

THE IMMIGRATION AND SPREAD OF SPRUCE (*Picea abies* (L.) KARST.) IN NORWAY, TRACED BY POLLEN ANALYSIS AND RADIOCARBON DATINGS, A PRELIMINARY REPORT

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Abstract

Biostratigraphical studies and radiocarbon datings from 86 sites, mostly ombrotrophic peatbogs, situated within the South-Norwegian spruce forest domain, show that the occupation of the areas by spruce forest was the result of a protracted spread from east, or northeast, to west and south, which started in late pre-Christian time and was completed during the Middle Ages.

Introduction

Spruce forest occupies today more than 50 % of all the forest in Norway and is restricted mainly to two separate regions: 1) the SE-Norwegian province, east of the Langfjellene mountain range, and 2) the Mid-Norwegian province, comprising Sør- and Nord-Trøndelag counties and adjacent part of Nordland (Fig. 2). Isolated populations occur also west of Langfjellene and, ssp. *obovata* (Led.) Hultén, in Finnmark in northern Norway (Gløersen 1884).

The replacement of the previous vegetation of light pine forests and populations of various deciduous tree species and shrubs by spruce and the establishment of extensive, dark and shady forests of this eastern, continental tree species, involved a comprehensive environmental change, which may have influenced man's life conditions in various ways.

It was early realised that spruce was a late immigrant to Scandinavia and until recently thought that the invasion of this tree species and resulting vegetational changes was conditioned by an abrupt climatic deterioration postulated to have taken place at the transition from the Subboreal to Subatlantic climate periods, around 2500 years ago. The results of the investigations discussed here reflect a rather complex picture of the spruce forest establishment in South Norway and give support, only locally, to the »fimbul winter» theory referred to above.

Material and methods

The spruce project under consideration consists of biostratigraphical investigations of peat columns from 73 peatbogs situated within the two main spruce forest provinces in Norway and from one peatbog in Voss, west of the Langfjellene range (Site 58). Additional data are drawn from investigations carried out by Danielsen (1970), Henningsmoen (1979) and Høeg (1978, 1979), from a dozen bogs and lakes situated in SW Østfold, S Vestfold, and Telemark (Sites 41 to 52).

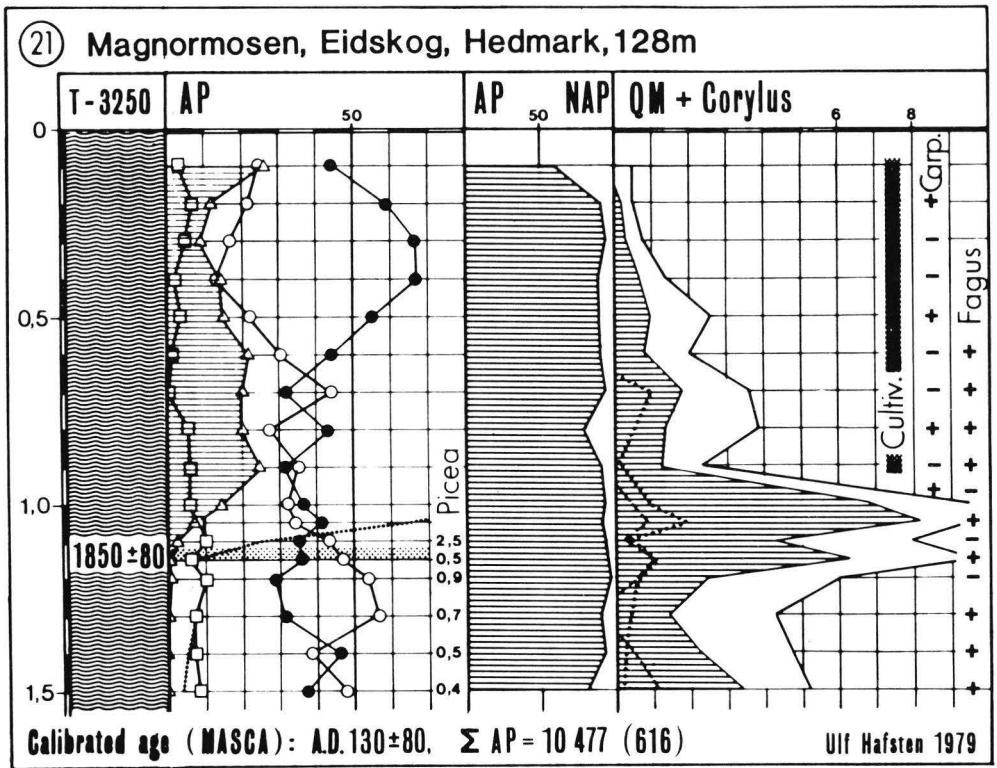


Fig. 1. Pollen diagram from Site 21, exemplifying the method which has been applied in order to trace the depth in the peat column at which the local spruce forest establishment is reflected and, hence, where the sample for radiocarbon dating has been taken.

