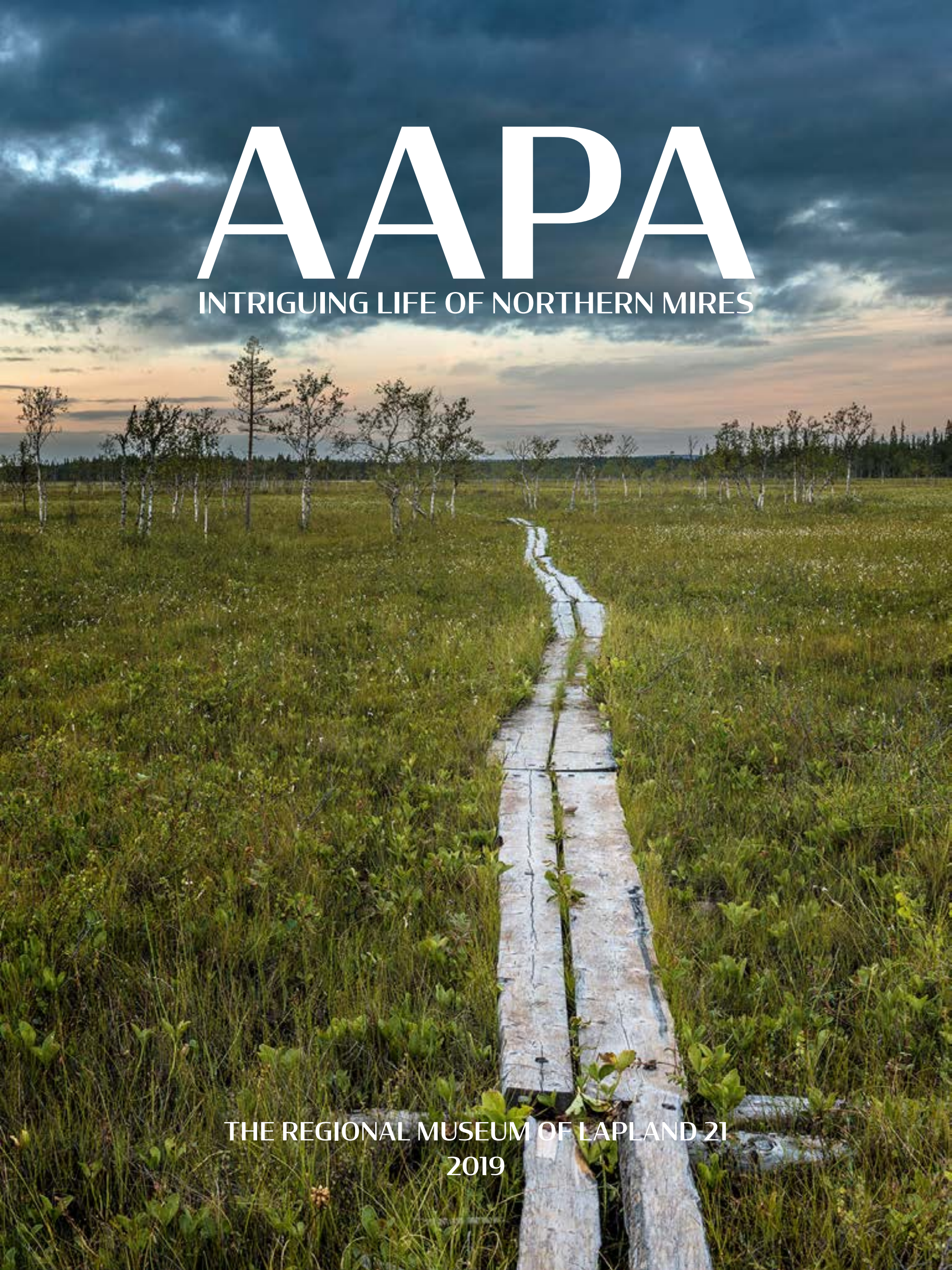
AAPA

INTRIGUING LIFE OF NORTHERN MIRES



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AAPA -INTRIGUING LIFE OF NORTHERN MIRES

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SISÄLLYS

WHAT IS A MIRE?

Mires or bogs are wetlands where the surface of the water is close to the surface of the ground and which form their own substrate, peat. According to geological classification, a mire must have a peat layer at least 30 cm thick, while in biologically defined mires the layer can be thinner.

Mires are complex ecosystems supporting species that are typical of them. The presence of mires, their vegetation and surface relief are influenced above all by climate, bedrock and the shape and relief of the terrain.

A BRIEF HISTORY OF NORTHERN MIRES

In the early stage of the Miocene Epoch (approximately 20 to 6 million years ago), the Coniferous Zone had not yet formed. Nor were there mires of the kind that are now typical of the northern regions of Eurasia and Northern America.

During the Miocene, the climate cooled considerably, as a result of which tropical and subtropical vegetation disappeared from the north. The most important species of the northern mires, the peat mosses (*Sphagnum*), speciated at the same time. This phenomenon is known as adaptive radiation, the considerable diversification of a group of species within a short period. In terms of evolution, the peat mosses of mires are very young, as the joint ancestral form of all presently living sphagnums did not evolve until 20 –7 million years ago. The history of the mires of the north is thus geologically short. Despite this, 3.5 million square kilometres of the Boreal and Arctic zones are presently covered by mires and 30% of carbon in the earth's soil is sequestered in them.

All extant peat mosses (*Sphagnum*) are of rather recent origin, since their common ancestor lived ca. 20-7 milloin years ago.

Photo: Jukka Salmela.

HOW DID MIRES FORM AND DEVELOP IN FINLAND?

During the Pleistocene Era (2.6 million–11,500 years ago) Northern Europe was covered several times by continental ice sheets. The last Ice Age ended around 11,000 years ago in part of Southern Finland and our oldest mires are just as old. The majority of Finland's mires, around 90% of them, have formed over the past eight thousand years. Paludification – the formation of mires – did not proceed at an even rate. Its speed depended on the prevailing climate. In Finland, paludification now takes place only along the shores with land uplift, as otherwise suitable areas have already evolved into mires and topography prevents the spread of mires into areas of mineral soils.

THREE TYPES OF MIRE FORMATION

Mire vegetation can grow only in a substrate that is sufficiently moist. With regard to climate, Finland is in an area favourable for the formation of mires; it is sufficiently wet and cool here. In addition, the relief of the country is mostly low, which means that soils are prone to be waterlogged.

The development of a mire can begin as so-called **primary mire formation** on land uncovered directly from under the ice or in shore areas rising from the sea through land uplift. In the Baltic Sea region there is primary paludification at the north end of the Bay of Bothnia where the land is still rising from the sea after the Ice Age. **Lake terrestrialisation** is a fairly general cause of paludification and a third cause is the **paludification of forest land.** The latter is due to rising levels of ground water caused, for example, by changes to climate or forest fires destroying vegetation and thus reducing evaporation.

THE NATURAL DEVELOPMENT OF MIRESS

Mires form their own substrates. The surface is oxygen-rich but an anaerobic layer follows soon beneath it, with very slow decomposition. Some of the biomass produced by mires is not decomposed and it forms peat, an organic soil. Because the prevailing type of vegetation of peat and its age can be defined, it is also possible to establish its stages of development. Mires formed through the overgrowing of a body of water have clayey lake sediment on the bottom, overlaid by *Carex* peat (a minerotrophic stage in which the mire received nutrients from nearby mineral soils) and last by sphagnum peat (an ombrotrophic stage with nutrients received only from rainwater).

Generally speaking, all mires in Southern Finland were originally minerotrophic or aapa mires, but they became ombroptrohic with the growth of sphagnum mosses. In Southern Finland, the raised bog is the main climax type, in other words a kind of equilibrium. In the north, the aapa mire, marked by flarks and strings of sphagnum is a climax type of mire determined by climate, with characteristics maintained by the cold climate and floodwaters in the spring

