RAPPORT BOTANISK SERIE 1994-1

REGIONAL VARIATION AND CONSERVATION OF MIRE ECOSYSTEMS. SUMMARY OF PAPERS

Asbjørn Moen and Richard Binns (editors)

UNIVERSITETET I TRONDHEIM
VITENSKAPSMUSEET

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Tidsskrift: Moen, A. & M. Selnes 1979. Botaniske undersøkelser på Nord-Fosen, med vegetasjonskart. - K. norske Vidensk. Selsk. Mus. Rapp. Bot. Ser. 1979 4: 1-96.

Bretten, S. & O.I. Rønning (red.) 1987. Fagmøte i vegetasjonsøkologi på Kongsvold 1987. - Univ. Trondheim, Vitensk. mus. Rapp. Bot. Ser. 1987 1: 1-63.

Kapittel: Gjærevoll, O. 1980. Fjellplantene. - s. 316-347 i P. Voksø (red.): Norges fjellverden. Forlaget Det Beste, Oslo.

Bok: Rønning, O.I. 1972. Vegetasjonslære. - Universitetsforlaget, Oslo/Bergen/Tromsø. 101 s.

Illustrasjoner

Eventuelle tabeller, plansjer og tegninger leveres på egne ark med angivelse av hvor i teksten de ønskes plassert.

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Utgiver

Universitetet i Trondheim,
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7004 Trondheim

Forsidebilder

Engmarihand
Dactylorhiza incarnata
(foto: A. Moen)

Fra Sølendet naturreservat i Røros
(foto: T. Arnesen)

Huldretorvmose
Sphagnum wulfianum
(foto: K.I. Flatberg)

Landskap ved elva Forra i Stjørdal og Levanger
(foto: S. Sivertsen)

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REGIONAL VARIATION AND CONSERVATION OF MIRE ECOSYSTEMS. SUMMARY OF PAPERS.

Asbjørn Moen and Richard Binns (eds.)

The report is printed in 300 copies

University of Trondheim,
Museum of Natural History and Archaeology,
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Trondheim June 1994

Abstract

Moen, A. & Binns, R. (eds.) 1994. Regional variation and conservation of mire ecosystems. Summary of papers. *Univ. Trondheim Vitensk. mus. Rapp. Bot. Ser. 1994 1:* 1- 61.

This volume consists of the summaries of the 53 papers (lectures and posters) submitted for presentation at the 6th field symposium of the International Mire Conservation Group, in Norway, in July 1994.

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Contents

Preface

This volume contains the summaries of lectures and posters submitted to the 6th field symposium of the International Mire Conservation Group being held in Norway in July 1994. Most of the contributions will be presented at the conference at the Museum of Natural History and Archaeology in Trondheim on 4-6th July (see section 3).

The contributions cover a wide range of subjects, their diversity reflecting the multiplicity of questions related to mire ecology and conservation. In the conference programme (section 3), we have tried to group the papers into logical categories, but in section 2 they are arranged alphabetically by the first author.

We have not tried to impose strict editorial uniformity on these summaries, but have altered (we hope improved) the English of most, and made a few minor deletions. As we wanted this volume to be ready before the symposium, time did not allow us to consult the authors about changes. Tight schedules also meant that not all participants were able to send extended summaries.

An edited proceedings of papers (lectures, posters) held at the symposium will be published as early as possible in 1995, probably in *Gunneria*, a series published by the University of Trondheim. All the authors contributing lectures and posters at the symposium have been invited to submit a paper based on their contribution for consideration for inclusion in the proceedings.

Inger Marie Growen and Arild Krovoll have re-typed the summaries.

Financial support for the symposium has been given by the Directorate for Nature Management, the University of Trondheim, the Ministry of the Environment and the Royal Norwegian Society of Sciences and Letters' Foundation.

The committee responsible for arranging the symposium has consisted of:

Mire ecologists: Asbjørn Moen, Kjell Ivar Flatberg and Stein Singsaas, Museum of Natural History and Archaeology, Department of Botany, University of Trondheim.

Nature management administration: Ingerid Angell-Petersen, Directorate for Nature Management.

Secretariat: Eirik Lind and Sølvi Hansen, Centre for Environment and Development, University of Trondheim, N-7055 DRAGVOLL, Norway.
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1. IMCG: Profile and aims

The International Mire Conservation Group (IMCG) is an international organisation of mire (peatland) specialists who have a particular interest in the conservation of mire (peatland) habitats.

Peatland soils cover some 5 to 8% of the world's land surface, but because peat formation is generally closely linked to climate, much of the world's resources lie in the northern climatic zones (temperate and boreal vegetational zones). This concentration of peat in some of the most industrialised countries of the world has meant that, since the 16th century, vast tracts of mire landscape have vanished throughout Europe. In many cases, these changes undoubtedly helped to transform the economies of certain regions and even, occasionally, whole nations. However, the environmental cost of this progress now means that some industrialised nations can point to a date in the near future when, without direct conservation effort, the very last natural mires will have vanished forever. For others, it is already too late - all natural mires in the Netherlands have been lost. In countries like Belgium, Denmark, Switzerland and most parts of Germany, nearly all the mires are damaged. The raised bogs of Ireland (apart from a few protected areas) may all be gone by 1997. Perhaps the most confusing situation is to be found in some eastern European countries, where mires with existing protection are threatened by the eastward expansion of western peat mining companies and by land-ownership reforms.

Mires suffer from limited scientific understanding and, perhaps more importantly, poor public perception of their true natural heritage and functional value. These factors compound and help to explain the scale of the losses. Against this backdrop, the need for an organisation such as the International Mire Conservation Group was agreed upon by a number of international mire specialists at a conference held in Finland in 1983.

The IMCG was formally established in 1984 at its first field symposium in Austria. Subsequently, field symposia have been arranged in Scotland, Sweden, Ireland and in 1992 in Switzerland. The 6th field symposium is being held in Norway on 4th - 15th July 1994, commencing and ending in Trondheim.

The IMCG aims to:

- highlight the problems facing mires on a world-wide basis and promote and support mire conservation efforts
- help policy makers at local, national and international levels to recognise that, where mires may be affected by their decisions, it is important to include mire conservation principles within the decision-making process at all levels and at the earliest opportunity
- stimulate the international exchange of ideas, information and experience among people working in the area of mire conservation and research
- act as an expert group available to individuals or organisations requiring information or assistance on the topic of mire conservation
- collate and maintain a regularly updated global audit of the mire environment and associated conservation programmes, as far as the data are available.

From 1992 to 1994 the IMCG has en elected board of three persons:

Chairman: Mr. Richard Lindsay, UK
Treasurer: Dr. Gerry Doyle, Ireland
Secretary: Dr. Gert Michael Steiner
University of Vienna
Department of Plant Ecology and Conservation Biology
A-1091 Vienna
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Ingerid Angell-Petersen

Conservation and management of mires in Norway

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The first Nature Conservation Act in Norway came into force in 1910, followed by new ones in 1954 and 1970. Four categories of protected area are covered by the Nature Conservation Act: national park, landscape protection area, nature reserve and natural monument.

The Nature Conservation Act was first used in 1911 when 52 plant species were protected in the Dovre mountains. By 1970, 36 areas in Norway had been protected, and ten years later the number was 250.

From the mid-1970's, county conservation plans began to be prepared for wetlands, mires, broad-leaved deciduous forests and seabird colonies. Such plans have now been produced for most counties, and conservation plans for coniferous forests will be completed in 1996. These plans are based on comprehensive surveys and each one is thoroughly reviewed by all the parties involved. 1422 conservation areas have so far been established, including 18 national parks. They cover a total of 200,000 ha (6.4% of the land area of Norway).

More than 25% of the original mire area of Norway below the forest limit has been drained. All the larger mires in extensive lowland districts have been affected by drainage reclamation. Peat cutting has in the past affected large areas of mire, particularly along the treeless coast of Norway. In contrast to most parts of Europe, mires in Norway were still being reclaimed for agriculture in recent decades. In the 1970's, about 10,000 ha were drained annually for agricultural and forestry purposes. In recent years, drainage of mires has been much reduced, but forestry still represents the greatest threat to Norwegian mires. Lowland mires have generally been most threatened and the Norwegian lowlands, i.e. the boreonemoral and southern boreal regions, have a low percentage of mires.

So far, 216 mire reserves have been established; in a few years, about 290 will be added to the mire plan. In addition to these reserves, mires are protected in national parks and other types of nature reserve. The total area of mires in Norway has been estimated to be about 3,000,000 ha (nearly 10% of the land surface), 2,100,000 ha of which are situated below the forest limit. At present, 1% of the mire area of Norway is protected as mire reserves, about another 2% being protected in national parks, wetland reserves, etc.

Restoration work (e.g. blocking of ditches) has been carried out in a few reserves. At Sølendet Nature Reserve in eastern central Norway, 100 ha have been restored as a former haymaking fen; the area has been regularly mown during the last decade. The great majority of mire reserves, however, have no management plan. In the fen areas of the reserves, the succession resulting from overgrowth began as soon as scything finished (often 4 or 5 decades ago) and grazing was much reduced.

Vladimir Antipin

Mires of Karelia and their conservation

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In Karelia, mires and paludified forests occupy more than 30% of the area - 5.4 mill. ha.

Fifteen types of mire complexes are distinguished on the basis of their structural characteristics, floristic composition, plant cover dynamics and water-mineral nutrition regime. Raised *Sphagnum* oligotrophic and liverwort-lichen-*Sphagnum* dystropich mire complexes are most common - about 33% of the total mire area. The structure of the plant cover of mire sites and mire complexes is discussed.

The first protected mire ecosystems were established in 1974. The Republican Mire Protection Programme was launched in 1992. Its aim is to select and preserve mire ecosystems that are typical (reference) and unique in the structure of their plant cover and genesis and that have regional, national and international importance, and also cranberry- and cloudberry-rich mires and mires with a great abundance of medicinal plants. The programme requires that all the projects connected with mire utilisation must undergo an ecological investigation. The total protected mire area is currently about 200,000 ha.

We would like to organise an international museum with a permanent exhibition devoted to mires of the Earth, based on theVodlozersky National Park. There are many virgin mires of different types in this park.

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Ingvar Backéus

Mires in Lesotho: their vegetation and need for conservation

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Most of the land area of Lesotho is occupied by the Maloti (Drakensberg) with the foothills at about 2000 m a.s.l. and the highest point at 3482 m a.s.l. Mires are frequently found on gentle slopes in valley bottoms in these mountains. They form an ecosystem morphologically somewhat related to boreal mires (cf. van Zinderen Bakker 1965).

The vegetation of the mires in the Maloti was described by van Zinderen Bakker & Werger (1974) and Backéus (1988). At middle altitudes (2400-2600 m a.s.l.), much of the mire vegetation is dominated by large tussocks of *Merxmuellera macowanii*. Where this grass grows, only a low cover of other species may be found, partly at the bases of the grass tussocks. These species include *Oxalis* cf. *obliquifolia, Ranunculus meyeri* and *Bryum alpinum*. The leaves of *M. macowanii* are very unpalatable, and also rigid and sharp, making it unpleasant for man and animals to walk where it grows. In somewhat wetter situations, *Isolepis fluitans* forms dense mats. This sedge is eagerly grazed, but can stand a high grazing pressure. In the *I. fluitans* mats, minute specimens of, among others, *Haplocarpha nervosa, Limosella major, Trifolium burchellianum* and *Lobelia_galpinii* can be found. In wet fen soaks, *Isolepis costata, Carex cognata* and *Senecio polyodon* occur frequently. *Merxmuellera macowanii* does not occur at high altitudes (2900-3200 m a.s.l). The sites studied were dominated by closely grazed swards of *Athrixia fontana, Limosella longiflora* or *Koeleria capensis*. Flarks are found at a few places at this altitude (Backéus 1989).

Both the peat and the mire vegetation are very resistant to erosion. Nevertheless, the mires of the Maloti are severely threatened by erosion caused by increasing grazing pressure. The destruction is mainly caused by grazing and trampling on the slopes upstream from the mires, not on the mires themselves. Gullies are easily formed in the mineral soil, thus causing a concentrated and rapid flow of water into the mires. Frequently, this causes narrow, but deep, channels to be formed through the peat, thus permanently draining the mire.

The mires of the Maloti are unique ecosystems with a specialized flora and fauna (especially insects). They are in strong need of protection.

Literature:

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Nikolay Bambalov

Problems of biospherically compatible bog resource utilization

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Four forms of biospherically-compatible bog resource utilization have been developed in Belarus.

Ecological bog management provides for preservation in the natural state or restoration of anthropogenically-damaged bog ecosystems, aimed at ecological balance in semi-natural landscape complexes.

