Bibliography, NORWAY **Björn Åge Tømmerås**

Historical perspectives and milestones in the research on natural forests

Directorate for Nature Management (1995): Nature Protection Areas in Norway
DN-report 3, 1-178. Trondheim
Abstract: The report gives an overview of the results from the area protection part of the Nature Conservation work in Norway from 1911-1994. History, status and further protection plans are mentioned. The various Acts which can be used for area protection are described: - the Nature Conservation Act, the Svalbard Act, The Wildlife Act and the Planning and Building Act. Information about each protection area is to be found in a register by county and on the map enclosures.
Key-words: Nature conservation, protected areas, map of protected areas

Directorate for Nature Management (1997): Change in Nature / Nature in change. Terrestrial Monitoring Programme 1990-1995 DN-report 72, 1-157. Trondheim
Abstract: The programme is designed to reveal effects of pollution on plants and animals on population and community levels. It consists of chemical and biological monitoring, and is divided into I) integrated studies on precipitation, soil, vegetation and fauna, and II) nation-wide and regional mapping of epiphytic lichens and pollutant levels in biota. The monitoring areas are located in both protected and unprotected boreal forests. This report gives an overview of the programme and an assessment of the results from the period 1990-1995.
Key-words: Terrestrial environment, transboundary pollution, synthesis, integrated monitoring

Hafsten U. (1992): The immigration and spread of Norway spruce (*Picea abies* (L.) Karst.) in Norway
Norsk Geogr. Tidskr. 46, 121-158
Abstract: Pollen-analytical investigations and radiocarbon datings of cores from ombrotrophic peat bogs in the Norwegian spruce forest domain reveal that occupation of the areas by Norway spruce was a result of a protracted spread from east or northeast to west and south. The occupation started furthest northeast in the central Norwegian spruce province in the Early Iron Age. By the end of the Roman periode, AD 400, practically the full length of the borderland to Sweden and also to the central lowland area were occupied. The most expansive colonization in central Norway occured from AD 600 to 1030. The latest to be established was the coastal spruce forest.
Key-words: Norway spruce, pollen analysis, palaeo-ecology

Kielland-Lund J. (1981): Die Waldgesellschaften SO-Norwegens
Phytocoenologia 9 (1/2), 53-250
Abstract: A monograph of the forest plant communities in southeast Norway, based on plantsociological classification and ecological investigations.
Key-words: Plant sociology, plant communities, plant ecology

Økland R.H. (1990): Vegetation ecology: theory, methods and applications with references to Fennoscandia. Sommerfeltia Suppl. 1, 1-233
Abstract: Textbook in ecology, emphasising theory and numerical methodology, using examples from the Northern systems (boreal forests, mires and alpine heaths).
Key-words: Vegetation ecology, data sampling, numerical classification and ordination

Stand structure research in natural forests

Huse S. (1965): Strukturformer hos urskogbestand i øvre Pasvik
Meldinger fra Norges landbrukshøgskole 44. Ås, Norway
Abstract: In a protected pine forest in a national park the tree and log composition, the tree structure and dead wood structure are analysed in detail. Horizontal and vertical mapping of patches clarify all the different successional stages in a virgin pine forest under free development.
Key-words: Succession, pine forest, structure maps

Horntvedt R., Aamlid D., Rørå A., Joranger E. (1992): Monitoring programme for forest damage. An overview of the Norwegian programme
Norw. J. Agr. Sci. 6, 1-17
Abstract: The Norwegian Monitoring Programme for Forest Damage started in 1985. The programme is in accordance with the recommendations given by FAO and ECE and includes measurements of air pollutants in forest, nationwide survey of forest growth and vigour, and observations and research on permanent plots.
Key-words: Air pollution, forest damage, monitoring programme, forest survey, vigour criteria

Støen O.G., Nellemann C., Eriksen R. (1997): National monitoring of forest vitality in Norway 1989-96, statistics
NIJOS Report 1/97, 1-82. Ås, Norway
Abstract: Annual surveys of crown density and crown colour have been conducted on ca. 8000 conifers and broad-leaves in Norway since 1989. A steady increase in defoliation has been observed for Norway spruce between 1989 and 1996. A similar negative, but less pronounced trend has been observed for the other tree species. The decline has taken place in most of Central and Southern Norway.
Key-words: Monitoring, forest damage, statistics