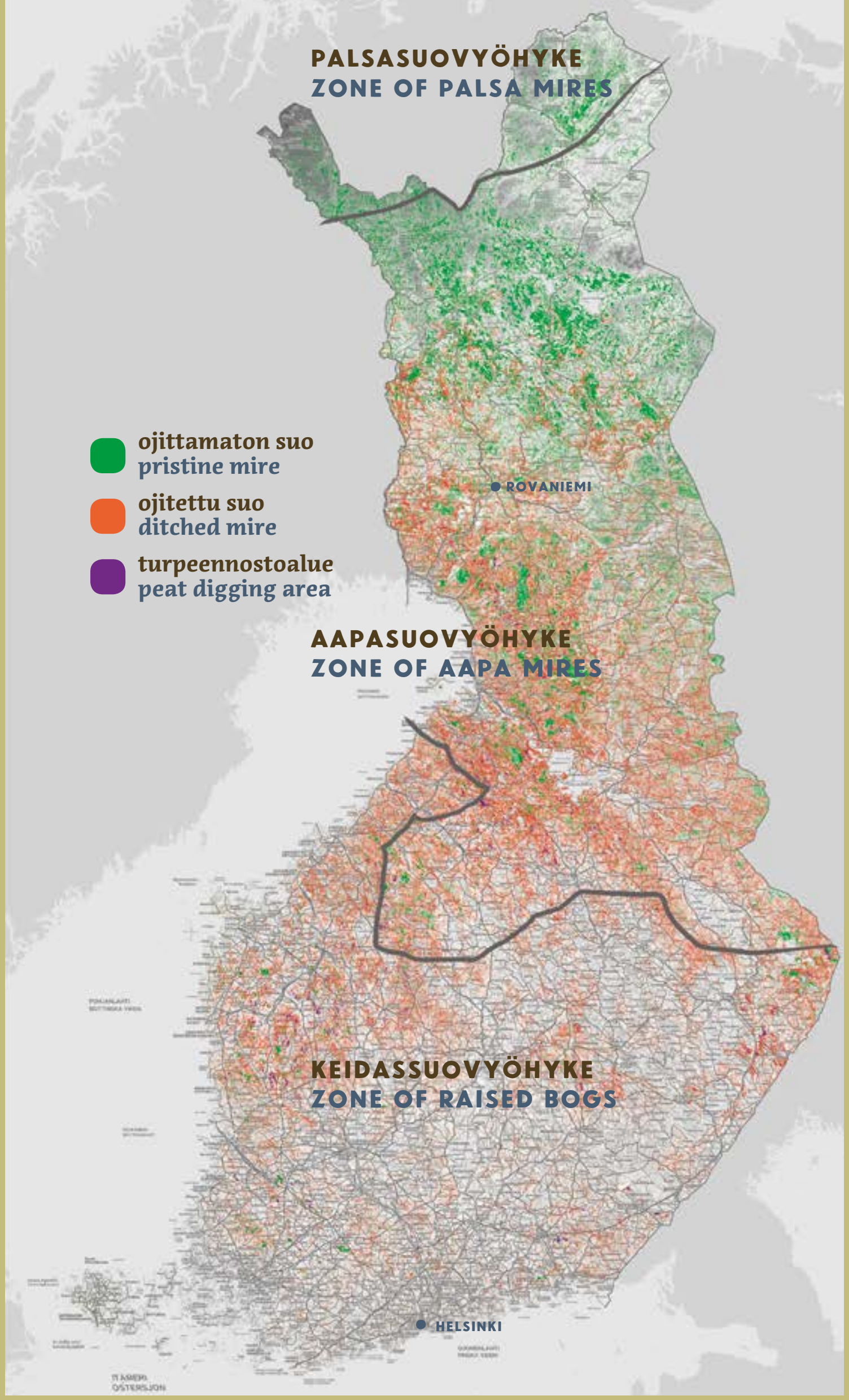
Aapa mire landscape at Viiankiaapa, summer 2018. Photo: Jukka Suvilehto.

RAISED BOGS IN THE SOUTH AND AAPA MIRES IN THE NORTH

The mires and bogs of Finland fall into two mire complex types, raised bogs and aapa mires.

Raised bogs predominate in Southern Finland. They are ombrotrophic, i.e. fed by rainwater. In these bogs the centre grows higher than the laggs and cannot receive additional nutrients from the surround mineral soil. The central part can be shield-shaped, flat or sloping, with two main forms of relief, hummocks and hollows. Growing on the surfaces of the hummocks are bog plant species such as *Sphagnum fuscum*, *Betula nana* and stunted *Pinus sylvestris*. The hollows are watery puddles without vegetation or covered with sphagnum moss. The ombroptrophic mire type is very barren, i.e. with few nutrients and low pH, even less than 4.

SUOMEN SUOT JA NIIDEN LUONNONTILAISUUS
MIRES OF FINLAND AND THEIR STATE OF NATURALNESS



Map: Seppo Tuominen.

There are also raised bogs in Lapland, but aapa mires are common there. The southern boundary of the aapa mire zone roughly follows the mid-boreal vegetation zone, which means that the mean annual temperatures is 2 degrees Celsius or less and evaporation during the summer is less than runoff. The aapa mires are minerotrophic, which means that they receive nutrients from both rainwater and surrounding mineral soils. Unlike in raised bogs, the central part is lower than the edges. The alternation of watery flarks and narrow strings of sphagnum peat, with the latter located crosswise to the flow of water, is characteristic of aapa mires. In the northern regions, the snow melts late, in April and May, and spring floods bring nutrients to the mires and flush away humic acids which lower pH. Because the growth season is short and cool, the aapa mires remain very wet throughout the summer. Aapa mires have a relatively high pH of 4–6.

Hummoc level string among wet flarks. Photo: Mauri Lähdesmäki.

Palsa mire at the subarctic zone. Photo: Mauri Lähdesmäki.

Local variants of the aapa mires are sloping fens and palsa mires. Sloping fens are found in hygrically marine areas where summer runoff is greater than evaporation. They occur in areas of high elevation such as the fells of Eastern Finland, in Kuusamo and on the fjelds. Palsa mires are the mires of the northern parts of Fjeld Lapland. Palsas are hummocks of peat containing permafrost. They can grow to heights of up to seven metres, but they will ultimately collapse, melt and form watery flarks. Palsa hummocks form on mires where wind in the winter removes most of the snow. A further group consist of the orohemiarctic mires above tree-level, the typical properties of which are springs, the effects of melting waters and a thin peat layer. The orohemiarctic mires are often eutrophic because sources of water and melting waters ensure good availability of nutrients.

A HUNDRED DIFFERENT MIRE TYPES

Where mire complex types reflect the morphology and hydrology of mires and bogs on a larger scale, there can be several site types in individual mires. There are four main mire types in Finland: pine mires, spruce mires, fens and rich fens. Swamps and spring fens are also classified as mires. Because mires change from one type to another in gradations it is also possible to distinguish combinations, such as the rich pine mire or the sarakorpi mire, with features of both the fen and the spruce mire.

Approximately a hundred different types of mires and bogs are known from Finland, but it is important to understand that the typology is above all a means for understanding the environmental factors that affect them. The typology also makes it possible to communicate between different actors in the field and to estimate the occurrence of different type of mires and their threatened status. The one hundred mire and bog types of Finland reflect the variation of climatic and geological conditions in the country.

Mire and bog types are identified with reference to vegetation:

• Stunted pines and various dwarf shrubs, such as *Vaccinium uliginosum* and *Rhododendron tomentosum* grow on pine mires, and in places *Eriophorum vaginatum* is the most visible species. The vegetation of pine mires grows on hummock level, i.e. these mires do not have pools of open water.

***Rhododendron tomentosum* is a common vascular plant of pine mires. Photo: Jukka Salmela.**

• Treeless **Sphagnum mires** or fens are open mires, in which the lawn or flark surfaces are the prevailing moist levels, which means that the surface of the ground water is close to that of the mire. These mires are the realm of sedges and sphagnum mosses, and along with the various sedges common plants in them include *Scheuchzeria palustris*, *Eriophorum angustifolium*, *Eriophorum russeolum* and *Rhynchospora alba*.

• Rich fens are open mires with high pH and they are mostly in areas of alkaline rock types in the bedrocks (especially in the so-called Lapland Triangle, Kuusamo and the greenschist zone of Lapland). With regard to their species of mosses and vascular plants, rich fens are among the most biologically diverse mires and many rare and threatened species grow on them. Their vegetation also includes sphagnum mosses typical of them, but in many of them the bottom layer consists of so-called brown mosses, i.e. other species than sphagnum mosses.

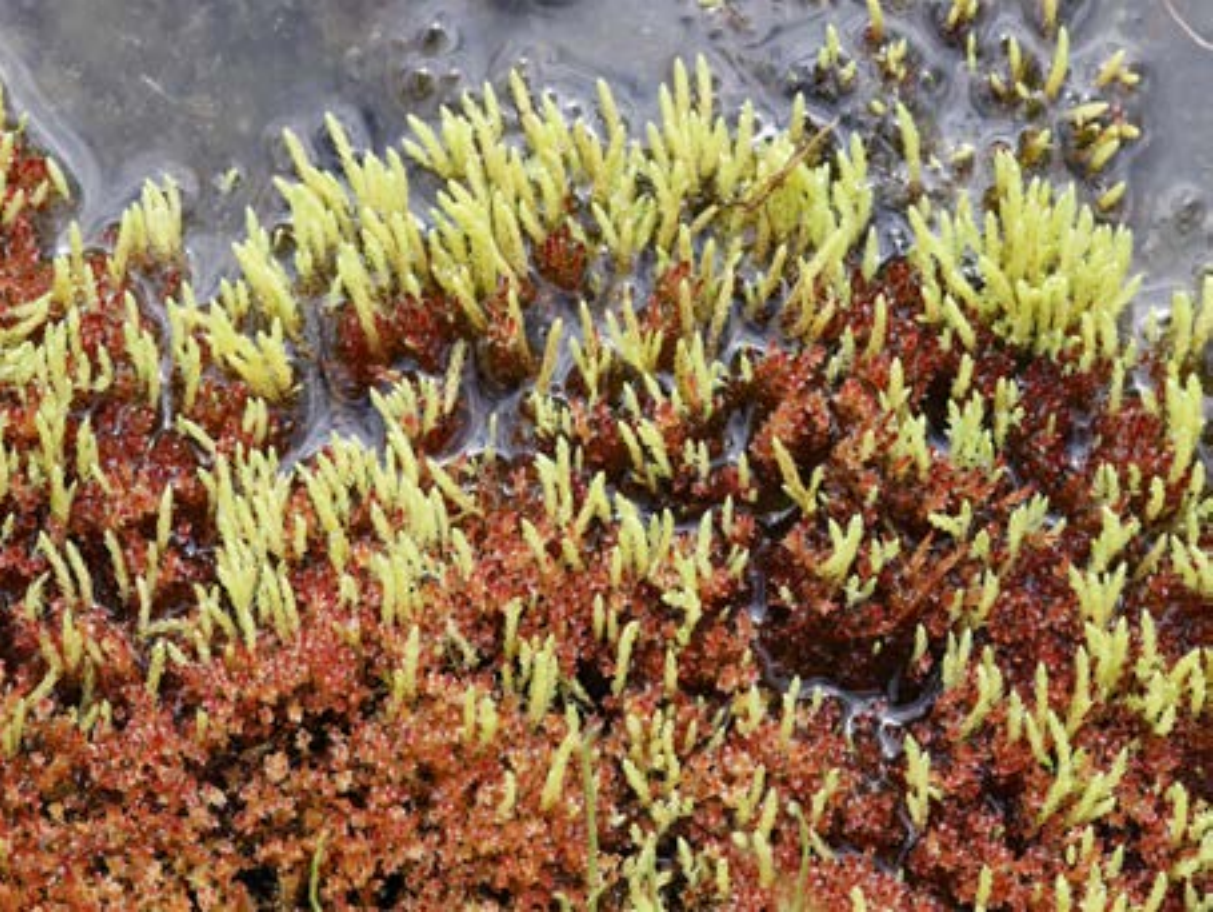
• Spruce mires have a thin peat layer and many plants are able to draw nutrients from mineral soil. The main tree species of these mires is spruce, but birch also grows on them. Typical plants of spruce mires include wood *Equisetum sylvaticum*, various ferns, *Crepis paludosa* and in northern Finland *Cicerbita alpina*.