Cultural-recreational bog management - preservation in the natural state and restoration of anthropogenically-damaged bogs - with the intention of using them for educational and training purposes, as field laboratories, natural monuments, historical and archaeological reserves, and in tourism and hunting, etc.

Agro-bog management - management of the development of true bogs or the restoration of anthropogenically-damaged bogs with the intention of increasing the yield of wild, semi-cultural and cultural species of berry-bearing, melliferous and medicinal plants.

Energy-technological bog management aims at intensifying the photosynthesis of bog phytocenosis for the annual reproduction of energy and organic raw material in the form of the biomass of bog plants that may be processed into solid, liquid or gaseous fuel, compost, cardboard, paper, packaging materials, etc.

Marina Botch

Modern trends in mire conservation: world picture

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Mire conservation programmes started at the end of the 1960's in Europe and ten years later in the USA. The methods and strategies used differ depending on mire areas, national traditions, scientific «Schools», etc. The paper is concerned with some principles of mire protection inWest (WE) and East (EE) Europe and in the USA. Americans have a peatland evaluation system based on (1) qualitative, (2) economic and (3) energy characteristics. The first includes «red flag features» (Larson 1976, 1982, 1990) and is based on mire functions and value. Adamus et al. (1991) introduced wetland functions. Odum (1978) proposed energy analysis. Economic methods were used by Gupta & Foster (1975) and Larson (1982). Whigham & Brinson (1990) proposed that suitable assessment methods should continue to be developed. In Europe, qualitative characteristics are used for mire protection (Sjörs 1971). Every country uses «red flag features». In WE, virgin mires cover rather small areas (except in the Scandinavian countries and Ireland) and they are well studied. The main tactics for mire protection in most European countries is to save the main mire areas (e.g. Switzerland). To this end, campaigns are organised during which TV, radio, newspapers, lectures, etc. are used to support the idea of mire protection. Mire restoration methods are widely used, too (e.g. Netherlands).

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Olivia Bragg* & Gert Michael Steiner¤

Applying groundwater mound theory to bog management on Puergschachenmoos in Austria

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Puergschachenmoos is the largest remaining valley-bottom bog in the Alps. It is situated in the Enns valley in the county of Styria in southeastern Austria. Because of its outstanding value, it was declared a Ramsar site in 1993. Strangely enough, the site is still not a nature reserve; only the central part of the mire has been rented by the WWF to prevent peat extraction. In the marginal parts, especially in the lagg zones, drainage and afforestation still continue.

Since the bog is now a Ramsar site, the Styrian government has started negotiating with the landowners to buy or rent the bog and the surrounding pastureland. Our team, consisting of a vegetation ecologist, a hydrologist, a GIS specialist and experts on agriculture and tourism, was asked by the WWF to prepare a scientific background report and the application for land and money as a basis for these negotiations and the possible future management of the area. The cost of this work is being reimbursed by the Styrian government and the Ministry for Environment, Youth and Family Affairs.

An initial vegetation survey, compared with historical data from 1947, revealed two zones where obvious changes had taken place. The hollows in the centre of the bog had become much smaller since 1947 and the mountain pines on the mire margin had grown higher and denser. When the groundwater mound beneath the site was modelled, an explanation was found for these changes. The melioration of the former much larger site and a drainage system around Puergschachenmoos had reduced the size, and lowered the hydrological base, of the groundwater body in such a way that the bog vegetation, especially in the hollows and the marginal zone, is already affected in the ways described above.

To stabilize at least the present situation, groundwater management of the drainage system is required. To improve the situation, management of the surrounding pastureland on peaty soils will also be needed.. Theoretically-based models have been prepared for these two approaches in order to calculate their costs, but without further investigations on the movement of the groundwater table over a longer period and the hydraulic conductivity of the peat it is impossible to give detailed answers. A project to work out the data required for a management and monitoring concept was suggested and is in preparation at the moment.

Antoni W.H. Damman

Major mire vegetation units in relation to the concepts of ombrotrophy and minerotrophy: a world-wide perspective

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Scandinavian ecologists have greatly increased our knowledge of mire vegetation and our understanding of peatland processes. They also have had a major impact on peatland terminology. For instance, terms such as bog and fen are now generally equated with ombrotrophic and minerotrophic vegetation, respectively. Locally these distinctions have proven very useful. However, when applied on a continental or world-wide scale, they can lead to misunderstanding. This is sometimes due to differences in definition, but mostly to regional differences in the nutrient status of ombrotrophic bogs. It is further complicated by the fact that the major phytosociological boundaries in mire vegetation do not correspond to the mineral soil water limit.

The purpose of this paper is:
1) to explain the causes of the differences in ombrotrophy,
2) discuss its effect on mire vegetation and classification, and
3) suggest ways to improve our classification of mires.

Eugenijus Drobelis

Mires of Lithuania and their conservation

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Wetlands cover about 6.5 % of Lithuania, and there are about 40,000 wetlands. Over 30 of these measure more than 1000 ha. 3,373,043 ha of farmland have excess moisture, and 2,673,293.3 ha, or 79,2 %, of these have been drained as a result of unregulated land reclamation. Today, the attitude is completely different. Prior to 1988, 44.2 thousand ha, or 10 % of all wetlands, had become protected areas. In 1992, new nature reserves were established in 20 wetland areas. There are about 90,000 ha of natural wetlands in Lithuania.

The most valuable wetlands have been declared strict nature reserves. Within one such strict nature reserve, Cepkeliu, which measures 10,590 ha, the largest wetland is preserved, covering an area of 6824 ha. The abundant fauna is represented by the following numbers of species: 36 mammals, 176 birds, 6 reptiles, 9 amphibians and over 1500 insects. The Zuvintas Nature Reserve (5442 ha), the Viesvile Nature Reserve (3216 ha), and the Kamanu Nature Reserve (4300 ha) are all strict reserves established to protect the largest wetlands in Lithuania. All of them fully meet the demands for protected areas set by the Ramsar Convention with the aim of protecting waterfowl and their habitats.

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Seppo Eurola & Pentti Hanhela

The botanical value of protected mire sites in the southern aapa mire area

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Introduction

Finland has a basic plan for mire conservation. It includes about 600 mire conservation areas covering 4900 km^2, of which over 200, covering 1660 km^2, are situated in the study area. Some small areas have been added later. This study is based on the original plan (1981) and on peatlands situated in nature and national parks.

Methods

The inventory was made on 152 randomly chosen plots measuring 0.5 x 0.5 km (381 km line) in conservation areas. A line transect method was used, the distance between transects being 50 m. The mire vegetation was allocated to 66 types of mire site. This kind of study has also been carried out in a raised bog area (Suikki & Hanhela 1993).

Results and discussion

I) In mire expanse vegetation, poor fens are protected too much in relation to their total area. Contrary to this, more spruce mires and swamps should be protected in mire margin vegetation.

2) The limits of the protected areas are partly non-natural, lacking thinly peat-covered margins which are heavily ditched.

3) The figures for birch fens, pine bogs/mires, pine fens and poor fens give satisfactory protection for the "usual" types of Finnish mires.

4) Rich fens are well protected. However, their total area is small, but their floristic value is great. For floristic reasons more protection of spruce mires, swamps and spring vegetation is needed. The 10 rarest types of mire site make up only 0.3 % of protected areas and include spruce mires (2), rich fens (1), swamps (3) and spring vegetation (4 sites). Thus, more small conservation areas are needed.

5) 11.9 % of the protected peatlands are ditched. Fortunately, over half of them are in recently drained condition and their vegetation has not changed much.

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Kjell Ivar Flatberg

The Sphagnum flora of Norway

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The Norwegian peat-moss flora is the most diverse in Europe, 47 species having been described. In addition, there are three species in the Arctic archipelago of Svalbard, *S. arcticum* Flatb. Frisv., *S. olafii* Flatb. and *S. tundrae* Flatb. Only *S. lenense* H. Lindb. ex Pohle (Arctic Russia), *S. skyense* Flatb. (Scotland) and *S. pylaesii* Brid. (France, Spain), among the known European species, remain unrecorded from Norway. All 47 Norwegian species are found in central Norway, which is therefore a unique peat-moss province, also in a world-wide context. The high diversity of peat mosses in this province is due to a meeting of floristic elements of southern (e.g. *S. viride*), western (Atlantic) (e.g. *S. strictum*), eastern (e.g. *S. wulfianum*), montane (e.g. *S. annulatum*) and northern (e.g. *S. aongstroemii*) geographical affinity and the great variation of undisturbed wetland vegetation types. My taxonomic revisions of northwest European peat mosses during the last two decades have resulted in the description of four new species and three subspecies based on Norwegian material. *S. troendelagicum* is the most exclusive of these, with its known distribution confined to central Norway. The *S. imbricatum* Russ. complex consists of two distinct taxa in Europe with different distribution and habitat preferences, *S. austinii* Sull. mainly confined to bog hummocks, and *S. affine* Ren. & Card. mainly confined to transitional poor and intermediate fen lawns. *S. imbricatum* (s. str.) is confined to eastern Asia. Five species are recognized in the *S. recurvum* complex, *S. angustifolium* (Russ.) C. Jens., *S. brevifolium* (Braithw.) Roell, *S. fallax* (Klinggr.) Klinggr., *S. flexuosum* Dozy & Molk. and *S. isoviitae* Flatb.

Peat mosses from central Norway are displayed in an exhibition during the conference, and a field colour guide to Norwegian peat mosses is presented. 40-45 of the Norwegian species are likely to be found during the excursion.

Susanne Rundlöf Forslund

Wetland inventory in Västerbotten

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This inventory of wetlands in the county of Västerbotten is one of the most extensive natural inventories carried out in Sweden. The project began in 1983 and required just over the equivalent of 15 years' full-time employment. It was concluded in 1993. The National Environmental Protection Agency's methods for surveying and classifying wetlands were used.

Wetlands are classed as areas where water lies at, or slightly above or below, the ground surface for most of the year. The term «wetland» also includes water bodies covered with a floating raft of vegetation. Wetlands can be divided into three categories: mires, shores and other wetlands.

Below the mountain region, inventories were made of every wetland measuring at least 50 ha. More than 25 % of the county is estimated to be wetland. The survey took in 14 % of this, where 4306 wetlands cover 700,000 ha. The mires are well documented, as just over 70 % of the total mire area was included in this inventory. But only 10 % of wet forests was surveyed. Interpretation of black and white aerial photographs provided fundamental knowledge about the wetlands of the county.

Mires dominate the wetlands and increase proportionately in the interior. On the coast, mires account for just over 70 % of the wetlands, but in the pre-montane region the percentage is 90. The coastal region is much more influenced by the sea, lakes, streams and rivers.

Sites were visited at 657 wetland locations or approximately 15 % of the total. Several species were discovered in the county for the first time. Descriptions and species lists were made of just over 9000 plant communities. 82,000 vascular plants were recorded from 369 species, and 31,000 mosses from 200 species. More than 5000 birds were recorded, mostly from a supplementary mire bird inventory of 154 sites, covering 62,000 ha. Butterflies and dragonflies were observed at a large number of sites. Molluscs were recorded on a few selected rich fens.

Categories of conservation value were identified, based on certain conservation criteria, primarily size, accessibility, unspoiled qualities, variety and selection. Following comparison between sites within a biogeographical region, the sites were automatically graded. Computer processing facilitated the grading of a large number of wetlands.

In the county, 403 sites have been placed in Class 1 «very high conservation value», accounting for slightly less than a quarter of the wetlands surveyed. Class 2 «high conservation value» also accounted for a quarter of the area, with 936 sites. Class 3 «some conservation value» is the largest category with 2395 sites and accounts for 40 % of the area. Class 4 «no existing conservation value» has no known conservation values and is substantially affected by exploitation. This class has 573 sites and accounts for 10 % of the area surveyed. The number and areal distribution of the classes varies from one biogeographical region to another.

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Peter Foss

23 internationally important raised bogs threatened

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A recent reappraisal of the status of the 99 Raised Bogs of European Conservation Importance in Ireland (Natural Heritage Areas) has revealed a level of damage that will almost certainly lead to the extinction of these sites before 1997, unless steps are taken to bring damage-causing activities under planning controls. The Irish Peatland Conservation Council has called for any development on a Natural Heritage Area (NHA) to be subject to planning controls and environmental impact study. Only in this way can the continued loss of the raised bogs be halted (see Note 1).

The 99 Raised Bogs of European Conservation Importance cover an area of 17,970 ha (6 % of the original raised bog area in Ireland) and represent the best examples of this habitat type in western Europe. In the last two years, since the IPCC published its Policy Statement and Action Plan listing sites of conservation interest, damage has been caused to 23 sites affecting an area of 5,608 ha of peatland. The damage includes traditional turf extraction, but this is insignificant when compared to the scale of the damage being caused by mechanical turf extraction schemes, road construction, drainage and fire.

