**Bibliography, SWEDEN** **Kjell Sjöberg**

*Historical perspectives and milestones in the research on natural forests*

Arnborg T. (1943): (Granberget. En växtbiologisk undersökning av ett sydlappländskt granskogsområde med särskild hänsyn till skogstyper och föryngring)
Almquist & Wiksells Boktryckeri, Uppsala och Stockholm
Abstract: A description of a forested area (4120 ha) in northern Sweden dominated by *Picea abies*. (In Swedish with a German summary)

Arnborg T. (1990): Forest types of northern Sweden. Introduction to and translation of "Det nordsvenska skogstypsschemat"
Vegetatio 90, 1-13
Abstract: A presentation of the forest types scheme widely used in Sweden in teaching and training in forestry from 1945 to the late 1970's. It is still used for pilot descriptions.

Björkman L., Bradshaw R. (1996): The immigration of *Fagus sylvatica* L. and *Picea abies* (L.) Karst. into a natural forest stand in southern Sweden during the last 2000 years
J. Biogeogr. 23, 235-244
Abstract: Although at continental scale migrations of *Fagus sylvatica* and *Picea abies* are under a broad climatic control, disturbance and local factors influence the immigration of these species into individual forest stands. In a palaeoecological analysis of a small forest hollow in the boreo-nemoral zone of southern Sweden, a forest stand with largely unbroken forest continuity resisted immigration of *Fagus* for almost 1000 years. However, two fires about 950 and 330 years ago were the disturbing factors that faciliated eventual *Fagus* immigration. *Picea* immigrated and achieved co-dominance in a single generation, without resistance from the existing forest. Thus migrational lag is demonstrable for *Fagus* but not *Picea*. The consequences of the immigration of these two species are discussed.

Bradshaw R. H. W., Hannon G. E. (1992): Climatic change, human influence and disturbance regime in the control of vegetation dynamics within Fiby Forest, Sweden
J. Ecol. 80, 625-632
Abstract: The paper deals with the immigration and rise to dominance of *Picea abies* within Fiby Forests, central Sweden. The investigation was based on pollen and charcoal analysis of tiny bogs which contained a 4000-year record. A mixed deciduous forest that existed 4000 years ago was replaced in a stepwise manner by a boreal community

Engelmark O. (1981): Forest history of Muddus National Park, N Sweden
Wahlenbergia 7, 33-38
Mixed deciduous-conifer forests dominate the forests in the Muddus National Park in northern Sweden. The most common deciduous trees are *Betula pubescens*, *B. verrucosa*, *Populus tremula*, *Salix caprea* and *Sorbus aucuparia*, while *Pinus sylvestris* and *Picea abies* dominate the conifer species. The past and present influence of fire, man and climate on these forests is discussed.

Engelmark O. (1984): Forest fires in the Muddus National Park (northern Sweden) during the past 600 years
Can. J. Bot. 62, 893-898
Between 1413 and the present, evidence of 47 fire years was obtained in the Muddus National Park in northern Sweden by dating the fire scars on living Scots pine (*Pinus sylvestris*), the oldest of which had germinated in 1274. The most common frequencies of fires in the pine forests occurred with the interval 81-90 years, while the mean frequency was 110 years.

Hallbäcken L., Tamm C.O. (1986): Changes in soil acidity from 1927 to 1982-1984 in a forest area of South-West Sweden
Scand. J. For. Res. 1, 219-232
A reinvestigation of soil profiles sampled for pH measurements in 1927 in four areas distributed over the country revealed a general decrease in pH with 0.3-0.9 units. While tree species effect and age effect in the spruce stands may be called biological acidification, acidification of deeper horizons, now often below pH 4.5 and in the aluminium buffer range, seems difficult to explain by the authors without assuming an influence of acid deposition.

Kullman L. (1987): Long-term dynamics of high-altitude populations of *Pinus sylvestris* in the Swedish Scandes
J. Biogeogr. 14,1-8
Regeneration success of Scots pine in a narrow altitudinal zone well below the altitudinal tree-limit in the Swedish Scandes was related to changes in summer mean temperature and thermal conditions during the late winter and spring. A positive impact of the twentieth-century climatic improvement was found.

Kullman L., Engelmark O. (1997): Neoglacial climate control of Subarctic *Picea abies* stand dynamics and range limit in northern Sweden
Arctic and Alpine Research 29, 315-326
Abstract: The study is focused on the performance of the *Picea abies* range limit in northern Sweden during the Neoglacial period of the Holocene, mainly after the climax of the Little Ice Age. It is speculated that the structure and performance of the studied system, i.e. outliers checked by sever ground frost, is a small-scale analogy to the situation preceding the general late Holocene expansion of spruce in Fennoscandia.

Linder P., Östlund L. (1998): Structural changes in three mid-boreal Swedish forest landscapes, 1885-1996
Biological Conservation 85, 9-19
Abstract: Changes in structure and composition of 123 000 ha of boreal forests were analysed using historical records. Since the late 1800s, both the number of large trees and the volume of snags have been reduced by about 90 %, and the area of old stands has diminished to <1 %. These fundamental changes have reduced the number of habitat for many red-listed species considerably.

Lindquist B. (1938). (Dalby Söderskog. En skånsk lövskog i forntid och nutid)
Acta Phytogeographica Suecica X
Abstract: A description of a Scanian deciduous forest. The history of the forest, topography, hydrology, the soil, the different tree species, the field layer, etc. are described. In Swedish with a German summary.

