RAPPORT BOTANISK SERIE 1994-2

EXCURSION GUIDE FOR THE 6th IMCG FIELD SYMPOSIUM IN NORWAY 1994

Asbjørn Moen and Stein Singsaas

UNIVERSITETET I TRONDHEIM
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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.

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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)

UNIVERSITETET I TRONDHEIM, VITENSKAPSMUSEET
RAPPORT BOTANISK SERIE 1994 2

EXCURSION GUIDE FOR THE 6th IMCG FIELD SYMPOSIUM IN NORWAY 1994

Asbjørn Moen and Stein Singsaas

The report is printed in 300 copies

University of Trondheim,
Museum of Natural History and Archaeology,
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N-7004 TRONDHEIM

Trondheim June 1994

ISBN 82 - 7126 - 855 - 4
ISSN 0802 - 2992

Abstract

Moen, A. & Singsaas, S. 1994. Excursion guide for the 6th IMCG field symposium in Norway 1994. Univ. Trondheim Vitensk.mus. Rapp. Bot. Ser. 1994 2:1-159

This guide contains a description of the variations found among the mires in central Norway. The main emphasis is on the hydromorphology, flora and vegetation, but the bird fauna and conservational aspects are also included. The regionality of the vegetation is stressed (5 zones/belts and 5 sections have been mapped). Nine main mire localities that will be visited during the excursion are also described. Rørmyra (locality 1), Kaldvassmyra (2) and Toppmyr/Røkmyr (9) are southern boreal mires with raised bog units. They represent three different (oceanic) sections. Tufsingdeltaet (5), Stormyra (6) and Bakkedalen (8) are middle boreal mires representing some of the most continental areas in Norway (localities 5 and 6, the slightly continental section) and the most oceanic areas (locality 8, the highly oceanic section). Typical mire units are flark fens and sting mixed mires (5), flat fens (6) and blanket bogs (8). The final localities, Upper Forra (3), Sølendet (4) and Haukskardmyrin (7), are mainly of northern boreal type but in quite different sections. Sloping fens dominate localities 3 and 4, palsa mires (the southernmost in Fennoscandia) are typical for locality 7. A complete list of vascular plant and Sphagna species, and some selected bryophytes are presented for 13 mire localities. The list numbers 490 taxa. A new phytogeographical (floristic) classification of 225 mire plants in southern Norway is presented. It includes 3 sub-groups of each of the 5 groups (elements) of species: western, southern, southeastern, eastern and alpine/upper boreal.

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Preface

This excursion guide has been prepared for the IMCG field symposium in Norway, July 1994. Together with the booklet presenting the 53 summaries of the conference (printed as no. 1994 1 in the same series) and the field colour guide of Norwegian Sphagna (which will be printed in the same series), this guide represents important material being published before the field symposium.

The planning of the mire excursion in Norway started a few days after the decision (in Switzerland in 1992) to visit Norway in 1994. The committee appointed to arrange this 1994 symosium (see below) discussed the route during the winter of 1992/93, and the mire ecologists (Flatberg, Moen & Singsaas) visited the most potential localities in the summer of 1993, including all the 9 localities that were finally chosen for the excursion. Ingerid Angell-Petersen, Eirik Lind and Thyra Solem also participated in the 1993 visits to Kaldvassmyra and Upper Forra (localities 2 and 3).

When preparing this guide, we have made use of material gathered over many years. Several people have contributed, and we would like to thank, here: Arvid Lillethun at the Norwegian Mapping Authority (maps), Bodil Willman at the Norwegian Institute for Nature Research (maps), Alf Ottar Folkestad, Hans Christian Gjerlaug and Asbjørn Thingstad (Environmental Officers in the counties we shall be visiting, for information on the status of the localities), Egil I. Aune, Liv Nilsen, Sigurd Saastad and other botanists at the Museum Botany Department (contributed on various occasions and in various capacities). Thyra Solem has written the sections on the vegetational history of Upper Forra and Haramsøy (sections 4.3.1 & 4.8.3), Øystein Størkersen section 5; Ingerid Angell-Petersen has contributed information on the conservation and use of the localities and written section 3.5. Kjell Ivar Flatberg is a co-writer (with Asbjørn Moen and Stein Singsaas) of section 3.4. Stein Singsaas has written sections 4.5-4.7, prepared species lists and contributed in many parts of the work. The great majority of this excursion guide has been written by Asbjørn Moen.

Philip Tallantire has translated or corrected some sections; the main English language editing being done by Richard Binns, who has simultaneously typed a few parts of the text. Typing has otherwise been done by Inger Marie Growen, who together with Randi Baadsvik, Arild Krovoll and Else Johanne Svorkås, helped to prepare figures and carried out technical editing.

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.

1. Introduction

1.1. The international Mire Conservation Group (IMCG)

The International Mire Conservation Group is a worldwide organisation of mire specialists (ecologists, nature administrators) with a particular interest in mire conservation. The IMCG began in Finland in 1983 and was formally established the following year at its first field symposium in Austria. Subsequently field symposia have been arranged in Scotland, Sweden, Ireland and in Switzerland. The 6th field symposium will be held in Norway during the period 4th - 15th July 1994, with Trondheim as the starting and ending point for visits to 9 mire locations in Norway, covering a wide range of mire types.

1.2. Central aims for the Field Symposium in Norway

A. To gather mire spesialists from different parts of the world in order to exchange knowledge about the variation (biodiversity) and conservation of mire systems. In particular, discussion will concentrate on joint terminology and the understanding of different classification systems.

B. To focus on the destruction of mires and peatlands of the world. Initiatives will be taken to support conservation efforts in different countries. Particular consideration will be devoted to the countries of Eastern Europe, where mires with existing protection are threatened by expansion eastwards of western peat mining companies.

C. To demonstrate the variation of mire types, vegetation and animal life on Norwegian mires. Emphasis will be placed on the regional variation of hydro-morphological mire types, plant communities and plant species. The nature of central Norway will be presented through a ten days excursion showing the shifts from the lowlands to the mountains (boreonemoral - low alpine regions) as well as from west to east (strongly oceanic to slightly continental section). The main mire communities and species of central Norway will be presented (including more than 90 per cent of the European Sphagnum species).

D. To present the results and experience of mire conservation work and management in Norway, similarly, experiences from orther countries will hopefully contribute to a two-way information exchange.

E. To prepare publications which will increase our knowledge of mire ecology, conservational problems, etc., primarily for the scientific world, but also for interested members of the general public. Prior publications (this excursion guide, Moen & Binns (1994) and Flatberg (in prep)) will hopefully promote communication during the field symposium itself. After the symposium, we plan to publish a report containing the resolutions, etc. in autumn 1994, followed by an edited proceedings containing papers (talks, posters) presented at the symposium, which it is hoped will be published early in 1995.

The main aim of this guide is to bring helpful information to the participants of the field excursion (and others interested in the topic) in order that the above aims can be achieved.

2 Features of the geography of Norway, with main emphasis on central Norway

2.1 Norway in brief

NORWAY (originally Nordweg, meaning the "northern way") is part of Scandinavia, the large peninsula in northwest Europe. It has borders with Sweden (1619 km), Finland (716 km) and Russia (196 km) (Fig. 2.1.1).

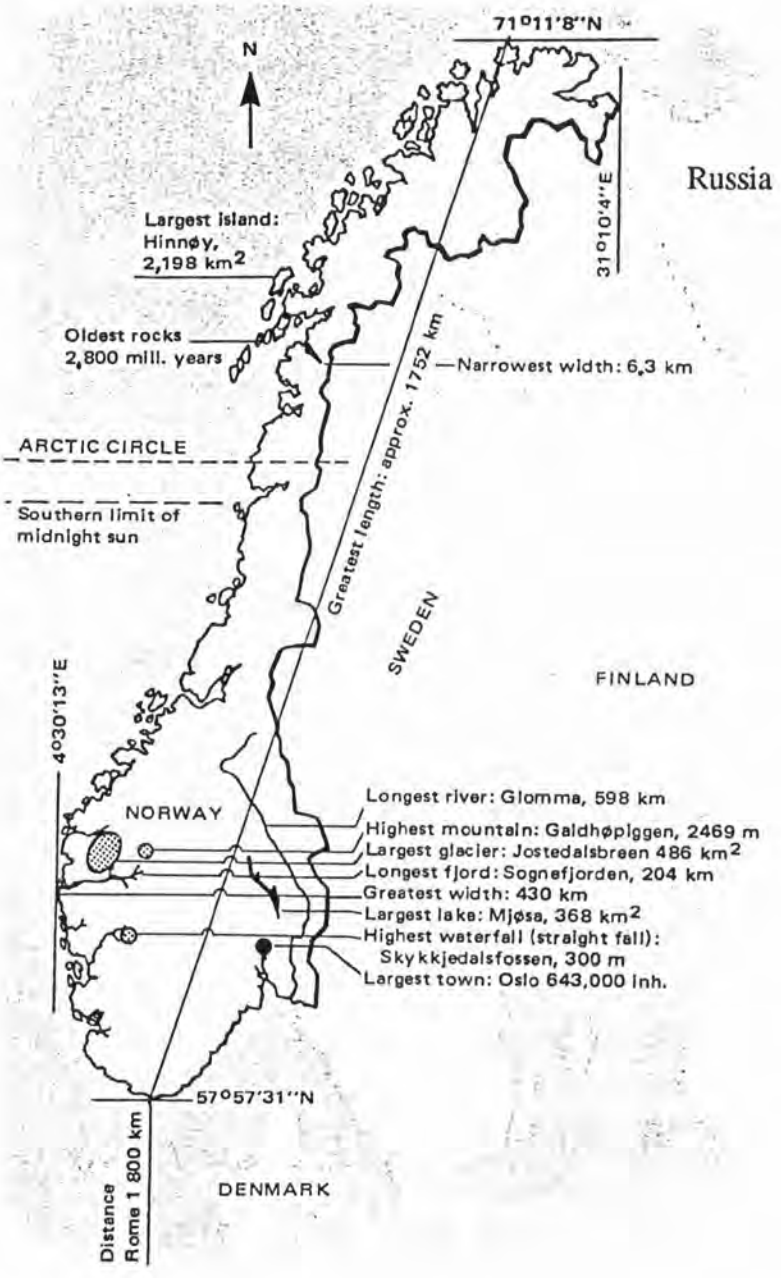


Fig. 2.1.1 Norway in brief (After Palmström 1988).

The land area is 324,000 km^2 (excluding Spitsbergen and Jan Mayen). About 10% of the country is covered by mires. A mere 2.8% of the area is cultivated soil, 5% is lakes, 20% productive forest, and less than 1% is populated.

The coastline (excluding fjords) measures 2650 km; including the 50,000 islands the total shoreline is as long as 55,000 km.

Norway has a population of 4,158,000 (1984), about 45% living in towns and built-up areas.

The first people came to Norway at least 10,000 years ago when the huge inland ice sheet receded.

Oslo is the capital and the largest city with a population of 643,000. Other large towns are:

Bergen	180 000
Trondheim	127 000
Stavanger	90 000

Trondheim is one of the oldest towns, celebrating its 1000 years anniversary in 1997.

2.2 Geology

2.2.1 Bedrock map

The geological map of Norway (Fig. 2.2.1) gives a very simplified picture of the bedrock of Norway and provides information on the age of the various rock divisions. A more detailed bedrock map of Norway on a scale of 1:1 mill. has been prepared by Sigmond et al. (1984), and along with a guide for users (Sigmond 1985) it forms part of the National Atlas of Norway.

2.2.2 Geological history

PRECAMBRIAN (4600-600 mill. yrs. ago) Norway is part of the Baltic Shield, one of the world's large continental shields. It includes Fennoscandia (Norway, Sweden, Finland) and the western part of Russia (Fig. 2.2.1). The dominant rocks originated in the Middle and Late Precambrian. To its west, the Baltic Shield is bounded by the Caledonian mountain range, and younger sedimentary rocks occur beyond that on the continental shelf underlying the Norwegian Sea and the North Sea.

PALÆOZOIC (600-250 mill. yrs. ago) The bedrock of a large part of Scandinavia is, as we see it now, basically a result of several episodes of folding, faulting and metamorphism during the Caledonian orogeny 550-400 mill. years ago when sea-floor sediments and lavas dating from Late Precambrian to Silurian time were compressed to form the Caledonian mountain range. This range is thought to have been eroded down to a low, hilly landscape over a period of 50 mill. years.

During the MESOZOIC era (250-66 mill. yrs. ago) Scandinavia was mostly a flat plain.

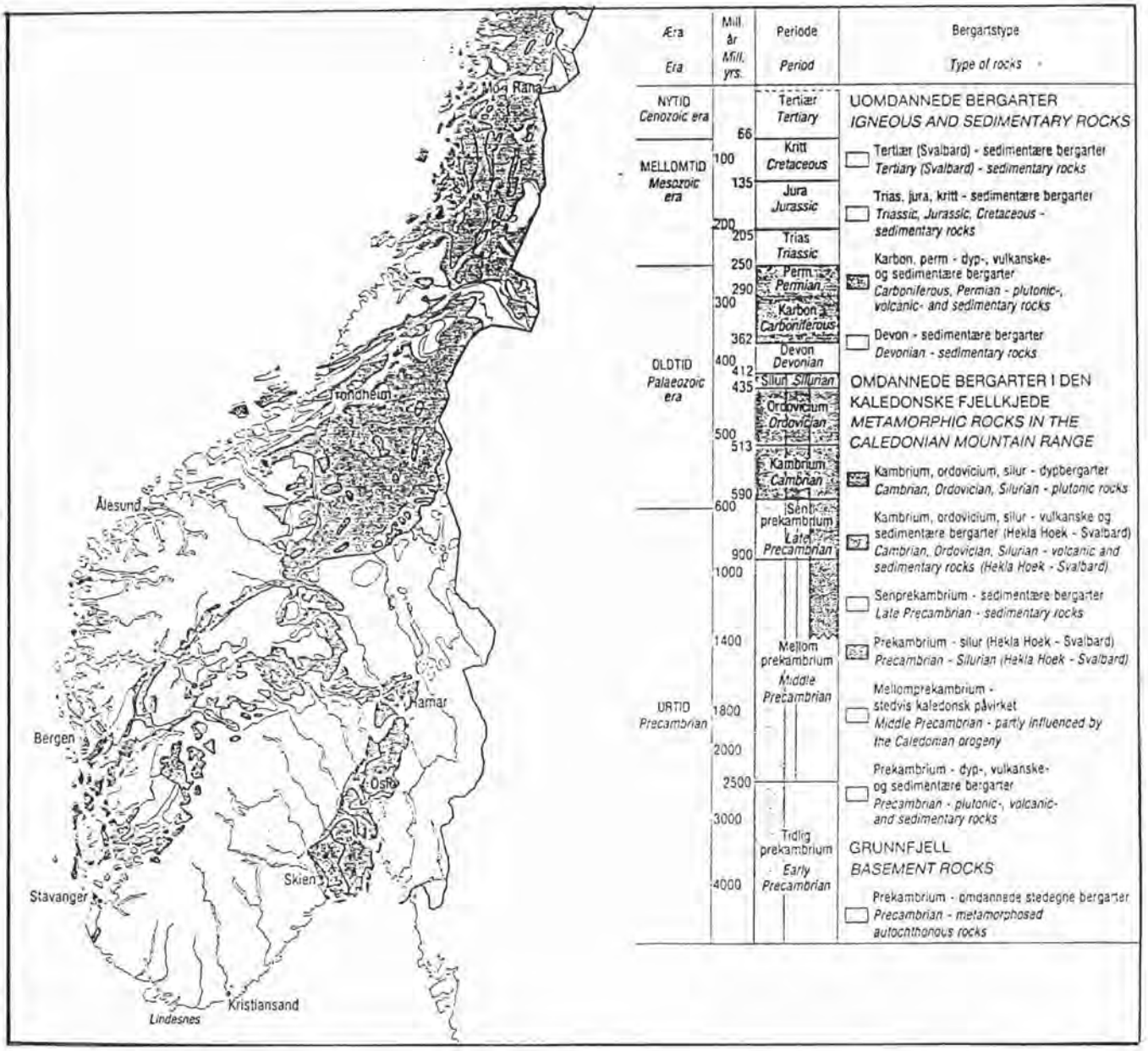


Fig. 2.2.1 Bedrock map of the southern two-thirds of Norway, scale 1:6 mill. Copy of Statens kartverk (1987). The original is in full colour (map B, enclosed for excursion participants). Map basis: The National Atlas of Norway, The Norwegian Mapping Authority, permission no. LNA 4 1559.

CENOZOIC (66-0 mill. yrs. ago) The flat, very low-lying Scandinavian landmass was uplifted and tilted about 20 mill. yrs. ago in connection with Tertiary faulting off the coast of western Norway. This event is responsible for the characteristic highlands in Norway. Rivers and glaciers have since eroded the rocks to create the topography we find in Norway today. Glacial erosion during several ice ages in the Quaternary period, the last of which ended some 10,000 years ago, effectively removed the previously weathered rock and accumulated gravel, sand and clay. The present-day rock surface in therefore fresh and in many places lacks a soil cover.

2.2.3 Favourable bedrocks and unconsolidated deposits (drift)

Siliceous rocks (granites, etc.), giving poor (acidic) mineral soils, cover a major part of Norway. In addition, podzol development and peat deposition under the influence of a cool, damp climate and acid-producing vegetation have resulted in large areas being dominated by soils which are very poor in plant nutrients.

Areas containing calcareous, readily-weathered types of bedrock are shown in figure 2.2.2. Most of these rocks date from the Cambro-Silurian period. Such bedrock covers extensive areas of central Norway and continues to dominate to the north. There are also some smaller areas of limestones and shales further south, notably in the Oslo region.

Most of the older, pre-glacial soil in Norway was swept out to sea during the Quaternary glaciations, and unconsolidated deposits play a largely insignificant role. The largest unbroken areas of such deposits are found near Oslo, in Jæren (extreme southwestern Norway) and near Trondheim, where glacial, fluvioglacial and marine deposits from the last Ice Age and the postglacial period cover great expanses. Because their chemical composition depends upon the nature of the parent rock, most of these deposits are acidic. The marine deposits, however, with their content of shell debris, are often nutrient-rich. As a consequence, rich vegetation (e.g. rich fens) can occur extensively in areas below the marine limit - the maximum height reached by the sea during the time when the ice sheet of the last Ice Age depressed the land most (about 10,000-11,000 years ago). Figure 2.2.3 shows the area below the marine limit in Norway.

2.2.4 Deglaciation of central Norway

The landscape of central Norway is extremely varied, with striking differences between the inland districts and coastal and fjord areas. Shallow valleys in the highland peneplains and rounded mountain ranges dominate the interior. The major features of this landscape were formed in pre-Quaternary time. In the coastal and fjord areas, young landforms predominate, with deep fjords which cut far into the landmass.

Extensive research carried out during the last 20 years or so provides an overview of the deglaciation of central Norway (e.g. Sollid & Sørbel 1981, Sollid & Reite 1983). The following is mainly based on the last-mentioned publication, which also has a useful reference list.

The continental ice sheet retreated from lowland areas on the coast of Møre & Romsdal more than 12,000 years ago, marking the beginning of the final melting of the ice sheet in central Norway. Radiocarbon dates indicate that coastal and outer fjord areas were ice free by Allerød

Fig. 2.2.2 Map of distribution of limestones and schists (black). The black dot indicates smaller outcroppings of the same rocks. 500 and 1000 m contours indicated. After Fægri (1960).

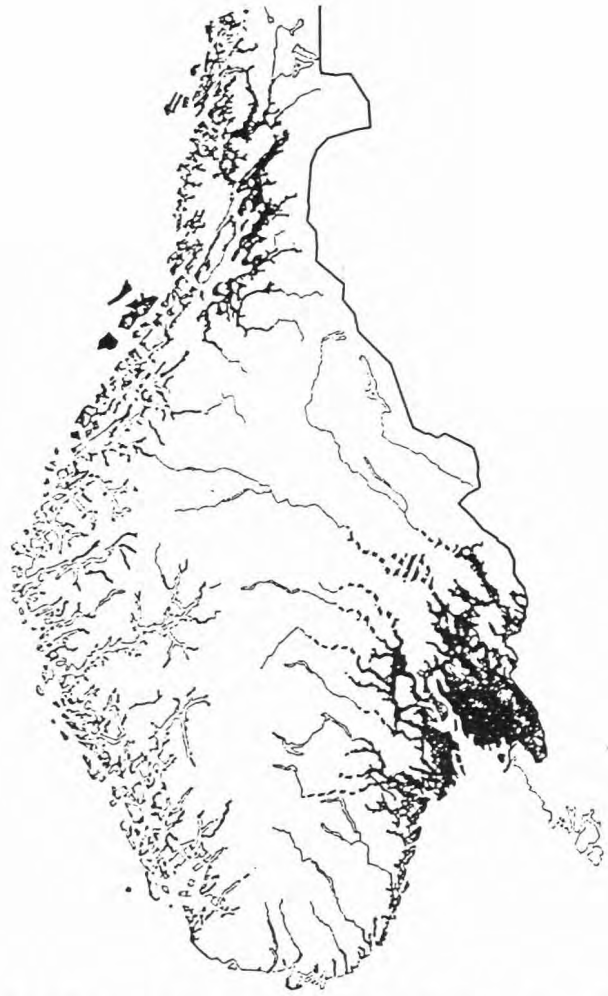


Fig. 2.2.3 Areas below the marine limit. The dark colour shows areas which are thought to have been covered by the sea after the last Ice Age. The first land areas emerged ahead of the glacier front some 14 000 - 13 000 years ago, whereas the inner fjord areas were deglaciated about 9 000 years ago. In southeastern Norway the division between the sea proper and the innermost fjord basin or lake is indicated by hatching. After Sørensen et al. (1987). Map basis: The National Atlas of Norway, The Norwegian Mapping Authority, permision no. LNA 4 1560.

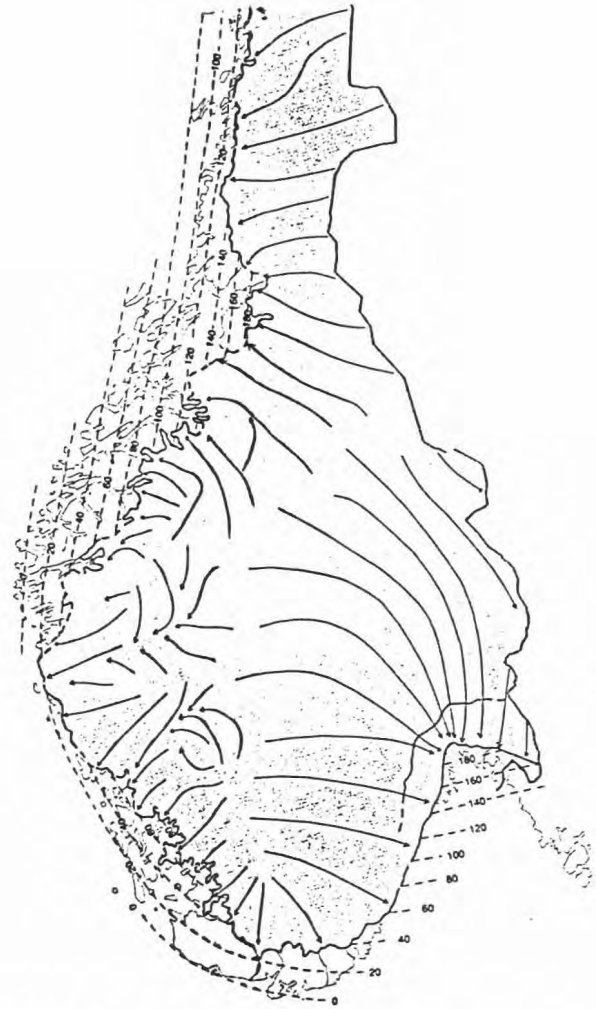


Fig. 2.2.4 The land uplift in relation to the present sealevel during the last 10 000 years. The broken lines (isobases) go through locations that had the same land uplift. The ice-marginal deposits of the Younger Dryas advance (the main advance, 11 000 - 10 000 C^{14}-years before present). Arrows show the ice-flow directions. After Sørensen et al. (1987). Map basis as figure 2.2.3.

time (11,800-11,000 BP). Some 3000 years later all the ice had melted, the present glaciers being formed later.

During the deglaciation, the retreat of the glaciers was interrupted by advances, or minor stillstands. The debris transported to the glacier front formed more or less continuous ice-marginal deposits in the form of moraines, deltas and submarine fluvioglacial deposits. The most significant ice-marginal deposits in central Norway are situated at the limit that has been dated to the Younger Dryas, which corresponds to the interval between 11,000 and 10,000 years ago (Figs. 2.2.4 and 2.2.5). Evidence from elsewhere in Fennoscandia suggests that the Younger Dryas represents the most extreme climatic deterioration during the deglaciation period.

The question of whether the Norwegian landmass was completely covered by an ice sheet, or whether ice-free coastal refuges existed during the maximum of the last Ice Age (20,000-18,000 BP), has been discussed at length. One aspect of this controversy, the possible survival of plant species during the last Ice Age on refuges along the Norwegian coast, has been strongly debated for about a hundred years. The Fennoscandian alpine flora contains several phytogeographical elements. A considerable number of species display a distinct distribution, and such species are, above all, found in two widely separated areas, one in the southern-central mountains of Norway (Jotunheimen-Dovre-Trollheimen), the other in northern Norway. About 30 taxa of vascular plants are bicentric, a smaller number are southern unicentric, e.g. *Pedicularis oederi*, and about 40 are northern unicentric species.

The county of Møre & Romsdal may have several such ice-free refuges, or nunataks, where alpine species survived the last Ice Age. Dahl (1990) summarises the nunatak hypothesis.

2.3 Climate

The climate of Norway is varied in the extreme. Firstly, there is the obvious variation in climate found in a country stretching across 13 degrees of latitude on both sides of the Arctic Circle. Secondly, there are the differences found anywhere in a mountainous country, from the lowlands to the high mountains. This makes it impossible to display the details of distributions of temperature, precipitation, etc. on small-scale maps. Thirdly, there is a very pronounced west-east gradient. The axis of greatest elevation lies far west and straddles the prevailing direction of airflow. The air masses coming in from the west are forced up and over the mountains, giving abundant precipitation on the windward side and low precipitation in the east.

The climate of Norway is excellently described in the National Atlas of Norway (Aune 1993), based on the normal period of 1961-1990. This publication (with an English summary) has 10 climatic maps, the most complete set published for Norway. These and the accompanying text give an insight into differences in weather and climate in Norway by showing how temperature, precipitation and wind vary geographically throughout the year and in a historic perspective.

The following is a short summary of the main climatic features in Norway, mainly based on Aune (1993). Figures 2.3.1, 2.3.2 and 2.3.3 are black and white copies of maps (Statens Kartverk 1987) giving the figures for the normal period of 1931-1960 for annual rainfall and January and July temperatures. (The originals in colour, on a scale of 1:6 mill., are enclosed for excursion participants.)

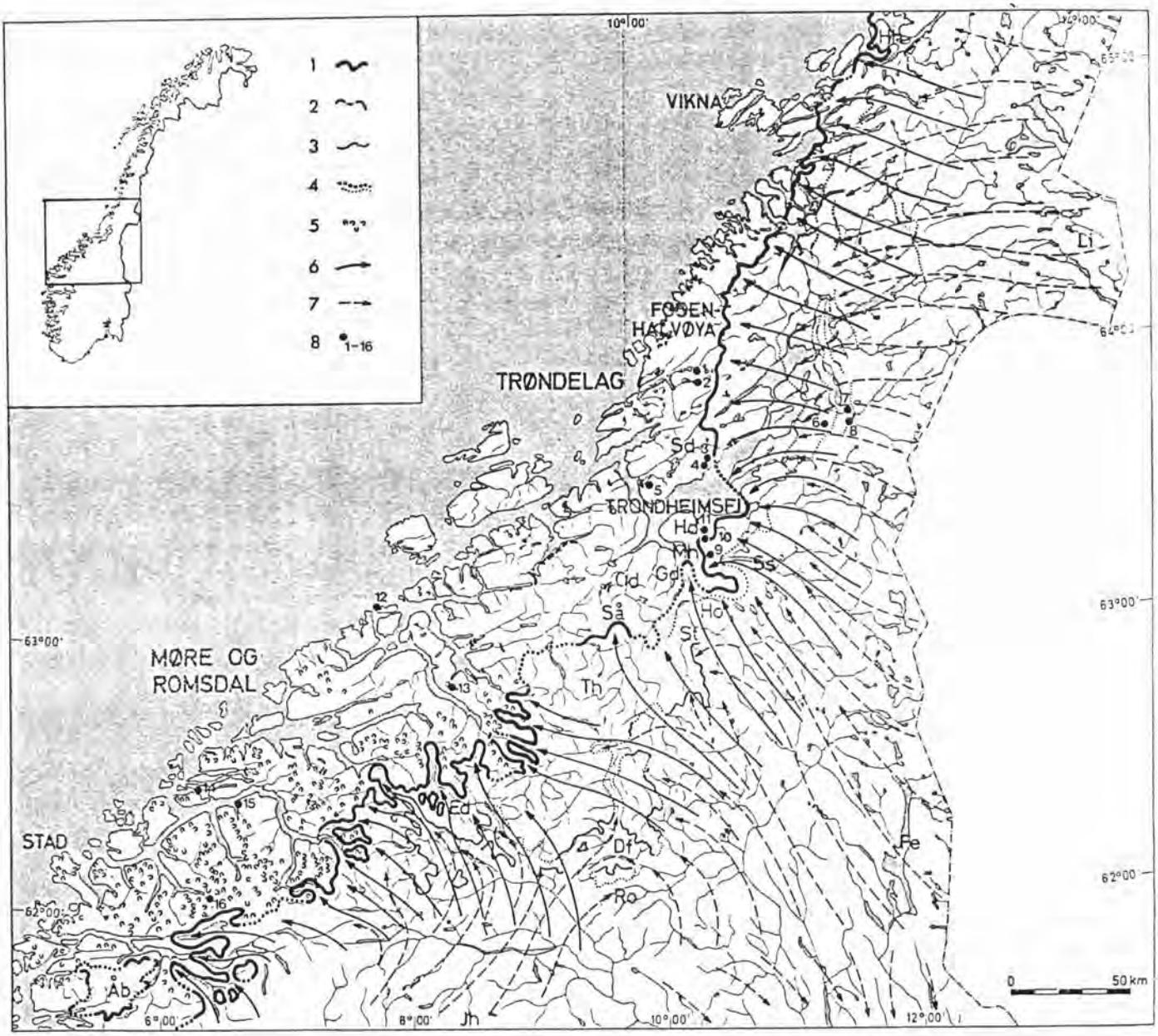


Fig. 2.2.5 The main glacial geological features of Central Norway, after Sollid & Sørbel (1981). Abbreviations of geographical names given are as follows: Hh=Heilhornet, Li=Lierne, Sd=Skaudalen, Hd=Heimdal, Mh=Melhus, Od=Orkdalen, Gd=Gauldalen, Ss=Selbusjøen, Så=Storås, St=Støren, Ho=Hovin, Th=Trollheimen, Ed=Eikesdalen, Df=Dovrefjell, Ro=Rondane, Fe=Femund, Åb=Ålfoten, Jh=Jotunheimen, 1=Maximum ice limit of the Younger Dryas advance, the main advance. 2=Terminal moraines older than the Younger Dryas. 3= Ice margin during the late Younger Dryas or during the transition to the Holocene, 4= Assumed ice-marginal positions. 5=Younger Dryas cirque moranies. 6=Younger Dryas ice flow directions. 7=Early Holocene ice-flow directions. 8=Sites of radiocarbon dates.

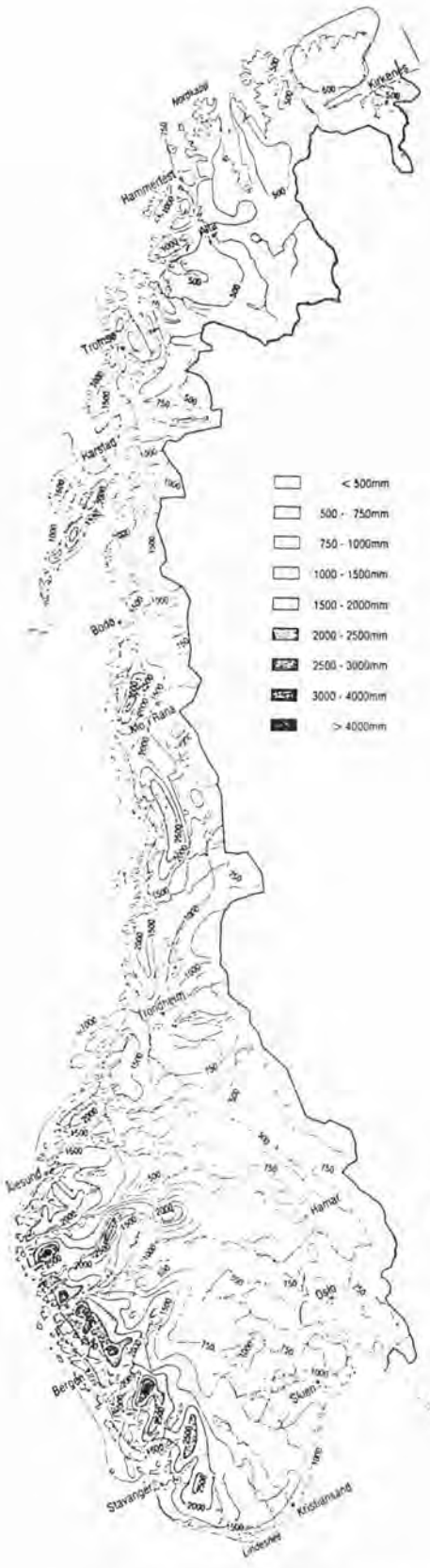


Fig. 2.3.1 Annual rainfall in mm, normal period 1931-60. Copy of Statens kartverk (1987, map D). Map basis: The National Atlas of Norway, The Norwegian Mapping Authority, permission no. LNA 4 1559.

Fig. 2.3.2 Normal temperature of day and night in °C, January (1931-60). Copy of Statens kartverk (1987, map E). Map basis: as in Figure 2.3.1.

Fig. 2.3.3 Normal temperature of day and night in °C, July (1931-60). Copy of Statens kartverk (1987, map F). Map basis: as in Figure 2.3.1.

2.3.1 Temperature

Thanks to the North Atlantic Ocean Current (the Gulf Stream) and the prevailing westerly winds, Norway has a much warmer climate than its location between 58° and 71°N should indicate.

The warmest region in Norway is along the coast from Agder to Sunnmøre, where the average temperature is 7-8°C. The coldest areas are in the mountains, where large parts of central Norway have a mean temperature lower than -4°C.

There are two main features in the normal temperature distribution in winter. One is the high temperatures along the coast. The coastline from Lindesnes to Lofoten has monthly means above 0°C. The other feature is the low temperatures in lowland areas inland. In calm, cold weather the coldest air will sink to the lowest parts of the terrain, creating a temperature inversion. The absolute minimum air temperature that has been measured at an official observation station in central Norway is -50.4°C in Røros. (-51.4°C has been measured at Karasjok in Finnmark.)

The growing season, when the normal daily temperature is above 5°C, is longest along the coast of western Norway (Vestlandet) where it locally exceeds 225 days. In low-lying parts of interior southeastern Norway (Østlandet), in the Tynset-Røros area, it is around 165 days.

2.3.2 Precipitation

The terrain is a very important factor in determining the distribution of precipitation in oceanic areas. High hills and mountains increase precipitation on the windward side.

Areas just inland from the coast itself receive most precipitation. The Brekke observation station just south of the mouth of Sognefjord has the highest normal annual precipitation with 3575 mm. Most precipitation, however, comes in mountainous areas where it is difficult to undertake systematic measurements. Parts of the westernmost glaciers have a normal annual precipitation of approximately 5000 mm. The maximum precipitation zone in Norway is one of the wettest in Europe. Although there is a marked seasonal variation with most precipitation in the autumn and least in the spring, there are no well-defined wet and dry seasons.

Mountain ranges protect southeastern Norway from the prevailing weather systems which give a great deal of precipitation. This region receives little precipitation, and most of it comes as showers in summer. Øygard in Skjåk has the lowest normal annual precipitation in Norway with 278 mm and Folldal has 364 mm.

The precipitation does not only vary geographically, there are also large variations from year to year. Brekke has annual totals ranging from 5596 mm to 2140 mm and Øygard in Skjåk from 392 mm to 152 mm.

Most of Norway generally has some precipitation (more than 0.1 mm) on more than 160 days of the year, with 250 days on parts of the coast of Trøndelag and less than 150 days in parts of southeastern Norway (Førland 1993). Throughout Norway, spring is the driest period of the year. Most continental areas receive most of their annual precipitation as summer showers. In more oceanic areas, the autumn has very high precipitation.

2.3.3 Snow cover

Most of Norway has permanent snow cover in winter. Outer lowland areas (the strongly oceanic sector) of central Norway have less than 50 days with snow cover. The lowlands of central Norway have more than 125 days, and most of the upper boreal zone has 150-200 days with snow. Most downslope areas of the northern boreal and alpine regions have more than 200 days with snow-covered ground, large areas having 220-250 days.

The upland areas along the coast have most days with snowfall (more than 70), but in westernmost places much of the snow will often melt quickly because the temperature generally exceeds 0°C in winter. Thus, the deepest snow (more than 200 cm) is to be found in colder, oceanic, upland areas further inland.

The snow cover is certainly important for groundwater conditions and paludification in upland areas, especially during spring and early summer when precipitation is low.

2.4 Vegetational regions

2.4.1 Terminology

Two different types of geographical variation in vegetation are recognised. The *regional variation* (also called zonal) is a response to the climate, whereas the *local variation* (azonal) is related to variations in the geological and geomorphological conditions. The regional variation in vegetation in Fennoscandia has been described by, for example, Sjörs (1963), Ahti et al. (1968) and Moen (1987); the last-mentioned paper gives a fuller description of the terms and criteria used here.

The term *vegetational region* (vegetational zone, vegetational belt, etc.) is employed when the plant cover is the sole classificatory criterion. When, in addition, the fauna of an area is included, the parallel form *biotic region* (or biome) is used, and, similarly, *climatic region* when the classification is based on climatic factors and *physical-geographical region* when all the components in nature are used.

The concept *vegetational zone* is used for regions that extend more or less continuously around the Earth's surface. The vegetation changes gradually in character from south to north. The term *vegetational belt*, on the other hand, designates altitudinally separated regions. The horizontal (in zones) and vertical (in belts) distribution of the Earth's vegetation cover is dependent on the cumulative warmth received during the growing season.

There is also a wide geographical variation in the vegetation from west to east on any landmass. The term *vegetational section* is used for such changes in the vegetation along this third dimension and is related to an oceanity-continentality gradient.

2.4.2 Vegetational zones (belts), emphasis on central Norway

Figure 2.4.1 shows the circumboreal zones of the Northern Hemisphare given by Hämet-Ahti (1981).

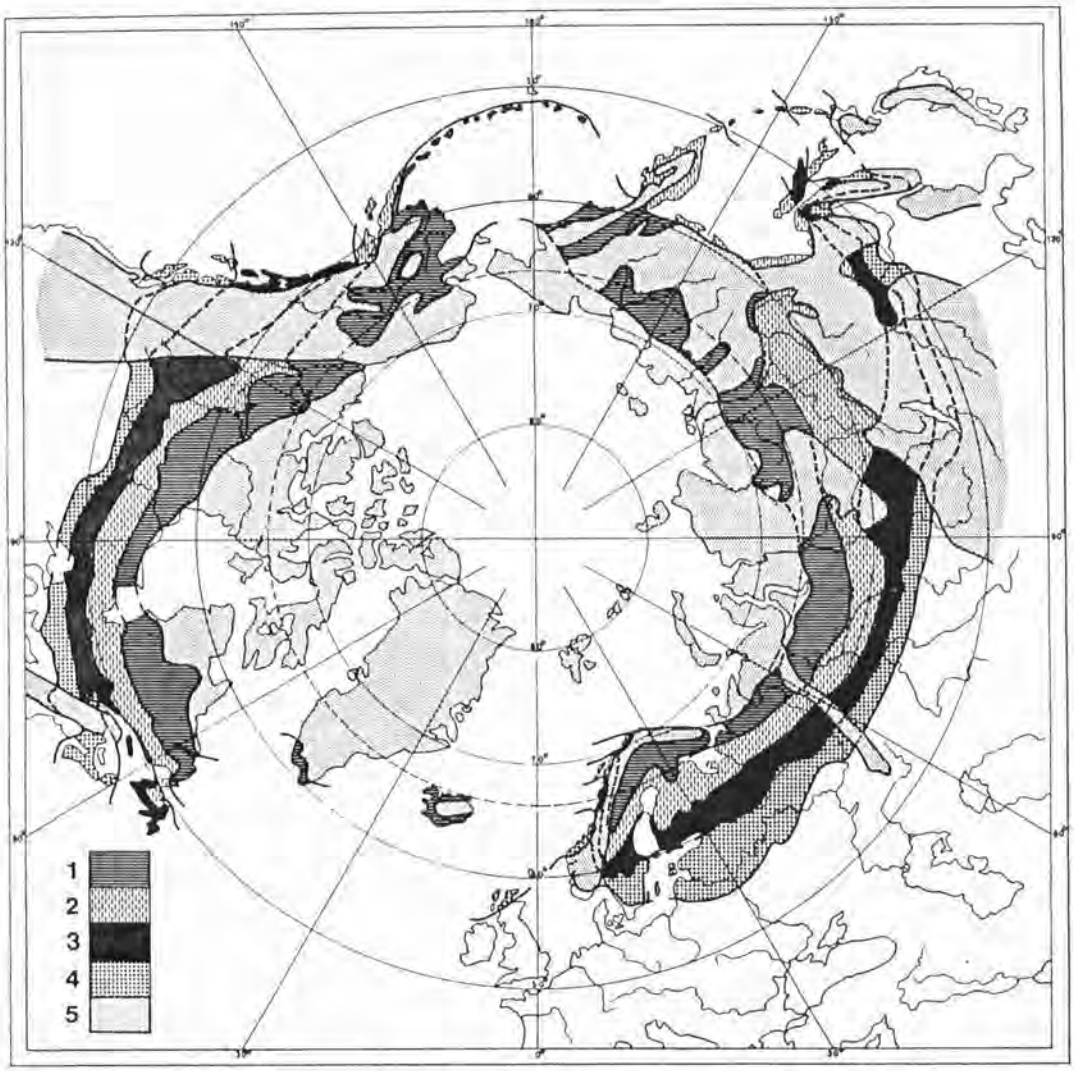


Figure 2.4.1 The circumboreal zones. 1. Northern boreal. 2. Middle boreal. 3. Southern boreal. 4. Boreonemoral. 5. Arctic and oroarctic areas (Hämet-Ahti 1981).

Moen (1987) describes in detail the zones and belts of central Norway (Fig. 2.4.2). On figures 2.4.2 and 2.4.3, the *coastal section* can be distinguished in the far west of Norway, and on the regional map (Fig. 2.4.3) this section is sub-divided into three separate altitudinal belts which are described in more detail in section 2.4.3. The remaining (greater) part of Norway is split into zones/belts as follows: *nemoral*, present only in the far south of Norway; *boreonemoral*, extending north to Trondheimsfjord; *southern boreal*, as far north as Salten; *middle boreal*, from southeastern Norway northwards up the major valleys into central Norway and northeastwards to Alta in northern Norway; *northern boreal*, up to the altitudinal (climatic) forest limit; and finally the *low, middle* and *high alpine* regions in the mountains. The main criteria used to separate these zones are shown in figure 2.4.4. The following regions (zones/belts) are represented in central Norway:

Boreonemoral region/zone

Patches of boreonemoral vegetation occur in central Norway. Most localities are south-facing and situated in areas with favourable geological (soil) conditions. Copses of deciduous forest with *Quercus robur, Fraxinus excelsior, Ulmus glabra* and other warmth-demanding species/communities are characteristic. A number of species (e.g. the three mentioned, see Fig. 2.4.5) occur at their northernmost localities in the world.

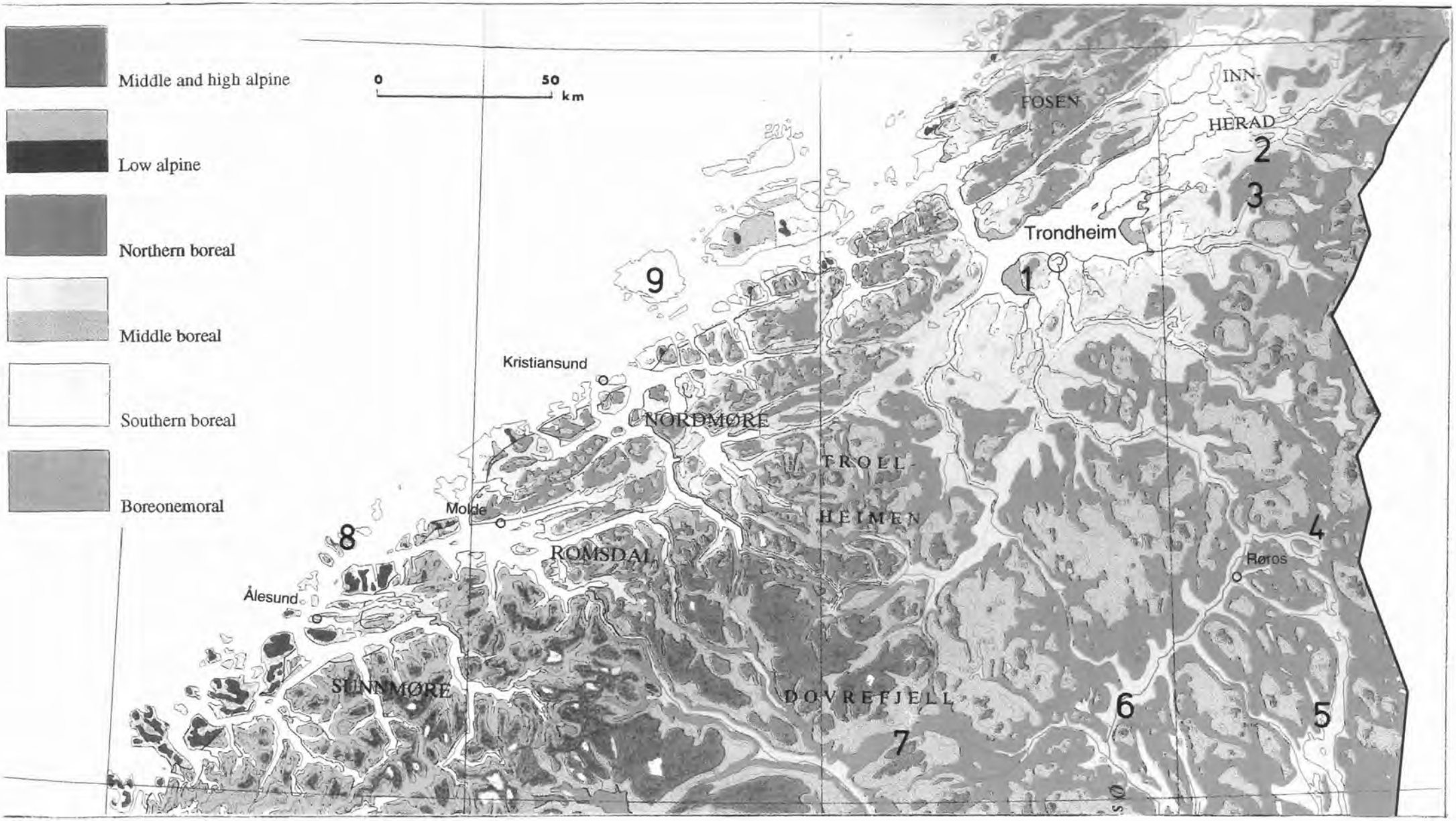


Fig. 2.4.2 Vegetational zones/belts of central Norway. The areas of the coastal section included in the zone-units. Modified after Dahl et al. (1986).
Map basis: The National Atlas of Norway, The Norwegian Mapping Authority, permission no. LNA 4 1657.
1-9: The excursion localities.

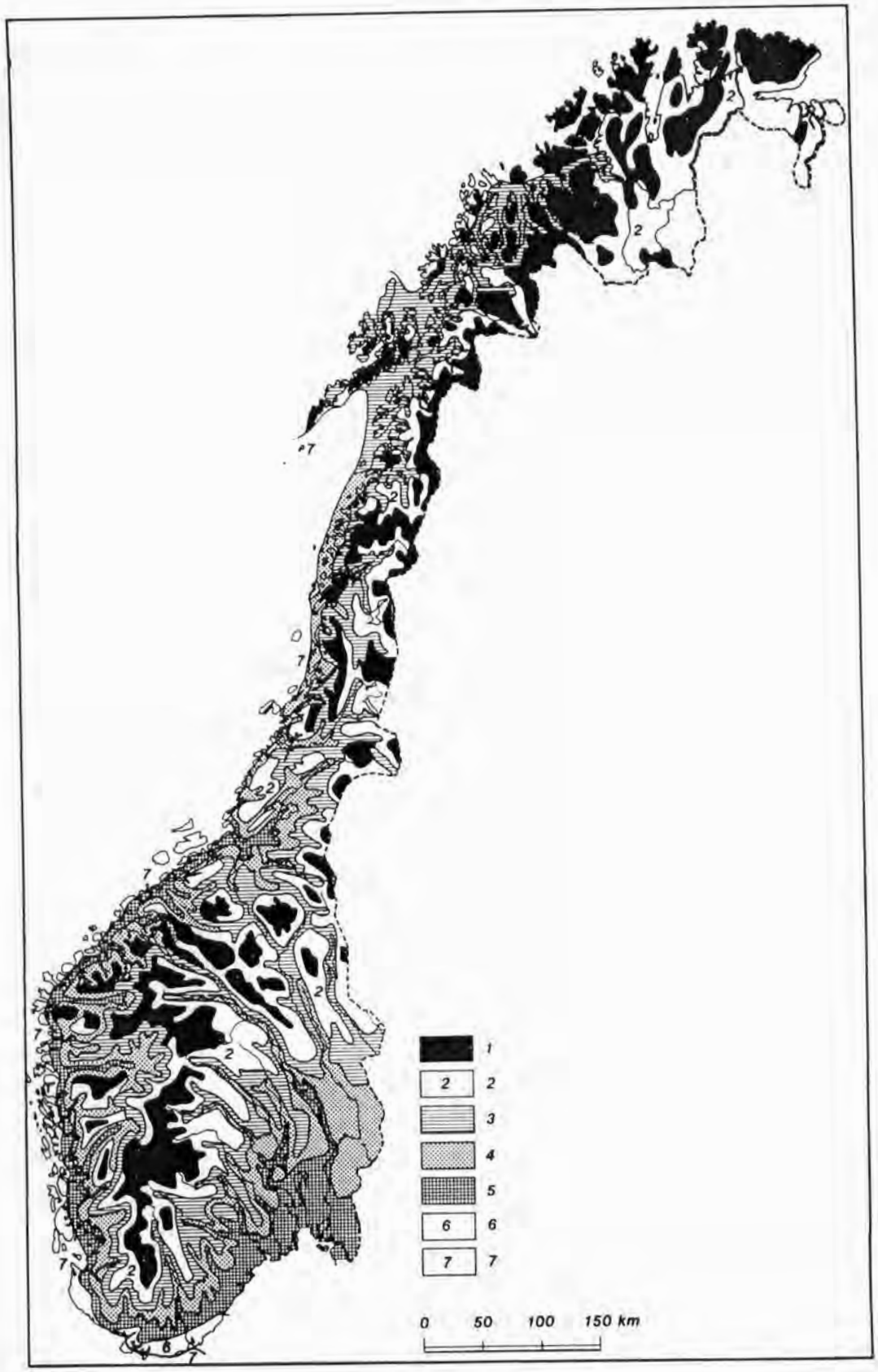


Fig. 2.4.3 The vegetational zones of Norway based on the scheme used in the map of vegtational regions of Norway. 1. Alpine region. 2. Northern boreal zone and region. 3. Middle boreal zone. 4. Southern boreal zone. 5. Boreonemoral zone. 6. Nemoral zone. 7. Coastal section. After Moen (1987).

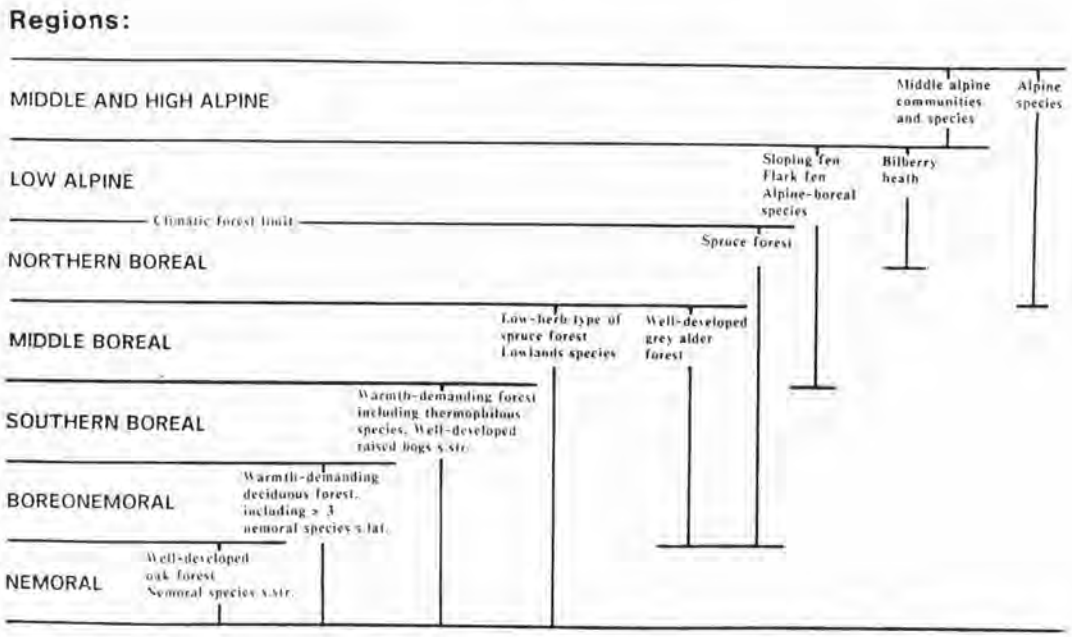


Fig. 2.4.4 Schematic representation of the main criteria used to separate the vegetational regions of Norway, the coastal section not included.

Fig. 2.4.5 Northern limits in Nordic countries of six of the tree species occurring in Central Norway. *Alnus glutinosa* (Engl. black alder; Norw. svartor); *Fraxinus excelsior* (ash; ask); *Quercus* ssp. (oak; eik); *Taxus baccata* (yew; barlind); *Tilia cordata* (linden; lind); *Ulmus glabra* (elm;alm) has a more or less continous distribution between Nord-Trøndelag and Jämtland, but on the map it is separated. The mapped species are all commonly cultivated, and often naturalized outside the natural distribution area shown on the map. Mainly after Hustich (1960) and Hultén (1971).

Southern boreal region/zone
This is dominated by coniferous forests interspersed with wide areas of alder forests and mires, e.g. raised bogs. It is rich in species requiring high summer temperatures. Southern deciduous trees occur locally. The zone occurs in the lowlands up to 100 m a.s.l. in the northwest, and up to 400 m a.s.l. in the interior southern part of central Norway (Fig. 2.4.6).

Middle boreal region/belt
This is also dominated by coniferous forests. Grey alder forests are present, but southern deciduous trees are lacking. Mires cover extensive areas, among them sloping fens, flark fens and different types of mixed mires. Its upper limit is at around 300 m a.s.l. on the coast, rising to more than 700 m in continental parts of central Norway (Fig. 2.4.7).

Northern boreal region/belt
This is dominated by birch forests and sparse low-yielding, productive coniferous forests with extensive areas of minerotrophic mires and has traditionally been used for summer farming. Its upper limit follows the climatic timberline (around 400 m a.s.l. in the west, rising to 1100 m a.s.l. in the Dovrefjell area) (Fig. 2.4.8).

Low alpine region/belt
Situated above the climatic timberline, this region is dominated by heath communities with, for example, *Betula nana* and *Vaccinium myrtillus* and scrubs dominated by grey willows *(Salix lapponum, S. glauca* and *S. lanata*). Minerotrophic mires are common and solifluction communities increase in abundance upwards. The low alpine region reaches 1400 m a.s.l. in the Dovrefjell area (Fig. 2.4.9).

2.4.3 Vegetational sections

Moen & Odland (1993, in Norwegian) define the sections and present maps of central Norway (Fig. 2.4.10), Fennoscandia and Denmark (Fig. 2.4.11). A detailed map of the whole of Norway is being prepared (Moen et al. in prep).

The starting point for drawing the boundaries on the maps has been the types of vegetation and those plant species which show limited distributions along a west-east gradient. The main criteria are shown in figure 2.4.12. The distribution of the various communities and species in Fennoscandia has formed the basis for the classification. The western/oceanic units and species have been especially important. Their distributions often show a tendency to coalesce in parts of Norway (e.g. many lowland species tend to have a western distribution). Summary of the various sections:

O3 Highly oceanic section
A sub-section O3 t can be distinguished here, defined by the occurrence of the frost-sensitive (winter thermophile) communities and species (hyperoceanic species). This sub-section represents a sectional boundary (according to Tuhkanen 1984) that coincides with the isotherm for the coldest month of 0°C or above (Aune 1993). The O3 section also comprises the remaining parts of the "coastal section" as it was delimited on the regional map (Dahl et al. 1986).

O2 Markedly oceanic section
A number of species with a western distribution are predominant and common in this section (group 3 in figure 2.4.12). The section boundary extends along the coast from Østfold to

Fig. 2.4.6 Contour map (isohypses, i.e. lines connecting points of equal height above sea-level) for the southern boreal region. After Moen (1987).

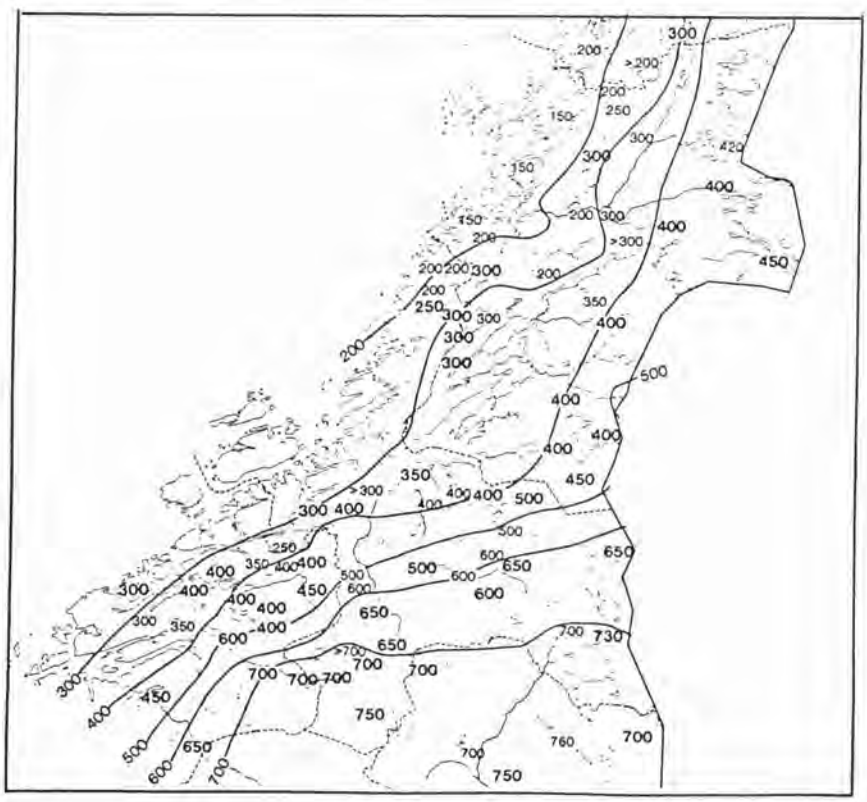


Fig. 2.4.7 Contour map (isohypses) for the upper limit of the middle boreal region. After Moen (1987).

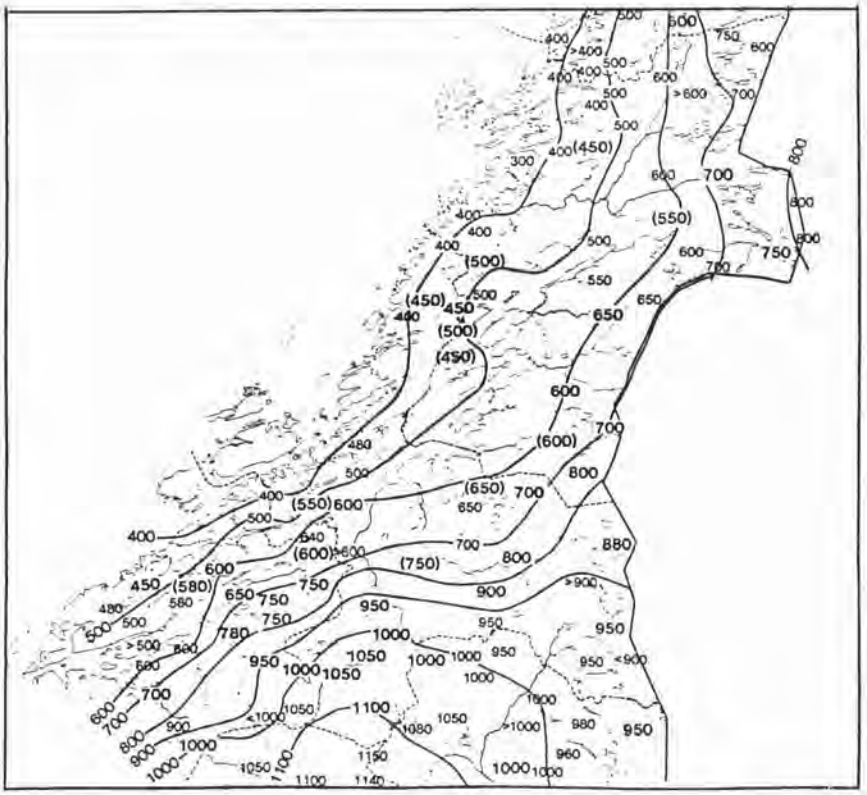


Fig. 2.4.8 Contour map (isohypses) for the upper limit of the northern boreal region, i.e. the altitude of the climatic forest limit. After Moen (1987).

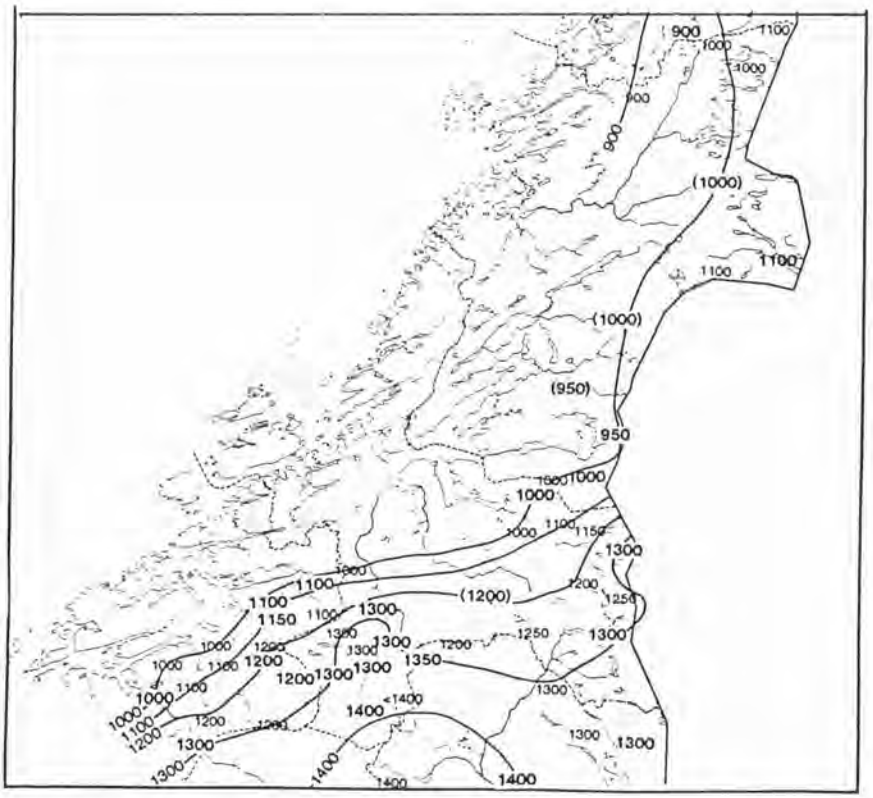


Fig. 2.4.9 Contour map (Isohypses) for the upper limit of the low alpine region. After Moen (1987).