Over the same period, 409 ha of raised bog have been purchased for conservation by the state, bringing the total area conserved to 2,568 ha, just 26 % of the Government target of 10,000 ha. The damage being caused could jeopardise the Government's plan to conserve 10,000 ha of raised bog.

Literature:
Note 1: The Irish Peatland Conservation Council is a national charity and is entirely supported by voluntary contributions. Conservation projects include: purchasing bogland nature reserves, providing resources and training for teachers and education groups, repairing damaged bogs, fostering a positive attitude towards bogs and encouraging lifestyles in harmony with the environment.

Ph. Grosvernier, Y. Matthey & A. Buttler

Microclimate and physical properties of peat: new clues to the understanding of bog restoration processes

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i) Knowledge of initial ecological conditions which allow *Sphagnum* mosses to recolonize a disturbed peatland mainly concerns the hydrosere system, as a dynamic form of terrestrialization, but few studies, if any, have described such recolonization by paludification.

ii) Two paludification successional series leading to the formation of a continuous *Sphagnum* carpet encountered in the Swiss Jura Mountains, with, as pioneer species, a) *Eriophorum vaginatum* and b) *Polytrichum alpestre,* are described. They suggest that both the physical properties of the peat and the microclimate play an important role in triggering the growth of *Sphagnum* on dry, and apparently hostile, bare peat surfaces.

iii) Two greenhouse experiments were undertaken to answer the questions a) Which *Sphagnum* species is best adapted for recolonizing dry, bare peat surfaces? b) What is the relative importance of a high water level? c) How can peat properties help to reinitiate *Sphagnum* growth? d) How far can a particular microclimate compensate for a low water table?

iv) Beyond its apparent sensitivity to ecological factors, *S. fallax* seems to be a very effective species in recolonizing dry, bare peat, particularly because of its fast growth rate and carpet-dwelling capacity, and its greater resistance to total desiccation, in terms of recovery ability, even when growing as isolated plants.

v) When *S. fallax* is grown as isolated plants on bare peat, like diaspores, the depth of the water table, the microclimate and the type of peat contribute equally to the variation in growth. Pore size distribution in the upper haplotelmic peat profile, as a result of an increased mineralization rate, appeared to be most relevant in influencing the water regime. On the other hand, communalism with some pioneer species can provide an effective alternative to the lack of a suitable permanent water table by creating a favourable microclimate.

Literature:

Grosvernier, Ph., Matthey, Y. & Buttler, A. (in press): Microclimate and physical properties of peat; new clues to the understanding of bog restoration processes. In: Wheeler, B., Shaw, S. & S. Fojt (eds.): *Restoration of temperate wetlands*, John Wiley & Sons.

Andreas Grünig

Results of the 1992 International Mire Conservation Group symposium in Switzerland

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Two years ago, the 5th IMCG field excursion and symposium took place in Switzerland. The meeting was the largest so far and was attended by 40 mire conservationists representing 18 countries from all over the world, including representatives from Canada, Estonia, Germany (former GDR), Japan, Poland, Russia and the USA. The event was a two week study tour of bogs, fens and mire landscapes in almost every part of the country.

The aim was to provide an introduction to the principal types of peatland in Switzerland. The delegates were immediately struck by the diversity and beauty of the different mires. It became evident that the country has a particularly important part to play in conserving some of Europe's outstanding high-altitude mire habitats. IMCG members had an opportunity to see the basic problems facing the conservation of mire habitats in a small, mountainous, yet densely populated and federalist, country which has already lost up to 90 % of its natural peatland heritage. The participants learned of the difficulties in implementing the Rothenthurm amendment to the Swiss Constitution. Problems of fenland and mire landscape conservation were discussed. The group also tried to understand how land-use conflicts had been resolved by negotiation and agreement, and how positive mire habitat management, stipulated by agreements, can support the process of rehabilitation of damaged peatlands.

By coincidence, the political debate on the protection of mire habitats and mire landscapes reached its climax at the time of the IMCG event in Switzerland. Press coverage of the issue throughout the country reached the extent of 300 to 400 newspaper articles per month. IMCG members were disappointed to discover that the most common objections to the proposed mire conservation law and decree were that the sites were too large and that the law was too restrictive in its interpretation of the constitutional amendment. The lesson to be learned was: mire conservation will always remain hard work, even when specific laws and decrees exist which are among the most advanced in the world. Evening lectures and presentations gave IMCG participants the opportunity to report on conservation issues in their own countries; specific problems were discussed and resolutions formulated. In the middle of the field excursion, the traditional IMCG symposium was held in Berne. Keynote lectures were given on mire conservation, peatland monitoring and the effect of climatic change on the development of peatlands. Comparisons were made between the situation in Switzerland and other densely populated countries, such as Austria, the Netherlands and Britain. The details of the excursion, additional information about Switzerland, the proceedings of the symposium and parts of the evening lectures were published together with the 1992 IMCG resolutions in «Mires and Man» (Grünig 1994).

During the excursion, the IMCG prepared formal resolutions which were sent to the central governments of 13 countries and to 58 local governments and non-governmental organisations. There were replies from 8 countries, but none from Finland, France, Japan, Poland and Russia. The countries that responded expressed a positive attitude towards the concept of mire conservation. However, the consequences of these Swiss resolutions were not much more uplifting than the results of the Irish resolutions passed in Dublin in 1990 on which Foss (1991) reported: «With a few notable exceptions, progress was disappointing».

In this paper, a review of the 1992 IMCG resolutions and the replies received will be examined, beginning with Austria.

Literature:
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Roland Haab

Monitoring the bogs and transitional mires of Switzerland (protection, management and vegetation development)

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In Switzerland, the bogs and transitional mires of national importance are now almost completely under protection as far as national legislation is concerned. In 1991, the Federal Council passed a law stipulating the conservation of the 514 objects in the Inventory of the Bogs and Transitional Mires of Switzerland (DFI 1991), covering 1500 ha. Two-thirds of the bog area in Switzerland have been impaired by human activity and a considerable part needs regular management.

The cantons are in charge of putting the protection legislation into effect and are thus called upon to see that the protection measures for the designated areas are recognized by the landowners and to regulate the respective land use. The Federal Government assists them with annual subsidies of several million Swiss Francs. Considering this amount of money and the necessary administrative work on the one hand, and the scarcity of bogs in Switzerland on the other, the question may well be asked whether these efforts do indeed lead to the results envisaged by the protectionists and those who made the laws.

For this reason, a comprehensive nation-wide monitoring concept has been developed at the Swiss Federal Institute for Forest, Snow and Landscape Research. In a one-year preliminary project in 1993, several methods were evaluated, tested and improved for monitoring purposes, in particular for observing changes in the vegetation.

The monitoring concept, however, is not confined to following the development of the bog vegetation. Its scope also takes in all the legal and planning procedures of the administration as well as the actual management measures carried out on the bogs. Thus, it will be possible to gain insight into how the most important protection measures and management techniques affect vegetation development. A solid basis for evaluation and decision making, which is not available today, can be established for a future bog protection policy in Switzerland.

The monitoring concept combines several stratified samples on different levels of focus. Not very time-consuming questions of a general nature are studied on a large sample (e.g. comparison between the total area of the objects according to the Federal Inventory and that of the objects in the cantonal protection plans), whereas more sophisticated investigations requiring a lot of work (e.g. relevees on permanent sample plots) are conducted on a smaller sample.

The development of the vegetation is observed by two methods, each using a different focus. Vegetation mapping based on aerial photography is used to investigate spatial dynamics and qualitative changes in the floristic composition of plant communities. Permanent sample plot studies are conducted to discover changes in the cover values of individual species, and over a longer period the analysis of the indicator values may reveal changes in site conditions. The methods elaborated in the preliminary project have been designed to provide results at an early stage that are exact, ecologically significant and, nevertheless, representative for the entire bog area and also to minimize the influence of the person conducting the study.

For the vegetation mapping, a set of 48 mapping units has been established to meet the specific requirements of monitoring. The scientific description of these units includes floristic sociological groups of species, dominant species. community architecture, as well as ecological features.

On-site mapping on large-scale infrared photographs (1:5 000) is processed photogrammetrically. The discernibility of the structure lines still accessible by stereoscope lies at about 0.5 m. Such a high resolution capacity allows, for example, any changes in the size of individual hummocks, hummock-hollow complexes or erosion complexes to be ascertained at an early stage, precisely and on a large scale.

A report about this project (Haab et al. 1994) was submitted to the federal authorities early in 1994. In this report, the concept is explained, the results of the evaluation and development of the methods are presented and three possible scenarios with different sample sizes are described and commented upon.

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Izabela Háberová

Mires of Slovakia

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Mires represent an important group of rare and threatened plant communities in Slovakia. They are a relict kind of vegetation representing an important refuge for Arctic flora which emigrated to the western Carpathian region during glacial periods.

From the point of view of nature conservation, the mires are important biotopes capable of fulfilling the task of providing genepool protection for a large group, 92 taxons, of endemic, rare and threatened taxons of vascular plants in the Slovakian flora. As regards phytocenology, these mostly belong to the classes, *Scheuchzerio-Caricetea fuscae* R. Tx. 1937, which comprises 35 associations, and *Oxcycocco-Sphagneta* Br.-Bl. et Tx 1943, which comprises 6 associations.

The mire ecosystems are protected in 38 state nature reserves, mainly located in national parks and protected landscape areas. The network of these protected areas will be completed after the wetland biotope mapping is concluded in 1996.

Partial monitoring using the monitoring system «Biota», which covers the main types of Slovakian ecosystems, is being carried out on permanent plots in the Klin Nature Reserve, a peat bog located in Horná Orava Protected Landscape Area.

Literature:

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Raimo Heikkilä

A complementary mire conservation programme for Finland

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A nationwide mire conservation programme for Finland was ratified in 1981. It consisted of 600 mires covering altogether c. 500,000 ha, mainly large mire complexes. During the 1980's, assessment of threatened plant and animal species and studies of rich fen vegetation showed that the diversity of mires was not yet adequately protected. Also some 50,000 ha of privately owned mires in the conservation programme were ditched during the 1980's. The development of a complementary network of mire reserves was therefore started in 1990 by the Nature Conservation Research Unit. During the work, parallel with studies of old forests, it was discovered that also small-scale mosaics of forests and mires were not well enough included in the mire conservation programme.

As a result of the work, a complementary mire conservation programme is being prepared consisting of c. 500 mires, covering altogether c. 120,000 ha. Most of the mires it is proposed to protect are small rich fens and fertile spruce mires which are threatened mire site types in Finland. Some large mire complexes, formerly intended to be worked for peat, have also been included because peat extractors have not started working the mires. Some of them are important habitats for threatened bird fauna, e.g. the peregrine falcon. The protection of succession series on mires along the coast of the Gulf of Bothnia where land uplift has taken place, and of some large areas of mosaics of mires and forests, up to 6200 ha in size in Lintusuo, near Oulu, is also of great importance.

Mati Ilomets

State of Estonian mires - past, present and future alternatives

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In 1922, Vellner published the first map of Estonian mires, which showed 517 mires covering a total area of 676,800 ha. Raudsepp (1946), using data mostly collected during World War II, detailed the peat resources of 935 mires (326,074 ha) and presented corresponding regional maps.Truu et al. (1964) gave the results of peat resource investigations of 6990 mires with a total area of 933,875 ha and published a coloured map of the mires. Between 1931 and 1955, the vegetation of Estonia was mapped and the distribution and structure of the plant communities was described by Laasimer (1965); mires covered 1,003 mill. ha, up to 5 % of which had been drained. Orru et al. (1993) published a map and reported some results of peat resource studies made over some 17 years from 1971 to 1987 by the Estonian Geological Survey which indicate the existence of 9836 peatlands on an area of 1,009 mill. ha. In 1993, the Ministry for the Environment supported a pilot study aimed at obtaining preliminary information about the state of our mires. The study was mostly based on data from unpublished reports dating from the last 20 years prepared by various governmental bodies (Forestry Agency, Amelioration Agency, etc.) and Tartu University. Although Valk (1988) states that some 30 % of Estonian mires have been drained, our results indicate that up to 70 % of mire areas have been drained or been significantly influenced by amelioration work. Some 10 % of minerotrophic fen sites and about 65 % of ombrotrophic bog sites are still in a virgin state. Almost all paludified sites are lost. There is an urgent need to map the state of Estonian mire sites. The destiny of our mires largely depends on legislation being developed to provide effective conservation to reduce the potential destruction of sites through land privatization and the rapidly increasing interest for exploiting peat resources.