Tomter S.M. (ed.) (1994): Skog 94. Statistics of forest conditions and resources in Norway
Norwegian Institute of Land Inventory (NIJOS). Ås, Norway
Abstract: This book is the result from the continuous national forest inventory. The data is updated and presented every second year.
Key-words: Forest statistics, forest inventory, forest production

Aamlid D., Venn K. (1993): Methods of monitoring the effects of air pollution on forest and vegetation of eastern Finnmark, Norway
Norw. J. Agr. Sci. 7, 71-87
Abstract: A monitoring system has been developed in order to reveal the actual forest health situation in areas of north-eastern Norway affected by air pollution from the Russian industry. Sampling is carried out on objectively chosen sample plots. Damage to vegetation and trees have been observed. Epiphytic lichens on birch stems are absent and show decrease coverage. Analyses of humus and plant tissues have shown elevated levels of nickel and copper in Norwegian forests located near the Russian border.
Key-words: North boreal forest, air pollution, monitoring system, vegetation, soil

Gap dynamics research

Tømmerås B.Å., Ødegaard F., Breistein J., Wilmann B., Gjershaug J.O. (1997): Fragmentation experiment in boreal spruce forest, the Mosvik project
NINA Oppdragsmelding 488, 1-33. Trondheim, Norway
Abstract: The main purpose of this project is to examine the biodiversity in boreal spruce forest, for several selected taxa, and to investigate how this biodiversity is affected by habitat fragmentation. Species composition, species number, and balance between species are influenced by habitat changes. The clear-cutting experiment consisting of both large and small scaled clear-cutting patterns, in old-growth forest, made it possible to examine effects of both habitat fragmentation and type of habitat fragmentation. The study intended to provide a basis for determining the pattern and size of clear-cuts to avoid or minimise biodiversity changes in boreal spruce forests.
Key-words: Boreal spruce forest, fragmentation, biodiversity

Succesional development, disturbances, management

Austad I., Skogen A. (1990): Restoration of a deciduous woodland in Western Norway formerly used for fodder production: effects on tree canopy and floristic composition
Vegetatio 88:1-20
Abstract: Experimental efforts were made to restore the traditional agriculture meadow woodland in a protected forest reserve in western Norway. The understory tree layer was removed. Old *Ulmus glabra* pollards and tall shrubs of *Corylus avellana* were pruned back to traditional shape and the field layer was mown once or twice yearly. After an early expansion of tall, nitrophilic herbs, low and medium sized herbs and grasses increased in numbers, frequency and abundance. The moss layer became more dense and varied, and the species diversity in the woodland increased enormously.
Key-words: Deciduous woodland, high pollarding, restoration and management, species diversity

Odland A., Bevanger K., Fremstad E., Hanssen O., Reitan O., Aagaard K. (1992): Mountain forest in South-Norway: Biology and management
NINA Oppdragsmelding 123, 1-90. Trondheim, Norway
Abstract: The report gives a review of the biological knowledge of upland forests in South Norway (defined as the upper coniferous forests below the climatic forest limit). Proposals are given to research projects which would increase the knowledge of these forests.
Key-words: Mountain forests, botany, mammals, ornithology, invertebrates, protection values, forestry, research, management

Tømmerås, B.Å. (1994): Natural dynamics of boreal forest. Elements and processes
DN-report 1994-5, 1-48. Trondheim, Norway
Abstract: In boreal forests there are mainly two types of forest development. The first one is continuous forest with high stability, several canopy layers and continuous regeneration (gap dynamics). These forests areas are naturally protected from fire and stormfelling. The second type of forest development is driven by frequent fire and/or stormfelling. Between these extremes there are continuous gradients. The paper analyses the following biodiversity content and dynamics.
Key-words: Forest ecology, natural forest dynamics, natural forest development