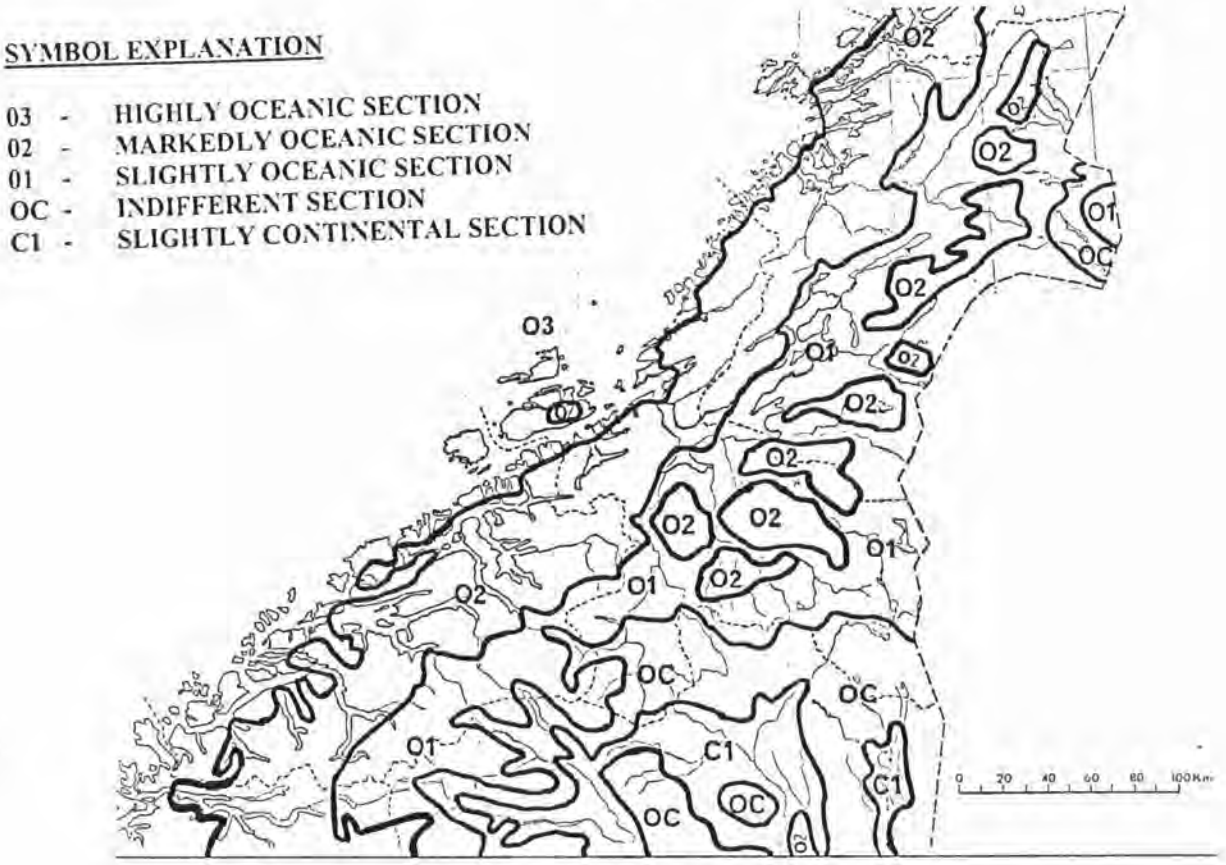


Fig. 2.4.10 Vegetational sections in central Norway. Copy from Moen & Odland (1993).

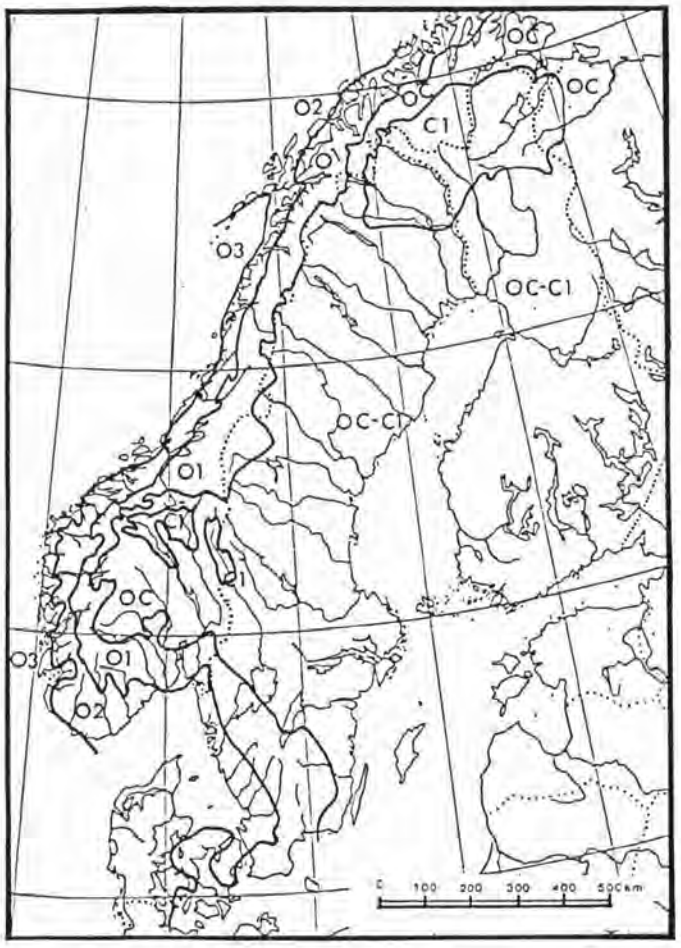
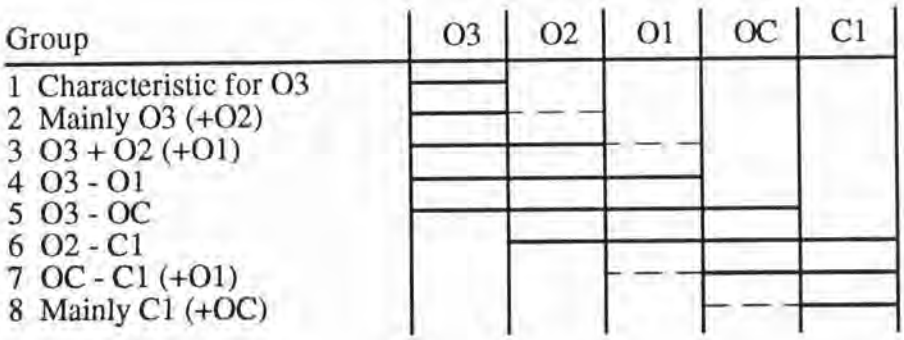


Fig. 2.4.11 Map of the vegetational sections in Fennoscandia and Denmark. The boundaries in Norway are based on those given in the detailed maps (figs 14 815) judging from the lowland condions. Those for the rest of the region are partly from Ahti et al.(1968).

Between sections OC and C1 no separations has been made for most parts of Sweden and Finland.



Group	Community	Species
1. Characteristic for O3 (t: Characteristic for subsection. O3t)	Open heathland at sealevel. The alpine vegetation is not differentiated into ridge and snowbed vegetation.	Vasculars: Erica cinerea[t], Hymenophyllum wilsonii, Luzula congesta[t], Vicia orobus[t], Scilla verna[t], Saxifraga hypnoides[t] Bryophytes: Dicranodontium uncinatum, D. asperulum, Pleurozia purpurea, Scapania ornithopodioides, Racomitrium ellipticum, Andreaea alpina, Breutelia chrysocoma, Campylopus brevipilus
2. Mainly O3 (+O2)	Bazzanio-Pinetum Hylocomio-Alnetum Primulo-Ulmetum Eurhynchio-Fraxinetum Blanket bogs	Vasculars: Carex binervis, Conopodium majus, Digitalis purpurea, Galium saxatilis, Hypericum pulchrum, Luzula sylvatica, Polygala serpyllifolia, Scirpus cespitosus ssp. germanicus, Dryopteris pseudomas, Sedum anglicum Bryophytes: Sphagnum imbricatum ssp. austinii, Hookeria lucens, Bazzania trilobata Bog hummocks include: Hypnum jutlandicum, Leucobryum glaucum, Rhytidiadelphus loreus, Sphagnum strictum, Cladonia portentosa
3. O3 + O2 (+O1)	Erico-Pinetum Leucobryo-Pinetum Corno-Betuletum Steep sloping fens	Vasculars: Erica tetralix, Juncus squarrosus, Narthecium ossifragum, Potamogeton polygonifolius Bryophytes: Odontoschisma sphagni, Sphagnum strictum
4. O3 - O1		Vasculars: Carex hostiana, C. pulicaris, C. tumidicarpa, Thelypteris limbosperma, Blechnum spicant Bryophytes: Plagiothecium undulatum, Leucobryum glaucum, Mnium hornum, Mylia taylorii, Sphagnum angermanicum, S. auriculatum, S. molle, Rhytidiadelphus loreus
5. O3 - OC	Sloping fens	Vasculars: Myrica gale, Succisa pratensis
6. O2 - C1	Alnus incana-forest Picea abies-forest String mires	Vasculars: Aconitum septentrionale, Angelica archangelica, Calamagrostis stricta, Carex buxbaumii, C. chordorrhiza, C. livida, Eriophorum gracile, Juncus stygius, Phyllodoce caerulea, Trollius europaeus, Viola biflora Bryophytes: Sphagnum balticum, S. subfulvum, Splachnum luteum
7. OC + C1 (+O1)	Calamagrostio-Salicetum pentandrae	Vasculars: Carex aquatilis, C. heleonastes, C. loliacea, Equisetum scirpoides, Galium trifidum, Pedicularis sceptrum-carolinum, Poa palustris, P. remota, Salix starkeana Bryophytes: Drepanocladus tundrae, Racomitrium microcarpon, Sphagnum wulfianum, Splachnum rubrum
8. Mainly C1 (+OC)	Palsa mires Calamagrostio lapponicae-Pinetum Saline soil areas	Vasculars: Carex disperma, C. globularis, C. laxa, C. tenuiflora, Ledum palustre, Salix myrtilloides, S. xerophila, Eriophorum russeolum, Moehringia laterifolia, Ranunculus lapponicus

Fig. 2.4.12 Schematic representation of the main criteria used to separate the vegetational sections of Norway. Modified after Moen & Odland 1993).

Troms. A number of species with an eastern distribution (*Picea abies, Aconitum septentrionale*) occur in the northern part of this section, but are absent from western Norway. Sections O3 and O2 represent those parts of the country that receive the highest precipitation, more than 1200 mm annually. The annual number of days on which precipitation is recorded is also high, more than 200 days with more than 0.1 mm (Førland 1993). Humidiphilous species and types of vegetation attain their optimum in these sections.

O1 Slightly oceanic section
The markedly western species do not occur here, or only occur sporadically (e.g. *Narthecium*), but a number of western species do occur (group 4 in figure 2.4.12). The annual precipitation is around 800-1200 mm.

OC Transitional section
This is characterised by the occurrence of both western (group 5) and eastern (groups 6 and 7) species and communities. The annual precipitation is generally between 500 and 800 mm.

C1 Slightly continental section
Eastern species are strongly represented in this section and western species are wholly absent. Palsa bogs are typical for the northern boreal and low alpine regions, and salt pans occur in the southern and middle boreal regions (Kleiven 1959). The continental grassland communities of Kielland-Lund (1992) are found here (group 8). The annual precipitation is less than 500 mm.

2.5 Vegetational history

During more than 20 years of biostratigraphical studies, Ulf Hafsten (late Professor at the Institute of Botany in the University of Trondheim), and his students studied the vegetational history of central Norway (e.g. Hafsten 1987, 1992) (see also sections 4.3 and 4.8 where Thyra Solem summarises the vegetational history of excursion localities nos. 3 and 8). Here, we are simply reprinting the abstract of the paper by Hafsten (1987) entitled "Vegetation, climate and evolution of the cultural landscape in Trøndelag, central Norway, after the ice age". Figures 2.5.1 and 2.5.2 are taken from this paper.

Based on the essential shifts in vegetation, traced by pollen analysis and radiocarbon measurements of more than a hundred peat and sediment cores from Sør- and Nord-Trøndelag counties, late and post-Weichselian time is subdivided into five climatic periods: 1) *The Pre-Warmth Period*, comprising a) the treeless tundra during late Allerød and Younger Dryas (ca. 11,500–10,000 B.P.) and b) the Preboreal forest essentially of Birch (cf. *Betula pubescens* aggr.) and with some Aspen (*Populus tremula*), Juniper (*Juniperus communis*) and Sea Buckthorn (*Hippophaë rhamnoides*), up to ca. 9000 B.P.; 2) *The Early Warmth Period*, up to 8000 B.P., with a dry and fairly warm climate with Pine (*Pinus sylvestris*) as the dominant forest component; 3) *The Optimal Warmth Period*, up to ca. 5000 B.P., with a moist and warm climate, enabling Grey Alder (*Alnus incana*), Hazel (*Corylus avellana*) and later on also Elm (*Ulmus glabra*) and probably Alder (*Alnus glutinosa*) and Cat's Tail (*Typha latifolia*) to grow in the area; 4) *The Late Warmth Period*, up to 4000 B.P., reflecting a climatic relapse distinguished by a transient mixed forest of retreating thermophilous and expanding hardy forest components; 5) *The Post-Warmth Period*, dominated by boreal forest elements such as Pine and Birch and from about the birth of Christ onwards also Spruce (*Picea abies*).

The intervention of man on the primeval forest may be traced back to the end of the Optimal Warmth Period, but it did not gain ground until the pre-Roman Iron Age when pollen reflecting cereal cultivation first appears in the profiles. The question whether cereal cultivation was practised also during the preceding period, when only animal husbandry is recorded, requires more detailed investigations.

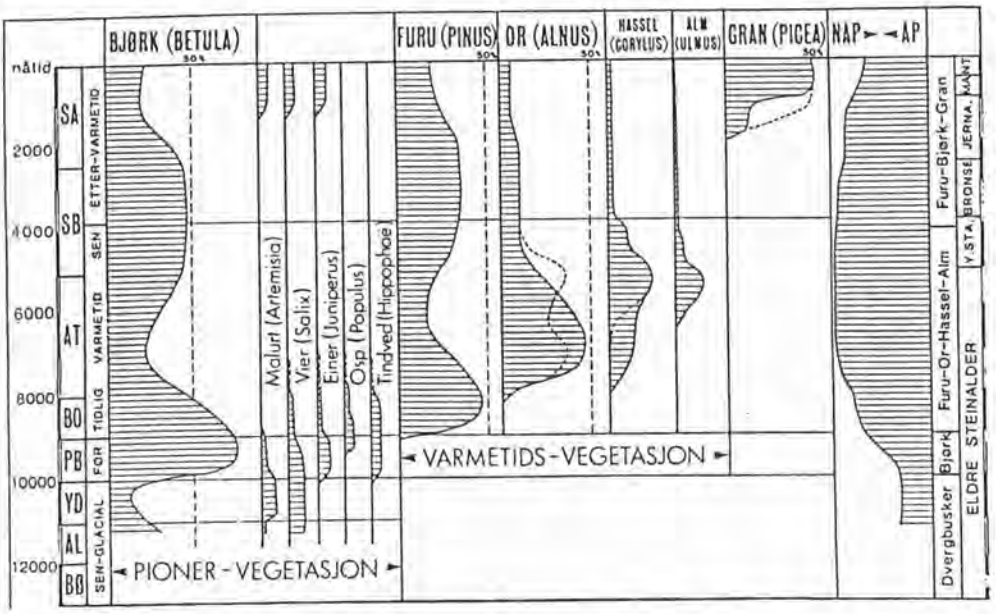
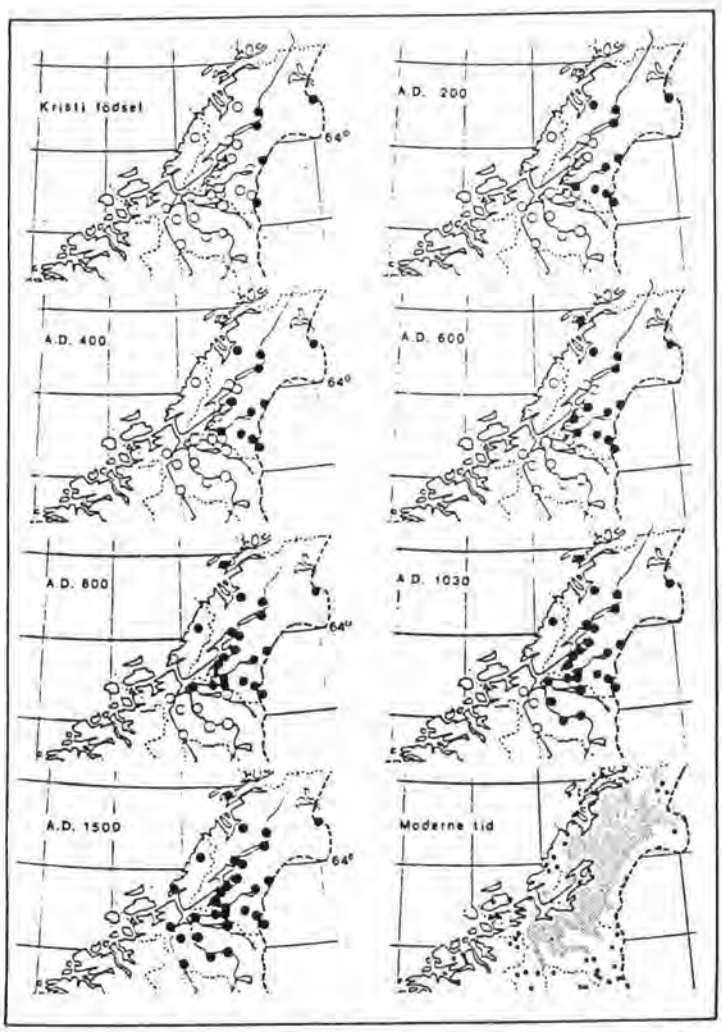


Fig. 2.5.1 Generalized pollen diagram for the inner part of the Trondheimsfjord area, showing the essential features of the vegetational development since the last part of the last ice age. Stippled curves indicate alternative developments. From Hafsten (1987). Abreviations in left-hand side as follows:
BØ=Bølling. AL=Allerød, YD=Younger Dryas, PB=Preboreal, BO=Boreal, AT=Atlanticum, SB=Subboreal and SA=Subatlanticum.



Map series displaying the immigration and spread of spruce forest within Trondelag, traced by means of pollen analysis and radiocarbon datings of cores from 32 sites. ● sites where local spruce forest had already been established. ○ sites where establishment had not yet occurred within the period in question.

Fig. 2.5.2 Spruce (*Picea abies*) in central Norway. From Hafsten (1987).

3. Mires in Norway, main emphasis on central Norway

3.1 Mire terminology

An apposite mire terminology system for use throughout Norway was prepared in connection with the national plan for mire nature reserves in Norway (e.g. Moen 1973, 1983, 1985). This terminology and the criteria used when classifying the mires closely agree with those that have been in general use in Fennoscandia for many years (e.g. Sjörs 1948, 1983, Malmer 1973, 1985, Gore 1983).

3.1.1 Basic concepts

Mires can be subdivided into two natural types: **ombrotrophic** mires (= **bogs**) that receive only atmospheric (= ombrogenous) water, and **minerotrophic** mires (= **fens**) that, in addition, receive water from the mineral soil (after Sjörs 1948, Du Rietz 1949, 1954). The **water level in the subsoil (the water table)** is defined as the highest level at which free (hydrostatic) water occurs, and all water below this level is termed **groundwater**. Soil saturation occurs wherever the water table lies close to the soil surface.

Three different modes of origin of mires can be distinguished (cf. e.g. Sjørs 1983):

1. The filling in (terrestrialization) of shallow lakes - occurs all over Norway, except in the upper alpine belts.

2. Primary mire formation occurs when peat forms directly on fresh moist or wet mineral soil after ice sheets melt, on alluvial plains and deltas, and on land emerging from the sea. Occurs commonly in Norway.

3. Paludification of originally less wet land that usually carries forest - the predominant mode of origin of Norwegian mires. In the most oceanic sections (e.g at Smøla), paludification occurs even on bare bedrock.

Mires can be subdivided hydrologically into **ombrogenous** and **minerogenous** (= **geogenous**) mires. Minerogenous mires can be further subdivided into: **topogenous** mires which are influenced by stagnant water (the water table is more or less horizontal), **soligenous** mires which are influenced by seepage water (the water table is not horizontal), and **limnogenous** mires which receive periodical supplies of flood water from other sources (the temporary water table is horizontal, having an effect similar to that in topogenous mires). The limits drawn between these three types of water supply are not always clear-cut, and it is often impossible to decide in the course of field studies to which type a particular mire area belongs. In general, the mineral subsoil beneath a soligenous mire is sloping, whereas it is flat beneath topogenous and limnogenous mires.

Springs were originally (Post & Granlund 1926) considered to be a type of topogenous mire, but Sjörs (1946) regarded them as sometimes representing soligenous mires. Hydrologically, springs are classified as either eustatic or astatic (cf. Stiny 1935, Thieneman 1942, Dahl 1957). The rate of waterflow, the water temperature and the chemical composition of the water of an **eustatic spring** remain constant throughout the year, whereas in an **astatic spring** these parameters vary. Dahl (1957) also pointed out that in lowland areas the temperature of the water in an eustatic spring follows fairly closely the mean annual air temperature of the locality. In mountainous areas, however, the long winter, with its snow

cover, causes the temperature of spring water to remain somewhat higher than the mean annual temperature.

3.1.2 Geographical concepts: mire feature, segment, unit, complex

"**Mire**" is mainly a geographical concept that comprises both the vegetation and the substrate (i.e. the peat). In addition, the term "mire" is sometimes used to characterise the habitat. "Mire" has now become an internationally accepted term that includes both bogs and fens (cf. Gore 1983: 27).

The concept "mire complex" was originally used by Cajander (1913). Sjörs (1948) proposed and defined the idea of a chain of concepts: **mire feature, mire site** and **mire complex (** Kleinformen, Formenteile and Grossformen in Aario (1932); cf. also Aartolahti 1965). A.Moen proposed an additional concept, the **mire synsite** during the work on the national plan for mire nature reserves in Norway (e.g. Moen & Pedersen 1981, Moen 1985). The following terms have been used in all Norwegian mire reports and publications after 1980: feature (Norw. myrstruktur), site (Norw. myrelement), synsite (Norw. myrelementsamling), complex (Norw. myrkompleks). An equivalent chain of four levels has been in common use the last decade, often with different names of the terms; e.g: Ivanov (1981; microform, microtope, mesotope, macrotope), Lindsay et al. (1988; microform, microtope, unit, complex), Økland (1989; (subfeature),feature, segment, synsegment, complex).

We now (**for discussion during the 6th IMCG field symposium)** propose to rename the terms, and use "mire unit" as the equivalent of mire synsite, and "mire segment" instead of mire site. The term "site" is avoided owing to its generally wide use (Økland 1989).
The standard concepts are then as follows (Table 3.1.1):

Table 3.1.1 Geographical concepts for mires. Examples of types of mire features, segments, units and complexes. Six groups of mire-units are given, 19 subdivisions of these being listed in Table 3.1.2.

Mire feature	Mire segment	Mire unit groups	Mire complex
Erosion channel	Bog plain	A Typical raised bog	Ombrotrophic
Erosion hag	Lagg	B Atlantic raised bog	Minerotrophic
Flark	Marginal forest	C Plane bog	Ombro-minerotrophic
Hollow	Soak	D Blanket bog	Minero-ombrotrophic
Hummock		E Mixed mire	
Kermi		F Minerotrophic mire	
Pool			
Rimpi			
String			
Swallow-holes			
Tarn			

A **mire feature** (microform) represents the local topographical situation where any particular plant community is growing, e.g. **hummocks** and **hollows** in ombrotrophic vegetation. As mire subfeatures the hummocks, lawns and carpets (corresponding to the hummock-mud bottom direction of vegetational variation) can be defined (Økland 1989). A number of features are in common use (e.g. Sjørs 1948 & 1983, Ruuhijärvi 1983, Lindsay et al. 1988).

Flark is used for a limited wet area in a fen, alternating with drier areas. **Rimpi** can be used for wetter fen areas in general. **String** is used for elevated areas perpendicular to the slope of the mire(both fen and bog strings occur). **Kermi** (hummock bank) can be used for ombrotrophic strings. **Hollow-pool** and **flark-pool** are water-filled, secondary depressions of bogs, respective fens. A **tarn** is a water-filled primary depression, a **swallow-hole** is a hole in the peat connected to a subterranean draining system.

Islet-hummock (peat-mound in Lindsay et al.1988,"miniature bog")
Erosion channels and **erosion hags** are features that occur on regressive mires. The channels are eroded by water, ice, wind, trampling, etc.; the hag tops most often lie at the original level of the undamaged mire plain (most often a bog).

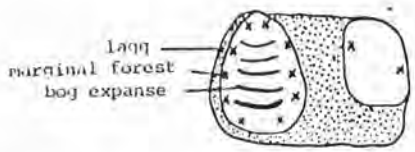
A **mire segment** (mire site, microtope) is a combination of those mire features which, at any particular location, are under the influence of fairly homogeneous hydrological conditions. It designates large-scale topographical parts of a fully-developed mire, e.g. the **lagg** (the fen strip separating the bog from the surrounding mineral soil), **fen soak** (dråg, a strip of fen between bog units), **bog plain** (the open central area) and **marginal forest** of a raised bog. The term mire element (Norw. myrelement) has previously been used by both Norwegian and Swedish authors, but is better avoided because it is illogical, since it is not an "elementary" part of a mire. Økland (1989) used mire segment as a synonym for mire element.

A mire unit (mire synsite, mesotope) is a characteristic combination of mire segments found on a particular mire; a few of these units represent important hydromorphological types, e.g. a fully-developed raised bog comprises the following segments: the open bog plain, the marginal forest and the lagg (cf. Fig.3.1.1). Some mire units, however, may comprise only one segment, e.g. a flat fen or a sloping fen.

The mire unit is the most natural classification level to use when classifying mires on the basis of their shape and surface patterns, and is in reality what has previously been used when classifying types of "mire complex" (cf. Sjörs 1948, Gore 1983). The Norwegian plan for mire reserves has since 1980 used a detailed classification system throughout Norway, in which **mire types** (i.e. hydromorphologically characterised mire units) fall into 6 main groups, each of which comprises two or more different types (mire units) (see Table 3.1.2 and next subsection). These in turn may be further subdivided into subtypes, e.g. different angles of slope on sloping fens (see figure 3.2.8).

A mire complex (macrotope) is composed of one or more mire units, i.e. it is the entire extent of a mire bounded by dry surface soil. Mire complexes in upper boreal and low alpine regions of Norway usually consist of several mire units of different types. A mire complex frequently includes sloping fen areas with different surface inclinations, flat fen areas and ombrotrophic areas, intermixed.

A mire complex can be characterised using the predominant type of mire unit present (e.g. a sloping fen complex), or using a single, typical mire unit (e.g. a palsa mire complex, even palsas cover less of the area than the flat fens). A simple classification, into ombrotrophic, minerotrophic, ombro-minerotrophic and minero-ombrotrophic types, according to the local dominance, has frequently been used in the work on mire reserves (e.g. Moen 1983). An ombrotrophic complex is at least 80% ombrotrophic, whereas an ombro-minerotrophic complex has 20-30 % of minerotrophic areas, etc.



Ombro-minerotrophic mire complex consisting of three mire units. On the left an eccentric raised bog, on the right a plane bog and in the middle a flat fen. The three types of mire segments present are also shown on the raised bog.

OMBROGENOUS PEAT
OMBROTROPHIC MIRE

ICE

MINEROGENOUS PEAT
MINEROTROPHIC MIRE

TREES (PINUS SYLVESTRIS)

OPEN WATER

TREES (BETULA PUBESCENS)

MINERAL SOIL AND SOLID ROCK

A-D: Ombrotrophic mire types

E : Mixed mires

F : Minerotrophic mire types

Ak (profile and in plan) Concentric raised bog
Ae (profile and in plan) Eccentric raised bog
Ar (profile) Ridge raised bog (and flat fen)
Au (profile) Plateau raised bog
B (profile) Atlantic raised bog
Ce (profile) Eccentric plane bog
Cr (profile) Margin plane bog
Dh (profile) Blanket bog s.str.
Es (profile and in plan) String mixed mire
Ep (profile and in plan) Palsa mire
Eø (in plan) Islet mixed mire
Ff (profile) Flat fen
Fb (profile) Sloping fen
(Fs Flark fen. Like Es, but with minerotrophic strings)

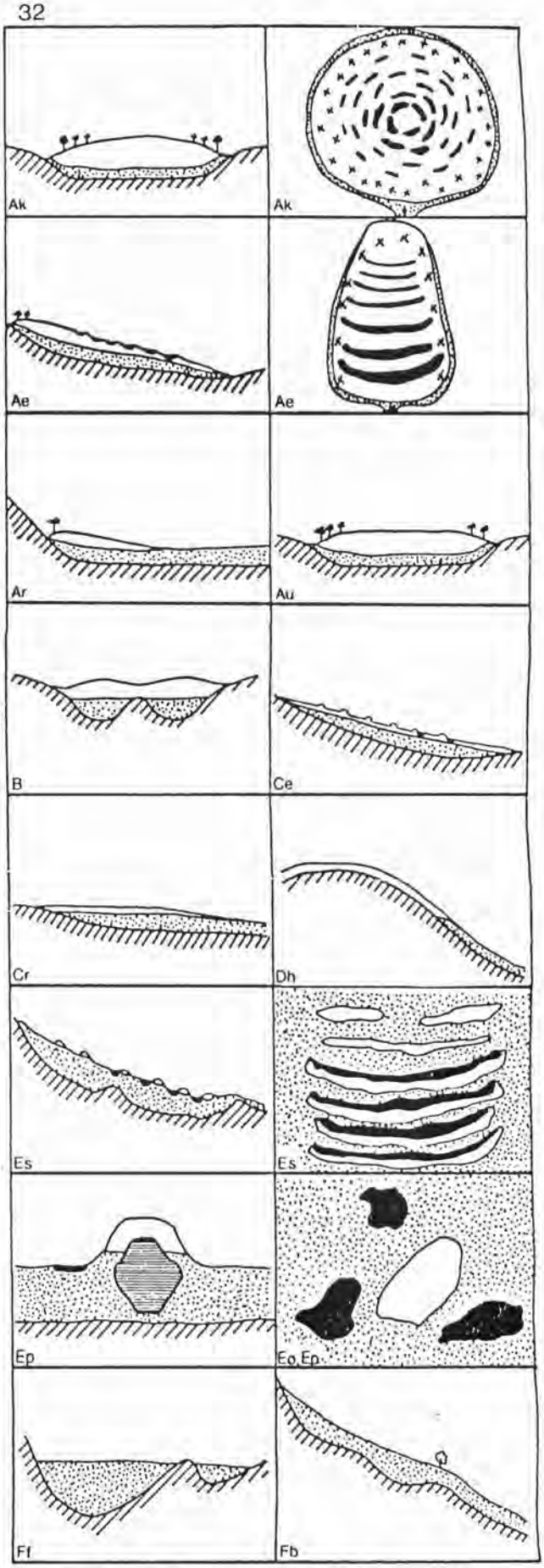


Fig. 3.1.1 Schematic presentation of the main mire types. The vertical scale in strongly exaggerated. Top left-hand corner: a mire complex consisting of three mire units, two of which comprise more than one type of mire segment. After Moen (1985).

Table 3.1.2. The different hydromorphologically defined mire-unit types used in connection with the national plan for mire nature reserves in Norway (where they were termed synsites). Eccentric features are regular, but not circular. Types in () are not occurring in central Norway. Based on Moen (1985).

A. Typical raised bogs (i.e. domed, with marginal forest and lagg).
(Ak Concentric raised bogs)
Ae Eccentric raised bogs
Au Plateau raised bogs
Ar Ridge raised bogs

B. Atlantic raised bogs (i.e. domed, without marginal forest and lagg).
(Bk A.r.b. with concentric features)
Be A.r.b. with eccentric features
Bu A. r. b. without regular features

C. Plane bogs (not distinctly domed).
Ce Eccentric plane bogs
Cr Margin plane bogs
Cu Other plane bogs

D. Blanket bogs
Dh Mound blanket bogs
Dt Sloping blanket bogs

E. Mixed mires
Es String mixed mires
Eø Islet mixed mires
Ep Palsa mires

F. Minerotrophic mires (fens)
Ff Flat fens
Fb Sloping fens
Fs Flark fens

G. Springs

3.2 Hydromorphological mire-unit types

The division into types of mire is based upon the external shape of the mires (their morphology) and the moisture type in the ground (hydrology). Mire units and their subdivisions are distinguished by studying aerial photographs and doing fieldwork. Stereoscopically examined aerial photographs show particularly clearly the shapes and structures of the mires, their angle of slope, drainage direction, etc. Field investigations are made to determine which parts are ombrotrophic (based on soil-water indicators of the plant cover), the angle of slope in the various parts of the mire (measured in new degrees (g) using a clinometer), and the height and breadth of structures, etc. This information forms the basis for deciding to which type of mire (mire unit and subunit) the feature belongs.

The intention has been to draw up a classification system that can be applied to every area of mire. Some unit-types are well defined and universally accepted (e.g. concentric raised bogs). Others are not so clearly defined, and are used collectively. These can probably in the end be further split into more units (e.g. Cu, Other plane bogs).

Here follows a short description of the 6 groups of mire-units, a more complete description will be printed in the proceedings volume from the IMCG field symposium. Figure 3.1.1 is a schematic sketch of 13 of the mire units. Figure 3.2.1 show the occurrence of the 413 mire localities investigated in central Norway, figures 3.2.2-8 show the occurrences of some of the mire unit-types.

The term **raised bog** is here used in a narrow sense and only covers distinctly domed ombrotrophic mire units. Raised bogs slope in all directions and slope down to minerotrophic areas or dry ground. The term "Hochmoor" is often used in mire science as a synonym for ombrotrophic bog (e.g. Overbeck 1975).

Typical raised bogs (A) embrace bogs with marginal forest and lagg. They usually have sharp boundaries to dry ground or adjacent types of mire. The presence of transitional types within the group is a recurring problem. It is also difficult to draw distinctions from types in groups B and C, but an attempt has been made to retain group A for raised bogs in the strict sense.

Atlantic raised bogs (B) are raised bogs lacking marginal forest and usually lacking marginal slopes and proper laggs. The doming may be weakly developed and it is often difficult to decide whether it results from the topography. The correct allocation of these bogs and those in group C is often difficult to make. An attempt has been made to place clear cases in group B and doubtful ones in group C. It is often difficult to delimit mire units, and Atlantic raised bogs are generally included in large mire complexes formed by several separate bogs amalgamating as a result of ombrogenic peat formation. Holmsen published several profiles across Atlantic raised bogs, e.g. from Smøla (Holmsen 1923: 86).

Group B includes types that correspond with "Flach-Hochmoore" (Oswald 1925) and "Plan-Hochmoore" (Aletsee 1967, Overbeck 1975).

Plane bogs (C) are ombrotrophic mires that are not classified as raised bogs. This is a heterogeneous group covering different types of ombrotrophic bog. The bogs are not domed, or the doming is vague. Minerotrophic patches often occur in hollows, and the term transitional is often used (e.g. Økland 1989). Marginal forests and laggs are generally poorly developed. A synonym is "pseudomosse", from Björkbäck, cited from Lundqvist (1969).

The term **blanket bog** (C)(Tansley 1949) is used in a strict sense for ombrotrophic units that cover the landscape like a blanket. To fulfil the requirements for the use of this term the ombrotrophic vegetation has to dominate a mound in the terrain, or slopes with an angle exceeding 3^g. The thickness of peat is often limited, and minerotrophic areas occur, especially in hollows such as erosion furrows, etc. Sloping fens are almost always found along with blanket bogs, and it is often difficult to draw boundaries between them. Within a single mire unit, the amount of minerotrophic areas must not exceed about 20 %.

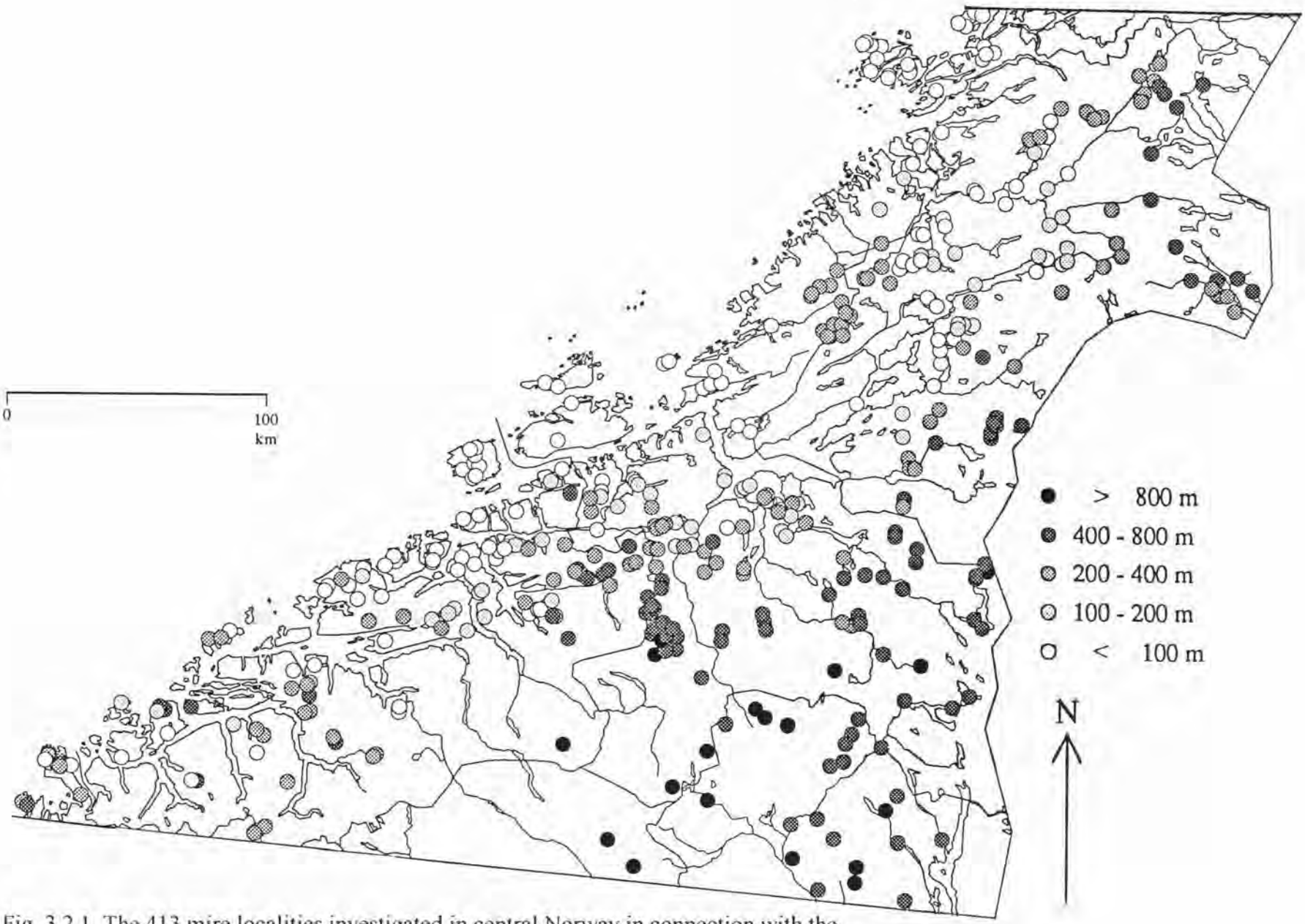


Fig. 3.2.1 The 413 mire localities investigated in central Norway in connection with the national plan for mire nature reserves. The localities are classified according to the mean elevation in m a.s.l.

Fig. 3.2.2

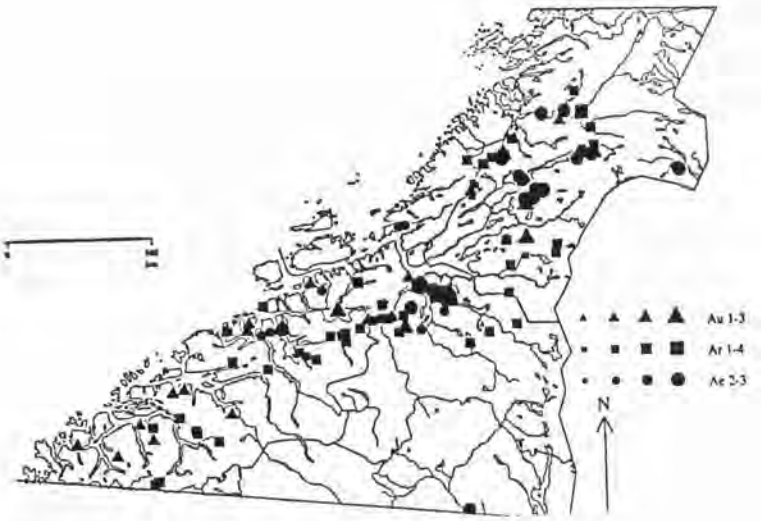


Fig. 3.2.3

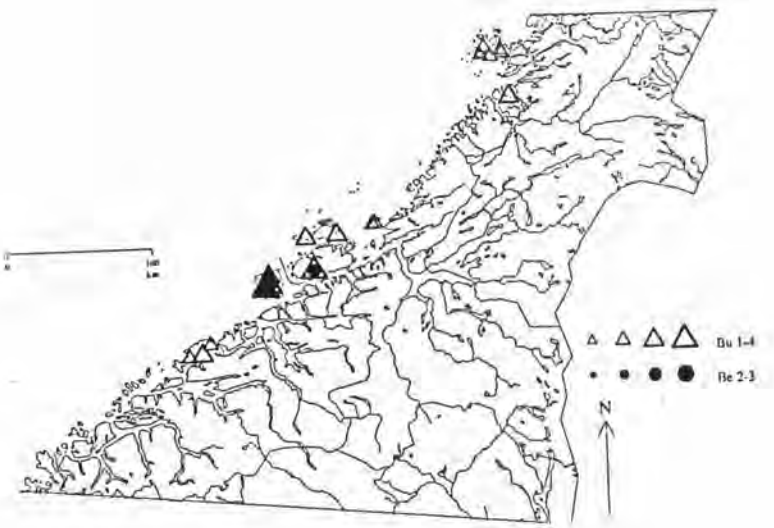


Fig. 3.2.2 and 3. Occurrence of the hydromorphological mire - unit types in central Norway, based on the localities in figure 3.2.1. Size of unit types: 1:<1 ha; 2:1-10 ha; 3:10-100 ha; 4>100 ha

Ae: Eccentric raised bogs

Ar: Ridge raised bogs

Au: Plateau reised bogs

Be: A.r.b. with eccentric features

Bu: A.r.b. without regular features

Fig. 3.2.4

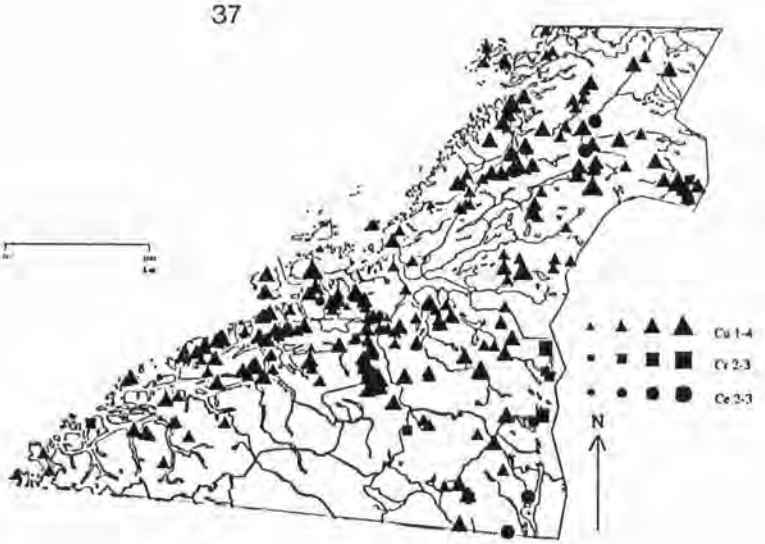


Fig. 3.2.5

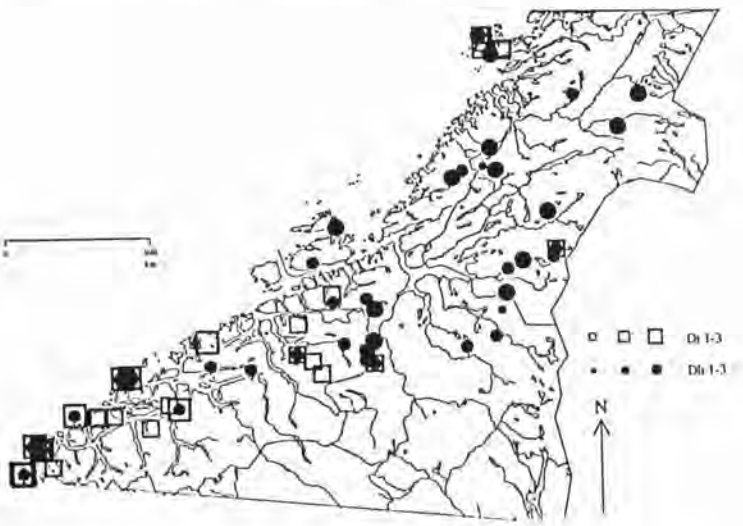


Fig. 3.2.6

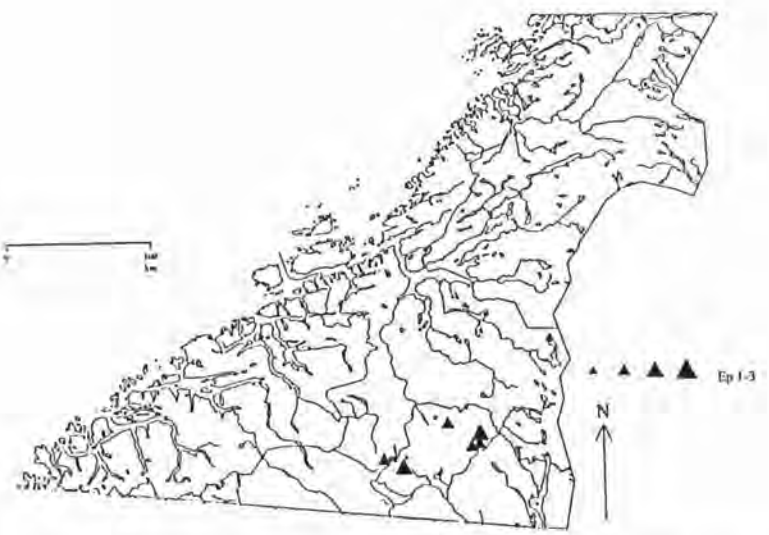


Fig. 3.2.4-6. Occurrence of the hydromorphological mire - unit types in central Norway, based on the localities in figure 3.2.1. Size of unit types: 1:<1 ha; 2:1-10 ha; 3:10-100 ha; 4>100 ha

Ce: Eccentric plane bogs Cr: Margin plane bogs Cu: Other plane bogs

Dh: Mound blanket bogs Dt: Sloping blanket bogs

Ep: Palsa mires

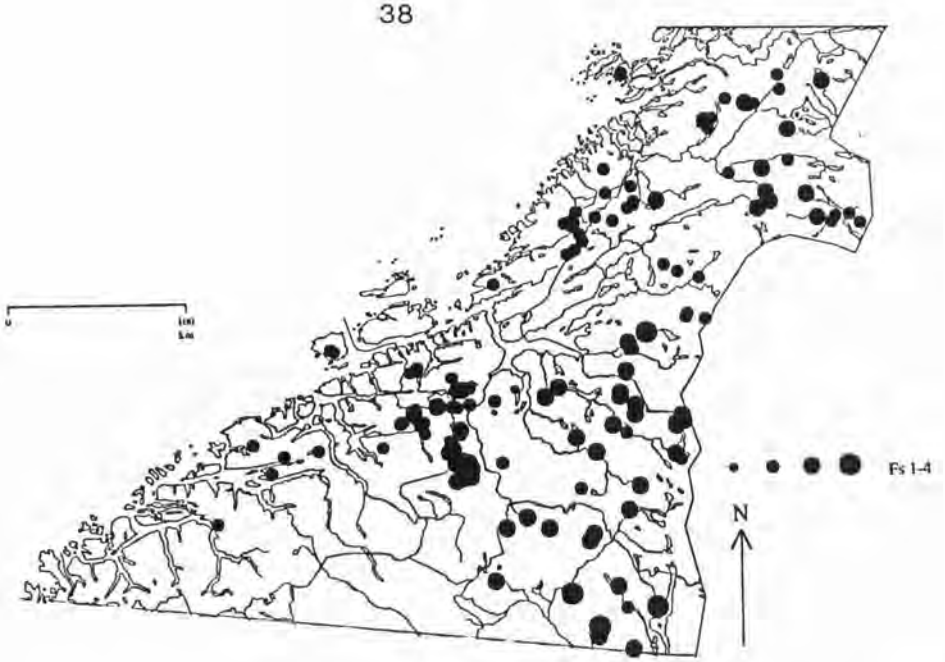


Fig. 3.2.7. Occurrence of the hydromorphological mire - unit types in central Norway, based on the localities in figure 3.2.1.
Size of unit types: 1:<1 ha; 2:1-10 ha; 3:10-100 ha; 4>100 ha

Fs: Flark fens

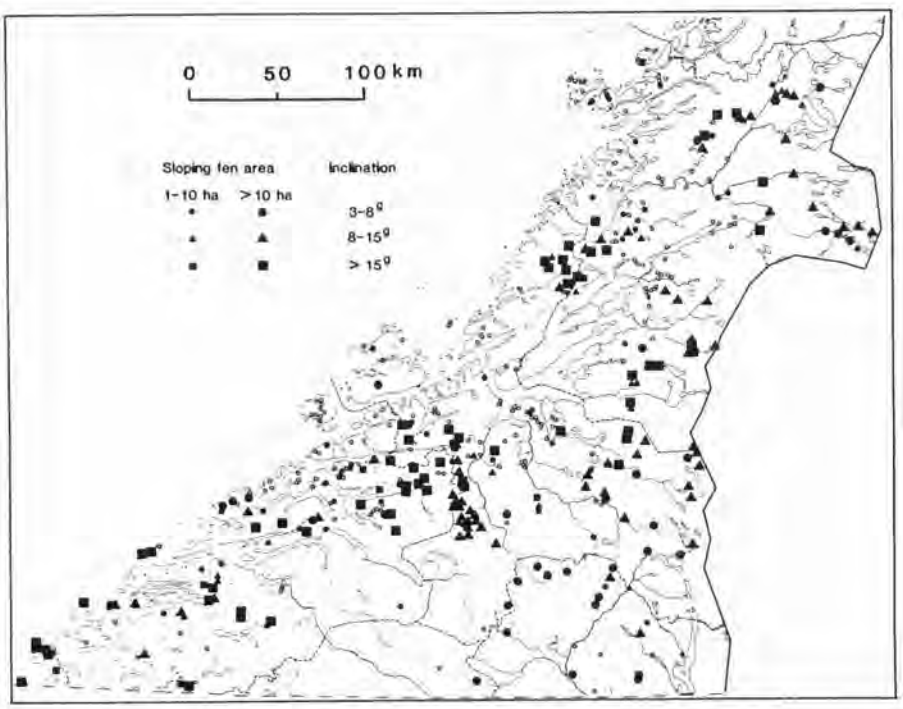


Fig. 3.2.8. Sloping fen localities covering an area of more than 1 ha in Central Norway (N of 62° N. lat.). **Gently sloping fens** have a surface inclination of 3-8°. **Strongly sloping fens** and **Very strongly sloping** fens have inclinations of 8-15° and > 15°, respectively.
After Moen (1990).

Mixed mires (D) include a mosaic of ombrotrophic features (usually hummocks) and minerotrophic areas. Typical mixed mires are stable. An attempt has been made to avoid units that are in process of becoming ombrotrophic ("Zwischenmoore" of Overbeck 1975).

Minerotrophic mires (E)(fens) are mires where minerotrophic portions dominate the mire unit (ombrotrophic areas account for less than 20 %). It is often difficult to demarcate the mire units. Sloping fens must have at least 3g of slope in an area larger than 0.1 ha.

3.3 Classification of mire vegetation

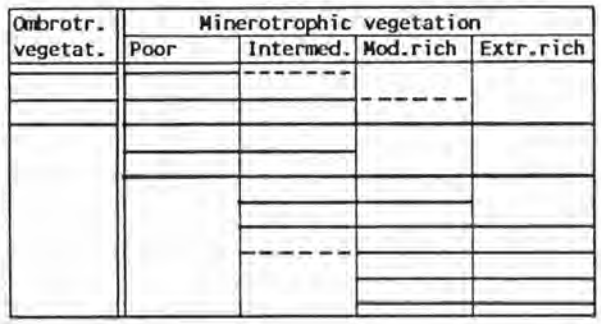
3.3.1 Units related to the local vegetational gradients

The main classification system of mire vegetation developed in connection with the national plan for mire nature reserves used divisions related to the three main local vegetational gradients (Sjörs 1948). A primary division into 5 major units was made on the basis of the bog - poor fen - rich fen vegetational gradient (Table 3.3.1 gives the species groups). Each of these major units was subdivided into open mire vegetation (mire expanse) or tree/scrub-covered mire vegetation (mire margin) (Table 3.3.2 gives the species groups). The open mire vegetation was further subdivided according to the hummock - mud bottom gradient (Table 3.3.3 gives the species groups). The result was 20 units, the transitional types to Magnocariceta providing another 2, and the spring vegetation another 3; the resulting 25 vegetation units are shown in figure 3.3.1. The mire vegetation units are easily related to local ecological differences on the mires (e.g. Sjörs 1948, 1983, Malmer 1973, 1985). This system has been used in the inventory (primary) mire reports for each county (e.g. Moen 1983, see also Moen 1985, 1990), and also used in the general system "Units for vegetation mapping in Norway" (Fremstad & Elven 1987). (Table 4.0.4 shows the 25 vegetation units, and their cover in percent within each of the 12 described localities).

3.3.2 Hierarchical phytosociological system

A hierarchical system was proposed for mire vegetation in Norway by Moen (1990), see Table 3.3.4. The system is based on the above mentioned system, the Nordhagen(1943) - Dahl(1957) system, and central European systems (e.g. Dierssen 1982, Rybnicek et al. 1984). The proposed system for mire and spring vegetation includes 3 classes, 5 orders and 14 alliances. The units reflect clearly the ecological conditions (see figure 3.3.2). The associations are not included, and further research and analyses of available data will need to be made before we can define the mire associations in Norway. Dierssen's (1982) 33 associations (as his 8 alliances of open "pure" mire communities) were defined in a traditional central European manner according to their characteristic and differential species. The broad associations were often based on a few vascular plants, and a number of them did not reflect the ecological conditions, e.g. associations covering the entire gradient from ombrotrophic to rich fen vegetation (further comments, see Moen 1990:200 ff.).

Table 3.3.1 Schematic representation of the occurrences of the main plant species of the boreal mire vegetation of central Norway, aranged according to the bog-poor fen-rich fen vegetational gradient. After Moen (1990).



———— : Common occurrence

- - - - - - - - - - - - - - - - : Rare or scattered

No symbol : Species absent or casual

Species groups

1. Melampyrum pratense, Rubus chamaemorus, Calliergon stramineum, Cephalozia spp., Cladopodiellia fluitans, Dicranum affine, D. leioneuron, Drepanocladus fluitans, Gymnocolea inflata, Mylia spp., Sphagnum balticum, S. capillifolium, S. compactum, S. cuspidatum, S. girgensohnii, S. lindbergii, S. magellanicum, S. majus, S. rubellum, S. russowii, S. tenellum.

2. Carex pauciflora, Eriophorum vaginatum, Rhynchospora alba, Scheuchzeria palustris, Vaccinium spp., Aulacomnium palustre, Sphagnum flexuosum s.lat., S. imbricatum, S. papillosum, S. pulchrum.

3. Andromeda polifolia, Carex limosa, Drosera anglica, D. rotundifolia, Erica tetralix, Huperzia selago, Myrica gale, Narthecium ossifragum, Oxycoccus spp., Scirpus cespitosus.

4. Carex canescens, C. echinata, C. magellanica, C. rotundata, Cornus suecica, Juncus filiformis, Trientalis europea, Sphagnum angermanicum, S. annulatum s.lat., S. centrale, S. molle, S. riparium.

5. Carex lasiocarpa, C. nigra, C. panicea, C. rostrata, Equisetum fluviatile, Eriophorum angustifolium, Menyanthes trifoliata, Molinia caerulea, Potentilla erecta, Odontoschisma elongatum.

6. Carex livida, Viola palustris, Calliergon sarmentosum, Cinclidium subrotundum, Dicranum bonjeanii, Drepanocladus exannulatus, D. tundrae, Sphagnum platyphyllum, S. subfulvum, S. subnitens, S. subsecundum s.lat., S. teres.

7. Carex chordorrhiza, C. dioica, C. tumidicarpa, Equisetum palustre, Euphrasia frigida, Hammarbya paludosa, Juncus stygius, Pedicularis palustris, Pinguicula vulgaris, Rhynchosphora fusca, Scirpus hudsonianus, Selaginella selaginoides, Succisa pratensis, Utricularia spp., Aneura pinguis, Drepanocladus badius, Paludella squarrosa, Sphagnum contortum, S. warnstorfii.

8. Parnassia palustris, Saussurea alpina, Tofieldia pusilla, Campylium stellatum, Drepanocladus revolvens, Homalothecium nitens, Lophozia borealis, Plagiomnium ellipticum, Scorpidium scorpoides.

9. Bartsia alpina, Carex appropinquata, C. buxbaumii, C. flava, C. heleonastes, C. pulicaris, C. saxatilis, Crepis paludosa, Dactylorhiza incarnata, Eleocharis quinqueflora, Eriophorum latifolium, Pedicularis oederi, Thalictrum alpinum, Triglochin palustris, Bryum pseudotriquetrum, Calliergon giganteum, C. richardsonii, C. trifarium, Calliergonella cuspidata, Cinclidium stygium, Meesia triquetra, M. uliginonsa, Plagiomnium elatum, Rhizomnium magnifolium, R. pseudopunctatum.

10. Carex atrofusca, C. capillaris, C. capitata, C. hostiana, C. lepidocarpa, C. microglochin, Dactylorhiza cruenta, D. pseudocordigera, Juncus castaneus, J. triglumis, Gymnadenia conopsea, Kobresia simpliciuscula, Listera ovata, Salix myrsinites, Saxifraga aizoides, Schoenus ferrugineus, Catoscopium nigritum, Cratoneuron spp., Ctenidium molluscum, Fissidens adianthoides, F. osmundoides, Lophozia rutheana.

Table 3.3.2 Schematic representation of the occurrences of the main plant species of the boreal mire vegetation of central Norway, arranged according to the mire expanse-mire margin vegetational gradient. Only a few of the mire margin species are listed in species group 5. After Moen (1990).

Species groups

1. Carex limosa, C. livida, C. rariflora, Drosera anglica, D. intermedia, Hammarbya paludosa, Juncus stygius, Pinguicula villosa, Rhynchospora alba, R. fusca, Scheuchzeria palustris, Schoenus ferrugineus, Calliergon trifarium, Cladopodiella fluitans, Drepanocladus fluitans, Gymnocolea inflata, Sphagnum balticum, S. cuspidatum, S. lindbergii, S. majus, S. subfulvum.

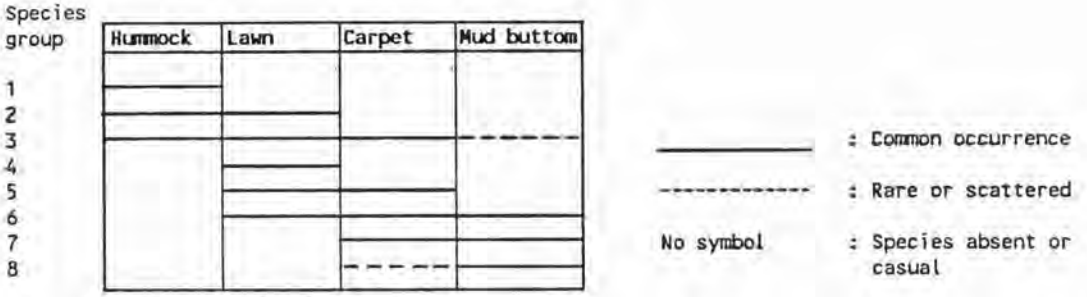
2. Carex chordorrhiza, C. pauciflora, Dactylorhiza incarnata, Drosera rotundifolia, Calliergon stramineum, Cinclidium stygium, Dicranum affine, Drepanocladus badius, D. revolvens, Lophozia borealis, L. rutheana, Scorpidium scorpioides, Sphagnum annulatum s.lat., S. fuscum, S. magellanicum, S. pulchrum, S. rubellum, S. subnitens.

3. Andromeda polifolia, Bartsia alpina, Betula nana, Calluna vulgaris, Carex atrofusca, C. dioica, C. hostiana, C. lasiocarpa, C. lepidocarpa, C. panicea, C. rostrata, C. tumidicarpa, Dactylorhiza cruenta, D. pseudocordigera, Eleocharis quinqueflora, Empetrum spp., Equisetum fluviatile, Erica tetralix, Eriophorum angustifolium, E. latifolium, E. vaginatum, Menyanthes trifoliata, Myrica gale, Molinia caerulea, Narthecium ossifragum, Oxycoccus spp., Parnassia palustris, Pedicularis palustris, Pinguicula vulgaris, Rubus chamaemorus, Scirpus cespitosus, S. hudsonianus, Selaginella selaginoides, Thalictrum alpinum, Tofieldia pusilla, Aneura pinguis, Campylium stellatum, Dicranum bonjeanii, Homalothecium nitens, Sphagnum compactum, S. contortum, S. papillosum, S. platyphyllum, S. subsecundum s. lat., S. tenellum, S. teres, S. warnstorfii.

4. Carex buxbaumii, C. canescens, C. echinata, C. flava, C. nigra, C. pulicaris, Dactylorhiza maculata, Equisetum palustre, Gymnadenia conopsea, Juniperus communis, Pedicularis oederi, Pinus sylvestris, Potentilla erecta, Succisa pratensis, Trientalis europaea, Viola epipsila, V. palustris, Vaccinium spp., Aulacomnium palustre, Calliergon giganteum, C. richardsonii, C. sarmentosum, Drepanocladus exannulatus, Sphagnum angermanicum, S. capillifolium, S. flexuosum s.lat., S. molle, S. riparium, S. russowii.

5. Agrostis canina, A. capillaris, Alnus spp., Betula pubescens, Calamagrostis purpurea, Carex capillaris, C. magellanica, C. stenolepis, C. vaginata, Cornus suecica, Crepis paludosa, Deschampsia cespitosa, Equisetum sylvaticum, Filipendula ulmaria, Galium boreale, G. palustre, Juncus filiformis, Melampyrum pratense, Picea abies, Polygonum viviparum, Ranunculus acris, Salix spp., Saussurea alpina, Calliergonella cuspidata, Cratoneuron spp., Philonotis spp., Plagiomnium spp., Sphagnum centrale, S. palustre, S. strictum.

Table 3.3.3 Schematic representation of the occurrences of the main plant species of the boreal mire vegetation of central Norway, arranged according to the hummock-mud bottom vegetational gradient. Only a few of the mire margin species are listed in species group 4. After Moen (1990).



Species groups

1. Calluna vulgaris, Empetrum spp., Pinguicula villosa, Pinus sylvestris, Vaccinium spp., Dicranum affine, Pleurozium schreberi, Racomitrium lanuginosum, Sphagnum capillifolium, S. fuscum, S. russowii, Cladina arbuscula coll., C. rangiferina, C. stellaris.

2. Betula nana, Melampyrum pratense, Rubus chamaemorus, Aulacomnium palustre, Dicranum bonjeanii, Homalothecium nitens, Mylia spp., Ptilidium ciliare, Sphagnum subfulvum, S. warnstorfii.

3. Andromeda polifolia, Drosera rotundifolia, Erica teralix, Eriophorum vaginatum, Oxycoccus spp., Dicranum leioneuron, Sphagnum magellanicum, S. papillosum, S. rubellum.

4. Bartsia alpina, Carex canescens, C. capillaris, C. echinata, C. flava, Dactylorhiza pseudocordigera, Kobresia simpliciuscula, Listera ovata, Molinia caerulea, Narthecium ossifragum, Schoenus ferrugineus, Saussurea alpina, Succisa pratensis, Thalictrum alpinum, Tofieldia pusilla, Drepanocladus badius, Fissidens adianthoides, F. osmundoides.