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Toshio Iwakuma & Ryuhei Ueno

Ecology of benthic invertebrates in mire waters

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Benthic macroinvertebrate communities were surveyed in streams and pools in Miyatoko Mire, a small mire in central Japan. The mire is covered with *Sphagnum fuscum, S. magellanicum, S. palustre* and *S. papillosum* and pools with *Menyanthes trifolia, Symphaea tetragona* and partly with *Phragmites australis.* The pH value ranged seasonally between 5.6 and 6.7 at spring sites, and 4.9 and 6.8 in streams and ponds. Macroinvertebrate communities were dominated by chironomids. A total of 38 species of chironomid adults were collected by rearing larvae collected from various parts of mire waters and by using a light trap and an insect net. These species belonged to four subfamilies, i.e. 13 Tanypodinae, 1 Prodiamesinae, 9 Orthocladiinae and 15 Chironominae species. The chironomid composition was similar to that of bog waters rather than fen waters since there were more species of Tanypodinae than Orthocladiinae, as reported for Canadian mire waters. Six to 11 chironomid species were collected from each sampling site.

In a shallow pool receiving stream water originating from a spring, a detritivore *Stictochironomus akizukii* and a carnivore *Procladius culiciformis* dominated the zoobenthos community. *S. akizukii* larvae fed on small algae such as *Aulacoseira* spp. and detritus whereas third and fourth instar larvae of *P. culiciformis* fed on first to third instars of *S. akizakii* as well as large diatoms and desmids such as *Frustria, Suriella, Closterium* and *Euastrum.* Each chironomid species had a two-year life cycle with overlapping two-year classes. The annual secondary production was 1.4 gCm^{-2} for *S. akizakii* and 1.0 gCm^{-2} for *P. culiciformis.* The primary production was 36 gCm^{-2} for benthic algae and 6.0 gCm^{-2} for epiphytic algae on macrophytes. *P. culiciformis* production was achieved mainly in early summer and depended on benthic algae, whereas *S. akizukii* production was achieved by detritus originating not only from algae but presumably from *Sphagnum* or macrophytes.

Janina Jasnowska & Leslaw Wolejko

Inventory - a key to the sound protection of mires in western Pomerania, Poland

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The poster presents in graphical form a relationship between the mire inventory and the use of data collected for nature protection purposes. Western Pomerania displays a wide range of young postglacial landscape features, thus providing good conditions for the development of different mire types.

A mire inventory, based on thorough stratigraphical and geobotanical research, was carried out by a team led by Prof. Mieczyslaw Jasnowski during the period 1956 - 1974. Since then, its results have provided guidelines for further scientific research and enabled a programme to be formulated for establishing a network of mire reserves. Moreover, the need to protect mires has been an important determining factor in the creation of several large protected areas, such as national parks and landscape parks. One of the largest European mire complexes has been protected through the newly-created Polish-German National Park, the «Lower Odra Valley».

The recent switch from state-controlled land use to market economy-oriented utilisation of resources creates a new challenge to local nature protection authorities. Mire inventory provides a tool for solving this problem, by offering a base for evaluation of mires and selection of objects for various nature management practices.

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Lebrecht Jeschke & Christina Paulson

Karst mires in the Jasmund (Isle of Rügen) National Park

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After nearly every large mire in central Europe has been drained and cultivated, or used for peat extraction, nature conservation interests are mainly directed to smaller mires. These often remain almost unchanged, and even if they have been disturbed it is possible to return them to their natural state.

At present in Mecklenburg-Vorpommern, a programme for restoring such mires is underway in large protected areas such as national parks, nature parks and biological reserves. In this connection, a list has been drawn up of the mires in the Jasmund National Park on the Isle of Rügen (2250 ha). The beech forest district of Stubnitz, where the subsoil derives from Cretaceous sediments, has about 90 small mires (1.5-10 ha). Only a quarter of these can be characterised as intact, where no disturbance in the hydrological balance can be seen.

The mires of the national park can be grouped in the following types:

- Kettle-hole mires in deep, dead-ice hollows of Pleistocene age having no distinct outflow of water (thermokarst)
- Karst mires (*senso stricto*) with water flowing away underground, probably through a swallow hole (Schluckloch)
- Spring mires and percolating mires in valleys with surface drainage

The peat-forming vegetation in kettle-hole mires is formed by *Sphagnum - Eriophorum* associations. That of karst mires varies depending on the movement of water. If the mire surface is fairly horizontal the *Carex elata* association dominates (= swamp mire, Versumpfungsmoor), and if it is inclined *Carex acutiformis - Carex paniculata* associations are the peat-forming vegetation (spring mire - Quellmoore, percolating mire - Durchströmungsmoor).

In stream valleys with forest-spring mires, the alder forest association *Cardamino - Alnetum* is developed.

In young spring hollows near the cliffed coast, the initial stages of chalk-spring mires (the *Cratoneurum commutatum* association) occurs.

Spring mires and percolating mires in karst mire holes were mainly drained last century and changed to meadows and pastures. Their restoration is difficult. Kettle-hole mires, in contrast, have seldom been drained. To restore these it is only necessary to stop water flowing away.

Hans Joosten

The Golden Flow: recent developments and future perspectives in international peat trade

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On a global scale, peat extraction harvests only a small quantity of peat in comparison with global peat resources and annual peat accumulation in mires. Extraction, however, is not evenly distributed over the mire regions, but focuses on a limited number of localities.

In recent years, various developments have been taking place that affect the quantities of peat being extracted and the international pathways of peat trade.

These developments include:

- increasing use of peat as a result of growing agricultural interest in horticulture, coupled with new legislation and new horticultural production techniques
- growing numbers of composts resulting from composting organic waste (household refuse)
- declining domestic peat resources in major peat consuming areas in western Europe
- local effects of the anti-peat campaigns of conservationist groups
- increased promotion of peat consumption by the co-ordinated efforts of the International Peat Producers Association
- geopolitical changes leading to the origin of new, independent states and associated changes in socio-economic and (energy) political conditions.

A review is given of recent developments in the quantities of peat extracted in several countries, both for energy production and horticultural purposes. Recent and future changes in international peat trade and their consequences for international mire conservation are discussed.

Tatjana Jurkovskaja

Approaches to the typology of mire systems

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A mire system is a large spatial unit of vegetation cover. It represents a complex mire massif formed by the fusion of several simple mire massifs during their evolution. The movement of water throughout the system means that they closely interact with each other, producing specific structures and appropriate vegetation characteristics only found in mire systems and absent from simple mire massifs.

To study the natural differentiation of mire systems, the author has analysed a large amount of personally collected data and reviewed those available in reference books and maps of peat resources, in addition to studying aerial and space photographs from a vast area of European Russia.

I propose to differentiate three types of mire system.

1. Mire systems formed by one type of mire massif. The differences between the massifs which comprise a system lie within the variation of a particular type of mire massif, being largely due to the size of the watershed. The massifs have followed a common evolution and their plant communities have the same spectrum of indicator species, dominants and highly constant species.

2. Mire systems formed by mire massifs of different types, whose differences are related to their different ages, but which have close dynamic relationships and whose communities have a similar spectrum of essential species.

3. Mire systems which have been produced by types of mire massifs belonging to different classes with different courses of development and greatly differing community compositions.

These principles and ways of representing the vegetation of mire systems have been tested on small-scale geobotanical maps made at the Department of Geography and Cartography in the Komarov Institute of Botany.

Marek Kloss & Jadwiga Sienkiewics

Hydrological types of mire in the Polish lowlands and related vegetation

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Assignment of mires in the Polish lowlands to distinct hydrological types is a complicated task. Depending upon water supply and mobility, the following basic types of mire were identified: fluviogenic, soligenic, topogenic and ombrogenic. Fluviogenic mires are typically covered by the vegetation of inundated plains, including reed beds (*Phragmition*) and tall sedge (*Magnocaricion*) communities. Sedge-moss communities (*Caricion lasiocarpae* and *Caricion fuscae*) frequently develop on soligenic mires when the substrate is saturated with water. Eutrophic alder communities develop where there is much lateral seepage or surface run-off. Topogenic mires are frequently forested with alder or birch woods (*Alnion glutinosae*) or may host tall sedge communities, e.g. *Caricetum elatae*. Ombrogenic mires are characteristically covered by dense *Sphagnum* carpets with *Sphagnion magellanici* communities or by pine forest communities associated with bogs (*Vaccinio uliginosi-Pinetum*).

Literature:
Okruszko 1983, Sjörs 1983, Kloss 1993

Robert Krisai

Mires of Tierra del Fuego and the need for conservation

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Because no-one is participating from the Southern Hemisphere, I want to draw attention to southernmost South America and its unique bog landscape.

The central part of Argentinean Tierra del Fuego presents an almost untouched, wide range of mires, mostly raised bogs, with bog pools, hummock/hollow patterns and quagmire areas on lake shores. The vegetation seems to be similar to that of the Northern Hemisphere, but contains a lot of endemic species.

Today, there is a chance of protecting part of it in its natural state, but even in this remote part of the world, population pressure and economic demand increase day by day; so something should be done!

Literature:
Roivainen, Schwaar, Moore, etc.

Tapio Lindholm & Hanna Heikkilä

Restoration of drained boreal mires in Finland

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In Finland, a great deal of the natural environment has been destroyed by large-scale drainage of mires for forestry. About 60 % of the mires in Finland have been drained. Most of the drainage has been done in southern Finland, where the proportion of drained mires exceeds 90 % in many regions.

Drainage starts a secondary succession which rapidly destroys the vegetation and original biotopes of the mires. Gradually, tree growth destroys the mosaic landscape pattern of mires and mineral-soil forests.

A mire conservation programme has been initiated in Finland to preserve some of the natural mire ecosystems. About 80 % of the mires in the programme have been protected, but about 100,000 ha of privately-owned mires are still awaiting a decision on protection. Almost half of this area has been drained recently. Some 5000 ha of the protected mires had already been drained before the decision to protect them. In nature reserves, mires should be in a natural state, and if they have been drained, they should be restored. There is also a need to restore unprotected areas, but a decision on this is still awaited. A great deal of forestry drainage has been unprofitable. There is also a need to restore mires for recreation purposes.

Some representative, drained mires in nature reserves have been selected for restoration experiments, including post-restoration monitoring and study. A detailed plan for restoring mire landscapes in the Seitseminen National Park has been prepared, and several others will be ready in 1994. A guidebook for mire restoration has been written on the basis of experience gained in the experimental areas.

Richard Lindsay

Living close to the edge - peatland conservation and classification

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Today the IMCG is ten years old. The organisation was conceived in Finland during a brief but enjoyable union between vegetation ecologists and peatland conservationists, and was born the following year in Austria. The organisation is essentially practical in outlook concerned with peatland conservation around the world rather than becoming too engrossed in the details of peatland ecology for its own sake. As such, the biennial field symposia of the IMCG provide two important functions. Firstly, they permit the members of the Group to see at first hand, as well as to some extent highlight, the particular problems facing peatland conservation in the host country. Secondly, the Field Symposia encourage the discussion of common problems and areas of difficulty in the field, using real-life examples to illustrate points. The practical nature of the Symposia is also emphasised by the fact that participants can contribute to, and endorse resolutions concerning peatland conservation issues. These resolutions focus on urgent peatland conservation issues around the world, and are sent by the Symposium organising committee to the appropriate authorities. However, this practical conservation work cannot divorce itself entirely from ecological science because the two are closely inter-linked; without sound science, nature conservation objectives can neither be determined nor achieved. One particular issue which needs to be urgently addressed is the question of peatland classification. The IMCG review of European mires, coordinated by Löfroth, has revealed a terminological Tower of Babel, particularly in relation to site types. This makes it extremely difficult to collate inter-nation statistics and thus also weakens international conservation efforts. Harmonising these various terms is likely to be relatively straightforward for prime, typical examples of the various classes, but the hard work begins at the edges; if the edges are defined ill one way, a resource may appear extremely rare, whereas a simple re-definition of the "edge" may result in a resource-base which is then extremely common. This fact is not lost on developers, who are increasingly attempting their own re-definitions of peatland systems for their own ends. This is an issue which we must address.

Ivan I. Lishtvan

Problems of restoration and rational utilization of commercially-worked peat deposits

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The conservation of bogs is part of the national policy of the Republic of Belarus within the field of environmental protection.