Malmström C. (1949): (Studier över skogstyper och trädslagsfördelning inom Västerbottens län) (Studien über Waldtypen und Baumartenverteilung im Län Västerbotten)
Meddel. från Statens skogsforskningsinstitutt Band 37, 11, 231 pp.

Abstract: Edaphic factors, climate, the types of forests and their developments, etc. in the province of Västerbotten, northern Sweden, are described. In Swedish with a German summary.

Persson S., Malmer N., Wallén B. (1987): Leaf litter fall and soil acidity during half a century of secondary succession in a temperate deciduous forest
Vegetatio 73, 31-45
Abstract: Vegetation, leaf litter fall and soil pH were sampled within semipermanent plots in a South-Swedish deciduous forest between 1935 and 1983. The greatest shifts in dominance among field layer species were found in those plots where the quality of the leaf litter had improved. These plots also showed a halt in the general tendency towards a decreasing pH in the topsoil.

Segerström U., Bradshaw R., Hörnberg G., Bohlin E. (1994): Disturbance history of a swamp forest refuge in northern Sweden
Biol. Conserv. 68,189-196
Abstract: Swedish swamp forests have been interpreted as refugia from fire with long histories of forest continuity, and they have a considerable conservation value because of their rich biodiversity, which includes many threatened species. Palaeoecological investigation of a small swamp forest in northern Sweden shows that the area was under cultivation 500 years ago. The present forest has only developed during the last 300 years as a consequence of changes in land-use.

Segerström U., Hörnberg G., Bradshaw R. (1994): The 9000-year history of vegetation development and disturbance patterns of a swamp-forest in Dalarna, northern Sweden
The Holocene 6, 37-48
Abstract: From analyses of pollen and charcoal in peat cores together with age-structure data of a swamp-forest site in the western part of central Sweden, the regional vegetation succession and the disturbance patterns over the last 9000 years are showed. The vegetation has been highly dynamic in response to both anthropogenic and ônaturalö disturbance, and to the immigration of *Picea.* Consequences for conservation policies are discussed.

Selander S. (1950): Floristic Phytogeography of South-Western Lule Lappmark (Swedish Lapland) I. Acta Phytogeographica Suecica 27, 1-200
Abstract: A description of human influence, regional distribution and origins of the flora, as well as migratory tracts and influence of topography and climate within the region.

Sernander R. (1936): (Granskär och Fiby urskog)
Acta Phytogeographica Suecica 8, 1-232
Abstract: A study of the part played by storm-gaps and dwarf trees in the regeneration of the Swedish spruce forest, with the forests of Granskär och Fiby in Uppland, central Sweden as a basis.

Sonesson M., Hoogesteger J. (1983): Recent tree-line dynamics (*Betula pubescens* Ehrh. ssp. *tortuosa* [Ledeb.] Nyman) in northern Sweden
Nordicana 47, 47-54
Abstract: In the Torneträsk area, in the northern part of the Scandinavian mountain range, the mountain birch, *Betula pubescens* Ehrh. ssp. *tortuosa* (Ledeb.) Nyman, sets the altitudinal and latitudinal tree lines. An expansion and thickening of birch woods has been noted during the past few decades. An altitudinal expansion is evident. Since the early 1930s, the peak summer periods, autumns and early winters in the area have become warmer by 0.5-1.0 °C, causing the mean annual temperature to increase by 0.5 °C as compared with the previous part of the century.

Tirén L. (1937): Forestry historical studies in the Degerfors district of the province of Västerbotten (Skogshistoriska studier i trakten av Degerfors i Västerbotten)
Medd. St. Skogsförs. Anst. 30, 67-322
Abstract: A description from Kulbäcksliden research forest of the history of the development of settlement and population, spread of forest fires and their importance for the type of forest stands, industrial conditions apart from forestry and its subsidiary industries (e.g. hunting and fishing, mining, cattle breeding an agriculture) and utilisation of the forests (felling and saw-milling, tar production, and potash manufacture). In Swedish with an English summary.

*Stand structure research in natural forests*

Bradshaw R., Zackrisson O. (1990): A two thousand year history of a northern Swedish boreal forest stand
J. Veg. Sci. 1, 519-528
Abstract: A study of successional processes within a northern Swedish boreal forest based on analysis of pollen, charcoal fragments and insect remains preserved in a deep mor humus layer on a small island in a large lake. *Picea abies* became established during the Little Ice Age, which was the longest period without fire in the record.

Engelmark O., Kullman L., Bergeron Y. (1994): Fire and age structure of Scots pine and Norway spruce in northern Sweden during the past 700 years
New Phytol. 126, 163-168
Abstract: The performance of *Pinus sylvestris* and *Picea abies* was studied in relation to the fire regime from the 1200s up to present in an old-growth boreal forest area. A J-shaped age distribution of pine during the study period suggests a stationary pattern in the landscape. The spruce age structure (from the 1600s onwards) also points towards a J-shape, although with slight deviations.

Hesselman H. (1935): (Fibyskogen och dess utvecklingshistoria)
Meddelanden från Statens Skogsförsöksanstalt nr 28
Abstract: A description of a forest in central Sweden which is set aside as a nature reserve.