***Sphagnum wulfianum* and *Ranunculus lapponicus* are northern species that thrive in spruce mires.**
Photo: Jukka Salmela.

• The vascular plants of the rich fens consists of various orchidaceae, sedges and herbs. Swamps are near bodies of water and they stand out from shore vegetation because of their peat layer. Tall sedges and grasses, bushes (*Myrica gale*, willows) or trees (*Alnus glutinosa*, *Betula pubescens*) typically grow on swamps. In springs, the ground water comes through to the surface as either seepage or open water (spring pool, spring brook).

• **Spring water** is even temperature throughout the year: 4–5 degrees Celsius in Southern Finland and 2–3 degrees Celsius in Lapland. Springs are distinguished by their vegetation from other mires and bogs, although partly the same species grow on them and the rich fens. Typical spring species are mosses such as *Philonotis spp*, *Pohlia wahlenbergii*, *Bryum weigelii* and various *Epilobium species*. Some of the northernmost observed occurrences of some southern species are from springs, because their ground does not freeze in winter, while the southernmost locations of some northern species are at springs because of their cool conditions in summer.

***Paludella squarrosa* is a typical moss species of rich fens.**
Photo: Mauri Lähdesmäki.



Pohlia wahlebergii **(pale) and** ***Bryum weigelii*** **(red) indicate groundwater influence.**
Photo: Jukka Salmela.

• Aro wetlands are seasonally dry habitats with thin peat layer, usually situated on soils with permeable substratum.

SPECIES DIVERSITY IN NORTHERN MIRES

Mires are extreme environments. The water can be highly acidic or in areas of limestone even alkalic. In summer, an open mire can be both sun-drenched and wet at the same time with large differences of day and night temperatures. Beneath the surface of the mire there is an anoxic layer making it difficult for the roots of plants to obtain oxygen. On the other hand, mires are highly stable and predictable environments that can remain almost unchanged at the level of the landscape for many centuries. They support a unique community of organisms, the members of which have adapted to their conditions.

Mire species can be broadly classified into three categories, **those living only on mires**, **those preferring mire environments** and **wide-ranging wetland species,** found not only in mires. For example, *Nola karelica* of the owlet moths lives solely in oligotrophic mires, feeding on *Andromeda polifolia* and *Rubus chamaemorus*. On the other hand, *Numenius phaeopus* is a typical nesting bird species of open mires, which in Forest Lapland also nests in cleared areas with sparse wood cover. There are also rare relict species from earlier climate periods growing in the mires. One such relict of a warm climate is *Erica tetralix*, found in Finland in only one mire in Kuhmo but having a wide distribution in the areas of marine climate in Europe.

The basis of life in mires is in photosynthesis and vegetation. At the bottom of the food chain in ponds and flarks is dissolved organic material (humus) and the bacteria that decompose it. Sphagnums, the main species of most mires, are not consumed by any animal species, but they and other mosses provide a habitat for astounding numbers of insect larvae, other invertebrates, protozoa, algae and microfungi.

HUMMOCKS

Forty-one species of sphagnum or peat-mosses are known from Finland. Sphagnums thrive on all kinds of mires and wetness levels (flarks, lawn and hummocks) but they are absent from the flarks of the calcareous mires. Sphagnums are the predominant species of most mires, forming the majority of their biomass. Sphagnum mosses are also so-called ecosystem engineers, because they make their habitat wet and acidic. They thrive on mires because of their excellent ability to bind water and to obtain nutrients from nutrient-poor mire water and to keep them in their cells. There can be from one to ten different species of sphagnum moss in an area measuring 10 x 10 cm.

***Sphagnum squarrosum* is one of the numerous Finnish peat mosses. Photo: Jukka Salmela.**

There are as many as 90 species of other mire-dwelling bryophytes in Finland. Because mosses have no roots, they absorb the water and nutrients that they need directly through their cell tissues. At the neutral or even alkalic end of the pH gradient of mires, there are so-called brown mosses, i.e. other mosses than sphagnums. There can be up to around thirty brown moss species in some rich fens. A third group of mosses living in mires consists of liverworts (Marchantiophyta), of which there are 26 mire species.

MIRE VEGETATION

A total of some 290 different species of vascular plants are known from Finnish mires. Sedge plants and shrubs are the basic plant species of many mire types. In extremely oligotrophic and acidic raised bogs supplied only by nutrients from rainwater, the range of species is quite small, consisting of, among others, *Scheuchzeria palustris*, *Carex limosa*, *Rhynchospora alba* and *Drosera longifolia*. Oligotrophic minerotrophic fens support various sedges, such as *Carex lasiocarpa*, *C. chordorrhiza*, *C. pauciflora* and *C. rotundata* in mires of the north. Species often found on treeless mires also include *Eriophorum angustifolium*, *Eriophorum russeolum* and *Trichophorum cespitosum*.

In mesotrophic fens nutrients are quite well available for plants and in these locations the range of vascular plants increases. Bluish green *Carex livida* is a typical flark species and other species include *C. diandra*, *C. echinata*, *Eriophorum gracile*, *Trichophorum alpinum*, *Molinia caerulea*, *Epilobium palustre*, *Equisetum fluviatile* and *Triglochin palustris*.

Large numbers of dwarf shrubs such as *Vaccinium uliginosum*, *Chamaedaphne calyculata* and *Rhododendron tomentosum* grow on pine mires, along with a few herbaceous plants such as *Eriophorum vaginatum* and *Rubus chamaemorus*.

A kind of speciality of hummocks in pine mires is the small *Pinguicula villosa*, which is hard to observe. Like other butterworts, this species is insectivorous: small insects are caught on the upper surface of the leaves and the plant digests from its catch the nutrients that it requires.

In the north there are high elevation pine mires where *Carex globularis* sedge predominates and spruce is the main tree species. Spruce mires can vary in terms of vegetation from relatively oligotrophic cloudberry-growing mires to luxuriant herb-rich spruce mires. Herb-rich spruce mires support partly the same species as herb-rich nemoral forests, i.e. *Paris quadrifolia*, *Matteuccia sthuriopteris* and *Daphne mezereum*.

***Saussurea alpina* is a vascular plant of northern rich fens. Photo: Mauri Lähdesmäki.**

In calcareous rich fens the water is at most slightly acidic or even alkalic. The electrical conductivity of the fen water can be high because of the large amount of calcium or magnesium ions in the water. Phosphorus, an important nutrient of rich fens, is bound into calcium phosphate, thus becoming poorly available to plants. In addition, excess amounts of calcium, which

is toxic to plants, end in them via nutrient intake. Rich fen plants have special membrane structures in their roots to avoid the excess absorption of calcium ions into cell tissue. They are also able, with the aid of specific acids to absorb required amounts of phosphorous, potassium and iron despite their decreased solubility. The vascular plants of the rich fens include various Orchidaceae, such as *Gymnadenia conopsea*, *Epipactis palustris*, *Malaxis monophyllos*, *Cypripedium calceolus* and *Dactylorhiza majalis subsp. lapponica.* Other herbaceous rich fen plants include *Bartsia alpina*, *Saussurea alpina*, *Equisetum scirpoides* and *Pinguicula alpina*. Of the woody plants, *Salix myrsinites* is found in the north, as also the extremely rare *Salix pyrolifolia*, which is known to grow wild only in Tervola and Kuusamo. There are also rare types of rich fens, rich birch fens, with large amounts of iron and phosphorous but low calcareous influence. A typical plant of the rich birch fens is *Saxifraga hirculus*, which can be easily identified by its late blooming and relatively large yellow inflorescences.