This paper briefly reviews the types of bogs in the Republic of Belarus, and their flora and fauna. Peat deposits are practically non-restorable when the biological productivity and water-absorption capacity of the bogs have been destroyed. The properties of peat deposits, such as the organic substances and minerals they contain, change when drainage takes place; erosion is, moreover, intensified. Basic trends in the utilisation of peat deposits and the criteria used when deciding targets are outlined, including a summary of products, processing methods and problems related to resource-saving technologies. Peat bogs that have been exploited may be restored in nature parks, nature reserves, etc., and may be protected there if they remain unexploited. When peat bogs that have been subjected to peat extraction are to be restored, their geomorphology must first be studied and they must be classified. The composition and properties of peat remaining in a deposit, the level of the biochemical transformation of peat-forming plants and the conditions for peat accumulation must be assessed.

Michael Löfroth

Status of European mires - distribution, threats and protection

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The goal of this IMCG project is to produce an expert report about the distribution, threats and conservation of mires in Europe. The last attempt to do so was in 1980 by Roger Goodwillie for the Council of Europe. However, that report was restricted to western Europe and involved no field work.

After the Goodwillie report was published, mire and wetland inventories were prepared by several European countries (e.g. Britain and Sweden). and other countries (e.g. Austria and Germany) have carried out detailed research and mapping of mires, particularly on mire ecology.

To date, the IMCG has compiled information on the distribution of the mire area, the different mire types, exploitation history, current threats, management practices, conservational status, etc. from 22 countries:

Austria, Belarus, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Iceland, Ireland, Italy, Latvia, Netherlands, Norway, Poland, Portugal, Russia, Spain, Sweden, Switzerland, United Kingdom.

We are also compiling information from other countries. The greatest lack of information at present relates to the Balkan area, Lithuania and the Ukraine. In recent decades, vast tracts of mire landscape have vanished throughout Europe. In the Netherlands, mires used to cover more than half of the land area. Now, all natural mires have been lost, some 375 km^2 of mire remnants are protected in more than 300 reserves. Intensive restoration and management are needed to improve the value of the nature in the protected areas; in fact, the Dutch situation shows how expensive mire conservation can become when it starts too late!

Nearly all the mires are damaged in countries like Belgium, Denmark, Switzerland and most of Germany. The raised bogs of Ireland (outside a few protected areas) may all be gone by 1997. Perhaps the most confusing situation is to find that in some eastern European countries, protected mires are threatened by the eastward expansion of western peat mining companies.

Asbjørn Moen

Classification systems for mires in Norway

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The different mire types (hydromorphological units of mire synsites) used in connection with the Norwegian national plan for mire nature reserves are described. The 17 types defined are grouped into 6 main ones: A. Typical raised bogs (domed, with marginal forest and lagg); B. Atlantic raised bogs, (domed, without marginal forest and lagg); C. Plane bogs (not distinctly domed); D. Blanket bogs (defined sensu stricto as an ombrotrophic type); E. Mixed mires (include both ombrotrophic and minerotrophic features); F. Minerotrophic mires (fens).
Two different systems of classification of mire vegetation in Norway are presented.

1. The main system used in the Norwegian national plan for mire preservation has been based on the three main directions of local variation of mire vegetation (after Sjørs 1948). The mire vegetation is classified into 20 separate units, defined by species groups. In addition, there are 5 units of spring and *Magnocaricetum* vegetation.

2. A hierarchical system is proposed for Norway (down to alliance level), based on the above-mentioned system, the Nordhagen (1943) - Dahl (1956) system, and the central European systems. This mire and spring classification system includes 3 classes, 5 orders and 14 alliances (Moen 1990).

Some other classification systems are briefly discussed. Following the Tüxen tradition, Dierssen (1982) classified the mire vegetation of northwestern Europe into broad associations and alliances, often based on a few vascular plants. It is argued that the entire species composition (the bryophytes are often the best indicator species on mires) should be used, and the units should clearly reflect the ecological conditions. The Holmsen-Løddesøl classification system (Løddesøl & Lid 1943) was previously very much used for practical mire inventory surveys in Norway. It is essentially a physiognomic system and does not separate units along the main vegetational gradients. It is considered unusable for phytosociological, ecological and regional studies.

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Asbjørn Moen, Trond Arnesen, Egil I. Aune & Dag-Inge Øien

Vegetational changes in rich fen vegetation induced by hay-cutting at Sølendet Nature Reserve

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Outlying lands in Norway were, for centuries, used as a source of hay and pasturage for domestic stock. In some parts of Norway (e.g. Sølendet Nature Reserve in central Norway), fens and grasslands were still being mown for hay in the traditional way up to and even after the 2nd World War. Experimental mowing by scythe was commenced 18 years ago on some areas at Sølendet and the vegetation has been returned to a state of ecological equilibrium with scything as a prime ecological factor. Altogether 160 ha of former haymaking lands have been restored, and the areas are managed (mown by a scythe or a motor mower) regularly.
The dry matter yields of the field layer decreased during the first few years after scything recommenced. In the quadrats scythed annually, the field layer yield after a few years had decreased to about 1/3 of the first harvesting; and to about 2/3 in quadrats which were scythed every other year (i.e. the practice of traditional haymaking of outlying areas). The below-ground biomass (roots and rhizomes) exceeds that of the above-ground shoots, and the ratio between the above- and below-ground biomass is lowest for the unscythed community.
Regular scything leads to an overall reduction in shrubs (e.g. *Betula nana, B. pubescens, Salix* spp.), dwarf shrubs and the litter layer; the proportion of herbs is generally reduced, whereas that of the graminoides is increased. Pleurocarpous, prostrate bryophytes (e.g. *Campylium stellatum)* are favoured, whereas acrocarpous and/or "hummock-building" bryophytes (e.g. *Sphagnum* spp.) are reduced by scything and trampling. The common occurrence in the fen lawn communities at Sølendet of several weakly-competitive, alpine species (e.g. *Carex atrofusca, Juncus alpino-articulatus, J. castaneus, J. triglumis* and *Saxifraga aizoides*) is thought to result from the regular scything of these areas in past decades. Both the numbers of shoots and the fertility of the above species, as of *Carex dioica, C. capillaris, C. flava, C. nigra, Eriophorum angustifolium* and *E. latifolium,* increase as a consequence of scything. *Molinia caerulea,* however, was found to be drastically reduced by intensive scything. Orchid species (e.g. *Dactylorhiza cruenta, D. pseudocordigera, Gymnadenia conopsea*) and *Pedicularis oederi* do not tolerate intensive scything, but are favoured in the lawn communities by extensive scything, which reduces competition from shrubs, *Molinia caerulea,* etc.
Intensive scything of the fen areas produces considerable quantitative changes in the plant communities. However, in general, the qualitative changes in the plant communities induced by scything have so far been limited. A possible reason is that, with regular scything as a prime ecological factor, these communities reached a state of equilibrium over past centuries and the time elapsing since its cessation has been too short for any major changes to occur.

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Asbjørn Moen, Stein Singsaas & Sigurd Mjøen Såstad

Regional variation and conservation of mires in Norway

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Surveys in connection with the Norwegian national plan for mire nature reserves began in 1969. Since then, about 1000 localities, generally including more than one discrete mire, have been investigated. The methods used and the information gathered are described in more than 40 regional reports already published (references to the most important ones can be found in Moen (1990)).

The main criteria for mire preservation in Norway have been:
1. preservation of representative mire ecosystems within the phytogeological regions
2. preservation of interesting ecosystems of more unusual or extreme types.

When classification systems were chosen, special effort was made to include criteria which are relevant for mire preservation purposes. The main emphasis was put on:
1. mire types (hydromorphology)
2. vegetation
3. flora.

Typical raised bogs mainly occur in the boreonemoral and southern boreal zones of the slightly oceanic and transitional (oceanic/continental) sections. Atlantic bogs occur in the same zones, but in the highly oceanic section. Transitional types of raised bogs are found in the distinctly oceanic section. Blanket bogs are found in the southern and middle boreal zones of the highly oceanic section and at the transition between the middle boreal and northern boreal zones in the distinctly oceanic section. Palsa mires mainly occur in the northern boreal zone of the slightly continental section. Sloping fens are found from the middle boreal to the alpine zones. Strongly sloping fens (inclinations of $15\text{-}20^{g}$) occur in the most oceanic areas. Sloping fens are generally absent from the slightly continental section, but gently sloping ones occur in the northern boreal zone. String mixed mires and flark fens are common in the middle and northern boreal zones of the most continental sections, but are rare elsewhere and lacking in the highly oceanic section.

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Moen, A. 1990. The plant cover of the boreal uplands of Central Norway. I. Vegetation ecology of Sølendet nature reserve; haymaking fens and birch woodlands. *Gunneria 63*: 1-451, 1 map.

Attila Molnár

Restoration and management programme for peat bogs on the NE Hungarian lowlands

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The mires of the NE Hungarian lowlands are the southernmost raised *Sphagnum*-bogs in Europe occurring in a lowland setting. They were only recognised in the early-1950's, because they are small, isolated islands surrounded by oak-gallery forests, pastures and arable land. They occur in ancient channels of the River Tisza which were formed in postglacial times. The bogs formed here as a result of an unusual successional process from earlier oxbow lakes.

Under natural conditions, the water supply was provided by flooding of the Tisza and groundwater moving from the Carpathians. River regulation, deforestation, enlargement of agricultural areas and drainage, which started in the last century, severely affected the mires resulting in partial drainage of the bogs and infiltration by fertilisers into parts of their banks. Based on the results of botanical and hydrobiological research started in 1952 and 1983, experts have proposed to replenish missing water by pumps and by blocking neighbouring drainage channels, and to create a buffer zone with forest plantations where agricultural areas have recently encroached. The Hortobagy National Park Directorate has started this work and the poster briefly describes our results and plans.

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Yaroslav Movchan

Mires of Ukraine: current situation and conservation perspectives

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Marshland protection is a problem of great importance at present. The largest mire areas have been preserved in Ukrainian Polissya. The national strategy for preserving biodiversity has now been worked out and includes various measures for conserving and restoring marshlands.

Mára Pakalne

Latvian mires and their conservation

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Mire vegetation covers 9.9 % of the total land area of Latvia. 70 % of all the mires are in a virgin state. The remainder have been drained for agricultural and forestry purposes, or used for peat extraction.

Vegetation has been studied in most detail on the coastal lowlands of Latvia, the region stretching along the coast of the Baltic Sea and the Gulf of Riga. This region is one of the richest in mires in Latvia. Ombrotrophic and minerotrophic mire vegetation is found there.

Most effort has been put into research concerning the extremely rich fen vegetation. Rare and characteristic mire communities have been distinguished. Rare associations include *Schoenetum ferruginei* and *Cladietum marisci*. Together with *Schoenus ferrugineus* and *Cladium mariscus*, extremely rich fen vegetation is the habitat of species that are rare in Latvia, such as *Myrica gale, Dactylorhiza incarnata, D. cruenta, Liparis loeselii, Gymnadenia conopsea* and *Ophrys insectifera.* Also the rare mosses *Moerckia hybernica* and *Riccardia multifida* are found there.
The association, *Caricetum lasiocarpae*, typical for the coastal lowland of Latvia, has to be protected also.

Mire vegetation has been investigated in protected areas, e.g. the Slitere and Grini Strict Nature Reserves, the Engure Protected Nature Area, as well as beyond their borders.

In Latvia, 12.2 % of all the mire covered area is being preserved in different types of protected nature areas - strict nature reserves, as well as nature areas for mires, cranberries, and botanical and zoological qualities.

Geert Raeymaekers

Mire conservation in the European Union as a result of the Habitat Directive, the Bird Directive and the financial instruments, ACE and LIFE

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Two directives, the Bird Directive (79/409) and the Habitat Directive (92/43), are the legal instruments for the implementation of the European Union's nature conservation policy. Since 1984, the financial instrument ACE, and more recently the LIFE regulation, have been approved to assist the Member States in the implementation of these directives.

An assessment will be given of the contribution of these directives to the conservation of mires in Europe, in particular the Bird Directive where some Special Protection Areas cover important mire vegetation, and the recently approved Habitat Directive for which Member States are preparing the list of sites containing Annex I Habitat types, such as several mire vegetation types.

The financial regulations, ACE and LIFE, have contributed to the conservation of mires in the EU. The paper/poster reviews the mire sites affected by these financial instruments and describes a few financed conservation activities in detail.

Tiit Randla

The Golden Eagle on Estonian mires

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At present, 21% of the territory of Estonia is covered with peatlands. There are 155 mires for every 1000 sq.km. Nesting sites of the Golden Eagle in Estonia are mainly on afforested islets and at the edges of firm, mineral ground on forest bogs. The present population numbers about 35 breeding pairs. Their nests are in old pines. The total number of pairs in the Baltic Sea area amounts to 700 pairs, most of them breeding in Sweden (400 pairs) and Finland (up to 220). The Golden Eagle has been protected since 1935, and its breeding success has been observed carefully since 1964. Before 1972, the number of young birds per productive nest was 1.5 (39 records), in 1975-87 it was 1.1 (89 records), in 1988-91, 1.3 (66 records) and in 1992-93, 1.0 (25 records). It seems to be quite sufficient. The population is at present larger than in the middle of the century or even than in the 1970's and the breeding success in Estonia is very similar to corresponding data from Sweden, Finland and Scotland. The stable population of the Golden Eagle on Estonian mires deserves international attention and every possible precaution to preserve their natural habitats.