Ground vegetation, biodiversity aspects, dead wood component related to stand structure

Berntsen B.; Hågvar S. (eds.) (1991): Norsk Urskog
Universitetsforlaget, Oslo, 159 pp.
Abstract: A general description of different virgin forests in Norway, their history and biological variations, with emphasis on biological value, threats and nature conservation.
Key-words: Virgin forests, flora, fauna, threats and protection

Directorate for Nature Management (1995): Strategy for monitoring biological diversity
DN-rapport 1994-7, 1-66. Trondheim, Norway
Abstract: A strategy for establishing an overall programme for monitoring of biological diversity in Norway by the year of 2000 is presented. The program should be based on relevant ongoing monitoring activities, as well as on the need for new biological registrations. The strategy suggests that monitoring activities should be organised according to biomes (nature types), and contains recommendations on extensive and intensive monitoring within each system.
Key-words: Monitoring, biological diversity, threats

Directorate for Nature Management (1998): Plan for monitoring biological diversity
DN-report 1998-1, 1-170. Trondheim, Norway
Abstract: The report presents a comprehensive proposal for the monitoring of biological diversity. The main objective of monitoring is to provide information on the state of the natural environment and on changes in biological diversity.
Recommendations are given for Norway's main ecosystems: forests, mires and wetlands, cultural landscape, mountains, fresh water systems, coastal areas (both terrestrial and aquatic), open sea and arctic ecosystem.
Key-words: National master plan, monitoring of biological diversity, threats, ecosystems: forests, mire and wetlands, cultural landscape, mountains, freshwater systems, coastal systems, open sea, polar ecosystems

Eilertsen O., Often A. (1994): Terrestrial monitoring programme. Studies in vegetation ecology of boreal birch forests in Gutulia National Park
NINA Oppdragsmelding 285, 1-69Trondheim, Norway
Abstract: A baseline study for monitoring the vegetation and soil in boreal birch forest is presented. Field methods based on permanent plots and extensive use of multivariate numerical analyses are important parts of the study. The investigation is primarily designed to study the distribution of species along various complex gradients in climate, moisture, nutrition, light etc., and to relate possible changes in the vegetation to both natural changes in the environment and to external impacts, such as air pollution.
Key-words: Boreal birch forest, vegetation, soil, terrestrial environment, monitoring

Odland A., Birks H.J.B., Line J.M. (1990): Quantitative vegetation-environment relationships in west Norwegian tall-fern vegetation
Nord. J. Bot. 10, 511-533
Abstract: The floristical variation within different types of tall-fern dominated vegetation is described, and the patterns are interpreted in terms of environmental variables. The investigation shows that some of the observed differences in vegetational composition can be explained in terms of relatively simple soil and climatic variables measured for each quadrat.
Key-words: Floristic variation, fern communities, vegetation and environment relationships, soil, numerical classification, constrained ordination

Odland, A., Birks, H.J.B., *Line J.M. (1995): Ecological optima and tolerances of Thelypteris limbosperma, Athyrium distentifolium*, and *Matteuccia struthiopteris* along environmental gradients in Western Norway
Vegetatio 120, 115-129
Abstract: The distribution and abundance of three different ferns are modelled statistically in relation to environmental variables along major climatic, topographic, and edaphic gradients in western Norway. *Athyrium distentifolium* has an ecological preference for low July and January temperatures, high altitudes, and soils of low to medium pH and base content. *Thelypteris limbosperma* has ecological optima of moderately high winter and summer temperatures, high humidity, medium altitudes, and acid soils. *Matteuccia struthiopteris* prefers high summer temperatures, nutrient rich soils, low humidity and low winter temperatures.
Key-words: Canonical correspondence analysis, ecological optima, fern ecology, gaussian logit regression, generalised linear models, weighted averaging

Stokland J. (1994): Biological diversity and conservation strategies in Scandinavian boreal forests
Dr. scient. thesis, University of Oslo
Abstract: The aim of this study is to improve the basic and applied knowledge about the biological diversity in boreal forests in Scandinavia. Birds and beetles are studied as two examples and the variation of their species composition in the forest landscape is documented. Furthermore, analyses of biodiversity and timber production patterns are performed to develop strategies to balance timber production and conservation.
Key-words: Diversity patterns, nature reserves design, birds, beetles