THE VITAL PARTNERSHIP OF FUNGI AND PLANTS

While mires are not actual "hot spots" of fungal diversity, agaric and boletes mushrooms are important decomposers and mycorrhizal partners of plants, which means that they assist plants in obtaining nutrients and receive products of photosynthesis in return. There are also microfungi of the sac fungi (Ascomycota) which live inside sphagnum mosses. Many of them have only recently been described scientifically, such as *Trizodia acrobia*, which was named in Finland in 2009.

Lyophyllum palustre is one of the large parasitic mushrooms living in mires that can cause the death of living sphagnum moss shoots.

The most diverse mires for agarics and boletes are wooded ones, especially pine mires. The species richness of fungus species on fens and rich fens is quite limited, but they include rarities such as *Armillaria ectypa*, *Bovista paludosa* and *Inocybe hirculus*.

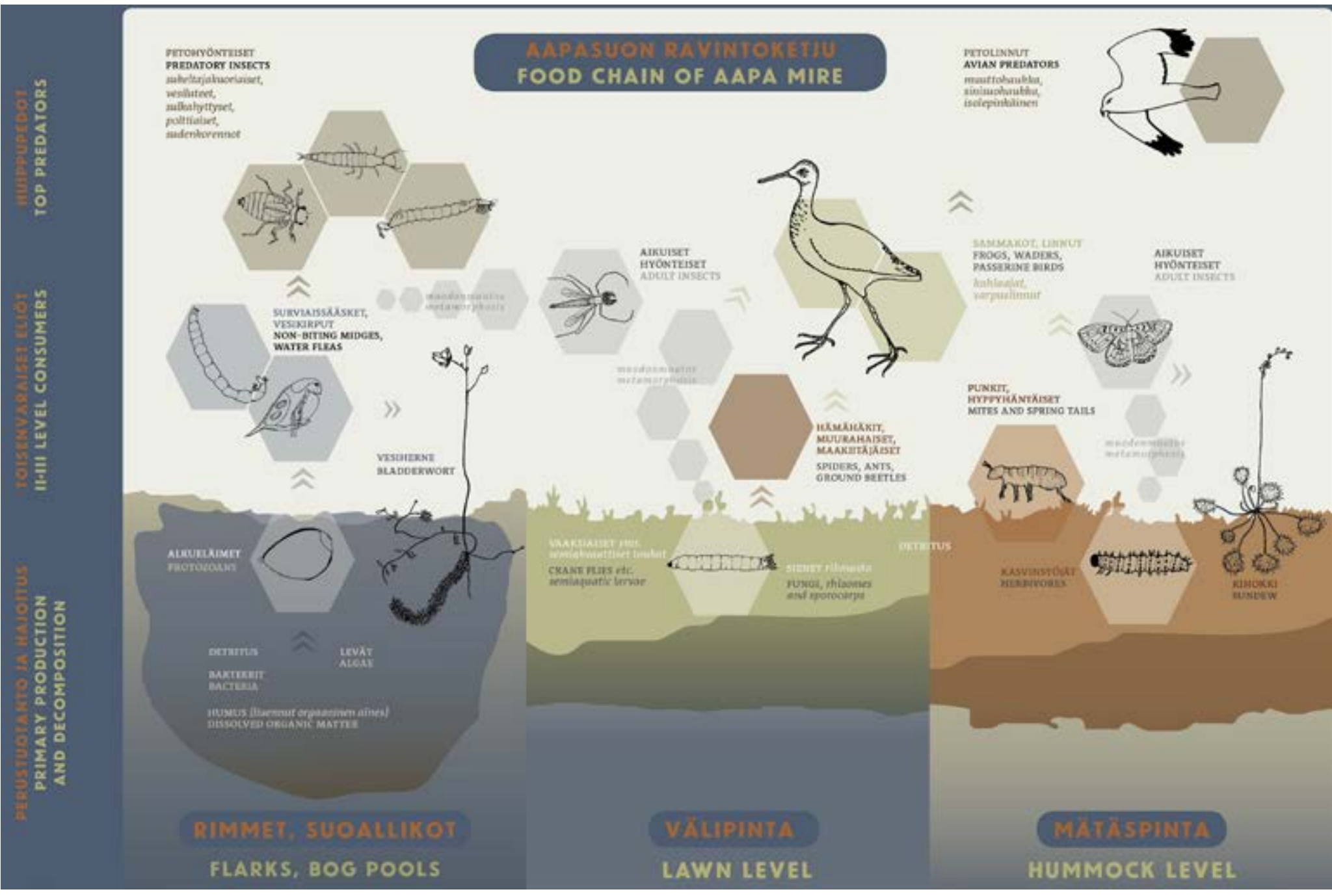
***Bovista paludosa* is a rare fungi of calcareous fens.**

Photo: Jukka Salmela.

A MILLION INVERTEBRATES PER SQUARE METRE

Over a million invertebrates per square metre have been counted on a pine mire in Southern Finland. Most of them were roundworms, mites, and springtails. Butterflies and other herbivores are dependent on, among others, *R. chamaemorus*, *A. polifolia*, *Eriophorum vaginatum* and *Betula nana*, which are important food plans. The aquatic insects of flarks and mire pools, such as caddisflies and non-biting midges, feed on the algae produced by the flarks, decomposing organic matter and other invertebrates (water fleas, copepods, rotifers, protozoa). Predatory aquatic insects, spiders and birds nesting on mires feed on detritivorous and grazing larvae of aquatic insects and their adults. The peregrines and hen harriers are the main predators of the mires, hunting other birds and rodents.

In addition to photosynthetic algae, dissolved organic matter and bacterial decomposition are the basis of food-webs of flarks. Among other primary consumers, Protozoa, small crustaceans and non-biting midges eat on bacteria and algae. Odonate naiads, phantom midge and dytiscid beetle larvae are the most important predators of flarks. Wet mossy surfaces are inhabited e.g. by crane fly larvae that eat on detritus. Spring tails, ants and spiders dwell on hummock level vegetation. Adult insects are eaten by insectivorous birds which in turn are predated by gyrfalcon and other avian predators. Fungi act as decomposers and mycorrhizal partners of plants. Some vasculars plants like *Utricularia*, *Drosera* and *Pinguicula* are insectivorous. Graphic design: Ulla Etto.



Lycosidae spiders in a rich fen.
Photo: Mauri Lähdesmäki.

ORB-WEAVERS AND RUNNERS

Of Finland's arachnids, 99 species live mainly on mires, although many of them also live on shores or on fjelds. The mires are homes to both orb-web spinners such as the Linyphiidae and predatory spiders that catch their prey by running (Lycosidae). Twenty-four species of Lycosidae have been found in the Vuotos mire area, including solely mire-dwelling species such as *Arctosa alpigena*, *Pardosa sphagnicola* and *Pirata insularis*. A previously unknown Lycosid species has been scientifically described in Finland, is *Pardosa maisa*, which in Finland lives only on mires and further south in Europe also in other wetlands.

DRAGONFLIES, MAYFLIES AND STONEFLIES

There are insects in aapa mires that would not immediately be imagined to live in these environment. Mayflies and stoneflies are groups of insects that are old in evolutionary terms, with larvae mostly living in running water. The *Paraleptophlebia strandii* is a running-water mayfly species that is quite common in Finland, though absent from the southern parts of the country. It was observed only a few years ago that it also lives in aapa mores, and in fact can appear locally in very large numbers. Its flight period is in the late summer, when large mating swarms of thousands of males can be seen on the flarks of aapa mires. The *Amphinemura palmeni* stonefly was a for a long while a poorly known species of which there had been only a few records in northernmost Lapland. This species also lives in wet aapa mires and full-grown specimens can be seen around the middle of August.

Dragonflies are highly visible insects on aapa mires in the summer. They are highly demanding with regard to the weather and are hardly to be seen on cool or cloudy days. Various dragonfly species with both similar (Zygoptera or damselflies) or different pairs of wings (Anisoptera or true dragonflies) live in flarks and bog pools. Adult true dragonflies with different pairs of wings are

Dragonfly naiad in a rusty flark of a rich fen.
Photo: Mauri Lähdesmäki.

large and fast fliers, while damselflies are smaller and slower in flight. Typical dragonfly species associated with mires include *Somatochlora arctica* and *S. alpestris*, which are common in Lapland, while their close relative *S. sahlbergi* lives in the mire ponds of the treeless fjelds in Fjeld Lapland. A common mire-living species is *Aeshna caerulea*, which has disappeared from most parts of Southern Finland owing to the drainage of mires with ditches. Of the damselflies, *C. johannsoni* is the only actual mire-associated species, but the widespread and common *C. hastulatum* also lives in mires.

PILLARS OF SMOKE ON MIRES

There are large numbers of the larvae of non-biting midges (Chironomidae) in the flarks and ponds of aapa mires. The larvae eat algae or decomposing organic matter, or are predators. Adult non-biting midges are numerous especially in the early summer and the mating swarms of the males can be so large that people sometimes confuse them with smoke. Along with their large numbers the non-biting midges are also rich in terms of species, with over a hundred species of them found on a single mire. The abundance of these insects is without doubt one of the reasons, why the numbers of breeding pairs and species of nesting birds are the largest particularly in Lapland.