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Clayton Rubec

Status of wetland conservation programmes and policies in Canada

Canadian Wildlife Service, Environment Canada, Suite 200, 1750 Courtword Cresc., Ottawa KIAOH3, Canada

Canada has developed one of the world's first wetland policies at the federal level and 4 Canadian provinces as well as major industrial groups are implementing the policies. The comprehensive approach taken by Canada is focusing on a non-regulatory programme to promote sustainability of wetland resources. Particulars on the status of implementing the federal policy on wetland conservation will be provided.

Kamil Rybníček

Bogs and fens on the vegetation map of Europe

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Preparation and editing of a map of the natural vegetation of Europe on a scale of 1:2,500 000 have reached their final stages. Information on the bogs and fens shown on this map is presented. A legend consisting of 24 units, divided into three major groups (ombrotrophic bogs, mixed ombro-minerotrophic mires and minerotrophic fens) is demonstrated. The origin, development, conception and classification of mapping units are discussed.

Jadwiga Sienkiewicz & Marek Kloss

Distribution and conservation of mires in Poland

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Poland lies within the zone of rheotrophic (low) mires which make up 92% of the entire wetland area, ombrotrophic mires (raised bogs) accounting for a mere 6.5% of the approximately 1.5 million ha of mire surface in the country. Some of the mires, along with their original vegetation, are preserved in a more or less intact shape and retain much scientific value. The distribution of mires is highly non-uniform, more than 80% of the mire resources being situated in northern Poland within a young glacial landscape of lakelands. Those mires are especially prone to decisions leading to exploitation that causes overdrying, shrinkage and accelerated mineralisation of organic matter. The average annual rate of decrease in peat deposits is about 1 cm for low peats and 3 cm for peat in raised bogs. Over 50 plant communities have been identified among the mire vegetation types, testifying to the considerable biodiversity of Polish mires even though over half the peat bogs in the northern part of the country have been anthropogenically changed into wet meadow and pasture vegetation. 40 plant associations related to mires are already subject to strict protection in nature reserves (70) and more reserves are planned. However, the protection of peatlands is becoming increasingly difficult due to the overall transformation process affecting the country's economy, and requires both legislative changes and increased education of decision makers.

Literature:

Jasnowski 1980, Denisiuk 1990, Kloss 1993.

Peter Skoberne

Peat bogs and their conservation in Slovenia

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The raised bogs (peat bogs) in Slovenia are situated on the southeastern border of their European distribution. The flora, vegetation and ecology of the peat bogs are well known and show some special characteristics. For instance, *Lycopediella innundata* occurs as an obligatory ombrotrophic species. The floristic picture is specific, too.

The largest peat bog in Slovenia was on Ljubljansko barje, south of the city of Ljubljana. The area has been in process of being drained since the 18th century and intensive peat cutting has taken place during the last century. Hence, only very scarce remnants with independent water regimes survive.

Other peat bogs are situated in the mountain areas and are much better preserved. The most important are Pokljuška barja, three *Sphagnum* complexes situated on an upland plateau in the Julian Alps and protected within the Triglav National Park, and a similar one, the Za Blatom peat bog on the Jelovica plateau.

Another large *Sphagnum* complex is on crystalline rocks on a mountain named Pohorje. Its floristic structure is poorer so this peat bog is evidently younger.

Fortunately, peat bogs in the mountains are not directly endangered at the moment. The potential threats are, in some cases, uncontrolled visitors, possible changes in water regime, overexploitation of forest in the surroundings and, in one case, cattle grazing.

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Thyra Solem

Vegetational history, history and development of blanket mires in central Norway

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Pollen analysis, 14C dating and peat stratigraphy from blanket mires covering drumlins northwest of Trondheimsfjord show that the peat blanket started to form about 7,800 years ago on the drumlin plateaux which then had a vegetation of scattered birch trees. From the plateaux, the peat formation spread slowly down the slopes. The mire surface later bore a cover of pines which disappeared about 4,900 years ago at the same time as peat formation commenced at the foot of the drumlins where dense birch vegetation was buried and peat growth spread upslope. The overall blanket of peat on the drumlins was completed well before the onset of the Subatlantic chronozone.

Blanket mires on the upland plateau on Haramsøy in western Norway have a different history, having formed simultaneously over large areas where grazing and regular burning of the vegetation, in addition to deteriorating climatic conditions, resulted in peat formation about 3,000 years ago.

Eiliv Steinnes

Temporal and spatial trends of heavy metal deposition studied by analysing peat cores from ombrotrophic bogs

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Atmospheric deposition is an important pathway for the supply of many chemical elements to terrestrial systems, both from natural and anthropogenic processes. Cores from ombrotrophic peat bogs are a useful tool for studying changes in deposition trends over the last few hundred years, as well as geographical differences in the airborne supply of the elements concerned. The talk will summarize work done on this topic in Norway over the last 15 years. The main emphasis is put on elements such as Pb, Zn, Cd, As, Sb and Se, which are supplied to southern Norway in appreciable amounts by long-range atmospheric transport from sources outside Norway. Useful information is also obtained about elements supplied from the marine environment, such as Mg, Sr, Br, I, B and Se. In the case of Se, the analysis of peat cores from different parts of Norway shows quite convincingly the atmospheric supply both from natural and anthropogenic processes.

Literature:

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Rob Stoneman

The Scottish Raised Bog Conservation Project

Scottish Wildlife Trust, Cramond House, Kirk Cramond, Edinburgh EH4 6NS,UK

The loss of raised bog in Scotland is staggering. The British National Peatlands Resource Inventory estimated that only 2000 ha of raised bog remain in a fairly natural condition out of an original resource of 25,000 ha. Despite raised bog as an ecosystem now being close to extinction in Scotland, sites are still threatened through road schemes (e.g. Gartshore Moss to the M80), opencast coalmining (e.g. Blantyre Muir), peat extraction (e.g. Flanders Moss, Fannyside Muir) and other developments. Perhaps more worrying is the neglect of our remaining raised bogs. Scottish raised bogs have been subject to a long history of peripheral peat cutting and drainage gradually altering their hydrology to the detriment of *Sphagnum* and the benefit of birch.

On a more positive note, there is a greater commitment to conservation through increased knowledge, increased legislation and increased awareness.

In Scotland, this commitment is reflected in the securing of EU LIFE funding to support the Scottish Raised Bog Conservation Project which is being co-ordinated by Scottish Wildlife Trust. The primary aim of this project is to conserve all of the remaining Scottish raised bog resource, with secondary aims to set in train an expansion of the resource and to provide a model for other EU countries.

To achieve these aims, the project will produce a working plan/strategy for the conservation of the resource. A practical strategy which will genuinely be significant requires:

1. More information concerning the value of raised bog, the state of the present resource, the technicalities of managing bogs and the threats to the resource.
2. The support, involvement and advice of other organisations.
3. Practical demonstration projects to use and evaluate both innovative and traditional bog management techniques.
4. Demonstration projects to restore badly damaged sites.
5. Dissemination of information collected.

Michael Succow

Mire regeneration in northeast Germany

Universität Greifswald, Botanisches Institut, Grimmer Str. 88, 17489 Greifswald, Germany

In northeast Germany, about 500,000 ha of fens (about 7% of the land) have been drained during the last 200 years. During the last decades, these have mainly been used as sown grasslands. At present, an *Agropyron repens* vegetation with low yield is growing on the degraded fens. Cultivation has been abandoned over large areas. A research project has started dealing with the conversion of these "problematic sites" into semi-aquatic ecosystems. The acute shortage of water in the mires can be overcome by provision of pretreated waste water. The establishment of peat-forming fen vegetation is planned: *Phragmites australis, Carex* sp., *Alnus glutinosa*, etc. In this way, areas accumulating organic material arise as well as filter areas for the discharge of nutrients and pollutants, places for endangered plant and animal species, areas where the ground water budget and the climate are stabilized on a landscape scale and areas for the production of harvestable phytomass.

Michael Succow

Classification system for mire vegetation of central Europe

The high natural mire vegetation in central Europe can be subdivided into five ecological - phytocoenological mire types:

mire type	pH of the peat	N_c in relation to $C(N_c)$	vegetation
oligotrophic - acid	<4.8	<3%	*Oxycocco - Sphagnetea*
mesotrophic - acid	<4.8	3 - 4,9%	*Sphagno - Caricetalia*
mesotrophic - subneutral	4.8 - 6.4	3 - 4,9%	*Caricetalia diandrae*
mesotrophic - calcareous	>6.4	3 - 4.9%	*Tofieldietalia*
eutrophic	3.5 - 8	> 4.9%	*Magnocarici - Phragmitetalia*

Literature:

Succow, M. 1988. *Landschaftsökologische Moorkunde*, VEB G. Fischer Verlag Jena. Teilauflage Borntraeger-Verlag Stuttgart, 340 pp.

Succow, M. 1971. Vorschlag einer soziologischen Neuliederung der mineralbodenwasser beeinflussten wachsenden Moorvegetation Mitteleuropas. *Fedders Repertorium 85:* 57-113.

Sigurd Mjøen Såstad & Asbjørn Moen

Vegetational-region classification of mire localities in central Norway, compared with species indicator-value classifications and climatic data

University of Trondheim, Museum of Natural History and Archaeology, Department of Botany, N-7004 Trondheim, Norway

347 mire localities from central Norway were assigned to different vegetational regions (5 zones/belts and 4 sections) by their location on regional maps (Moen 1987, Moen & Odland 1993). The same localities were assigned to two regional indicator values for climate (Ellenberg site scores). These were scored as mean temperature and continentality values for the species present at each locality, using the regional indicator values 'Temperaturzahl' and 'Kontinentalitätszahl' in the list of Ellenberg et al. (1991). Finally, a set of climatic data was obtained by spatial interpolation of meteorological observations to the latitude and longitude of the localities (Leemans & Cramer 1991). The aim of this study was to compare the vegetational-region classification with different climatic parameters. By comparing the same climatic data set with regional indicator values for climate, we have tried to test whether such a classification system, developed with a focus on central Europe, can be transferred to Norwegian mire vegetation.

Locality-centred comparison

The Ellenberg site scores and the interpolated climatic data were compared with the vegetational-region classification by discriminant analysis. The proportion of localities classified to the correct zone or section, using each climatic variable and the Ellenberg site score, was used to estimate the corroboration. In general, the interpolated climatic data accounted for more of the zonal variation than the Ellenberg site scores. The mean temperature of the coldest month and the Ellenberg index of continentality were the parameters that best predicted the sectional affinities of the localities.

Species-centred comparison

The species indicator values T and K in Ellenberg et al. (1991) were compared with two calculated sets of species indicator values: 1) The weighted average for the presence of each species in the regions was used to calculate zonal and sectional indicator values, and 2) the mean of a given climatic parameter at all sites where a species was present was used as an indicator value for that climatic parameter (climatic species scores). Correlation analysis between climatic species scores and the scores based on the two classification approaches revealed the same trends as for the sites. However, a much higher correlation with climatic species scores was found in zonal and sectional indicator values than in Ellenberg scores. This indicates that transferring a species indicator value system like that of Ellenberg is of limited value unless modifications are made to meet the varying conditions in the regions where the system is applied. In this context, the derivation of local species indicator values based on, for example, the weighted averages of the species present in vegetational regions seems more appropriate, at least for scores aiming at describing the regional preferences of the species.

Literature:

Ellenberg, H., Weber, H.E., Düll, R., Wirth, V., Werner, W. & Paulissen, D. 1991. Zeigwerte von Pflanzen in Mitteleuropa. *Scripta Geobotanica XVIII*, 1-248.

Leemans, R. & Cramer, W. 1991. *IIASA database for mean monthly values of temperature precipitation and cloudiness on a global terrestrial grid.* RR-91-18 International Institute for Applied System Analysis, Laxenburg, Austria.

Moen, A. 1987. The regional vegetation of Norway; that of Central Norway in particular. *Norsk Geografisk Tidsskrift. 41:* 179-226, 1 map.
Moen, A. & Odland, A. 1993. Vegetasjonsseksjoner i Norge. In: Krovoll, A. & Moen, A. (red.). Fagmøte i vegetasjonsøkologi på Kongsvoll 1993. *Univ. Trondheim. Rapp. Bot. Ser. 1993 2:* 37-53.