Sætersdal M., Birks H.J.B. (1993): Assessing the representativeness of nature reserves using multivariate analysis: Vascular plants and breeding birds in deciduous forests, western Norway
Biological Conservation 65, 121-132
Abstract: Multivariate analyses are used as a tool for delimiting representative types of deciduous woods in western Norway, based on vascular plants and and breeding birds. The relationships between the species assemblages and environmental variables such as climate, area, habitat features, landscape attributes and disturbances have been investigated.
Key-words: Broad-leaved deciduous forests, nature reserve selection, multivariate analyses, plants, birds, representativeness

Sætersdal M. (1994): Rarity and species/area relationships of vascular plants in deciduous woods, western Norway - applications to nature reserve selection
Ecography 17, 23-38
Abstract: The Rabionowitz model of rarity is applied to a vascular list from 60 deciduous woods in western Norway. Rarity at local and regional scale is compared. At local scale rarity was primarily due to narrow geographical distribution of species. At the regional scale the most frequent form of rarity was due to restricted habitat specificity. It is shown that a single large wood supports fewer regional-scale rare species than do combinations of two small woods of equal area.
Key-words: Biological diversity, rarity, broad-leaved deciduous forests, nature reserve selection

Sætersdal M., Line J.M., Birks H.J.B. (1993): How to maximize biological diversity in nature reserve selection: Vascular plants and breeding birds in deciduous woodlands, western Norway
Biological Conservation 66, 131-138
Abstract: Three possible quantitative methods to identify a set of reserves that includes all species of interest are presented, using plant and bird lists from 60 deciduous woods in western Norway. The first method concentrates on the so-called endemic species (i.e. those present at only one site). The second repeatedly selects a chosen number of sites at random, aiming at maximising the number of species for that number of sites. The third procedure finds the small-

est set of sites that will include each species at least once. Results from the three methods are discussed and compared with related broad-scale studies in Australia.
Key-words: Biological diversity, broad-leaved deciduous forests, nature reserve selection, plants, birds

Økland R.H., Eilertsen O. (1993): Vegetation-environment relationships of boreal coniferous forests in the Solhomfjell area, Gjerstad, S Norway
Sommerfeltia 16, 1-254
Abstract: The understory vegetation in an area dominated by boreal coniferous forests is subjected to detailed ecological analysis, based on measuring species abundances and environmental variables from the same sample plots. Ordination methods provided two main coenocline axes, interpretable in ecological terms. The first axis is interpreted as the response to a broad-scale topographical complex-gradient. The second axis, mainly affecting the species composition in the bottom layer, is interpreted as a fine scale paludification gradient. The causes of variation along these gradients are discussed. Methods are discussed with particular reference to monitoring. The potential of an integrated concept using permanent plots, parallel investigation of vegetation and environmental parameters, and gradient analysis, is stressed.
Key-words: Boreal coniferous forests, DCA, environmental factors, gradient, LNMDS, monitoring, ordination, vegetation

Økland R.H., Eilertsen, O. (1997): Dynamics of understory vegetation in an old-growth boreal coniferous forest (1988–1993)
J. Veg. Sci. 7, 747-762
Abstract: Understory vegetation changes in a South Norwegian old-growth coniferous forest were studied between 1988 and 1993 in 200 $1m^2$ vegetation plots. The aims were to quantify the amount of between-year compositional change, and to elaborate the environmental basis for long-term vegetation change. Statistically significant vegetation change is demonstrated for most one-year periods and for the five-year period in most forest types. The largest vegetation change observed, measured as plot displacement along DCA ordination axes, reflects a change from medium-rich spruce forests towards poor spruce forests, and is interpreted as a long-term trend. In the same period there is a decrease in soil pH and exchangeable Ca, and an increase in Al and Mn, suggesting that the vegetation change might be related to soil acidification.
Key-words: Acidification, boreal coniferous forest, canonical correspondence analysis, detrended correspondence analysis, pH, species richness, vegetation change