Non-biting midge *Omisus caledonicus* is one of the hundreds of species of mire-dwelling lower Diptera. Photo: Sami Karjalainen.

The large numbers of flies on the aapa mires is not limited to the non-biting midges. Also the crane flies thrive on the mires of the north. They are large or middle-sized insects with long legs living mostly in various types of wetland. Like the birds, the number of mire-dwelling species of crane flies is largest in Lapland. Of the crane flies of Finland, 56 species (16% of all species) live primarily in mires. The largest numbers are in the rich fens where several rare species can be found.

The best-known two-winged insects are without doubt the blood-sucking species: mosquitoes, biting midges, black flies and horse flies. All these blood-sucking insects can be found in mires, although the larvae of the black fly live in running water. Mosquito larvae live mostly in small seasonally dry snow-melt pools. They cannot breed in the larger ponds of the aapa mire, as they are eaten by predatory insects, especially phantom midges (*Chaoborus*). Of the biting midges, only the species of the genus *Culicoides* attacks mammals and there can be massive numbers of these small midges with spotted wings in mires.

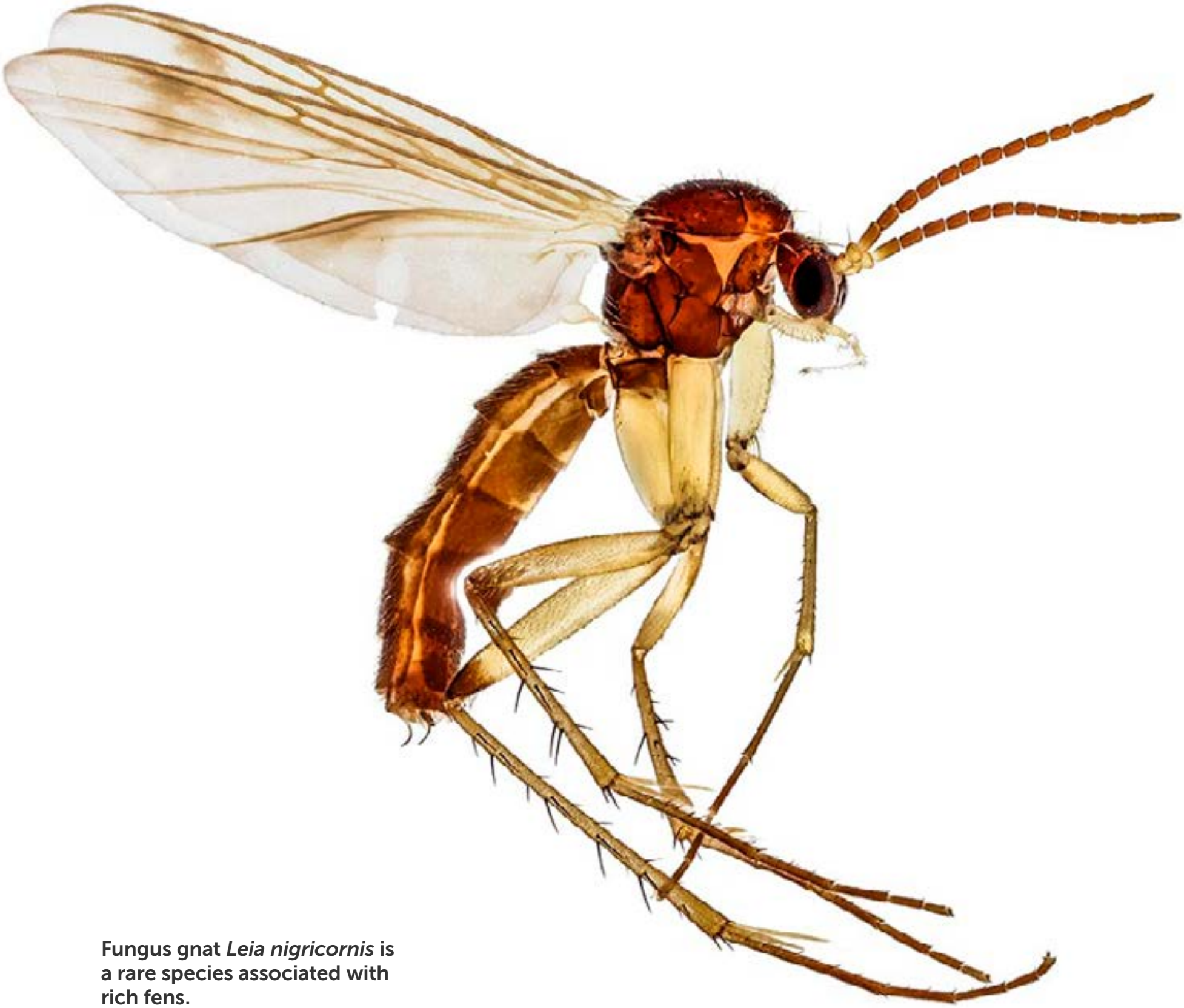
Mouth parts of horse fly are adapted for blood-feeding. Photo: Sami Karjalainen.

Predatory phantom midge larvae keep mosquitoes away from from bog-pools.
Photo: Sami Karjalainen.

Mires are the habitats of also several other biting midges the females of which either feed on flowers or suck the hemolymph of larger insects. The larvae of horseflies lives in mires and in damp shore areas and adult horse-flies flies become a nuisance only on hot days in the summer.

There are also fungus gnats and dark-winged fungus gnats in mires, although the majority of these species live in forested environ-

**Tyrphobiontic biting midge *Monohelea estonica* does not attack on mammals.
Photo: Sami Karjalainen.**



**Fungus gnat *Leia nigricornis* is a rare species associated with rich fens.
Photo: Sami Karjalainen.**

ments. It has been discovered only in recent years that there are also species of these gnats that live only on rich fens. Of the dark-winged fungus gnats, for example the large and impressive Sciara species is restricted to rich fens. Though taxonomically known for about 15 years, it is still without a scientific name. *Neoplatyura noorae*, a rare predatory fungus gnat species on rich fens was scientifically described as a new species in 2014. For the time being, it is known only from Lapland . Another fungus gnat that lives only on rich fens is *Leia nigricornis*, which was for 84 years known only from its type locality in Alaska. In 2012, it was observed in Lapland as a species new to Eurasia. Numerous lower dipteran species live on the mires of the north and only a small proportion of them are blood-sucking insects.

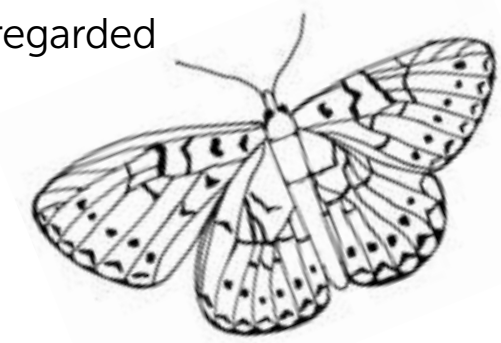
BEETLES, MOTHS & BUTTERFLIES AND CADDISFLIES

The beetles of the mires also make wide use of the resources of their environment. In the early summer, when the sedges are in bloom, *Donacia* beetles gather at the inflorescences. These beetles are insects with a metallic sheen, the larvae of which live in the roots of aquatic plants.

The *Donacia aureocincta* is one of the rarest species of this family. It lives in the flarks of aapa mires and on the banks of mire ponds. This species was scientifically described by the Finnish entomologist **John Sahlberg** in 1921, which is quite a late date for the description of a relatively large European beetles. There are diving beetles in mire ponds, some of which have specialised in catching the larvae of mosquitoes. Other beetles of the mires include Carabidae, Staphylinidae, Cantharidae and Scirtidae.

The butterflies of Finland include around 200 species living on mires, of which 58 are primarily mire species. They include impressive and colourful so-called macromoths (such as the Papilionoidea, geometer moths and owlet moths) as well as smaller and less noticeable micromoths such as leaf roller moths and tineid moths. The mire-dwelling moths are without exception herbivorous. Most of the species consume various different plants, but there are also monophagous larvae that eat only a single plant, and a few species that eat mosses. Butterflies closely associated with mires include, for example, *Boloria frigga, Erebia disa*, *Lasionycta skraelingia* and *Nola karelica*, which are found solely in mires and bogs throughout their area of distribution. The vast majority of mire butterflies feed on the shrubs and grasses of hummocks such as *Betula nana*, *Vaccinium uliginosum*, *Rhododenron tomentosum*, *Andromeda polifolia* and *Rubus chamaemorus*. There are very few rich fen species of butterflies and they are without exception rare. For example, *Aethes kyrkii* and *Eucosma saussureana* are monophagous with regard to *Saussurea alpina*, *Kessleria fasciapennella* subsists solely on *Parnassia palustris* and *Scrobipalpopsis petasitis* exclusively on *Petasites frigidus*. An exceptional moth is also *Buckleria paludum*, the larvae of which feed on the *Drosera rotundifolia*, which is known as a carnivorous plant.

