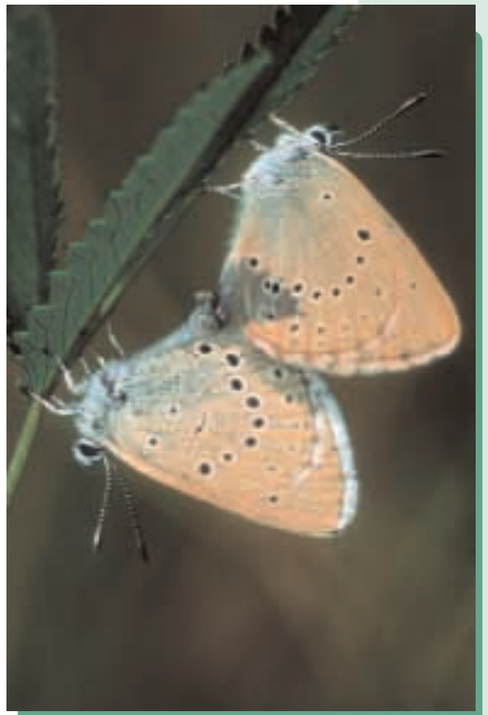

Photo 29: Scarce Large Blue is a protected species of Molinia meadows with Burnet species

Photo 30: Marsh Fritillary is a peculiar butterfly species of the largest mires of Hungary

two broods, sometimes three in drier years, and males and females always migrate, allowing occupation of new mires.

A beautiful species of drying up meadows is the Marsh Fritillary (*Euphydryas aurinia*). Larvae feed on Devilsbit Scabious. In mating season there are many of them flying from flowers to another one or having relax on willow leaves. Lesser Marbled Fritillary (*Brenthis ino*) occur only on mires that have Meadowsweet its edge regions. There were just a few sites known to nature conservation, however they started to increase in numbers. They can be observed even outside mires, e.g. in montane meadows, in fens or in edge region of wet forests.

In stems of the large Marsh Spurge that occurs in marginal zones of mires, in marshes associated to mires there are two species of Aphid flies, *Chamaesphecia hungarica* and *C. palustris*. The first is an endemic species to the Carpathian Basin, the latter also occurs in mires and marshlands of steppes of Ukraine and South-Russia. Living in the stem of Spurge,

Photo 31: Moor frog in breeding period

larvae feed on the plant creating different cavities inside the spongy part of it.

Vertebrate species requiring more space occurring in extensive mire systems lack from the Hungarian fauna since isolated mires do not provide large enough habitats for them. Dogfish (*Umbra krameri*) is a typical representative of fish related to mires. In spring there is a bloom for a frog species Moor frog (*Rana arvalis*) and the brilliantly blue males have a spectacular view. In less denser areas, where there is more open water in edges of mires (lag zone) there are dozens of Common Newt (*Triturus vulgaris*). Viviparous Lizard (*Lacerta vivipara*) is restricted to mires of Nyírség region. As it can be learnt from their name eggs are often carried by females that seemingly give birth to juveniles. Among mammals, there is also a true mire-dweller species. Though the Root Vole (*Microtus oeconomus*) has strong populations in northern countries, it is considered to be a glacial relict that is fairly rare species occurring only in larger mires. The Eigg Vole (*Microtus agrestris*) is a slightly commoner species than the previous one.

There is no specific bird species restricted to mires. Perhaps the strictly protected Corncrake (*Crex crex*) that prefers mostly Molinia meadows sedge communities and tussocks. Nevertheless it also breeds in marshes and hay-meadows even in cultivated land. Its distinct call can

Photo 32: Great Sundew prefers rough peat surface

be heard in night during the breeding season. When there are more males in a site, they are quite active also by day.

Why conserve mires?