In order to avoid contamination during sampling the peat columns were collected in continuous lengths, by hammering 2 m long and 0.10 m wide plastic pipes into the bogs. In order to obtain samples for radiocarbon measurements, which did not contain plant material that has assimilated old, radiologically inactive carbon from the ground water, sampling was restricted primarily to ombrotrophic peatbogs (i.e. bogs having a plant cover which receives almost all its nutrition and water from the atmosphere).

The depth in the peat columns at which the local spruce forest establishment is reflected, was traced by means of pollen analysis, and the determination of the time when this event took place, by means of radiocarbon measurements of 3 to 5 cm thick portions of the peat columns (Fig. 1). The ^{14}C measurements were carried out at Trondheim Radiological Dating Laboratory. The results of the datings were reported both as conventional ages before present (1950) and as dendrochronologically calibrated ages (MASCA), referring to Christian chronology.

All the sites under consideration, including site number and calibrated age for the local spruce forest establishment, have been displayed on a map of South Norway (Fig. 2). In order to present the progression in the spruce forest establishment in Norway in a more distinct way, a series of maps have been put together, displaying with black symbols the position of the spruce forest at the end of each archaeological period involved (Fig. 3). — Because the centuries around the birth of Christ were so important

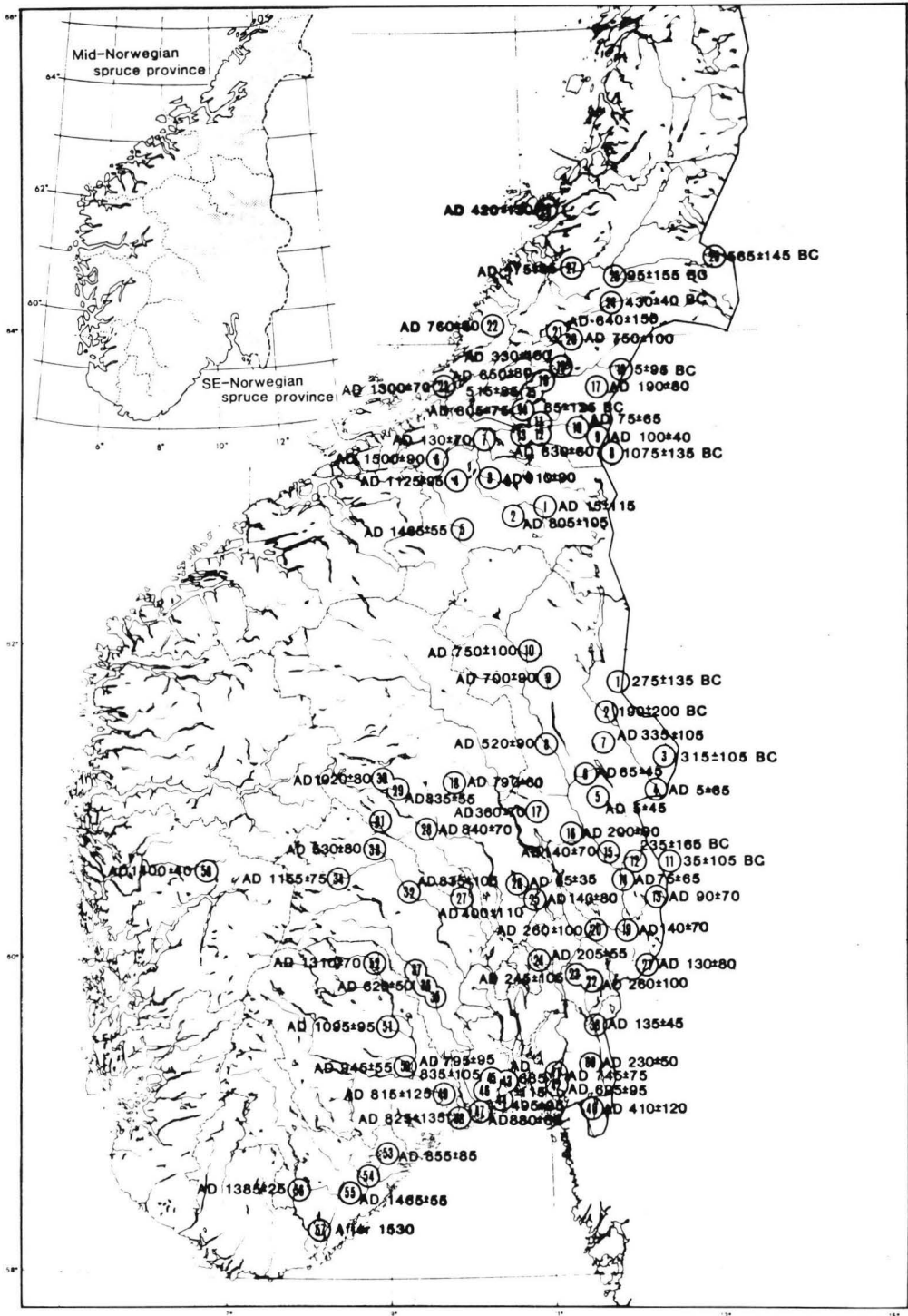


Fig. 2. Map of South Norway displaying the location of the sites, together with the site number and calibrated radiocarbon age for the local spruce forest establishment. — Sites 41 to 52 according to investigations by Danielsen (1970), Henningsmoen (1979) and Høeg (1978, 1979).