Økland T. (1988): An ecological approach to the investigation of a beech forest in Vestfold, SE Norway
Nord. J. Bot. 8, 375-407
Abstract: The vegetation of a protected beech forest is analysed for species composition in sample plots, using both percentage cover and frequency in subplots as abundance measurements. Environmental variables are sampled from the same plots. The vegetation is classified into four topographical/ecological types. Ecological gradients are identified using Detrended Correspondence Analysis (DCA). The advantages for choosing frequency in subplots are discussed, and the advantages of using DCA and statistical interpretation with integration of ecological measurements in vegetation-environment studies are emphasised.
Key-words: Beech forests, Norway, vegetation types, soil, subjective classification, numerical ordination

Økland T. (1996): Vegetation-environment relationships of boreal spruce forests in ten monitoring reference areas in Norway
Sommerfeltia 22, 1-349

Abstract: Vegetational and environmental monitoring of boreal spruce forest was initiated in 1998 at the Norwegian Institute of Land Inventory (NIJOS). As a basis for monitoring, relationships between trees, understory vegetation and environmental conditions were analysed for each of ten reference areas. This comprehensive paper describes methods and the results of the investigation of the ten plots and also gives a discussion of the use of numerical analysis used in the interpretation of the main gradients in the dataset.
Key-words: Boreal spruce forest, CCA, DCA, ecology, environment, gradient, LNMDS, monitoring, Norway, ordination, permanent plots, vegetation

Aarrestad P.A.: Floristical composition and plant communities in broad-leaved deciduous forests in Hordaland county, Western Norway
Submitted
Abstract: Natural and semi-natural broad-leaved deciduous forests in western Norway have been described with regards to species composition and vegetation structure, as a basis for further studies of the vegetation and the environmental relationships. Plant communities based on numerical classification are described and discussed in relation to equivalent forest communities in Scandinavia and in Great Britain.
Key-words: Broad-leaved deciduous forest, plant communities, numerical classification, indirect gradient analyses

Aarrestad P.A. (in prep.): Vegetation and environment relationship in broad-leaved deciduous forests in Hordaland county, Western Norway
Manuscript
Abstract: The vegetation of natural and semi-natural broad-leaved deciduous forests in western Norway has been studied in relation to their environment. The investigation is based on phytosociological and ecological analyses of forest stands dominated by *Corylus avellana*, *Fraxinus excelsior*, *Ulmus glabra* and *Tilia cordata*. A *Fraxinus excelsior* dominated forest type is located on soils with a relative high soil moisture, total nitrogen and extractable phosphorous content, and is probably a successional stage from formerly cultivated forests. A more thermophilous *Corylus avellana* dominated forest is found on medium dry soils, It has a denser tree canopy and is, in general, less influenced by cultural impact. Within these two main forest communities several plant communities can be associated with differences in soil richness. Several species of trees, shrubs, ferns, graminides, herbs and bryophytes show ecological optima along selected environmental variables within the deciduous forests.
Key-words: Broad-leaved deciduous forest, vegetation, soil, canonical correspondence analysis, ecological optima, weighted averaging, generalised linear models

Aarrestad P.A., Aamlid D. (1999): Vegetation monitoring in South-Varanger, Norway - Species composition of ground vegetation and its relation to environmental variables and pollution impacts. - Environmental Monitoring and Assessment (In print)
Abstract: The area along the Norwegian-Russian border is threatened by air pollution from emission sources at the Kola Peninsula. A permanent net of objectively chosen monitoring sites have been established in eastern Finnmark, Norway. Environmental variables and species abundances data from field- and bottom layer have been recorded from these sites. Multivariate data analysis has been used to describe the variation in the species composition and its relation to natural environmental variables and pollution impact. Pollution variables have been found statistically significant correlated to the variation in the species data, but they explain only a minor part of the variation. The pollution impact over several years may have lead to a reduced lichen cover in the bottom layer vegetation.
Key-words: Air pollution, vegetation monitoring, north boreal forests, indirect and direct gradient analysis