One of the most important features of mires is the peat formation in which organic material is conserved and fossilized. As sediment traps, not only do they conserve signs of vegetation around them, but also from outside where these are filtered from. These also include pollen and small seeds or leaves carried by wind. Consequently layers created during peat formation also include parts of flora and fauna present in the site. This can be fairly interesting when formation of peat and other different sediment layers (dusk, sediments, soils, etc.) have been lasting from thousand years. Therefore the complete history of the mire can be in hand that can be studied and overview like reading family photo albums. Different stages in development of mires can be

described. By studying remnants of animals or plants, even the environmental conditions of mires can be complied. First the age of a certain layer is determined scientifically. Then plant material is identified, and their quantities are described to each other. Finally this ratio is compared to similar vegetations presently and consequences can be drawn from climate and vegetation during formation of the layer. For example: if remnants of the Labrador Tea (*Ledum palustre*) or Heath species, furthermore pollen of evergreen species are found in the sample, climate and vegetation of mires that time was similar to those of taiga for sure. Obviously scientific studies on age determination are of significant importance, though human brain has an outstanding ability to figure out new things. Floral development of the Carpathian Basin after glacial period is now more or less known thanks to scientific studies described above.

As history closed in mires tells us almost everything, consequently it is frequently hardly known how much data is lost when a mire disappears with its peat layers. In other words, we can conclude that this is the same when a library is lost before books of it are read through.

However we should not forget about living mires! Ecosystems of them are fascinating especially when one come across living creatures in isolated hidden sites in Hungary after having seen them in

Pboto 33: The Labrador Tea is a typical scrub of boreal raised bogs

northern or mountainous areas. Since these species preferring cold climate can also occur in our country. These are called scientifically as relicts, and habitats that host them are the relict-reservoirs. Mires are definitely such habitats.

Mires occupy only limited areas in Hungary therefore they are quite rare similarly to their flora and fauna.

Conservation of mires means also conservation of rarities. As there is no need to explain why it is important to save the Hungarian Crown, it is unnecessary to explain why should we conserve the only habitat of an Orchid species Bog Orchid (*Hammarbya paludosa*).

Rare species and their habitats are frequently sensitive to changes in their environment, therefore much attention should be paid for them. According to paragraph 2 of Article 23 of Act on Nature Conservation No. LIII of 1996 by virtue of the law, all mires in Hungary are nationally protected. To fulfill this obligation it was indispensable to make a national inventory for mires. Results of this project are presented in the following chapter.

Results of mire inventory in Hungary

It is not an easy task to carry out a comprehensive inventory for mires at national level even if the given country is small and these habitats occupy only a limited area of it. Before starting the field work a detailed hypothetical work had been done, e.g. gathering all scientific data, preparations, collecting archive data, cadastral maps, etc. During this preparatory phase a definition had been elaborated for mires based on nature conservation considerations. This is fundamentally the same as of Ádám Boros. Nevertheless it also allowed inclusion those habitats that had been changed by influences caused by humans. According to this, the following types had been listed:

1. Raised bogs with Eriophorum species;
2. Transition mires;
3. Mires with closed reed beds or bulrush beds;
4. Tussock sedge communities;
5. Rich fens;
6. Tall herb communities related to mires;
7. Flushes;
8. Swamps, mire scrubs.

The field work was started in 1998. After having completed the exciting field identifications, and descriptions, a fairly long process was started aiming at collecting the land registration numbers and associated data. After the necessary public administrative consultation process, the comprehensive set of data was announced in 2002.