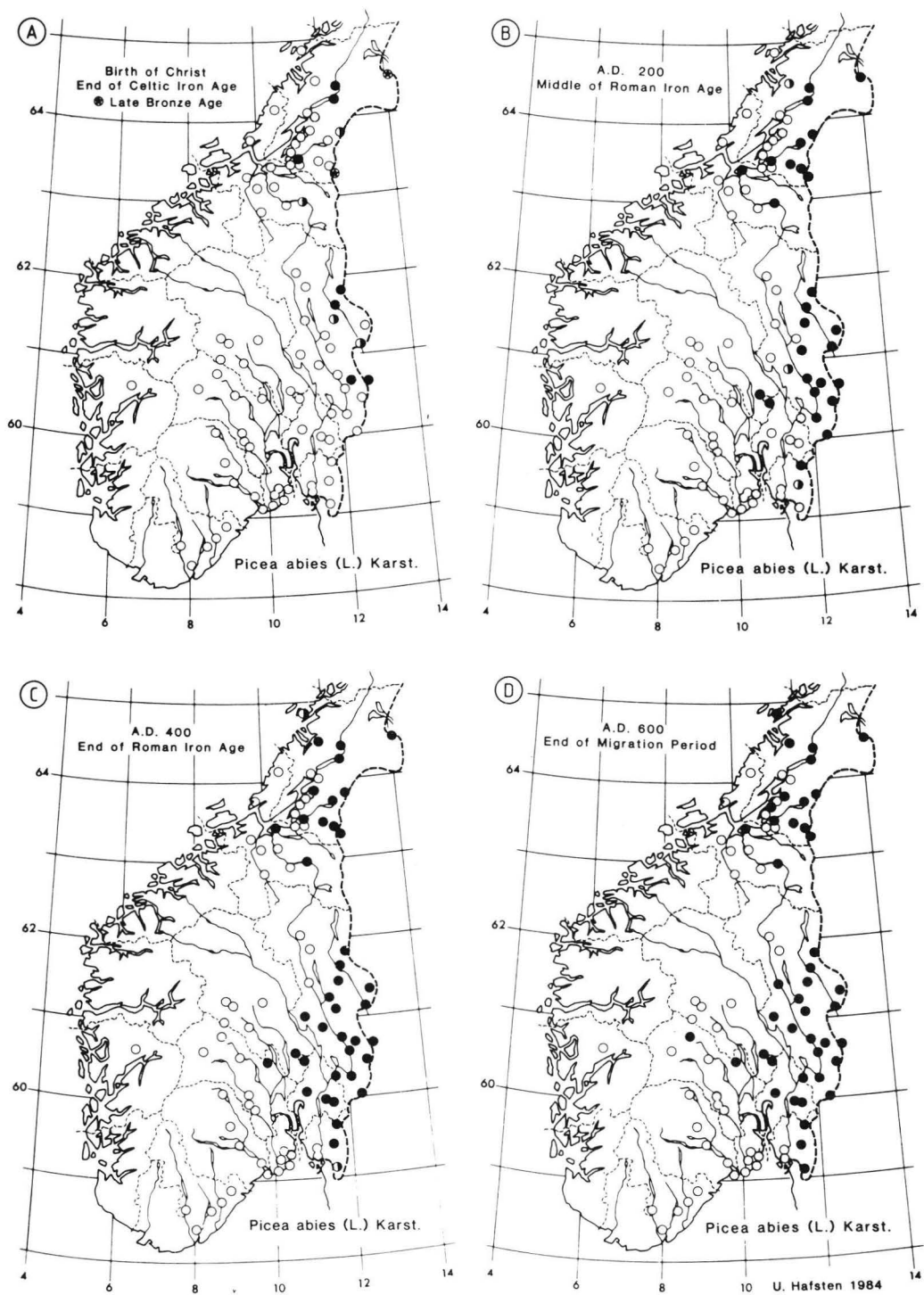
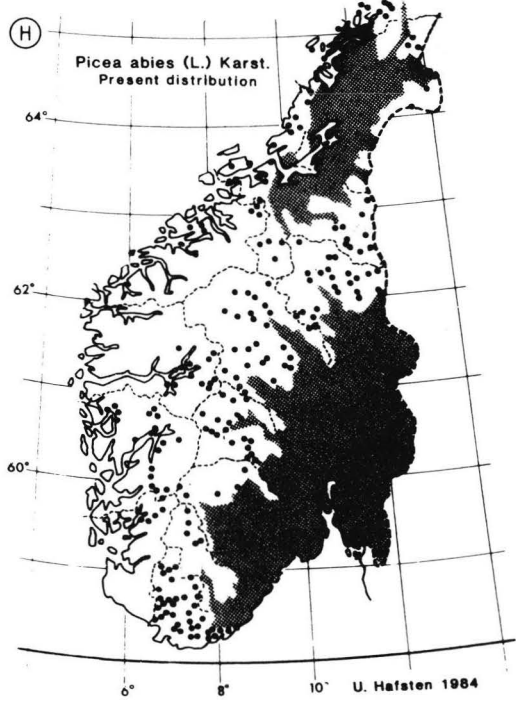
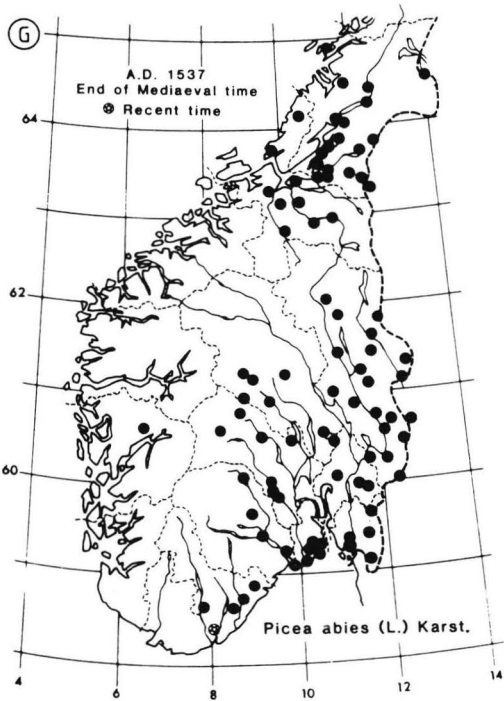