Caddis flies are aquatic insects that breathe oxygen dissolved in water. Many of these species can be found in large numbers in flark fens. Caddis flies can be divided into roughly two groups, ones that construct tubular cases and ones without tubes. The case building caddisflies construct a protective case that follows the larva as it moves around on the bottom of the flark or on top of aquatic plants. *Agrypnia picta*, for example, is a caddisfly species found throughout Finland that often flies in large swarms above flarks in the middle of summer. The larvae of the last larval stage of the Hydroptilidae have a translucent and flat protective case. The Hydroptilidae are only 2–3 mm long and they suck the juices of plants. The *Oxyethira mirabilis*, in particular, is often found in large numbers in mires. The non-tube making caddis flies living in mires belong to the Polycentropodidae family, and their larvae weave nets for themselves. Species in mire flarks and pools can include at least *Holocentropus insignis* and *H. dubius*, of which the latter can be regarded as an actual mire species.



FROM LIZARDS TO AMPHIBIANS

Compared with the tropics or Southern Europe, the species diversity of reptiles and amphibians in the aapa mire region is quite limited. Only seven species are to be found in the Middle and North Boreal zones, such as common frog (*Rana temporaria*), moor frog (*R. arvalis*), common lizard (*Zootoca vivipara*) and viper (*Vipera berus*). Vipers can be seen at the edges of mires although they are not an actual mire species. Common lizards are most readily sighted on duckboards on sunny days. Only amphibians use mires as their breeding environment, but none of them are restricted to mires. Mires can be locally important at least for the moor frog, which needs a breeding pond that is not prone to drying. The mating call of the males is like the bark of a dog or the sound of putting an empty bottle under water. The moor frog can be easily identified from the mating call, but outside the spawning season it can be difficult to distinguish it from the common frog.

Wet flarks and bog-pools of aapa mires are important breeding sites for moor frog.
Photo: Esa Huhta.

A flock of taiga bean goose. Photo: Mauri Lähdesmäki.

BIRDS PREFER PEATLANDS

Birds are the most prominent and loudest animals of mire environments and no doubt the best-known ones. Depending on sources, 19 to 26 bird species nesting in Finland are classified as mire birds.

The birds of the mires include highly different species, galliformes such as *Lagopus lagopus*, *Calcarius lapponicus* and *Motacilla flava* of the passerines, *Anser fabalis* of the Anseriformes, various waders such as *Tringa glareola*, *Phalaropus lobatus* and *Calidris pugnax*, corvids (*Lanius excubitor*) and Accipitridae (*Circus cyaneus*, *Falco peregrinus*). Asio flammeus is the only owl species specialising in open mires and the large crane (*Grus grus*) is the only representative of its family in Finland. *Lagopus lagopus* is the only year-round bird of the mires; the other nesting birds are migratory.

The most numerous nesting species of the mires is *Anthus trivialis*, of which there are an estimated 990,000 breeding pairs in Finland. Along with mires, this species also nests in other open terrain. Other numerous mire birds are *M. flava*, *T. glareola*, *L. lagopus* and *Numenius phaeopus*. The largest species richness of Finnish mire-bird species is in the areas of Kittilä, Sodankylä and southern Inari, where practically speaking all the nesting birds of the mires are to be found. Many of them, such as *P. lobatus*, *N. phaeopus*, T*ringa erythropus*, *Lymnocryptes minimus* and *Calidris falcinellus* have quite a northern distribution, and the best mires for birds are the aapa mires of the north, which have both flarks and pine mires.

There are of course many other species than mire birds proper in the large mire areas of Lapland. Various waterfowl, such as *Gavia arctica*, *Mergellus albellus* and *Cygnus cygnus* can nest in the pools of mires, and *Tetrastes bonasia*, *Aegolius funereus* and *Perisoreus infaustus* can be seen in the islets of forests in mires. For example, up to 145 species of birds have been observed in a single year in the ornithologically rich mires of the Vuotos area. Of these, 126 were nesting species and the total number of birds was 53,000. Eighteen of the bird species of the area were waders, which can be regarded as a high count.

Wood sandpiper is one of the most common mire-dwelling waders. Photo: Timo Helle.

Waders are an important element among the birds of the aapa mires of Lapland. The largest and most numerous of these is *T. glareola*, while *Limosa lapponica* is the rarest with the smallest population. It is typical of many waders for the males to be responsible for caring for the young. The male *T. erythropus,* for example, broods the eggs for most of the 20-day brooding period, and the female usually begins her migration before the young are hatched. Waders typically lay their eggs in May or early June and the young are hatched in June or early July at the latest. During the summer waders migrate to their wintering areas on the coasts of Western Europe, the Mediterranean and Sub-Saharan Africa.

VIIANKIAAPA

Situated some 15 kilometres northeast of the centre of Sodankylä, Viiankiaapa is one of the most impressive mires in Central Lapland. It is included in the National Peatland Strategy and the EU's Natura 2000 network. With an area of 66 square kilometres, Viiankiaapa, like other aapa mires, consists of several mire types. Most of the area consists of open fens surrounded by swamps with 'candle spruces' and pine bogs. The special feature of Viiankiaapa, its luxuriant rich birch fens, presumably gave the name to the whole mire area. The place-name *Viianki* derives from the word *viita* meaning dense deciduous forest.

The high nutrient content of Viiankiaapa due to the greenschist of the local bedrock, elements from which rise along with groundwater to the mire's areas of springs The iron compounds that are formed (siderite and vivianite) lower the acidity of the mire, thus improving the solubility of nutrients required by plants. The phosphorus in vivianite (ferric phosphate) also has a direct fertilising effect. Nutrients and water are brought to the aapa mire not only by springs but also by the waters from snow melting in the spring over a large catchment area.

The most interesting plant species of Viiankiaapa mire are concentrated in the rich fens and spring areas. Marsh saxifrage (*Saxifraga hirculus*) and Lapland buttercup (*Ranunculus lapponicus*) are among species requiring special protection (**EU Nature Directive, Appendix II**). The same is true of several moss species, such as *Meesia longiseta*, *Hamatocaulis vernicosus* and *H. lapponicus*. There are many other endangered species, such as *Carex heleonastes* and four species of marsh orchids.

Of the large predators, bear (*Ursus arctos*) and lynx (*Lynx lynx*) visit Viiankiaapa mire regularly and wolverine (*Gulo gulo*) and wolf (*Canis lupus*) occasionally. Ornithologically, the area is one of the best in Central Lapland, whether in terms of the numbers of species, density of birds, or the number of endangered species. Species that have rapidly become endangered include many waders, such as the ruff (*Calidris pugnax*) and the spotted redshank (*Tringa erythropus*) and the meadow pipit (*Anthus pratensis*) and western yellow wagtail (*Motacilla flava*) of the passerines. Apparently the most important reason for the decline of species is the decrease of wetland areas along migratory routes and in the wintering zone, which in turn underlines the importance of nesting areas in their natural state for the protection of species.

Viiankiaapa is an important recreational area for both local people and visitors from further away. Visiting the mire is facilitated by duckboard routes at the south and north ends

(some of the duckboards are in poor condition) with towers for bird watching. Stretching almost as far as the eye can see, the mire offers different experiences according to the season: the shiny crust snows of April, the call of the whooper swans (*Cygnus cygnus*) and Eurasian cranes (*Grus grus*) in the spring, cloudberries and cranberries to be picked, and the winter gloom. For reindeer herders, Viiankiaapa and its nearby surrounding are good reindeer pastures in the spring, summer and autumn, along with providing an opportunity to tend to reindeers in a calm and relatively limited area all year round.

The first human inhabitants settled in the vicinity of Viiankiaapa around 7,000 years ago. They were prehistoric people of unknown origin who appear to have merged with the Sámi who moved north from the Finnish Lake District approximately 1,000 years ago. Individual words of their ancient language might be found particularly in place-names, whereas place-names deriving from the Kemi Sámi language that died out in the 19th century are considerably more common, for example the prefix 'Sakatti' of Sakattikumpu, a forested hillock rising from the middle of Viiankiaapa.

The earliest livelihoods were hunting, fishing and gathering. The main game animal was forest reindeer (*Rangifer tarandus fennicus*). The remains of pitfalls dug for hunting can still be seen as shallow depressions in the terrain around Viiankiaapa and the islets of forest within it. Later on, the hunting of forest reindeer was replaced by the management of semi-domesticated reindeer and Finnish colonists arriving in the region brought with them the practices of farming and livestock raising, which the old local population gradually adopted alongside their former wilderness-based economy. The farmers of Kersilö, Moskuvaara and Siurunmaa still gathered hay at Viiankiaapa in the early 1950s.

The natural state of Viiankiaapa mire is threatened by plans for mining. Large deposits of copper and nickel ore that have been discovered under the mire are to be excavated in an underground mine. The adverse effects of noise and dust, however, cannot be avoided and damage to the bedrock will cause risks to maintaining the water balance of the mire. Waste water to be discharged in the River Kitinen is also a source of concern. The International Union for the Conservation of Nature recommends the voluntary withdrawal of mining companies from the region while urging government to undertake legislative measures banning ore prospecting in conservation areas.

Photo: Jukka Suvilehto.

MIRES AND PEATLANDS ALTERED BY MAN

Finland has originally had around 10 million hectares of mires and peatlands, i.e. 30% of its land area. The resources provided by them have been sustainably utilised for millennia, in gathering berries and bog iron, and in hunting. Since the 17th century, mires have been put to use above all in agriculture and forestry by altering their natural state. In the industrial era, peat has been extracted for fuel and mires have been submerged under artificial lakes to provide hydroelectric power. Owing to human activities, many types of mires and peatlands and mire-based species have become endangered. Mires, however, can be restored to a condition similar to their natural state.