Hofgaard A. (1993): Structure and regeneration pattern in a virgin *Picea abies* forest in northern Sweden
J.Veg.Sci. 4, 601-608.
Abstract: Age structure, spatial regeneration patterns, and substrate were studied in a high-altitude boreal *Picea abies* forest (with tree ages up to 410 yr) in northern Sweden. The results suggest that recruitment is primarily dependent on germination substrate but also negatively correlated with the density of the tree layer. 60 % of all spruce trees <1.3 m high grew in substrates connected with treeûfall; c. 40 % were found on decomposing logs and stumps, covering only ca. 6 % of the forest floor. Peaks in age distribution are probably climatically induced. The results challenge the previous assumptions that this kind of forest undergoes cyclic development. Long-term structural stability with climatically induced minor variations may be an alternative model

Sonesson M. (1974). Late Quaternary forest development of the Torneträsk area, North Sweden 2. Pollen analytical evidence. Oikos 25, 288-307
Abstract: A description of the forest development of the Torneträsk area, northern Sweden, based on pollen analytical evidence. For example, the Pine period (C14 age 4700/4500-1500 BC in the central and eastern parts, possibly 3800-1500 BC in western) was the thermal maximum period for the area, and *Pinus* and *Betula* dominated the forests.

*Modelling the stand structure*

Bradshaw R., Gemmel P., Björkman L. (1994): Development of nature-based silvicultural models in southern Sweden: the scientific background
For. Landscape. Res. 1, 95-110
Abstract: Biological archives of forest history are used to guide the development of nature-based silvicultural models for southern Sweden, where few natural reference forest stands remain. Species-rich, mixed deciduous forest is the natural conditions for southern Sweden, but management practices have created monotonous, species-poor forest types. Nowadays intensive browsing by moose and deer is very disadvantageous for deciduous species. Goals shared by both production and environmental considerations such as altered grazing regime, diversity of forest types, mixed forest stands, and disturbance measures that stimulate regeneration, and practical silvicultural methods that will achieve these goals are discussed.

Engelmark O., Hofgaard A., Arnborg T. (1998): Successional trends 219 years after fire in an old *Pinus sylvestris* stand in northern Sweden
J. Veg. Sci. 9, 583-592
Abstract: Results from repeated analyses of a permanent plot established in 1947, combined with retrospective stand age structure data, in an old *Pinus sylvestris* stand in Muddus National Park in northern Sweden.

Persson T. (ed). (1980): Structure and function of northern coniferous forests - an ecosystem study
Ecol. Bull. 32
Abstract: The volume is a documentation of the studies conducted within the Swedish Coniferous Forest Project, consisting of 37 individual papers dealing with aspects of the structure and function of Scots pine forests in central Sweden. The general objective of the study was to deepen the knowledge of plant growth interpreted in an ecosystem context.

*Gap dynamic research*

Hofgaard A. (1993): 50 years of change in a Swedish boreal old-growth *Picea abies* forest
J. Veg. Sci. 4, 773-782
Abstract: A study of the changes in the tree layer (>1.3 m) and sapling layer (<1.3 m, including seedlings) of a Swedish boreal old-growth *Picea abies* forest from the 1930s to the 1980s (studied in permanent plots). Ca. 25% of the trees present during the first analysis were no longer alive during the second one. It is suggested that the amount of coarse woody debris available for regeneration, the occurrence of seedlings. and seedling mortality constitute concurrent factors through which climatic fluctuation, in a long-term perspective, direct stand recruitment and density.

Hörnberg G., Ohlson M., Zackrisson O. (1995): Stand dynamics, regeneration patterns and long-term continuity in boreal old-growth *Picea abies* swamp-forests
J. Veg. Sci. 6, 291-298
Abstract: Ten old-growth swamp-forests dominated by *Picea abies* were studied in northern Sweden. In a short-term perspective (<300 yr), the swamp-forests are characterised by individual trees continually emerging while others are dying. It is suggested that internal dynamics of continuous small-scale distribution in combination with local site-specific factors determine the structure of these forests. The hypothesis that Scandinavian spruce swamp-forests in general have been functioning as true long-term fire-free refugia is modified by the presented results.

Hytteborn H., Packham J. R., Verwijst T. (1987): Tree population dynamics, stand structure and species composition in the montane virgin forest of Vallibäcken, Northern Sweden
Vegetatio 72, 3-19
Abstract: The population dynamic of *Betula pubescens* and *Picea abies*, studied in a boreal forest in northern Sweden, are governed by a process of storm gap regeneration similar to the gap regeneration described for boreo-nemoral forests.

Hytteborn H., Liu Q.-H., Verwijst T. (1991): Natural disturbance and gap dynamics in a Swedish boreal spruce forest
In: Nakagoshi N., Golley F.B. (eds.): Coniferous forest ecology, from an international perspective. SPB Academic Publishing bv,The Hague, 93-108
Abstract: A primeval spruce (*Picea abies*) forest in central Sweden (Fiby urskog) consisted of a small-scaled mosaic created by storms, was studied. About 31 % of the forest was made up of small gaps, which mostly were initiated by the fall of a single tree. A gap was defined as the part of a stand where one or several trees had created an empty space in the canopy either by death or by both death and subsequent falling. The majority of trees that died were infected previously by fungi. About 57 % of all trees snapped off, 29 % was uprooted and 13 % was standing dead. Tree size distribution and percentage of gap area seemed to have been relatively constant during a longer period.