5. Carex atrofusca, C. dioica, C. hostiana, C. lepidocarpa, C. nigra, C. panicea, C. pauciflora, C. tumidicarpa, Dactylorhiza cruenta, D. incarnata, Eriophorum latifolium, Euphrasia frigida, Myrica gale, Parnassia palustris, Pinguicula vulgaris, Scirpus cespitosus, S. hudsonianus, Selaginella selaginoides, Campylium stellatum, Lophozia borealis, L. rutheana, Sphagnum contortum, S. papillosum, S. platyphyllum, S. subnitens, S. subsecundum s.lat., S. teres.

6. Carex lasiocarpa, C. rostrata, C. saxatilis, Drosera anglica, Eleocharis quinqueflora, Equisetum palustre, Eriophorum angustifolium, Menyanthes trifoliata, Pedicularis palustris, Phragmites australis, Triglochin palustre, Aneura pinguis, Cladopodiella fluitans, Drepanocladus revolvens, Sphagnum balticum, S. compactum, S. pulchrum, S. tenellum.

7. Carex chordorrhiza, C. limosa, C. heleonastes, Hammarbya paludosa, Rhynchospora alba, Scheuchzeria palustris, Utricularia spp., Calliergon giganteum, C. richardsonii, C. sarmentosum, C. trifarium, Cinclidium stygium, Cladopodiella fluitans, Drepanocladus exannulatus, D. fluitans, Gymnocolea inflata, Scorpidium scorpioides, Sphagnum annulatum s.lat., S. cuspidatum, S. lindbergii, S. majus, S. riparium.

8. Carex livida, Juncus stygius, J. triglumis, Lycopodiella inundata, Rhynchospora fusca, Utricularia intermedia, Fossombronia foveolata, Siphula ceratites.

		Ombrotrophic vegetation	Minerotrophic vegetation (fen)			
Mire margin (Tree/shrub-covered mire)		Bog	Poor fen	Inter-mediate fen	Moderately rich fen	Extremely rich fen
		E	K	P	T	X
Mire expanse (Open mire)	Hummock	A	F	(F)	(F)	-
	Lawn	B	G	L	Q	V
	Carpet	C	H	M	R	W
	Mud bottom	D	I		S	
Magnocaricetum fen			Ø		Å	
Spring vegetation			Y	Z	Æ	

A. Open bogs, hummock
B. Open bogs, lawn
C. Open bogs, carpet
D. Open bogs, mud bottom
E. Wooded bogs
F. Open fens, hummock
G. Open poor fens, lawn
H. Open poor fens, carpet
I. Open poor fens, mud bottom
K. Wooded or scrub-covered poor fens
L. Open intermediate fens, lawn
M. Open interm. fens, carpet & mud bottom
P. Wooded or scrub-covered intermediate fens
Q. Open moderately rich fens, lawn
R. Open moderately rich fens, carpet
S. Open moderately rich fens, mud bottom
T. Wooded or scrub-covered moderately rich fens
V. Open extremely rich fens, lawn
W. Open extr. rich fens, carpet & mud bottom
X. Wooded or scrub-covered extr. rich fens
Y. Poor spring
Z. Intermediate spring
Æ. Rich spring
Ø. Poor Magnocariceta fen
Å. Rich Magnocariceta fen

Fig. 3.3.1 Vegetational units used in the surveys made in connection with the Norwegian national plan for mire nature reserves. After Moen (1990).

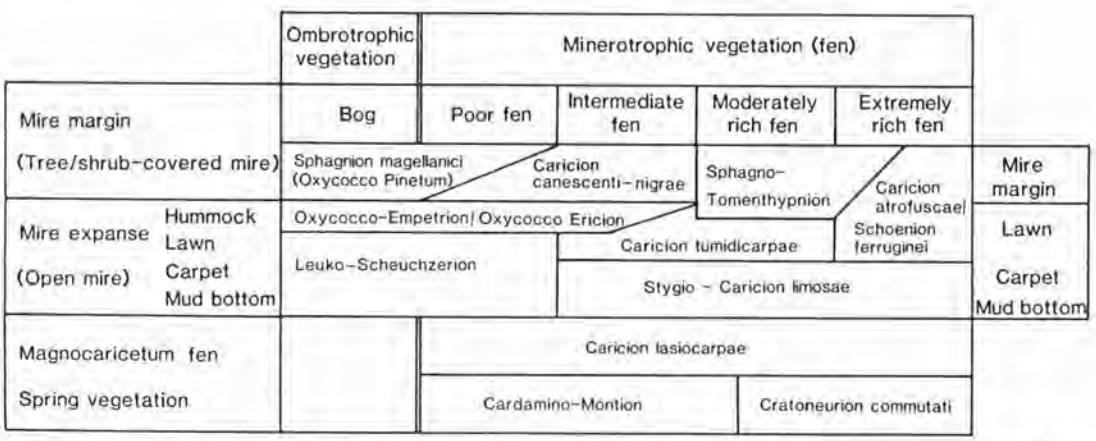


Fig. 3.3.2 The main mire and spring alliances in Norway, schematically grouped along the three main vegetational gradients, found on mires. After Moen (1990).

Table 3.3.4 A hierarchical classification system (Classes - Orders - Alliances) for the vegetation of mires and springs in Norway. After Moen (1990).

Cl. 1: *Oxycocco-Sphagnetea* Br.-Bl. et Tx. 43
- Ord. 1.1: *Sphagnetalia magellanici* Pawl. 28 em. Moore 68
  - All. 1.1.1: *Oxycocco-Empetrion hermaphroditi* Nordh. 36
    Hummock vegetation of the boreal-alpine regions.
  - All. 1.1.2: *Sphagnion magellanici* Kästn. et Flössn. 33
    (Includes *Oxycocco-Pinetum* K.– Lund 81)
    Mainly a *Pinus*-dominated bog vegetation.
- Ord. 1.2: *Erico-Sphagnetalia* Schwick. 40 em. Br.-Bl. 49
  - All. 1.2.1: *Oxycocco-Ericion tetralicis* (Nordh. 36) Tx. 37 em. Moore 68
    Hummock vegetation in the coastal section.
  - All. 1.2.2: *Ericion tetralicis* Schwick. 33
    Mainly damp (oceanic) heathlands.

Cl. 2: *Scheuchzerio-Caricetea nigrae* (Nordh. 36) Tx. 37
- Ord. 2.1: *Scheuchzerietalia palustris* Nordh. 36
  - All. 2.1.1: *Leuko-Scheuchzerion palustris* Nordh. 43
    - 2.1.1a: *Scirpo-Eriophorenion vaginati* Nordh. 43
    - 2.1.1b: *Cuspidato-Scheuchzerienion* Nordh. 43
      Lawn communities (a) and carpets - mud bottoms (b) of ombrotrophic mires and poor fens.
  - All. 2.1.2: *Stygio-Caricion limosae* Nordh. 36
    Carpet and mud bottom communities of intermediate - rich fens.
  - All. 2.1.3: *Caricion lasiocarpae* Van den Berghen 49
    Tall-sedge, fen communities, including communities transitional to the *Magnocaricion*.
- Ord. 2.2: *Caricetalia nigrae* (Koch 26) Nordh. 36
  - All. 2.2.1: *Caricion canescenti-nigrae* Nordh. 36
    Mire margin communities of poor - intermediate fens.
  - All. 2.2.2: *Sphagno-Tomenthypnion* Dahl 57
    Mainly mire margin communities of intermediate - rich fens, most often forming a zone between the rich fen communities and the hummock vegetation.
  - All. 2.2.3: *Caricion tumidicarpae* Rybníček 64
    Lawn communities of intermediate - moderately rich fens.
  - All. 2.2.4: *Caricion atrofuscae* Nordh. 35
    Lawn communities of extremely rich fens in the northern boreal - low alpine regions, mainly mire margin vegetation.
  - All. 2.2.5: *Schoenion ferruginei* Nordh. 36
    Lawn communities of extremely rich fens in the boreonemoral - middle boreal regions.

Cl. *Montio-Cardaminetea* Br.-Bl. et Tx. 43
- Ord.: *Montio-Cardaminetalia* Pawl. 28
  - All.: *Cardamino-Montion* Br.-Bl. 26
    Vegetation of poor - intermediate springs.
  - All.: *Cratoneurion commutati* Koch 28.
    Vegetation of rich springs.

3.4 A phytogeographical sub-division of mire plants found in southern Norway

Kjell Ivar Flatberg, Asbjørn Moen and Stein Singsaas

I. Introduction - conception and intent

Work on a national plan for mire nature reserves in Norway started in 1969 and the associated fieldwork continued throughout the 1970's up to 1984 (see e.g. Moen 1973, 1985). All the work dealing with the whole of southern Norway was carried out at the University of Trondheim, principally by Asbjørn Moen and Kjell Ivar Flatberg, although a number of other botanists and botany students were also involved. For southern Norway the work involved over 1000 days spent in the field and more than 1000 mires were visited and described. A large number of scientific reports have been published. Some of these deal with an entire county, others with specific parts of the country (regions). The most important reports are those of Moen (1970, 1975, 1983, 1984), Flatberg (1971, 1976), Moen & Wischmann (1972), Torbergsen (1979, 1980), Kofoed (1979), Moen & Pedersen (1981), Moen et al. (1983), Singsaas & Moen (1985).

A vast body of botanical data has been collected in conjunction with this work on the mire survey of southern Norway, all of which is held at the Department of Botany. About 5000 collections of phanerogams were made and almost as many of cryptogams (mainly bryophytes). 900 field checklists of the mire floras were obtained.

As well as providing a basis for the planned nature reserves, this material represents a store of information of great scientific value. It provides a useful starting point for constructing regional surveys of mires in different parts of southern Norway. The distributions of hydrotopographical types of mire, of the plant species comprising the mire vegetation, and of special features of the mire vegetation (e.g. dominance relationships) are all of particular interest here. Geographical gradients that are relevant in these connections are the changes from west to east, north to south, and with altitude.

A classification according to the floras of different mires forms an important part of all regional studies of mires in Norway. The aim of the present paper is to sub-divide the plants found growing on mires in southern Norway according to their distributions in Fennoscandia (including Denmark).

II. Sub-division into distributional groups

1. Choice of species

The basis for the choice of species to use in the sub-division is the field checklist for mire plants used at the Department of Botany (Fig. 3.4.1). The species included in the list are shown in the figure. Additional species, not included in the list, are also tabulated. Altogether there are 157 phanerogams and 68 bryophytes.

Myrplanter (mire plants)

Lokalitet (locality) .....

.....

.....

Grid.ref. ..... Høgde o.h.(altitude) .....

Reg.av (recorder) .....

Dato (date) .....

/: forekomst (species recorded)

O: innsamling (species collected)

Aln g,i. Andr. Arct a. Bet n,p. Call. Emp h, n. Erica. Jun. Led. Lois. Myr. Oxyc m,q. Pic. Pin. Prun p. Rham f. Sal ar,au,ca,gl,ha, he,la,lap,li,myrs,myrt,nig,pe,ph,rep. Sorb. Vacc m,u,v-i.

Alc. Alis. An n. Ang a,s. Bart. Calla. Calth. Card am,ny,pr. Cer cae,cer. Cham. Cic. Cirs h,p. Coel. Com. Coral. Corn. Cre. Chrys a. Cyst m. Dact c,f,i,m,ps,t. Dro a,i,r. Dry l.o. ph,th. Epil ad,al,an,da,ho,la,pa. Epip h,p. Eq a,f,h,pa,pr,sc,sy,v. Euphr. Fil u. Gal b,p,s, t,u. Gent pn,pu. Ger s. Ge r. Gymn. Ham. Hipp v. Ir. Iso e,l. Koen. Lem m,t. Leont.

Tillegg (additional species):

Vascular plants:

Blech. Card fl. Car acuti, bin, dist, hart, panicul, pseudoc, rip. Cladium. Dry cri. Luz conge, syl. Microst. Poa rem. Sal sin.

Cryptogams

Anthel. Barb q. Brachyt tur. Breut. Cincl sub. Dicr ang, dru, spa. Drep pro, tr. Hyp b, ju, pra. Kia gl. Lophoz bor. Myl a. Odont s. Plagioth un. Sph j, vir. Spl r.

Linum c. Lis c,o. Litt. Lobel. Lyc a,i,s. Lycopus. Lys t,v. Lythr. Mai. Melam p. Ment aq,ar. Meny. Mont. Myo b,c,p. Myrio a. Narth. Nigr. Nu l,p. Nymph. Oxyr. Parn. Ped l,oe,p, sc-c,sy. Peta f. Peuc. Ping a,vi,vu. Plat b,c. Polyg s,v. Pol v. Pota al,fi,n,po. Pote er. Prune. Pyr m,r. Ram. Ran ac,co,fla. Rub a,ch. Rum acetosa. Saus. Sag nod,p. Sax aiz,hir,n,s. Scut g. Selag. Solid. Spar a,er,h,m. Stell als,ca,nem. Succ. Thal al. Tof p. Trien. Trigl p. Troll. Tuss. Utr i,mi,o. Val sam. Ver al,b,sc,se. Vic cr. Vio b,ep,pa.

Agros ca,st,t. Alo ae,g. Anth. Briz. Calama ca, n,p. Car acuta,ad,ap,aq,atra,atro,big,br,bu,cae, can,capil,capit,cho,dia,dio,disp,ech,ela,elo,flac, flav,glo,hele,hos,ju,lap,las,lax,lepi,lim,liv,lol, mag,microg,ni,no,oed,pall,panicea,parall,pauc, puli,ra,rem,ros,rot,sax,sca,sten,ten,tum,vag,ves. Desch c,f. Eri a,b,g,l,m,r,s,v. Fes r,v. Gly f. Hier o. Junc al,arc,art,ba,bi,buf,bul,cas,con,ef, f,k,sq,st,trig. Holc l. Kob s. Luz m,su. Mel n. Mol. Nard. Phal a. Phrag. Phl c. Poa alpig, alpin,pa,pr. Rhy a,f. Scheu. Schoen. Sc ca,g,h, l,mam,pal,q,sy. Siegl. Typ a,l.

Br ps,we. Call g,r,sa,tr. Call-ella. Camp s. Cat. Cincl s. Clim. Crat c,d,f. Ct m. Di-ella p. Dicr bo,lei. Drep b,ex,f,i,r,tu,u. Fiss a,o. Hel. Hyp cup. Leucob. Mees t,u. Mn ci,ho,ps,pu,ru, se. Onch v,w. Pal sq. Phil cal,f,s. Pohl w. Rhac l. Rhod. Rhyt l,s,t. Scler p. Scorp s. Spl am,l, s,v. Tom.

Sph anger,ann,aong,b,ce,com,con,cu,fa coll.(fa s. str.,angu,fl),fi,fu,gi,im,li,mag,maj,mo,ne,o,pal, pap,pla,pu,q,ri,rub,rus,sq,st,subf,subn,subs coll. (subs s.str.,au,in),ten,ter,wa,wu.

Bazz t. Jung co. Leioc ban,r. Moerch. Ricc m, pi. Scap ul,un.

Cetr d,e,i,niv. Cl alpe,im,te. Icm. Siph.

Fig. 3.4.1 A field checklist of mire plants used for the mire conservation plan; the species arranged in the following order: woody species, herbs, grass-like species (graminoids), leaf mosses s.str., Sphagna, liverworts and lichens. Additional species are listed.

Great attention has been paid to including as wide a selection of species as possible, whilst excluding ubiquitous ones. Species that would appear to be markedly expanding their ranges and species that are primarily spread anthropogenically have also been excluded, whenever practicable.

2. Mire species

The term "mire species" is used here in a wide connotation and includes plants associated with springs and flushes. In addition to the species that comprise the vegetation of mires, including springs, a number of phytogeographically distinct species that are found in closely related vegetation types, such as wet grasslands and the damp coastal heathlands that are found in close proximity to mires have also been included. Some plants associated with bodies of fresh water, especially those found in the littoral zone, have also been included. The plants associated with the foregoing types of vegetation have been included because they are often found growing close to mires, in transitional types of vegetation, and because these species have been recorded in the course of the mire investigations. There has been no intention, however, of providing any complete species lists for these closely associated vegetation types. Some species have a much more restricted distribution when growing in mire vegetation *sensu latiore* compared to their total distribution (e.g. *Blechnum spicant* and *Rhytidiadelphus loreus).* Here, the occurrences in mire vegetation are stressed. The species include several different categories:

* species that only grow on mires, such as *Scheuchzeria palustris*

* species that are commonly found on mires, but which are also common in other closely related types of vegetation, e.g. *Bartisa alpina*

* species that occur on mires, but whose main distribution is in other related vegetation types, e.g. *Carex binervis*

* species that are not encountered on mires *sensu stricto,* but which are associated with types of vegetation that border on to mires, i.e. swamp plants e.g. *Cicuta virosa,* or those growing in streams in mires, e.g. *Potamogeton polygonifolius.*

3. Nomenclature

The nomenclature for phanerogams follows Lid (1985), and that for mosses Frisvoll et al. (1984). *Sphagnum imbricatum* ssp. *austinii* and ssp. *affine* are listed in accordance with Flatberg (1984) and the separation of *Sphagnum annulatum* and *S. jensenii* is in accordance with Flatberg (1988a), *Sphagnum viride* was described by Flatberg (1988b).

4. Sources used for the species distributions

Important works utilized in connection with the distributions of the phanerogams are Fægri (1960), Hultén (1971), Hultén & Fries (1986) and Gjærevoll (1990). The data for the distribution of mosses are mainly derived from Nyholm (1954-69) and Hallingbäck & Holmåsen (1985), although Albertson (1949), Størmer (1969, 1984), Mogensen (1973), Smith (1978) and Hedenäs (1993) have also been used. The works consulted for peat mosses were Mossornas Vänner (1993), Flatberg (1984, 1986, 1993) and Flatberg & Moen (1972). Jørgensen (1934), Arnell (1956) and Frisvoll & Moen (1980) were used for the hepatics.

Floristic maps showing both the horizontal and altitudinal distributions are particularly useful, but only a few species have been mapped, e.g. *Myrica gale* in central Norway (Ouren 1974). Singsaas & Moen (1985) and Holten (1987) have published maps with the altitudinal distribution shown in profile. Information on the altitudinal distribution of species is mainly found in the floras and phytogeographical works referred to and in material at the Department of Botany (Herb TRH).

The distributional patterns of the species in Fennoscandia and Denmark have formed the basis for the sub-division into groups. To have used the picture given by their distributions in Norway alone would have been a much too narrow basis, since quite different groupings often tend to converge in this respect. Even for Fennoscandia, differences of opinion can emerge when discussing the choice of the main grouping into which a particular species should be placed, because there are species distributions here which form transitions from one group to another. In many cases, the species distributions outside Fennoscandia have had to be considered, e.g. Meusel et al. (1965, 1978) and Hultén & Fries (1986).

5. Vegetational regions

As already mentioned, the distributional patterns of the plant species in Fennoscandia have primarily been used for the sub-division into groups. Nevertheless, species have both horizontal (longitudinal and latitudinal) and altitudinal distributions. Traditionally, the horizontal distribution has been considered the most important one in phytogeographical classifications. In the present paper an attempt has been made also to take into account the altitudinal distributions when constructing the groups. Particularly in respect of Norway, the different regions (sections and zones) have a longitudinal and latitudinal distribution whilst at the same time occurring as altitudinal belts.

The sub-division of the regional vegetation of Norway follows the work of Dahl et al. (1986), Moen (1987) and Moen & Odland (1993). The vegetational zones (belts designate altitudinal differences) with mires in Norway include: nemoral, boreonemoral, southern boreal, middle boreal, northern boreal and low alpine.

The vegetational sections (synonymous with vegetational sector of Ahti et al. (1968) of Norway (cf. Moen & Odland 1993) include: highly oceanic section (O3), markedly oceanic section (O2), slightly oceanic section (O1), transitional (oceanic/continental) section (OC), slightly continental section (C1).

6. The groups

The species have been sub-divided into 5 phytogeographical groups mainly following the sub-division of Takhtajan (1986) (in 5 floristic provinces, cf. also Gjærevoll 1992). Furthermore, the groups have been assigned to sub-groups according to just how marked their distributional pattern is in relation to the main groupings. Similar phytogeographical groupings have been used in Norway by, for example, Bendiksen & Halvorsen (1981) and Økland (1989). A distribution map for species representative of each of the 15 sub-groups distinguished is provided (Figs. 3.4.2-16). These species provide an average indication of the variation found in the horizontal distribution between the 15 sub-groups. The maps follow those of Hultén (1971) in the main.

1. Western species	a. Strongly western b. Slightly western c. Western tendency
2. Southern species	a. Strongly southern b. Slightly southern c. Southern tendency
3. Southeastern species	a. Strongly southeastern b. Slightly southeastern c. Southeastern tendency
4. Eastern species	a. Strongly eastern b. Slightly eastern c. Eastern tendency
5. Alpine species	a. Strongly alpine and upper boreal b. Slightly alpine and upper boreal c. Upper boreal tendency

III. The phytogeographical groups

A number of species show edaphic preferences or demands. These often show a tendency to have discontinuous distributions within their overall distributional areas, although they have also been placed within the different groups. In the following species' lists the **rich fen species** are designated with an * symbol.

1. Western species

An attempt has been made to include in the western group as a whole only species that are relatively exclusive here, that are absent from the eastern parts of Fennoscandia, and that do not penetrate to any great extent into the Gulf of Bothnia or Russia. The species of sub-group **a** have their main occurrences in the highly oceanic section (O3), but most of them also have scattered occurrences in the markedly oceanic section (O2), cf. Moen & Odland (1993). Sub-group **b** includes species with their main occurrences in the O3 and O2 sections and scattered occurrences in the slightly oceanic section (O1). The species of sub-group **c** also have their main occurrences in the O3 - O1 sections, with restricted eastward distributions (lacking in the continental sections).

a. strongly western species - e.g. *Polygala serpyllifolia* (Fig. 3.4.2)

These occur along the Norwegian coast from Skien-Kristiansand to Trondheimsfjord. *Luzula sylvatica* and *Sphagnum imbricatum* ssp. *austinii* extend as far north as Lofoten. *Luzula congesta* is found as far south as Stavanger and is a more lowland species than the others, with an altitudinal limit of 350 m a.s.l. (Fægri 1960). *Carex binervis* is not present in Denmark, whereas the other species are also found in Denmark and in places along the west coast of Sweden. *Sphagnum imbricatum* ssp. *austinii*, with a few localities in Østfold and a single one in Hedmark, represents a transition to the next sub-group b.

Phanerogams
Carex binervis, Galium saxatile, Luzula congesta, Luzula sylvatica, Polygala serpyllifolia, Scirpus cespitosus ssp. *germanicus*

Cryptogams
Breutelia chrysocoma, Sphagnum imbricatum ssp. *austinii*

When present in ombrotrophic (or poor fen) hummock vegetation, the following species have a strongly western distribution: *Bazzania trilobata, Hypnum jutlandicum, Leucobryum glaucum, Plagiothecium undulatum, Rhytidiadelphus loreus, Sphagnum strictum.* In fen margin communities and transitional communities to damp heathlands, all the above species also occur in the b. sub-group.

b. Slightly western species - e.g. *Narthecium ossifragum* (Fig. 3.4.3)
These species form a broad area along the coast from Østfold northwards, and their northern limits lie between Helgeland and northern Troms. They are often found a good way along Trondheimsfjord and some extend into Jämtland over the Swedish border. They are present in Denmark and are most frequent in the western part of southern Sweden. *Carex hostiana* and *Blechnum spicant* are relatively widespread over the whole of southern Sweden. The majority of species are absent from Finland. With the exception of *Potamogeton polygonifolius,* which is mainly a lowland species (up to 400 m a.s.l. - Fægri 1960), the majority of the species in this sub-group extend into the northern boreal region. *Blechnum spicant* and *Thelypteris limbosperma* are mainly minerogenic species; they also occur in mire margin vegetation in the oceanic sections.

Phanerogams
*Blechnum spicant, * Carex hostiana, * Carex pulicaris, Erica tetralix, Juncus squarrosus, Narthecium ossifragum, Pedicularis sylvatica, Potamogeton polygonifolius, Thelypteris limbosperma*

Cryptogams
Bazzania trilobata, Hypnum jutlandicum, Leucobryum glaucum, Odontoschisma sphagni, Plagiothecium undulatum, Rhytidiadelphus loreus, Sphagnum molle, S. strictum

c. Species with a western tendency - e.g. *Carex tumidicarpa* (Fig. 3.4.4)
Compared to group b, these species form an even broader area along the coast from Østfold northwards, often penetrating along Oslofjord. They are relatively widespread over the whole of southern Sweden, with scattered occurrences in Finland, most often in the southwest. *Racomitrium lanuginosum* is very common (dominant) in hummocks in the most oceanic sections, becoming more scattered along the oceanity - continentality gradient.

Phanerogams
Carex tumidicarpa

Cryptogams
Mylia taylorii, Racomitrium lanuginosum, Sphagnum angermanicum, S. auriculatum, S. quinquefarium

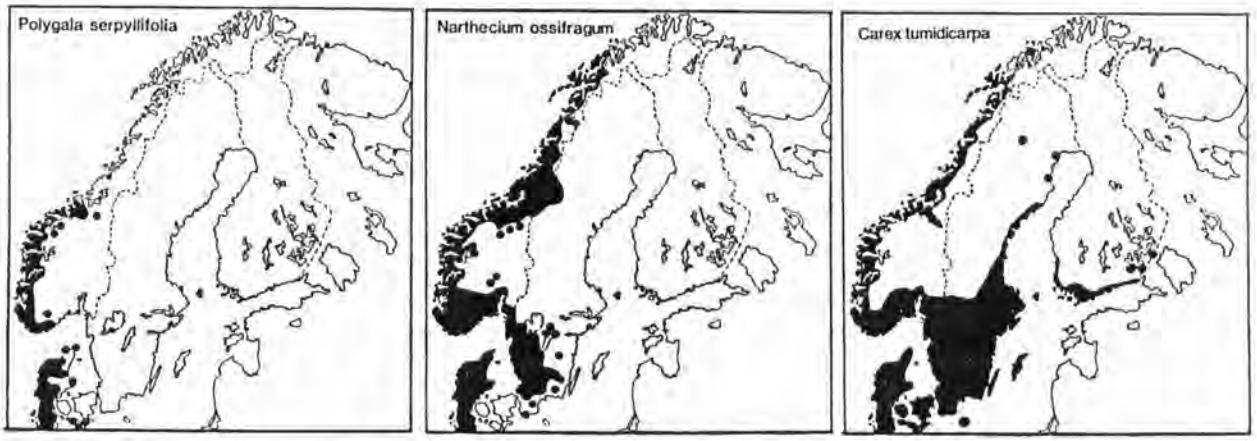


Fig. 3.4.2-4 The distribution of *Polygala serpyllifolia, Narthecium ossifragum* and *Carex tumidicarpa* in Fennoscandia. Modified after Hultén (1971).

2. Southern species
This main group is somewhat heterogeneous and includes some species which are often considered to belong to the western group. Transitional types are also found to the western and southeastern groups.

a. Strongly southern species - e.g. *Typha angustifolia* (Fig. 3.4.5)
In Fennoscandia, the main distribution of this group lies in the south, i.e. Denmark and southern Sweden. *Cladium mariscus* is found at two localities in Finland, whereas *Gentiana pneumonanthe* is wholly absent. These two apart, the species occur quite commonly in southern Finland. Their distribution in Norway is chiefly in the southern part of southeastern Norway (Oslofjord-Mjøsa), but many are present along the Skagerrak coast and the coast of western Norway as far north as Bergen. *Lycopus europaeus, Carex paniculata* and *C. disticha* have outlying localities further north (Trøndelag-Nordland). The species in this sub-group do not extend beyond the boreonemoral region, except occasionally a little way into the southern boreal region.

Phanerogams
*Carex acutiformis, C. disticha, * C. hartmanii, C. paniculata, C. pseudocyperus, C. riparia, * Cladium mariscus, * Epipactis palustris, Gentiana pneumonanthe, Lycopus europaeus, Typha angustifolia*

b. Slightly southern species
The species in this sub-group can themselves be sub-divided according to 2 main distributional patterns.

1. Present in Finland - e.g. *Alnus glutinosa* (Fig. 3.4.6)
These species are found in Denmark and southern Sweden and along the coast as far north as the Gulf of Bothnia. They are present in Finland too, along the southern and central coasts of the Gulf of Bothnia. They extend in Norway from Østfold to the lower reaches of the valleys in the southeast and along the coast, *Iris pseudacorus* as far as Lofoten. They are present in the lowlands in Norway up to and including the southern boreal zone. Most of them occur in the lower part of the middle boreal region and, particularly in Finland, they are rather common in the greater part of that region.

Phanerogams
Alnus glutinosa, Iris pseudacorus, Rhynchospora fusca, Typha latifolia, Veronica beccabunga

2. Absent/rare in Finland. For the most part, these species have a similar distribution to those in no. 1, but show a more western trend, which means that they barely extend into southern Finland, nor do they penetrate up as far as the Gulf of Bothnia on the Swedish side. *Holcus lanatus* is somewhat of an exception, but Hultèn (1971) states that it is spread anthropogenically in the northern and eastern parts of its distributional area.

Phanerogams
* *Carex flacca, Drosera intermedia, Holcus lanatus, Platanthera chlorantha*

Cryptogams
Sphagnum imbricatum ssp. *affine, S. inundatum, S. palustre, S. viride*

c. Species with a southern tendency
This is a heterogeneous grouping of species which can only be further sub-divided with difficulty. In Norway, the common factor in their distributions is that they are found in the southern part of the southeastern region and in a relatively wide zone along the coast from Østfold northwards to Nordland or Troms. Most of them are found up to and including the middle boreal region and a few have outlying localities in the northern boreal region. Their northern limits in eastern Fennoscandia, i.e. northern Sweden and Finland, are variable.

1. Present in central Finland - e.g. *Salix aurita* (Fig. 3.4.7)
In Norway, these species have a continuous distribution up to Trøndelag. They are also found as far north as the Gulf of Bothnia in the eastern parts of their ranges, as well as in the middle boreal region in central and northern parts of Sweden and Finland.

Phanerogams
*Glyceria fluitans, Hammarbya paludosa, Juncus bulbosus, Lycopodiella inundata, Myrica gale, Rhynchospora alba, Ranunculus flammula, Salix aurita, S. repens, * Schoenus ferrugineus*

Cryptogams
* *Moerchia hibernica, Riccardia multifida, Sphagnum cuspidatum, S. rubellum*

2. Absent from central Finland. These species do not usually occur in the middle boreal region in either northern Sweden or central Finland along the coasts of the Gulf of Bothnia. They are present, on the other hand, in Jämtland and, like those in no. 1, their range is continuous in Norway up to Trøndelag.

Phanerogams
*Cardamine flexuosa, * Carex lepidocarpa, Danthonia decumbens, * Epipactis helleborine, Juncus articulatus, J. conglomeratus, J. effusus, * Linum catharticum, Polygala vulgaris, Stellaria alsine*

Cryptogam
Sphagnum subnitens

Fig. 3.4.5-7 The distribution of *Typha angustifolia, Alnus glutinosa* and *Salix aurita* in Fennoscandia. Modified after Hultén (1971).

3. Southeastern species

The separation of this group from the southern species is based on the location of their main ranges in Fennoscandia, in conjunction with those in Finland and the Baltic, with or without Denmark. The term southeastern, as used here, does not necessarily imply that their main distributional area lies in the eastern European floristic province (Takhtajan 1986).

a. Strongly southeastern species - e.g. *Dryopteris cristata* (Fig. 3.4.8)

This is a sub-group which is only weakly represented among mire species. In Fennoscandia, it mainly occurs in the southeast, i.e. Denmark (frequently more common in the east of that country), southern Sweden and southern Finland, at times in the central part, but not, or only seldom, in the Gulf of Bothnia. The species are present in Norway from Arendal and Østfold up to Mjøsa.

Phanerogams

Carex elata, Dryopteris cristata, Thelypteris palustris

b. Slightly southeastern species - e.g. *Peucedanum palustre* (Fig. 3.4.9)

This sub-group is more widely distributed than sub-group a, since the species are also found around the Gulf of Bothnia, as well as further north in Finland. In Norway, there is some variation for the different species. *Microstylis monophyllos,* in addition to its lowland localities in southeastern Norway, also occurs in Østerdalen and Gudbrandsdalen. Other species are present along the fjords of western Norway and Trøndelag, but not further north except for a few which reach the southern part of Nordland.

Phanerogams

*Alisma plantago-aquatica, Calla palustris, Carex elongata, Frangula alnus, Lysimachia vulgaris, Lythrum salicaria, * Microstylis monophyllos, Peucedanum palustre, Salix cinerea, Scirpus sylvaticus*

c. Species with a southeastern tendency - e.g. *Lysimachia thyrsiflora* (Fig. 3.4.10)

This sub-group has an even wider distribution than a or b, in that the species are found further north or at higher altitudes. In Norway, these species often occur as far north as Lofoten, Vesterålen and Troms. *Cicuta virosa* occurs in the eastern parts of Fennoscandia northwards to Finnmark.

Phanerogams
*Carex acuta, * C. appropinquata, Cicuta virosa, Lysimachia thyrsiflora, Scutellaria galericulata*

Fig. 3.4.8-10 The distribution of *Dryopteris cristata, Peucedanum palustre* and *Lysimachia thyrsiflora* in Fennoscandia. Modified after Hultén (1971).

4. Eastern species
These are either not found at all in the western parts of Fennoscandia, or decline sharply in frequency westwards. Their main occurrence in Norway is in the slightly continental section (C1); they are totally lacking in the most oceanic sections.

a. Strongly eastern species - e.g. *Carex globularis* (Fig. 3.4.11)
These species have continuous distributions in Fennoscandia from the east in the boreal parts of Finland and Sweden. In northern Norway, they are present in inner Finnmark and at times in Troms as well. In southern Norway, their main range is in the eastern part of the southeast, where they continue unbroken from their range in Sweden. They are absent from Denmark.

Phanerogams
Carex disperma, C. globularis, C. laxa, C. tenuiflora, Eriophorum brachyantherum, Ledum palustre, Salix myrtilloides

b. Slightly eastern species
1. Absent from Denmark - e.g. *Pedicularis sceptrum-carolinum* (Fig. 3.4.12)
Members of this group have somewhat wider distributions in Norway than those of group a, extending over the border into Trøndelag from Sweden. A few of them have outlying localities in the interior of western Norway, between Rogaland and Nordmøre. With the exception of *Pinguicula villosa, Carex heleonastes* and *Salix starkeana,* they are all found west of the watershed, from Nordland northwards.

Phanerogams
*Carex aquatilis, * C. heleonastes, C. loliacea, * Equisetum scirpoides, Galium trifidum, Pedicularis sceptrum-carolinum, Pinguicula villosa, Rubus arcticus, Salix starkeana*

Cryptogams
Dicranum drummondii, D. procerus, D. trichophyllus, D. tundrae, Hypnum pratense, Sphagnum aongstroemii, S. wulfianum, Splachnum rubrum.

2. Present in Denmark. These species have additional localities southwards and eastwards, and are present in Denmark.

Phanerogams
Alopecurus aequalis, Calamagrostis stricta, Eriophorum gracile, Poa palustris, P. remota

c. Species with an eastern tendency
1. Absent from Denmark - e.g. *Carex chordorrhiza* (Fig. 3.4.13)
This sub-group is distinguished from sub-group b on the ground that the species are less common in western Norway than further east.

Phanerogams
* *Carex buxbaumii, C. livida, C. stenolepis, Juncus stygius*

Cryptogams
Sphagnum balticum, S. jensenii, S. subfulvum, Splachnum luteum

2. Present in Denmark. This group resembles no. 1, but the species also extend into Denmark from the south and east.

Phanerogams
Carex chordorrhiza, C. vesicaria, Corallorhiza trifida, Scheuchzeria palustris, Scirpus hudsonianus

Cryptogams
Helodium blandowii, Sphagnum obtusum

Fig. 3.4.11-13 The distribution of *Carex globularis, Pedicularis sceptrum-carolinum* and *Carex chordorrhiza* in Fennoscandia. Modified after Hultén (1971).

5. Alpine and upper boreal species
The designation "alpine" is employed in a broad sense. This group is primarily distinguished by its greater or lesser affinity with the alpine and upper boreal regions. Hultén (1950) generally listed the phanerogams included in this group as either arctic, arctic-montane or European boreal-montane species.

a. Strongly alpine and upper boreal species
1. Absent from the lowlands - e.g. *Carex atrofusca* (Fig. 3.4.14)
In Fennoscandia, these species have their main distributional areas in the mountain chain, although they may occur in the northern boreal region, but only exceptionally at lower altitudes. Gradual transitions are found with those in no. 2.

Phanerogams
** Carex atrofusca, * C. microglochin, * C. parallela, * C. saxatilis, Juncus arcticus, * J. biglumis, * J. castaneus, * Salix arbuscula, S. lanata*

Cryptogams
Kiaeria glacialis, Scorpidium turgescens

2. Also in the lowlands in the north. The ranges of these species chiefly resemble those in no. 1, but they extend down to sea level in Nordland and sporadically towards sea level from Stad to Trøndelag. The species occur commonly in the northern boreal region and the upper part of the middle boreal region.

Phanerogams
Carex atrata, C. bigelowii, C. rariflora, Cerastium cerastoides, Epilobium anagallidifolium, Salix herbacea, Saxifraga stellaris

The following species are only present in the southern mountain areas:

Gentiana purpurea, Kobresia simpliciuscula, * Pedicularis oederi*

b. Slightly alpine and upper boreal species
The species in this sub-group show a wider amplitude than those in sub-group a; their lower altitudinal limits generally lie in the middle boreal region. This is particularly obvious, from the distributional maps, in the central and northern parts of Sweden and Finland.

1. Middle boreal-alpine - e.g. *Salix myrsinites* (Fig. 3.4.15)
Arctostaphylos alpina and *Loiseleuria procumbens* are mainly alpine heathland species, but in the most oceanic sections they are present in mire hummocks.

Phanerogams
*Arctostaphylos alpina, Carex adelostoma, * C. capitata, C. norvegica, C. rotundata, * Dactylorhiza lapponica, * Epilobium alsinifolium, * E. davuricum, E. hornemannii, E. lactiflorum, E. scheuchzeri, * Juncus triglumis, Loiseleuria procumbens, Petasites frigidus, * Salix myrsinites, Sparganium hyperboreum, Stellaria calycantha, * Thalictrum alpinum, Viola biflora*

Cryptogams
Anthelia spp., *Barbilophozia quadriloba, Cinclidium subrotundum, Dicranum angustum, D. spadiceum, * Jungermannia exsertifolia, * Lophozia borealis, Scapania uliginosa*

2. Lowlands north of Stad. Their distributions in the main resemble those of no. 1, but these species also occur commonly in the lowlands from Stad-Trøndelag northwards.

Phanerogams
**** Bartsia alpina, Phleum alpinum, Salix glauca, * Saussurea alpina, * Saxifraga aizoides, * Tofieldia pusilla, * Nigritella nigra*** - this species has a unique distribution, with its main centre in the central part of Scandinavia.

c. Species with an alpine and upper boreal tendency - e.g. *Betula nana* (Fig. 3.4.16)
These are all species whose main distributional areas lie in the mountains and the boreal regions (northern boreal to southern boreal), but which may have sporadic localities further south, e.g. in Denmark. Many of the moss species are also found in lowland areas in parts of central Europe. These have been considered by Albertson (1949), amongst others, as being relict localities. The species that are mostly restricted to the higher-lying parts of central Europe are: *Calliergon sarmentosum, C. trifarium, Cratoneuron decipiens, Drepanocladus badius* and *Oncophorus wahlenbergii.*

Phanerogams
*Betula nana, * Carex capillaris, Empetrum hermaphroditum, * Equisetum variegatum, Luzula sudetica, Oxycoccus microcarpus, Salix lapponum, Selaginella selaginoides*

Cryptogams
** Brachythecium turgidum, Bryum weigelii, * Calliergon richardsonii, C. sarmentosum, * C. trifarium, * Catoscopium nigritum, * Cinclidium stygium, * Cratoneuron decipiens, Dicranella palustris, Drepanoclauds badius, Hypnum bambergeri, * Meesia triquetra, * M. uliginosa, Oncophorus virens, O. wahlenbergii, Paludella squarrosa, Philonotis seriata, Sphagnum annulatum, S. centrale, S. lindbergii*

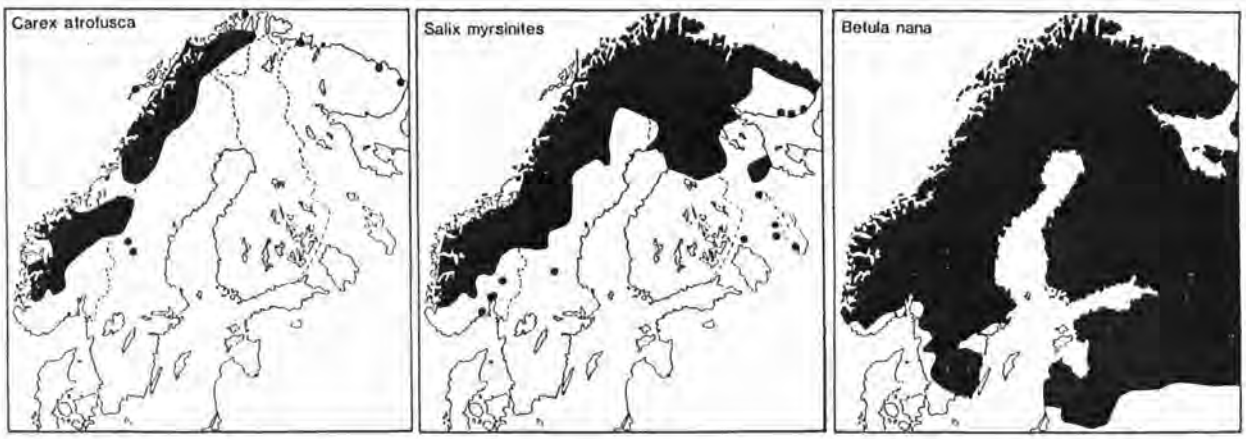


Fig. 3.4.14-16 The distribution of *Carex atrofusca, Salix myrsinites* and *Betula nana* in Fennoscandia. Modified after Hultén (1971).

3.5 Conservation status of mires in Norway

Ingerid Angell-Petersen

3.5.1 Exploitation and threats

More than 25% of the original mire area of Norway below the forest limit is drained. In large lowland districts all larger mires are affected by drainage reclamation. Peat cutting has in the past affected large mire areas, particularly along the woodless coast of Norway. In contrast to most other parts of Europe, mires in Norway have been reclaimed for agriculture even during the last decades. In the 1970s about 10 000 ha were annually drained for forestry purposes. In recent years drainage of mires have been most threatening, and the lowlands of Norway, i.e. the boreonemoral and the southern boreal regions (Moen 1987), have a low percentage of mires. The upper boreal regions of Norway, generally, have high percentage of mires (including sloping fens, etc).

3.5.2 Status of the plan for mire nature reserves

Under the auspices of the Ministry of the Environment, a number of national plans for nature protection have been drawn up. The mire reserve plan and the plan of conservation of wetlands (primarily as bird sanctuaries) are two such plans. Status of protected areas are shown in Table 3.5.1.

Today 217 mire reserves are established, in a few years about 70 more will be included in the mire plan. In addition to these reserves, mires are protected in the national parks and in other types of nature reserves, e.g. wetland reserves (183 nos, 513 km^2, see Table 3.5.1). Upper Forra nature reserve in Nord-Trøndelag country is another example an additional reserve, covering 106 km^2 of land area, about 60% of which are mires. At present 1% of the mire area is protected as mire reserves, another 2% of the mire area is protected in the wetland reserves, national parks etc.

3.5.3 Management of mire reserves

Restoration work (e.g. blocking of ditches) has been done in a few reserves. At Sørlendet nature reserve in the eastern part of central Norway, an area of 100 ha has been restored as a former haymaking fen; the area has been regularily mown during the last decade. The great majority of mire reserves however have no management plans. In the fen areas of the reserves, the succession of overgrowth is going on as the scything finishes (often 4-5 decades ago), and grazing is much reduced.

A problem for many of our lowland mire reserves is the reserve borders, which often are too close to the mire. For these reserves we have no guarantee against modern forestry, ditches or other encorachments close to the mire. This may cause problems for preservation of the mire system in the future, with lowering of the water table etc.

Table3.5.1: Number (N) and area (km^2) of mire and wetland reserves in Norway at 1. January 1994 (*: The county plan not completed). The addition to mire reserves: Øvre Forra nature reserve, Nord-Trøndelag: 106 km^2.

Counties	Mire reserves N	Mire reserves km^2	Wetland reserves N	Wetland reserves km^2
Østfold	15	6,2	25	23
Oslo & Akershus	20	9,1	18	64
Hedmark	3	3,9	19	140
Oppland	16	14	20	79
Buskerud	15	9,8	9	9,7
Vestfold	11	11	10	5,5
Telemark	17	3,7	7	37
Aust-Agder	17	15	6	4,7
Vest-Agder	13	4,2	7	7,3
Rogaland	7	2,8	1*	0,7
Hordaland	10	5,5	1*	0,5
Sogn og Fjordane	0	0	0*	0
Møre og Romsdal	0	0	27	46
Sør-Trøndelag	22	73	13	26
Nord-Trøndelag	21+1	159	17	20
Nordland	16	70	1*	13
Troms	13	21	2*	2,3
Finnmark	0	12	2*	21
Totals 1991	**217+1**	**420 km^2**	**183**	**500km^2**

3.6 Mire area and mire regions

The total area of mires in Norway was in the 1920s estimated to 30 000 km^2 (nearly 10% of the land surface), of which 21 000 km^2 was situated below the forest limit (Løddesøl 1948). More than 25 % of the original mire area of Norway below the forest limit has been drained. Figure 3.6.1 shows the distribution of mires in central Norway.

The mires cover rather small areas in the nemoral, boreonemoral and southern boreal regions of Norway, and in the middle and high alpine regions the mires are totaly absent. The largest areas of mire are found in the middle and northern boreal regions, cf. figures 3.6.2 & 3. Figure 3.6.4 shows a preliminary map of mire regions in Norway, based on the distribution of hydromorphological mire types and the vegetation and flora of the mires.

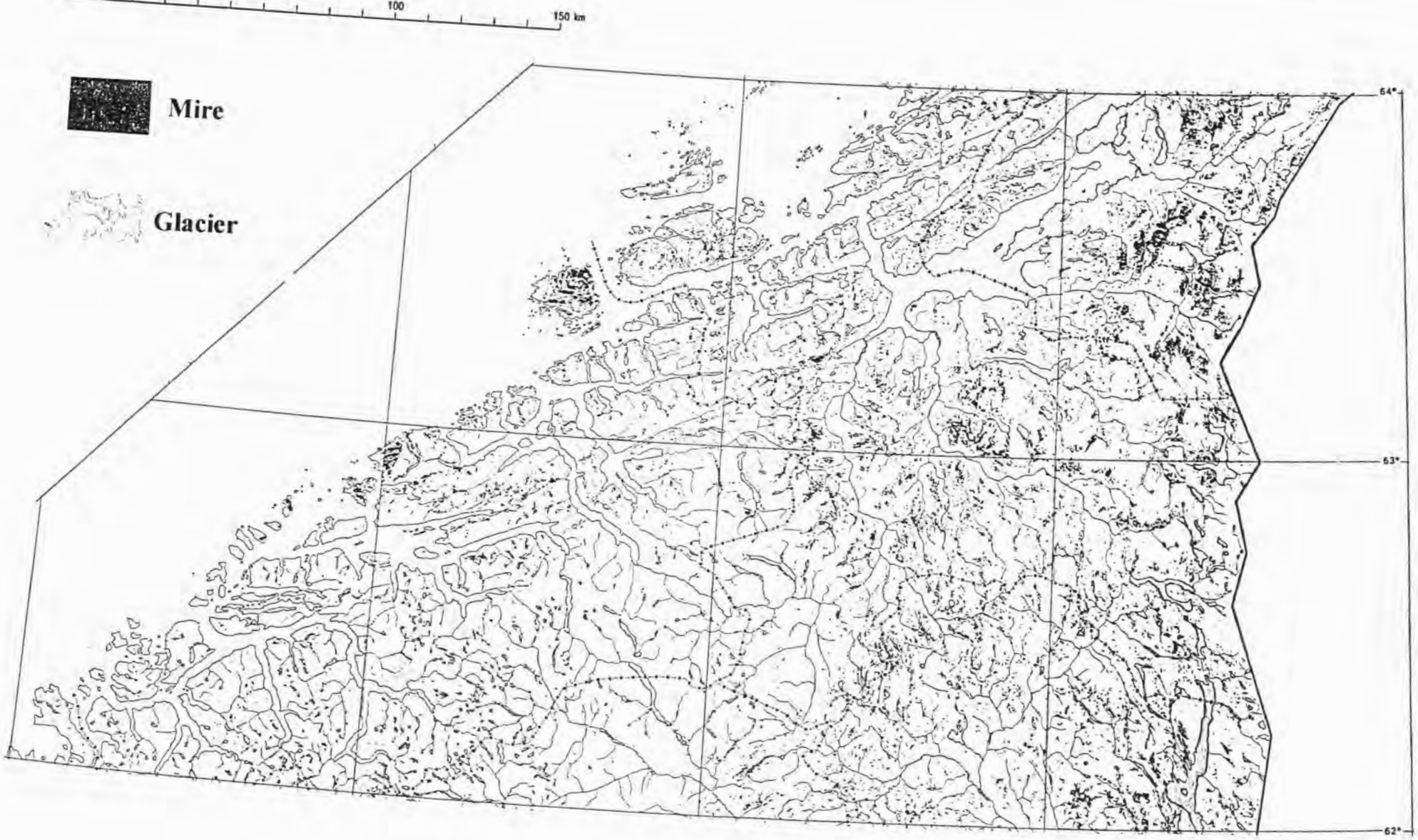
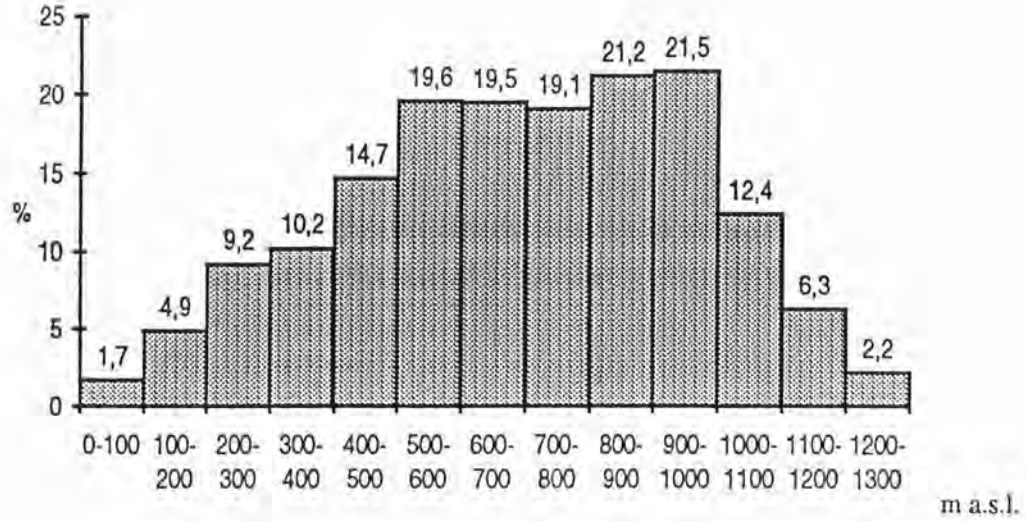


Fig. 3.6.1 Mires in central Norway. The registration is taken from topographic map series M 711. Map basis: The National Atlas of Norway, The Norwegian Mapping Authority, permisson LNA 4 1560.



Mire regions (Fig. 3.6.4):	Raised bogs	Aapa mires		Alpine mires
Vegetational regions: (Moen 1987)	Boreonemoral and Southern boreal	Middle boreal	Northern boreal	Alpine regions

Fig. 3.6.2 The percentage of the land surface covered by mires in the eastern parts of Østlandet. After Næss (1969).

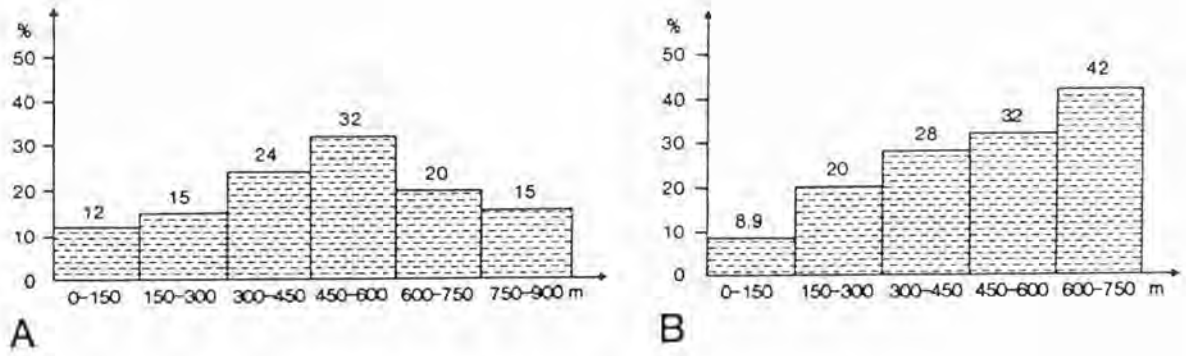


Fig. 3.6.3 The percentage of the land surface covered by mires in the counties of Sør-Trøndelag (A) and Nord-Trøndelag (B) at different altitudes, using as a basis the mire area up to the coniferous forest limit; total areas covered by mires in the two counties are 1514 km² (19% of the total area) and 2481 km² (20%), respectively. Data from the Landsskog-takseringen 1964-76, after Moen (1983) and Moen et al. (1983).

Fig. 3.6.4 Mire regions in Norway, preliminary map (After Moen 1994).

4. Excursion localities

4.0 General survey

Chapter 4 gives a description of the 9 localities we are going to visit during the excursion on 2nd July (locality 1) and 4th to 14th July (localities 2-9). In addition to the 9 primary localities to visit, we also bring some information on a few additional localities (7b Haugtjørnin, Oppdal; 7c Fokstumyra, Dovre: 8b Haramsøy, Haram; 8c Hustadmyrane, Fræna; 9b Røkmyrane, Smøla). A majority of these localities we will pass close by with the bus, and we wil have short visits to some of them.

Tables 4.0.1-4 and Appendix A bring standard information from the 9 primary localities, and the 5 additional ones: Climatic data, span of elevation, regional character, mire-unit types, vegetation units and species list.

Table 4.0.1. Climatic data for the mire localities obtained from a database on terrestrial climate (Leemans and Cramer 1991, Prentice et al. 1992). The values are based on weather records from most stations operated by the Norwegian Meteorological institute, by spatial interpolation to latitude and longitude values of the mire localities. The interpolation technique was triangulation of all data points followed by smooth surface fitting. Data is lacking for locality 7a.

The following bioclimatic indices were calculated from the climatic data: accumulated temperature during the growing season (growing degree days) above 0 and 5 degrees centigrade(GDD0 and GDD5), mean temperature in coldest and warmest month (MTCO and MTWA), mean annual precipitation (APREC) and annual potential evapotranspiration (APET). APET was calculated from interpolated data on temperature, precipitation, sunshine hours and latitude, using a simple deterministic "bucket" model (Cramer and Prentice 1988). The model corrects for elevation when estimating temperature, but not precipitation and sunshine. For upland localities in western Norway the interpolation procedure underestimates the amount of annual precipitation.

Loc. no.	Name	GDD0	GDD5	MTCO	MTWA	APREC	APET
1	Rørmyra, Trondheim	1959	905	-3,5	14	880	390
2	Kaldvassmyra, Verdal	1873	877	-4,6	14,2	994	382
3	Upper Forra, Levanger etc.	1498	620	-5,3	12,5	1043	356
4	Sølendet, Røros	1215	463	-9,4	11,5	653	347
5	Tufsingdeltaet, Os	1344	558	-10,6	12,3	544	365
6	Stormyra, Tynset	1551	704	-11,8	13,3	432	384
7a	Haukskardmyrin, Dovre						
7b	Haugtjørnin, Oppdal	944	275	-9,6	9,6	630	326
7c	Fokstumyra, Dovre	1118	392	-10,1	10,7	452	343
8a	Bakkedalen, Haram	2171	826	0,6	12,5	1303	381
8b	Haramsøy, Haram	2199	831	0,7	12,5	1286	380
8c	Hustadmyrane, Fræna	2438	1044	0,6	13,7	1229	400
9a	Toppmyrane, Smøla	2277	976	0,1	13,4	1090	393
9b	Røkmyrane, Smøla	2313	989	0,3	13,5	1096	394
Mean values		1762	728	-4,8	12,6	895	372

Table 4.0.2. The localities assigned to vegetational zones/belts and sections, including their span in elevation

Loc	Name	Elevation (m a.s.l.) Lower limit	Upper limit	Mean	Zone/belt	Section
1	Rørmyra, Trondheim	170	170	170	Southern boreal	Slightly oceanic
2	Kaldvassmyra, Verdal	190	190	190	Southern boreal	Slightly oceanic
3	Upper Forra, Levanger etc.	380	730	555	Northern boreal	Markedly oceanic
4	Sølendet, Røros	700	800	750	Middle boreal	Indifferent
5	Tufsingdeltaet, Os	660	670	665	Middle boreal	Slightly continental
6	Stormyra, Tynset	475	475	475	Middle boreal	Slightly continental
7a	Haukskardmyrin, Dovre	1050	1050	1050	Northern boreal	Slightly continental
7b	Haugtjørnin, Oppdal	1080	1120	1100	Low alpine	Indifferent
7c	Fokstumyra, Dovre	940	970	955	Northern boreal	Slightly continental
8a	Bakkedalen, Haram	200	260	230	Middle boreal	Highly oceanic
8b	Haramsøy, Haram	160	300	230	Southern boreal	Highly oceanic
8c	Hustadmyrane, Fræna	30	50	40	Southern boreal	Highly oceanic
9a	Toppmyrane, Smøla	20	20	20	Southern boreal	Highly oceanic
9b	Røkmyrane, Smøla	20	20	20	Southern boreal	Highly oceanic

Table 4.0.3. The mire-unit types (hydromorphological), estimated as percent of total mire area within each locality. Zero designates a cover less than 0.5 %. Data is lacking for locality 7a and 7c.

Codes: Ae = eccentric raised bog; Au,4 = plateau raised bog with distinct (irregular) features; Au,5 = ditto, without distinct features; Ar = ridge raised bog; Be = atlantic raised bog with eccentric features; Bu = ditto, without regular features; Ce = eccentric plane bog; Cu,4 = other plane bog, with distinct irregular features; Cu,5 = ditto, without distinct features; Cr = margin plane bog; Dh = mound blanket bog; Dt = sloping blanket bog; Es = string mixed mire; Eø,2 = islet mixed mire s.str.; Ep = palsa mire; Eø,4 = islet mixed mire with erision; Ff = flat fen; Fb = sloping fen (lawn type); Fs = flark fen; Fb,4 = heathland fen; Fb7 = sloping fen, Calluna type; G = spring.

Loc. n	Name	Area (haa)	Ae	Au,4	Au,5	Ar	Be	Bu	Ce	Cu,4	Cu,5	Cr	Dh	Dt	Es	Eø,2	Ep	Eø,4	Ff	Fb	Fs	Fb,4	G	Fb,7
1	Rørmyra, Trondheim	18	50								20								30				0	
2	Kaldvassmyra, Verdal	40		35	30														33				2	
3	Upper Forra, Levanger etc.	5000				0				3	2		1						29	60	4			
4	Sølendet, Røros	130										1				2			10	87			0	
5	Tufsingdeltaet, Os	500							10						15				40		20			
6	Stormyra, Tynset	150									5								95					
7a	Haukskardmyrin, Dovre																							
7b	Haugtjørnin, Oppdal	10															20		80					
7c	Fokstumyra, Dovre																							
8a	Bakkedalen, Haram	100								5			25	30				5	15			10	0	10
8b	Haramsøy, Haram	100											40	30					10			5		15
8c	Hustadmyrane, Fræna	200						2		40								22	25			7		
9a	Toppmyrane, Smøla	400					8	85											5		2			
9b	Røkmyrane, Smøla	250					20	75											5					

Table 4.0.4. Mire vegetation units (A-Å) as percent of the total mire area within each locality. Zero designated less than 0.5%. Data is lacking for localities 7a and 7c.

			Bog veg.					Poor fen veg.					Interm. veg.			Rich veg.				Extr. rich			Spring			Magnoc.	
Loc.	**Name**	**Area** (haa)	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**K**	**L**	**M**	**P**	**Q**	**R**	**S**	**T**	**V**	**W**	**X**	**Y**	**Z**	**Æ**	**Ø**	**Å**
1	Rørmyra, Trondheim	18	17	17	17	11	4		8	3						8			8	8					1		
2	Kaldvassmyra, Verdal	40	21	21	11	8	4			2						2	7	7	2	7	7				2		
3	Upper Forra, Levanger etc.	5000	3	1	1	0	2	2	22	8	8	14	14	7	1	14	2		1	1							
4	Sølendet, Røros	130	1		0			1			0					41	3	3		44	3	5			0		
5	Tufsingdeltaet, Os	500	6	2	2	2	0	20	16	20	8	0	4	17	2	0											
6	Stormyra, Tynset	150	2				2	2				7		35	7		35		7		1	1					
7a	Haukskardmyrin, Dovre																										
7b	Haugtjørnin, Oppdal	10	4					4		4	1					18	22	1	4	18	18	4					
7c	Fokstumyra, Dovre																										
8a	Bakkedalen, Haram	100	35			24		16	12	2	11		0			0								0	0		
8b	Haramsøy, Haram	100	43			33		13	4		7		0			0											
8c	Hustadmyrane, Fræna	100	23			15		19	19	7	9		7			0											
9a	Toppmyrane, Smøla	400	63	14	17	1		2	1	2																	
9b	Røkmyrane, Smøla	250	61	13	21	1		1	1	1																	

Codes:

A. Open bogs, hummock
B. Open bogs, lawn
C. Open bogs, carpet
D. Open bogs, mud-bottom
E. Wooded bogs
F. Open poor fens, hummock
G. Open poor fens, lawn
H. Open poor fens, carpet
I. Open poor fens, mud-bottom
K. Wooded or scrub-covered poor fens
L. Open intermediate fens, lawn
M. Open intermediate fens, carpet & mud-bottom
P. Wooded or scrub-covered intermediate fens
Q. Open rich fens, lawn
R. Open rich fens, carpet
S. Open rich fens, mud-bottom
T. Wooded or scrub-covered rich fens
V. Open extremely rich fens, lawn
W. Open extremely rich fens, carpet & mud-bottom
X. Wooded or scrub-covered extremely rich fens
Y. Poor spring
Z. Intermediate spring
Æ. Rich/extremely rich spring
Ø. Poor Magnocariceta
Å. Rich Magnocariceta

4.1 Locality 1. Rørmyra, Trondheim, Sør-Trøndelag

Map sheet M711: 1621 IV UTM: NR 64,26 Elevation: 170 m a.s.l.
Area: 30 ha. Figures: 4.1.1-4 Tables: 4.0.1 - 4 and 4.1.1.
References: Flatberg (1970), Klokk (1974), Moen (1983).
Status: Rørmyra Nature Reserve covers 19.2 ha of the area N and W of the road (Fig. 4.1.2).
Vegetational regions: Rørmyra is situated in the upper part of the southern boreal zone (the middle boreal is defined as starting at ca. 200 m a.s.l. - Moen 1987), in the transition between the markedly oceanic section (O2) and the slightly oceanic section (O1).

Location, geology, climate and land use
Rørmyra is situated 3 km W of the centre of Heimdal, on the boundary to Trondheim bymark (a large area N and W of Rørmyra that is protected for outdoor activities). The area is much in use for outdoor activities, field excursions, etc.

Rørmyra is situated just below the marine limit (in this area at about 175 m a.s.l. Sørensen et al. 1987). The bedrock is greenstone of Cambro-Ordovician age.

The annual mean temperature is 4.7 °C (January -3.3 °C, July 13.2 °C, at Moholt station). Annual precipitation is ca. 1000 mm (940 mm at Nidarvoll station). Snow normally covers the ground on about 150 days from November to April. Some years the ground is heavily frozen, e.g. winter/spring 1994 (on 19th May, we were unable to dig through the hummocks with a spade, even the hollows were frozen).

Peat has been cut from the southern part of Rørmyra for litter and fuel during the present century, and the same part of the mire has been changed into agricultural land during the last few decades. The road was built across the mire before the last World War. Weekend homes stand close to the border of the reserve in the S and W.

Mire types
The highest parts of Rørmyra are in the E; the surface slopes gently westwards. Figure 4.1.4 shows a transect of the eastern part, from mineral ground with spruce (*Eu-Piceetum*) communities, through the lagg, the marginal slope of the raised bog, across the top, and on down the slope with rather regular alternations between hummocks and hollows. The peat depth is 5-6 m (and even more) over large areas.