NUTRIENT-RICH MIRES CONVERTED INTO FIELDS

The first recorded instances of using mires for arable cultivation date from the 17th century. So-called swidden cultivation was practised by drying mires and burning the peat layer of the surface. This method later included adding mineral soil. In the 1920s the **Finnish Association for Mire Cultivation** developed a classification for cultivation on mires with which they could be charted and evaluated according to their vegetation. The best mires for cultivation were spruce mires with rich vegetation and rich fens with brown moss, while the poorest ones for these purposes were pine mires with sphagnum. The suitability of nutrient-rich mores for cultivation had already been known earlier. A book on mire classification by **A. K. Kajander** from 1913 points out that rich fens are hard to find especially in the southern parts of Finland, but most of them have been converted into fields. A total of approximately one million hectares of Finnish mires have been cleared into fields.

An abandoned agricultural peatland is becoming a thicket. Photo: Jukka Suvilehto.

FINLAND – A WORLD LEADER IN FOREST DRAINAGE

The drainage of mires in Finland was already carried out in the 1860s for the purpose of increasing the area of arable land. The clearing of fields was not completed on these mires, which became sites for growing timber. In the 19th century, mires were also drained to prevent night frosts, as wet mires were believed to be locations prone to night frost. In fact, the surface layer of a drained mire will increase the risk of night frost on nights in the early summer. Mires were also drained because of another incorrect assumption of preventing the paludification of nearby mineral soils. The paludification of mineral soils, however, was no longer common in the 19th century, which meant that digging these 'protective ditches' was basically useless work.

Drainage for forestry was performed in order to lower water table and increase wood growth. Regrettably often the result was a destroyed peatland with poor timber yield. Photo: Jukka Suvilehto.

The first actual forest drainage ditches were excavated in the early 20th century in state-owned forests. The drainage of privately owned forest land began in 1928 when Finland's first Forest Improvement Act was passed. Forest drainage ditches were dug with shovels and spades until the 1950s and later with mechanical meas. In 1969, drainage ditches were excavated in up to 250,000 hectares of mire and peatland. The new drainage of mires ended for practical purposes in the mid-1990s. By this time, six million hectares of Finland's mire and peatland had been drained with ditches, mostly for the needs of forestry. The drainage of mires concentrated particularly in the area south of Lapland, but the mire environments of South-West and Southern Lapland have suffered from drainage. Finland has the slightly dubious honour of being the world leader in forest drainage.

Former Posoaapa mire, current reservoir. Nattaset fells of Sompio Nature Reserve on the background. Photo: Pauli Laalo, 1972. Collections of the Regional Museum of Lapland.

POSOAAPA – A SUBMERGED MIRE

With an area of over 70 square kilometres, Posoaapa was Europe's largest aapa mire. Most of the nesting bird species of northern mires were known from the area, which also had an exceptionally large density of birds. The special value of the location was due to its large area, natural state and predominance of rich fens. **The artificial lake that was created at the site also inundated three former villages: Mutenia, Korvanen and Riesto.** Posoaapa and its nearby surroundings, a total of 300 square kilometres of mire and peatland, were submerged under the Lokka artificial lake in 1967. The artificial lake regulates the amount of water flowing to the hydroelectric power stations on the River Kemijoki.

ENERGY FROM PEAT

The history of using peat as fuel in Finland dates back to the 1880, but it was not until the 1960s that the use of peat for energy became widespread. Peat is also used as a substrate and litter but these uses are of relatively minor significance in view of biodiversity.

Between 6 and 40 million cubic metres of peat are extracted per year in Finland, corresponding to 5–35 TWh of energy. The large annual variation is due to summer conditions, especially precipitation. It is estimated that there are approximately 1.2 million hectares of mire and peatland in Finland that are technically and economically suited to peat extraction. The present area of peat fields in Finland is roughly 65,000 hectares, but drainage has also dried and thus weakened the condition of mires surrounding peatlands. Peat accounts for an average of 19% of district heating in Finland.

Peat suited to energy use must meet certain quality requirements of quality with regard to calorific value among other factors. Peat fields should be situated close to roads to permit the cost-efficient transport of peat to combustion plants. Benefits of the use of peat for energy are the domestic origin of the fuel and its positive effect on employment in outlying regions. On the other hand, peat is regarded as a fossil fuel, because as a natural resource it is renewed very slowly. Peat fields also cause considerable hazards for bodies of water, although this industry makes use of sedimentation basins and buffer areas.

Peat digging area in southwestern Lapland. Photo: Jukka Suvilehto.

THREATENED MIRE ENVIRONMENTS

The number of mires in their natural state in Finland collapsed during the 20th century. On a broader scale, undrained mires and peatlands are to be found only in Kainuu, North Ostrobothnia and Lapland. Unfortunately, the drainage of surrounding areas also dries seemingly undrained mires. The changes in the amount and quality of water coming into a mire can, for example, change a minerotrophic aapa mire into a more barren ombrotrophic mire.

A number of large mires or peatland areas were officially protected in Finland for the first time when the first national parks and nature reserves were founded in the 1930s and 1950s. The large-scale destruction of mires and peatland made people aware of the small extent of protected mire environments and as a result the first plans for preserving mires and peatland on government-owned land were drawn up in the 1960s.

In 1978, Finland's Council of State, following a proposal drawn up by the National Parks Committee decided to establish new nature reserves and national parks which would include important mire and peatland areas. The actual tour de force of conservationists was the so-called basic programme for the conservation of peatland (1979, 1981), the most important goal of which was the official protection of intact mire complexes. Later in the 1980s and 1990s, peatlands were protected or reserved for conservation in the programmes for the official protection of bodies of water for birds, broad-leaved woodland and the old forests of North Finland and the Wilderness Areas Act. A number of important sites, such as the Vuotos area at Pelkosenniemi were placed under protection through the European Union's Natura 2000 network at the beginning of the 2000s. The Nature Conservation Act and the Forest Act, which came into force in 1997 influenced the protection of small peatland sites and the protection of the habitats of mire-based species in particular need of conservation.

A total of 13% (1.13 million hectares) of Finland's mires and peatlands are currently under official protection. The geographical distribution of these protected sites, however, is skewed, as the majority of them, totalling almost 750,000 hectares, are in the North Boreal Zone.

Despite the relatively good conservation situation the mire and peatland habitats of Southern Finland are endangered. Many mire types, especially spruce mires, rich fens and spring fens, have been evaluated as endangered at the national level, but in Southern Finland many pine mire and fen types are also endangered. Mires and peatlands are the primary habitats of 223 endangered species and the secondary habitat of 420 other species. Half of all the endangered species of the mires live in rich fens. There are endangered species especially among butterflies, vascular plants and mosses, along tens of species of true flies and homopteran insects, fungi, spiders and birds.

The endangered status of various species is due to the outright disappearance of mire and peatland habitats and their qualitative degeneration owing to drainage, resulting in drying and vegetal invasion. Climate change may also threaten at least the northernmost mire and peatland species in the future. Mires have been restored in Finland already in

Keroplatid fungus gnat *Asindulum nigrum* is a rare and threatened species, known only from one rich fen in Finland. Adults are diurnal and often visit on flowers of *Saxifraga hirculus*. Photo: Jukka Salmela.

the 1970s, but to a greater extent only since the 1990s. A total of some 33,000 hectares of mires have been restored, for the most part in conservation areas. The aim of restoration is to restore to the mire its typical hydrology, i.e. level and quality of water and thereby the characteristics and species that it would have in its natural state. The restoration of mires usually involves damming the drainage ditches and removing timber that has grown on the mire if it was originally treeless.

FROM CARBON SINKS TO SOURCES OF EMISSIONS

Over the millennia, the mires of Finland have evolved into the present raised and aapa mires, as the prevailing climate and the relief and forms of the terrain have defined the kinds of mires that develop in different areas. Although some 60% of Finland's mires have been converted into fields, forest, artificial lakes and peat areas, mires in their natural state are still important elements of the landscape, especially in Ostrobothnia, Kainuu and most of Lapland. Because mires are a wet and acidic environment, in which only relatively few specialised wetland species thrive they not threatened for the time being by alien species that would replace elements of original nature. Although alien species do not threaten the natural habitat of our mires, climate change can have an effect on the properties of mires. The palsa mires of northernmost Lapland are greatly endangered, because they have only a very limited climatic range within which they appear. A possibly warming climate and increasing precipitation can destroy permafrost palsa hummocks of the region during the present century. The aapa mires will probably not be lost, but larger amounts of rainfall may change these mires in the north to have more flarks. The lawn level treeless mires of the southern part of the aapa mire zone will most likely grow sphagnum moss and become raised bogs, thus expanding the zone of these mires in Finland. Aridity in the summer is favourable for some sphagnum mosses, and *Sphagnum compactum* can become the predominant species of seasonally dry open mires. Greater dryness and heat will speed the decomposition of organic matter and mires can change from being carbon sinks to sources of carbon dioxide emissions.

Farmers at river Aatsinki, Kuolajärvi 1934. Photo: Erkki Mikkola, National Board of Antiquities.