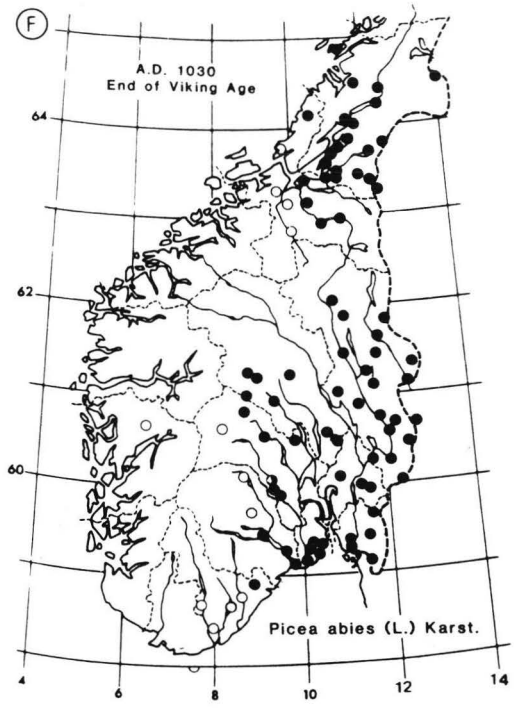
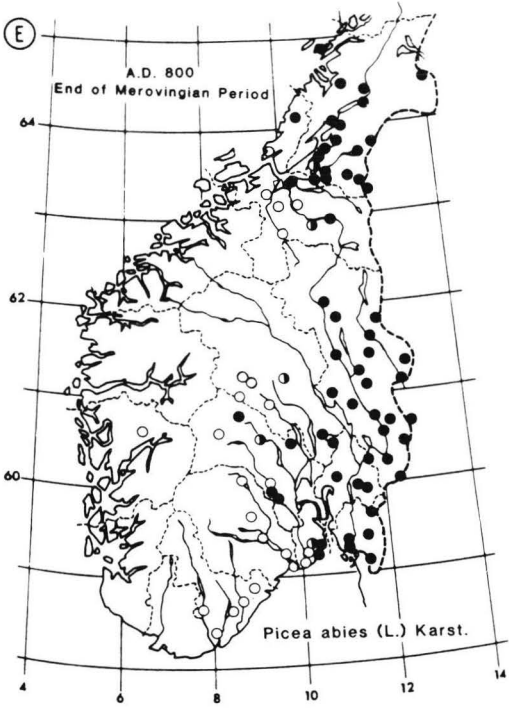