*Successional development, disturbances*

Angelstam P. (1996): Ghost of forest past - natural disturbance regimes as a basis for reconstruction of biologically diverse forests in Europe
In: DeGraaf R., Miller R. I. (eds): Conservation of faunal diversity in forested landscapes, 287-336
Abstract: The most important habitat types for wildlife populations in Europe, including Sweden, and the disturbance regimes impacting them are described and discussed (include the boreal forest dominated by fire, temperate deciduous forests dominated by gap-phase dynamics and grazing, and riparian forests dominated by flooding).

Bergeron Y., Engelmark O., Harvey B., Morin H., Sirois L. (1998): Key issues in disturbance dynamics in boreal forests
J. Veg. Sci. 9, 463-610
Abstract: Based on contributions presented at the IAVS Workshop on Disturbance in Boreal Forests, held at the University of Québec, Canada, August 26-30, 1996. Major themes are for example: conjunctive changes in climate and disturbance, the stress-disturbance continuum, disturbances in the boreal forest - more than fire, and disturbance dynamics and forest management.

Bradshaw R.H.W. (1993): Tree species dynamics and disturbance in three Swedish boreal forest stands during the last two thousand years
J. Veg. Sci. 4, 759-764
Abstract: Data from three forest stands for the past 2000 yr show how the shade-intolerant species *Pinus sylvestris* and *Betula pubescens* maintain significant populations in the Swedish boreal landscape. Reduction of the fire frequency during the last 200 yr has favoured *Picea abies*.

Engelmark O. (1987): Fire history correlations to forest type and topography in northern Sweden
Ann. Bot. Fennici 24, 317-324
Abstract: The relationship of fire history to forest type and topography were examined on plots in Muddus National Park in northern Sweden. Repeated surface fires seem to have promoted the longevity of *Pinus sylvestris* (>700 years old), and to have maintained the lichen-dominated forest type.

Engelmark O. (1999): Boreal forest disturbances
In: Walker L. (ed.): Ecosystems of disturbed ground. Ecosystems of the world 16. Elsevier, Amsterdam, 175-200
Abstract: Synthesises fire and other disturbance factors in the Circumpolar Boreal forest, i.e. herbivory and tree defoliators, internal stand disturbances, human impact, and climate change and disturbance.

Engelmark O., Bradshaw R., Bergeron Y. (eds.) (1993): Disturbance dynamics in boreal forest
J. Veg. Sci. 4, 729-832
Abstract: In total 14 original papers from Sweden and Canada dealing with general studies on disturbance and species adaptations to disturbance, tree population dynamics on different time-scales, and community-level responses to disturbance.

Jonsson B.G., Dynesius M. (1993): Uprooting in boreal spruce forests - long-term variation in disturbance rate
Can. J. For. Res. 23, 2383-2388
Abstract: The temporal forest floor disturbance pattern caused by uprooted trees over a period of 120 years is presented from four study sites in the northern boreal zone in southern Lapland, northern Sweden. There was a strong aggregation in temporal distribution, resulting in large variations in disturbance rate between different decades, which implies periods with low availability of exposed soil. More retrospective studies to evaluate long-term variation in disturbance regime parameters and studies on the temporal availability of exposed and colonizable soil is recommended.

Schimmel J., Granström A. (1996): Fire severity and vegetation response in the boreal Swedish forest
Ecology 77, 1436-1450
Abstract: Plant survival and colonisation was studied over an experimental gradient, from fire lightly scorching the soil to fire consuming most of the organic soil layer, at two forest sites in northern Sweden. Three rhizomatous species, the dwarf shrubs *Vaccinimum myrtillus* and *V. vitis idaea* and the grass *Deschampsia flexuosa*, were dominant in the vegetation. After fires that consumed only the moss layer, cover of the *Vaccinium* species returned to prefire levels within 2-4 yr, and *D. flexuosa* showed a dramatic increase in cover as well as in fruiting. Fires that burned slightly deeper nearly eliminated *D. flexuosa*, and the deepest burning fires also eliminated *Vaccinium* spp. Differences between treatments were still great after 5 yr, indicating that variation in depth of burn will have a long-lasting impact on the vegetation. The results indicate that in boreal forest, depth of burn is a more important variable than fire front intensity for the understory vegetation, in contrast to the situation in ecosystems with little accumulation of organic material on the mineral soil.

Uggla E. (1958): Skogsbrandfält i Muddus nationalpark
Acta Phytogeographica Suecica 41, 1-116

Abstract: In Swedish with an English summary: Forest fire areas in Muddus National Park, northern Sweden. Describes the development of vegetation and soil on burnt areas from 1920, 1933, 1941 and 1947 in Muddus National Park, northern Sweden. The species in the tree layer, the field layer and the bottom layer are treated separately.

Zackrisson O. (1977): Influence of forest fires on the North Swedish boreal forest
Oikos 29, 22-32
Abstract: The frequency of forest fires during the past 600 yr was studied within boreal forest ecosystems in a river valley in northern Sweden. Fire scars in living and dead trees were used for dating past fires. A mean interval of 80 yr was found.

Zackrisson O., Nilsson M.-C., Steijlen I., Hörnberg G. (1995): Regeneration pulses and climate-vegetation interactions in nonpyrogenic boreal Scots pine stands.
J. Ecol. 83, 469-483
Abstract: Age and diameter distributions of nonpyrogenic, virgin Scots pine (*Pinus sylvestris*) populations were studied at different sites of *Empetrum-Vaccinium* type along a latitudinal gradient in northern Sweden. A much smaller number of experimentally planted pine and spruce seeds established and survived in vegetation dominated by *Empetrum hermaphroditum* than in that dominated by *Cladina* spp. A wave-like regeneration pattern of pine may result from successful establishment in periods with good seed production on ground dominated by *Vaccinium* spp. and *Cladina* spp.