FEED FOR CATTLE FROM MEADOWS ON MIRES

In North Finland in particular, meadows on mires were important places for growing hay well into the 20th century. Fens with various small sedges were the most common mire meadow locations. They included the meadows on open mires of the southern parts of Lapland, where horsetail, swamp grass, and bogbean were gathered to provide feed for animals. Bogbean was regarded as good milking feed, i.e. it increased the yield of milk.

Whole families would often go to the outlying open mire meadows for longer periods in the late summer to cut hay. The grasses were cut with a long-handled scythe with a wing-shaped mesh made of a branch and withes attached to it for gathering the sparsely growing soft grass into piles. The dried hay was collected either with a loop of plaited withes worn on the back or with poles borne like a stretcher. It was usually piled into a conical stack, or gathered into a hay barn if there was one at the site. Horses were of no use on the open mire with its soft quaggy surface until it froze in the winter and the hay was collected with a sledge.

The haymakers would sleep in a tent-like shelter (rankinen) to protect them against mosquitoes. It was set up at the foot of spruces or inside the hay barn. Some people even had tepee-shaped huts (kota) at the meadows. Provisions included food that would keep well, such as dried meat, salted fish, potatoes, so-called bread cheese (squeaky cheese) and bread. Butter and clabbered milk would stay cool when submerged in a wooden container in the mire or a swampy location

ROUTES AND FOOTWEAR OF THE MIRE FOLK

Like frozen lakes, marshy terrain provided flat and unobstructed routes in winter. A hard, weight-bearing crust on the snow and ice cover made movement from one place to another considerably easier and permitted contacts with even distant areas already in the Stone Age.

Along with winter means of transport such as skis, toboggans and sledges, there were special mire skis worn like snowshoes when moving about in summer on marshes and mires. Mire shoes (Fi. *heinäantura, vitsakenkä, risukenkä*) could be made by tying a piece of board worn under the foot to an arrangement of juniper withes.

Similar footwear could be attached to the hooves of horses if they needed to be used on mires. The marshy crossings of the most important routes were fitted with duckboards or an actual road of round logs or planks was built for crossing the mire.

Farmers cutting hay, Ylitornio 1921. Photo: T. H. Itkonen, National Board of Antiquities.

MIRES AS ARCHIVES OF THE PAST

Hundreds of wooden archaeological artefacts or their parts have been discovered in mires. Wooden objects quickly decay on the surface of mires; they will become dark-coloured in the oxygen-rich surface layer but in the anaerobic and acidic deeper parts organic materials can be preserved for thousands of years almost unchanged. Mires contain immense amounts of subfossil remains of plants from which we can observe the impact of man on nature through, for example, grazing livestock, slash-and-burn agriculture and other farming. The locations of finds in mire layers can be given precise dates either with radiocarbon dating or pollen analysis.

Famous mire finds in Finnish archaeology include the Antrea net, which is over 10,000 years old, and a sledge runner from Heinola which is almost the same age. A wooden sculpture depicting the head of a European elk from Lehtojärvi at Rovaniemi is dated to approximately 8,400 years ago and a fish traps made of laths are over 5,000 years old. Mires and wetland sites Northern Finland have revealed, among other finds, more or less preserved ancient skis, sledge runners, tobbogans, boats and even a pair of wooden skates. Rare finds include a 4,500-year-old paddle from Savukoski and a wooden spoon over 3,000 years old decorated with an elk's head from Pälkättivuoma in Kittilä.

GOODS FROM THE MIRES

CLOUDBERRY

(RUBUS CHAMAEMORUS)

The cloudberry is the most highly regarded and sought-after berry growing on mires. It has a highly aromatic taste and high vitamin C content. It is particularly important in East and North Finland, regions where undrained mires still remain.

Cloudberry belongs to the rose (Rosaceae) family and its genus *Rubus*, with a distribution across the northern regions of Eurasia and North America. In Europe, it is found in places in British Isles, the Baltic region, Russia and the mountain ranges of Central Europe, though not in the Alps. It grows widely in Fennoscandia but is rare in Denmark. Cloudberry grows on the hummocks of nutrient poor mires, on acidic substrates typically among sphagnum mosses and shrubs.

Cloudberries spread efficient with aid of their stolons, and their roots may extend as deep as half a metre into the peat. Sexual reproduction from seeds is quite rare. Unlike other plants of the genus Rubus, the cloudberry is dioecious, with the stamens and pistils in different flowers. The cloudberry blooms in early summer and its petals, usually five, are white. The flower is pollinated by insects, with hoverflies, house flies, dance flies and bumblebees as important pollinators. Flies are particularly important pollinators in North Lapland. The cloudberry does not have mycorrhizae. It is an important nutritional plant for the larvae of many lepidopterans, such as *Boloria frigga*, *Pyrgus centaureae* and *Lampronia luzella*.

Cloudberry is dioecious, female plant on left and male on right. Photos: Jukka Salmela.

The berries of this plant ripen by late July – mid-August. The berry is a drupe, i.e. a single berry consists of several seeds. A single berry may contain between one and forty seeds. The raw berry is red and hard and will not be easily removed from its receptacle. The ripe berry is distinguished by its juiciness, softness and ease of picking.

Cloudberry crops can vary greatly from one year to another. The best yields can be up to 330 kg/ha, which means that the pick from one hectare can be worth as much as 3,000 €. Because the cloudberry blossoms already in the early summer, it is susceptible to cold weather. The pistil flowers will not produce berries if the temperature reaches below —2 degrees Celsius. Heavy rain can remove the petals, making it hard for pollinators to notice the flowers. Cold weather at the time of inflorescence can also influence the activity of the pollinators and the beetle species *Galerucella sagittariae* can destroy stands of cloudberries.

Green fruit of cloudberry on the left (do not pick these!) and ripe berry on the right. Photos: Jukka Salmela.

CRANBERRY *(VACCINIUM OXYCOCCOS AND V. MICROCARPUM)*

The cranberry is a heath or heather plants (Ericaceae) of the genus *Vaccinium*. The berries have a tart taste, ripening to be edible in the autumn and remaining edible under snow cover until the following spring. Like other berries, the cranberry is healthy and recommended for treating infections of the urinary tract. Two closely related species, the large and small cranberry, are found in Finland. Only the large cranberry is of economic significance.

The large cranberry (*V. oxycoccos*) has a wide distribution in the northern regions of both Eurasia and North America. In Europe, it is found in, among other regions, the British Isles, Fennoscandia and Central Europe, but it has disappeared at least from Spain, the French Pyrenees, Croatia and Romania. The large cranberry grows on wet fens, pine mires and combined pine and spruce mires. Some mire butterfly species also feed on cranberries, but apparently only Boloria aquilonaris subsists solely on them.

Flower of bog cranberry. Photo: Jukka Salmela.

The fragile leaved stems of the large cranberry twist across sphagnums, the stems with blossoms form at the tips of the forks and there several flowers together. The petals are red and recurved. Cranberries are insect-pollinated monoicous plants apparently pollinated only by apids, bumblebees in particular. The pistil can also be fertilised by pollen from the same flower. Because cranberry do not blossom until June–July, they are not as sensitive to cold weather as the cloudberry of the early summer. With its mychorrhiza, which the cranberry forms together with a species of sac fungi, it can absorb nutrients better from its acidic substrate. The berries are white or light coloured when raw and dark red when ripe. The annual cranberry crop in Finland is around 20 million kilograms. The small cranberry (*V. microcarpum*) is similar to the large cranberry, but its flowers grow individually and the berry is smaller. The species has a more continental and more northern distribution, growing in drier locations than the large cranberry.

Green fruit of bog cranberry on the left, ripe fruit on the right. Kuvat: Jukka Salmela.

SPHAGNUM MOSSES, PEAT AND LABRADOR TEA

Sphagnum mosses are the most typical plants of mires and their utilisation has long traditions. They are antiseptic, preventing the growth of fungi and bacteria. Sphagnums have been used for dressing and cleaning wounds. They are also quite useful when defecating in the forest without any toilet paper available.

Peat, consisting of the undecomposed parts of sphagnum mosses and other plants are suited not only for furnaces but also as raw material for the textile industry and for taking care of one's health. Peat textiles have been made in Finland since the 1990s and in Europe cottongrass peat fibres have used for making, among other products, carpets, duvets and horse blanket. Peat fibre clothing is light and warm, absorbing the secretions of the skin and burning poorly like wool. Therapeutic peat baths were already known in the Roman Empire. A hot peat bath at around 40 degrees Celsius is an aid for treating rheumatic pain and strain injuries, while cold baths can used for treating inflammations. The effect of these bathes is based on the antiseptic and antiviral properties of peat. Peat also contains biologically active components that permeate the skin and influence, among other things, hormonal activity and metabolism.

***Sphagnum lindbergii* is a common peat moss of minerotrophic fens.**

Photo: Jukka Salmela.

Labrador or marsh tea (*Rhododendron tomentosum*) is a relative tall dwarf shrub growing on pine mires and in Lapland also in coniferous forests. In plant cultivation, its essential oils have been noted to prohibit damages caused by larvae of cabbage moth. Extracts of Labrador tea are used in homeopathy to treat insect bite. Labrador tea is also component of massage oils used for relieving pain.

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