The Rørmyra complex consists of a large eccentric bog unit and a number of smaller units of plane (transitional) bogs and flat fens. Springs are common in the marginal zone, mostly in the N. Fen soaks are common, separating the various ombrotrophic units. A stream flows across the complex, near the NE margin, towards NW, meeting another one from the N, before flowing southwards in the W, forming the boundary of the reserve.
Rørmyra is a typical mire complex for this part of central Norway, constructed as a mosaic of ombrotrophic and minerotrophic units. The regular form of the eccentric unit is easily recognised, although some of the other nature reserves in central Norway (in more continental lowlands) show this regular form better, e.g. Bjørnmyra in Trondheim (5 km E of Rørmyra) and Mormyra in Skaun (20 km SE of Rørmyra).

Flora

The flora of Rørmyra is rich, the main reason being the occurrence of a large number of calciphilous species (Appendix Table 2).
Western species (e.g. *Narthecium ossifragum* occurring as dominant, *Carex hostiana* and *C. pulicaris*) are the most common of the defined phytogeographical groups. *Scheuchzeria palustris, Drepanocladus tundrae* and *Sphagnum balticum* are examples of eastern species. *Carex lepidocarpa, Myrica gale* and *Schoenus ferrugineus* are very common or dominant species, and have a distribution with a southern tendency. A large number of alpine/upper boreal species occur, mainly in springs and the rich fen margin, e.g. *Epilobium davuricum, Juncus triglumis* and *Thalictrum alpinum.*

Vegetation

Bog vegetation covers more than 2/3 of the mire complex (about 2/3 of the nature reserve), and of this, wooded bog vegetation makes up about 1/6. On the bog expanse, hummocks, lawns and carpets cover about the same area. The large units have a majority of lawns and carpets, and scattered occurrences of mud bottom. The smaller units are dominated by hummocks. The ombrotrophic vegetation at Rørmyra includes 21 vascular plant species (including *Picea abies* that only occurs as small individuals) (Figure 4.1.5). In addition, *Myrica gale* may occur in pure ombrotrophic places?
The species forming most cover on hummocks are *Calluna vulgaris, Pleurozium schreberi* and *Sphagnum fuscum. Narthecium* characterises the lawns, and *Rhynchospora alba* and *Sphagnum cuspidatum* the carpets and mud bottoms.
The extremely rich lawn communities covering about 10 % of the nature reserve belong to the *Schoenion ferruginei* alliance. In addition to *Schoenus*, a large number of vascular plant species occur, e.g. *Carex lepidocarpa* and *Thalictrum alpinum.*

Route

We will first visit the eastern part of the mire, which is not inside the nature reserve. (We hope to protect this area as an "educational reserve" - the city of Trondheim is the owner.) Ditches can be seen close to the parking place; these are remnants of old peat cuttings.

The bog expanse has well-developed mosaics of (sub-)features: hummocks, lawns, carpets and mud bottoms. The *Calluna* limit is rather distinct (separating hummocks and lawns).

The mire profile area (Fig. 4.1.4) with spruce forest (*Eu-Piceetum* communities), lagg, marginal bog and bog expanse, the last-mentioned having a peat depth of more than 5 m.

We continue into the nature reserve NW of the road, crossing the road and the stream, and go up to the extremely rich fen where we see sharp boundaries between ombrotrophic hummocks and extremely rich lawn communities. Typical fen soaks with extremely rich vegetation.

Back to the bus along the NE margin of the mire, with forested mire margin vegetation and damp spruce forest communities (*Chamaemoro-Piceetum*).
Information about the nature reserve is found close to the bus.

Conservational problems for discussion

1. The road across the mire, the road as a neighbour to a nature reserve.
2. The trampling effect.
3. Nature reserve - educational reserve.

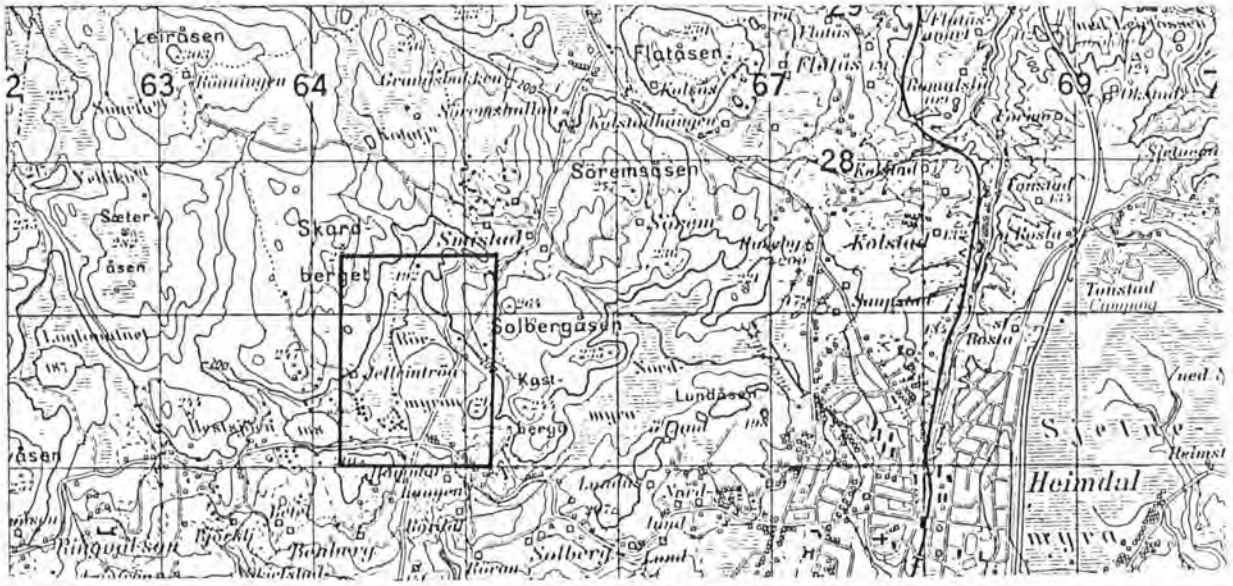


Fig. 4.1.1 Locality 1. Rørmyra, Trondheim, Sør-Trøndelag. The area covered by fig. 4.1.2 is outlined. Map basis: Sheet 1621 IV, Series M 711, Grid zone 32 V, 100 km square: NR. Printed with permission from the Norwegian Mapping Authority.

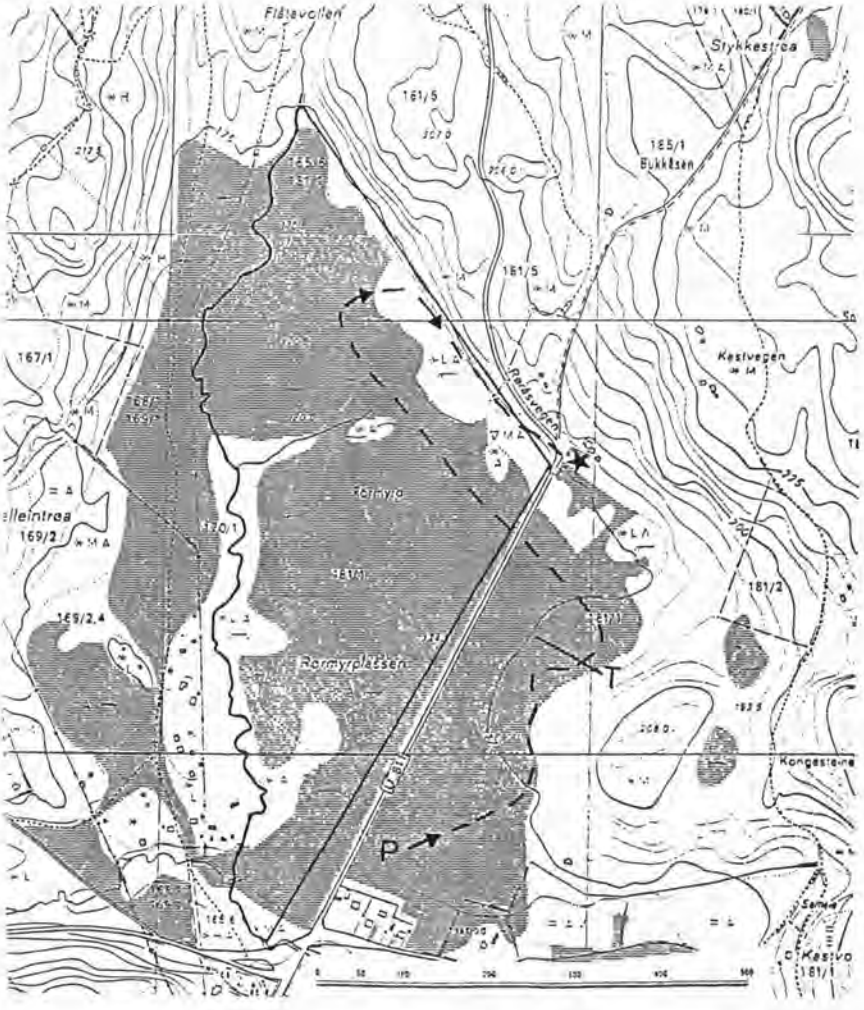


Fig. 4.1.2 Rørmyra. The boundary of the nature reserve outlined. P: Start of excursion. Asterisk: finish. The transect (T, see fig. 4.1.3) is shown on the eastern margin. Map basis: Economic map: CK 125-5-284.

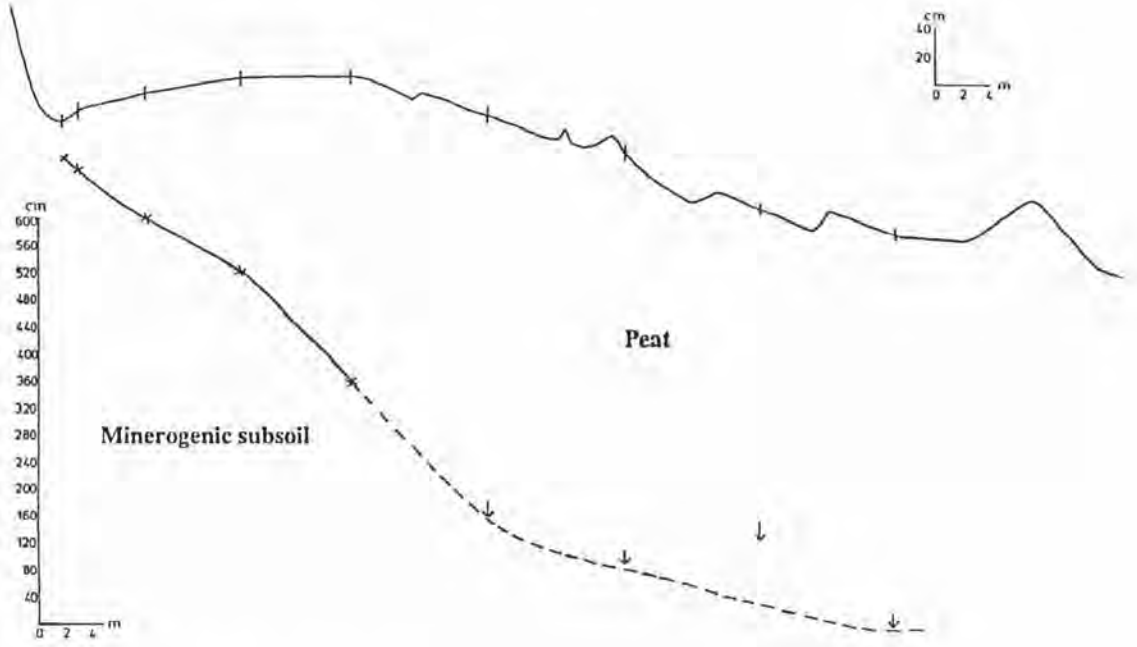


Fig. 4.1.3 Peat profile of the raised bog area (see fig. 4.1.2). The left-hand scale shows the peat depth, the right-hand scale (exaggerated) shows the surface contours.

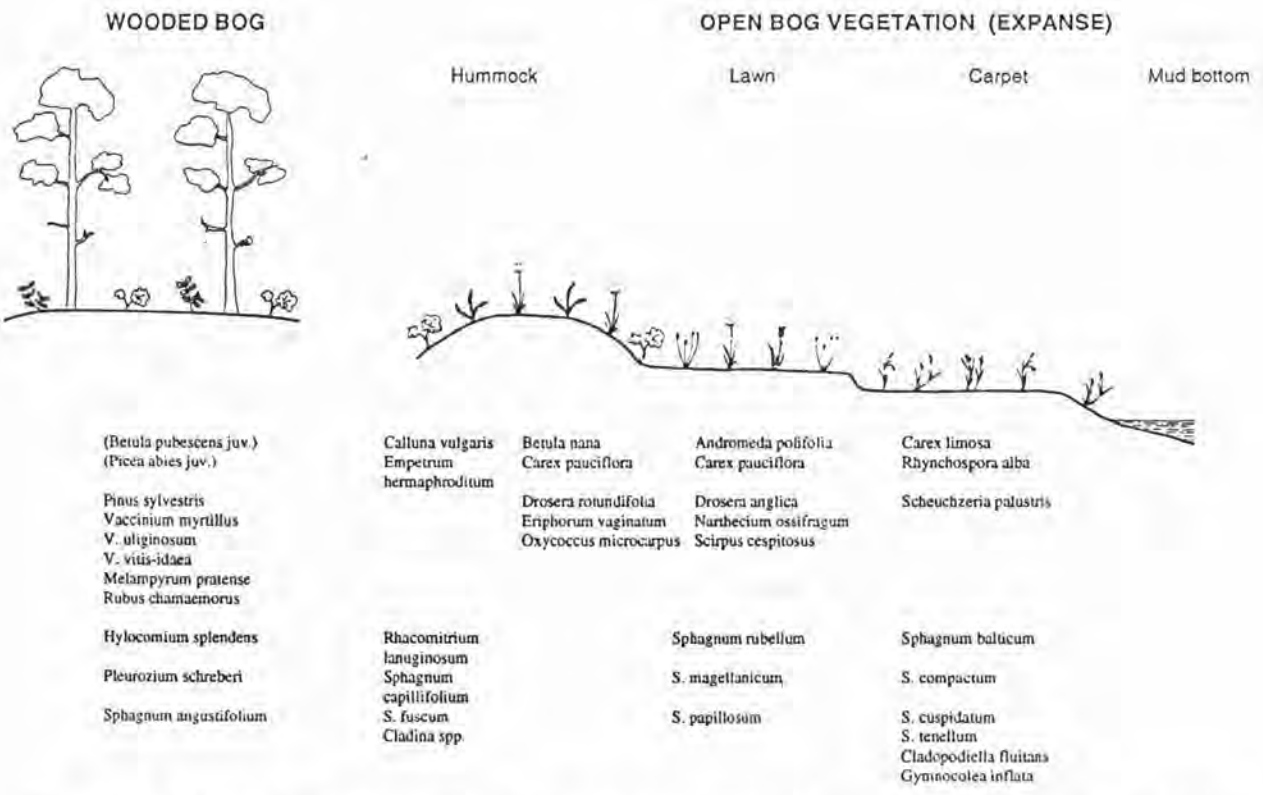


Fig. 4.1.4 Schematic representation of the species occurring in ombrotrophic (bog) vegetation in central Norway (e.g. Rørmyra in Trondheim). Complete list of vascular plant; some of the most common cryptogams are included. Species in ( ) occur only as small individuals in bog vegetation.

Table 4.1.1. Rørmyra, Trondheim. Species list of mire plants. Vascular plants and Sphagna are complete; only some other cryptogams are included.

TYPE	Species name
K	Agrostis capillaris
K	Agrostis stolonifera
K	Alnus incana
K	Andromeda polifolia
K	Anemone nemorosa
K	Anthoxanthum odoratum
K	Betula nana
K	Betula pubescens
K	Calamagrostis stricta
K	Calluna vulgaris
K	Caltha palustris
K	Cardamine amara
K	Carex canescens
K	Carex capillaris
K	Carex chordorrhiza
K	Carex dioica
K	Carex echinata
K	Carex flava
K	Carex hostiana
K	Carex lasiocarpa
K	Carex lepidocarpa
K	Carex limosa
K	Carex magellanica
K	Carex nigra
K	Carex panicea
K	Carex pauciflora
K	Carex pulicaris
K	Carex rostrata
K	Carex tumidicarpa
K	Carex vaginata
K	Cirsium palustre
K	Cornus suecica
K	Dactylorhiza maculata
K	Deschampsia cespitosa
K	Deschamspia flexuosa
K	Drosera anglica
K	Drosera rotundifolia
K	Eleocharis quinqueflora
K	Empetrum hermaphroditum
K	Epilobium alsinifolium
K	Epilobium davuricum
K	Epilobium palustre
K	Equisetum arvense
K	Equisetum fluviatile
K	Equisetum palustre
K	Eriophorum angustifolium
K	Eriophorum latifolium
K	Eriophorum vaginatum
K	Euphrasia frigida
K	Festuca rubra
K	Filipendula ulmaria
K	Galium boreale
K	Galium palustre
K	Geum rivale
K	Hierochloe odorata
K	Juncus articulatus
K	Juncus filiformis
K	Juncus triglumis
K	Juniperus communis
K	Listera cordata
K	Luzula multiflora
K	Lycopodiella inundata
K	Menyanthes trifoliata
K	Molinia caerulea
K	Myrica gale
K	Nardus stricta
K	Narthecium ossifragum
K	Oxycoccus microcarpus
K	Oxycoccus quadripetalus
K	Parnassia palustris
K	Pedicularis palustris
K	Picea abies
K	Pinguicula vulgaris
K	Pinus sylvestris
K	Polygonum viviparum
K	Potentilla erecta
K	Potentilla palustris
K	Rhynchospora alba
K	Rubus chamaemorus
K	Salix aurita
K	Salix glauca
K	Salix lapponum
K	Salix nigricans
K	Salix pentandra
K	Salix phylicifolia
K	Saussurea alpina
K	Scheuchzeria palustris
K	Schoenus ferrugineus
K	Scirpus cespitosus ssp. cesp
K	Scirpus hudsonianus
K	Selaginella selaginoides
K	Succisa pratensis
K	Thalictrum alpinum
K	Tofieldia pusilla
K	Trientalis europaea
K	Triglochin palustris
K	Tussilago farfara
K	Utricularia intermedia
K	Vaccinium myrtillus
K	Vaccinium uliginosum
K	Vaccinium vitis-idaea
K	Vicia cracca
K	Viola biflora
K	Viola epipsila
K	Viola palustris
L	Cladina stellaris
M	Aneura pinguis
M	Bryum pseudotriquetrum
M	Calliergon giganteum
M	Calliergon sarmentosum
M	Calliergon trifarium
M	Calliergonella cuspidata
M	Campylium stellatum
M	Cinclidium stygium
M	Climacium dendroides
M	Cratoneuron commutatum
M	Cratoneuron decipiens
M	Cratoneuron filicinum
M	Dicranum leioneuron
M	Drepanocladus badius
M	Drepanocladus exannulatus
M	Drepanocladus revolvens
M	Drepanocladus tundrae
M	Homalothecium nitens
M	Lophozia bantriensis
M	Lophozia borealis
M	Lophozia rutheana
M	Moerckia hibernica
M	Paludella squarrosa
M	Philonotis calcarea
M	Philonotis fontana
M	Plagiomnium elatum
M	Plagiomnium ellipticum
M	Pseudobryum cinclidioides
M	Racomitrium lanuginosum
M	Rhytidiadelphus triquetrus
M	Scapania undulata
M	Scorpidium scorpioides
M	Sphagnum angustifolium
M	Sphagnum balticum
M	Sphagnum brevifolium
M	Sphagnum capillifolium
M	Sphagnum compactum
M	Sphagnum contortum
M	Sphagnum cuspidatum
M	Sphagnum fuscum
M	Sphagnum girgensohnii
M	Sphagnum isoviitae
M	Sphagnum lindbergii
M	Sphagnum magellanicum
M	Sphagnum majus
M	Sphagnum papillosum
M	Sphagnum pulchrum
M	Sphagnum recurvum coll.
M	Sphagnum riparium
M	Sphagnum rubellum
M	Sphagnum subnitens
M	Sphagnum subsecundum
M	Sphagnum tenellum
M	Sphagnum teres
M	Sphagnum warnstorfii

H= hybrid, K=vascular plant, M=bryophyte, L=lichen

4.2 Locality 2. Kaldvassmyra, Verdal, Nord-Trøndelag

Map sheet M711: 1722 III UTM: PR 27,68-69 Elevation: 185 - 190 m a.s.l.
Area: 40 ha. Figures: 4.2.1-5 Tables: 4.0.1 - 4 and 4.2.1.
References: Moen & Moen 1977, Moen, J. 1977, Moen, A. et al. 1983
Status: Kaldvassmyra Nature Reserve covers 43 ha, established in 1984 as part of the wetland plan (Fig. 4.2.2).
Vegetational regions: Kaldvassmyra is situated in the upper part of the southern boreal zone (the middle boreal is here defined as being above ca. 250 m a.s.l. - Moen 1987), in the slightly oceanic section (O1).
Avifauna: Section 5.

Location, geology, climate and land use
The marine limit in the Verdal area is about 180 m a.s.l. (Sollid & Sørbel 1981), i.e. Kaldvassmyra is situated just above that limit. The valley floor at Kaldvassmyra has thick deposits of glaciofluvial material, mainly locally derived clay and fine-grained sand (Sollid 1976). The bedrock in the area consists of Ordovician phyllite, mica schist and limestone. The limestone covers large areas S of Kaldvassmyra, e.g. Ramsåsen.

The annual mean temperature is 2.8 °C (January -6.7 °C, July 12.6 °C, at Suul station). The annual precipitation is ca. 840 mm (at Buran station).
The road between Kaldvassmyra and Ramsåsen is an old one; new roads (not shown on the maps) were built W and N of the mire during the 1980's. Just before conservation took place, the spruce forest on the mineral soil at the margin was felled, and even coniferous forest on the mire margin itself. The forest will recover inside the reserve through natural seedlings.

Ditches to increase forest production were dug on southern and eastern parts of the mire before 1974 (see the photo, Fig. 4.2.5). An old winter road for timber transport crosses the mire, and traces of it can still be easily seen, as also can the site of an old stockpile of logs on the mire margin in the SW. The traditional use of the mire has ended and the mire will recover.

Mire types
Ombrotrophic units dominate. The main unit covers about 1/3 and is classified as a plateau raised bog with marked features. Here, high hummocks occur in a mosaic with carpets and mud bottoms. The peat depth is 3.5 to 4 m (Figure 4.2.4). A number of smaller raised bog units are found (separated by fen soaks) where the most common sub-features are hummocks and lawns. On the western 1/3 of the complex, a flat fen surrounds a lake, Kaldvatnet. S and W of Kaldvatnet, a large number of very strong springs feed cold (Norw."kald", i.e. the name of the lake), calcareous water into the lake. The pH of the spring water is 7.2-7.7, and the pH in Kaldvatnet, which has deep deposits of calcareous mud, reaches 8.0. This spring system, with the calcareous Kaldvatnet and the surrounding fens, is unique for Trøndelag. (Similar systems are known from Vefsn in Nordland.)

The ombrotrophic units are typical for the upper southern boreal and lower middle boreal regions of inner Trøndelag. In this district, many large bogs seem to be regressive (with high hummocks and eroding mud bottoms) rather than progressive.

Flora

The flora is rich, southern (lowland) species (e.g. *Rhynchospora alba* and *Sphagnum cuspidatum*) occurring together with many alpine/boreal species (mainly in the springs, e.g. *Cystopteris montana, Equisetum scirpoides* and *E. variegatum*).

Moen & Moen (1977) published a number of local distribution maps for vascular species.

Vegetation

Racomitrium lanuginosum dominates the high hummocks, *Sphagnum fuscum* being the most common hummock species elsewhere.

Phytosociological analyses of the mire and spring vegetation of Kaldvassmyra are found in a thesis by J. Moen (1977).

Route

A short visit to this locality, emphasising
1) the raised bog with its high hummocks
2) the spring area in the SW.

Conservational problems for discussion

1. The roads as neighbours to the reserve.
2. The influence of past felling of forest on the mire complex.
3. Is the narrow buffer zone sufficient when modern forestry practices take place right up to the boundary of the reserve?
4. The influence of trampling.

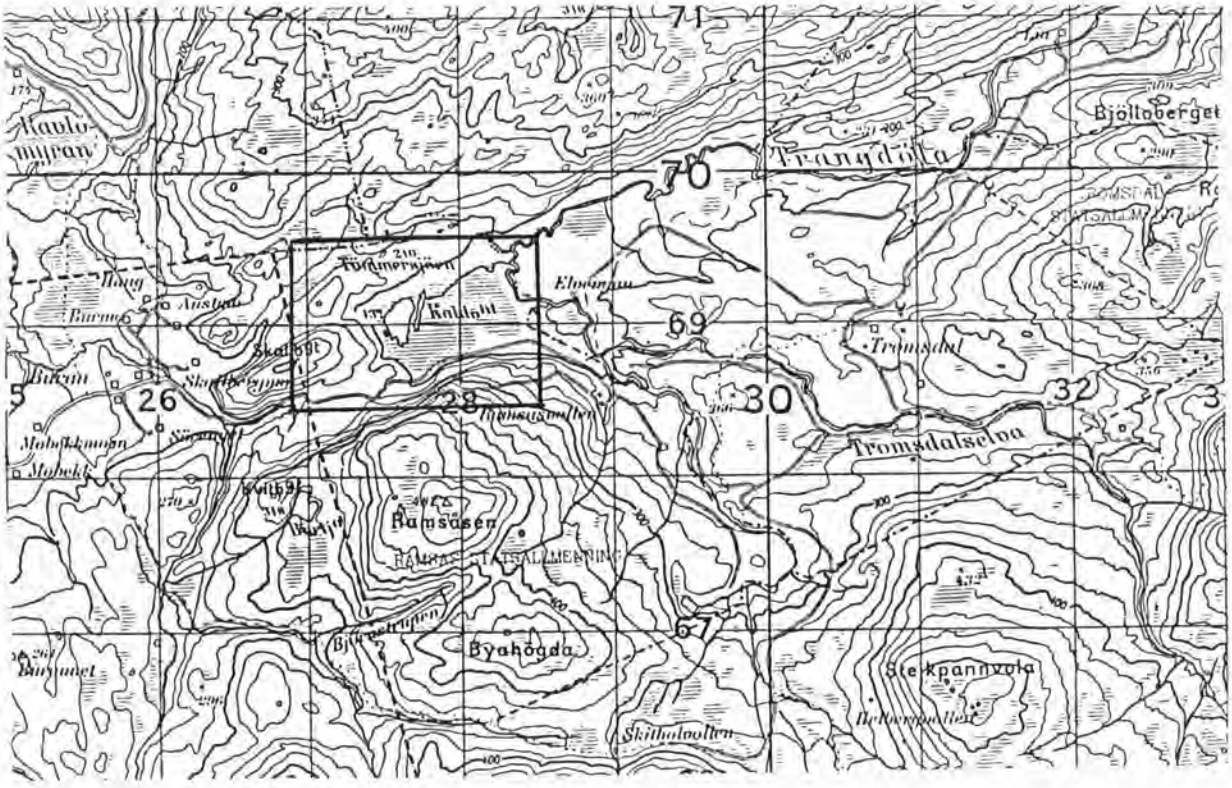


Fig. 4.2.1 Locality 2. Kaldvassmyra, Verdal, Nord-Trøndelag. The area covered by the vegetation map (fig. 4.2.3) is outlined in black. Map basis: Sheet 1720 II, Series M 711. Grid zone: 32 V, 100 km square: PR. Printed with permission from the Norwegian Mapping Authority.

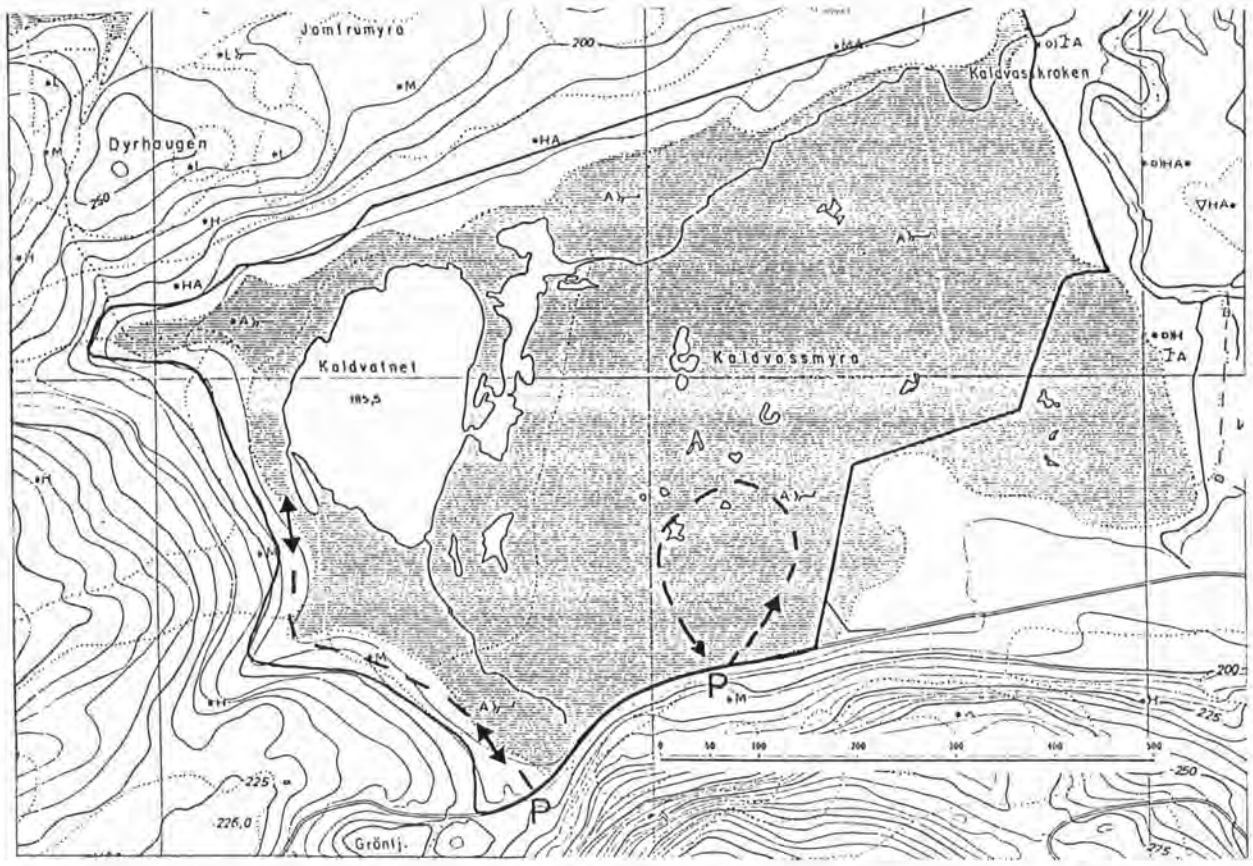


Fig. 4.2.2 Kaldvassmyra. The boundary of the nature reserve outlined. P: Start of excursion. Map basis: Economic map: CU 133-5-2.

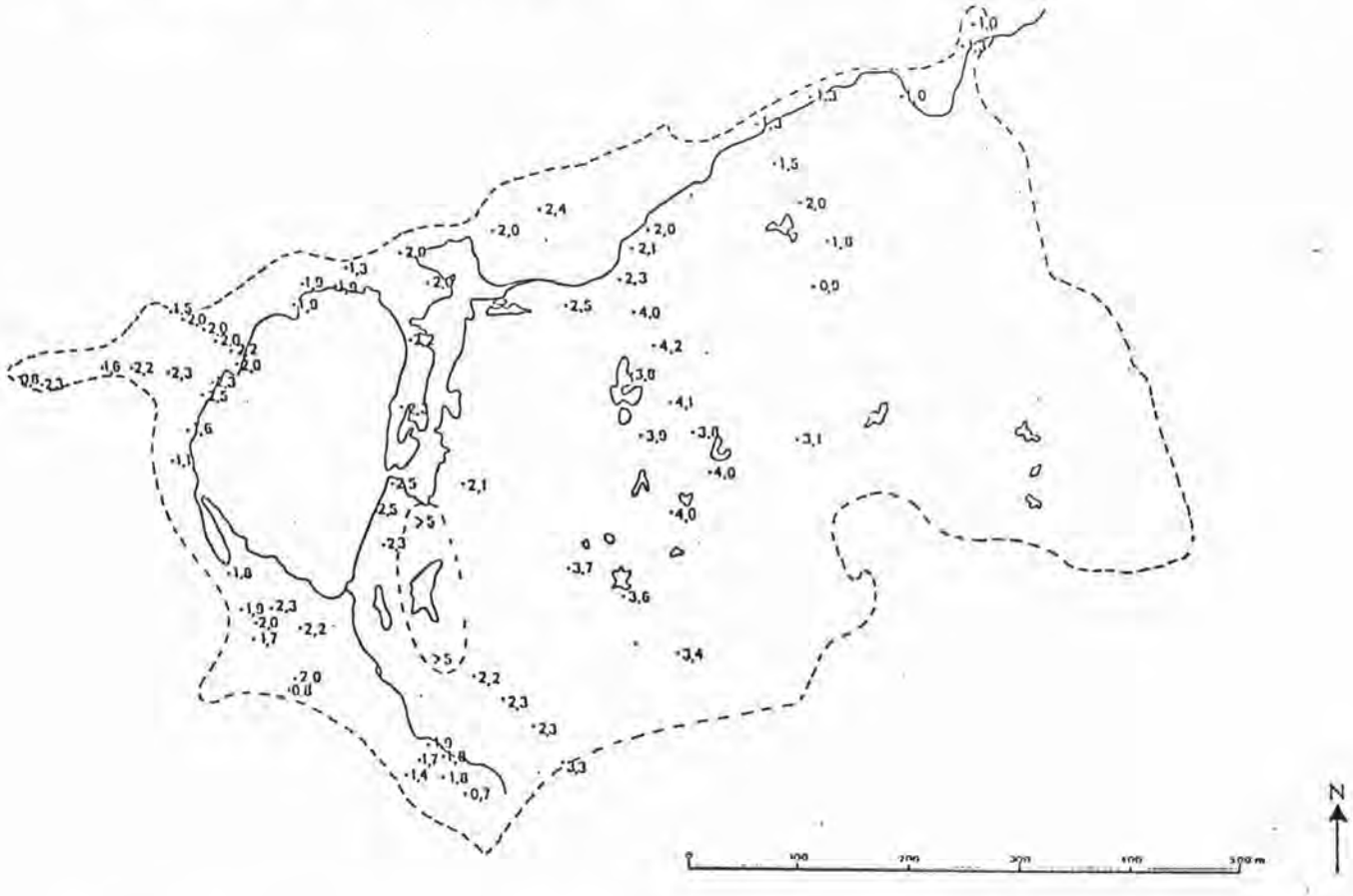
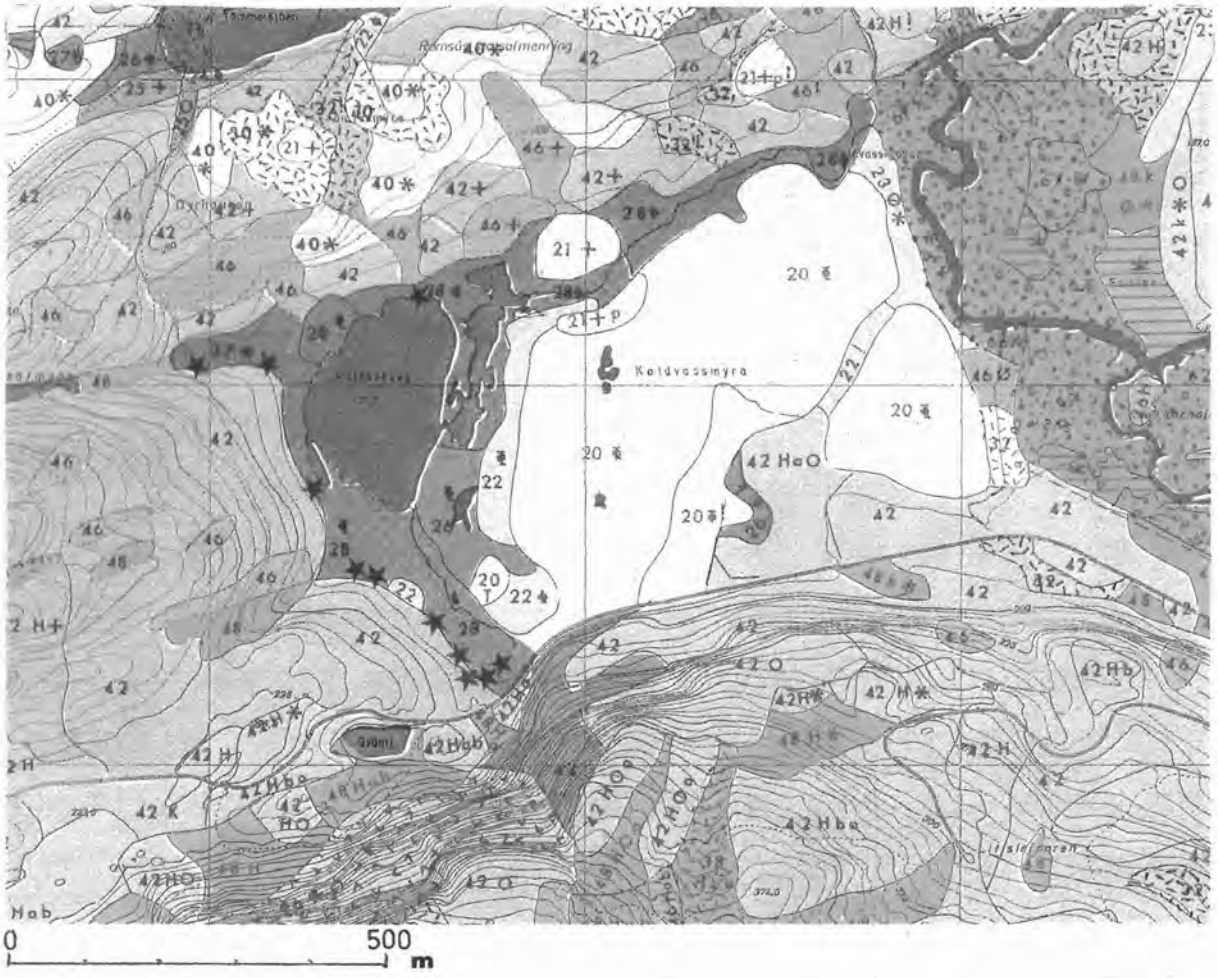


Fig. 4.2.3 Kaldvassmyra. Peat depth in m (From Moen, J. 1977).



19	Calcareous spring	T	Hummocks	32.	Damp mesotrophic spruce forest
20.	Open bogs			38.	Damp eutrophic spruce forest
21.	Wooded bogs		Lawns and carpets	40.	Oligotrophic pine forest
22.	Open poor fens		Mud bottom	42.	Mesotrophic spruce forest
23.	Wooded or scrub-covered poor fens			421.	Vaccinium myrtillus type
24.	Open intermediate fens			422.	Fern sub-type
25.	Wooded or scrub-covered intermediate fens			44.	Calcareous pine forest
26.	Open rich fens			46.	Low herb spruce forest
27.	Wooded or scrub-covered rich fens			48.	Tall herb spruce forest
28.	Open extremely-rich fens			67.	Grey alder forest
30.	Damp oligotrophic pine forest			108.	Summer farm meadows

Fig. 4.2.4 Kaldvassmyra. Copy of: Vegetation map of Tromsdal, Verdal and Levanger, Nord-Trøndelag. (After Moen & Moen 1977).

Table 4.1.2. Kaldvassmyra, Verdal. Species list of mire plants. Vascular plants and Sphagna are complete; only some other cryptogams are included.

TYPE	Species name
H	Carex flava x lepidocarpa
K	Agrostis capillaris
K	Agrostis stolonifera
K	Alchemilla sp.
K	Alnus incana
K	Alopecurus geniculatus
K	Andromeda polifolia
K	Anemone nemorosa
K	Angelica sylvestris
K	Anthoxanthum odoratum
K	Bartsia alpina
K	Betula nana
K	Betula pubescens
K	Calamagrostis purpurea
K	Calamagrostis stricta
K	Calluna vulgaris
K	Caltha palustris
K	Cardamine amara
K	Cardamine pratensis
K	Carex acuta
K	Carex appropinquata
K	Carex bigelowii
K	Carex buxbaumii
K	Carex canescens
K	Carex capillaris
K	Carex chordorrhiza
K	Carex diandra
K	Carex dioica
K	Carex echinata
K	Carex elongata
K	Carex flava
K	Carex lasiocarpa
K	Carex lepidocarpa
K	Carex limosa
K	Carex livida
K	Carex loliacea
K	Carex magellanica
K	Carex nigra
K	Carex norvegica
K	Carex pallescens
K	Carex panicea
K	Carex pauciflora
K	Carex pulicaris
K	Carex rostrata
K	Carex tumidicarpa
K	Carex vaginata
K	Carex vesicaria
K	Cerastium fontanum
K	Chrysosplenium alternifolium
K	Cirsium helenioides
K	Corallorhiza trifida
K	Cornus suecica
K	Crepis paludosa
K	Cystopteris montana
K	Dactylorhiza incarnata
K	Dactylorhiza maculata
K	Deschampsia cespitosa
K	Deschamspia flexuosa
K	Drosera anglica
K	Drosera rotundifolia
K	Eleocharis mamillata
K	Eleocharis quinqueflora
K	Empetrum hermaphroditum
K	Empetrum nigrum
K	Epilobium alsinifolium
K	Epilobium angustifolium
K	Epilobium davuricum
K	Epilobium hornemannii
K	Epilobium lactiflorum
K	Epilobium palustre
K	Equisetum arvense
K	Equisetum fluviatile
K	Equisetum hyemale
K	Equisetum palustre
K	Equisetum pratense
K	Equisetum scirpoides
K	Equisetum sylvaticum
K	Equisetum variegatum
K	Eriophorum angustifolium
K	Eriophorum latifolium
K	Eriophorum vaginatum
K	Euphrasia frigida
K	Festuca rubra
K	Festuca vivipara
K	Filipendula ulmaria
K	Galium boreale
K	Galium palustre
K	Galium uliginosum
K	Geranium sylvaticum
K	Geum rivale
K	Glyceria fluitans
K	Gymnocarpium dryopteris
K	Hammarbya paludosa
K	Hierochloe odorata
K	Huperzia selago
K	Juncus alpinoarticulatus
K	Juncus articulatus
K	Juncus bufonius
K	Juncus filiformis
K	Juncus stygius
K	Juncus triglumis
K	Juniperus communis
K	Linum catharticum
K	Listera cordata
K	Luzula multiflora
K	Luzula sudetica
K	Maianthemum bifolium
K	Melampyrum pratense
K	Melica nutans
K	Menyanthes trifoliata
K	Molinia caerulea
K	Nardus stricta
K	Nymphaea sp.
K	Orthilia secunda
K	Oxycoccus microcarpus
K	Oxycoccus quadripetalus
K	Oxyria digyna
K	Parnassia palustris
K	Pedicularis palustris
K	Phragmites australis
K	Picea abies
K	Pinguicula vulgaris
K	Pinus sylvestris
K	Poa pratensis
K	Polygonum viviparum
K	Potamogeton filiformis
K	Potamogeton natans
K	Potentilla erecta
K	Potentilla palustris
K	Pyrola minor
K	Pyrola rotundifolia
K	Ranunculus acris
K	Rhynchospora alba
K	Rubus chamaemorus
K	Rumex acetosa
K	Sagina procumbens
K	Salix arbuscula
K	Salix aurita
K	Salix caprea
K	Salix glauca
K	Salix hastata
K	Salix lapponum
K	Salix myrsinites
K	Salix nigricans
K	Salix pentandra
K	Salix phylicifolia
K	Saussurea alpina
K	Saxifraga aizoides
K	Saxifraga stellaris
K	Scirpus cespitosus ssp. cespitosus
K	Scirpus hudsonianus
K	Selaginella selaginoides
K	Solidago virgaurea
K	Sorbus aucuparia
K	Stellaria alsine
K	Stellaria crassifolia
K	Stellaria nemorum
K	Succisa pratensis
K	Thalictrum alpinum
K	Thelypteris phegopteris
K	Tofieldia pusilla
K	Trientalis europaea
K	Triglochin palustris
K	Tussilago farfara
K	Utricularia intermedia
K	Utricularia minor
K	Vaccinium myrtillus
K	Vaccinium uliginosum
K	Vaccinium vitis-idaea
K	Vicia cracca
K	Viola biflora
K	Viola palustris
L	Cetraria ericetorum
L	Cetraria islandica
L	Cladina stellaris
L	Cladonia uncialis
L	Icmadophila ericetorum
M	Aneura pinguis
M	Bryum pseudotriquetrum
M	Calliergon giganteum
M	Calliergon richardsonii
M	Calliergon sarmentosum
M	Calliergon trifarium
M	Calliergonella cuspidata
M	Campylium stellatum
M	Catoscopium nigritum
M	Cinclidium stygium
M	Climacium dendroides
M	Cratoneuron commutatum
M	Cratoneuron decipiens
M	Cratoneuron filicinum
M	Dicranella palustris
M	Dicranum leioneuron
M	Drepanocladus badius
M	Drepanocladus exannulatus
M	Drepanocladus revolvens
M	Drepanocladus tundrae
M	Drepanocladus uncinatus
M	Fissidens adianthoides
M	Homalothecium nitens
M	Lophozia bantriensis
M	Lophozia borealis
M	Lophozia rutheana
M	Moerckia hibernica
M	Paludella squarrosa
M	Philonotis calcarea
M	Philonotis fontana
M	Plagiomnium elatum
M	Plagiomnium ellipticum
M	Pohlia wahlenbergii
M	Racomitrium lanuginosum
M	Rhizomnium pseudopunctatum
M	Rhytidiadelphus triquetrus
M	Scorpidium scorpioides
M	Sphagnum angermanicum
M	Sphagnum angustifolium
M	Sphagnum balticum
M	Sphagnum capillifolium
M	Sphagnum compactum
M	Sphagnum contortum
M	Sphagnum cuspidatum
M	Sphagnum fallax
M	Sphagnum fuscum
M	Sphagnum girgensohnii
M	Sphagnum lindbergii
M	Sphagnum magellanicum
M	Sphagnum majus
M	Sphagnum papillosum
M	Sphagnum pulchrum
M	Sphagnum rubellum
M	Sphagnum subfulvum
M	Sphagnum subnitens
M	Sphagnum subsecundum
M	Sphagnum subsecundum coll.
M	Sphagnum tenellum
M	Sphagnum teres
M	Sphagnum warnstorfii

H= hybrid, K=vascular plant, M=bryophyte, L=lichen

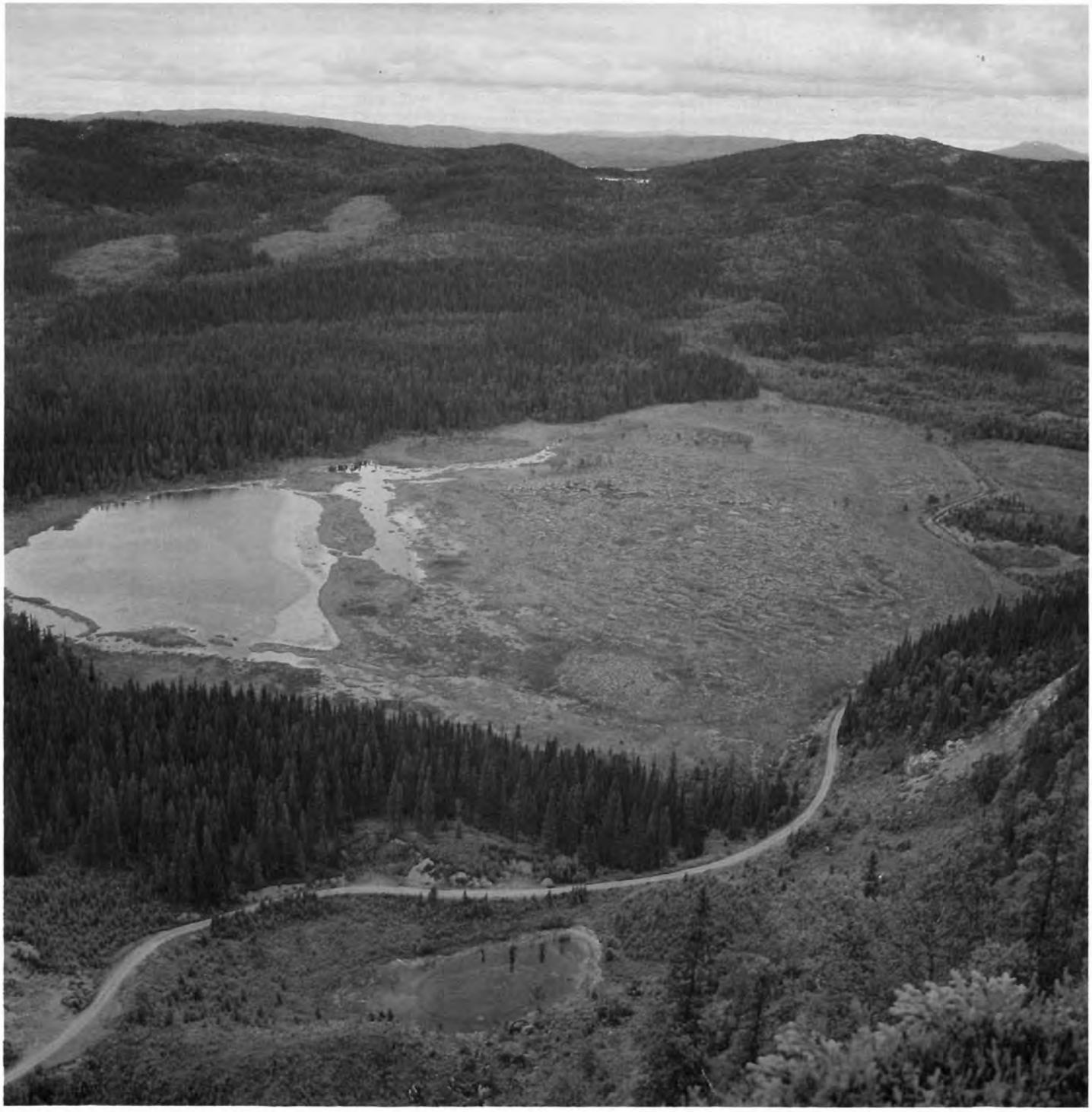


Fig. 4.2.5 Kaldvassmyra seen from Ramsåsen. Kaldvatnet (with calcareous mud seen at the margins) to the left. Photo A. Moen 1973.

4.3 Locality 3. Upper Forra, Levanger, etc., Nord-Trøndelag

Map sheet M711: 1722 III UTM: PR 20-34, 50-60
Elevation: (375) 400-500 (936) m a.s.l.
Mire area: ca. 50 km2. Figures: 4.3.1-4. Tables: 4.0.1 - 4 and 4.3.1.
References: Hafsten & Solem (1976), Moen, A. et al. (1976, 1983), Moen & Jensen (1979), Solem (1991a, b).
Status: Upper Forra Nature Reserve covers 108 km2 (land area: 106 km2), established 1990 (Fig. 4.3.2).
Vegetational regions: Most of the nature reserve is in the northern boreal region, but small areas are in the upper part of the middle boreal (below ca. 400 m) and the low alpine (above ca. 600-650 m a.s.l.) regions. The Upper Forra area is in the markedly oceanic section (O2). The vegetational history is dealt with in sub-section 4.3.1. and the avifauna in section 5.

Location, geology, climate and land use
The River Forra is a tributary of the River Stjørdal (Figs. 4.3.2 and 4.3.5) and has a catchment basin of 608 km2. The river rises as the outlet of Lake Feren (altitude 401 m a.s.l.). In the Upper Forra area, the river has a broad, meandering course with a fall of only 3.3 m over a distance of 8 km.

The geology is varied. In the west, there are easily weathered, calcareous strata with rather harder rocks on the Hundskinnrygg ridge, and east of the Glunka are still harder rocks that are most resistant to weathering. In the lower-lying parts of the area, extensive drift deposits overlie the bedrock. These deposits are largely morainic in origin, but were deposited as fluvio-glacial material, most of the finer fractions being carried furthest and deposited in the lowermost-lying parts of the area. On both the northern and southern margins of the Upper Forradal area are morainic ridges (drumlins) that are almost flat-topped and several kilometres in length (Fig. 4.3).

The annual mean temperature is about 2.2 °C (January -7.2 °C, July 13.1 °C, at the Færen meteorological observation station (Moen & Jensen 1979). The annual precipitation is 952 mm at this station, but this figure is certainly too low to be representative for the central parts of the Upper Forra area. The snow cover lasts from October to May; in some years, large areas are snow covered until June.

The central parts of the Upper Forradal area comprise wide stretches of open mire flanking the gently-flowing Forra, Heståa and Glunka rivers. This area, measuring 30-40 km2, is virtually a shallow upland basin, bounded on all sides by low, but distinct, mire-covered or wooded ridges (cf. Fig. 4.3.6).

During the last 2000 years, the natural resources of the area have been utilised for iron production (section 4.3.1), grazing, haymaking, etc. There have been at least 17 upland dairy farms inside the present nature reserve, the majority in the western part where the vegetation is richest. Until about 1930 and during the last World War, large fen areas were used for haymaking. As the mowing has stopped and grazing is much reduced, the successions of overgrowth are visible throughout the area.

The forests have been used for fuel for both the iron production and the farming, and timber has also been taken from the area, remnants from timber floating and regulation dams being

found along the River Forra. Old tracks through the Upper Forra valley from Levanger to Jämtland (in Sweden) testify to the close contact between the two nations. Forra has been, and still is, an important area for hunting and fishing. Reindeer herding now takes place within the area.

In about 1960, the electricity board began planning to exploit the Forra basin. Through the 60's, 70's and 80's, a great struggle went on between exploitation supporters and those who wanted to save the Forra nature. Moen & Jensen (1979) summarise a multi-disiplinary project clarifying the biologically interesting features and conservational aspects of the Upper Forra area and the consequences of damming 11.7 km2 of it. In 1986, the Norwegian Parliament adopted Conservation Plan III for watercourses, and Forra was finally saved from exploitation.

Upper Forra is popular for recreation in summer and winter. The river is not least pleasant for canoeing on. The area is also much used for skiing, hunting, fishing, berry-picking and walking. Some facilities are provided for the recreational use, e.g. paths which may be of benefit to walkers and may protect the mire from too much trampling.

Mire types

About 80% of the central part of the area is mire covered. Sloping fens dominate (about 60 % of the mire area), mostly with an angle of 3-10g, but steeper slopes are common, up to 20g. Flat fens cover about 30% and occur all over the area. However, very large flat fens dominate the wide valley floors, frequently wet fens with small tarns here and there. Smaller units of flark fens with mud bottoms and flark pools are common, mostly in the transitional areas between flat fens and sloping fens. Ornithologists are particularly interested in these wetter types of mire habitat (see section 6). The flat summits of the ridges and the intervening flat areas are often covered by mires. Ombrotrophic segments are often dominant on the top of the drumlins, which have the best examples of blanket bogs (covering less than 1% of the mire area). Various kinds of plane (transitional) bogs cover about 5% of the mire area, occurring mainly as small units in a mosaic with flat fens. Ridge raised bogs are rare. Only 12 springs have been recorded on the vegetational map, which covers 70 km2.

Flora

A full species list of vascular plants in the Upper Forra area is found in Moen et al. (1976) and covers 326 species (mire plants are in Tables 4.0.1 and 4.3.1). There is a high representation of western species, e.g. Narthecium ossifragum (dominating large areas), Carex hostiana, Sphagnum angermanicum (very common), S. molle and S. strictum. Species with an eastern tendency occur all over the area, e.g. Carex livida, Juncus stygius and Splachnum luteum. More typical eastern species (like Galium trifidum) are only found in the easternmost part. An interesting and rich alpine flora occurs on Hårskallen (in the northwest), e.g. Carex atrofusca, C. microglochin, Kobresia simpliciuscula and Pedicularis oederi (the last five species will not be seen during this excursion to Upper Forra).

Vegetation

Cover estimates from the vegetational map (covering 70 km2), show that 62% of the area is mire covered. More than 50% of this area is covered by poor fens, lawn communities making up about half of this. Wooded or scrub-covered poor fens, carpets and mud bottoms also cover large areas. Intermediate lawn and carpet communities are also common, especially in central and western parts. In the northwest of the area (e.g. near Heglesvollen at the start of our route), large areas of rich fen occur, and even extremely rich fens, mostly having lawn

communities (see the vegetational map, figure 4.3.3). About 7% of the mire area is mapped as ombrotrophic, about half of this being hummock vegetation (the commonest species in the bottom layer are Racomitrium lanuginosum, Pleurozium schreberi, Sphagnum fuscum, S. capillifolium and Cladina spp.).

Route

We start a long walk (about 6 km) from the parking site in Heståsdalen, close to Heglesvollen where we will look at the old iron ovens on our return. As we go eastwards, the sloping fens on the left-hand side (N) are rich or extremely rich, the flat fens down to the Heståa being mostly poor or intermediate. We will have a closer look at the flora (Sphagnum species) and vegetation. Most mineral ground vegetation belongs to the heath series (brown on the vegetational map), but some areas are richer, belonging to the grassland vegetational series (green on the map).

We then cross the Heståa river and go up the drumlin to the top of the ridge and follow this eastwards to the places marked with an X on the vegetational map (N of Salthammarvollen) where we will take a closer look at the blanket bog and transects, etc. (see 4.3.1).

Then we turn S and W, and have a long mire walk back to Heglesvollen. We should have walked to Reinsjøen and Hundskinnryggen to see the enormous mires to the E, and the alluvial forest along the meandering River Forra, but that would be 3-4 km extra. Perhaps a small group will take this trip? We will all go to the extremely rich sloping fens S of Heglesvollen, and the remnants of the old iron ovens will be demonstrated.

Conservational problems for discussion

1. The influence of trampling.

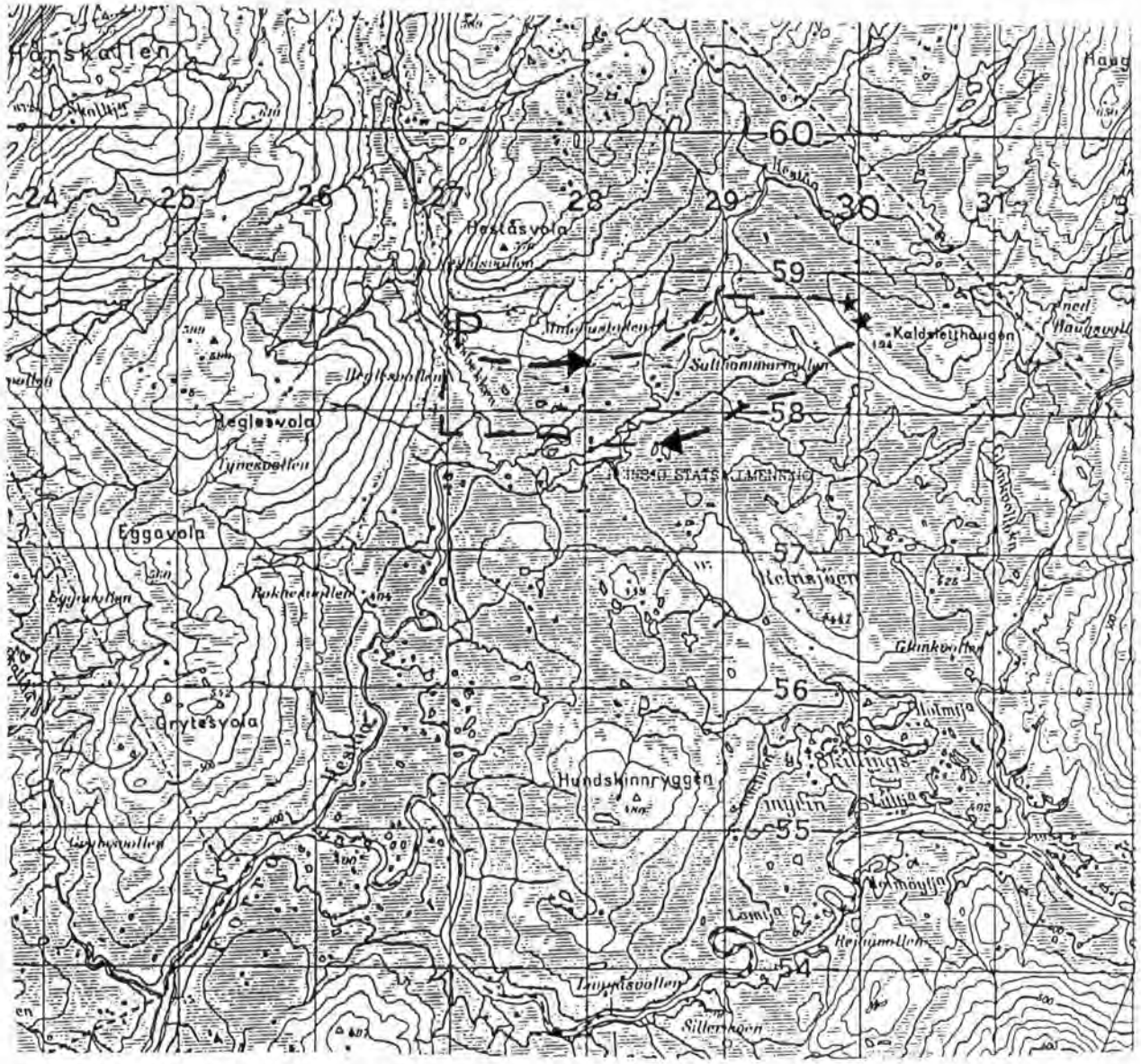


Fig. 4.3.1 Locality 3. Upper Forra, Levanger etc., Nord-Trøndelag. Map basis: Sheet 1722 III, Series M 711, Grid zone 32 V, 100 km square: PR. P: Start of excursion. Asterisks: Blanket bog area. Printed with permission from the Norwegian Mapping Authority.

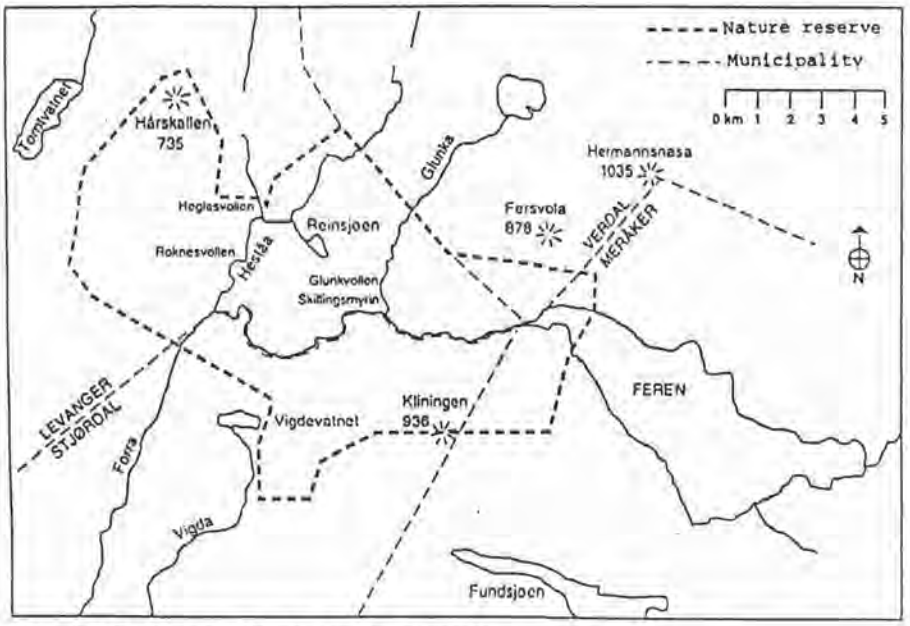


Fig. 4.3.2 Upper Forra nature reserve.