*Biodiversity aspects, dead wood component related to stand structure*

Ås S. (1993): Are habitat islands islands? Woodliving beetles (*Coleoptera*) in deciduous forest fragments in boreal forests
Ecography 16, 219-228
Abstract: Among other things, fire dynamics have been changed in modern forestry. As a result the size and numbers of deciduous forest patches have been reduced as well as the number of deciduous trees within the coniferous forest, which has exaggerated the insularity of deciduous forest patches within the boreal coniferous forest zone. An explanation to the apparent lack of insularity effects in the study is the relative recent commencement of intensive forestry in the studied areas and the fact that the matrix is of rather high quality.

Angelstam P.K. (1998): Maintaining and restoring biodiversity in European boreal forests by developing natural disturbance regimes
Journal of Vegetation Science 9, 593-602
Abstract: A conceptual model is presented as a guide to the maintenance and restoration of ecological sustainable boreal forest. The major explanatory variable in the model is the effect of wildfire on sites with different fuel characteristics and climates found in the European boreal forest.

Angelstam P; Majewski P. (1996): Reference landscapes for improved landscape management in eastern and western Europe
In: Bachmann P., Kuusela A., Uuttera J. (eds): Assessment of biodiversity for improved forest management. European For. Inst. Proc. No 6, 111-123
Abstract: A comparison of the forests in the Komi district in Russia and in Sweden and the development of forestry activities during recent decades. It is also a discussion about the possibilities to study the biodiversity in the different forested regions in relation to forestry activities.

Berg Å., Ehnström B., Gustafsson L., Hallingbäck T., Jonsell M., Weslien J. (1994): Threatened plant, animal, and fungus species in Swedish forests: Distribution and habitat associations
Conservation Biology 8, 718-731
Abstract: A large part of the Swedish forests is used for commercial forestry, which has had a huge impact on the structure and function of forest ecosystems. The present knowledge on the distribution and habitat associations of 1487 threatened forest species in Sweden is compiled, and an attempt is made to identify structures and elements that are critical for their occurrence. Guidelines for the maintenance of threatened forest species are suggested.

Edenius L., Sjöberg K. (1997): Distribution of birds in natural landscape mosaics of old-growth forests in northern Sweden: relations to habitat area and landscape context
Ecography 20, 425-431
Abstract: Breeding birds were censused for three years in twenty patches ranging in size in natural landscape mosaics of virgin old-growth spruce forest and mire in a nature reserve in northern Sweden. There was a strong effect of patch area on species richness, but no effect of matrix type. Small patches (< 5 ha) had fewer and large patches (> 10 ha) more species than expected. Overall distribution of species across patches showed a highly significant nested pattern, indicating that a few habitat generalists occupy all size classes, whereas more demanding species avoid small patches regardless of landscape composition.

Gustafsson L. (1994): A comparison of biological characteristics and distribution between Swedish threatened and non-threatened forest vascular plants
Ecography 17, 39-49
Abstract: A majority of the threatened taxa occur in the southern deciduous woodlands, which only constitute c. 0.5% of the total forested area in Sweden. The considerably more threatened taxa in southern Sweden is a consequence of the successively higher number of forest vascular plants from the north towards the south. Threatened taxa grow in forests with significantly higher soil fertility than non-threatened taxa.

Gustafsson L., Eriksson I. (1995): Factors of importance for the epiphytic vegetation of aspen Populus tremula, with special emphasis on bark chemistry and soil chemistry
Journal of Applied Ecology 32, 412-424
Abstract: The cover of bryophytes and of foliose and fruticose lichens of stems of aspen was studied in a forest in central Sweden. The most important factors affecting the composition of the epiphytic vegetation were field-layer vegetation type and light conditions, and basal area of aspen soil exchangeable Ca and soil exchangeable Na. There were significant correlations between bark chemistry and soil chemistry.

Hansson L. (ed.) (1997): Boreal ecosystems and landscapes: structures, processes and conservation of biodiversity
Ecol. Bull. 46, 203 pp.
Abstract: The book is a summation of a research program on "Remnant habitats in production landscapes" that was initiated and supported by the Swedish Environmental Protection Agency. Data are synthesised from various aspects and try to deduce suitable conservation management for boreal ecosystems and landscapes.

Jonsson B.G., Esseen P.-A. (1990): Treefall disturbance maintains high bryophyte diversity in a boreal spruce forest
Journal of Ecology 78, 924-936
Abstract: Bryophyte diversity was compared in patches formed by uprooting with that of the undisturbed forest floor in a north Swedish *Piece abyss* forest. The bryophyte diversity was significantly higher in patches with soil disturbance compared with undisturbed forest floor.

Four reasons are proposed: uprooting creates space for bryophyte colonisation, disturbed patches have high habitat heterogeneity, within-patch disturbance continues long after patch formation through erosion from the tip-up mound, and the small patch size implies a short distance to potential sources of bryophyte diaspores which should increase the chance of establishment.

Thus, treefall disturbance is regarded as important for both the persistence of colonists and the maintenance of high bryophyte diversity in boreal-forest ecosystems.