Altogether more than 1000 sites of mires had been registered in the mire inventory project in the territory of the nine national park directorates. Based on the data, the most frequent areas in terms of mires are located in central, southern and south-western parts of Transdanubia, the western part of sandy area of Danube-Tisza Interfluvial, furthermore in Nyírség. Mires are the least abundant in southern part of Tiszántúl. As another result of the project an uneven distribution of mire types was clearly revealed. As it was mentioned before, the least frequent type of mires are transition mires covering less than 1 % of the total surface covered altogether by mires in Hungary. Likewise, flushes are also

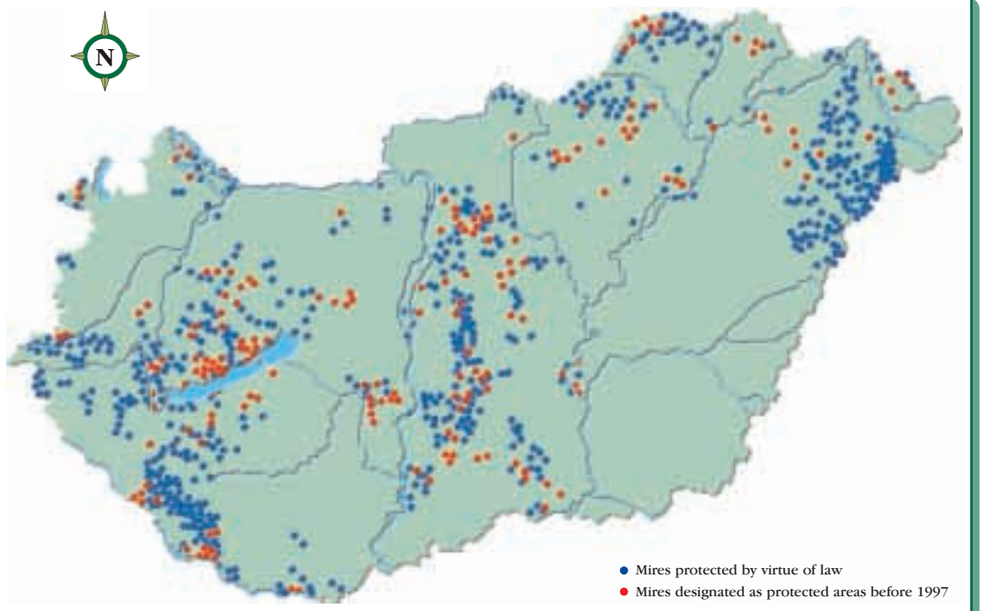

Figure 2: Distribution of mires in Hungary

very rare with the coverage just as double as of transition mires. Only one tenth of Hungarian mires fall to rich fen category, while mires with closed reed beds or bulrush beds and tussock sedge communities are quite common in our country. They represent initial phases of mire development, and often located around 'better mires' having a kind of buffer capacity in case of adverse influences. Nearly half of the listed mires fall into these categories. Swamps and mire scrubs has also high proportion being present in one third of Hungarian mires showing a signs for maturity of these mires.

Concerning naturalness, signs of degradation could be observed in almost half of listed sites. These are caused by various reasons, but collectively lack of water is the most important threat to them. Therefore it is another important challenge to restore them since the majority of their ecosystem can be still conserved! After having completed the inventory, it is now the task to complete a baseline survey, moreover after having consultations with owners to compile management plans aiming at maintaining and restoring them. Even the inventory should be updated yearly indicating changes or including discovered new sites.

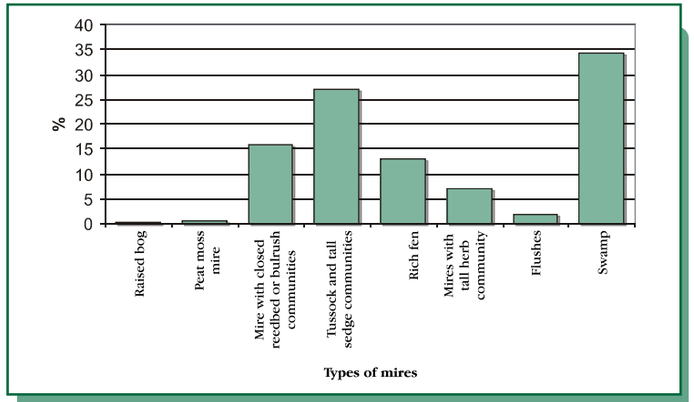

Figure 3: Principal types of mires in Hungary

Threats to mires

In the past, more than 1% of the territory of Hungary could be considered as mires. This was not a small area, since climate of the Carpathian Basin is not the most appropriate for classical mire development. Even today, Hungary is not the poorest country in terms of mires: Austria, Slovak or Czech Republic have less mires than Hungary. Obviously the more northern country, the more numbers of mires it has.