Tatsuichi Tsujii

Invitation to mires in Japan

Institute of Agro-forestrial Ecology, Faculty of Agriculture, Hokkaido University, N-9, W-9 Sapporo 060, Japan

The Japanese archipelago consists of more than 390 islands and extends about 3000 km from north to south parallel to the eastern rim of the Eurasian continent. Compared to the size of the islands, their mountains rise to high altitudes, and have deep gorges and varied landforms. Under these circumstances, the climate of Japan clearly varies seasonally as well as regionally, especially from north to south in the archipelago, and from the Sea of Japan to the Pacific Ocean.

Three-quarters of the land area of the Japanese archipelago is mountainous. This area is dissected by numerous small rivers and streams, and eroded slopes are generally steep. Most of the plains and basins are covered in sands and gravels, and are dispersed throughout the mountainous areas.

Flat areas, including plateaus, terraces and plains, have been used for agricultural activities from ancient times. Especially in Honshu (Main Island), Shikoku and Kyushu, the plains which are dominated by wetlands were originally mainly utilized as paddy fields.

On Hokkaido (the northernmost island), 80% of the wetland in Japan remains in its natural state. The large mires originated from the damming up of embayments through sand-bar growth when the sea level was rising in postglacial times. They are shallow and generally eutrophic.

Some small, beautiful mires are scattered in mountain ranges or on the terrace along the eastern Pacific coast and are mainly fed by rain and fog.

František Urban

Protection of mires in the Czech Republic

Min. of the Environment, Vršovická 65, 100 10 Praha 10, Czech Republic

A map shows the distribution of mires, protected mires and other main types of protected areas in the Czech Republic. It is accompanied by a brief description and photographs of the most interesting and important types of mire.

Luidmila Vakarenko

Green book of the Ukraine as a mirror of Ukrainian mires (representation aspects)

252179 Kyiv 179, P.O.Box 190, Ecocentre, Ukraine

A green book of the Ukraine contains descriptions of 127 rare, disappearing and typical plant communities; 12 of the communities are represented by bog vegetation.

Descriptions of rare bog communities requiring preservation include information about the reasons for the desired protection and their ranking, ecological peculiarities of syntaxons, phytocenotical and species diversity and the extent to which they are represented in the protected areas of Ukraine.

The distribution of bog plant communities requiring preservation is shown on a map of the Ukraine.

Literature:

Shelyag-Sosonko, Yu. R. (ed.). 1987. *Green book of the UkrSSR: rare, vanishing and typical plant communities requiring preservation.* 216 pp. Kiev (in Russian).

Sake van der Schaaf

Relations between acrotelm depth, phreatic levels and their seasonal fluctuations, surface slope and drainage effects in a raised bog in the Irish Midlands

Department of Water Resources, Agricultural University, NL6709PA Wageningen, The Netherlands

During 1990-1992, hydrological field research was carried out on Raheenmore Bog in County Offaly. The bog comprises 162 ha and is typically dome shaped in cross section. The central part is still in a fairly good condition; other parts have been affected by drainage and turf cutting. Both have caused surface subsidence, resulting in increased surface slopes of a bog surface that formerly was relatively flat.

The ground-water regime obviously has been influenced by the changed morphological character of the bog. Ground-water levels not only are lower in the affected than in the relatively unaffected parts, but their seasonal fluctuation is also considerably larger. Generally, there is a good correlation between ground-water depth and the rate of fluctuation expressed as standard deviation around the mean level. The correlation with slope is somewhat less good (at least in part caused by the technique of determining the slope), but still of an acceptable significance.

The water level fluctuations in the flat and relatively unaffected part remained within 0.20 m below the surface during a two-year observation period from January 1990 through January 1992, whereas levels of about 1 m below the surface occurred locally in the more sloping parts and near the disturbed margins.

The acrotelm was surveyed during the same period. The thickness of the top layer of humification degree 4 or less on the scale of Von Post & Granlund was the parameter surveyed. It was found that where the slope was about 0.5% or steeper, measured over a distance of 100 m or more, the top 5-10 cm of the peat usually had a degree of humification of 5-7, often overlying a layer with a lower degree of humification. This sequence could be an indication of a relatively recent change in hydrological conditions, related to human activities. This zone generally coincided with the zone of lowered ground-water levels and increased level fluctuations.

Stepan Zaiko

Evolution and transformation of drained mires: ecological and economic aftermath

Kirova II-19, Minsk, Belarus

Continuous monitoring of drained areas has been carried out. It was found that with increasing length of agricultural use there was deterioration in the quality of water, the moisture capacity of the soil, the amount of moisture available to plants, the absorption ability of the soil and the structural state of the arable soil horizon, while the content of available phosphorus and potassium increases. The loss of organic matter and changes in the properties of the peaty soil lead to its transformation into mineral soil with 50 % less fertility. Research based on this monitoring has led to models being developed for the evolution of peaty soils under different conditions. If the level of drainage is optimal and a positive balance of organic matter is maintained through the use of organic fertilizers, peaty soils will not be threatened with destruction. If soils are ameliorated, the structure of the soil cover also changes. Some methods for predicting changes in drained peaty soil have been worked out. More than 200,000 ha of ameleriorated peaty soils have so far been transformed into mineral soil in Belarus, and it is forecast that this will increase by 110,000 ha by 2010.

Literature:

Zaiko, S. 1993. Change and forecast of the soil cover of the drainaged territories *Soil cover structure.* Moscow.

Zaiko, S. 1990. *Soil evolution of meliorated territories in Belarus.* Minsk. (In Russian).

Zaiko, S. 1989. *Drained peat soils evolution in Belarus - Czechoslovak soil science conference, May 1989.* Praha.

Stephen C. Zoltai

The use of peatland dynamics to indicate climatic change

Northern Forestry Centre, 5320 - 122 Street, Edmonton, Alberta, Canada T6H 3S5

In the boreal region of Canada, permafrost is restricted to *Sphagnum*-dominated peatlands. Concentrated in the northern part of the boreal forest, permafrost is present in palsas and peat plateaus that are usually associated with collapse scars. These collapse scars are round to oval in outline, have clearly defined edges and often contain dead, partially submerged trees. In the mid-boreal zone, bogs and fens have internal depressions which are roughly circular or ovoid in outline, but have indistinct borders and are depressed only about 20 to 30 cm below the level of the mire. A distinct layer of tree remains, needles, or feather mosses occurs in these depressions, about 50 cm below the level of the fen. These internal depressions do not contain permafrost at present but did in the recent past. Indications from radiocarbon and dendrochronological dating are that widespread permafrost thawing commenced about the middle of the 19th century and is still continuing. In the southern part of the boreal zone, there are no internal depressions in the bogs, indicating that they did not contain permafrost. Here, the bog peat is generally thin over the underlying fen peat. Radiocarbon dating indicates that bog development was initiated about 2000 to 3000 years ago, possibly in response to cooler and moister climatic conditions. Basal dates of fen peat along the southern margin of the boreal zone indicate that fen development began only about 6000 years ago, covering marsh or shallow pond deposits.

The following climatic changes are reflected in the peatlands of the boreal zone in western Canada:

Before 6000 BP: dry, arid climate, no peatland development. 6000 to 3000 BP: cooler, moister climate, with fen development. 3000 BP: cooler, moister climate, with bog development. Permafrost initiated in bogs of northern regions. About 700 BP: colder climate allows permafrost development in the mid-boreal region. About 150 BP: warmer climate thaws the permafrost in the mid-boreal region.

Literature:

Vitt, D.H., Halsey, L.A. & Zoltai, S.C. 1994. The bog landforms of continental western Canada in relation to climate and permafrost patterns. *Arctic and Alpine Research 26*: 000-000.

Zoltai, S.C. 1990. Holocene climatic change and the distribution of peatlands in western interior Canada. *Quaternary Research 33:* 231-240.

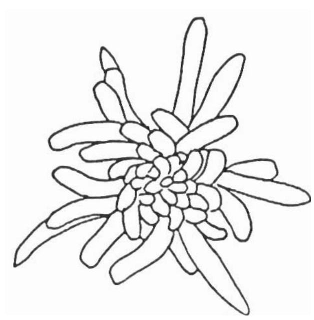
3. Preliminary programme, 15th june 1994

Regional Variation and Conservation of Mire Ecosystems

----------Time schedule for the Conference----------

Monday 4th july

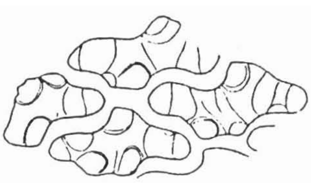
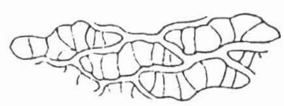
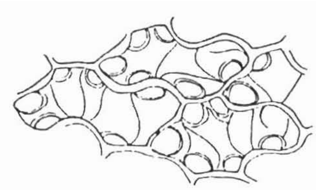
09.00 - 12.00	Registration, installation of posters and visit to exhibitions at the Museum + plain lunch	Place: Suhmhuset (see map on back cover)
12.00	**Welcome** **Opening of Conference**	Karsten Jakobsen (Rector of The University of Trondheim) and Peter Johan Schei (Director of the Directorate for Nature Management, Norway)
SESSION I	**IMCG - WORK, PERSPECTIVES AND RESOLUTIONS**	**Chairman: Richard Lindsay**
12.30	Living close to the edge - peatland conservation and classification	Richard Lindsay (Scottish Natural Heritage, U.K)
12.50	Proceedings of the 1992 International Mire Conservation Group Symposium in Switzerland	Andreas Grünig (Swiss Federal Inst. for Forest, Snow and Landscape Research, Switzerland)
13.10	Status of European mires - distribution, threats and protection	Michael Löfroth (The National Environmental Protection Agency, Sweden)
13.30	*Summary of the session*	
13.40	Coffee break	
SESSION II	**TERMINOLOGY, CLASSIFICATION, REGIONALITY**	**Chairman: Gerry Doyle**
14.00	Introduction	Gerry Doyle (Faculty of Science, University College Dublin, Ireland)
14.05	Major mire vegetation units in relation to the concepts of ombrotrophy: a world-wide perspective	Antoni W. H. Damman (Dept. of Ecol. and Evolutionary Biol., University of Connecticut, U.S.A)
14.35	Classification systems for mires in Norway	Asbjørn Moen (Museum of Nat. Hist. and Archaeology, University of Trondheim)
14.55	Bogs and fens on the vegetation map of Europe	Kamil Rybnícek (Bot. Inst., Academy of Sciences, Czech Republic)
15.15	Coffee break	
15.35	Classification system of mire vegetation of Central Europe	Michael Succow (Bot. Inst., University of Greifswald, Germany)
15.55	The approaches to typology of mire systems	Tatjana Jurkovskaja (Komarov Bot. Inst., Russian Academy of Science, Russia)
16.15	The Sphagnum flora of Norway	Kjell Ivar Flatberg (Museum of Nat. Hist and Archaeology, University of Trondheim)
16.35	*Summary of the session*	
16.45	Introduction to the excursion to Rørmyra	
18.00	Departure for Ringve from Ambassadeur hotel/Suhmhuset	
18.15	Guided tour at the Ringve Botanical Garden	
19.30	*Dinner at Ringve*	



Time Schedule for the Conference

Tuesday 5th July

SESSION III	**EXCURSION TO RØRMYRA**	
08.30	Departure by bus from Ambassadeur hotel/ Suhmhuset	
09.00	Arrival at Rørmyra	
11.45	Departure from Rørmyra	
12.00	*Lunch at Suhmhuset*	
SESSION IV	**INTERNATIONAL PROTECTION WORLD - WIDE SURVEY, GENERAL TOPICS**	**Chairman: Antoni W.H. Damman**
13.00	Introduction	Antoni W.H. Damman
13.05	The Golden Flow: Recent development and future perspectives in international peat trade	Hans Joosten (Laboratory of Palaeobotany and Palynology, Utrecht, Netherlands)
13.35	Modern position in mire conservation: world picture	Marina Botch (Komarov Bot. Inst., Russian Academy of Science, Russia)
13.55	The use of peatland dynamics to indicate climatic change	Stephen Zoltai (Northern Forestry Centre, Alberta, Canada)
14.35	Coffee break	
14.55	Temporal and spatial trend of heavy metal deposition studied by analysis of peat cores from omrotrophic bogs	Eiliv Steinnes (Dept. of Chemistry, College of Arts & Science, University of Trondheim)
15.15	Microclimate and physical properties of peat: new clues to the understanding of bog restoration processes	Ph. Grosvernier, Y. Matthey and A. Buttler (all at Bot. Inst., University of Neuchâtel, Switzerland)
15.45	*Summary of the session*	
SESSION V	**MIRE DISTRIBUTION & PROTECTION; NATIONAL SURVEYS: EASTERN EUROPE**	**Chairman: Kamil Rybnícek**
16.05	Introduction	Kamil Rybnícek
16.10	Belarus: Problems of biospherically compatible bog resources	Nikolai N. Bambalov (Inst. for Problems of Natural Resource Usage & Ecol., Acadamy of Science, Belarus)
	Problems of restoration and rational utilization of cutover peat deposits	Ivan Lishtvan (Inst. for Problems of Natural Resource Usage & Ecol., Academy of Science, Belarus)
	Evolution and transformation of drained mires: Ecological and economical aftermath	Stepan Zaiko (Belarus)
16.40	Estonia: State of Estonian mires - past, present and future alternatives	Mati Ilomets (Inst. of Ecol., Tallin, Estonia)
16.55	Latvia: Latvian mires and their conservation problems	Màra Pakalne (Dept. of Bot. and Ecol., University of Latvia, Latvia)
17.10	*Coffee break and posters*	