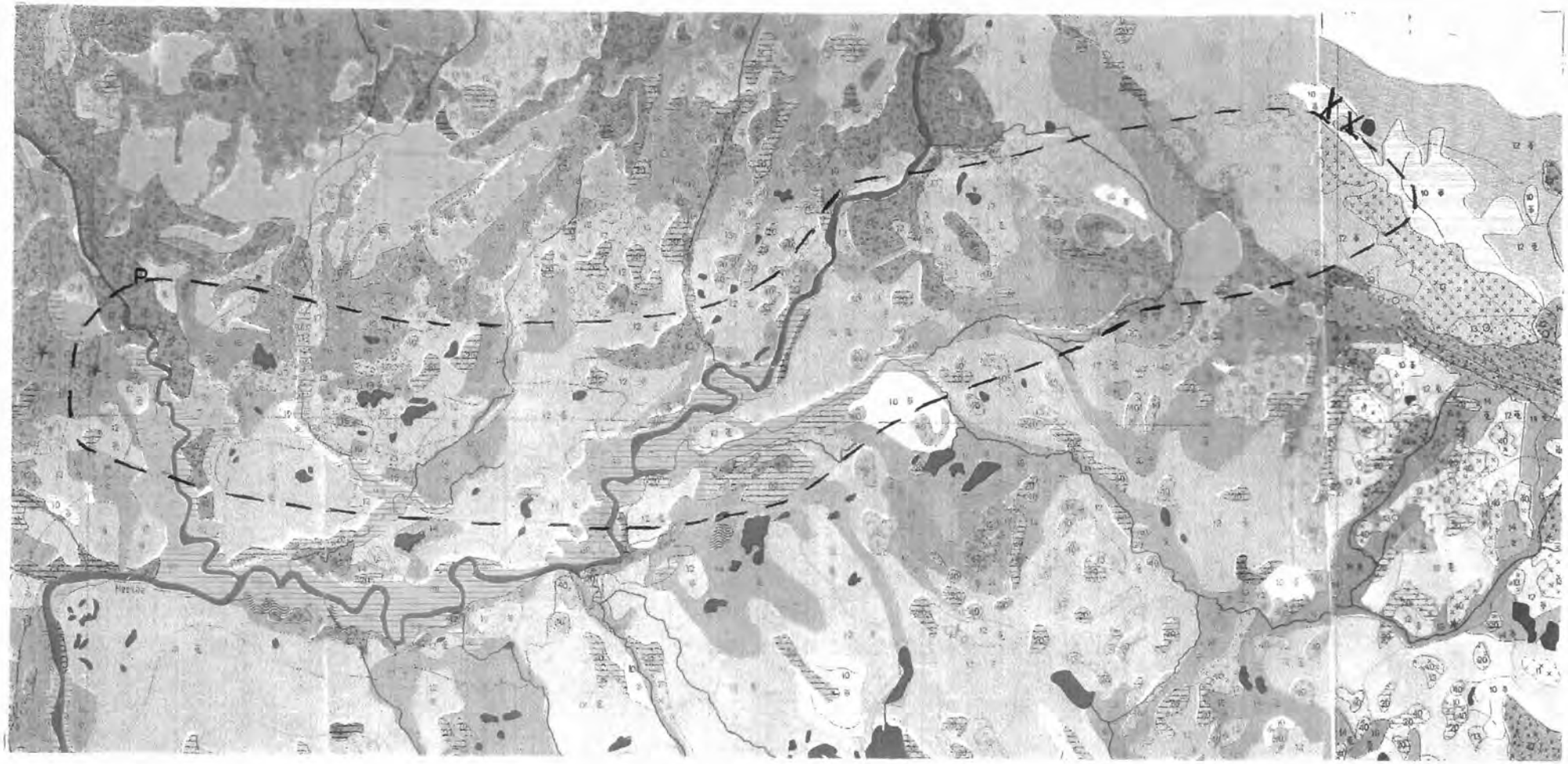


Fig. 4.3.3 Upper Forra. Copy of vegetation map. After Moen et al. (1976). P: Start of excursion. Asterisks: Blanket bog area.

Fig. 4.3.4 View of Upper Forra area, to the N with Hårskallen and Heståsdalen. Photo: P. Moen.

Fig. 4.3.5 View of upper Forra area to the E with Hermannsnasa in the background. Photo: P. Moen.

Table 4.1.3. Upper Forra, Levanger etc. Species list of mire plants. Vascular plants and Sphagna are complete; only some other cryptogams are included.

TYPE	Species name
K	Agrostis canina
K	Agrostis capillaris
K	Agrostis stolonifera
K	Alchemilla sp.
K	Alnus incana
K	Andromeda polifolia
K	Anemone nemorosa
K	Angelica sylvestris
K	Anthoxanthum odoratum
K	Bartsia alpina
K	Betula nana
K	Betula pubescens
K	Calamagrostis purpurea
K	Calamagrostis stricta
K	Calluna vulgaris
K	Caltha palustris
K	Cardamine pratensis
K	Carex adelostoma
K	Carex atrofusca
K	Carex bigelowii
K	Carex brunnescens
K	Carex buxbaumii
K	Carex canescens
K	Carex capillaris
K	Carex chordorrhiza
K	Carex dioica
K	Carex echinata
K	Carex flava
K	Carex hostiana
K	Carex juncella
K	Carex lasiocarpa
K	Carex lepidocarpa
K	Carex limosa
K	Carex livida
K	Carex magellanica
K	Carex microglochin
K	Carex nigra
K	Carex norvegica
K	Carex pallescens
K	Carex panicea
K	Carex pauciflora
K	Carex pulicaris
K	Carex rostrata
K	Carex rotundata
K	Carex tumidicarpa
K	Carex vaginata
K	Carex vesicaria
K	Cerastium cerastoides
K	Cerastium fontanum
K	Chrysosplenium alternifolium
K	Cirsium helenioides
K	Cirsium palustre
K	Coeloglossum viride
K	Corallorhiza trifida
K	Cornus suecica
K	Crepis paludosa
K	Cystopteris montana
K	Dactylorhiza cruenta
K	Dactylorhiza fuchsii
K	Dactylorhiza incarnata
K	Dactylorhiza maculata
K	Dactylorhiza pseudocordigera
K	Deschampsia cespitosa
K	Deschamspia flexuosa
K	Drosera anglica
K	Drosera rotundifolia
K	Eleocharis quinqueflora
K	Empetrum hermaphroditum
K	Epilobium angustifolium
K	Epilobium davuricum
K	Epilobium hornemannii
K	Epilobium lactiflorum
K	Epilobium palustre
K	Equisetum arvense
K	Equisetum fluviatile
K	Equisetum palustre
K	Equisetum sylvaticum
K	Equisetum variegatum
K	Eriophorum angustifolium
K	Eriophorum latifolium
K	Eriophorum vaginatum
K	Euphrasia frigida
K	Festuca rubra
K	Festuca vivipara
K	Filipendula ulmaria
K	Galium boreale
K	Galium palustre
K	Galium uliginosum
K	Geranium sylvaticum
K	Geum rivale
K	Gymnadenia conopsea
K	Gymnocarpium dryopteris
K	Hammarbya paludosa
K	Hierochloe odorata
K	Huperzia selago
K	Juncus alpinoarticulatus
K	Juncus articulatus
K	Juncus biglumis
K	Juncus castaneus
K	Juncus conglomeratus
K	Juncus filiformis
K	Juncus stygius
K	Juncus triglumis
K	Juniperus communis
K	Kobresia simpliciuscula
K	Leontodon autumnalis
K	Listera cordata
K	Listera ovata
K	Loiseleuria procumbens
K	Luzula multiflora
K	Luzula sudetica
K	Maianthemum bifolium
K	Melampyrum pratense
K	Melica nutans
K	Menyanthes trifoliata
K	Molinia caerulea
K	Montia fontana
K	Nardus stricta
K	Narthecium ossifragum
K	Nymphaea sp.
K	Orthilia secunda
K	Oxycoccus microcarpus
K	Oxyria digyna
K	Parnassia palustris
K	Pedicularis oederi
K	Pedicularis palustris
K	Phleum alpinum
K	Picea abies
K	Pinguicula vulgaris
K	Pinus sylvestris
K	Platanthera bifolia
K	Poa alpina
K	Poa pratensis
K	Polygonum viviparum
K	Potamogeton natans
K	Potentilla erecta
K	Potentilla palustris
K	Prunella vulgaris
K	Pyrola minor
K	Pyrola rotundifolia
K	Ranunculus acris
K	Rubus chamaemorus
K	Rumex acetosa
K	Sagina procumbens
K	Salix arbuscula
K	Salix aurita
K	Salix glauca
K	Salix hastata
K	Salix herbacea
K	Salix lanata
K	Salix lapponum
K	Salix myrsinites
K	Salix nigricans
K	Salix phylicifolia
K	Saussurea alpina
K	Saxifraga aizoides
K	Saxifraga stellaris
K	Scheuchzeria palustris
K	Scirpus cespitosus ssp. cesp
K	Scirpus hudsonianus
K	Selaginella selaginoides
K	Solidago virgaurea
K	Sorbus aucuparia
K	Sparganium angustifolium
K	Sparganium hyperboreum
K	Sparganium minimum
K	Stellaria alsine
K	Stellaria nemorum
K	Succisa pratensis
K	Thalictrum alpinum
K	Thelypteris limbosperma
K	Thelypteris phegopteris
K	Tofieldia pusilla
K	Trientalis europaea
K	Triglochin palustris
K	Utricularia intermedia
K	Utricularia ochroleuca
K	Vaccinium myrtillus
K	Vaccinium uliginosum
K	Vaccinium vitis-idaea
K	Valeriana sambucifolia
K	Vicia cracca
K	Viola biflora
K	Viola palustris
L	Icmadophila ericetorum
M	Aneura pinguis
M	Bryum pseudotriquetrum
M	Calliergon sarmentosum
M	Calliergon trifarium
M	Calliergonella cuspidata
M	Campylium stellatum
M	Cinclidium stygium
M	Climacium dendroides
M	Cratoneuron commutatum
M	Cratoneuron decipiens
M	Dicranella palustris
M	Dicranum bonjeanii
M	Drepanocladus badius
M	Drepanocladus exannulatus
M	Drepanocladus fluitans
M	Drepanocladus revolvens
M	Fissidens adianthoides
M	Hypnum jutlandicum
M	Leucobryum glaucum
M	Lophozia bantriensis
M	Lophozia borealis
M	Lophozia rutheana
M	Philonotis fontana
M	Plagiomnium elatum
M	Racomitrium lanuginosum
M	Rhizomnium pseudopunctatum
M	Scorpidium scorpioides
M	Sphagnum angermanicum
M	Sphagnum annulatum
M	Sphagnum annulatum coll.
M	Sphagnum auriculatum
M	Sphagnum balticum
M	Sphagnum capillifolium
M	Sphagnum centrale
M	Sphagnum compactum
M	Sphagnum contortum
M	Sphagnum fallax
M	Sphagnum flexuosum
M	Sphagnum fuscum
M	Sphagnum girgensohnii
M	Sphagnum imbricatum ssp. aff
M	Sphagnum isoviitae
M	Sphagnum jensenii
M	Sphagnum lindbergii
M	Sphagnum magellanicum
M	Sphagnum majus
M	Sphagnum molle
M	Sphagnum papillosum
M	Sphagnum platyphyllum
M	Sphagnum pulchrum
M	Sphagnum recurvum coll.
M	Sphagnum rubellum
M	Sphagnum russowii
M	Sphagnum strictum
M	Sphagnum subfulvum
M	Sphagnum subnitens
M	Sphagnum subsecundum
M	Sphagnum tenellum
M	Sphagnum teres
M	Sphagnum warnstorfii
M	Splachnum ampullaceum
M	Splachnum luteum
M	Splachnum sphaericum
M	Splachnum vasculosum

H= hybrid, K=vascular plant, M=bryophyte, L=lichen

4.3.1 Vegetational and blanket bog history of the Forra mire area

Thyra Solem

Pollen analytical investigations have been carried out on this vast area of mire to learn about the age, origin and development of blanket mires and vegetational changes in connection with ancient iron production. This has resulted in 10 published pollen diagrams from the area (Hafsten & Solem 1976, Solem 1991a, b).

The oldest ^{14}C dating of the transition between the mineral subsoil and the peat in this area is about 8400 years BP, the peat core having been taken from the top of the Salthammar drumlin (Hafsten & Solem 1976). This drumlin is covered with blanket bog and was later studied in detail (Solem 1991a). Eight peat cores were taken at spaces of 5 m vertically in a transect across the drumlin, and the peat depth was measured at 4 m intervals along the transect which was placed about 100 m northwest of the peat core from 1976. The oldest mire formation started on the drumlin plateau and spread slowly down the slopes. Near the base of the northeastern slope, mire formation started about 7500 years ago where birch trees disappeared because of waterlogging, and the mire subsequently advanced up the sloping ground. The youngest ^{14}C dating of basal peat is about 2400 years BP, on the southwestern slope (Fig. 1).

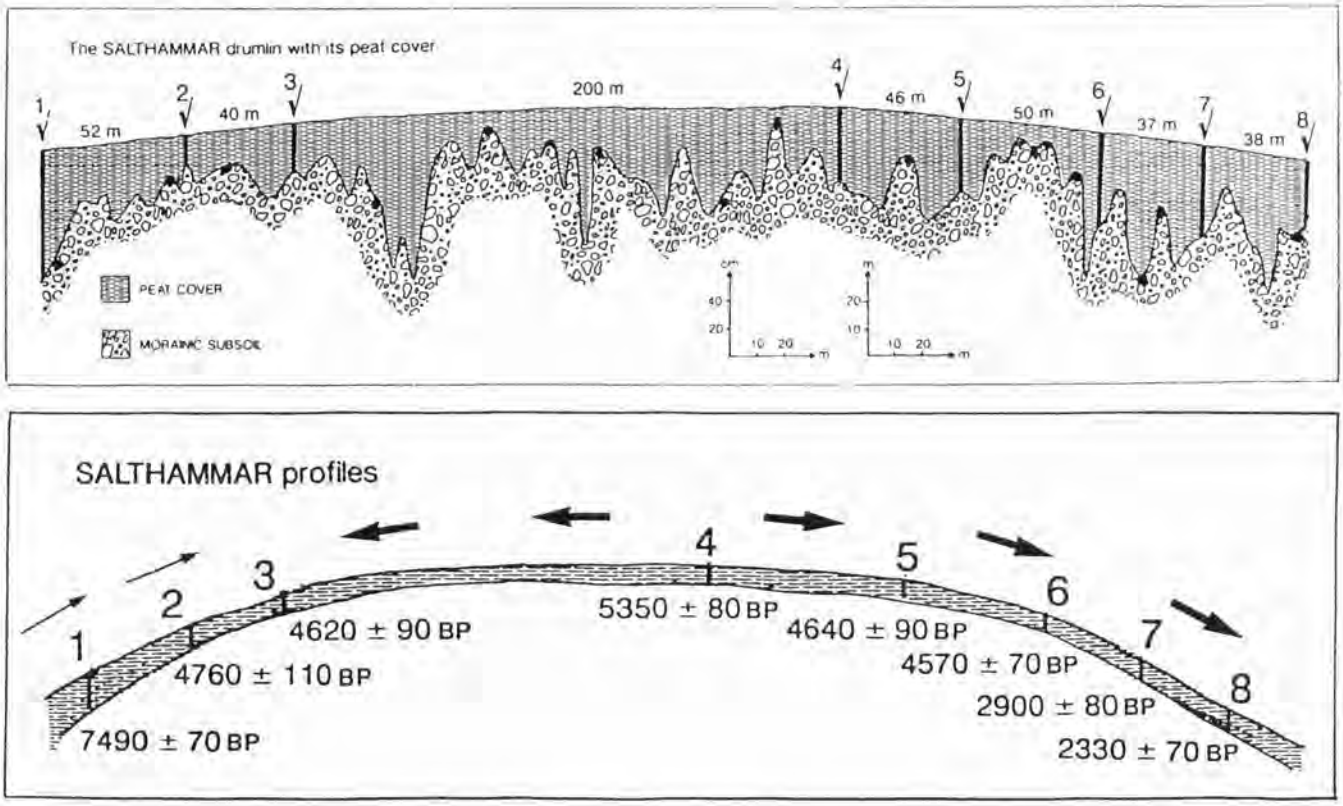


Fig. 4.3.6 Above: Surface contours (right-hand scale) of the Salthammar drumlin showing the locations of the eight profiles in the transect. The vertical scale of the peat is exaggerated on the left-hand scale. Detected rocks are marked with black dots. Below: Cross section of the Salthammar drumlin showing the dates for initiation of peat formation and the temporal spread of the blanket peat cover. Thick arrows: downslope spread of the peat blanket. Thin arrows: upslope spread of mire. Modified after Solem (1991a).

The model for the formation of blanket bog on the drumlin, shown in Fig. 1, is similar to that on other drumlins closer to the coast, but the mineral subsoil of the Salthammar drumlin has a very uneven surface and demonstrates the fact that numerous depressions had to be filled with mire before a continuous peat cover was achieved.

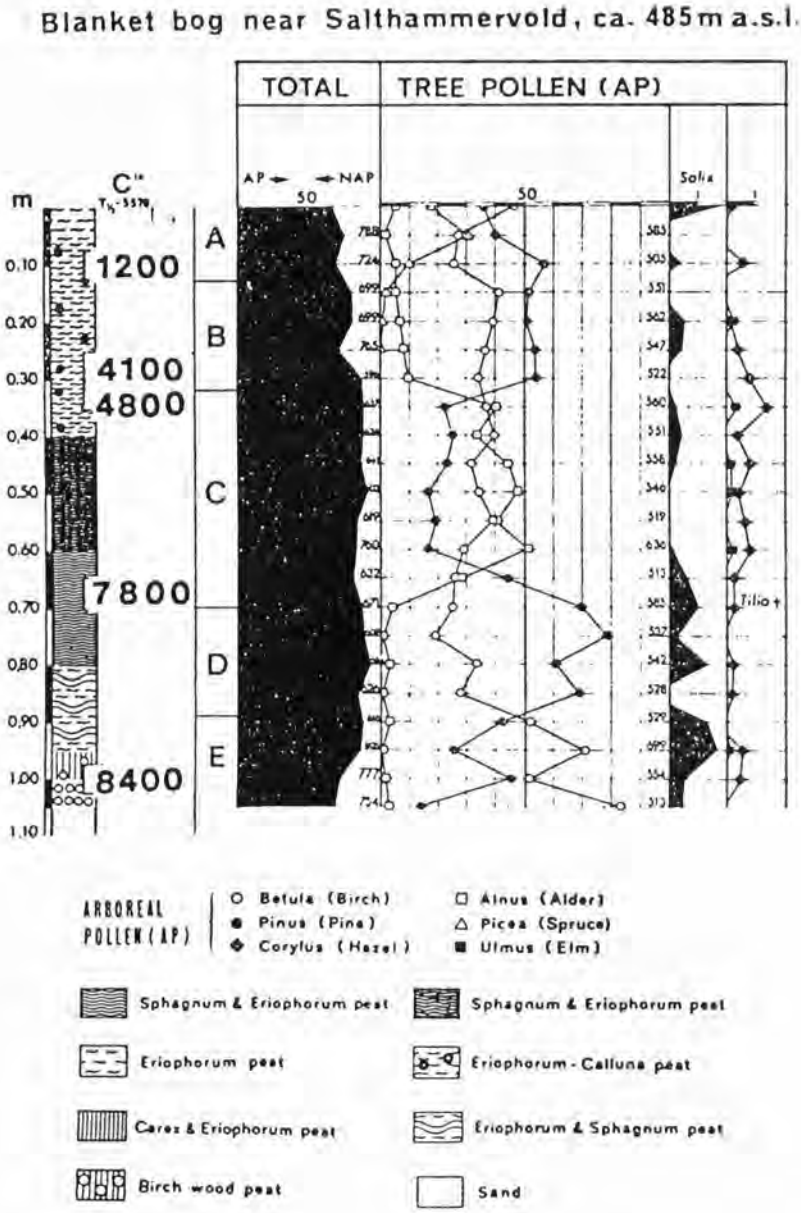


Fig. 4.3.7 Tree pollen diagram from the Forra mire area. The ages are approximate and in ^{14}C years BP. Modified after Hafsten & Solem (1976).

The landscape 8400 years ago was characterised by an open vegetation where birch (*Betula*) was the dominant tree species. A few pine trees (*Pinus*) were also present and alder (*Alnus*) was probably not far away. The birch forest gradually became mixed with an increasing number of pines that would occupy the drier sites in the terrain and eventually become the dominating forest species in a climate that was relatively warm and dry. About 7800 years ago, alder had a rapid expansion at the onset of damper and milder conditions. Alder pollen dominated the pollen rain for almost 3000 years and in this pollen diagram from the Forra area it started to decline about 4800 years ago. The alder decline varies in age within the area, as it does in Trøndelag in general. However, the start of the alder dominance of the vegetation is quite uniform. In the pollen diagrams from the Forra area there are also very small pollen curves for elm (*Ulmus*) and hazel (*Corylus*). These warmth-demanding species have probably never actually grown in this area, but reflect the vegetation at sites closer to Trondheimsfjord where pollen curves for these species are stronger, though still quite small. The present-day hazel/elm vegetation is considered to be a relict one and occurs only in localities where the local climate and soil conditions are favourable. Since their occurrence in pollen diagrams always coincides with the alder dominance, the Alnus pollen curve is a valuable marker for the postglacial warmth period this far north.

In the pollen diagram from Forra, a ^{14}C dating from 30-35 cm below the surface gave an age of 4800 years BP and another from 25-30 cm below the surface gave an age of 4100 years BP. This demonstrates the very slow peat growth in the Subboreal chronozone. This is also quite characteristic for pollen diagrams from elsewhere in Trøndelag. The last major event in the general vegetational history is the immigration of spruce (*Picea*) from the east. In this Forra diagram, spruce expanded about 1200 years ago. The general expansion varies somewhat in age within the area, but is very rapid; this may be because there was extensive iron production based on "bog iron ore" in the Forra area. The iron production lasted from about 2000 to 1100 BP and involved two different smelting techniques, but furnaces from the Roman Age (about 2000 to 1600 BP) are most numerous. The fuel for the furnaces was wood, mostly pine, but also some birch. The production sites were scattered over most of the area, and since spruce reached the area during the iron production period, the constant removal of pine and birch over centuries left open niches for the establishment and spread of this species.

In several cases, the iron production sites are situated at the same localities as old summer farms. The start of summer farming has not been ^{14}C dated, but may have occurred while iron pruduction was still taking place. Summer farming continued for several centuries after iron production ended.

The earliest human activity in the Forra area has been ^{14}C dated to about 4000 years BP and was of a temporary nature, probably hunting. These people did not affect the vegetation to any extent. The iron production that started about 2000 years ago and lasted for almost 1000 years affected the pine and birch vegetation to a degree that may have eased the establishment of spruce. The summer farming that may have started during the iron production period then continued to keep the tree vegetation in the vicinity of the farms at bay.

4.4 Locality 4. Sølendet, Røros, Sør-Trøndelag

Map sheet M711: 1720 II UTM: PQ 44-45,52-54 Elevation: 700-800 m a.s.l.
Mire area: 1.4 km^2 Figures: 4.4.1-2 Tables: 4.0.1 - 4 and 4.4.1
References: Moen (1983, 1990), Arnesen, Moen & Øien (1993)
Status: Sølendet Nature Reserve was established in 1974 and extended in 1990; the reserve now covers 306 ha.
Vegetational regions: Sølendet lies at the transition between the middle and northern boreal regions in the indifferent (oceanic/continental) section (OC), close to the slightly oceanic section.
The birdlife is dealt with in section 5.

Location, geology, climate and land use
The predominant bedrock is grey-green phyllite. Most of the nature reserve is covered by ground moraine composed of base-rich phyllite with a high proportion of clay particles, yielding a nutrient-rich soil which readily becomes waterlogged. Fine-grained, nutrient-poor sand predominates on the flatter parts (below 706 m). There are more than 50 marked springs inside the nature reserve borders, most of them occurring as spring lines at an altitude of 770-780 m a.s.l. There are also numerous, more diffuse seepages of groundwater. These springs and seepages carry calcareous, mineral-rich water (pH: 7.8, specific conductivity value: 180 ¡uS/cm) to the fen surface throughout the year.

Figure 4.4.4 shows the terrain and the various hydrological structures; the hydrology explains the extensive occurrence of extremely rich fens on the gently sloping morainic areas. After permeating through the peat, the seepage water collects on the lower-lying, flat, sandy parts of Sølendet, to drain away along small valleys. These are all flooded by calcareous water in spring. During most of the year, however, the water table in these valleys lies below the surface. The types of vegetation on the fens and grasslands of these valleys are of particular interest (see later).

The annual mean temperature at Sølendet is about +0.6 °C, and the January and July means are -9.0 °C and +11.7 °C, respectively (references in Moen 1990). The mean annual precipitation is about 600 mm, more than half of which falls during June-September.

The snow cover in most years lasts from late October to late May, usually 210-220 days; the snow depth in winter is ca. 1 m. In years when temperatures are particularly low and there is little or no snow cover, frost may penetrate the soil and peat to a considerable depth and it lasts until summer.

The traditional haymaking at Sølendet ceased about 1950, after a gradual decrease in intensity over the preceding decades. Most of the hay swards were formerly cut every second year; the full history of haymaking is not known, but haymaking was certainly practised at Sølendet for hundreds of years. The main tools used to be scythes, hay rakes and horse-drawn, summer hay sledges. The work involved scything, drying the herbage and transporting the hay to the hay barns or haystacks. Calculations based on data for the final decades of haymaking indicate that haymaking in the nature reserve in summertime involved about 1000 man-days annually. The hay was transported down to the farms during the winter.

A vegetational succession commenced as soon as haymaking ceased, the most obvious change being the formation of scrub and a heavy litter layer in the tall-growing fen and swamp communities. Restoration of the former haymaking lands at Sølendet started in 1976. Large-scale clearance (by axe) was mostly completed by 1983, by which time ca. 560 da of scrub-covered land had been cleared. Altogether 1600 da of former haymaking lands have been restored and most of these areas have been mown (with a scythe or a motor mower) three to seven times during the years 1976-1993.

The main aims of the management plan for the nature reserve are to reconstitute and preserve the former type of cultural landscape, to maintain a wide variety of vegetation types and to further the well-being of rare species. Some areas of the reserve are managed intensively, some are more extensively managed and some are left untouched.

Mire types

Sloping fens cover about 85 % of the mire area, flat fens 10%, the rest is small units of islet mixed mires and plane bogs (domimated by hummock vegetation). A large number of springs occur.

Flora

The vascular flora of Sølendet includes 294 taxa, 25 of which are hybrids. The bryophyte flora includes 256 species (cf. Moen 1990; the mire species are listed in Table 4.4.1).

Carex hostiana is the most typical of the western species, *C. appropinquata* has a southeastern distribution in Fennoscandia; both are "lowland species" that occur at Sølendet at or close to their upper distributional limits in Fennoscandia. A large number of species with an alpine and upper boreal distribution in Fennoscandia occur, e.g. *Carex atrofusca, Kobresia simpliciuscula, Juncus castaneus* and *Pedicularis oederi*. 25 taxa of orchids (including 12 hybrids) are found at Sølendet, a number of them being very numerous, e.g. *Dactylorhiza cruenta, D. fuchsii, D. pseudocordigera, Gymnadenia conopsea* and *Listera ovata*.

Vegetation

Mires cover 45% of the nature reserve. The bog, poor fen and intermediate fen vegetation together cover only 1%, the remainder represents rich and extremely rich fen vegetation. Moen (1990) published a large number of phytososiological analyses, the samples being amalgamated into 8 groups (including 1 covering spring vegetation) (comparison with Fennoscandian literature is in Table 8.3.1 in Moen 1990):

1. Rich fen, *Scorpidium* communities (*Stygio-Caricion limosae*)
2. Rich fen expanse, *Campylium* communities (*Caricion atrofuscae*)
3. Rich fen margin, *Campylium* communities (*Caricion atrofuscae*)
4. Rich fen, *Sphagnum warnstorfii* communities (*Sphagno-Tomenthypnion*)
5. Rich fen, *Drepanocladus-Meesia* communities (*Caricion lasiocarpae*)
6. Rich fen, *Salix* communities (*Sphagno-Tomenthypnion*)
7. Bog hummock, *Sphagnum fuscum* communities (*Oxycocco empetrion*)
8. Rich spring, *Cratoneuron* communities (*Cratoneurion commutati*)

The mean pH values of the peat in the stands of the fen clusters varied between 5.9 and 6.7, the pH in the water between (6.1) 6.7 and 7.3, and the specific conductivity between 74 and 162 ¡uS/cm. The minor variation in the pH values in fen communities is explained by the nature

of the vegetation, only rich fen communities being investigated. The surface inclination of the mire stands varied between 0^g and 6^g. The *Scorpidium, Drepanocladus-Meesia* and *Sphagnum fuscum* communities occur on flat mires and the *Campylium* communities on sloping fens. The highest inclination values were recorded for the fen margin communities.

The peat depth of stands on flat areas mostly exceeded 0.6 m; sloping fens usually had a peat depth of 0.2-0.4 m, mire margin types having even lower values. The water table during dry periods varied very much, from the rather high levels of the *Scorpidium* and *Drepanocladus-Meesia* communities, to the low levels of the *Campylium* communities. As is generally found (e.g Havas 1961, Persson 1962), the greater the surface slope of the fen, the deeper the water table in dry periods and the thinner the peat layer.

Route

We will follow the longer nature trail, making 13 stops for brief information, cf. Appendix C (copy from Arnesen & Moen 1994). In addition, we will make a digression to the west from stop no. 5. Altogether, the walk will be about 5 km. In addition to the topics described in the Nature Trail Guide, we will highlight:

* intensive studies of permanent plots (above and below-ground biomass, diversity studies, orchid flowering, etc.) at localities 2 (or 3), demonstrated by Dag Inge Øien and Evelyn Thor
* studies by Liv Nilsen on the effect of cattle ("storfe") grazing on an area on the margin of the reserve in the S; grazed beyond a fence, not grazed beyond the nature reserve
* studies by Trond Arnesen on the trampling effect and burning of brash
* demonstration of a two-wheeled motor mower, scythe and other equipment used in managing the reserve, by the supervisor, Tom Johansen.

Conservational problems for discussion

1. The influence of trampling and the effect of the nature trails.
2 The management plan, mowing with a motor mower, compared to a scythe.

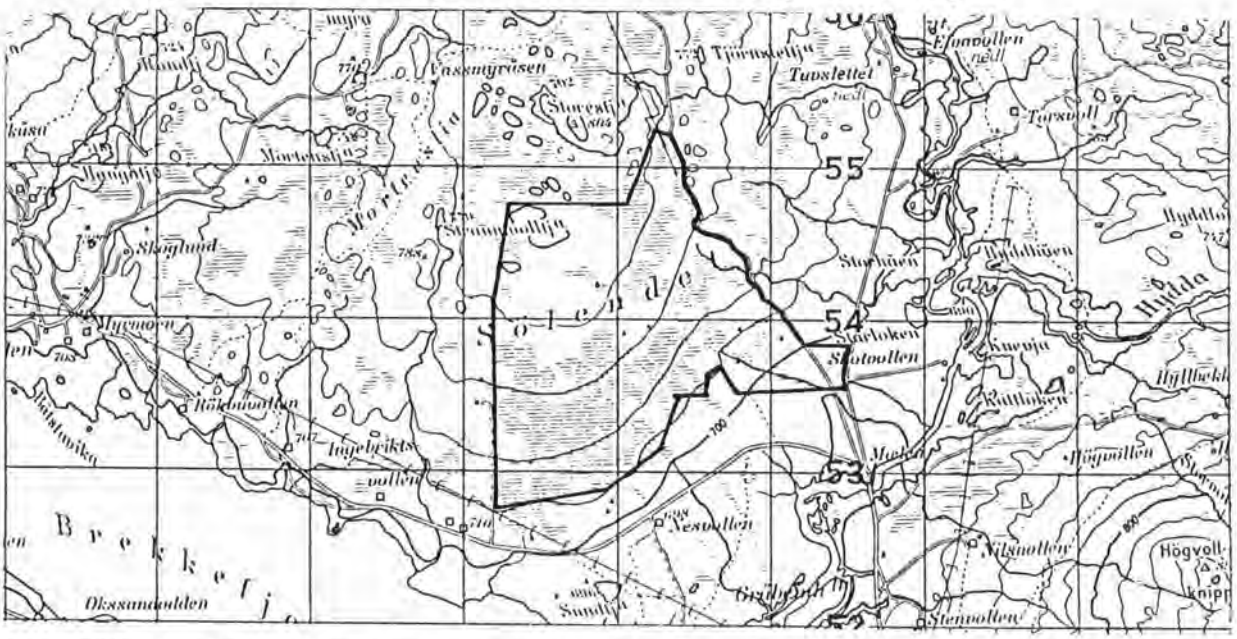


Fig. 4.4.1 Locality 4. Sølendet nature reserve, Røros, Sør-Trøndelag. The boundary of the nature reserve outlined. Map basis: Sheet 1720 II, Series M 711, Grid zone 32 V, 100 km square: PQ. Printed with permission from the Norwegian Mapping Authority.

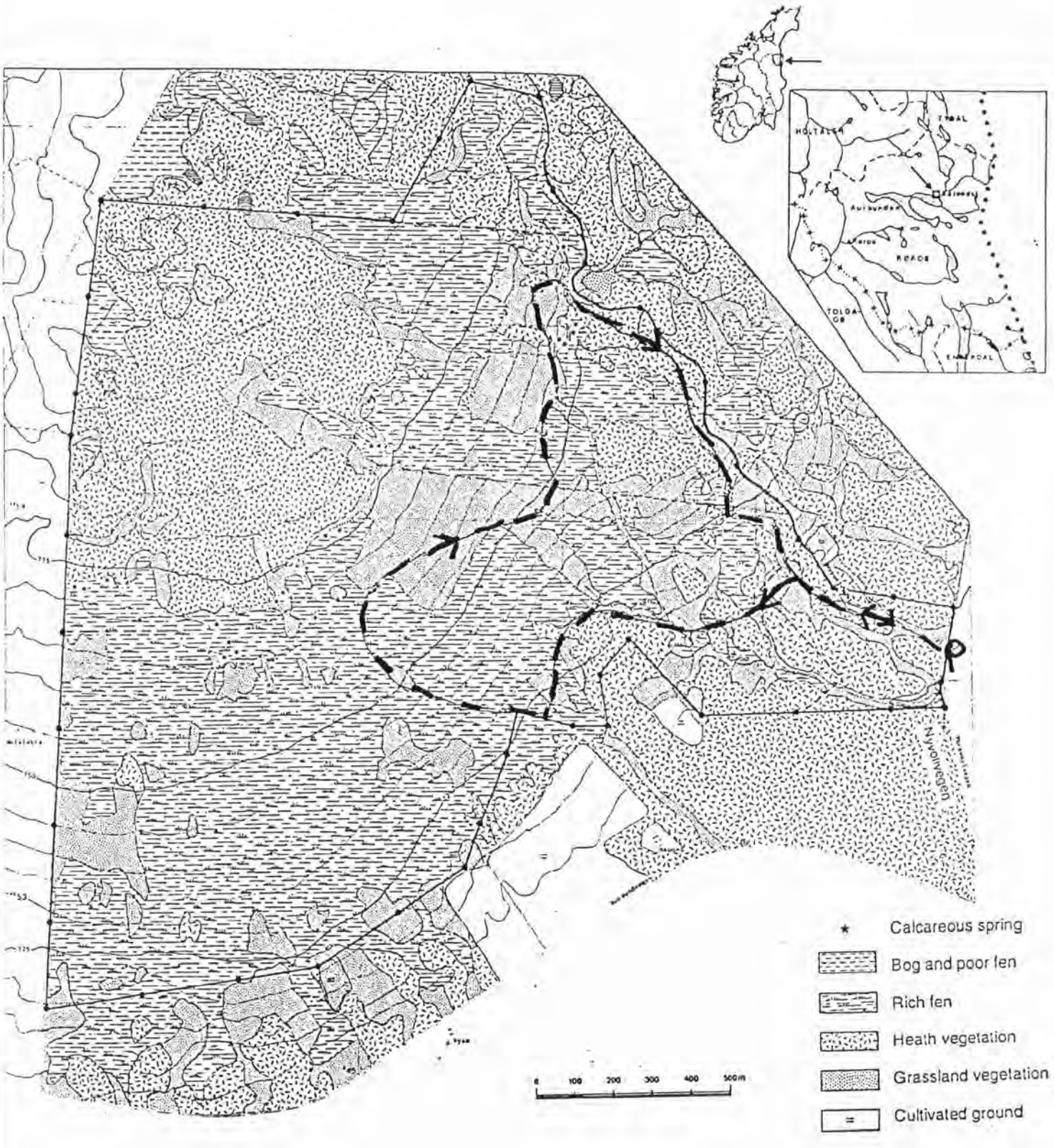


Fig. 4.4.2 Sølendet. P: Start of excursion.

Table 4.1.4: Sølendet, Røros. Species list of mire plants. Vascular plants and Sphagna are complete; only some other cryptogams are included.

TYPE	Species name
H	Carex flava x hostiana
K	Agrostis canina
K	Agrostis capillaris
K	Alchemilla sp.
K	Alnus incana
K	Alopecurus aequalis
K	Andromeda polifolia
K	Angelica archangelica
K	Angelica sylvestris
K	Anthoxanthum odoratum
K	Arctostaphylos alpinus
K	Bartsia alpina
K	Betula nana
K	Betula pubescens
K	Calamagrostis purpurea
K	Calamagrostis stricta
K	Calluna vulgaris
K	Caltha palustris
K	Cardamine pratensis
K	Carex appropinquata
K	Carex atrata
K	Carex atrofusca
K	Carex bigelowii
K	Carex brunnescens
K	Carex buxbaumii
K	Carex canescens
K	Carex capillaris
K	Carex capitata
K	Carex chordorrhiza
K	Carex dioica
K	Carex echinata
K	Carex flava
K	Carex heleonastes
K	Carex hostiana
K	Carex juncella
K	Carex lasiocarpa
K	Carex limosa
K	Carex livida
K	Carex magellanica
K	Carex microglochin
K	Carex nigra
K	Carex norvegica
K	Carex pallescens
K	Carex panicea
K	Carex pauciflora
K	Carex rostrata
K	Carex saxatilis
K	Carex stenolepis
K	Carex vaginata
K	Carex vesicaria
K	Cerastium fontanum
K	Cirsium helenioides
K	Cirsium palustre
K	Coeloglossum viride
K	Corallorhiza trifida
K	Cornus suecica
K	Crepis paludosa
K	Dactylorhiza cruenta
K	Dactylorhiza fuchsii
K	Dactylorhiza incarnata
K	Dactylorhiza maculata
K	Dactylorhiza pseudocordigera
K	Deschampsia cespitosa
K	Deschamspia flexuosa
K	Drosera anglica
K	Eleocharis quinqueflora
K	Empetrum hermaphroditum
K	Epilobium alsinifolium
K	Epilobium angustifolium
K	Epilobium davuricum
K	Epilobium hornemannii
K	Epilobium lactiflorum
K	Epilobium palustre
K	Equisetum arvense
K	Equisetum fluviatile
K	Equisetum hyemale
K	Equisetum palustre
K	Equisetum pratense
K	Equisetum scirpoides
K	Equisetum sylvaticum
K	Equisetum variegatum
K	Eriophorum angustifolium
K	Eriophorum latifolium
K	Eriophorum vaginatum
K	Euphrasia frigida
K	Festuca rubra
K	Filipendula ulmaria
K	Galium boreale
K	Galium palustre
K	Galium trifidum
K	Geranium sylvaticum
K	Geum rivale
K	Gymnadenia conopsea
K	Gymnocarpium dryopteris
K	Hierochloe odorata
K	Huperzia selago
K	Juncus alpinoarticulatus
K	Juncus castaneus
K	Juncus filiformis
K	Juncus triglumis
K	Juniperus communis
K	Kobresia simpliciuscula
K	Leontodon autumnalis
K	Listera cordata
K	Listera ovata
K	Luzula multiflora
K	Luzula sudetica
K	Lycopodium annotinum
K	Maianthemum bifolium
K	Melampyrum pratense
K	Melica nutans
K	Menyanthes trifoliata
K	Molinia caerulea
K	Nardus stricta
K	Nigritella nigra
K	Oxycoccus microcarpus
K	Parnassia palustris
K	Pedicularis oederi
K	Pedicularis palustris
K	Pedicularis sceptrum-carolinum
K	Petasites frigidus
K	Phleum alpinum
K	Picea abies
K	Pinguicula vulgaris
K	Pinus sylvestris
K	Poa alpina
K	Poa pratensis
K	Polygonum viviparum
K	Potamogeton filiformis
K	Potentilla erecta
K	Potentilla palustris
K	Prunus padus
K	Pyrola minor
K	Pyrola rotundifolia
K	Ranunculus acris
K	Rubus chamaemorus
K	Rumex acetosa
K	Salix arbuscula
K	Salix caprea
K	Salix glauca
K	Salix hastata
K	Salix lanata
K	Salix lapponum
K	Salix myrsinites
K	Salix nigricans
K	Salix pentandra
K	Salix phylicifolia
K	Salix starkeana
K	Saussurea alpina
K	Saxifraga aizoides
K	Scirpus cespitosus ssp. cespitosus
K	Scirpus hudsonianus
K	Selaginella selaginoides
K	Solidago virgaurea
K	Sorbus aucuparia
K	Sparganium angustifolium
K	Sparganium minimum
K	Stellaria calycantha
K	Succisa pratensis
K	Thalictrum alpinum
K	Tofieldia pusilla
K	Trientalis europaea
K	Triglochin palustris
K	Trollius europaeus
K	Tussilago farfara
K	Utricularia minor
K	Utricularia ochroleuca
K	Vaccinium myrtillus
K	Vaccinium uliginosum
K	Vaccinium vitis-idaea
K	Valeriana sambucifolia
K	Veronica alpina
K	Veronica scutellata
K	Viola biflora
K	Viola epipsila
K	Viola palustris
L	Cladina stellaris
L	Icmadophila ericetorum
M	Aneura pinguis
M	Bryum pseudotriquetrum
M	Bryum weigelii
M	Calliergon giganteum
M	Calliergon richardsonii
M	Calliergon sarmentosum
M	Calliergon trifarium
M	Calliergonella cuspidata
M	Campylium stellatum
M	Catoscopium nigritum
M	Cinclidium stygium
M	Climacium dendroides
M	Cratoneuron commutatum
M	Cratoneuron decipiens
M	Cratoneuron filicinum
M	Dicranella palustris
M	Dicranum bonjeanii
M	Drepanocladus badius
M	Drepanocladus exannulatus
M	Drepanocladus fluitans
M	Drepanocladus revolvens
M	Drepanocladus tundrae
M	Drepanocladus uncinatus
M	Fissidens adianthoides
M	Fissidens osmundoides
M	Homalothecium nitens
M	Jungermannia exsertifolia
M	Lophozia bantriensis
M	Lophozia borealis
M	Lophozia rutheana
M	Meesia triquetra
M	Meesia uliginosa
M	Moerckia hibernica
M	Oncophorus virens
M	Paludella squarrosa
M	Philonotis calcarea
M	Philonotis fontana
M	Plagiomnium elatum
M	Plagiomnium ellipticum
M	Pohlia wahlenbergii
M	Pseudobryum cinclidioides
M	Rhizomnium pseudopunctatum
M	Rhodobryum roseum
M	Scapania undulata
M	Scorpidium scorpioides
M	Sphagnum angustifolium
M	Sphagnum annulatum coll.
M	Sphagnum balticum
M	Sphagnum capillifolium
M	Sphagnum centrale
M	Sphagnum contortum
M	Sphagnum fuscum
M	Sphagnum girgensohnii
M	Sphagnum lindbergii
M	Sphagnum magellanicum
M	Sphagnum platyphyllum
M	Sphagnum recurvum coll.
M	Sphagnum riparium
M	Sphagnum russowii
M	Sphagnum subnitens
M	Sphagnum teres
M	Sphagnum warnstorfii
M	Splachnum luteum
M	Splachnum sphaericum
M	Splachnum vasculosum

H= hybrid, K=vascular plant, M=bryophyte, L=lichen

4.5 Locality 5. Tufsingdeltaet, Os, Hedmark

Map sheet M711: 1719 II UTM: PQ 45,02 Elevation: 660-670 m a.s.l. Area: 6 km^2 (land area) Figures: 4.5.1-3 Tables: 4.0.1-4 and 4.5.1. References: Volden (1977), Moen (1983)
Status: Nature reserve
Vegetational region: The mire is situated in the slightly continental section of the middle boreal zone.

Location, geology, climate and land use
Tufsingdeltaet is situated on both sides of the River Tufsinga close to Lake Femund, Norway's third largest lake. This part of the county is generally characterised by a mixture of mire and nutrient-poor pine forest.

The bedrock consists of arkose and feldspathic quartzite. The mire is on fluvial fine sand and silt.

The climate is continental. Temperature data are from the meteorological observation station at Drevsjø and precipitation from Tufsingdal. The mean normal temperatures are: annual 0.2 °C, January -11.5 °C and July 11.9 °C. The annual normal precipitation is 568 mm.

Parts of the wetland area used to be cut by the farmers for cattle fodder; this applies especially to the tall sedge vegetation, e.g. on the delta proper. There has been some grazing in the northern parts of the reserve. None of these activities are considered as being harmful to the reserve.

Mire types
The mire complex consists of several mire units. Of these can be mentioned (in order of importance): flat fen, flark fen, string mixed mire and eccentric plane bog. The strings are of hummock or lawn character, whereas the flarks can be either pools, mud bottoms or carpets. Hollows on the plane bog consist of lawns or carpets.

Flora
Of phytogeographical interest are species with an eastern distribution like *Carex globularis, C. laxa, Rubus arcticus* and *Sphagnum aongstroemii*. Species with an alpine distribution, such as *Arctostaphylos alpinus* and *Carex bigelowii,* are also present.

Vegetation
Fen vegetation prevails at this locality, although bog vegetation is present. Poor and intermediate carpet and mud bottom vegetation are perhaps the types that make up the largest part. This applies both to the flat fens and the flark fens as well as string mixed mire units, the last two intergrade to a large extent. Typical species are *Carex rostrata, C. limosa, Eriophorum angustifolium, Menyanthes trifoliata, Drosera anglica, Sphagnum compactum, S. majus, S. lindbergii* and *Gymnocolea inflata. Carex livida, C. chordorrhiza* and *Scorpidium scorpioides* also occur frequently. The vegetation of the flark fens shifts towards the intermediate in the larger flarks on the lower part. Among the typical species of the lawns are *Scirpus cespitosus, Carex pauciflora, Eriophorum angustifolium, E. vaginatum, Sphagnum angustifolium, S. magellanicum* and *S. balticum*. Rich fen vegetation is present in minor patches.

Hummock vegetation of both open and wooded types is found. It is often of the ordinary *Sphagnum fuscum* and *Pleurozium* types. An unusual type of hummock vegetation is found on shallow peat in some places near the margin. In addition to ericaceous species, lichen species are prominent, e.g. *Alectoria ochroleuca, Cetraria nivalis, C. islandica* and *Cladonia stellaris* (the latter dominating).

Willow swamp occurs in a few places, and swamp forest is not uncommon near the river. Much of the delta area itself consists of tall sedge fen (*Magnocaricetum*) with *Carex rostrata, C. aquatilis, C. lasiocarpa, C. vesicaria, Eriophorum angustifolium* and *Menyanthes trifoliata.*
Phytosociological analyses from the site have been made by Volden (1977).

Both the mire and the delta are important areas for birds (see the section on the avifauna).

Route
We shall enter the area from the W side to look at the flat fen. Here, lichen-dominated hummocks can be seen. A small stream with willow swamp touches on this part. The walk continues towards the river where there is wooded fen and swamp forest. After lunch we shall take a walk to include a fine example of flark fen where we shall study distinct mire features. On our way back to the bus we will be walking over hummocky parts.

Conservational problems for discussion
The Tufsingdelta Nature Reserve was established as part of the wetland conservation plan for Hedmark. Some small boats are used in part of the area and may sometimes disturb the birds.

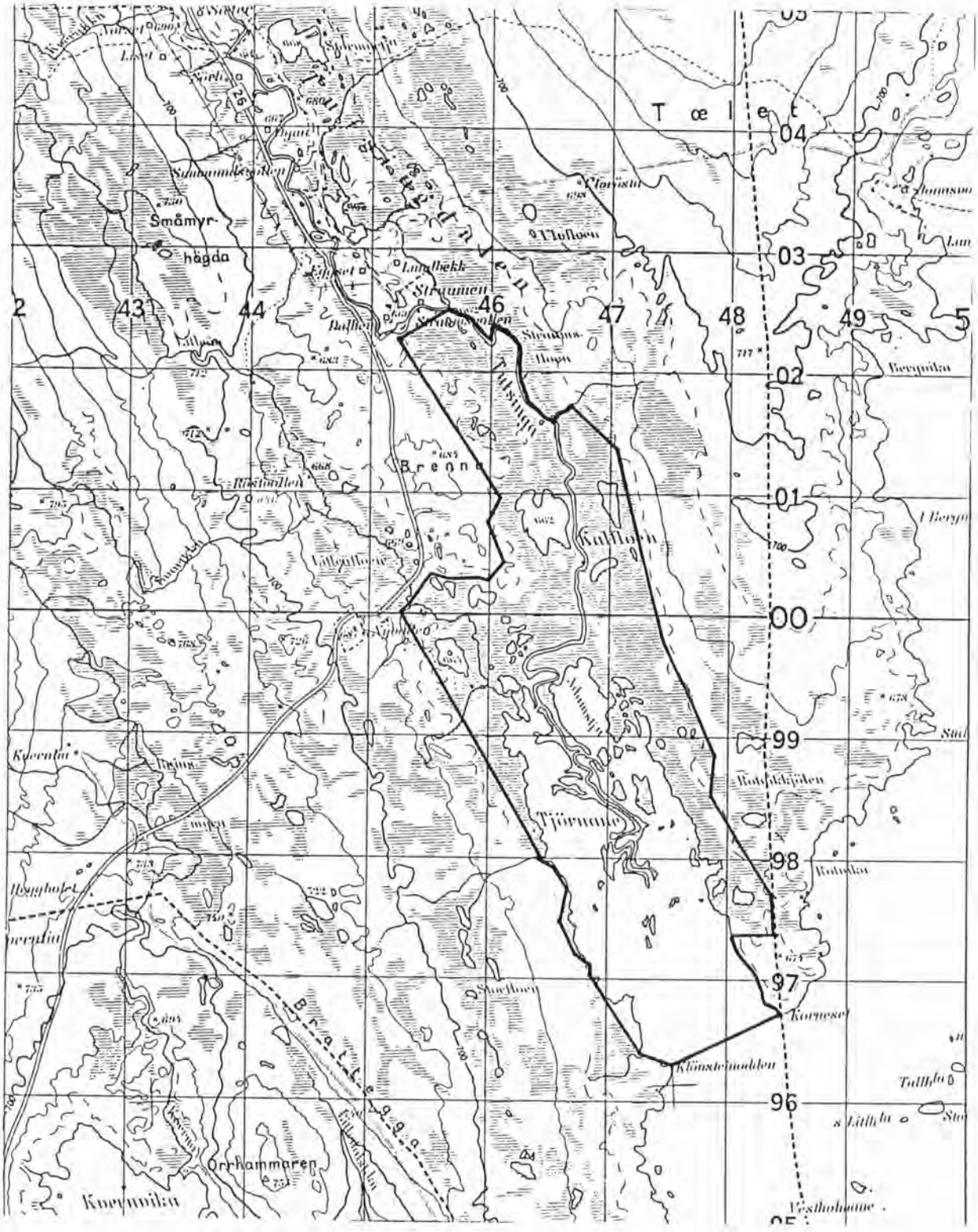


Fig. 4.5.1 Locality 5. Tufsingdeltaet nature reserve, Os, Hedmark. Map basis: sheet 1719 II, Series M 711, Grid zone 32 V, 100 km square: PQ and PP. The boundary of the nature reserve outlined. Printed with permission from the Norwegian Mapping Authority.

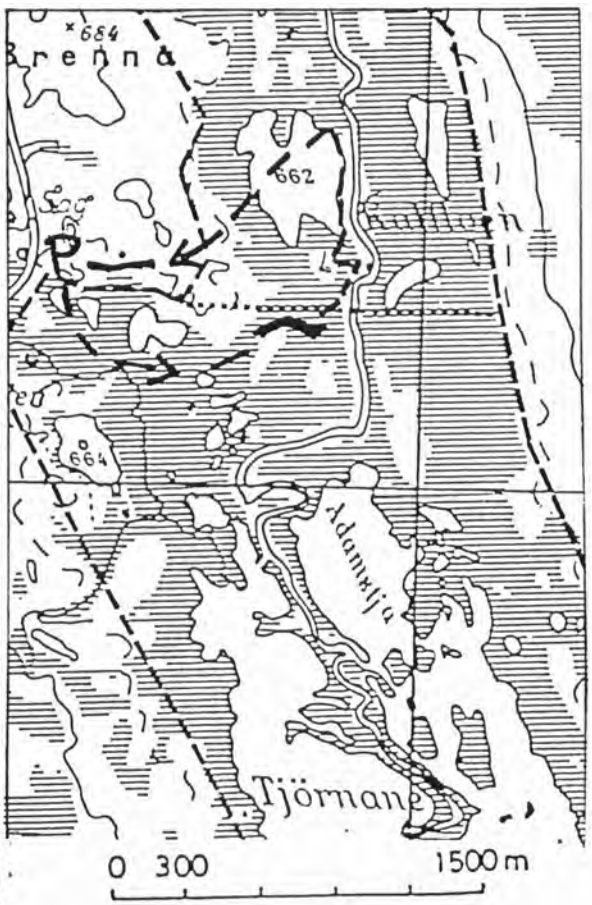


Fig. 4.5.3 Tufsingdeltaet.
P: start of excursion.

Fig. 4.5.2 Tufsingdeltaet. Aerial photo of a larger part of the reserve. The outlet of the river into Femunden can be seen. Please note the large and distinct flark fen unit west of the river in the central part of the photograph. Photo: Norsk Luftfoto 230686, series 8946, M6.

Table 4.1.5. Tufsingdeltaet, Os. Species list of mire plants. Vascular plants and Sphagna are complete; only some other cryptogams are included.

TYPE	Species name
K	Agrostis canina
K	Agrostis capillaris
K	Andromeda polifolia
K	Angelica sylvestris
K	Anthoxanthum odoratum
K	Arctostaphylos alpinus
K	Betula nana
K	Betula pubescens
K	Calamagrostis purpurea
K	Calamagrostis stricta
K	Calluna vulgaris
K	Caltha palustris
K	Cardamine amara
K	Carex bigelowii
K	Carex canescens
K	Carex chordorrhiza
K	Carex dioica
K	Carex echinata
K	Carex flava
K	Carex globularis
K	Carex juncella
K	Carex lasiocarpa
K	Carex laxa
K	Carex limosa
K	Carex livida
K	Carex magellanica
K	Carex nigra
K	Carex panicea
K	Carex pauciflora
K	Carex rostrata
K	Carex vaginata
K	Deschampsia cespitosa
K	Deschamspia flexuosa
K	Drosera anglica
K	Drosera rotundifolia
K	Empetrum hermaphroditum
K	Equisetum fluviatile
K	Equisetum palustre
K	Equisetum sylvaticum
K	Eriophorum angustifolium
K	Eriophorum vaginatum
K	Filipendula ulmaria
K	Galium boreale
K	Galium trifidum
K	Geranium sylvaticum
K	Geum rivale
K	Huperzia selago
K	Juncus alpinoarticulatus
K	Juncus filiformis
K	Juncus stygius
K	Juniperus communis
K	Luzula multiflora
K	Luzula sudetica
K	Melampyrum pratense
K	Menyanthes trifoliata
K	Molinia caerulea
K	Myriophyllum alterniflorum
K	Nardus stricta
K	Oxycoccus microcarpus
K	Pedicularis lapponica
K	Pedicularis palustris
K	Pedicularis sceptrum-carolinum
K	Petasites frigidus
K	Pinguicula villosa
K	Pinguicula vulgaris
K	Pinus sylvestris
K	Polygonum viviparum
K	Potentilla erecta
K	Potentilla palustris
K	Ranunculus acris
K	Rubus arcticus
K	Rubus chamaemorus
K	Salix aurita
K	Salix glauca
K	Salix hastata
K	Salix lapponum
K	Salix nigricans
K	Salix phylicifolia
K	Saussurea alpina
K	Scheuchzeria palustris
K	Scirpus cespitosus ssp. cespitosus
K	Scirpus hudsonianus
K	Selaginella selaginoides
K	Solidago virgaurea
K	Stellaria calycantha
K	Succisa pratensis
K	Tofieldia pusilla
K	Trientalis europaea
K	Utricularia intermedia
K	Vaccinium myrtillus
K	Vaccinium uliginosum
K	Vaccinium vitis-idaea
K	Valeriana sambucifolia
K	Viola biflora
K	Viola palustris
L	Cetraria islandica
L	Cetraria nivalis
L	Cladina stellaris
L	Icmadophila ericetorum
M	Calliergon sarmentosum
M	Campylium stellatum
M	Drepanocladus badius
M	Drepanocladus exannulatus
M	Drepanocladus revolvens
M	Homalothecium nitens
M	Lophozia borealis
M	Scorpidium scorpioides
M	Sphagnum angustifolium
M	Sphagnum aongstroemii
M	Sphagnum balticum
M	Sphagnum capillifolium
M	Sphagnum compactum
M	Sphagnum fuscum
M	Sphagnum girgensohnii
M	Sphagnum lindbergii
M	Sphagnum magellanicum
M	Sphagnum majus
M	Sphagnum papillosum
M	Sphagnum platyphyllum
M	Sphagnum pulchrum
M	Sphagnum recurvum coll.
M	Sphagnum riparium
M	Sphagnum rubellum
M	Sphagnum russowii
M	Sphagnum squarrosum
M	Sphagnum subfulvum
M	Sphagnum subsecundum
M	Sphagnum tenellum
M	Sphagnum teres
M	Sphagnum warnstorfii
M	Splachnum luteum

H= hybrid, K=vascular plant, M=bryophyte, L=lichen

4.6 Locality 6. Stormyra, Tynset, Hedmark

Map sheet M711: 1619 III UTM: NQ 86,02 Elevation: 475 m a.s.l. Area; 2.2 km^2 (total), 1.4 km^2 (mire) Figures: 4.6.1-3 Tables: 4.1-4 and 4.6.1 References: Singsaas (1981, 1989), Moen (1983) Status: Not protected (in preparation)
Vegetational region: Stormyra is situated in the middle boreal zone and the slightly continental section (C1).

Location, geology, climate and land use
Stormyra is situated in the northern part of the Østerdalen valley, along the eastern bank of the River Glomma, the largest river in Norway. The surroundings consist of hillsides covered with pine forest, mixed with farmland at lower elevations.

The bedrock is feldspathic quartzite and grey or green phyllite and mica schist. The mire is situated entirely on fluvial sand and silt.

The climate of the site is continental. Data from the nearest meteorological observation station (Tynset) show an annual normal mean temperature of 0.2 °C, a normal January mean temperature of -13.1 °C, a normal July mean temperature of 12.4 °C and an annual normal precipitation of 400 mm. The snow cover lasts from the end of October to the beginning of May.

The mire vegetation proper is only very slightly influenced by man. An exception is some cutting of forest in connection with a power line affecting the margin. There are almost negligible traces of a few old ditches and minor peat cuttings. Between the mire and the river is a belt of meadow vegetation which used to be cut by neighbouring farms for animal fodder. This area is now losing its open character because of tree growth.

Mire types
Most of the Stormyra mire complex consists of flat fen. The central parts are dominated by carpets/(mud bottom) with scattered islands of tree-covered hummocks. There are two mire tarns on the mire. The mire margins often have transitions into swamp forest. A couple of small streams have their outlet onto the mire.

Flora
Species of phytogeographical interest can be considered as having either an alpine/upper boreal or an eastern distribution. The first group includes *Carex capitata* and *Salix arbuscula*. Eastern species include *Carex globularis, C. laxa, C. tenuiflora* and *Sphagnum wulfianum.*

Vegetation
Intermediate and rich fen carpet vegetation covers a large part of the mire area, which has a constantly high water table during the growing season. This vegetation has an open field layer of such species as *Carex limosa, C. livida, C. panicea, Drosera anglica* and *Menyanthes trifoliata. Scorpidium scorpioides* is the most prominent species in the bottom layer. *Utricularia intermedia* and *Drepanocladus exannulatus* occur in the wettest parts. Patches may be dominated by *Campylium stellatum* and *Drepanocladus revolvens*.

Open willow scrub with *Salix pentandra* and *S. lapponum* can be found in a couple of places where small streams feed the mire with water. These places with moving water have such

species as *Caltha palustris, Potentilla palustris, Calamagrostis stricta* and the mosses *Calliergon giganteum, Plagiomnium ellipticum, Pseudobryum cinclidioides, Rhizomnium pseudopunctatum* and (rarely) *Helodium blandowii.*

More typical lawn vegetation is nearly absent or occurs in small patches.

Characteristic low hummock transitional to lawn with rich fen vegetation can be found here and there on the mire margins. This type is dominated by woody species such as *Betula nana, Calluna vulgaris, Oxycoccus microcarpus, Empetrum hermaphroditum, Andromeda polifolia* and *Vaccinium uliginosum.* Species restricted to this type include *Salix mysinites* and *Equisetum variegatum. Sphagnum warnstorfii* is often the dominant moss species. Other important species are *Tomentypnum nitens* and *Sphagnum angustifolium.* The hummock vegetation at these localities is mostly tree-covered, mainly by *Pinus sylvestris.*

A hummock vegetation consisting of less demanding species is most frequently found. In the central parts of the mire, the hummocks are inhabited by intermediate fen species in their lower parts, forming an abrupt transition to the rich fen carpets. The higher parts have poor fen vegetation. In addition to the indifferent woody species which are typical for hummock vegetation, *Drosera rotundifolia, Tofieldia pusilla, Sphagnum subfulvum* and *S. warnstorfii* are typical in the lower parts. In the higher parts of the hummocks these mosses are replaced by *Sphagnum angustifolium, Hylocomium splendens* and *Pleurozium schreberi.* On the mire margin, *Carex globularis* occurs together with *Sphagnum russowii* and *S. girgensohnii.*

Some parts may be classified as ombrotrophic (plane, transitional bog), even though indicators of minerotrophy such as *Equisetum palustre* have only scattered occurrences, perhaps able to reach mineral water with their roots. Otherwise, this vegetation is dominated by ericaceous species together with Pleurozium schreberi, Sphagnum fuscum and Cladonia lichens.

The mire tarns are very poor in species, due to the humic water. *Potamogeton natans, Sparganium* sp., *Utricularia vulgaris* and *Phragmites australis* have been noted here. Phytosociological analyses were published by Singsaas (1989).

Route

The route will start by following the margin to see some of the species of strongly eastern distribution. We will see the most common mire features (and sub-features) with carpets and tree-covered hummocks at this locality. After crossing the northern part we shall have lunch on the meadow close to the river. Crossing the mire again we shall have a look at both rich hummock vegetation and the area of possible plane bog character to get an impression of the ecology of these parts. Hopefully, birds can be observed during the walk. The mire is important for migrating wetland bird species.

Protection and restoration

Stormyra is a high priority locality for the plan for mire reserves in the county of Hedmark and the proposal for securing it is in the hands of the authorities. The meadow area may also be included and will perhaps be restored to its former character.