Unfortunately, Hungary is on the top in destruction of mires. More than 97% of mires in the country had been drained and the water maintaining them was led away. Our extensive mire systems like e.g. Ecsedi-láp, Sárrét, Rétköz and Hanság had been lost during water regulation works in the 19th and 20th centuries. Coverage of peatlands in Hanság was estimated at 23 350 hectares in 1915, of which 3500 hectares had been survived by 1975, in Ecsedi-láp there were an estimated 16 977 hectares peatland of which nothing present today. Thus, unique and exciting ecosystems of these territories had lost before we could have detailed information on them. Agricultural intensification forced after the World War II had destroyed those remnants of mires survived adverse influences of water regulation works. In this way, important peatlands have been converted into maize cultures with using huge state subsidies. Those that had not been ploughed up, were used intensively as hay meadows or grazing areas. In case of hay meadows, sensitive species had disappeared, in case of latter one, weed species invaded the area. Mining had also negative effect on

Photo 34: Ploughed rich fen invaded by weeds

Photo 35: Survival of Marsh Gentian is threatened by inappropriate timing of mowing

Photo 36: Great Sundew prefers rough peat surface

mires. Peat is an important rough material used for different purposes, principally for horticulture. As a consequence of peat mining destroying a mire at Vindornya, the Bog Rosemary (*Andromeda polifolia*) has become extinct from Hungary. This is also true for Great Sundew (*Drosera anglica*).

Mining has indirect influences on mires, too. Several mires of Bakony Hills had been destructed due to karst water level drop caused by bauxite mining. Karst springs feeding these mires become dry. Slow dying process of rich mire complex between Lesencetomaj and Lesenceistvánd started to accelerate when gravel pits had stopped their vital water supply. The previously pink meadows when Birdseye Primrose was blooming became weed fields and Alpine Butterwort (*Pinguicula alpina*) got extinct from Hungary. Though there were 7 individuals of them in 1994, the plastic bottles as alternative water supply failed to save the species.

Changes in vegetation also means adverse influence on fauna related to mires. Due to changing microclimate or probably physiognomic changes in vegetation caused many species worse

conditions for many – previously more abundant species. The Alcon Blue (*Maculinea alcon*), Dusky Large Blue (*Maculinea nausithous*) have became rare or extinct like Violet Copper (*Lycaena helle*) or the Large Heath (*Coenonympha tullia*). It should be noted that unwished activities of collectors also contributed to this process as case of False Ringlet (*Coenonympha oedippa*) showed it.

Fires should also be listed as threatening factor, since fire can destroy huge amount of peat within minutes like at Ecsedi-láp, Hanság, Káli Basin, Kállósemjén, Lesencetomaj.

Vegetation of remnants of mires is also threatened by environmental pollution. Essentially Nitrogen (NO^{3-}, NO^{2-}) and Phosphorous (PO_4^{3-}) filtered through soil and carried by precipitation are responsible for harming sensitive plant species living in a Nitrogene-poor habitat. Because of surplus Nitrogene, certain species (e.g. reed) are spreading or aggressive, invasive species invade mires pushing out true mire dweller species. The most dangerous

Photo 37: Fire deteriorating peatlands

species among them are Golden Rods (*Solidago gigantea*) and Canadian Golden-Rod (*Solidago canadensis*) of North American origin. There are often dry marshlands and rich fens covered by yellow carpet of Golden Rods but also native weed species can appear in drier mires.