Nilsson S. G., Arup U., Baranowski R., Ekman S. (1995): Tree-dependent lichens and beetles as indicators in conservation forests
Conserv. Biol. 9, 1208-1215
Abstract: A test of the possibility to use the conspicuous lichen *Lobaria pulmonaria* as indicator of the number of tree-dependent, red-listed species in 18 stands of hemiboreal forest in southern Sweden. Eight stands with *L. pulmonaria* had about nine red-listed lichens, but 10 stands without L. pulmonaria had only about one such species. The variation between stands in the number of red-listed wood beetles was considerable, but it was very weakly correlated with the number of red-listed lichens. The number of red-listed wood beetles dependent on d27ead trees was not different in areas with or without *Lobaria pulmonaria*, but the number of red-listed wood beetles dependent on hollow trees was higher in stands with *Lobaria pulmonaria* than in those without the lichen. Stands with this lichen species also contained significantly more of other types of lichens that have been proposed as indicators of forest continuity. The authors stress the need for identification of species that could serve as indicators of different types of forest continuity and identify some organism groups that may indicate the different types.

Nilsson S.G., Baranowski R. (1997): Habitat predictability and the occurrence of wood beetles in old-growth beech forests
Ecography 20, 491-498
Abstract: Wood beetle fauna was sampled in living hollow, standing dead and downed dead beech *Fagus sylvatica* logs in fragmented old-growth forests in southern Sweden. Species richness was similar in the three types of microhabitat in nearly primeval stands, but in previously (50-100 yr ago) managed stands species richness was lower in living hollow trees. The number of red-listed beetle species per sample was higher in living hollow beeches in nearly primeval stands than in formerly managed stands, but there was no difference in downed dead beeches. Among 55 red-listed species found, 69 % had a higher frequency in nearly primeval stands than in previously managed stands.

Ohlsson M., Söderström L., Hörnberg G., Zackrisson O., Hermansson J. (1997): Habitat qualities versus long-term continuity as determinants of biodiversity in boreal old-growth swamp forests
Biological Conservation 81, 221-231
Abstract: In this study of 10 small remnants of boreal old-growth swamp forests in northern Sweden, no relationship was found between the occurrence of 33 lichen and fungi species considered to indicate natural forests with long stand continuity and the known long-term continuity of the forests. Actually, the forests most affected by earlier natural and man-made fires harboured more of these species than forests less affected by fire disturbance. Instead, the most important variable explaining biodiversity as well as presence of öcontinuity indicator speciesö was the amount of dead wood present.

Pettersson R.B. (1996): Effect of forestry on the abundance and diversity of arboreal spiders in the boreal spruce forest
Ecography 19, 221-228

Abstract: Five lichen-rich natural spruce *Picea abies* forests and adjacent mature, selectively logged lichen-poor forests in northern Sweden were selected as sample sites. Lichen-rich forests had over three times more spiders on the branches than the lichen-poor forests. Diversity indices showed a higher diversity of spiders in lichen-rich than in lichen-poor forests. It is suggested that habitat structure (branch size and epiphytic lichen abundance) could be an explanation for the greater number of spiders in old, lichen-rich spruce forests.

Sjöberg K., Ericson L. (1997): Mosaic boreal landscapes with open and forested wetlands
Ecol. Bull. 46, 48-60
Abstract: A review of patterns and processes of importance for the biodiversity in Fennoscandian wetland mosaic landscapes, which also describes man's past and present impact, and outline a strategy for conservation. The boreal landscape was earlier characterised by a mosaic of open and forested wetlands and forests. Drainage and felling operations have largely changed that pattern. Several organisms depend upon the landscape mosaic.

Sjöberg K., Lennartsson T. (1995): Fauna and flora management in forestry
In: Hytönen M. (ed.): Multiple-use forestry in the Nordic countries. The Finnish Forest Research Institute, 191-243
Abstract: A description of the development of silvicultural methods in Sweden to meet the demands for maintaining biological diversity.

Söderström L. (1988): Sequence of bryophytes and lichens in relation to substrate variables of decaying coniferous wood in northern Sweden
Nord. J. Bot. 8, 89-97
Abstract: The species sequence on decaying logs during the decay period was investigated in a forest in northern Sweden. Wood texture (degree of surface erosion) was the most important variable in separating species.

Tibell L. (1992): Crustose lichens as indicators of forest continuity in boreal coniferous forests
Nord. J. Bot. 12, 427-450
Abstract: The crustose lichen flora in boreal coniferous forests from southern Sweden to Lapland in the north, was surveyed. Some species were found exclusively in forests with a long continuity. An indicator species index of forest continuity was designed. The index was highly correlated with forest continuity and also with occurrence of species listed as threatened.

*Comparisons between natural forests/managed forests*

Andersson L.I., Hytteborn H. (1991): Bryophytes and decaying wood – a comparison between managed and natural forest
Holarct. Ecol. 14, 121-130
Abstract: A comparative study between a managed forest and a natural forest regarding the supply of decaying wood on the ground and the occurrence of bryophytes on the wood, especially epixylic specialists. The total substrate surface of wood is larger in the primeval forest. Logs of *Populus tremula* occurred only in the natural forest. An important proportion of the wood substrate in the natural forest consisted of logs of large diameter class, while these logs were missing in the managed forest. The bryophyte flora on decaying wood was most species-rich in the natural forest, where sixteen epixylic specialists occurred, while only five of these species occurred in the managed forest.