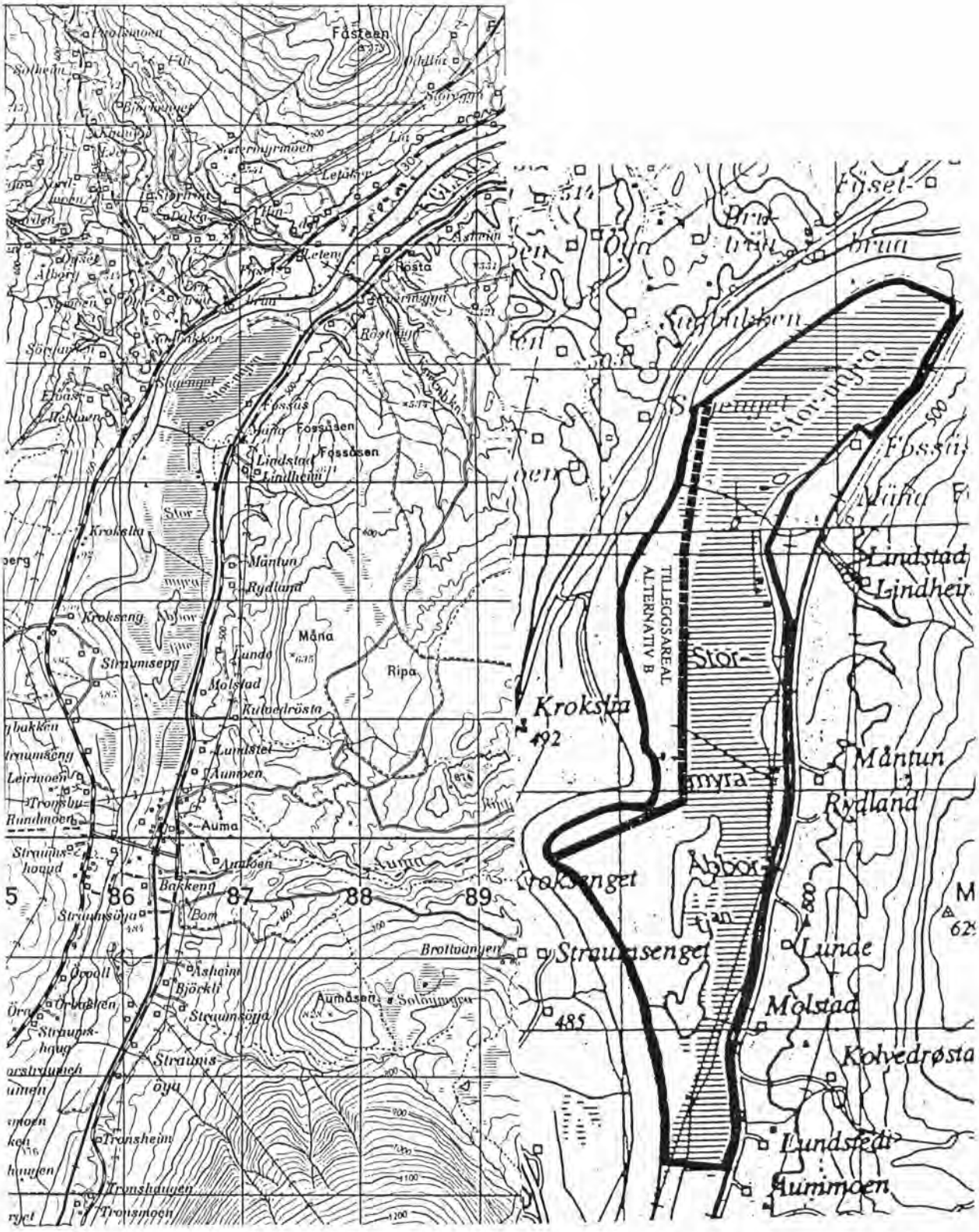


Fig.. 4.6.1 Locality 6. Stormyra, Tynset, Hedmark. Map basis: 1619 III and IV, Series M 711, Grid zone: 32 V, 100 km square: NQ. Printed with permission from the Norwegian Mapping Authority.

Fig. 4.6.2 Stormyra. The map shows the proposed boundaries of the planned nature reserve with the additional area of formerly mown meadow vegetation.

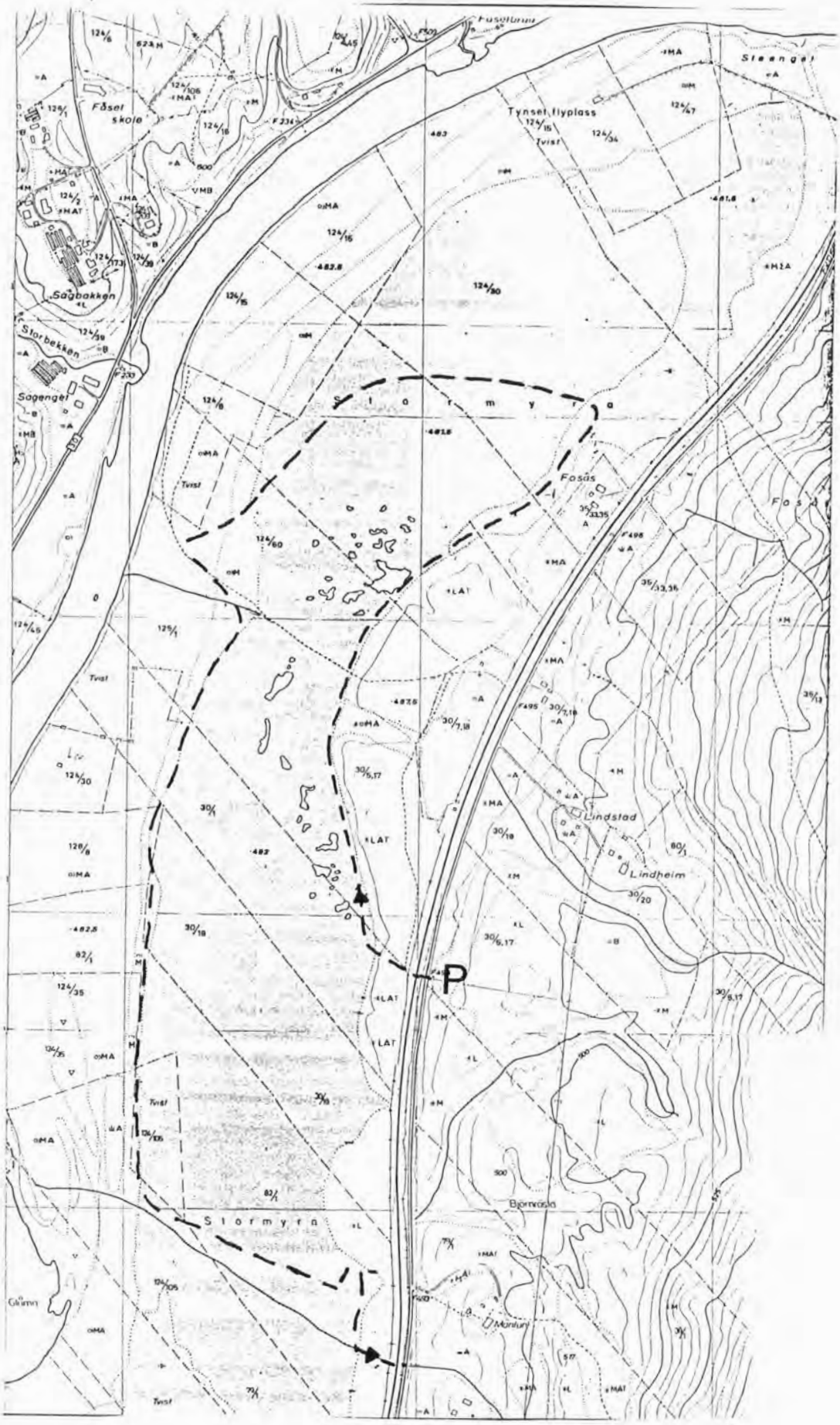


Fig. 4.6.3 Stormyra. P: start of excursion. Map basis: Economic map: CN 099-5-2 and 4.

Table 4.1.6. Stormyra, Tynset. Species list of mire plants. Vascular plants and Sphagna are complete; only some other cryptogams are included.

TYPE	Species name
K	Agrostis canina
K	Agrostis capillaris
K	Agrostis stolonifera
K	Alnus incana
K	Alopecurus aequalis
K	Andromeda polifolia
K	Angelica sylvestris
K	Anthoxanthum odoratum
K	Betula nana
K	Betula pubescens
K	Calamagrostis purpurea
K	Calamagrostis stricta
K	Calluna vulgaris
K	Caltha palustris
K	Cardamine amara
K	Cardamine nymanii
K	Cardamine pratensis
K	Carex adelostoma
K	Carex aquatilis
K	Carex brunnescens
K	Carex buxbaumii
K	Carex canescens
K	Carex capillaris
K	Carex capitata
K	Carex chordorrhiza
K	Carex dioica
K	Carex echinata
K	Carex flava
K	Carex globularis
K	Carex juncella
K	Carex lasiocarpa
K	Carex laxa
K	Carex limosa
K	Carex livida
K	Carex magellanica
K	Carex nigra
K	Carex oederi
K	Carex panicea
K	Carex pauciflora
K	Carex rostrata
K	Carex scandinavica
K	Carex tenuiflora
K	Carex vaginata
K	Carex vesicaria
K	Cerastium fontanum
K	Cirsium helenioides
K	Corallorhiza trifida
K	Dactylorhiza incarnata
K	Deschampsia cespitosa
K	Deschamspia flexuosa
K	Drosera anglica
K	Drosera rotundifolia
K	Eleocharis quinqueflora
K	Empetrum hermaphroditum
K	Epilobium angustifolium
K	Epilobium palustre
K	Equisetum arvense
K	Equisetum fluviatile
K	Equisetum hyemale
K	Equisetum palustre
K	Equisetum scirpoides
K	Equisetum sylvaticum
K	Equisetum variegatum
K	Eriophorum angustifolium
K	Eriophorum scheuchzeri
K	Eriophorum vaginatum
K	Euphrasia frigida
K	Festuca rubra
K	Filipendula ulmaria
K	Galium boreale
K	Galium palustre
K	Galium uliginosum
K	Geranium sylvaticum
K	Geum rivale
K	Gymnocarpium dryopteris
K	Huperzia selago
K	Juncus alpinoarticulatus
K	Juncus bufonius
K	Juncus filiformis
K	Juniperus communis
K	Leontodon autumnalis
K	Luzula multiflora
K	Luzula sudetica
K	Lycopodium annotinum
K	Melampyrum pratense
K	Menyanthes trifoliata
K	Molinia caerulea
K	Nardus stricta
K	Orthilia secunda
K	Oxycoccus microcarpus
K	Oxycoccus quadripetalus
K	Parnassia palustris
K	Pedicularis palustris
K	Pedicularis sceptrum-carolin
K	Petasites frigidus
K	Phragmites australis
K	Picea abies
K	Pinguicula villosa
K	Pinguicula vulgaris
K	Pinus sylvestris
K	Poa palustris
K	Poa pratensis
K	Polygonum viviparum
K	Potamogeton alpinus
K	Potamogeton natans
K	Potentilla erecta
K	Potentilla palustris
K	Prunus padus
K	Pyrola minor
K	Pyrola rotundifolia
K	Ranunculus acris
K	Rubus chamaemorus
K	Salix arbuscula
K	Salix caprea
K	Salix glauca
K	Salix lapponum
K	Salix myrsinites
K	Salix nigricans
K	Salix pentandra
K	Salix phylicifolia
K	Saussurea alpina
K	Scirpus cespitosus ssp. cesp
K	Scirpus hudsonianus
K	Selaginella selaginoides
K	Solidago virgaurea
K	Sorbus aucuparia
K	Sparganium angustifolium
K	Stellaria alsine
K	Succisa pratensis
K	Thalictrum alpinum
K	Thelypteris phegopteris
K	Tofieldia pusilla
K	Trientalis europaea
K	Triglochin palustris
K	Utricularia intermedia
K	Utricularia minor
K	Vaccinium myrtillus
K	Vaccinium uliginosum
K	Vaccinium vitis-idaea
K	Valeriana sambucifolia
K	Viola epipsila
K	Viola palustris
L	Cladina stellaris
M	Aneura pinguis
M	Bryum pseudotriquetrum
M	Calliergon giganteum
M	Calliergon richardsonii
M	Calliergon sarmentosum
M	Calliergon trifarium
M	Campylium stellatum
M	Catoscopium nigritum
M	Cinclidium stygium
M	Climacium dendroides
M	Drepanocladus badius
M	Drepanocladus exannulatus
M	Drepanocladus revolvens
M	Drepanocladus tundrae
M	Fissidens adianthoides
M	Fissidens osmundoides
M	Helodium blandowii
M	Homalothecium nitens
M	Lophozia borealis
M	Lophozia rutheana
M	Meesia triquetra
M	Meesia uliginosa
M	Oncophorus wahlenbergii
M	Paludella squarrosa
M	Plagiomnium ellipticum
M	Pseudobryum cinclidioides
M	Rhizomnium pseudopunctatum
M	Rhytidiadelphus triquetrus
M	Scorpidium scorpioides
M	Sphagnum angustifolium
M	Sphagnum annulatum coll.
M	Sphagnum balticum
M	Sphagnum capillifolium
M	Sphagnum centrale
M	Sphagnum compactum
M	Sphagnum contortum
M	Sphagnum fuscum
M	Sphagnum girgensohnii
M	Sphagnum lindbergii
M	Sphagnum magellanicum
M	Sphagnum obtusum
M	Sphagnum papillosum
M	Sphagnum platyphyllum
M	Sphagnum russowii
M	Sphagnum squarrosum
M	Sphagnum subfulvum
M	Sphagnum subsecundum
M	Sphagnum teres
M	Sphagnum warnstorfii
M	Sphagnum wulfianum
M	Splachnum ampullaceum
M	Splachnum luteum
M	Splachnum sphaericum
M	Splachnum vasculosum

H= hybrid, K=vascular plant, M=bryophyte, L=lichen

4.7.1 Locality 7a. Haukskardmyrin, Dovre, Oppland

Map sheet M711: 1519 III UTM: NP 19,90 Elevation: 1050 m a.s.l. Area: 103 ha Figures: 4.7.1-2 References: Torbergsen (1979), Sollid & Sörbel (1981)
Status: Nature reserve
Vegetational region: Haukskardmyrin is situated on the transition between the slightly continental (C1) and the indifferent (OC) sections in the upper part of the northern boreal zone.

Location, geology, climate and land use
Haukskardmyrin is located on the Dovrefjell mountain plateau between Dombås and Hjerkinn. This area is mostly a wide mountain massif, intersected by elevated valleys with subalpine birch forest.

Geologically, the mire is located in a transition area between quartz diorite, granite, monzonite and diorite, gabbro and metagabbro.

Climatic data are from the meteorological station at Fokstua, and the normal mean temperatures are: annual 0.0 °C, January -8.0 °C and July 9.8 °C. The normal annual precipitation is 435 mm.

The mire has not been disturbed by man, except for a power line that crosses part of it.

Mire types
Palsa mire is the most extensive mire unit in this mire complex. Flat fen is also common, and there are sloping fens in some of the marginal parts.

The most interesting aspect at this locality is the palsa mire. There are several palsa mires in the Dovrefjell area; in fact, the majority of palsa mires in southern Norway are here. Of these, Haukskardmyrin is both the largest and the one with the best developed palsas. The palsas in this southern area of Norway generally do not attain the heights of those found in northern Fennoscandia. At Haukskardmyrin, we can see several palsas, both small ones and continuous ones up to 25 da in area. Sollid & Sörbel (1981) reported the maximum palsa height as 3 m at this locality, but last year we were only able to measure 2 m at the most, so perhaps a decline is taking place. Some of the palsas have cracks resulting from erosion. For further information on the characteristics and dynamics of palsas see e.g. Sollid & Sørbel (1974). There are also several pools on the mire, often in connection with the degradation of palsas.

Vegetation
The vegetation of this site has not been thoroughly investigated. Most of the minerotrophic vegetation is made up of fen carpets and lawns with *Carex rostrata* and *Eriophorum angustifolium*. Hummock vegetation both on the palsas and elsewhere is dominated by *Cladonia* species and *Cetraria nivalis*. Other common species are *Betula nana* and *Eriophorum vaginatum*.

Route
We shall enter the mire at the southwestern end to see the largest palsas and then move northeastwards to take a closer look at the highest ones. We will finish on the fen portion. From the ridge, we get a fine view over the Fokstumyra Nature Reserve. Short notes on

Fokstumyra and Haugtjørnin are given below. The latter is another palsa mire area from which we have more vegetational data.

Conservational problems for discussion

Haukskardmyrin has recently become protected as part of the mire conservation plan for the county of Oppland. There are no special conflicts at this locality.

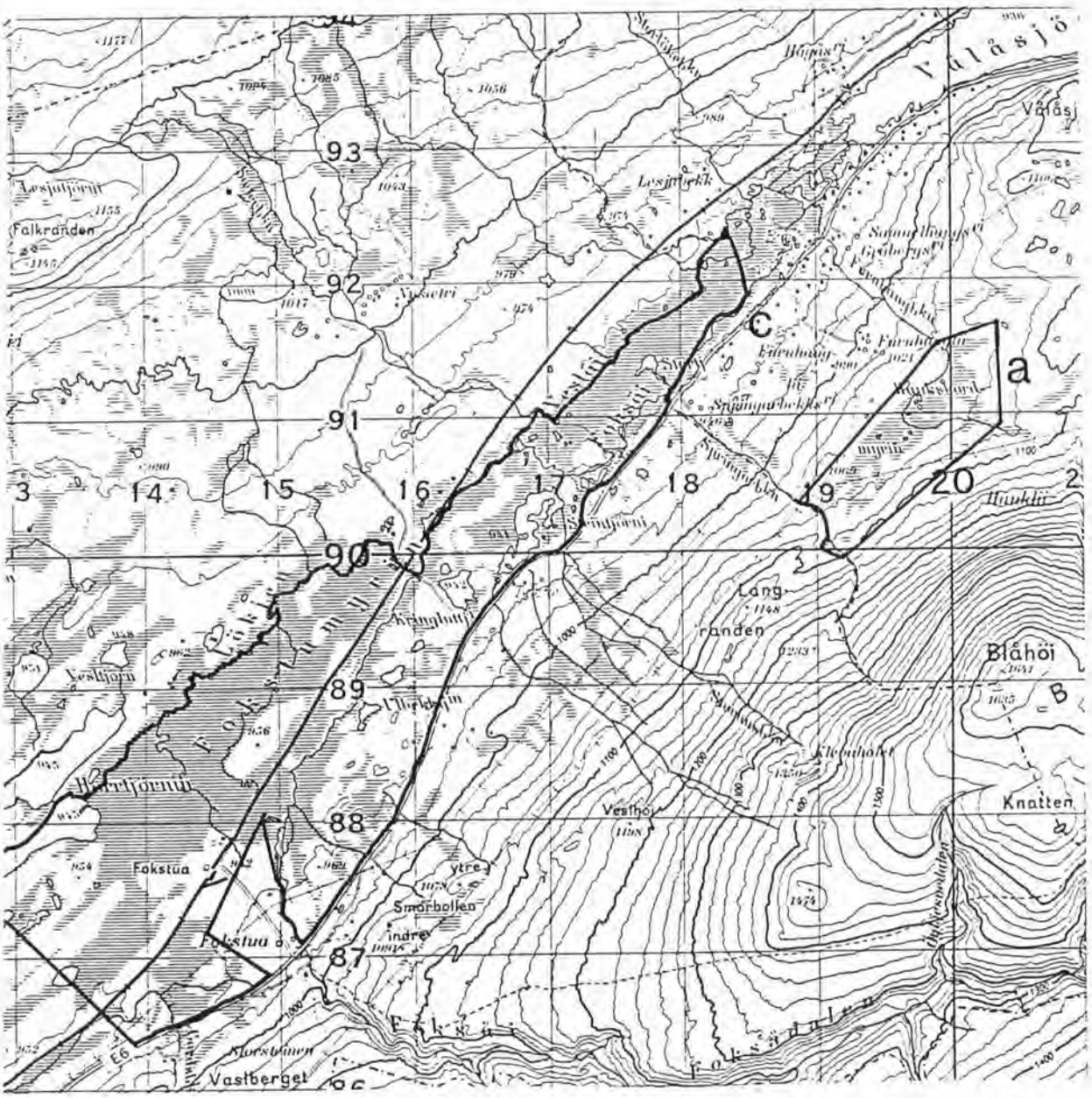


Fig. 4.7.1 Locality 7a. Haukskardmyrin nature reserve and locality 7c Fokstumyra nature reserve, Dovre, Oppland. Map basis: 1519 III, Series: M 711, Grid zone: 32 V, 100 km square: NP, The boundary of the nature reserves outlined. Printed with permission from the Norwegian Mapping Authority.

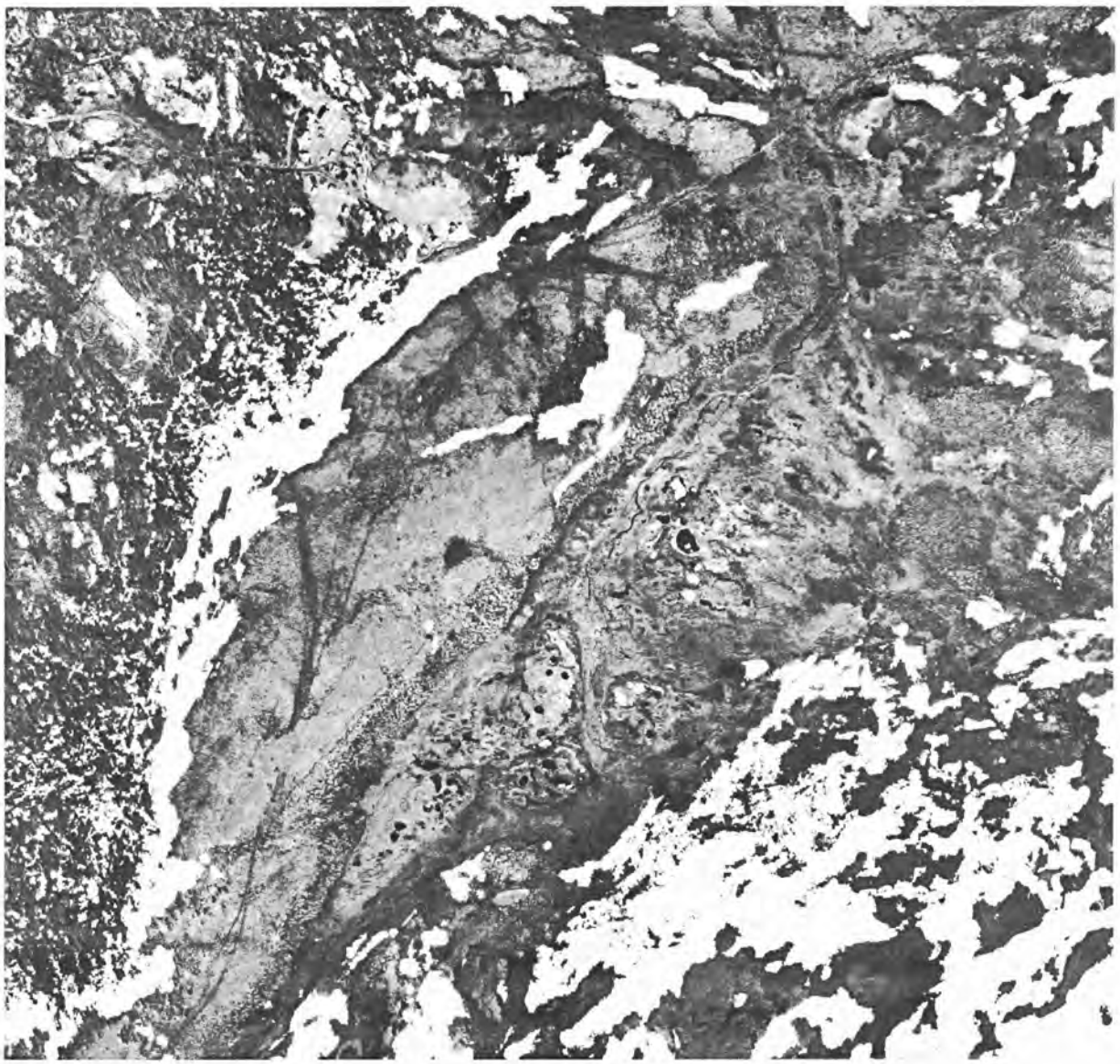


Fig. 4.7.2 Haukskardmyrin. Aerial photograph covering the locality. Palsas are distinguishable as light grey areas with one or more circular pools attached to them. Locality 7c. Photo: Norsk Luftfoto 240587, Series: 9308, A13.

4.7.2 Locality 7b. Haugtjørnin, Oppdal, Sør-Trøndelag

Map sheet M711: 1519 I UTM: NQ 39,13 Elevation: 1120 m a.s.l.
Area: 1 km^2 Tables 4.0.1-4
References: Sollid & Sørbel (1974), Moen (1983)
Status: Protected (within Dovrefjell National Park)
Vegetational region: Haugtjørnin is situated in the indifferent section (OC) of the low alpine zone.

This locality is situated about 8 km NE of Kongsvoll in an area of calcareous bedrock. The climate is much the same as at the previous locality; the normal mean temperatures being -0.3 °C (annual), -9.8 °C (January) and 9.9 °C (July) and the precipitation is 445 mm (all measured at Kongsvoll).

Flat fen is the most common mire unit here; palsa mire only covers minor parts. The palsas at this locality are fewer, more scattered and smaller; the largest being about 1 da and no more than 1 m high.

Among the alpine species to be found here are: *Carex atrofusca, C. microglochin, C. saxatilis, Salix arbuscula* and *S. lanata*. The fen vegetation is rich and extremely rich, and of both carpet and lawn type. Some of the rich fen is scrub-covered (willow fen). The hummock vegetation on the palsas seems to be ombrotrophic with *Betula nana, Empetrum hermaphroditum, Vaccinium* spp., *Rubus chamaemorus, Sphagnum fuscum, Cetraria nivalis* and *Cladonia arbuscula* as the common species.

4.7.3 Locality 7c. Fokstumyra, Dovre, Oppland

Map sheet M711: 1519 III UTM: NP 14,88 Elevation: 940-970 m a.s.l.
Area: 7.5 km^2 (70 % mire) Figures: 4.7.1 Tables: 4.0.1-2
Status: Nature reserve
Vegetational region: The locality falls within the slightly continental section (C1) of the northern boreal zone.

Fokstumyra is situated some 1.5 km W of Haukskardmyrin. The railway line intersect the mire complex. The mire complex has a variety of fen types, including tall willow scrub and often rich vegetation. The mire flora contains some interesting species with an eastern distribution, e.g. *Carex heleonastes, Galium trifidum, Pedicularis sceptrum-carolinum* and *Rubus arcticus*.

Fokstumyra is renowned for its birdlife and part of it was protected in 1923. (Please see chapter 5.)

4.8.1 Locality 8a. Bakkedalen on Skuløy, Haram, Møre & Romsdal

Map sheet M711: 1220 III UTM: LQ 60-61, 51-53 Elevation: 200-260 m a.s.l.
Area: ca. 1 km^2 Figures: 4.8.1-4 Tables: 4.0.1 - 4 and 4.8.1
Reference: Moen (1984)
Status: It is proposed to protect Bakkedalen in connection with the mire conservation plan for Møre & Romsdal, which has not yet been adopted (ready for 2-3 years, but does not seem to gain priority at the Ministry of the Environment). The proposed reserve (Fig. 4.8.1) covers 1.625 km^2.
Vegetational regions: Bakkedalen is situated in the middle boreal region, in the highly oceanic section (O3).

Location, geology, climate and land use
Like most of the islands off the coast of Møre & Romsdal (e.g. Haramsøy, see 4.8.2), Skuløy consists of a central upland plateau which falls steeply towards a low strandflat, located no higher than 25-30 m a.s.l. (Holtedahl 1958). The plateau rises to its maximum height in the northern part of the island, at Skulen (493 m a.s.l.). The peatlands on the strandflat cover more than 3 km^2. However, like all the similar mires in this part of Møre & Romsdal, they are seriously affected by drainage, peat cutting, etc.

The upland plateau is (as on Haramsøy and some other islands in the neighbourhood) covered with extensive mire complexes (including blanket bogs).

The bedrock of the area consists of "Granitic gneiss with variable degree of deformation; banded gneiss, migmatite gneiss" (Larsen, Klakegg & Longva 1988). The superficial deposits (drift) in the Bakkedalen area consist of till, in some places of great thickness. This thickness seems to result from the incorporation of pre-existing, thick deposits of weathered material from before the last Ice Age. The area has been glaciated at least three times during the Weichselian with intervening interstadial periods. The last deglaciation occurred before 12,300 years BP (Larsen, Klakegg & Longva 1988).

The annual mean temperature is 6.9 °C (January 2.0 °C, July 12.5 °C, at Hildre meteorological station at Haram, 13 m a.s.l.). The annual precipitation is 1410 mm at the same station, certainly too low a value to be representative for the upland areas of Skuløy and Haramsøy (at least 2000 mm seems reasonable, the station at Stadlandet, at 75 m a.s.l., having 2183 mm).

The land-use history of the mires on Skuløy should be similar to that on the neighbouring island of Haramsøy (see section 4.8.3). As a consequence, large areas of the mires are in reality man-made, starting with peat accumulation following excessive utilisation some 3000 years ago. (A rather parallel history to that of the Ceide fields and Belderrig in Co. Mayo visited by the IMCG group on 15th September 1990 (Foss 1991:54 ff.)). In recent centuries, the area has been much used for peat cutting, summer farming, grazing, etc. After the last World War, there has been less use until 1980 when farmers started transforming 40 ha of Bergedalen into agricultural land. A new road (2.3 km) was built, and 25 ha of former mire is now being cultivated.

Mire types
A mire landscape in a mosaic consisting of coastal heathlands, both damp and drier types. The transitions between the different mire types and from those to the heathland types are frequently gradual. About half the mire area is classified as blanket bog, both mound units and sloping units occurring. Transitional types to sloping fens (elevations up to 18^{g}) and damp heathlands are

common. Flat fens occur commonly, and on the flat areas there are also units of plane (transitional) bog and islet mixed mires. The last two types have large erosion channels (as also do some of the blanket bogs), and high hummocks (better named erosion hags?) are common. Springs occur in a few places, most of them are small.

Flora

Western species dominate, e.g. *Carex binervis, C. flacca, C. hostiana, C. pulicaris, Polygala serpyllifolia, Potamogeton polygonifolius, Danthonia decumbens.* Some slightly alpine/upper boreal species also occur, e.g. the rich-fen species *Bartsia alpina* and *Tofieldia pusilla.*

Vegetation

Ombrotrophic vegetation covers about half of the mire area. Hummock communities dominate, but mud bottoms are also common. Lawn and carpet communities (s.str.) cover very small areas. Hummock vegetation, defined as communities above the *Calluna* limit (Sjörs 1948), covers a wide ecological amplitude in oceanic areas; species like *Narthecium ossifragum* and *Scirpus cespitosus* are then common in the lower part of the hummock vegetation (called low ridge by Lindsay et al. (1988), who even distinguished a high ridge sub-feature above the carpet level). The dominant occurrence of *Calluna* on heathlands and mires in the most oceanic sections is typical, and is explained by the water table being rather constant throughout the year; the *Calluna* roots are not drowned by a high water table in flow periods (mostly when snow is melting), as is the situation in lawn communities in more continental areas.

On the high hummocks, *Erica tetralix, Eriophorum vaginatum* and in some places *Betula nana* are common, in addition to *Calluna. Racomitrium lanuginosum* and *Sphagnum imbricatum* dominate the bottom layer. The lower hummochs have such species as *Sphagnum magellanicum, S. papillosum, S. rubellum* and *Pleurozium schreberi.* Poor fen communities are common, and smaller areas of intermediate and rich fen, and spring vegetation occur N of Bakkedemma.

Route

We will walk from the summer farm area in Bergedalen up to the blanket bogs in the proposed nature reserve at Flemsdemma, and on to the S. Then to the east (if the weather is nice, some people may want to go to the hill tops further to the E), and down to the ruins of a summer farm. We will then continue further down along Kvernhuselva, and follow the path down the hillside to the lowland. This is VERY STEEP, and we MUST use the path, which is distinct, but DEMANDING!

Conservational problems for discussion

1. Management, restoration.
2. The role of the summer farm close to the nature reserve; these summer farms use a great deal of artificial fertiliser!

4.8.2 Locality 8b. Haramsøy (upland mires), Haram, Møre og Romsdal

Map sheet M711: 1120 II UTM: LQ 55-56,51-52 Elevation: 140-320 m a.s.l.
Area: ca 1 km^2 Figures: 4.8.1-4. Tables: 4.0.1 - 4 and 4.8.1.
References: Hafsten & Tallantire (1978), Moen (1984), Solem (1989)
Status: The mires between Mannen and Hestevollane on Haramsøy were proposed for conservation in 1978 (note to the Ministry of the Environment by Kofoed and Moen (Moen 1984:24 ff)). The blanket bogs in this area were considered to be among the most valuable localities in Norway and were proposed for inclusion in the international Telma mire conservation plan (Moen 1979). During the winter of 1979/80, after a hard struggle, the farmers started exploiting the mires. They intend to reclaim 110 ha for agricultural land, and most of this has been completed. A road (7.2 km) has been built across the blanket bogs.
Vegetational regions: The lower-lying mires S of Ulla are in the southern boreal region, but most of the area is situated in the middle boreal region. The whole area is in the highly oceanic section (O3).

In general, the geography and plant cover are as described in section 4.8.1. The main difference between the localities in the 1970s was that the mires on Haramsøy had much better developed blanket bog units. These were larger and blanket peat covered domes, ridges and slopes with different sloping directions, and erosion channels were regular features in some of the blanket bog units.

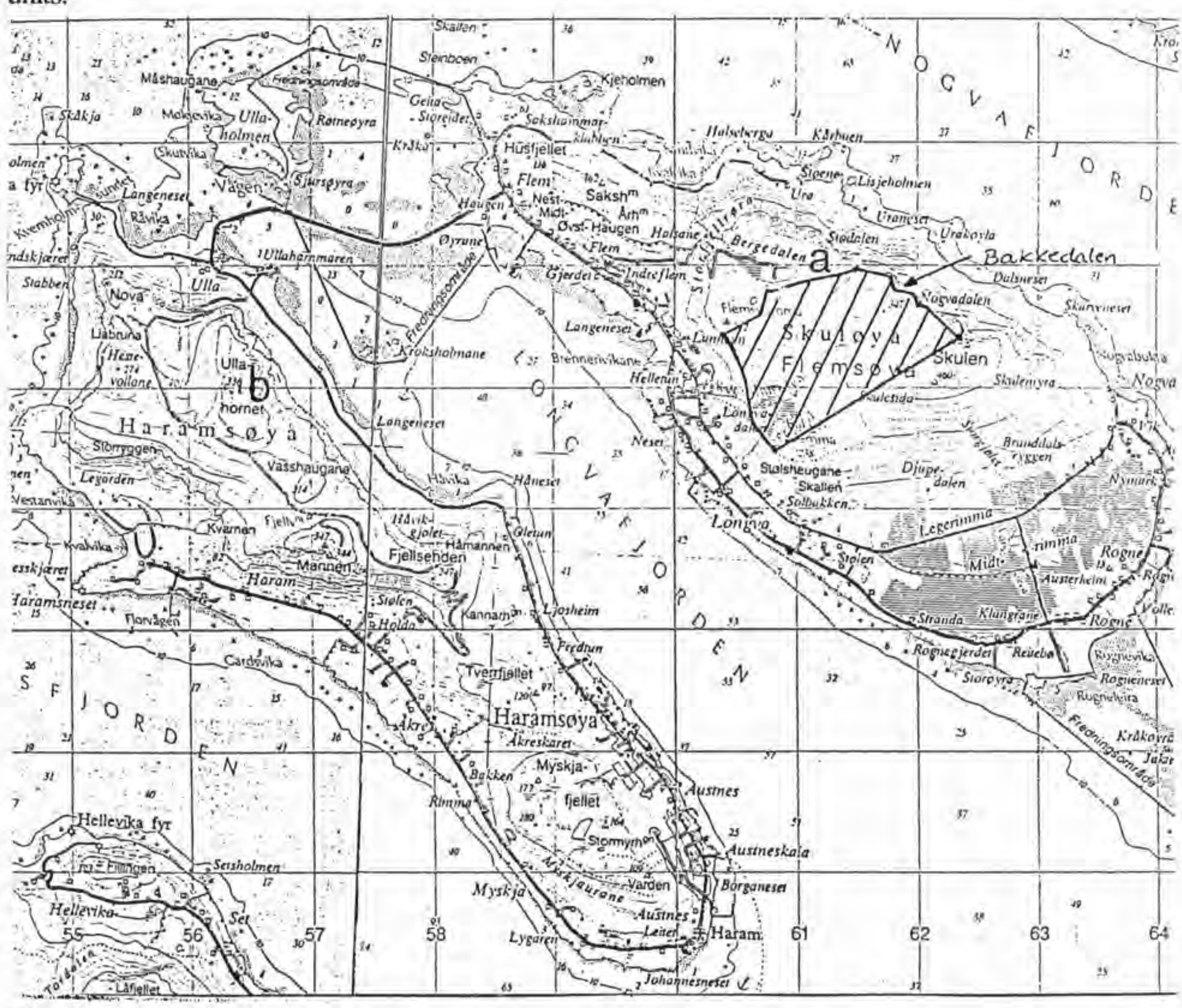


Fig. 4.8.1 Localities 8a, Bakkedalen and 8b, Haramsøy, Haram, Møre og Romsdal. Proposed boundary for the planned nature reserve is outlined. The scale is somewhat reduced. Map basis: sheet 1120 II and 1220 III, Grid zone: 32 V, 100 km square:LQ. Printed with permission from the Norwegian Mapping Authority.

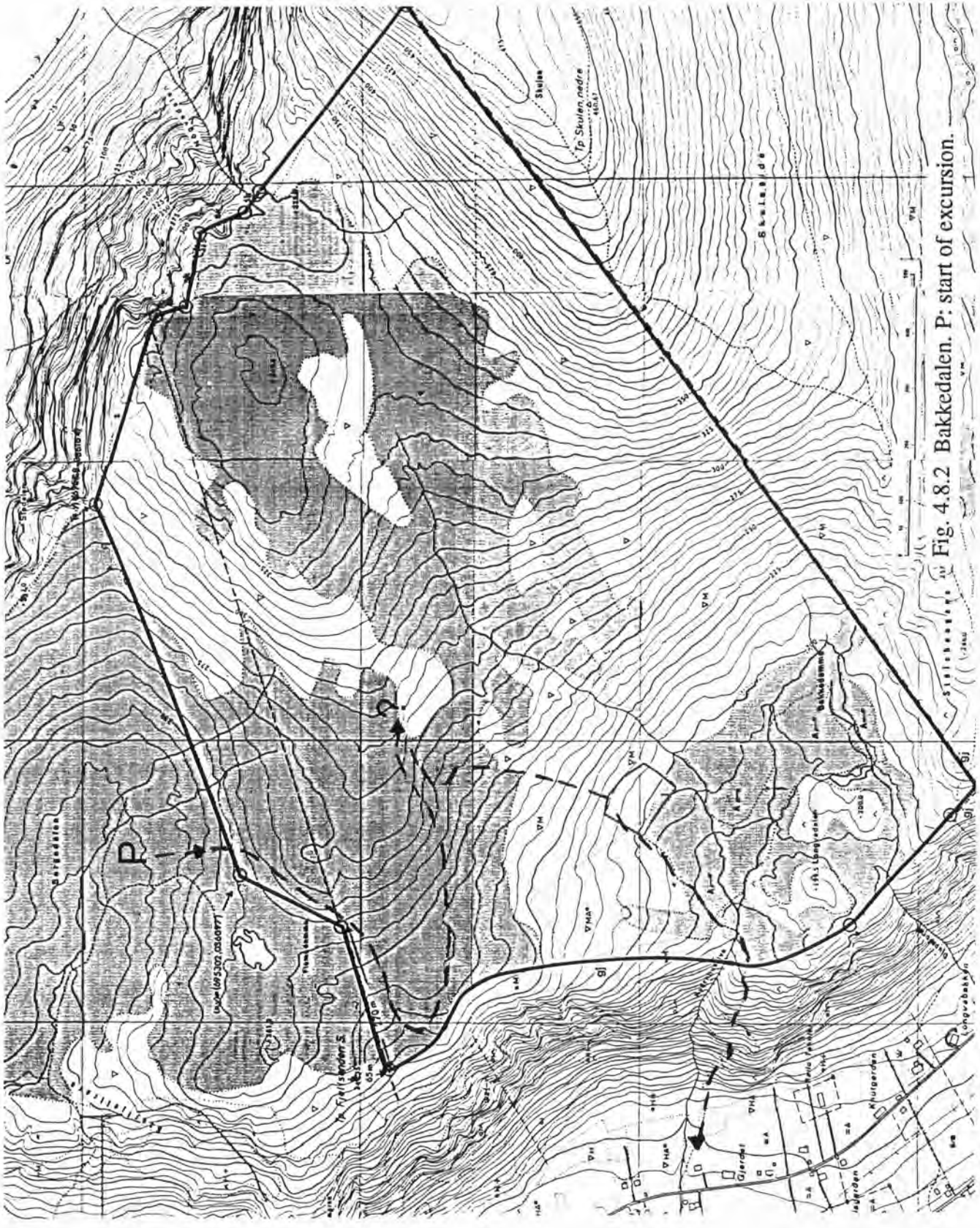


Fig. 4.8.2 Bakkedalen. P: start of excursion.

Table 4.1.8. Bakkedalen, Haram. Species list of mire plants. Vascular plants and Sphagna are complete; only some other cryptogams are included.

TYPE	Species name
K	Agrostis canina
K	Alchemilla sp.
K	Andromeda polifolia
K	Anthoxanthum odoratum
K	Arctostaphylos alpinus
K	Bartsia alpina
K	Betula nana
K	Betula pubescens
K	Calluna vulgaris
K	Carex bigelowii
K	Carex canescens
K	Carex dioica
K	Carex echinata
K	Carex flacca
K	Carex hostiana
K	Carex limosa
K	Carex nigra
K	Carex pallescens
K	Carex panicea
K	Carex pauciflora
K	Carex pulicaris
K	Carex rostrata
K	Carex tumidicarpa
K	Cirsium palustre
K	Cornus suecica
K	Crepis paludosa
K	Dactylorhiza maculata
K	Dactylorhiza traunsteineri
K	Danthonia decumbens
K	Deschampsia cespitosa
K	Deschamspia flexuosa
K	Drosera anglica
K	Drosera rotundifolia
K	Empetrum nigrum
K	Epilobium palustre
K	Equisetum hyemale
K	Equisetum sylvaticum
K	Erica tetralix
K	Eriophorum angustifolium
K	Eriophorum latifolium
K	Eriophorum vaginatum
K	Euphrasia frigida
K	Festuca vivipara
K	Filipendula ulmaria
K	Geranium sylvaticum
K	Geum rivale
K	Gymnocarpium dryopteris
K	Huperzia selago
K	Juncus alpinoarticulatus
K	Juncus articulatus
K	Juncus bulbosus
K	Juncus conglomeratus
K	Juncus squarrosus
K	Juniperus communis
K	Leontodon autumnalis
K	Luzula multiflora
K	Melampyrum pratense
K	Menyanthes trifoliata
K	Molinia caerulea
K	Nardus stricta
K	Narthecium ossifragum
K	Oxycoccus microcarpus
K	Parnassia palustris
K	Pinguicula vulgaris
K	Pinus sylvestris
K	Polygala serpyllifolia
K	Potamogeton polygonifolius
K	Potentilla erecta
K	Pyrola minor
K	Ranunculus flammula
K	Rubus chamaemorus
K	Rumex acetosa
K	Sagina procumbens
K	Salix aurita
K	Saxifraga aizoides
K	Saxifraga stellaris
K	Scirpus cespitosus ssp. cespitosus
K	Selaginella selaginoides
K	Solidago virgaurea
K	Sorbus aucuparia
K	Sparganium angustifolium
K	Succisa pratensis
K	Tofieldia pusilla
K	Trientalis europaea
K	Triglochin palustris
K	Vaccinium myrtillus
K	Vaccinium uliginosum
K	Vaccinium vitis-idaea
K	Valeriana sambucifolia
K	Viola biflora
K	Viola palustris
L	Cetraria islandica
L	Icmadophila ericetorum
M	Aneura pinguis
M	Calliergon sarmentosum
M	Campylium stellatum
M	Cratoneuron commutatum
M	Cratoneuron filicinum
M	Dicranella palustris
M	Dicranum leioneuron
M	Drepanocladus badius
M	Drepanocladus revolvens
M	Hypnum jutlandicum
M	Racomitrium lanuginosum
M	Rhytidiadelphus loreus
M	Scapania uliginosa
M	Scorpidium scorpioides
M	Sphagnum auriculatum
M	Sphagnum brevifolium
M	Sphagnum capillifolium
M	Sphagnum compactum
M	Sphagnum cuspidatum
M	Sphagnum fuscum
M	Sphagnum imbricatum
M	Sphagnum isoviitae
M	Sphagnum magellanicum
M	Sphagnum papillosum
M	Sphagnum recurvum coll.
M	Sphagnum rubellum
M	Sphagnum subnitens
M	Sphagnum subsecundum
M	Sphagnum tenellum
M	Sphagnum viride
M	Sphagnum warnstorfii

H= hybrid, K=vascular plant, M=bryophyte, L=lichen

4.8.3 Vegetational and blanket bog history at Nordøyane

Thyra Solem

These hat-shaped islands off the coast of Møre & Romsdal are almost treeless except for occasional *Picea* plantations, and the strandflats are extensively cultivated. The Tapes transgression can be traced as a beach ridge along the strandflats about 10 m a.s.l. Haramsøy and Skuløy have areas of blanket bog on upland plateaus, and the blanket bog history has been investigated on Haramsøy (Solem 1989). A transect of peat columns taken at intervals of 5 m vertically has been studied on the Mannen bog (Fig. 4.8.3).

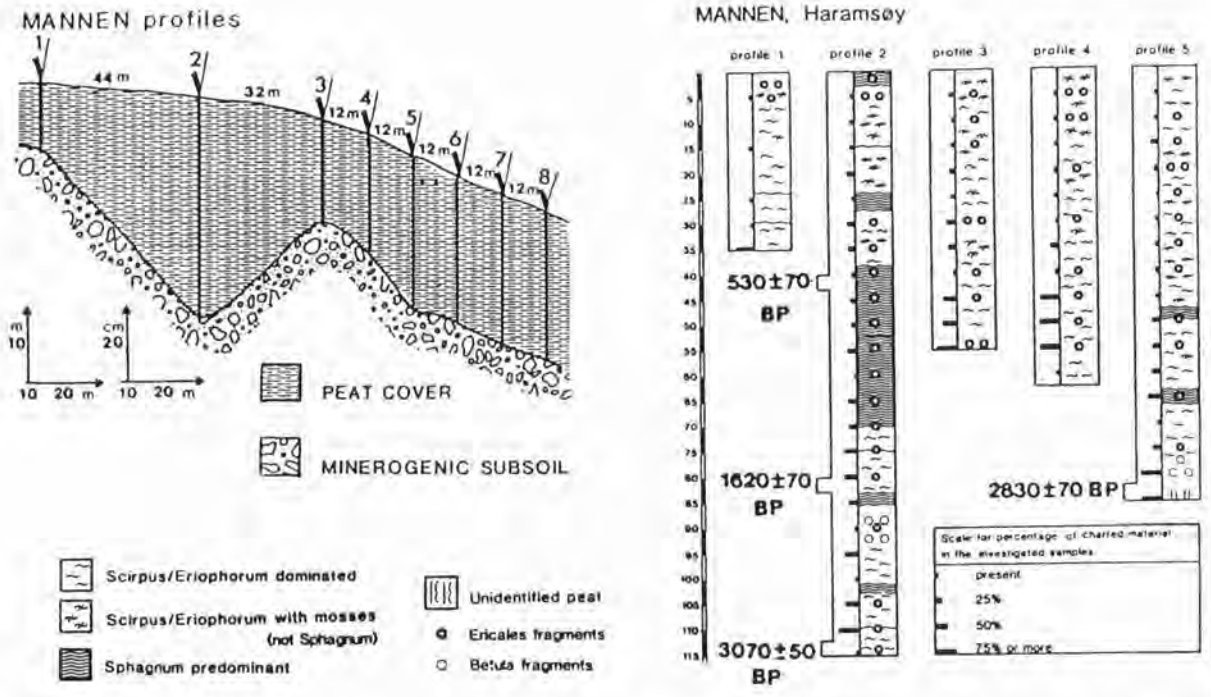


Fig. 4.8.3 Left: Cross section of the peat cover and minerogenic subsoil on the Mannen bog. The left-hand scale shows the bog slope and the right-hand scale has the vertical axis exaggerated. Only the peat depth was measured at sites 6-8. Right: The stratigraphical columns for sites 1-5 have a scale for the content of charred material in the samples investigated. Ages are in ^{14}C years BP. Modified from Solem (1989).

The constant occurrence of charred material indicates that the vegetation was burned regularly. The transition from peat to mineral soil was ^{14}C dated in two of the profiles and gave approximately the same age, about 3000 years BP. Bog formation took place practically instantaneously over a relatively wide area and is confirmed by an age of about 2700 years BP from the bottom peat at another site on the upland plateau (Hafsten & Tallantire 1978).

A pollen diagram from the upland plateau also has traces of human activity throughout the peat column (Fig. 4.8.4). Pollen curves of plants connected with this activity, such as *Ranunculus acris*

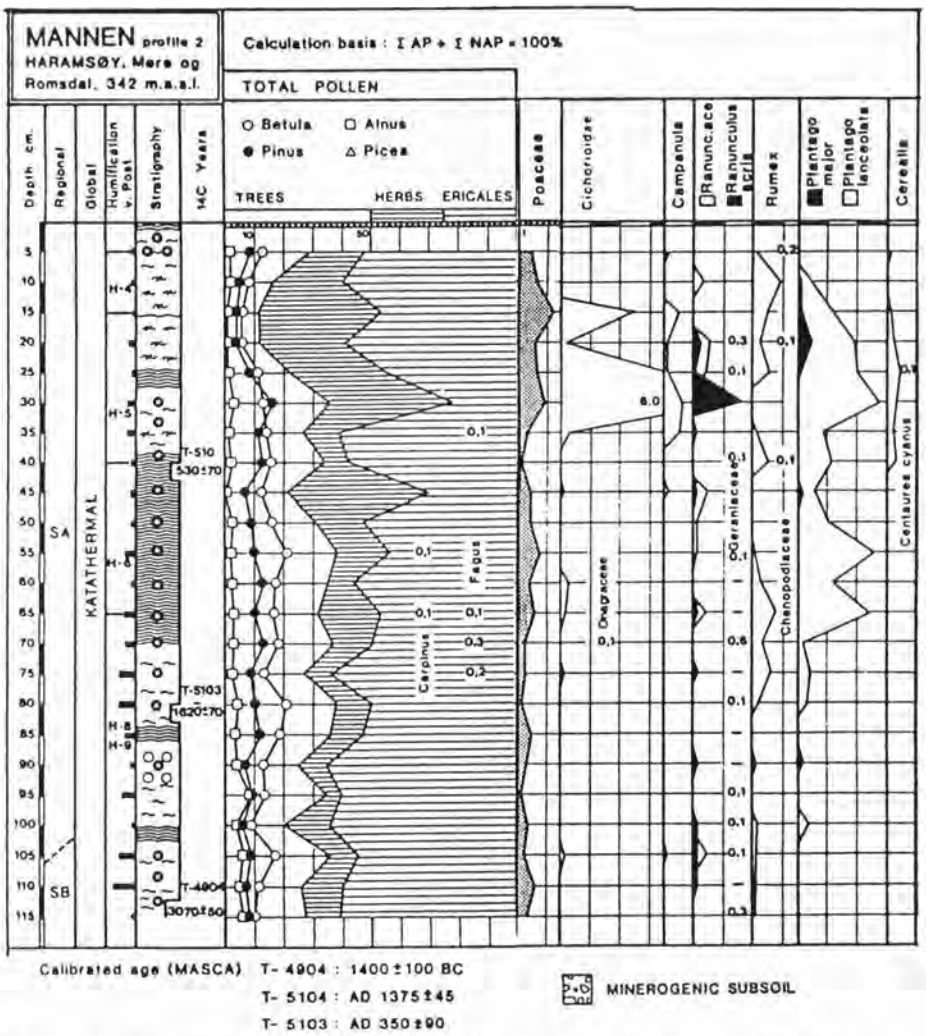


Fig. 4.8.4 Selected pollen curves from the diagram at site 2, Mannen bog.

type, *Plantago lanceolata*, *P. major*, *Rumex*, Cichorioidae, *Centaurea cyanus* and *Cerealia*, are convincing from the 80 cm level upwards; below that level they are not conclusive, but there is again a regular occurrence of charred material in the stratigraphy, indicating human impact in the form of periodical burning of the vegetation, as mentioned above. This was done to allow or promote grasses in the vegetation and to renew *Calluna* which, when young, is a good fodder plant

and important in a climate that allows livestock, especially sheep, to graze outdoors throughout the year.
The insignificant tree-pollen curves and the fact that practically no tree remnants were recorded in the blanket bogs suggest that the original vegetation on the upland plateau may have been a treeless heath. However, the combined effect of grazing and regular burning would, with the added stress of the deteriorating climate 3000 years ago, promote peat initiation and accumulation - in other words, the blanket bogs are "man-made".

Pollen diagrams from three sites on the strandflat gave valuable information about an early population. Human activity can be traced back to at least about 6800 years ago. This is confirmed by Mesolithic dwellings on Skuløy and other islands in the Nordøyane group (Bjerck 1982 and references therein). For several thousand years, it was probably only the strandflat that was colonised. The mires that developed on the landward side of the Tapes ridge were long ago converted into pastures and fields. The first sign of cereal growing on the strandflat has not been ^{14}C dated, but occurred in the Subboreal chronozone. With a growing population, the need for additional land would arise, and activity expanded to the upland plateaus where livestock could graze. This expansion seems to have taken place about 300 years ago.

4.8.4. Locality 8c. Hustadmyrane, Fræna, Møre & Romsdal

Map sheet M711: 1220 I UTM: LQ 98-99,74-78, MQ 00,75-78; Elevation: 25-50 m a.s.l.
Area: ca 2 km^2 Figures: 4.8.5 Tables: 4.0.1 - 4
Reference: Moen (1984)
Status: It is proposed to protect Hustadmyrane (called Gule-/Stavikmyrane nature reserve) in connection with the mire conservation plan for Møre & Romsdal, which has not yet been adopted by the Ministry of the Environment. The proposed reserve (Fylkesmannen i Møre og Romsdal, 1988) covers an area of 8.1 km^2, including 0.4 km^2 of lake area.
Vegetational regions: Hustadmyrane is situated in the southern boreal zone, in the highly oceanic section (O3).

Geography, mire types
The locality is situated in the large gneiss area of western Norway, it belongs to the strandflat area, Holtedahl (1958, cf section 4.8.1). The Hustad district has extensive mire areas, among the most extensive in Norway. The locality is situated in the southwestern part, close to the coast. The peat mostly stands directly on the bedrock, only a few depressions have superficial deposits (partly marine). Further east in Hustad (at Hostadvatnet) thick superficial deposits occur under the peat, and large mire areas have been cultivated after the first settlement in 1918. (More than half of the farms in Fræna have been established on peatlands). Because of the lack of superficial deposits and large areas with very decomposed peat (partly shallow), large mire areas are still rather untouched in the Gule/Stavik area. The mires also have very much pine remnants (*Pinus* stumps) in the peat, and they are classified as difficult to cultivate (Personal information Anders Hovde, June 1994). Holmsen (1922) described peat profiles at a number of localities from the Hustad area, most of them plane bogs, but also distinctly raised (doomed) bog units.

Most of the mire area is classified as plane (transitional) bogs, only a few atlantic raised bog units are found in the investigated area.

The annual mean temperature at Hustad is about 6.0 °C, the January and July means are 0.3 °C and 12.4 °C, respectively. The mean annual precipitation is about 1350 mm in the flat lowlands, at Hostadvatn (80 m a.s.l., close to a mountainous area some 10 km further east), the precipitation is measured to 2050 mm.

Flora,vegetation
Oceanic plants and vegetational types predominate, cf. the referred publications and tables.

Route, conservational problems
The Hustadmyrane area will not be visited during the excursion, but we will pass the area with the bus, and have a distance view to the mire landscape.

The area has been much in use for peat-cutting and farming activities during long time. The western part of the proposed nature reserve was burnt as late as in the 1950s. Still today the differences caused by burning can be seen, in the hummock vegetation *Racomitrium lanuginosum, Sphagnum imbricatum, S. fuscum* and other *Sphagna* are much more common than in the areas burnt ca 40 years ago (there *Hypnum jutlandicum* and *Hylocomium splendens* are common species). What about burning in future, in nature reserves?

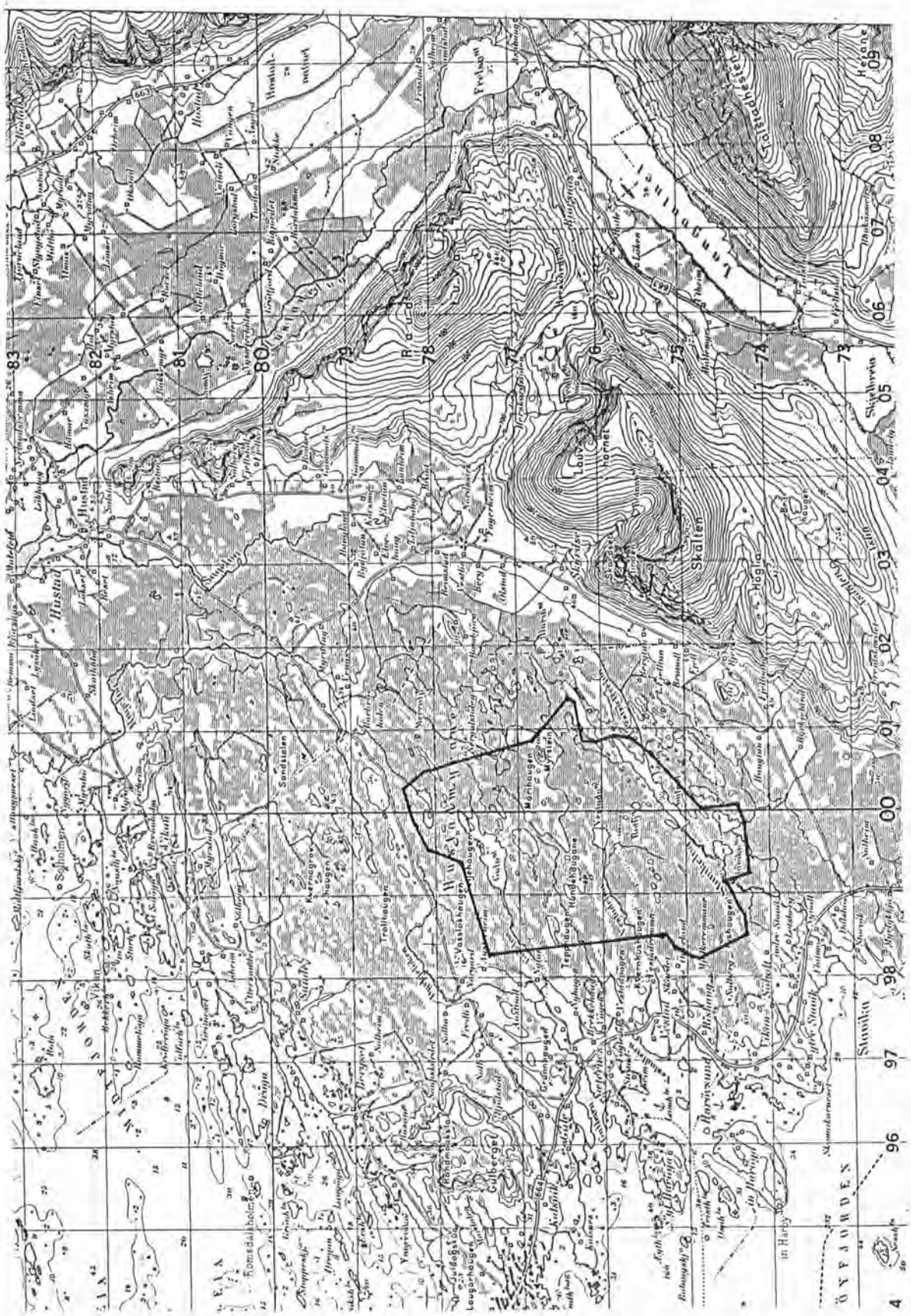


Fig. 4.8.5 Locality 8c, Hustadmyrane, Fræna, Møre og Romsdal. Proposed boundary for the planned mire reserve is outlined. The scale is somewhat reduced. Map basis: sheet 1220 I, Series: M 711, Grid zone: 32 V, 100 km square: LQ and MQ. Printed with permission from the Norwegian Mapping Authority.

4.9.1 Toppmyrane, Smøla, Møre & Romsdal

Map sheet M711: 1321 I UTM: MR 48-52, 29-30; Elevation: 20 m a.s.l.
Area: 4 km^2. Figure: 4.9.1. Tables: 4.0.1 - 4 and 4.9.1.
Reference: Osvald (1925), Moen (1984), Sageidet (1992).
Status: Toppmyrane was planned to be protected in connection with the mire conservation plan for Møre & Romsdal, or as a part of a conservation plan for wetlands at Smøla. However, the status at the moment is uncertain.
Vegetational regions: Toppmyrane is situated in the southern boreal zone, in the highly oceanic section (O3).

Location, geology, climate and land use
The main island of Smøla covers about 200 km^2, in addition ca 1000 smaller islands belong to the island group, the mean height above sea level is 15 m. Smøla belongs to the strandflat area (Holtedahl 1958, see section 4.8).

The bedrock of Smøla consists mainly of quartz diorite (Ordovician age), smaller areas at Skjølberg have limestone. Superficial deposits (drift) are thin or absent on Smøla; small areas have marine deposits and till. Peatlands (areas with more than 30 cm of peat) cover 31% of the land area of the main island of Smøla, ca 1/4 of this area having more than 2 m of peat (Lie 1987). Large mire areas with shallow peat and transitional types to damp heathland occur, so the mire area of Smøla is about half of the land area. Nearly the whole mire area is lies directly on the bedrock.

The annual mean temperature (at Molstad in the middle of the island) is 5.7 °C (January -0.3 °C, July 12.3 °C). The annual precipitation is 1155 mm at the same station.

The farmland area of Smøla covers 12.4 km^2, (with 124 farmers, Lie 1987), a large part is cultivated mires. In the 1930s, a large agricultural project, cultivation of mires, was started at Smøla (as in the Hustad area, see comments under section 4.8.4). Most of this project was localized to the Frostadheia area (the part of the island with the largest mire area at that time), ca 3 km N of Toppmyran. Growing of carrots and swedes on cultivated peat has earned good incomes for decades on Smøla; more of the agricultural production is now animal husbandry. However, large areas have been taken out of use in recent decades as the thin soil (cultivated peat) has shrunk, and the bedrock (often as ridges with standing groundwater between) is visible at the surface. New areas have been cultivated in the last few years, but only areas with a peat thickness exceeding 2 m are allowed to be used. All large mires on Smøla are influenced by ditches, and the large mires with deep peat are threatened. Planted forest belts (most common species of *Pinus* and *Picea*) occur in many places throughout Smøla (not close to Toppmyrane at present), and plans exist for further planting in the near future.

Toppmyrane is affected by the road crossing the mire complex. The area W of the road is cultivated. The last project started in 1980, and 8 ha has been cultivated close to the road. East of the road, old ditches extend 600 m eastward. Very large areas are intact further east, covering a stretch of ca 4 km, with a mire area of ca 5 km^2. Toppmyrane is today (together with the Havmyrane area of Hitra) the largest intact raised bog area in southern Norway, and one of the most valuable mires for protection.

Mire types

In the mire landscapes on Smøla in general, and the Toppmyrane area in particular, the mires occur in a mosaic also consisting of coastal heathlands, both damp and drier types. The transitions between the different mire types and from those to the heathlands are frequently gradual. More than 90 % of the mire area is classified as atlantic raised bogs. Units without regular features (acentric types) dominate, and a number of small units with eccentric features occur on the slopes down from large raised bog areas. Flat fens are common at the margins, especially in the east, and a few, small minerotrophic units with regular features (mud bottom/carpet flarks) are classified as flark fens. Most of the Toppmyrane area is progressive (actively peat-producing areas), regressive areas with erosion systems are common on Smøla, but not at Toppmyrane.

Flora

A number of western species are common, as also are weakly southern and alpine/boreal species, see the species lists. *Dicranum groenlandicum* is common in hummock vegetation, and is used as a characteristic species of the westernmost section in northern Norwegian mires, cf. Vorren (1979a,b), Eurola & Vorren (1980). *Sphagnum balticum* represents a weak eastern species occurring at Toppmyrane.

The flora of Toppmyrane is extremely poor, taking into consideration the rather large area. In general, the ombrotrophic vegetation includes some species on Smøla (and other ombrotrophic bogs in the most oceanic sections, cf. list of species at Hitra, Skogen 1969) that usually grow only minerotrophic in the more eastern parts of Fennoscandia: *Arctostaphylos alpina, Carex pauciflora* (x), *Dactylorhiza maculata, Narthecium ossifragum* (x), *Pinguicula vulgaris* (x), *Aulacomnium palustre* (x), *Hypnum jutlandicum, Leucobryum glaucum, Rhytidiadelphus loreus, Sphagnum papillosum* (x), *S. pulchrum, S. strictum, S. subnitens.* (Species with an x have a wide occurrence in bog vegetation in oceanic sections in Norway).

Vegetation

Ombrotrophic vegetation covers about 95% of the mire area. Hummock communities dominate, lawn and carpet communities are common, and mud bottom covers very small areas. Hummock vegetation is defined as communities above the *Calluna* limit (see further comments under section 4.8.1).

Large, uniform areas are dominated by *Eriophorum vaginatum*, with *Cladina* spp. in the bottom layer. *Calluna, Empetrum nigrum, Rubus chamaemorus, Pleurozium schreberi, Racomitrium lanuginosum, Sphagnum imbricatum* ssp. *austinii* and *S. rubellum* are common species.The lawn and carpet communities are common at the margins, including *Narthecium, Scirpus cespitosus, Sphagnum magellanicum, S. papillosum, S. tenellum,* and in wetter areas also *Sphagnum cuspidatum* and *S. viride.*

Erica tetralix and *Betula nana* are common on the high hummocks. Small tarns occur rather commonly, and often have vegetation (e.g. *Menyanthes trifoliata, Carex rostrata*) on the western side, generally with eroded margins (and without any plant cover) in the eastern part. The reason is that the prevailing wind direction is westerly, and waves cause erosion in the eastern part of the tarns (Osvald 1925). Small streams and swallow-holes are common in the eastern part of Toppmyrane.