And there are still adverse factors or negative interventions. In many cases, forestation or alder, ash, poplar plantation have negative influences on mires. In addition, swamp forests used for profit-making, weed encroachment after final

Photo 38: Rich fens covered by Golden Rods in Transdanubia

harvest or impoverishment of undergrowth are important factors.

Harvesting forests around mires have indirect impact on mires changing microclimate, increasing sediment transport caused by erosion. These also contribute to sedimentation of mires. The factors mentioned above were the most frequent ones, but there are also alterations of mires into ponds, filling up of mires with waste, stopping springs of flushes, creating paved roads across mires, etc.

What can we do for mires?

Obviously, we should not do what has been elaborated in the previous chapter. In conservation of mires, designating them as protected areas only provides the ability of management for nature conservation purposes. Conservation of mires means on the other hand restoration of them if necessary.

The first restoration activities had been carried out by involving non governmental organizations in the cases of Kelemér Mohosok and Kállósemjén Nagymohos. There were two feasible options for their conservation: terminating succession adversely affecting the site and water supply. Although in the mire of Kelemér cutting of aggressively invading reed, condensation of peat layer by trampling and cleaning of lag zone had been completed, only removing of reed had positive impact. Unfortunately, for the water supply only a plan had been compiled.

Water supply was successfully provided for Nagymohos of Kállósemlyén from a canal nearby the mire, subsequently from a well. Not only positive impact had the artificial water supply, but also negative due to inappropriate quality of water. Accumulation of organic materials was observed soon in the mire therefore vegetation started to change. There were also activities for restoration of mires like in mires of Egerbakta, Csaroda (Nyíres-tó and Bábtava) and Sirok (Nyírjes-tó).

Though removal of Aspen have been carried out at Egerbakta and water was supplied by large tanks, these measures failed. Dry years of eighties and nineties had serious impact on mires and these 'first aid actions' given were generally unsuccessful.

As a success story, water supply of Nyirjes-tó and Bábtava at Csaroda can be mentioned, where a rather comprehensive and detailed study had been elaborated prior the measures implemented. Mires of these sites recovered at surprising pace that created favourable conditions for other restoration measures. Another success is water regime restoration in some mires of Káli-basin. For conservation of the last large population of Birdseye Primrose (*Primula farinosa*) risks had also been taken, but finally time proved the planner. The rich fen was surrounded here by a canal circle filled with raised water level. There was only one serious problem of depositing the peaty soil dug out. Since transfer of this material was not feasible, it was spread along the dike taking the risk of weed encroachment. As it was envisaged, encroachment of weeds took place, however a fairly quick regeneration of the site happened. Primroses started to make the wet area again pink.

Reconstruction of some parts in Hanság also happened by water regime alterations. The watercourse of Répce is now the main water supply for the site that slowly

Photo 39 : Rich fens with Birdseye Primroses in Káli Basin, with the canal stabilising the water level

regenerate the mire system of the site.

Higher precipitation of the past few years clearly showed that if mires had enough water, they can regenerate fairly rapidly. Nyírjes of Sirok was threatened by forestation, floating islands of it settled, birches on them started to fix it and even Aspen appeared quickly. After two years with high rainfall, water level of it raised with a meter, peat layer started to swell and lifted up consequently trees are now vanishing.

Based on the experiences it can be concluded that before any interventions, detailed and comprehensive studies should be elaborated. After having implemented the measures, continuous observations, monitoring of ecosystem of the mires is indispensable. These can be carried out by experienced staff of nature conservation and research institutes, thus those who are interested in such activities, should contact the national park directorates. It is very important since any measures implemented in ex lege protected mires should be authorized.

Prevention is even more important than interventions, in which owners and managers can assist the most. It does not mean necessarily a total ban for human activities, since for the health of mires, nature friendly use of land also contributes. Sooner or later conservation, nature conservation management and exhibition of these sites got the investments back.

Let think and plan ahead in order to conserve mires for our grandchildren so they can also see the secret life of them. In other words, World is not inherited from our fathers, but it is borrowed from our grandchildren.

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