Angelstam P., Mikusinski G. (1994): Woodpecker assemblages in natural and managed boreal and hemiboreal forests - a review
Ann. Zool. Fennici 31, 157-172
Abstract: The occurrence of many woodpecker species may indicate a high degree of naturalness of forests. A comparison between (among other things) the degree of specialisation of the different woodpecker species with their population trends and with changes in habitat distribution in the boreal/hemiboreal landscape over the last century, shows that there is a close connection between the degree of specialisation, the changes in forests and recent population trends. Thus woodpecker species as a group are in conflict with intensive forest management.

Edenius L., Elmberg J. (1996): Landscape level effects of modern forestry on bird communities in North Swedish boreal forests
Landscape Ecol. 11, 325-338
Abstract: The effect of the large-scale forestry on landscape structure and the structure and composition of boreal bird communities was studied in North Sweden. Based on point counts along forestry roads, it was concluded that species richness and relative abundance of forest birds were higher in landscapes with low forestry impact. After controlling for patch size, forest age and tree species composition, a significant effect of forestry impact remained for so called "Siberian" species group and for *Anthus trivialis*. The results imply that these species may be sensitive to forest fragmentation.

Ehnström B., Långström B., Hellqvist C. (1995): Insects in burned forests - forest protection and faunal conservation (preliminary results)
Entomol. Fennica 6, 109-117
Abstract: The beetle colonisation of fire-damaged trees was studied in the year after a fire in seven forests in south and central Sweden. The burned pines displayed a large range in fire damage. Spruce were more sensitive than pine, and a few fire-damaged spruces had some green foliage left. The pine shoot beetle, *Tomicus piniperda* was the main coloniser of pine trees. On spruce, two bark beetles, *Polygraphus poligraphus* and *Pityogenes chalcographus*, were common.

Esseen P.-A., Renhorn K.-E., Pettersson R. B. (1996): Epiphytic lichen biomass in managed and old-growth boreal forests: effect of branch quality
Abstract: Ecol. Appl. 6, 228-238
Biomass and species composition of canopy lichens on branches of Norway spruce (*Picea abies*) was compared in three pairs of old-growth and managed (selectively logged) stands in northern Sweden. Old-growth stands had six times higher lichen mass per spruce branch, and two times higher expressed as percentage of branch mass, compared to mature stands of managed forest. Lichen mass was strongly related to mass, diameter, and age of branches. Fruticose, pendulous species (*Alectoria sarmentosa* and *Bryoria* spp.) were highly sensitive to forest practices. In contrast, type of forest had no significant effect on foliose species.

Esseen P.-A., Ehnström B., Ericson L., Sjöberg K. (1997): Boreal forests
Ecol. Bull. 46, 16-47
Abstract: A review of patterns and processes of importance for biodiversity in the Fennoscandian boreal forest. It describes man's past and present impact and outline a strategy for conservation.

Gustafsson L., Hallingbäck T. (1988): Bryophyte flora and vegetation of managed and virgin coniferous forests in South-West Sweden
Biol. Conserv. 44, 283-300
Abstract: The bryophyte flora and vegetation were compared in one virgin and three managed *Picea abies* stands in SW Sweden. The composition of the bryophyte vegetation did not differ

much between the stands. Rare hepatics growing on large logs distinguished the virgin stand from the managed stands. Consideration should be given to the bryophytes when forestry is conducted; large logs should be allowed in a stand, forest fens should be left undrained, and areas with old trees left when clear-cutting.

Hansson L., Larsson T-B. (1997): Conservation of boreal environments: a completed research program and a new paradigm
Ecol. Bull. 46, 9-15
Abstract: A description of nature conservation movements during the 20th century and their relations to various ecological research approaches. Also the background to the Swedish research programme "Remnant habitats in production landscapes" is presented.

Nilsson S. G. (1979): Effects of forest management on the breeding bird community in southern Sweden
Biol Conserv. 135-143
Abstract: A natural and a managed forest of similar age were compared in the province of Småland, southern Sweden. The total bird density was three times higher in the natural forest.

Nilsson S. G. (1997): Forests in the temperate-boreal transition: natural and man-made features
Ecol. Bull. 46, 61-71
Abstract: The main ecological features of the forests in the nemoral-boreal transition zone in Europe are reviewed. The reasons behind the transition in time from a species-rich forest dominated by deciduous trees to one with few species dominated by conifers are discussed.

Schlyter F., Lundgren U. (1993): Distribution of a bark beetle and its predator within and outside old growth forest reserves: No increase of hazard near reserves
Scand. J. For. Res. 8, 246-256
Abstract: The hypothesis that reserves create a hazard because pest insects are more abundant in unmanaged forest reserves than in managed forests was tested by pheromone trapping of *Ips typographus* within and outside two small old growth forest reserves in southern Sweden. Also a second hypothesis, that more predators existed in the diverse ecosystem in the reserves, resulting in fewer bark beetles, was tested. The important predator *Thanasimus formicarius* was monitored together with the prey. No change in the catches of prey was showed and the predator was caught in small numbers, but in a pattern opposite to the predictions of the hypothesis of higher catches inside the reserves.