Route
We will walk into intact and ditched areas of Toppmyrane and/or Røkmyrane, and also have a look at areas taken out of use for agriculture (because of bedrock at the surface). We will perhaps visit an area of extremely rich fen vegetation at Skjølberg.

Conservational problems for discussion
1. Management, restoration.
2. The role of farming rather close to the nature reserve; a great deal of artificial fertiliser is used!

4.9.2 Røkmyrane, Smøla, Møre & Romsdal

Map sheet M711: 1321 I UTM: MR 45-49, 26-27; Elevation: 20 m a.s.l.
Area: 2.5 km^2 in E, 1.5 km^2 in W. Figures: 4.9.1-3. Tables: 4.0.1 - 4
Reference: Moen (1984).
Status: Røkmyrane E. was proposed (Moen 1984) to be protected in connection with the mire conservation plan for Møre & Romsdal, or as part of a conservation plan for wetlands at Smøla. However, the status at the moment is uncertain, and recent information say that a larger part of the mire complex has been drained during the last decade! Røkmyr E , was classified as the second most valuable mire area on Smøla (Moen 1984). Røkmyran W today seems more intact and valuable for protection!
Vegetational regions: Røkmyr is situated in the southern boreal zone of the highly oceanic section (O3).

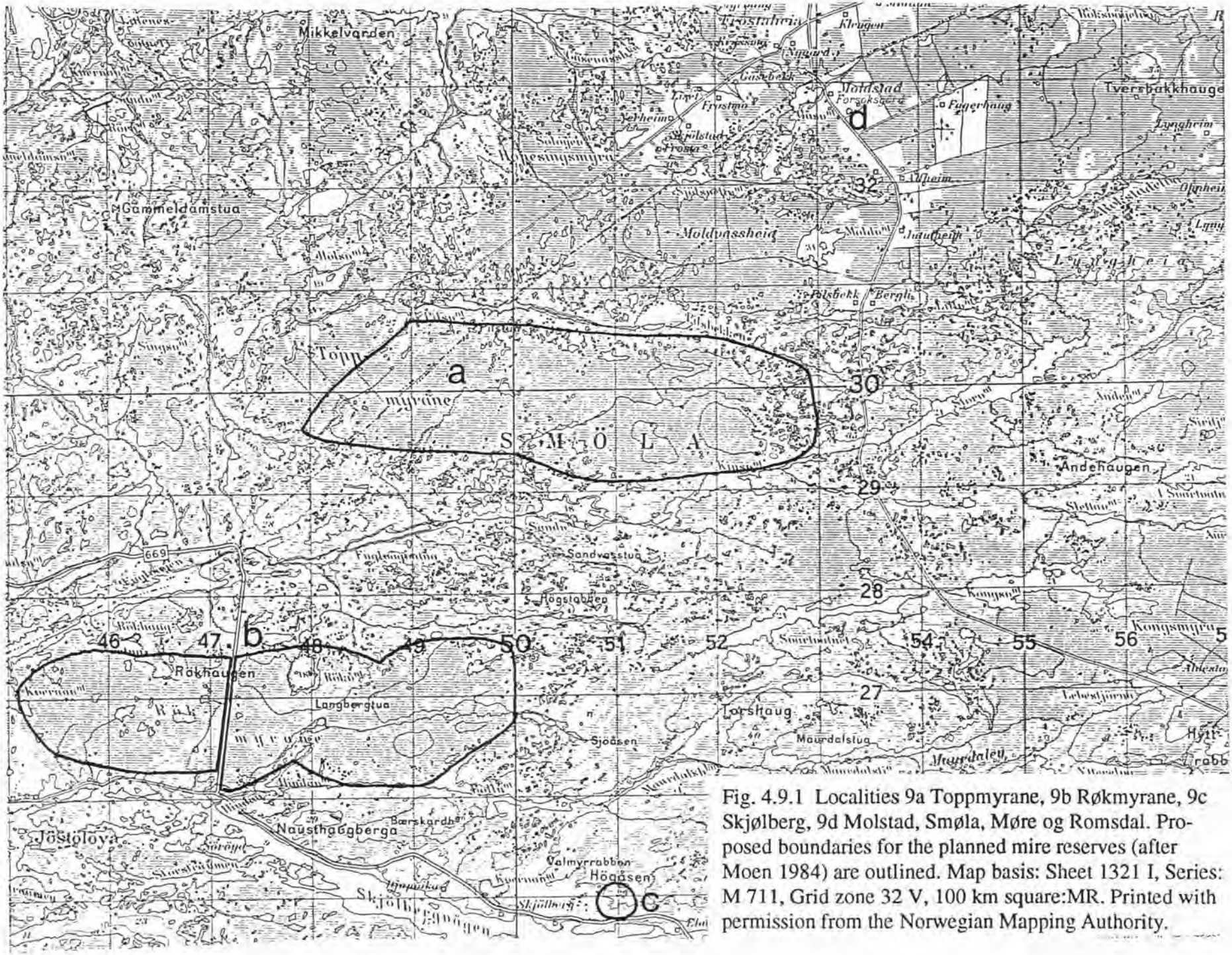


Fig. 4.9.1 Localities 9a Toppmyrane, 9b Røkmyrane, 9c Skjølberg, 9d Molstad, Smøla, Møre og Romsdal. Proposed boundaries for the planned mire reserves (after Moen 1984) are outlined. Map basis: Sheet 1321 I, Series: M 711, Grid zone 32 V, 100 km square:MR. Printed with permission from the Norwegian Mapping Authority.

Fig. 4.9.2 Røkmyran, Smøla. Atlantic raised bog with eccentric features.
Fig. 4.9.3 Extremely rich fen at Nordmarka, Møre og Romsdal. *Dactylorhiza incarnata.*

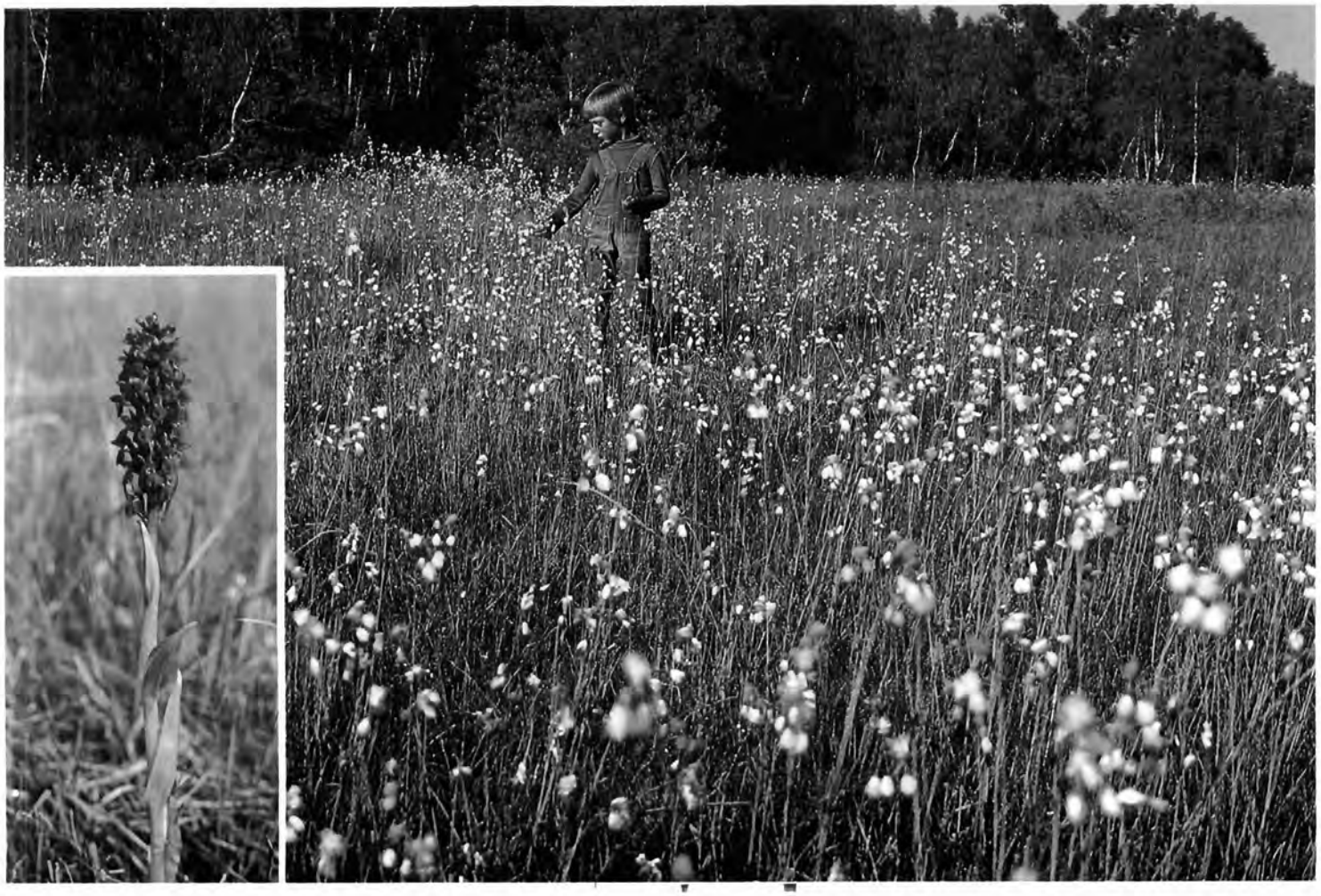


Table 4.1.9. Toppmyrane, Smøla. Species list of mire plants. Vascular plants and Sphagna are complete; only some other cryptogams are included.

TYPE	Species name
K	Agrostis capillaris
K	Andromeda polifolia
K	Arctostaphylos alpinus
K	Bartsia alpina
K	Betula nana
K	Betula pubescens
K	Calluna vulgaris
K	Caltha palustris
K	Carex canescens
K	Carex lasiocarpa
K	Carex limosa
K	Carex magellanica
K	Carex nigra
K	Carex panicea
K	Carex pauciflora
K	Carex rostrata
K	Cornus suecica
K	Dactylorhiza maculata
K	Deschampsia flexuosa
K	Drosera anglica
K	Drosera rotundifolia
K	Empetrum nigrum
K	Empetrum sp.
K	Equisetum fluviatile
K	Erica tetralix
K	Eriophorum angustifolium
K	Eriophorum vaginatum
K	Galium palustre
K	Juncus bulbosus
K	Juncus filiformis
K	Juncus squarrosus
K	Leontodon autumnalis
K	Menyanthes trifoliata
K	Molinia caerulea
K	Myriophyllum alterniflorum
K	Narthecium ossifragum
K	Nuphar sp.
K	Nymphaea sp.
K	Oxycoccus microcarpus
K	Oxycoccus sp.
K	Phragmites australis
K	Pinguicula vulgaris
K	Pinus sylvestris
K	Potamogeton polygonifolius
K	Potentilla erecta
K	Potentilla palustris
K	Ranunculus flammula
K	Rhynchospora alba
K	Rubus chamaemorus
K	Salix aurita
K	Salix lapponum
K	Scirpus cespitosus ssp. cespitosus
K	Sparganium angustifolium
K	Succisa pratensis
K	Tofieldia pusilla
K	Trientalis europaea
K	Vaccinium uliginosum
K	Vaccinium vitis-idaea
L	Cetraria islandica
L	Cladina portentosa
L	Cladina stellaris
M	Bazzania trilobata
M	Dicranum leioneuron
M	Drepanocladus fluitans
M	Hypnum jutlandicum
M	Racomitrium lanuginosum
M	Rhytidiadelphus loreus
M	Sphagnum angustifolium
M	Sphagnum auriculatum
M	Sphagnum balticum
M	Sphagnum capillifolium
M	Sphagnum compactum
M	Sphagnum contortum
M	Sphagnum cuspidatum
M	Sphagnum fallax
M	Sphagnum flexuosum
M	Sphagnum fuscum
M	Sphagnum imbricatum
M	Sphagnum lindbergii
M	Sphagnum magellanicum
M	Sphagnum palustre
M	Sphagnum papillosum
M	Sphagnum platyphyllum
M	Sphagnum pulchrum
M	Sphagnum recurvum coll.
M	Sphagnum rubellum
M	Sphagnum subnitens
M	Sphagnum tenellum

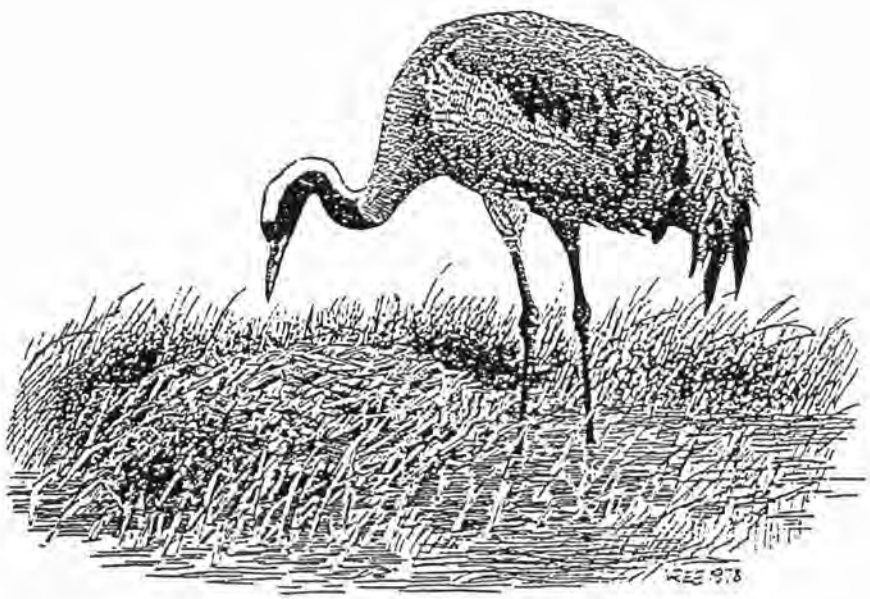
H= hybrid, K=vascular plant, M=bryophyte, L=lichen

5. An ornithological excursion guide for the 6th IMCG excursion to central Norway 7 - 15 July 1994

Øystein R. Størkersen, Directorate for Nature Management, Trondheim

During our excursion, we shall visit both the interior and coastal zones. A "transect" like this will of course produce widely different species. The sites located in the interior may be regarded as more or less similar as regards their bird fauna. Only in the more extreme alpine areas like Dovrefjell (Fokstumyra and Haukskardtjørnin) can we expect additional new species, such as the more extreme alpine species typical for the Scandinavian mountains. The occurrence of rodents always strongly influences the occurrence of birds of prey. This is the best lemming year since 1967 on Hardangervidda (to the south of our area), but we also have large numbers of rodents locally in the lowlands around Trondheimsfjord and possibly at some of our localities. Moving out to the coast, we shall experience additional species connected with coastal areas. The mixture of species associated with the mire or bog itself and species from the surroundings will be even more apparent here. However, in the following description, I shall try to pinpoint the more typical species connected with mires, but at the same time also mention some other species likely to be seen in adjacent areas. Finally, I should mention that if the prime season to see the flora is July, then the best time to study the birds will be June. Consequently, the time of our visit is not ideal for birdwatching and we may even experience some southward autumn migration!

The drawings are by the artists, Rune Roaldkvam and Viggo Ree, and are reproduced from the Norwegian Breeding Birds Atlas (1994).



Forra is one of the largest mire and wetland systems in the southern boreal part of Norway. Even if bird densities are not always high, this vast area constitutes an important breeding ground for both nationally rare and common species. The mixture of wet mires and woodlands of birch, pine and spruce creates ideal breeding habitats for typical species like Crane *Grus grus*, Wood Sandpiper

Tringa glareola (with an eastern breeding occurrence in Norway), Greenshank *Tringa nebularia*, Redshank *Tringa totanus*, Ruff *Philomachus pugnax* (which is particularly numerous), Snipe *Gallinago gallinago* and locally also Great Snipe *Gallinago media*, Whimbrel *Numenius phaeopus*, Red-necked Phalarope *Phalaropus lobatus* and Woodcock *Scolopax rusticola*. Along the numerous watercourses and lakes, Willow Warbler *Phylloscopus trochilus*, Reed Bunting *Emberiza schoeniclus*, Yellow Wagtail *Motacilla flava thunbergi* and Common Sandpiper *Actitis macularia* abound. Special and typical species in forested areas are Jay *Garrulus glandarius*, Siberian Jay *Perisoreus infaustus*, Three-toed Woodpecker *Picoides tridactylus*, Coal Tit *Parus ater*, Crested Tit *Parus cristatus*, Willow Tit *Parus montanus*, Crossbill *Loxia curvirostra* and Parrot Crossbill *Loxia pytyopsittacus*, along with more common species like Meadow Pipit *Anthus pratensis*, Tree Pipit *Anthus trivialis*, Brambling *Fringilla montifringilla*, Redpoll *Carduelis flammea*, Redwing *Turdus iliacus*, Song Thrush *Turdus philomelos*, Fieldfare *Turdus pilaris*, Robin *Erithacus rubecula*, Redstart *Phoenicurus phoenicurus* and Goldcrest *Regulus regulus*. Lesser Spotted Woodpecker *Dendrocopos minor*, Icterine Warbler *Hippolais icterina*, Garden Warbler *Sylvia borin* and Blackcap *Sylvia atricapilla* may occasionally breed in "richer" deciduous forests. The most common waterfowl in this area will be Black-throated Diver *Gavia arctica*, Red-throated Diver *Gavia stellata*, Mallard *Anas platyrhynchos*, Teal *Anas crecca*, Wigeon *Anas penelope*, Tufted Duck *Aythya fuligula* and Goldeneye *Bucephala clangula*. The occasional Golden Eagle *Aquila chrysaetos* may pass over, as may Rough-legged Buzzard *Buteo lagopus*, Merlin *Falco columbarius* and Short-eared Owl *Asio flammeus*. The open mires are ideal for lekking Black Grouse *Tetrao tetrix*, while Capercaillie *Tetrao urogallus* can be found lekking in the pine forests, Willow Grouse *Lagopus lagopus* abound everywhere.

At **Sølendet**, the most outstanding ornithological features will be Crane *Grus grus*, Great Snipe *Gallinago gallinago*, Whimbrel *Numenius phaeopus* and Wood Sandpiper *Tringa glareola*. The topography does not encourage a high density of most waders, but passerines can be quite numerous. Typical passerines will be Grey Flycatcher *Muscicapa striata*, Siskin *Carduelis spinus*, Redpoll *Carduelis flammea*, Brambling *Fringilla montifringilla*, Redwing *Turdus iliacus*, Song Thrush *Turdus philomelos*, Fieldfare *Turdus pilaris*, Reed Bunting *Emberiza schoeniclus*, Meadow Pipit *Anthus pratensis*, Tree Pipit *Anthus trivialis* and Willow Tit *Parus montanus*. Species like Black Grouse *Tetrao tetrix*, Capercaillie *Tetrao urogallus* and Willow Grouse *Lagopus lagopus* occur more rarely. In years with an abundance of rodents, the area may have other species like Great Grey Shrike *Lanius excubitor*, Rough-legged Buzzard *Buteo lagopus*, Kestrel *Falco tinnunculus* and Short-eared Owl *Asio flammeus*. Along the watercourses, Common Sandpiper *Actitis hypoleucos* and Reed Bunting *Emberiza schoeniclus* are numerous.

Tufsingdeltaet is an important wetland on the shores of Lake Femund. In this part of Norway, the surrounding area of birch and pine forests usually contains a low density of birds. Typical species are Willow Tit *Parus montanus*, Redstart *Phoenicurus phoenicurus*, Fieldfare *Turdus pilaris*, Redwing *Turdus iliacus* and Brambling *Fringilla montifringilla*. In damper parts and along the shores, the birch forests may contain an array of additional species like Dunnock *Prunella modularis*, Garden Warbler *Sylvia borin*, Grey Flycatcher *Muscicapa striata*, Song Thrush *Turdus philomelos*, and the occasional Icterine Warbler *Hippolais icterina* and Robin *Erithacus rubecula*. In open areas with mires and *Salix* bushes, Reed Bunting *Emberiza schoeniclus* is characteristic, together with Yellow Wagtail *Motacilla flava* and Bluethroat *Luscinia svecica*. The delta itself primarily has an important function as a breeding and moulting area for a number of species of waterfowl and waders. The most common waders are Snipe *Gallinago gallinago*, Common Sandpiper *Actitis hypoleuca*, Wood Sandpiper *Tringa glareola*, Redshank *Tringa totanus*, Greenshank *Tringa nebularia*, Ruff *Philomachus pugnax*, Whimbrel *Numenius phaeopus*, Lapwing

Vanellus vanellus and Red-necked Phalarope *Phalaropus lobatus*. Crane *Grus grus*, Black-throated Diver *Gavia arctica* and Red-throated Diver *Gavia stellata* also breed here. Characteristic waterfowl species are Teal *Anas crecca*, Tufted Duck *Aythya fuligula*, Goldeneye *Bucephala clangula* and occasionally Wigeon *Anas penelope* and Pintail *Anas acuta*. The Arctic Tern *Sterna paradisea* also regularly occurs in the interior of central Norway. A number of more sporadically occurring species like Slavonian Grebe *Podiceps auritus* and Little Gull *Larus minutus* may also be found.

The diversity at **Stormyra** is above average for the mires in the upper reaches of the River Glomma. Being situated in the transition zone between the lowlands and the alpine zone, and surrounded by pine forests and cultivated land, Stormyra shows a great variety of species. This particularly applies during the migratory seasons. Rarer species like Shoveler *Anas clypeata* and Great Snipe *Gallinago media* may also breed here. Typical breeding species are Reed Bunting *Emberiza schoeniclus*, Meadow Pipit *Anthus pratensis*, Tree Pipit *Anthus trivialis* and Whinchat *Saxicola rubetra*. Among the common waders are Snipe *Gallinago gallinago*, Redshank *Tringa totanus*, Greenshank *Tringa nebularia*, Green Sandpiper *Tringa ochropus* and Common Sandpiper *Actitis hypoleuca*. The most common wildfowl are Wigeon *Anas penelope*, Teal *Anas crecca*, Mallard *Anas platyrhynchos*, Tufted Duck *Aythya fuligula* and Goldeneye *Bucephala clangula*. Crane *Grus grus*, Short-eared Owl *Asio flammeus* and Black-headed Gull *Larus ridibundus* may also be seen here.

Haukskardtjørnin is situated close to the more famous Fokstumyra Nature Reserve. Additional species in this small area will naturally be the more alpine species that may occur in the vicinity. These may be Snow Bunting *Plectrophenax nivalis*, Shore Lark *Eremophila alpestris*, Ptarmigan *Lagopus mutus*, Raven *Corvus corax* and Dotterel *Charadrius morinellus*. Within the reserve, species likely to be encountered are Golden Plover *Pluvialis apricaria*, Wood Sandpiper *Tringa glareola*, Redshank *Tringa totanus* and Red-necked Phalarope *Phalaropus lobatus*, Meadow Pipit *Anthus pratensis*, Ring Ouzel *Turdus troquatus*, Wheatear *Oenanthe oenanthe*, Yellow Wagtail *Motacilla flava* and Bluethroat *Luscinia svecica*. Common breeding species in the surrounding birch forest are Willow Warbler *Phylloscopus trochilus*, Brambling *Fringilla montifringilla*, Fieldfare *Turdus pilaris*, Redwing *Turdus iliacus*, Willow Tit *Parus montanus*, Kestrel *Falco tinnunculus* and Merlin *Falco columbarius*. More rarely, the Lesser Whitethroat *Sylvia curruca* may also be found.

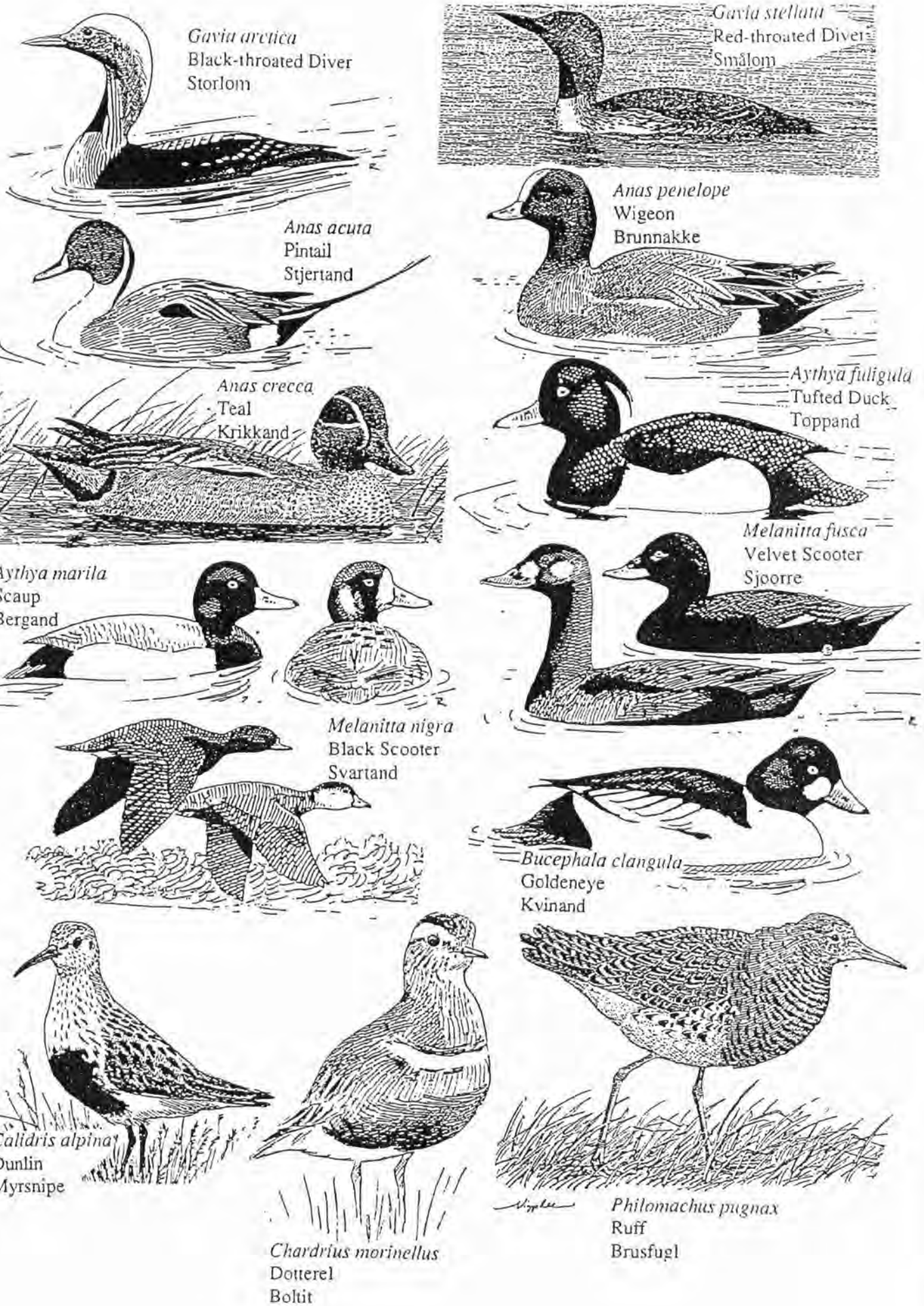
From Kongsvold fjellstue, an early morning visit to Fokstumyra is an option for those who are interested, prior to our visit to the nearby Haukskardtjørnin.

Fokstumyra is classical in an ornithological and nature conservation context. This area is regarded as internationally important and when the animal life here was protected in 1923 the area was among the first in Norway to be protected by the Nature Conservation Act. Later, in 1969, a nature reserve was established. The first known ornithological work in this area dates back to 1816. Fokstumyra is also a typical example of a Norwegian alpine mire complex. Interesting Quaternary features can also be seen in this area. Although access to Fokstumyra is restricted during the breeding season, it is still permissible to walk on a path through the reserve (2-4 hours walk). No deviation from the path is allowed! Even if the best time of year to watch birds here is May and June, typical examples of the fauna should still be present in the area in July. Whimbrel *Numenius phaeopus*, Wood Sandpiper *Tringa glareola*, Redshank *Tringa totanus*, Greenshank *Tringa nebularia*, Snipe *Gallinago gallinago* and Red-necked Phalarope *Phalaropus lobatus* are all very common. Other waders to be seen are Ruff *Philomachus pugnax* and Golden Plover *Pluvialis apricaria*, and also breeding Cranes *Grus grus*. Among the common passerines are Bluethroat

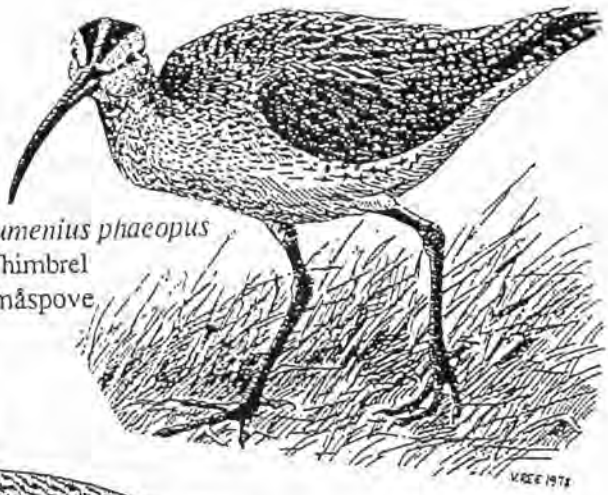
Luscinia svecica, Lapland Bunting *Calcarius lapponicus* and Yellow Wagtail *Motacilla flava*. Many waterfowl also occur: Tufted Duck *Aythya fuligula*, Scaup *Aythya marila*, Velvet Scoter *Melanitta fusca*, Black Scoter *Melanitta nigra*, Goldeneye *Bucephala clangula*, Mallard *Anas platyrhynchos*, Wigeon *Anas penelope*, Pintail *Anas acuta* and more rarely Shoveler *Anas clypeata* and Garganey *Anas querquedula*. Black-throated Diver *Gavia arctica* breed on the larger lakes. Other common and widespread species here are Swift *Apus apus*, House Martin *Delichon urbica*, Reed Bunting *Emberiza schoeniclus*, Redwing *Turdus iliacus*, Fieldfare *Turdus pilaris*, Cuckoo *Cuculus canorus*, Willow Warbler *Phylloscopus trochilus* and Wheatear *Oenanthe oenanthe*. Dipper *Cinclus cinclus* breed commonly on the outskirts of the area, along rapidly flowing streams. This area is one of the few breeding localities for Hen Harrier *Circus cyaneus* in Norway. Other raptors are Rough-legged Buzzard *Buteo lagopus*, Kestrel *Falco tinnunculus*, Merlin *Falco columbarius* and Short-eared Owl *Asio flammeus*. Long-tailed Skua *Stercorarius longicaudus* also regularly breed here. Both Golden Eagle *Aquila chrysaetos* and Gyr Falcon *Falco rusticolus* occur on this upland plateau (called Dovre). Prior to the building of the railway through the reserve, the Lesser White-fronted Goose *Anser erythropus* and Broad-billed Sandpiper *Limicola falcinellus* bred on these wetlands.

Because of its physical characteristics, the blanket bog of **Bakkedalen** itself harbours only a few bird species. Nonetheless, some species here are typical representatives for such coastal bogs. Golden Plover *Pluvialis apricaria*, Willow Grouse *Lagopus lagopus* and Meadow Pipit *Anthus pratensis* are characteristic. Other breeding species are Snipe *Gallinago gallinago*, Twite *Carduelis flavirostris*, Wheatear *Oenanthe oenanthe*, Ring Ouzel *Turdus torquata*, Lapwing *Vanellus vanellus*, Curlew *Numenius arquata* and Black Grouse *Tetrao tetrix*. The odd White-tailed (Sea) Eagle *Haliaetus albicilla* may also pass over. In the surroundings, numerous additional species may appear, like Whitethroat *Sylvia communis* and Skylark *Alauda arvensis*. Finally, I should mention that a number of rarer species from southern parts of Europe turn up from time to time on the island of Skuløy (e.g. Spectacled Warbler, Savi's Warbler and Lesser Kestrel!).

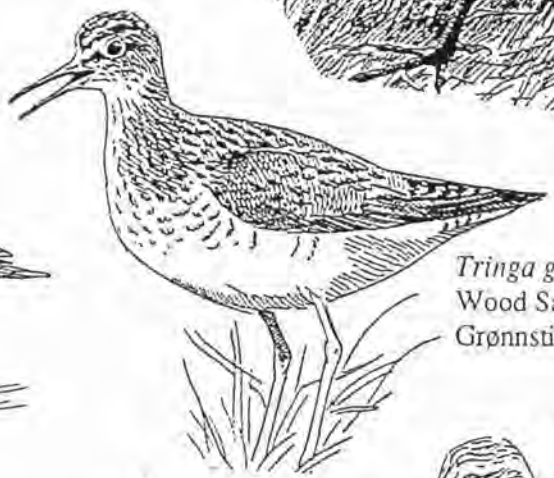
Smøla with its vast mires and rocky outcrops offers breeding opportunities for species from the coastal zone and those that are traditionally regarded as more interior species. Examples are Willow Grouse *lagopus lagopus* (mostly brown all year round, i.e. the so-called Smøla Willow Grouse!), Golden Plover *Pluvialis apricaria* and Dunlin *Calidris alpina*. These three species are characteristic for these mires. Other species are more associated with the coast: Grey-lag Goose *Anser anser* and Arctic Skua *Stercorarius skua*. Curlew *Numenius arquata*, Redshank *tringa totanus*, Lapwing *Vanellus vanellus* and Snipe *Gallinago gallinago* are among the most dominant wader species in these coastal areas. Typical passerines are Wheatear *Oenanthe oenanthe*, Meadow Pipit *Anthus pratensis*, Whinchat *Saxicola torquata* and even the rare Stonechat *Saxicola rubetra* may occur. The Red-throated Diver *Gavia stellata* breeds in more secluded lakes. Smøla is most famous for its wintering population of waterfowl, notably Red-necked Grebe *Podiceps grisegena*, Great Northern Diver *Gavia immer*, Scoters *Melanitta spp.*, Long-tailed Duck *Clangula hyemalis*, Eider *Somateria mollissima*, Red-breasted Merganser *Mergus serrator* and Grey Heron *Ardea cinerea*, together with large numbers of auks and cormorants. Along the coast, an array of the most common breeding Norwegian species may turn up anywhere in suitable habitats, like Rock Pipit *Anthus spinoletta*, Twite *Carduelis flavirostris*, Oystercatcher *Haematopus ostralegus*, Ringed Plover *Charadrius hiaticula*, Curlew *Numenius torquata* and Whitethroat *Sylvia communis*.


Gavia arctica
Black-throated Diver
Storlom
Gavia stellata
Red-throated Diver
Smålom
Anas acuta
Pintail
Stjertand
Anas penelope
Wigeon
Brunnakke
Anas crecca
Teal
Krikkand
Aythya fuligula
Tufted Duck
Toppand
Melanitta fusca
Velvet Scooter
Sjoorre
Aythya marila
Scaup
Bergand
Melanitta nigra
Black Scooter
Svartand
Bucephala clangula
Goldeneye
Kvinand
Calidris alpina
Dunlin
Myrsnipe
Chardrius morinellus
Dotterel
Boltit
Philomachus pugnax
Ruff
Brusfugl

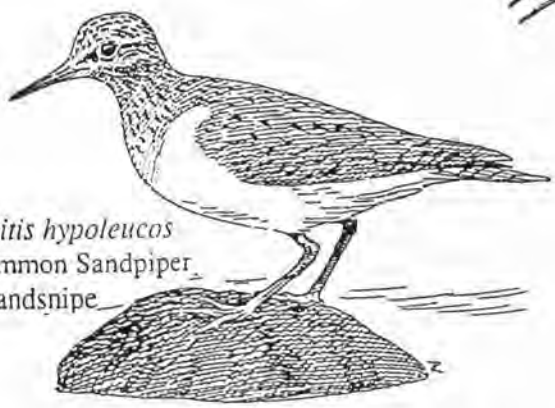
Gallinago gallinago
Snipe
Enkeltbekkasin



Numenius phaeopus
Whimbrel
Småspove



Tringa glareola
Wood Sandpiper
Grønnstilk



Actitis hypoleucos
Common Sandpiper
Strandsnipe

Tringa nebularia
Greenshank
Gluttsnipe

Asio flammeus
Short-eared Owl
Jordugle

Phalaropus lobatus
Red-necked Phalarope
Svømmesnipe

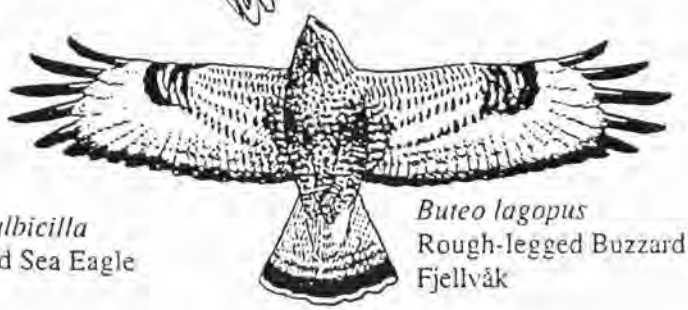
Circus cyaneus
Hen Harrier
Myrhauk

Surnia ulula
Hawk Owl
Haukugle

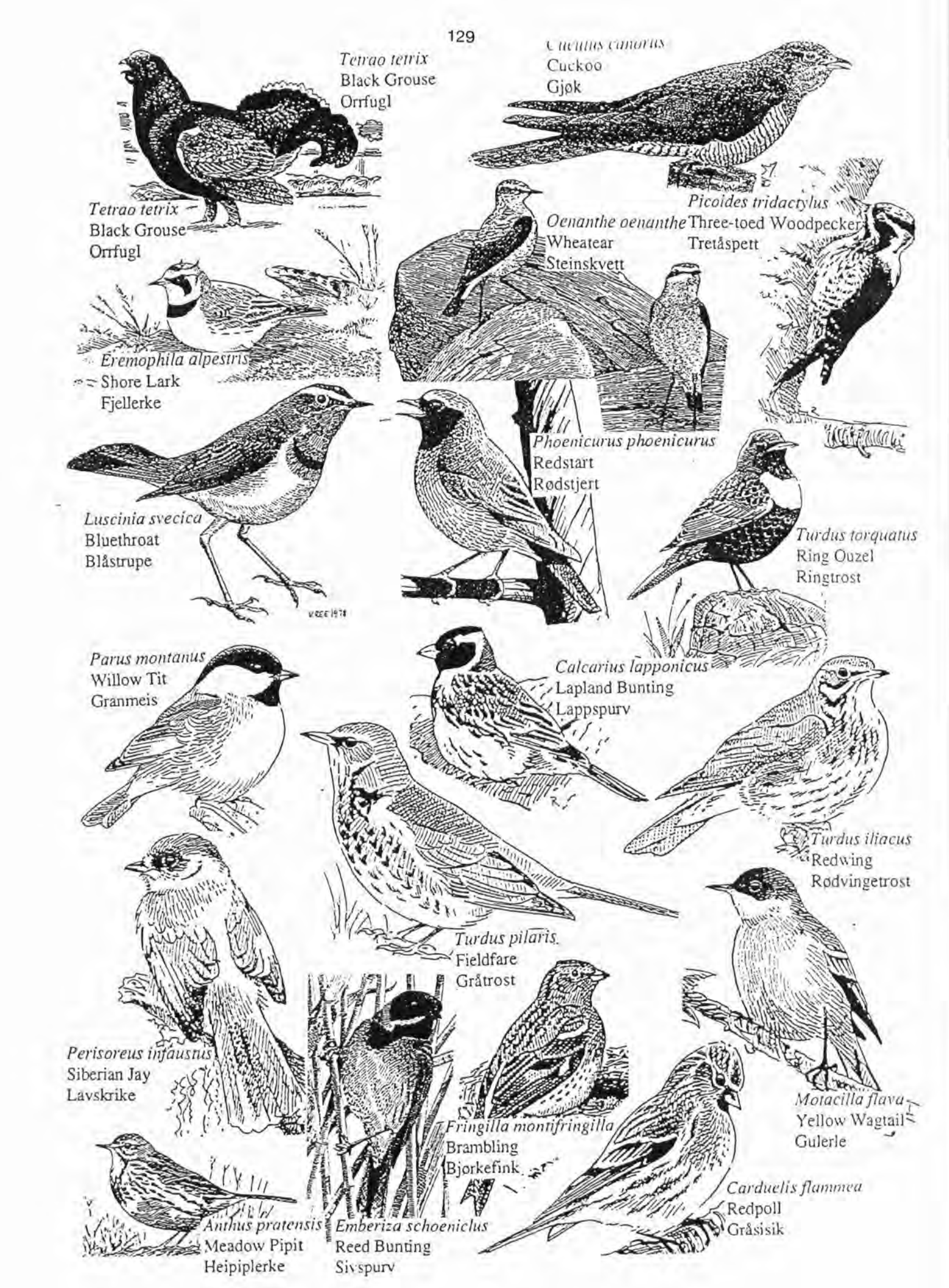
Pluvialis apricaria
Golden Plover
Heilo

Falco columbarius
Merlin
Dvergfalk

Haliaetus albicilla
White-tailed Sea Eagle
Havorn



Buteo lagopus
Rough-legged Buzzard
Fjellvåk


Tetrao tetrix
Black Grouse
Orrfugl
Cuculus canorus
Cuckoo
Gjøk
Tetrao tetrix
Black Grouse
Orrfugl
Picoides tridactylus
Three-toed Woodpecker
Tretåspett
Oenanthe oenanthe
Wheatear
Steinskvett
Eremophila alpestris
Shore Lark
Fjellerke
Phoenicurus phoenicurus
Redstart
Rødstjert
Luscinia svecica
Bluethroat
Blåstrupe
Turdus torquatus
Ring Ouzel
Ringtrost
Parus montanus
Willow Tit
Granmeis
Calcarius lapponicus
Lapland Bunting
Lappspurv
Turdus iliacus
Redwing
Rødvingetrost
Turdus pilaris
Fieldfare
Gråtrost
Perisoreus infaustus
Siberian Jay
Lavskrike
Motacilla flava
Yellow Wagtail
Gulerle
Fringilla montifringilla
Brambling
Bjørkefink
Carduelis flammea
Redpoll
Gråsisik
Anthus pratensis
Meadow Pipit
Heipiplerke
Emberiza schoeniclus
Reed Bunting
Sivspurv

Species latin	English name	Norwe-gian name	Locality: Date:		
Gavia stellata	Red-throa ted Diver	Smålom			
G. arctica	Black-thr. Diver	Storlom			
Ardea cinerea	Grey Heron	Gråhegre			
Anser anser	Grey-lag Goose	Grågås			
Tadorna tadorna	Shelduck	Gravand			
Anas penelope	Wigeon	Brunnak-ke			
A. platyrhyn	Mallard	Stokkand			
A. acuta	Pintail	Stjertand			
A. crecca	Teal	Krikkand			
Aythya fuligula	Tufted Duck	Toppand			
Somateria mollissima	Eider	Ærfugl			
Clangula hyemalis	Long-tail-ed Duck	Havelle			
Melanitta nigra	Black Scooter	Svartand			
M. fusca	Velvet Scooter	Sjøorre			
Bucephal. clangula	Golden-eye	Kvinand			
Mergus serrator	Red-brea-sted Merg	Siland			
M. merganser	Goos-ander	Laksand			
Circus cyaneus	Hen Harrier	Myrhauk			
Accipiter nisus	Sparrow-hawk	Spurve-hauk			
A. gentilis	Goshawk	Hønse-hauk			
Buteo lagopus	Rough-leg ged Buzz.	Fjellvåk			
Haliaetus albicilla	White-tail. Sea Eagle	Havørn			
Aquila chrysaet.	Golden Eagle	Kongeørn			
Falco tinnuncul.	Kestrel	Tårnfalk			
F. columb.	Merlin	Dvergfalk			
Lagopus lagopus	Willow Grouse	Lirype			
L. mutus	Ptarmigan	Fjellrype			
Tetrao urogallus	Capercail-lie	Storfugl			
T. tetrix	Black Grouse	Orrfugl			
Grus grus	Crane	Trane			
Haemato. ostralegus	Oystercat-cher	Tjeld			
Charardr. hiaticula	Ringed Plover	Sandlo			
Pluvialis apricaria	Golden Plover	Heilo			
Vanellus vanellus	Lapwing	Vipe			
Calidris alpina	Dunlin	Myrsnipe			
C. temminck.	Temmin-ck's Stint	Temmin-cksnipe			

Philomac. pugnax	Ruff	Brusfugl		
Numenius arquata	Curlew	Storsp-ove		
N. phaeopus	Whimbrel	Småspove		
Limosa limosa	Black-tail. Godwit	Svarthale-spove		
Tringa totanus	Redshank	Rødstilk		
T. nebularia	Green-shank	Gluttsnipe		
T. glareola	Wood Sandpiper	Grønn-stilk		
T. ochropus	Green Sandpiper	Skog-snipe		
Actitis hypoleuca	Common Sandpiper	Strand-snipe		
Scolopax rusticola	Wood-cock	Rugde		
Gallinago media	Great Snipe	Dobbelt-bekkasin		
G. gallinago	Snipe	Enkelt-bekkasin		
Phalarop. lobatus	Red-neck. Phalarope	Svømme-snipe		
Stercorar. parasitic.	Arctic Skua	Tyvjo		
S. longicaud.	Long-tail. Skua	Fjelljo		
Larus ridibundus	Black-hea ded Gull	Hette-måke		
L. canus	Common Gull	Fiske-måke		
Sterna hirundo	Common Tern	Makrell-terne		
S. paradisae.	Arctic Tern	Rødnebb-terne		
Columba palumbus	Wood Pigeon	Ringdue		
Cuculus canorus	Cuckoo	Gjøk		
Asio flammeus	Short-eared Owl	Jordugle		
Surnia ulula	Hawk Owl	Haukugle		
Apus apus	Swift	Tårnseiler		
Dryocop. martius	Black Woodpec.	Svart-spett		
Dendroc. major	Great Spott. W.	Flagg-spett		
D. minor	Lesser Spotted W	Dverg-spett		
Picoides tridactylu.	Three-toed W.	Tretåspett		
Aaluda arvensis	Skylark	Sanglerke		
Riparia riparia	Sand Martin	Sandsvale		
Hirundo rustica	Swallow	Låvesvale		
Delichon urbica	House Martin	Taksvale		
Anthus spinoletta	Rock Pipit	Skjærpip-lerke		
A. trivialis	Tree Pipit	Trepip-lerke		
A. pratensis	Meadow Pipit	Heipip-lerke		
Motacilla alba	Wagtail	Linerle		

Motacilla flava	Yellow Wagtail	Gulerle			
Cinclus cinclus	Dipper	Fossekall			
Troglody. troglody.	Wren	Gjerde-smett			
Prunella modularis	Dunnock	Jemspurv			
Erithacus rubecula	Robin	Rødst-rupe			
Luscinia svecica	Blueth-roat	Blåstrupe			
Phoenicur. phoenicur.	Redstart	Rødstjert			
Saxicola rubetra	Whinchat	Busk-skvett			
S. torquata	Stonechat	Svart-strupe			
Oenanthe oenanthe	Wheatear	Stein-skvett			
Turdus torquata	Ring Ouzel	Ringtrost			
T. merula	Blackbird	Svarttrost			
T. pilaris	Fieldfare	Gråtrost			
T. iliacus	Redwing	Rødvinge-trost			
T. philom.	Song Thrush	Måltrost			
Hippolais icterina	Icterine Warbler	Gulsanger			
Sylvia borin	Garden Warbler	Hage-sanger			
S. curruca	Lesser Whitethro.	Møller			
S. communis	White-throat	Tornsanger			
S. atricapilla	Blackcap	Munk			
Phyll. trochilus	Willow Warbler	Løvsanger			
Phyll. collybita	Chiffchaff	Gran-sanger			
Regulus regulus	Goldcrest	Fugle-konge			
Ficedula hypoleuca	Pied Fly-catcher	Svarthvit fluesnapp.			
Muscicap. striata	Grey Flycatcher	Gråflue-snapper			
Parus montanus	Willow Tit	Granmeis			
P. cristatus	Crested Tit	Toppmeis			
P. major	Great Tit	Kjøttmeis			
P. ater	Coal Tit	Svartmeis			
Lanius excubitor	Gr.Grey Shrike	Varsler			
Sturnus vulgaris	Starling	Stær			
Perisoreus infaustus	Siberian Jay	Lavskrike			
Garrulus glandarius	Jay	Nøtte-skrike			
Pica pica	Magpie	Skjære			
Corvus corax	Raven	Ravn			
C. corone	Hooded Crow	Kråke			
Fringilla coelebs	Chaffinch	Bokfink			

F. monti-fringilla	Brambling	Bjørke-fink		
Carduelis spinus	Siskin	Grønn-sisik		
C. chloris	Green-finch	Grønnfink		
Pyrrhula pyrrhula	Bullfinch	Dompap		
Carduelis flammea	Redpoll	Gråsisik		
C. flavirostr.	Twite	Bergirisk		
Loxia curvirostr.	Crossbill	Grankors-nebb		
L. pytyo-psittacus	Parrot Crossbill	Furukors-nebb		
Emberiza citrinella	Yellow-hammer	Gulspurv		
E. schoenicl.	Reed Bunting	Sivspurv		
Calcarius lapponic.	Lapland Bunting	Lapp-spurv		
Plectroph. nivalis	Snow Bunting	Snøspurv		

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Appendix A. List of mire species for 13 of the localities described in chapter 4. Data is lacking for locality 7a.

Locality numbers, names and municipalities: 1. Rørmyra, Trondheim; 2. Kaldvassmyra, Verdal; 3. Upper Forra, Levanger etc.; 4. Sølendet, Røros; 5. Tufsingdeltaet, Os; 6. Stormyra, Tynset; 7b. Haugtjørnin, Oppdal; 7c. Fokstumyra, Dovre; 8a. Bakkedalen, Haram; 8b. Haramsøy, Haram; 8c. Hustadmyrane, Hustad; 9a. Toppmyrane Smøla; 9b. Røkmyrane, Smøla.

TYPE	Species name	1	2	3	4	5	6	7b	7c	8a	8b	8c	9a	9b
H	Betula nana x pubescens											x		
H	Carex flava x hostiana				x									
H	Carex flava x lepidocarpa		x											
K	Agrostis canina			x	x	x	x		x	x	x			
K	Agrostis capillaris	x	x	x	x	x	x		x		x		x	x
K	Agrostis stolonifera	x	x	x			x							
K	Alchemilla sp.		x	x	x			x	x	x	x	x		
K	Alnus incana	x	x	x	x		x					x		
K	Alopecurus aequalis				x		x							
K	Alopecurus geniculatus		x											
K	Andromeda polifolia	x	x	x	x	x	x	x	x	x	x	x	x	x
K	Anemone nemorosa	x	x	x							x			
K	Angelica archangelica				x			x						
K	Angelica sylvestris		x	x	x	x	x				x	x		
K	Anthoxanthum odoratum	x	x	x	x	x	x	x	x	x	x			
K	Arctostaphylos alpinus				x	x		x	x	x	x	x	x	x
K	Bartsia alpina		x	x	x				x	x	x	x		x
K	Betula nana	x	x	x	x	x	x	x	x	x	x	x	x	x
K	Betula pubescens	x	x	x	x	x	x		x	x	x	x		x
K	Calamagrostis purpurea		x	x	x	x	x		x			x		
K	Calamagrostis stricta	x	x	x	x	x	x		x					
K	Calluna vulgaris	x	x	x	x	x	x		x	x	x	x	x	x
K	Caltha palustris	x	x	x	x	x	x	x	x			x		x
K	Cardamine amara	x	x			x	x							
K	Cardamine nymanii						x	x						
K	Cardamine pratensis		x	x	x		x		x					
K	Carex acuta		x											
K	Carex adelostoma			x			x		x					
K	Carex appropinquata		x		x									
K	Carex aquatilis						x							
K	Carex atrata				x									
K	Carex atrofusca			x	x			x	x					
K	Carex bigelowii		x	x	x	x		x	x	x	x			
K	Carex brunnescens			x	x		x							
K	Carex buxbaumii		x	x	x		x							
K	Carex canescens	x	x	x	x	x	x	x	x	x		x	x	x
K	Carex capillaris	x	x	x	x		x	x	x		x			
K	Carex capitata				x		x		x					
K	Carex chordorrhiza	x	x	x	x	x	x	x	x					
K	Carex diandra		x											
K	Carex dioica	x	x	x	x	x	x	x	x	x	x	x		
K	Carex echinata	x	x	x	x	x	x			x	x	x		
K	Carex elongata		x											
K	Carex flacca									x	x			
K	Carex flava	x	x	x	x	x	x							
K	Carex globularis					x	x							
K	Carex heleonastes				x				x					

H=hybrid; K=vascular plant; M=bryophyte; L=lichen

TYPE	Species name	1	2	3	4	5	6	7b	7c	8a	8b	8c	9a	9b
K	Carex hostiana	x		x	x					x	x	x		
K	Carex juncella			x	x	x	x		x					
K	Carex lasiocarpa	x	x	x	x	x	x		x			x	x	x
K	Carex laxa					x	x							
K	Carex lepidocarpa	x	x	x										
K	Carex limosa	x	x	x	x	x	x		x	x		x	x	x
K	Carex livida		x	x	x	x	x		x					
K	Carex loliacea		x											
K	Carex magellanica	x	x	x	x	x	x		x				x	x
K	Carex microglochin			x	x			x	x					
K	Carex nigra	x	x	x	x	x	x	x	x	x	x	x	x	x
K	Carex norvegica		x	x	x									
K	Carex oederi						x							
K	Carex pallescens		x	x	x					x	x	x		
K	Carex panicea	x	x	x	x	x	x	x	x	x	x	x	x	x
K	Carex pauciflora	x	x	x	x	x	x			x	x	x	x	x
K	Carex pulicaris	x	x	x						x	x	x		
K	Carex rariflora							x						
K	Carex rostrata	x	x	x	x	x	x	x	x	x	x	x	x	x
K	Carex rotundata			x										
K	Carex saxatilis				x			x	x					
K	Carex scandinavica						x							
K	Carex stenolepis				x									
K	Carex tenuiflora						x							
K	Carex tumidicarpa	x	x	x						x	x	x		
K	Carex vaginata	x	x	x	x	x	x		x					
K	Carex vesicaria		x	x	x		x							
K	Cerastium cerastoides			x				x						
K	Cerastium fontanum		x	x	x		x		x		x			
K	Chrysosplenium alternifolium		x	x										
K	Cirsium helenioides		x	x	x		x							
K	Cirsium palustre	x		x	x					x	x			
K	Coeloglossum viride			x	x									
K	Corallorhiza trifida		x	x	x		x							
K	Cornus suecica	x	x	x	x					x	x		x	x
K	Crepis paludosa		x	x	x					x	x			
K	Cystopteris montana		x	x										
K	Dactylorhiza cruenta			x	x									
K	Dactylorhiza fuchsii			x	x									
K	Dactylorhiza incarnata		x	x	x		x							
K	Dactylorhiza maculata	x	x	x	x					x	x	x	x	x
K	Dactylorhiza pseudocordigera			x	x									
K	Dactylorhiza traunsteineri									x				
K	Danthonia decumbens									x				
K	Deschampsia cespitosa	x	x	x	x	x	x		x	x	x	x		
K	Deschampsia flexuosa	x	x	x	x	x	x			x	x	x	x	x
K	Drosera anglica	x	x	x	x	x	x			x	x	x	x	x
K	Drosera rotundifolia	x	x	x		x	x			x	x	x	x	x
K	Eleocharis mamillata		x									x		
K	Eleocharis quinqueflora	x	x	x	x		x					x		
K	Empetrum hermaphroditum	x	x	x	x	x	x	x	x					
K	Empetrum nigrum		x							x	x		x	x
K	Empetrum sp.											x	x	x

H=hybrid; K=vascular plant; M=bryophyte; L=lichen

TYPE	Species name	1	2	3	4	5	6	7b	7c	8a	8b	8c	9a	9b
K	Epilobium alsinifolium	x	x		x									
K	Epilobium angustifolium		x	x	x		x		x					
K	Epilobium davuricum	x	x	x	x									
K	Epilobium hornemannii		x	x	x									
K	Epilobium lactiflorum		x	x	x									
K	Epilobium palustre	x	x	x	x		x		x	x		x		
K	Equisetum arvense	x	x	x	x		x		x					
K	Equisetum fluviatile	x	x	x	x	x	x		x			x		x
K	Equisetum hyemale		x		x		x			x				
K	Equisetum palustre	x	x	x	x	x	x	x	x			x		
K	Equisetum pratense		x		x									
K	Equisetum scirpoides		x		x		x							
K	Equisetum sylvaticum		x	x	x	x	x			x	x	x		
K	Equisetum variegatum		x	x	x		x	x	x					
K	Erica tetralix									x	x	x	x	x
K	Eriophorum angustifolium	x	x	x	x	x	x	x	x	x	x	x	x	x
K	Eriophorum latifolium	x	x	x	x					x	x	x		
K	Eriophorum scheuchzeri						x							
K	Eriophorum vaginatum	x	x	x	x	x	x	x	x	x	x	x	x	x
K	Euphrasia frigida	x	x	x	x		x			x	x			
K	Festuca rubra	x	x	x	x		x		x		x	x	x	
K	Festuca vivipara		x	x					x	x	x	x		
K	Filipendula ulmaria	x	x	x	x	x	x		x	x	x	x		
K	Galium boreale	x	x	x	x	x	x		x					
K	Galium palustre	x	x	x	x		x		x			x		x
K	Galium trifidum				x	x			x					
K	Galium uliginosum		x	x			x		x					
K	Geranium sylvaticum		x	x	x	x	x	x	x	x	x			
K	Geum rivale	x	x	x	x	x	x	x	x	x	x			
K	Glyceria fluitans		x											
K	Gymnadenia conopsea			x	x									
K	Gymnocarpium dryopteris		x	x	x		x			x				
K	Hammarbya paludosa		x	x										
K	Hierochloe odorata	x	x	x	x									
K	Hippuris vulgaris								x					
K	Huperzia selago		x	x	x	x	x	x	x	x	x	x		
K	Juncus alpinoarticulatus		x	x	x	x	x		x	x		x		
K	Juncus articulatus	x	x	x						x	x			
K	Juncus biglumis			x					x					
K	Juncus bufonius		x				x							
K	Juncus bulbosus									x	x	x		x
K	Juncus castaneus			x	x				x					
K	Juncus conglomeratus			x						x	x	x	x	
K	Juncus effusus										x			
K	Juncus filiformis	x	x	x	x	x	x		x			x		x
K	Juncus squarrosus									x	x	x	x	x
K	Juncus stygius		x	x		x								
K	Juncus triglumis	x	x	x	x			x	x					
K	Juniperus communis	x	x	x	x	x	x	x	x	x	x	x		
K	Kobresia simpliciuscula			x	x									
K	Leontodon autumnalis			x	x		x		x	x	x			x
K	Linum catharticum		x											
K	Listera cordata	x	x	x	x						x			

H=hybrid; K=vascular plant; M=bryophyte; L=lichen

TYPE	Species name	1	2	3	4	5	6	7b	7c	8a	8b	8c	9a	9b
K	Listera ovata			x	x									
K	Loiseleuria procumbens			x				x						
K	Luzula multiflora	x	x	x	x	x	x	x	x	x	x		x	
K	Luzula sudetica		x	x	x	x	x	x	x					
K	Luzula sylvatica										x			
K	Lycopodiella inundata	x												
K	Lycopodium annotinum				x		x				x			
K	Maianthemum bifolium		x	x	x									
K	Melampyrum pratense		x	x	x	x	x		x	x		x	x	
K	Melica nutans		x	x	x									
K	Menyanthes trifoliata	x	x	x	x	x	x	x	x	x	x	x	x	x
K	Molinia caerulea	x	x	x	x	x	x			x	x	x	x	x
K	Montia fontana			x										
K	Myrica gale	x										x		
K	Myriophyllum alterniflorum					x		x						x
K	Nardus stricta	x	x	x	x	x	x	x	x	x	x			
K	Narthecium ossifragum	x		x						x	x	x	x	x
K	Nigritella nigra				x									
K	Nuphar pumila												x	
K	Nuphar sp.													x
K	Nymphaea sp.		x	x								x	x	x
K	Orthilia secunda		x	x			x							
K	Oxycoccus microcarpus	x	x	x	x	x	x	x	x	x	x	x	x	x
K	Oxycoccus quadripetalus	x	x				x						x	
K	Oxycoccus sp.													x
K	Oxyria digyna		x	x							x			
K	Parnassia palustris	x	x	x	x		x		x	x	x			
K	Pedicularis lapponica					x		x	x					
K	Pedicularis oederi			x	x			x	x					
K	Pedicularis palustris	x	x	x	x	x	x	x	x			x		
K	Pedicularis sceptrum-carolinum				x	x	x							
K	Pedicularis sylvatica											x		
K	Petasites frigidus				x	x	x		x					
K	Phleum alpinum			x	x			x	x					
K	Phragmites australis		x				x					x	x	x
K	Picea abies	x	x	x	x		x							
K	Pinguicula villosa					x	x							
K	Pinguicula vulgaris	x	x	x	x	x	x	x	x	x	x	x	x	x
K	Pinus sylvestris	x	x	x	x	x	x			x		x		x
K	Platanthera bifolia			x										
K	Poa alpina			x	x									
K	Poa palustris						x							
K	Poa pratensis		x	x	x		x							
K	Polygala serpyllifolia									x		x		
K	Polygonum viviparum	x	x	x	x	x	x	x	x					
K	Potamogeton alpinus						x	x	x					
K	Potamogeton filiformis		x		x									
K	Potamogeton natans		x	x			x							
K	Potamogeton polygonifolius									x			x	x
K	Potentilla erecta	x	x	x	x	x	x			x	x	x	x	x
K	Potentilla palustris	x	x	x	x	x	x	x	x				x	x
K	Prunella vulgaris			x									x	
K	Prunus padus				x		x							

H=hybrid; K=vascular plant; M=bryophyte; L=lichen

TYPE	Species name	1	2	3	4	5	6	7b	7c	8a	8b	8c	9a	9b
K	Pyrola minor		x	x	x		x			x	x			
K	Pyrola rotundifolia		x	x	x		x							
K	Ranunculus acris		x	x	x	x	x	x	x		x			
K	Ranunculus flammula									x				x
K	Rhynchospora alba	x	x									x		x
K	Rubus arcticus					x			x					
K	Rubus chamaemorus	x	x	x	x	x	x	x	x	x	x	x	x	x
K	Rumex acetosa		x	x	x			x	x	x	x			
K	Sagina procumbens		x	x						x		x		
K	Salix arbuscula		x	x	x		x	x	x					
K	Salix aurita	x	x	x		x				x	x	x	x	x
K	Salix caprea		x		x		x							
K	Salix glauca	x	x	x	x	x	x	x	x		x			
K	Salix hastata		x	x	x	x			x					
K	Salix herbacea			x				x	x					
K	Salix lanata			x	x			x	x					
K	Salix lapponum	x	x	x	x	x	x	x	x					x
K	Salix myrsinites		x	x	x		x	x	x					
K	Salix nigricans	x	x	x	x	x	x					x		
K	Salix pentandra	x	x		x		x							
K	Salix phylicifolia	x	x	x	x	x	x	x	x					
K	Salix starkeana				x									
K	Saussurea alpina	x	x	x	x	x	x	x	x		x			
K	Saxifraga aizoides		x	x	x			x	x	x	x	x		
K	Saxifraga stellaris		x	x				x		x	x			
K	Scheuchzeria palustris	x		x		x								
K	Schoenus ferrugineus	x												
K	Scirpus cespitosus ssp. cespito	x	x	x	x	x	x	x	x	x	x	x	x	x
K	Scirpus cespitosus ssp. german										x	x		
K	Scirpus hudsonianus	x	x	x	x	x	x		x					
K	Selaginella selaginoides	x	x	x	x	x	x	x	x	x	x	x		
K	Solidago virgaurea		x	x	x	x	x		x	x	x			
K	Sorbus aucuparia		x	x	x		x			x	x	x		
K	Sparganium angustifolium			x	x		x		x	x			x	x
K	Sparganium hyperboreum			x					x					
K	Sparganium minimum			x	x							x		
K	Stellaria alsine		x	x			x							
K	Stellaria calycantha				x	x			x					
K	Stellaria crassifolia		x											
K	Stellaria nemorum		x	x										
K	Succisa pratensis	x	x	x	x	x	x			x	x	x		x
K	Thalictrum alpinum	x	x	x	x		x	x	x					
K	Thelypteris limbosperma			x										
K	Thelypteris phegopteris		x	x			x							
K	Tofieldia pusilla	x	x	x	x	x	x	x	x	x	x	x		x
K	Trientalis europaea	x	x	x	x	x	x	x		x	x	x		x
K	Triglochin palustris	x	x	x	x		x		x	x	x	x		
K	Trollius europaeus				x									
K	Tussilago farfara	x	x		x									
K	Utricularia intermedia	x	x	x		x	x		x					
K	Utricularia minor		x		x		x					x		
K	Utricularia ochroleuca			x	x									
K	Vaccinium myrtillus	x	x	x	x	x	x	x		x	x	x		

H=hybrid; K=vascular plant; M=bryophyte; L=lichen

TYPE	Species name	1	2	3	4	5	6	7b	7c	8a	8b	8c	9a	9b
K	Vaccinium uliginosum	x	x	x	x	x	x	x	x	x	x	x	x	x
K	Vaccinium vitis-idaea	x	x	x	x	x	x	x	x	x	x	x		x
K	Valeriana sambucifolia			x	x	x	x			x		x		
K	Veronica alpina				x			x						
K	Veronica scutellata				x									
K	Vicia cracca	x	x	x					x		x			
K	Viola biflora	x	x	x	x	x		x		x				
K	Viola epipsila	x			x		x							
K	Viola palustris	x	x	x	x	x	x		x	x	x		x	
L	Cetraria ericetorum		x											
L	Cetraria islandica		x			x			x	x				x
L	Cetraria nivalis					x		x	x					
L	Cladina portentosa											x		x
L	Cladina stellaris	x	x		x	x	x	x	x					x
L	Cladonia uncialis		x											
L	Icmadophila ericetorum		x	x	x	x		x	x	x				
M	Aneura pinguis	x	x	x	x		x	x	x	x	x	x		
M	Bazzania trilobata													x
M	Bryum pseudotriquetrum	x	x	x	x		x	x	x			x		
M	Bryum weigelii				x			x						
M	Calliergon giganteum	x	x		x		x							
M	Calliergon richardsonii		x		x		x		x			x		
M	Calliergon sarmentosum	x	x	x	x	x	x	x	x	x	x	x		
M	Calliergon trifarium	x	x	x	x		x	x	x					
M	Calliergonella cuspidata	x	x	x	x									
M	Campylium stellatum	x	x	x	x	x	x	x	x	x	x	x		
M	Catoscopium nigritum		x		x		x	x	x					
M	Cinclidium stygium	x	x	x	x		x	x	x					
M	Climacium dendroides	x	x	x	x		x		x					
M	Cratoneuron commutatum	x	x	x	x					x				
M	Cratoneuron decipiens	x	x	x	x									
M	Cratoneuron filicinum	x	x		x					x		x		
M	Ctenidium molluscum											x		
M	Dicranella palustris		x	x	x			x		x		x		
M	Dicranum bonjeanii			x	x				x					
M	Dicranum leioneuron	x	x							x			x	x
M	Drepanocladus badius	x	x	x	x	x	x	x	x	x		x		
M	Drepanocladus exannulatus	x	x	x	x	x	x	x	x		x			
M	Drepanocladus fluitans			x	x							x		x
M	Drepanocladus revolvens	x	x	x	x	x	x	x	x	x	x	x		
M	Drepanocladus tundrae	x	x		x		x	x	x					
M	Drepanocladus uncinatus		x		x									
M	Fissidens adianthoides		x	x	x		x		x					
M	Fissidens osmundoides				x		x							
M	Helodium blandowii						x							
M	Homalothecium nitens	x	x		x	x	x	x	x					
M	Hypnum jutlandicum			x						x	x	x	x	x
M	Jungermannia exsertifolia				x									
M	Leucobryum glaucum			x							x	x	x	
M	Lophozia bantriensis	x	x	x	x									
M	Lophozia borealis	x	x	x	x	x	x	x	x					
M	Lophozia rutheana	x	x	x	x		x	x	x					
M	Meesia triquetra				x		x		x					

H=hybrid; K=vascular plant; M=bryophyte; L=lichen

TYPE	Species name	1	2	3	4	5	6	7b	7c	8a	8b	8c	9a	9b
M	Meesia uliginosa				x		x		x					
M	Moerckia hibernica	x	x		x									
M	Oncophorus virens				x									
M	Oncophorus wahlenbergii						x							
M	Paludella squarrosa	x	x		x		x	x	x					
M	Philonotis calcarea	x	x		x									
M	Philonotis fontana	x	x	x	x									
M	Plagiomnium elatum	x	x	x	x									
M	Plagiomnium ellipticum	x	x		x		x		x					
M	Pohlia wahlenbergii		x		x			x						
M	Pseudobryum cinclidioides	x			x		x							
M	Racomitrium lanuginosum	x	x	x						x	x	x	x	x
M	Rhizomnium pseudopunctatum		x	x	x		x							
M	Rhodobryum roseum				x									
M	Rhytidiadelphus loreus									x	x			x
M	Rhytidiadelphus triquetrus	x	x				x							
M	Riccardia multifida										x			
M	Scapania uliginosa									x				
M	Scapania undulata	x			x									
M	Scorpidium scorpioides	x	x	x	x	x	x	x	x	x	x	x		
M	Sphagnum angermanicum		x	x										
M	Sphagnum angustifolium	x	x		x	x	x	x	x		x		x	x
M	Sphagnum annulatum			x										
M	Sphagnum annulatum coll.			x	x		x							
M	Sphagnum aongstroemii					x								
M	Sphagnum auriculatum			x						x		x	x	x
M	Sphagnum balticum	x	x	x	x	x	x							x
M	Sphagnum brevifolium	x								x				
M	Sphagnum capillifolium	x	x	x	x	x	x		x	x	x	x	x	x
M	Sphagnum centrale			x	x		x							
M	Sphagnum compactum	x	x	x		x	x			x	x	x	x	x
M	Sphagnum contortum	x	x	x	x		x							x
M	Sphagnum cuspidatum	x	x							x	x	x	x	x
M	Sphagnum fallax		x	x										x
M	Sphagnum flexuosum			x										x
M	Sphagnum fuscum	x	x	x	x	x	x	x	x	x	x	x	x	x
M	Sphagnum girgensohnii	x	x	x	x	x	x		x					
M	Sphagnum imbricatum									x	x	x	x	x
M	Sphagnum imbricatum ssp. affin			x										
M	Sphagnum inundatum												x	
M	Sphagnum isoviitae	x		x						x				
M	Sphagnum jensenii			x										
M	Sphagnum lindbergii	x	x	x	x	x	x		x				x	x
M	Sphagnum magellanicum	x	x	x	x	x	x		x	x	x	x	x	x
M	Sphagnum majus	x	x	x		x						x		
M	Sphagnum molle			x								x		
M	Sphagnum obtusum						x							
M	Sphagnum palustre										x			x
M	Sphagnum papillosum	x	x	x		x	x		x	x	x	x	x	x
M	Sphagnum platyphyllum			x	x	x	x							x
M	Sphagnum pulchrum	x	x	x		x						x		x
M	Sphagnum recurvum coll.	x		x	x	x			x	x	x	x	x	x
M	Sphagnum riparium	x			x	x		x						

H=hybrid; K=vascular plant; M=bryophyte; L=lichen

TYPE	Species name	1	2	3	4	5	6	7b	7c	8a	8b	8c	9a	9b
M	Sphagnum rubellum	x	x	x		x				x	x	x	x	x
M	Sphagnum russowii			x	x	x	x		x		x			
M	Sphagnum squarrosum					x	x							
M	Sphagnum strictum			x								x		
M	Sphagnum subfulvum		x	x		x	x							
M	Sphagnum subnitens	x	x	x	x					x	x	x	x	x
M	Sphagnum subsecundum	x	x	x		x	x	x	x	x				
M	Sphagnum subsecundum coll.		x								x	x		
M	Sphagnum tenellum	x	x	x		x				x	x	x	x	x
M	Sphagnum teres	x	x	x	x	x	x	x	x		x			
M	Sphagnum virida									x				
M	Sphagnum warnstorfii	x	x	x	x	x	x	x	x	x	x			
M	Sphagnum wulfianum						x							
M	Splachnum ampullaceum			x			x							
M	Splachnum luteum			x	x	x	x							
M	Splachnum sphaericum			x	x		x		x					
M	Splachnum vasculosum			x	x		x							
Total number of species		161	237	249	243	131	197	97	148	124	118	119	66	88

H=hybrid; K=vascular plant; M=bryophyte; L=lichen

Appendix B. Name of mire plants in central Norway; Scientific, English, Norwegian. First coloumn refers to the 15 phytogegraphical subgroups described in section 3.4.