Time Schedule for the Conference

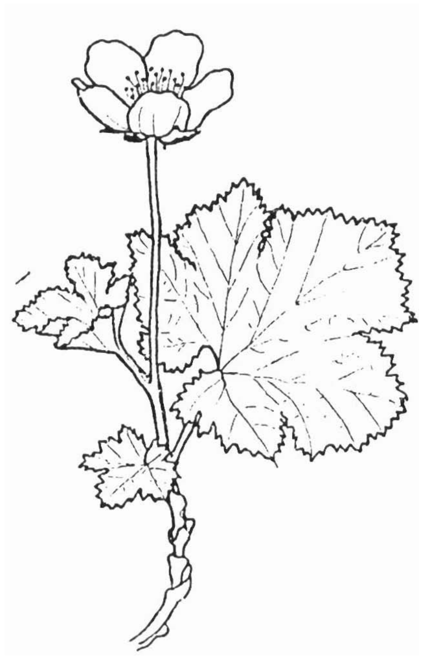
Tuesday 5th July

POSTERS

Czech Rep.	Protection of mires in the Czech republic	František Urban (Ministry of the Environment, Czech Republic)
Estonia	The golden eagle in Estonian mires	Randla Tiit (Ministry of the Environment, Estonia)
Hungary	Restoration and management program of peat-bogs on the NE Hungarian lowland	Atilla Molnár (Hortobágy National Park, Hungary)
Lithuania	Mires of Lithuania and their conservation	Eugenijus Drobelis (Environmental Protection Department, Lithuania)
Poland	Hydrological types of mires in Polish lowlands and related vegetation	Marek Kloss (Inst. of Plant Ecol., Polish Academy of Sciences, Poland) and Jadwiga Sienkiewicz (Environment Protection Inst., Poland)
	Inventory - a key to sound protection of mires in Western Pomerania, Poland	Janina Jarnowska and Leslaw Wolejko (both at Bot. Dept., Acricultural University, Poland)
Ukraina	Green book of Ukraine as a mirror of Ukrainian mires	Luidmila Vakarenko (Ecocentre, Kiev, Ukraine)

SESSION V CONTINUED

17.45	Slovenia: Peat-bogs and their conservation in Slovenia	Peter Skoberne (Slovenia)
18.00	Poland: Distribution and conservation of mires in Poland	Jadwiga Sienkiewicz and Marek Kloss
18.15	Russia: Mires and their conservation	Vladimir Antipin (Biol. Inst., Karelian Research Centre, Russia)
18.30	Slovakia: Mires of Slovakia	Izabela Háberová (Slovak Agency for the Environment)
18.45	Ukraine: Mires of Ukraine: current situation and perspectives on conservation	Yaroslav Movchan (Ecocentre, Kiev, Ukraine)
19.00	*Summary of the session*	
20.00	*Dinner at Pinocchio restaurant*	



Time Schedule for the Conference

Wednesday 6th July

SESSION VI	**MIRE DISTRIBUTION & CONSERVATION NATIONAL SURVEYS: WESTERN EUROPE**	**Chairman: Hans Joosten**
08.30	Introduction	Hans Joosten
08.35	Austria: Applying ground water mound theory to bog management on Pürgschachenmoos in Austria	Olivia Bragg (Dundee University, U.K) and Gert Michael Steiner (Dept. of Vegetation Ecol. and Conservation Biol., University of Vienna, Austria)
08.55	Finland: The botanical value of protected mire sites in the southern Aapa mire area	Seppo Eurola and Pentti Hanhela (both at Dept. of Bot., University of Oulu, Finland)
09.15	Germany: Mire-regeneration in Northeast Germany	Michael Succow
09.35	Ireland: Relations between acrotelm depth, phreatic levels and their seasonal fluctuations, surface slope and drainage effects in a raised bog in the Irish midlands	Sake van der Schaaf (Dept. of Water Resources, Agricultural University, Netherlands)
09.55	Scotland: The Scottish raised bog conservation project	Rob Stoneman (The Scottish Wildlife Trust, Scotland)
10.15	Coffee break	
10.35	Sweeden: Wetland-inventory in Västerbotten county	Susanne R. Forslund (County administration, Västerbotten county, Sweden)
10.55	Switzerland: Monitoring the bogs and the transitional mires of Switzerland (protection, management and vegetation development)	Roland Haab (Swiss Federal Inst. for Forest, Snow and Landscape Research, Switzerland)
11.15	*Summary of the session*	
SESSION VII	**MIRE DISTRIBUTION & CONSERVATON NATIONAL SURVEYS OUTSIDE EUROPE**	**Chairman: Stephen Zoltai**
11.30	Introduction	Stephen Zoltai
11.35	Canada:Peatland sustainability in Canada	Clayton Rubec (Canadian Wildlife Service, Ottawa, Canada)
11.55	Lesotho: Mires in Lesotho: their vegetation and need of conservation	Ingvar Backéus (Dept. of Ecol. and Bot., Uppsala University, Sweden)
12.15	*Lunch and posters*	

POSTERS	(to Sessions VI,VII and VIII)	
Finland	A complementary mire conservation programme for Finnland	Raimo Heikkilä (Research Centre of the Nature Reserve "Friendship", Finland)
	Restoration of drained boreal mires in Finland	Taipo Lindholm and Hanna Heikkilä (both at National Board of Waters and the Environment, Finland)
Ireland	Internationally important raised bogs threatened	Peter Foss (Irish Peatland Conservation Council, Ireland)
Germany	Karst mires in the National-park of Jasmund (Isle of Rügen)	Lebrecht Jeschke (National park administration, Meclenburg-Vorpommern, Germany) and Christina Paulson (Germany)

Regional Variation and Conservation of Mire Ecosystems

Time Schedule for the Conference

Wednesday 6th July

POSTERS (to Sessions VI,VII and VIII)

Japan	Ecology of bentic invertebrates in mire waters	Toshio Iwakuma and Ryuhei Ueno (both at Environmental Biol. Division, National Inst. for Environmental Studies, Japan)
Norway	Conservation and management of mires in Norway	Ingerid Angell-Petersen (Directorate for Nature Management, Norway)
	Vegetational changes in rich fen vegetation induced by hay-cutting at Sølendet nature reserve.	Asbjørn Moen, Trond Arnesen, Egil I. Aune and D. I. Øien (all at The Museum of Nat. Hist. and Archaeology, University of Trondheim)
	Regional variation and conservation of mires in Norway	Asbjørn Moen, Stein Singsaas and Sigurd Såstad (all at the Dept. of Bot., The Museum of Nat. Hist and Archaeology ., University of Trondheim)
	Vegetational history; history of development of blanket mires in Central Norway	Thyra Solem (Dept. of Bot., The Museum of Nat. Hist. and Archaeology, University of Trondheim)
	Vegetation region classification of mire localities in central Norway compared to species indicator-value classifications and to climatic data.	S. Såstad and A. Moen (both at Dept. of Bot., The Museum of Nat. Hist. and Archaeology, University of Trondheim)
SESSION VIII	**MIRE DISTRIBUTION, CONSERVATION NATIONAL SURVEY: MIRES IN NORWAY**	**Chairman: Olav Nord-Varhaug**
13.30	Introduction	Olav Nord-Varhaug (Directorate for Nature Management, Norway)
13.35	Vegetational history; history of development of blanket mires in Central Norway	Thyra Solem
13.55	Regional variation and conservation of mires in Norway	Asbjørn Moen, Stein Singsaas and Sigurd Såstad
14.15	Conservation and management of mires in Norway	Ingerid Angell-Petersen
14.30-15.00	SUMMARY OF CONFERENCE CONCLUSIONS	
15.00	*Coffee and posters*	

Friday 15th July

Final session at the museum

10.00	Intoduction
10.10	Geert Rayemakers: Mire Conservation in the European Union as a result of the Habitat Directive, Bird Directive and Financial Instruments ACE and LIFE
10.30	Tatsuichi Tsujii (Faculty of Agriculture, Hokkaido University, Japan): Invitation to mires in Japan
10.50	Resolutions. IMCG in the future. Election of board members
14.00	End of Field Symposium

K. NORSKE VIDENSK. SELSK. MUS. RAPP. BOT. SER. 1974-86
UNIV. TRONDHEIM VITENSK. MUS. RAPP. BOT. SER. 1987-

1974 1 Klokk, T. Myrundersøkelser i Trondheimsregionen i forbindelse med den norske myrreservatplanen. 30 s. kr 20,-
2 Bretten, S. Botaniske undersøkelser i forbindelse med generalplanarbeidet i Snillfjord kommune, Sør-Trøndelag. 24 s. utgått
3 Moen, A. & T. Klokk. Botaniske verneverdier i Tydal kommune, Sør-Trøndelag. 15 s. utgått
4 Baadsvik, K. Registreringer av verneverdig strandengvegetasjon langs Trondheimsfjorden sommeren 1973. 65 s. kr 40,-
5 Moen, B.F. Undersøkelser av botaniske verneverdier i Rennebu kommune, Sør-Trøndelag. 52 s. utgått
6 Sivertsen, S. Botanisk befaring i Åbjøravassdraget 1972. 20 s. utgått
7 Baadsvik, K. Verneverdig strandbergvegetasjon langs Trondheimsfjorden - foreløpig rapport. 19 s. kr 20,-
8 Flatberg, K. I. & B. Sæther. Botanisk verneverdige områder i Trondheimsregionen. 51 s. utgått

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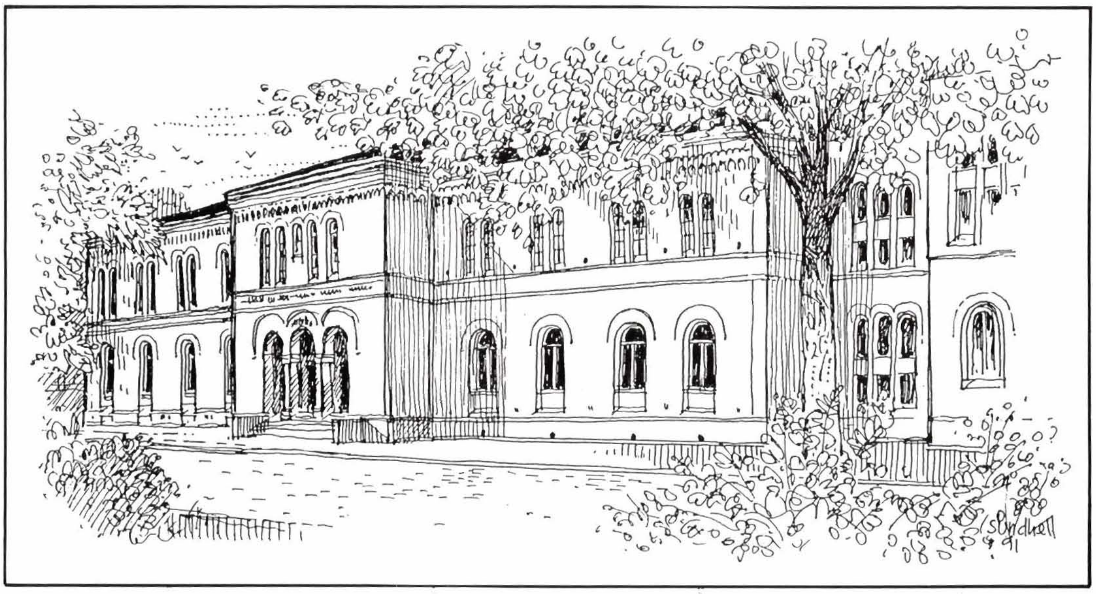

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