Söderström L. (1988): The occurrence of epixylic bryophytes and lichen species in an old natural and a managed forest stand in northeast Sweden
Biol. Conserv. 45, 169-178.
Abstract: An old natural spruce stand and a managed spruce stand were compared with regard to occurrence of epixylic bryophyte and lichen species and amount of decaying wood in different size classes and decay stages. Epixylic species were predominant in the managed stand. This difference is explained by differences in humidity regimes, with the managed stand exposed to drought more often than the natural stand. It is concluded that drought-sensitive bryophytes growing on logs in intermediate stages of decay are among the species most threatened by modern forest management.

*Applications for silviculture*

Angelstam P., Pettersson B. (1997): Principles of present Swedish forest biodiversity management
Ecol. Bull. 46, 191-203
Abstract: A review of measures to combine management for wood and biodiversity at the scale of trees, stands and landscapes during the recent decade.

Atlegrim O., Sjöberg K. (1995): Effects of clear-cutting and selective felling in Swedish boreal coniferous forest: response of invertebrate taxa eaten by birds
Entomol. Fennica 6, 79-90
Abstract: A study of short-term effects (0-4 years) of selective felling and clear-cutting on the food resources of insectivorous birds. Clear-cuttings had significantly lower abundance and biomass, and a different composition of herbivorous larvae and spiders, as well as a lower total biomass of invertebrates in the field layer than controls. Selective fellings did not differ from controls in the occurrence of herbivorous larvae and spiders.

Atlegrim O., Sjöberg K. (1996): Effects of clear-cutting and single -tree selection harvest on herbivorous insect larvae feeding on bilberry (*Vaccinimum myrtillus*) in uneven-aged boreal *Picea abies* forests
Forest Ecology and Management 87, 139-148
Abstract: The effects of clear-cutting and single-tree selection on herbivorous insect larvae feeding on bilberry (*Vaccinium myrtillus*) were studied. Abundance of geometrids and exposed folivorous larvae were significantly lower in clear-cut areas than in selection felled and uncut controls. Significantly lower total abundance of herbivorous larvae were found in clear-cuttings compared to uncut controls. Bilberry stem and leaf damage was significantly higher in selection fellings and controls than in clear-cuttings. Lower availability and quality of bilberry may explain the reduced abundance of larvae and the reduced consumption of bilberry by larvae in clear-cuttings. The results suggest that clear-cutting negatively affect bilberry, herbivorous larvae feeding on bilberry, and their interaction. Contrary to the negative effects on clear-cutting, bilberry, insect larvae and their interaction in selection felling seems to resemble that in uncut forests.

Atlegrim O., Sjöberg K., Ball J. P. (1997): Forestry effects on a boreal ground beetle community in spring: Selective logging and clear-cutting compared
Entomol. Fennica 8, 19-26.
Abstract: To compare the effects of two tree-harvesting methods (clear-cutting and single tree selection felling), spring-occurring ground beetle (*Carabidae*) were studied by pitfall trapping in northern Sweden. In general, the carabid community in the selection loggings resembled that in the uncut control forest, indicating a low effect of this harvesting method.

Bader P., Jansson S., Jonsson B.G. (1995): Wood-inhabiting fungi and substratum decline in selectively logged boreal spruce forests
Biol. Conserv. 72, 355-362
Abstract: The effects of selective cuttings on wood-inhabiting fungi were studied in a gradient from extensively logged to semi-natural forests of Norway spruce forests in the boreal zone of Sweden. Based on fruit bodies, both the total species number as well as the number of threatened species decreased with increasing degree of cutting.

Björse G., Bradshaw R. (1998): 2000 years of forest dynamics in southern Sweden: suggestions for forest management
Forest Ecology and Management 104, 15-26

Abstract: Maps, presented at 500-year intervals covering the last 2000 years and based on syntheses of fossil pollen data, are presented. There has been a widespread transformation from rich, mixed deciduous forest types to species-poor coniferous-dominated forest types. The transformation is interpreted as being partially a consequence of the climate-driven, continental-scale migrations of *Fagus* and *Picea*, but the major controlling factor appears to have been former land-use.

Fries C. , Carlsson M., Dahlin B., Lämås T., Sallnäs O. (1998): A review of conceptual landscape planning models for multiobjective forestry in Sweden
Abstract: The paper reviews the approaches to multiple objective landscape planning that have developed in Swedish forestry in the 1990s. The objectives include both timber production and maintenance of biodiversity, but include also such aspects as aesthetics and recreation.

Fries C., Johansson O., Pettersson B., Simonsson P. (1997): Silvicultural models to maintain and restore natural stand structures in Swedish boreal forests
For. Ecol. Managem. 94, 89-103
Abstract: On the basis of current knowledge of natural forest dynamics, management options for three major site types in boreal Sweden which mimic natural dynamics better than traditional forestry, is presented. In the natural stages, the sites carried (I) Scots pine forest, (ii) deciduous or Norway spruce dominated forest, and (iii) Norway spruce forest regenerated by so-called gap dynamics, respectively.

Pettersson R.B., Ball J.P., Renhorn K.-E., Esseen P.-A., Sjöberg K. (1995): Invertebrate communities in boreal forest canopies as influenced by forestry and lichens with implications for passerine birds.
Biological Conserv. 74, 57-63
Abstract: An investigation on the effects of commercial forestry on canopy-living invertebrates in the boreal forest. The study was conducted during late winter, when invertebrate abundance is lowest, and when small differences may be critical to foraging birds. Natural forests had significantly greater invertebrate diversity than managed forests and nearly five times as many invertebrates per branch. The number and biomass of invertebrates were related to the abundance of lichens.