Subgroup	Latin	English	Norwegian
	Carex flava x hostiana		
	Carex flava x lepidocarpa		
	Agrostis canina	Brown Bent-grass	Hundekvein
	Agrostis capillaris	Common Bent-grass	Engkvein
	Agrostis stolonifera	Fiorin	Krypkvein
	Alchemilla sp.		Marikåpe
SEb	Alisma plantago-aquatica	Water-Plantain	Vassgro
	Alnus incana	Grey Alder	Gråor
Sb	Alnus glutinosa	Alder	Svartor
Eb	Alopecurus aequalis	Orange Foxtail	Vassreverumpe
	Alopecurus geniculatus	Marsh Foxtail	Knereverumpe
	Andromeda polifolia	Bog Rosemary	Kvitlyng
	Anemone nemorosa	Wood Anemone	Kvitveis
	Angelica archangelica	Garden Angelica	Kvann
	Angelica sylvestris	Wild Angelica	Sløke
	Anthoxanthum odoratum	Sweet Vernal-grass	Gulaks
Ab	Arctostaphylos alpinus	Alpine Bearberry	Rypebær
Ab	Bartsia alpina	Alpine Bartsia	Svarttopp
Ac	Betula nana	Dwarf Birch	Dvergbjørk
	Betula pubescens	Downy Birch	Vanlig bjørk
Wb	Blechnum spicant	Hard Fern	Bjønnkam
	Calamagrostis purpurea		Skogrørkvein
Eb	Calamagrostis stricta	Narrow Small-reed	Smårørkvein
SEb	Calla palustris		Myrkongle
	Calluna vulgaris	Ling, Heather	Røsslyng
	Caltha palustris	Kingcup, Marsh Marigold	Soleihov
	Campanula rotundifolia	Harebell	Blåklokke
	Cardamine amara	Larger Bitter-cress	Bekkekarse
Sc	Cardamine flexuosa	Wood Bitter-cress	Skogkarse
	Cardamine nymanii		Polarkarse
	(C. pratensis ssp. polemonioides)		
	Cardamine pratensis	Cuckoo Flower	Engkarse
	(C.pratensis ssp. dentata)		
SEc	Carex acuta	Slender Tufted Sedge	Kvass-starr
Ab	Carex adelostoma (C. buxbaumii ssp.mutica)		Tranestarr
SEc	Carex appropinquata	Fibrous Tussock-sedge	Taglsatrr
	Carex aquatilis ssp. stans		Tundrastarr
Eb	Carex aquatilis	Water Sedge	Norlandsstarr
Aa	Carex atrata	Black Sedge	Svartstarr
Aa	Carex atrofusca	Scorched Alpine Sedge	Sotstarr
Aa	Carex bigelowii	Stiff Sedge	Stivstarr
Wa	Carex binervis	Green-ribbed Sedge	Heistarr
	Carex brunnescens		Seterstarr
Ec	Carex buxbaumii	Club Sedge	Klubbestarr
	(C. buxbaumii ssp. buxbaumii)		
	Carex canescens	White Sedge	Gråstarr
Ac	Carex capillaris	Hair Sedge	Hårstarr
Ab	Carex capitata		Hodestarr
Ec	Carex chordorrhiza	String Sedge	Strengstarr
	Carex diandra	Lesser Tussock-sedge	Kjevlestarr
	Carex dioica	Dioecious Sedge	Tvebustarr
Sa	Carex disticha	Brown Sedge	Duskstarr
	Carex echinata	Star Sedge	Stjernestarr
SEb	Carex elongata	Eleongated Sedge	Langstarr
Sb	Carex flacca	Glaucous Sedge	Blåstarr
	Carex flava	Yellow Sedge	Gulstarr

Subgroup	Latin	English	Norwegian
Ea	Carex globularis		Granstarr
Eb	Carex heleonastes		Huldrestarr
Wb	Carex hostiana	Tawny Sedge	Engstarr
	Carex juncella (C. nigra ssp. juncella)		Stolpestarr
	Carex lasiocarpa	Slender Sedge	Trådstarr
Ea	Carex laxa		Finnmarksstarr
Sc	Carex lepidocarpa		Nebbstarr
	Carex limosa	Mud Sedge	Dystarr
Ec	Carex livida		Blystarr
Eb	Carex loliacea		Nubbestarr
	Carex magellanica (C. paupercula)	Bog Sedge	Frynsestarr
Aa	Carex microglochin		Agnorstarr
	Carex nigra (C. nigra ssp. nigra)	Common Sedge	Slåttestarr
Ab	Carex norvegica (C. norvegica ssp. norvegica)	Close-headed Alpine Sedge	Fjellstarr
	Carex oederi (C. serotina ssp. serotina)		Beitestarr
	Carex pallescens	Pale Sedge	Bleikstarr
	Carex panicea	Carnation-grass	Kornstarr
Sa	Carex paniculata	Greater Tussock-sedge	Toppstarr
Aa	Carex parellea		Smalstarr
	Carex pauciflora	Few-flowered Sedge	Sveltstarr
Wb	Carex pulicaris	Flea Sedge	Loppestarr
Aa	Carex rariflora	Loose-flowered Alpine Sedge	Snipestarr
	Carex rostrata	Beaked Sedge, Bottle Sedge	Flaskestarr
Ab	Carex rotundata		Rundstarr
Aa	Carex saxatilis	Russet Sedge	Blankstarr
	Carex scandinavica (C. serotina ssp. pulchella)		Musestarr
Ec	Carex stenolepis		Vierstarr
Ea	Carex tenuiflora		Tvillingstarr
Wc	Carex tumidicarpa (C. demissa)		Grønnstarr
	Carex vaginata	Sheathed Sedge	Slirestarr
Ec	Carex vesicaria	Bladder Sedge	Sennegras
Aa	Cerastium cerastoides	Starwort Mouse-ear Chickweed	Brearve
	Cerastium fontanum	Common Mouse-ear Chickweed	Vanlig arve
	Chrysosplenium alternifolium	Alternative-leaved Golden-saxifrage	Vanlig maigull
SEc	Cicuta virosa	Cowbane	Selsnepe
	Cirsium helenioides	Melancholy Thistle	Kvitbladtistel
	Cirsium palustre	Marsh Thistle	Myrtistel
	Coeloglossum viride	Frog Orchid	Grønnkurle
Ec	Corallorhiza trifida	Coral-root	Korallrot
	Cornus suecica	Dwarf Cornel	Skrubbær
	Crepis paludosa	Marsh Hawk's-beard	Sumphaukskjegg
	Cystopteris montana	Mountain Bladder-fern	Fjell-lok
	Dactylorhiza cruenta (D. incarnata ssp. cruenta)		Blodmarihand
	Dactylorhiza fuchsii	Common Spotted Orchid	Skogmarihand
	Dactylorhiza incarnata (D. incarnata ssp. incarnata)	Early Marsh Orchid	Engmarihand
	Dactylorhiza maculata	Heath Spotted Orchid	Flekkmarihand
Ab	Dactylorhiza pseudocordigera (D. lapponica)		Fjellmarihand
	Dactylorhiza traunsteineri	Narrow leaved Marsh Orchid	Smalmarihand
Sc	Danthonia decumbens	Heath Grass	Knegras
	Deschampsia cespitosa (D. cespitosa ssp. cespitosa)	Tufted Hair-grass	Sølvbunke
	Deschamspia flexuosa	Wavy Hair-grass	Smyle

Subgroup	Latin	English	Norwegian
	Drosera anglica	Great Sundew	Smalsoldogg
	Drosera rotundifolia	Round-leaved Sundew	Rundsoldogg
	Eleocharis mamillata		Mjuksivaks
	Eleocharis quinqueflora	Few-flowered Spike-rush	Småsivaks
Ac	Empetrum hermaphroditum (E. nigrum ssp.hermaphroditum)	Crowberry	Fjellkrekling
	Empetrum nigrum (E. nigrum ssp. nigrum)	Crowberry	Krekling
Ab	Epilobium alsinifolium	Chickweed Willow--herb	Kildemjølke
Aa	Epilobium anagallidifolium	Alpine Willow-herb	Dvergmjølke
	Epilobium angustifolium	Rosebay Willow-herb	Geitrams
Ab	Epilobium davuricum		Linmjølke
Ab	Epilobium hornemannii		Setermjølke
Ab	Epilobium lactiflorum		Kvitmjølke
	Epilobium palustre	Marsh Willow-herb	Myrmjølke
Sc	Epipactis helleborine	Broad Helleborine	Breiflangre
	Equisetum arvense	Field Horsetail	Åkersnelle
	Equisetum fluviatile	Water Horsetail	Elvesnelle
	Equisetum hyemale	Rough Horsetail	Skavgras
	Equisetum palustre	Marsh Horsetail	Myrsnelle
	Equisetum pratense	Shady Horsetail	Engsnelle
Eb	Equisetum scirpoides		Dvergsnelle
	Equisetum sylvaticum	Wood Horsetail	Skogsnelle
Ac	Equisetum variegatum	Variegated Horsetail	Fjellsnelle
Wb	Erica tetralix	Cross-leaved Heath	Klokkelyng
	Eriophorum angustifolium	Common Cotton-grass	Duskull
Ea	Eriophorum brachyantherum		Gullull
Eb	Eriophorum gracile	Slender Cotton-grass	Småull
	Eriophorum latifolium	Broad-leaved Cotton-grass	Breiull
Ab	Eriophorum scheuchzeri		Snøull
	Eriophorum vaginatum	Cotton-grass, Hare`s-tail	Torvull
	Euphrasia frigida		Fjelløyentrøst
	Festuca rubra	Reed Fescue	Rødsvingel
	Festuca vivipara	Viviparous Fescue	Geitsvingel
	Filipendula ulmaria	Meadowsweet	Mjødurt
SEb	Frangula alnus	Alder Buckthorn	Trollhegg
	Galium boreale	Northern Bedstraw	Kvitmaure
	Galium palustre	Lesser Marsh Bedstraw	Myrmaure
Wa	Galium saxatile	Heath Bedstraw	Kystmaure
Eb	Galium trifidum		Dvergmaure
	Galium uliginosum	Fen Bedstraw	Sumpmaure
Aa	Gentiana purpurea		Søterot
	Geranium sylvaticum	Wood Crane`s-bill	Skogstorkenebb
	Geum rivale	Water Avens	Enghumleblom
Sc	Glyceria fluitans	Floating Sweet-grass	Mannasøtgras
	Gymnadenia conopsea	Fragrant Orchid	Brudespore
	Gymnocarpium dryopteris	Oak Fern	Fugletelg
Sc	Hammarbya paludosa	Bog Orchid	Myggblom
	Hierochloe odorata	Holy-grass	Marigras
	Hippuris vulgaris	Mare`s-tail	Hesterumpe
Wb	Holcus lanatus	Yorkshire Fog	Englodnegras
	Huperzia selago	Fir Clubmoss	Lusegras
Sb	Iris pseudacorus	Yellow Iris	Sverdlilje
	Juncus alpinoarticulatus	Alpine Rush	Skogsiv
Sc	Juncus articulatus	Jointed Rush	Ryllsiv
Aa	Juncus articus		Finnmarkssiv
Aa	Juncus biglumis	Two-flowered rush	Tvillingsiv
	Juncus bufonius	Toad Rush	Paddesiv

Subgroup	Latin	English	Norwegian
Sc	Juncus bulbosus	Bulbous Rush	Krypsiv
Aa	Juncus castaneus	Chestnut Rush	Kastanjesiv
Sc	Juncus conglomeratus	Compact Rush	Knappsiv
Sc	Juncus effusus	Soft Rush	Lyssiv
	Juncus filiformis	Thread Rush	Trådsiv
Wb	Juncus squarrosus	Heath Rush	Heisiv
Ec	Juncus stygius		Nøkkesiv
Ab	Juncus triglumis	Three-flowered Rush	Trillingsiv
	Juniperus communis	Juniper	Einer
Aa	Kobresia simpliciuscula	False Sedge	Myrtust
	Leontodon autumnalis	Autumnal Hawkbit	Følblom
Sc	Linum catharticum	Fairy Flax	Vill-lin
	Listera cordata	Lesser Twayblade	Småtveblad
	Listera ovata	Twayblade	Stortveblad
Ab	Loiseleuria procumbens	Trailing Azalea	Greplyng
Wa	Luzula congesta		Heifrytle
	Luzula multiflora (ssp.multiflora+ ssp.frigida)	Heath Woodrush	Engfrytle
Ac	Luzula sudetica		Myrfrytle
Wa	Luzula sylvatica	Great Woodrush	Storfrytle
Sc	Lycopodiella inundata	Marsh Clubmoss	Myrkråkefot
	Lycopodium annotinum	Interrupted Clubmoss	Strid kråkefot
Sa	Lycopus europaeus	Gipsywort	Klourt
SEc	Lysimachia thyrsiflora	Tufted Loosestrife	Gulldusk
SEb	Lysimachia vulgaris	Yellow Loosestrife	Fredløs
	Maianthemum bifolium	May Lily	Maiblom
	Melampyrum pratense	Common Cow-weat	Stormarimjelle
	Melica nutans	Mountain Melick	Hengeaks
	Menyanthes trifoliata	Buckbean, Bogbean	Bukkeblad
	Molinia caerulea	Purple moor-grass	Blåtopp
	Montia fontana	Blinks	Kildeurt
Sc	Myrica gale	Bog Myrtle, Sweet Gale	Pors
	Myriophyllum alterniflorum	Alternative-flowered Water-milfoil	Tusenblad
	Nardus stricta	Mat-grass	Finnskjegg
Wb	Narthecium ossifragum	Bog Asphodel	Rome
Ab	Nigritella nigra		Svartkurle
	Nuphar pumila	Least Yellow Water-lily	Soleinøkkrose
	Nymphaea sp.		Kvit nøkkrose
	Orthilia secunda	Serrated Wintergreen	Nikkevintergrønn
Ac	Oxycoccus microcarpus (Vaccinium microcarpum)	Small Cranberry	Småtranebær
	Oxycoccus quadripetalus (Vaccinium oxycoccos)	Cranberry	Tranebær
	Oxyria digyna	Mountain Sorrel	Fjellsyre
	Paris quadrifolia	Herb-Paris	Firblad
	Parnassia palustris	Grass-of-Parnassus	Jåblom
	Pedicularis lapponica		Bleikmyrklegg
Aa	Pedicularis oederi		Gullmyrklegg
	Pedicularis palustris	Marsh Lousewort, Red-rattle	Vanlig myrklegg
Eb	Pedicularis sceptrum-carolinum		Kongsspir
Wb	Pedicularis sylvatica	Lousewort	Kystmyrklegg
Ab	Petasites frigidus		Fjellpestrot
Ab	Phleum alpinum	Alpine Cat's-tail	Fjelltimotei
	Phragmites australis	Common Reed	Takrør
	Picea abies	Norway Spruce	Gran
Eb	Pinguicula villosa		Dvergtettegras
	Pinguicula vulgaris	Common Butterwort	Tettegras

Subgroup	Latin	English	Norwegian
	Pinus sylvestris	Scots Pine	Furu
	Platanthera bifolia	Lesser Butterfly Orchid	Vanlig nattfiol
Sb	Platanthera chlorantha	Greater Butterfly Orchid	Grov nattfiol
	Poa alpina	Alpine Meadow-grass	Fjellrapp
Eb	Poa palustris	Swamp Meadow-grass	Myrrapp
	Poa pratensis (P. pratensis ssp. pratensis)	Smooth Meadow-grass	Engrapp
Eb	Poa remota		Storrapp
Wa	Polygala serpyllifolia	Heath Milkwort	Heiblåfjør
Sc	Polygala vulgaris	Common Milkwort	Storblåfjør
	Polygonum viviparum	Alpine Bistort	Harerug
	Potamogeton alpinus	Reddish Pondweed	Rusttjønnaks
	Potamogeton filiformis	Slender-leaved Pondweed	Trådtjønnaks
	Potamogeton natans	Broad-leaved Pondweed	Vanlig tjønnaks
Wb	Potamogeton polygonifolius	Bog Pondweed	Kysttjønnaks
	Potentilla erecta	Tormentil	Tepperot
	Potentilla palustris	Marsh Cinquefoil	Myrhatt
	Prunella vulgaris	Selfheal	Blåkoll
	Prunus padus	Bird Cherry	Hegg
	Pyrola minor	Common Wintergreen	Perlevintergrønn
	Pyrola rotundifolia	Round-leaved Wintergreen	Lægevintergrønn
	Ranunculus acris	Meadow Buttercup	Engsoleie
Sc	Ranunculus flammula	Lesser Spearwort	Grøftesoleie
	Ranunculus reptans	Slender Creeping Spearwort	Evjesoleie
Sc	Rhynchospora alba	White Beak-sedge	Kvitmyrak
Sb	Rhynchospora fusca	Brown Beak-sedge	Brunmyrak
Eb	Rubus arcticus	Artic Bramble	Åkerbær
	Rubus chamaemorus	Cloudberry	Molte
	Rubus saxatilis	Stone Bramble	Tågebær
	Rumex acetosa	Common Sorrel	Engsyre
	Sagina procumbens	Procumbent Pearlwort	Tunarve
Aa	Salix arbuscula	Mountain Willow	Småvier
Sc	Salix aurita	Eared Willow	Ørevier
	Salix caprea	Goat Willow	Selje
Ab	Salix glauca		Sølvvier
	Salix hastata		Bleikvier
Aa	Salix herbacea	Dwarf Willow	Musøre
Aa	Salix lanata	Woolly Willow	Ullvier
Ac	Salix lapponum	Downy Willow	Lappvier
Ab	Salix myrsinites	Whortle-leaved Willow	Myrtevier
	Salix nigricans (S. myrsinifolia ssp. myrsinifolia)	Dark-leaved Willow	Svartvier
	Salix pentandra	Bay Willow	Istervier
	Salix phylicifolia	Tea-leaved Willow	Grønnvier
Sc	Salix repens	Creeping Willow	Krypvier
	Salix reticulata	Net-leaved Willow	Rynkevier
Eb	Salix starkeana		Blåvier
Ab	Saussurea alpina	Alpine Saussurea	Fjelltistel
Ab	Saxifraga aizoides	Yellow Saxifrage	Gulsildre
	Saxifraga oppositifolia	Purple Saxifrage	Rødsildre
Aa	Saxifraga stellaris	Starry Saxifrage	Stjernesildre
Ec	Scheuchzeria palustris	Rannoch Rush	Sivblom
Sc	Schoenus ferrugineus	Brown Bog-rush	Brunskjene
	Scirpus cespitosus ssp. cespitosus		Småbjønnskjegg
Wa	Scirpus cespitosus ssp. germanicus		Storbjønnskjegg
Ec	Scirpus hudsonianus		Sveltull
SEb	Scirpus sylvaticus	Wood Club-rush	Skogsivaks
SEc	Scutellaria galericulata	Skullcap	Skjoldbærer

Subgroup	Latin	English	Norwegian
Ac	Selaginella selaginoides	Lesser Clubmoss	Dvergjamne
	Sibbaldia procumbens	Sibbaldia	Trefingerurt
	Solidago virgaurea	Golden-rod	Gullris
	Sorbus aucuparia	Rowan, Mountain Ash	Rogn
	Sparganium angustifolium	Floating Bur-reed	Flotgras
Ab	Sparganium hyperboreum		Fjellpiggknopp
	Sparganium minimum	Least Bur-reed	Småpiggknopp
Sc	Stellaria alsine	Bog Stitchwort	Bekkestjerneblom
Ab	Stellaria calycantha (S. borealis)		Fjellstjerneblom
	Stellaria crassifolia		Saftstjerneblom
	Stellaria nemorum	Wood Stitcworth	Skogstjerneblom
	Succisa pratensis	Devil's-bit Scabious	Blåknapp
Ab	Thalictrum alpinum	Alpine Meadow Rue	Blåsprett
Wb	Thelypteris (Oreopteris) limbosperma	Lemon-scented Fern	Smørtelg
	Thelypteris phegopteris (Phegopteris connectilis)	Beech Fern	Hengeving
Ab	Tofieldia pusilla	Scottish Asphodel	Bjønnbrodd
	Trientalis europaea	Chickweed Wintergreen	Skogstjerne
	Triglochin palustris	Marsh Arrowgrass	Myrsaulauk
	Trollius europaeus	Globe Flower	Ballblom
	Tussilago farfara	Coltsfoot	Hestehov
	Utricularia intermedia	Intermediate Bladderwort	Gytjeblærerot
	Utricularia minor	Lesser Bladderwort	Småblærerot
	Utricularia ochroleuca		Mellomblærerot
	Vaccinium myrtillus	Bilberry, Blaeberry	Blåbær
	Vaccinium uliginosum	Bog Bilberry	Blokkbær
	Vaccinium vitis-idaea	Cowberry	Tyttebær
	Valeriana sambucifolia		Vendelrot
	Veronica alpina	Alpine Speedwell	Fjellveronika
Sb	Veronica beccabunga	Brooklime	Bekkeveronika
	Veronica scutellata	Marsh Speedwell	Veikveronika
	Vicia cracca	Tufted Vetch	Fuglevikke
Ab	Viola biflora		Fjellfiol
	Viola epipsila	Marsh Volet	Stor myrfiol
	Viola palustris	Marsh Violet	Myrfiol
	Cetraria ericetorum		Smal islandslav
	Cetraria islandica		Islandslav
	Cetraria nivalis		Gulskinn
Wb	Cladina portentosa		Kystreinlav
	Cladina stellaris		Kvitkrull
	Cladonia uncialis		Pigglav
	Icmadophila ericetorum		Torvmosedreper
	Ochrolechia frigida		Fjellkorkje
	Aneura pinguis		Fettmose
Ab	Anthelia spp.		Snømose
	Aulacomnium palustre		Myrfiltmose
Ab	Barbilophozia quadriloba		Kloskjeggmose
Wb	Bazzania trilobata		Storstylte
Ac	Brachythecium turgidum		Fjell-lundmose
Wa	Breutelia chrysocoma		Gullhårmose
	Bryum pseudotriquetrum		Bekkevrangmose
Ac	Bryum weigelii		Blodvrangmose
	Calliergon giganteum		Stauttjønnmose
Ac	Calliergon richardsonii		Sumptjønnmose
Ac	Calliergon sarmentosum (Warnstorfia sarmentosa)		Blodtjønnmose

Subgroup	Latin	English	Norwegian
	Calliergon stramineum (Straminergon stramineum)		Grastjønnmose
Ac	Calliergon trifarium (Pseudocalliergon trifarium)		Navartjønnmose
	Calliergonella cuspidata		Broddmose
	Campylium stellatum		Myrstjernemose
Ac	Catoscopium nigritum		Svartknoppmose
Ac	Cinclidium stygium		Myrgittermose
Ab	Cinclidium subrotundum		Rundgittermose
	Climacium dendroides		Palmemose
	Cratoneuron commutatum (Palustriella commutata + P. falcata)		Stortuffmose
Ac	Cratoneuron decipiens (Palustriella decipiens)		Fjærtuffmose
	Cratoneuron filicinum		Granntuffmose
Ac	Dicranella palustris		Kjeldegrøftmose
Ab	Dicranum angustum		Grassigd
	Dicranum bergeri		Sveltsigd
	Dicranum bonjeanii		Pjusksigd
Ab	Dicranum drummondii		Kjempesigd
	Dicranum groenlandicum		Putesigd
	Dicranum leioneuron		Akssigd
	Dicranum scoparium		Ribbesigd
Ab	Dicranum spadiceum		Rørsigd
Ac	Drepanocladus badius (Loeskypnum badium)		Stuttklo
	Drepanocladus exannulatus (Warnstorfia exannulata)		Vrangklo
	Drepanocladus fluitans (Warnstorfia fluitans)		Vassklo
Eb	Drepanocladus procerus		
	Drepanocladus revolvens (Scorpidium revolvens)		Brunklo
Eb	Drepanocladus trichophyllus		Nøkkeklo
Eb	Drepanocladus tundrae (Warnstorfia tundrae)		Hakeklo
	Drepanocladus uncinatus (Sanionia uncinata)		Bleikklo
	Fissidens adianthoides		Saglommemose
	Fissidens osmundoides		Stivlommemose
Ec	Helodium blandowii		Myrfjær
	Homalothecium nitens (Tomentypnum nitens)		Gullsilkemose
	Hylocomium splendens		Etasjehusmose
Ac	Hypnum bambergeri		Kloflette
Wb	Hypnum jutlandicum		Heiflette
Eb	Hypnum pratense		Jamneflette
Ab	Jungermannia exsertifolia		Kjeldesleivmose
Aa	Kiaeria glacialis		Jøkelfrostmose
Wb	Leucobryum glaucum		Blåmose
	Lophozia bantriensis		Kjeldeflik
Ab	Lophozia borealis (Gymnocolea borealis)		Brunflik
	Lophozia rutheana		Praktflik
Ac	Meesia triquetra		Skruesvanemose
Ac	Meesia uliginosa		Nervesvanemose
Sc	Moerckia hibernica		Myrsløyfe
Wc	Mylia taylorii		Rødmuslingmose

Subgroup	Latin	English	Norwegian
Wb	Odontoschisma sphagni		Sveltskovlmose
	Oncophorus sp.		Sprikemose
Ac	Oncophorus virens		Myrsprike
Ac	Oncophorus wahlenbergii		Fjellsprike
Ac	Paludella squarrosa		Piperensermose
	Philonotis calcarea		Kalkkjeldemose
	Philonotis fontana		Teppekjeldemose
Ac	Philonotis seriata		Skruekjeldemose
	Plagiomnium elatum		Kalkfagermose
	Plagiomnium ellipticum		Sumpfagermose
Wb	Plagiothecium undulatum		Kystjamnemose
	Pleurozium schreberi		Furumose
	Pohlia wahlenbergii		Kaldnikkemose
	Pseudobryum cinclidioides		Kjempemose
Wc	Racomitrium lanuginosum		Heigråmose
	Rhizomnium pseudopunctatum		Fjellrundmose
	Rhodobryum roseum		Rosettmose
Wb	Rhytidiadelphus loreus		Kystkransmose
	Rhytidiadelphus squarrosus		Engkransmose
	Rhytidiadelphus triquetrus		Storkransmose
Sc	Riccardia multifida		Fjærsaftmose
	Scapania irrigua		Sumptvebladmose
Ab	Scapania uliginosa		Kjeldetvebladmose
	Scapania undulata		Bekketvebladmose
	Scorpidium scorpioides		Myrmakkmose
Aa	Scorpidium turescens		Kvapmakmose
Wc	Sphagnum angermanicum		Glasstorvmose
	Sphagnum angustifolium		Klubbetorvmose
Ac	Sphagnum annulatum		Pisktorvmose
	Sphagnum annulatum coll.		
Eb	Sphagnum aongstroemii		Fjelltorvmose
Wc	Sphagnum auriculatum		Horntorvmose
Ec	Sphagnum balticum		Svelttorvmose
	Sphagnum brevifolium		
	Sphagnum capillifolium		Furutorvmose
Ac	Sphagnum centrale		Kratt-torvmose
	Sphagnum compactum		Stivtorvmose
	Sphagnum contortum		Vritorvmose
Sc	Sphagnum cuspidatum		Vasstorvmose
	Sphagnum fallax		Broddtorvmose
	Sphagnum flexuosum		Bleiktorvmose
	Sphagnum fuscum		Rusttorvmose
	Sphagnum girgensohnii		Grantorvmose
	Sphagnum imbricatum		Kysttorvmose
Sb	Sphagnum imbricatum ssp. affine		
Wa	Sphagnum imbricatum ssp. austinii		
Sb	Sphagnum inundatum		Flotorvmose
	Sphagnum isoviitae		
Ec	Sphagnum jensenii		
Ac	Sphagnum lindbergii		Bjørnetorvmose
	Sphagnum magellanicum		Kjøtt-torvmose
	Sphagnum majus		Lurvtorvmose
Wb	Sphagnum molle		Fløyelstorvmose
Ec	Sphagnum obtusum		Butt-torvmose
Sb	Sphagnum palustre		Sumptorvmose
	Sphagnum papillosum		Vortetorvmose
	Sphagnum platyphyllum		Skeitorvmose
	Sphagnum pulchrum		Fagertorvmose
Wc	Sphagnum quinquefarium		Lyngtorvmose
	Sphagnum recurvum coll.		

Subgroup	Latin	English	Norwegian
	Sphagnum riparium		Skartorvmose
Sc	Sphagnum rubellum		Rødtorvmose
	Sphagnum russowii		Tvaretorvmose
	Sphagnum squarrosum		Spriketorvmose
Wb	Sphagnum strictum		Heitorvmose
Ec	Sphagnum subfulvum		Lapptorvmose
Sc	Sphagnum subnitens		Blanktorvmose
	Sphagnum subsecundum		Kroktorvmose
	Sphagnum subsecundum coll.		
	Sphagnum tenellum		Dvergtorvmose
	Sphagnum teres		Beitetorvmose
Sb	Sphagnum viride		
	Sphagnum warnstorfii		Rosetorvmose
Eb	Sphagnum wulfianum		Huldretorvmose
	Splachnum ampullaceum		Pæremøkkmose
Ec	Splachnum luteum		Gulmøkkmose
Eb	Splachnum rubum		Rødmøkkmose
	Splachnum sphaericum		Blankmøkkmose
	Splachnum vasculosum		Knappmøkkmose

Sølendet naturreservat

Veiledning til natursti

Guide to the nature trails

Trond Arnesen
Asbjørn Moen

Botanisk avdeling • Vitenskapsmuseet, Trondheim
Direktoratet for naturforvaltning
Røros kommune
1994

Sølendet Nature Reserve

Welcome to Sølendet!

This nature reserve was established in 1974. The total area of the reserve is 3064 daa (ca. 766 acres). About a half of this is covered by rich fens (calcareous fens), the remainder is mainly wooded grassland and heaths. More than 50 springs arise along the upper margins of the reserve. These provide the fens with a supply of calcareous, mineral-rich water, and is the basis for an especially rich flora. Several quite rare species are present in local abundance.

For many centuries past, and up to the 1950's both the fens and grasslands of Sølendet were scythed to yield a supply of winter fodder for the livestock on the farms of the Brekken district. Appreciable extents of the Sølendet reserve are once again being mown, but now using a two-wheeled tractor, with the aim of maintaining the former open landscape. Two of the old bothies, three hay-barns and some of the stack poles have been restored.

Two nature trails have been laid out, traversing the most interesting parts of the reserve; the longer one is 3 km and the shorter route is 1.5 km in length.

This brochure is intended to provide you with information about the various points of interest to be seen along these paths.

Please remember that all plants on the Sølendet reserve are protected by law.

Enjoy yourselves !

1ST STOP: NERLAUA

Sølendet has been used as a source of hay for hundreds of years. When cut and dried, the hay was either stored in barns (Norw. "laue"), or set up as haystacks. The hay was taken down

to the valley farms on sledges in wintertime. Some of the Nerlaua grassland areas are once again being scythed for hay nowadays.

This hay-barn is built in the manner traditional for all the larger hay-barns in this district, with solid timbers in the gable and pine-planking for the walls.

2ND STOP: BLACK VANILLA ORCHID GRASSLAND

Named after the orchid (*Nigritella nigra*) which flowers here during the summer (in July). It thrives best on open calcareous grassland, both on grazed areas and on areas cut for hay. It disappears when such usages cease and the vegetation coarsens. Other common plant species present here are lady's mantle (*Alchemilla* spp.), harebell (*Campanula rotundifolia*), mat grass (*Nardus stricta*), alpine cinquefoil (*Potentilla crantzii*).

3RD STOP: WILLOW SCRUB AND OVERGROWN HAYLAND

Downslope from the path, regular scything ceased during the 1940's and unhindered overgrowth has occurred since then, a process that is taking place more or less everywhere on the outlying grasslands of Norway. The willow grassland is luxuriant with tall herbs such as lousehat (*Aconitum septentrionale*) and meadowsweet (*Filipendula ulmaria*), and grasses such as wood millet (*Milium effusum*). On the part above the path, regular scything has been recommenced.

4TH STOP: OLDERBUA. RESTORATION AND MANAGEMENT OF A HAYMAKING LANDSCAPE

Since the hay harvest could last for several weeks, the haymakers needed a bothy (Norw. "bu") in which they could live during that time. Repair and rebuilding of such dwellings, and of the hay-barns, is an essential part of the work involved in creating a typical haymaking landscape. Another important activity is mowing large parts of the grasslands and fen vegetation, using a two-wheeled motor mower instead of a scythe. Areas mown at intervals of two or three years (Management cathegory A, cf. map on cover) will appear as the original haymaking landscape. Other areas are mown at intervals of six to ten years (Cathegory B) or not mown at all (Cathegory C).

From here on, the longer and the shorter route of the trails are separated.

5TH STOP: A TYPICAL RICH FEN AREA

The mires formerly cut for hay in this area are rich fens, which receive their nutrient supply from the calcareous soil. This, together with the streamwaters and seepage derived from the calcareous springs, account for the distinctive flora here. Important species are yellow sedge (*Carex flava*), broad-leaved cotton grass (*Eriophorum latifolium*), yellow mountain saxifrage (*Saxifraga aizoides*) and many orchids. The old poles, which are still visible on some of the fens (e.g. at 5th stop of the short path) were used to stack the hay on (cf. 11th stop).

6TH STOP: HAYMAKING AND FARMING

The sixth stop for those of you following the longer route provides a view that includes the northeastern part of the Aursunden lake. The valley farms of Brekken district are visible to southward, with the Vigelfjella hills (rising to almost 1600 m. altitude) behind them. Those of you who have taken the shorter route have now reached Øverlaua, one of the barns used to store the hay until the winter. A large part of the fodder supply for the livestock in winter was obtained from the upland fens and grassland areas. Each farm had traditional rights to these areas. The manure that accumulated in the cowsheds and stables during the winter was then used as fertilizer to increase the yield of the crops grown on the infield.

7TH STOP: THE WOODED GRASSLANDS

Herbs and broad-leaved grasses predominate in the luxuriant vegetation of the wooded grasslands which provided a very good quality hay. Herbs such as lady's mantle (*Alchemilla* spp.), common spotted orchid (*Dactylorhiza fuchsii*), wood crane's-bill (*Geranium sylvaticum*) and twayblade (*Listera ovata*) are common species. In springtime there is a rich bird fauna here, typical of the subalpine birch forests in this district. In the woodlands the bluethroat (*Luscinia svecica*), the willow grouse (*Lagopus lagopus*), the brambling (*Fringilla montifringilla*) and the willow warbler (*Phylloscopus trochilus*) are important species. On the open fens you can observe birds like the grey crane (*Grus grus*) and the common lapwing (*Vanellus vanellus*). Common mammals in this area are the elk (*Alces alces*), the red fox (*Vulpes vulpes*), the mountain hare (*Lepus timidus*) and the roe deer (*Capreolus capreolus*).

8TH STOP: AN AREA USED FOR RESEARCH

Permanent quadrats form a vital part of the study areas for botanical research being carried out on the Sølendet nature reserve. Some of these quadrats are mown every year or at longer intervals, some are left untouched. Notice the differences in the vegetation.

The aim of the research is to discover what effect schyting has on plant productivity, flowering and nutritive values, and also how the vegetation changes when subjected to regular trampling.

9TH STOP: A MINERAL-RICH SPRING

More than 50 such springs supply the Sølendet fens with calcareous, mineral-rich water, thereby providing the conditions necessary for the growth of many demanding plant species. The spring water flows over the fens and runs out as streams lower down. These streams eventually cut small valleys (Norw. "vassdaler") on the flat, sandy plains below. Common plant species around the springs, all of which require calcareous conditions for growth, are e.g. yellow mountain saxifrage (*Saxifraga aizoides*) and scorched alpine sedge (*Carex atrofusca*). Spring- and tufa-loving mosses predominates in the bottom layer.

10TH STOP: DALBUA - A TYPICAL HAYMAKERS' BOTHY

This bothy was used by the scythers and rakers to spend the nights in. The haymaking season could last from the first half of July until well into September, with a pause whilst the meadows on the infield were mown. The men scythed and the womenfolk raked. The cut grass was allowed to dry on the ground and then either piled onto the stack poles, or stored in the hay-barns.

11TH STOP: A STACK POLE

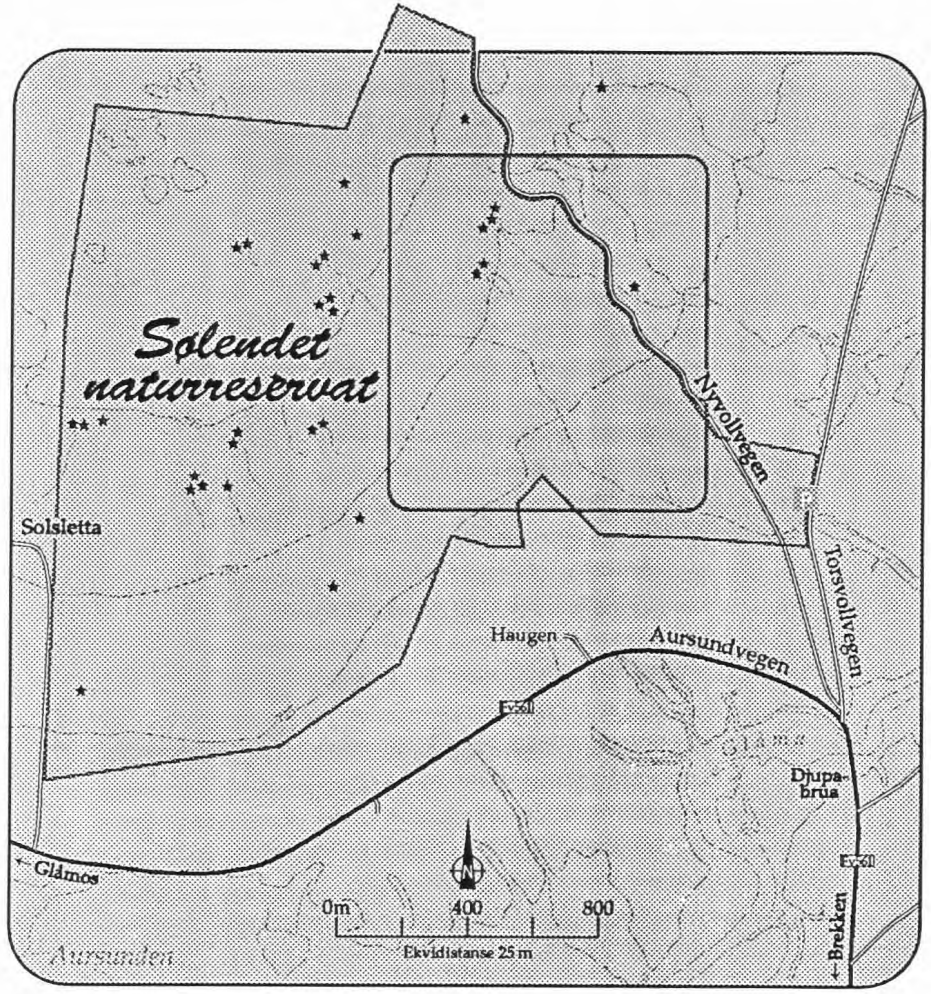
About two-thirds of all the hay made at Sølendet used to be stored on stack poles. A ring of birch branches was arranged around the base of the pole, with a second ring placed on top of the hay when it had reached about midway up the stack. This improved the ventilation. Each such haystack was, if possible, 3 m high, and broader in the middle than at the base. As each swathe of hay was placed on the pole, it was "combed" with the rake, to ensure that any rainwater would be channelled outwards and downwards. A cut peat was finally impaled on top of the stackpole, for additional protection against rain.

12TH STOP: MIDTILAUA - THE EFFECTS OF HAYMAKING

Midtilaua is typical of the smaller kind of hay-barns, with widely spaced timber to allow free ventilation. It is situated in an area which is now mown at about 3-yearly intervals. This scything interval leads to an increase in the proportion of such grasses and low herbs as sweet vernal-grass (*Anthoxanthum odoratum*), moon daisy (*Leucanthemum vulgare*) and species of gentian (*Gentianella* spp.) and moonwort (*Botrychium* spp.)

13TH STOP: WOODED HEATHLAND

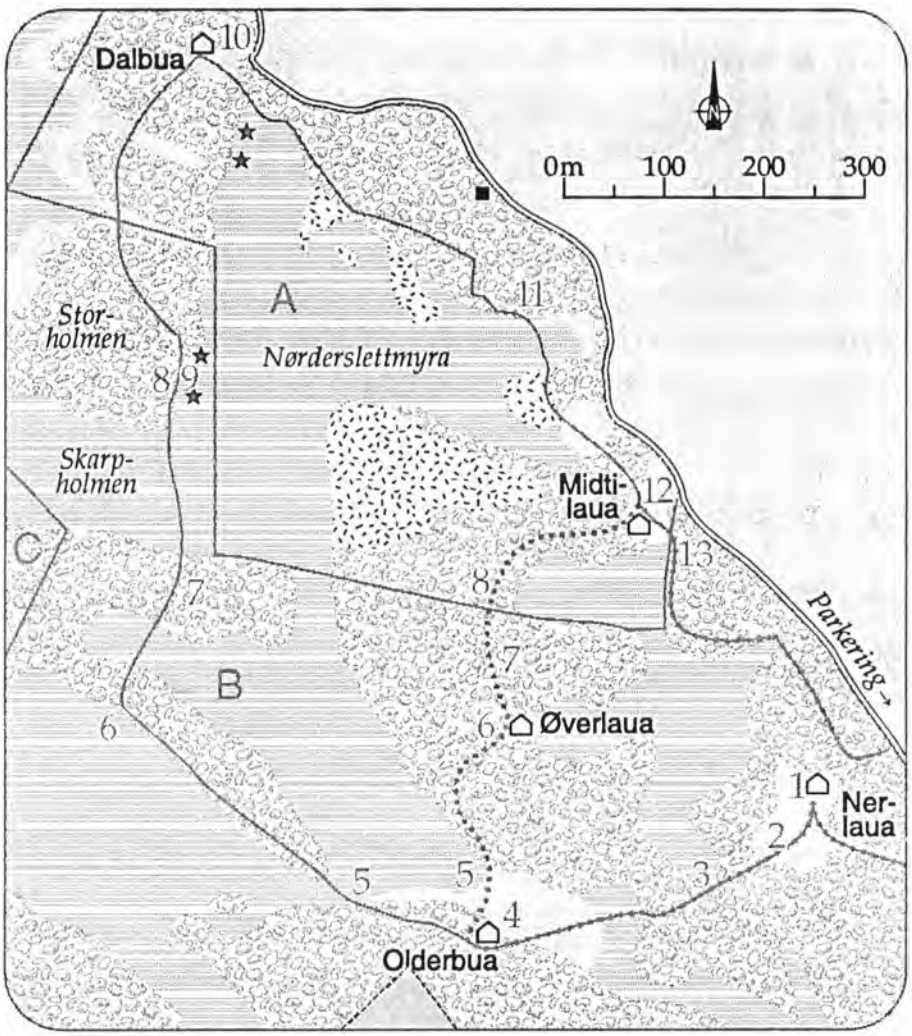
Wooded heathland produces little grass and such areas were not mown for hay, but were used for summer pasturage. Common plants are juniper (*Juniperus communis)* and ericaceous species, e.g. crowberry (*Empetrum hermaphroditum*) and cowberry (*Vaccinium vitus-idea*).



Tegnforklaring/Legend

- Reservatgrense/*Reserve boundary*
- ★ Rikkilde/*Calcareous spring*
- Vei/*Road*
- Utsnitt på stikart/*Part of map enlarged overleaf*
- Parkering/*Parking*

Oversiktskart



Stikart for Sølendet naturreservat

- Engbjørkeskog/*Wooded grassland*
- Heibjørkeskog/*Wooded heath*
- Åpen eng/*Open grassland*
- Myr/*Fen*
- Fukthei med dvergbjørk/*Damp heath with Betula nana*
- Reservatgrense/*Reserve boundary*
- B Skjøtselskategori (s. 8)/*Management category (p. 29)*
- Lang sti/*Longer trail*
- Kort sti/*Shorter Trail*
- Rikkilde/*Calcareous spring*
- Bu/*Bothy*
- Løe/*Hay-barn*

Layout: O.M. Eienbord. Tegninger: Ståle Myklebost. Trykk: NNNNNNNN 1993

K. NORSKE VIDENSK. SELSK. MUS. RAPP. BOT. SER. 1974-86
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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

1975 1 Flatberg, K. I. Botanisk verneverdige områder i Rissa kommune, Sør-Trøndelag. 45 s. utgått
2 Bretten, S. Botaniske undersøkelser i forbindelse med generalplanarbeidet i Åfjord kommune, Sør-Trøndelag. 51 s. kr 40,-
3 Moen, A. Myrundersøkelser i Rogaland. Rapport i forbindelse med den norske myrreservatplanen. 127 s. kr 40,-
4 Hafsten, U. & T. Solem. Naturhistoriske undersøkelser i Forradalsområdet - et suboceanisk, høytliggende myrområde i Nord-Trøndelag. 46 s. kr 20,-
5 Moen, A. & B. F. Moen. Vegetasjonskart som hjelpemiddel i arealplanleggingen på Nerskogen, Sør-Trøndelag. 168 s., 1 pl. kr 60,-

1976 1 Aune, E. I. Botaniske undersøkjingar i samband med generalplanarbeidet i Hemne kommune, Sør-Trøndelag. 76 s. kr 40,-
2 Moen, A. Botaniske undersøkelser på Kvikne i Hedmark, med vegetasjonskart over Innerdalen. 100 s., 1 pl. utgått
3 Flatberg, K. I. Klassifisering av flora og vegetasjon i ferskvann og sump. 39 s. kr 20,-
4 Kjelvik, L. Botaniske undersøkelser i Snåsa kommune, Nord-Trøndelag. 55 s. kr 40,-
5 Hagen, M. Botaniske undersøkelser i Grøvuområdet i Sunndal kommune, Møre og Romsdal. 57 s. kr 40,-
6 Sivertsen, S. & Å. Erlandsen. Foreløpig liste over Basidiomycetes i Rana, Nordland. 15 s. kr 20,-
7 Hagen, M. & J. Holten. Undersøkelser av flora og vegetasjon i et subalpint område, Rauma kommune, Møre og Romsdal. 82 s. kr 40,-
8 Flatberg, K. I. Myrundersøkelser i Sogn og Fjordane og Hordaland i forbindelse med den norske myrreservatplanen. 112 s. kr 40,-
9 Moen, A., L. Kjelvik, S. Bretten, S. Sivertsen & B. Sæther. Vegetasjon og flora i Øvre Forradalsområdet i Nord-Trøndelag, med vegetasjonskart. 135 s., 2 pl. kr 60,-

1977 1 Aune, E. I. & O. Kjærem. Botaniske undersøkingar ved Vefnsavassdraget, med vegetasjonskart. 138 s. 4 pl. kr 60,-
2 Sivertsen, I. Botaniske undersøkelser i Tydal kommune, Sør-Trøndelag. 49 s. kr 20,-
3 Aune, E. I. & O. Kjærem. Vegetasjon i planlagte magasin i Bjøllådalen og Stormdalen, med vegetasjonskart i 1:10 000, Saltfjellet/Svartisen-prosjektet. Botanisk delrapport nr. 1. 65 s., 2 pl. kr 60,-
4 Baadsvik, K. & J. Suul (red.). Biologiske registreringer og verneinteresser i Litlvatnet, Agdenes kommune i Sør-Trøndelag. 55 s. kr 40,-
5 Aune, E. I. & O. Kjærem. Vegetasjonen i Saltfjellområdet, med vegetasjonskart Bjøllådal 2028 II i 1:50 000. Saltfjellet/Svartisen-prosjektet. Botanisk delrapport nr. 2. 75 s., 1 pl. kr 60,-
6 Moen, J. & A. Moen. Flora og vegetasjon i Tromsdalen i Verdal og Levanger, Nord-Trøndelag, med vegetasjonskart. 94 s., 1 pl. kr 60,-
7 Frisvoll, A. A. Undersøkelser av mosefloraen i Tromsdalen i Verdal og Levanger, Nord-Trøndelag, med hovedvekt på kalkmosefloraen. 37 s. kr 20,-
8 Aune, E. I., O. Kjærem & J. I. Koksvik. Botaniske og ferskvassbiologiske undersøkingar ved og i midtre Rismålsvatnet, Rødøy kommune, Nordland. 17 s. kr 20,-

1978 1 Elven, R. Vegetasjonen ved Flatisen og Østerdalsisen, Rana, Nordland, med vegetasjonskart over Vesterdalen i 1:15 000. Saltfjellet/Svartisen-prosjektet. Botanisk delrapport nr. 3. 83 s., 1 pl. kr 60,-
2 Elven, R. Botaniske undersøkelser i Rien-Hyllingen-området, Røros, Sør-Trøndelag. 53 s. kr 40,-

3 Aune, E. I. & O. Kjærem. Vegetasjonsundersøkingar i samband med planene for Saltdal-, Beiarn-, Stor-Glomfjord- og Melfjordutbygginga. Saltfjellet/Svartisen-prosjektet. Botanisk delrapport nr. 4. 49 s. kr 20,-
4 Holten, J. I. Verneverdige edellauvskoger i Trøndelag. 199 s. kr 40,-
5 Aune, E. I. & O. Kjærem. Floraen i Saltfjellet/Svartisen-området. Saltfjellet/Svartisen-prosjektet. Botanisk delrapport nr. 5. 86 s. kr 40,-
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7 Frisvoll, A. A. Mosefloraen i området Borrsåsen-Barøya-Nedre Tynes ved Levanger. 82 s. kr 40,-
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1979 1 Moen, B. F. Flora og vegetasjon i området Borrsåsen-Barøya-Kattangen. 71 s., 1 pl. kr 40,-
2 Gjærevoll, O. Oversikt over flora og vegetasjon i Oppdal kommune, Sør-Trøndelag. 44 s. kr 20,-
3 Torbergsen, E. M. Myrundersøkelser i Oppland i forbindelse med den norske myrreservatplanen. 68 s. kr 40,-
4 Moen, A. & M. Selnes. Botaniske undersøkelser på Nord-Fosen, med vegetasjonekart. 96 s., 1 pl. kr 60,-
5 Kofoed, J. -E. Myrundersøkingar i Hordaland i samband med den norske myrreservatplanen. Supplerande undersøkingar. 51 s. kr 40,-
6 Elven, R. Botaniske verneverdier i Røros, Sør-Trøndelag. 158 s., 1 pl. kr 60,-
7 Holten, J. I. Botaniske undersøkelser i øvre Sunndalen, Grødalen, Lindalen og nærliggende fjellstrøk. Botaniske undersøkelser i 10-årsverna vassdrag. Delrapport 1. 32 s. kr 20,-

1980 1 Aune, E. I., S. Aa. Hatlelid & O. Kjærem. Botaniske undersøkingar i Kobbelv- og Hellemo-området, Nordland med vegetasjonskart i 1:10 000. 122 s., 1 pl. kr 60,-
2 Gjærevoll, O. Oversikt over flora og vegetasjon i Trollheimen. 42 s. kr 20,-
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4 Aune, E. I., S. Aa. Hatlelid & O. Kjærem. Botaniske undersøkingar i Eiterådalen, Vefsn og Krutvatnet, Hattfjelldal. 58 s., 1 pl. kr 60,-
5 Baadsvik, K., T. Klokk & O. I. Rønning (red.). Fagmøte i vegetasjonsøkologi på Kongsvoll, 16. - 18.3 1980. 279 s. kr 60,-
6 Aune, E. I. & J. I. Holten. Flora og vegetasjon i vestre Grødalen, Sunndal kommune, Møre og Romsdal. 40 s., 1 pl. kr 60,-
7 Sæther, B., T. Klokk & H. Taagvold. Flora og vegetasjon i Gaulas nedbørfelt, Sør-Trøndelag og Hedmark. Botaniske undersøkelser i 10-årsverna vassdrag. Delrapport 2. 154 s., 3 pl. kr 60,-

1981 1 Moen, A. Oppdragsforskning og vegetasjonskartlegging ved Botanisk avdeling, DKNVS, Museet. 49 s. kr 20,-
2 Sæther, B. Flora og vegetasjon i Nesåas nedbørfelt, Nord-Trøndelag. Botaniske undersøkelser i 10-årsverna vassdrag. Delrapport 3. 39 s. kr 20,-
3 Moen, A. & L. Kjelvik. Botaniske undersøkelser i Garbergselva/Rotla-området i Selbu, Sør-Trøndelag, med vegetasjonskart. 106 s., 2 pl. kr 60,-
4 Kofoed, J. -E. Forsøk med kalibrering av ledningsevnemålere. 14 s. kr 20,-
5 Baadsvik, K., T. Klokk & O. I. Rønning (red.). Fagmøte i vegetasjonsøkologi på Kongsvoll 15.-17.3.1981. 261 s. kr 60,-
6 Sæther, B., S. Bretten, M. Hagen, H. Taagvold & L. E. Vold. Flora og vegetasjon i Drivas nedbørfelt, Møre og Romsdal, Oppland og Sør-Trøndelag. Botaniske undersøkelser i 10-årsverna vassdrag. Delrapport 4. 127 s. kr 40,-
7 Moen, A. & A. Pedersen. Myrundersøkelser i Agder-fylkene og Rogaland i forbindelse med den norske myrreservatplanen. 252 s. kr 60,-
8 Iversen, S. T. Botaniske undersøkelser i forbindelse med generalplanarbeidet i Frøya kommune, Sør-Trøndelag. 63 s. kr 40,-

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1983	1	Moen, A. og medarbeidere. Myrundersøkelser i Nord-Trøndelag i forbindelse med den norske myrreservatplanen. 160 s.	kr 40,-
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1984	1	Krovoll, A. Undersøkelser av rik løvskog i Nordland, nordlige del. 40 s.	kr 20,-
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1986	1	Singsaas, S. Flora og vegetasjon i Ormsetområdet i Verran, Nord-Trøndelag. Supplerende undersøkelser. 25 s.	kr 20,-
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1987	1	Bretten, S. & O. I. Rønning (red.). Fagmøte i vegetasjonsøkologi på Kongsvoll 1987. 63 s.	kr 40,-
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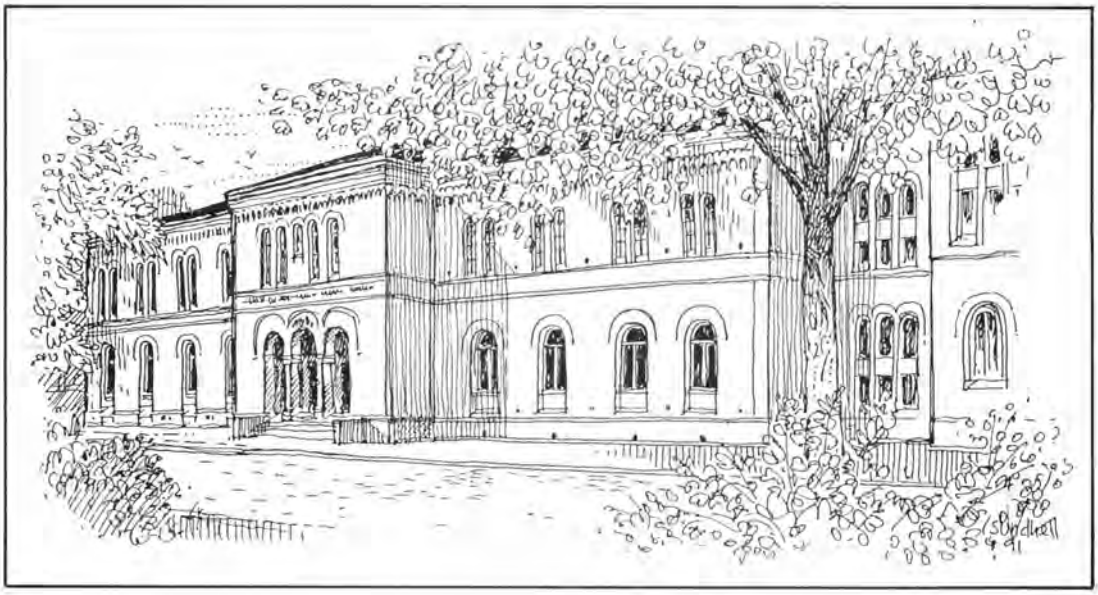

ISBN 82 - 7126 - 855 - 4
ISSN 0802 - 2992