Fig. 3. Map series illustrating the results on the immigration and spread of spruce, obtained by biostratigraphical studies and radiocarbon datings of cores from 86 sites situated within the S-Norwegian spruce forest areas. Left page refers to various Early Iron Age stages; right page, to Late Iron Age stages and Mediaeval and Recent times. Filled circles signify sites where the local spruce establishment has already taken place



within the period in question; half filled circles indicate establishments dating at the transition to the next period and therefore could have occurred in either period; open circles denote sites where the local spruce establishment has not yet been reflected for the period in question. Map H is based on the maps published by Lindquist (1948) and Fægri (1950).

as to immigration and initial establishment of spruce forest, the situation at around A.D. 200, i.e. midway in the Roman Iron Age, has also been presented (Fig. 3 B).

The spruce forest establishment

The sites reflecting the highest ages for the spruce forest establishment are located in the eastern part of Trøndelag and adjacent parts of Sweden, where spruce forest may have been present already in the Bronze Age (Sites 8 and 25). Sites reflecting a pre-Christian spruce forest establishment are found also in the northern borderland of the SE-Norwegian spruce forest province (Fig. 3 A). To the west and south, in both provinces, the ages of the spruce forest establishment generally become lower. These features indicate that spruce invaded South Norway from the northeast, after a three thousand years long migration through Finland and northern Sweden (Aartolahti 1966, Tolonen & Ruuhijärvi 1976: 189, Tallantire 1972).

The consistent time lag existing between the ages obtained for the spruce forest establishment at the eastern sites on one hand, and at the western and southern sites on the other, reveals that the spread of spruce was a result of a rather protracted migration, even within the two Norwegian spruce forest provinces. If one compares the most extreme dates obtained from the eastern and the western part of the SE-Norwegian spruce province, viz. Site 1 in Engerdal, close to the Swedish border, and Site 34 in Hol in Hallingdal, near the western boundary of continuous spruce forest, one finds that the occupation of the SE-Norwegian province lasted for a period of minimum 1200 years (1430 \pm 210).

The Mid-Norwegian spruce province — In Trøndelag a rather slow migration seems to have taken place, from pre-Christian populations in the eastern borderland (Sites 8, 18 and 25), down the Stjørdalen, Helgådalen-Verdalen and Sanddøla valley to the region just east of Trondheimsfjorden which was occupied by spruce mostly during the Merovingian Period (Fig. 3 E).

In the region south of Trondheimsfjorden a migration might have occurred from two early Roman or late Celtic Iron Age centres, in Trondheim (Site 7) and upper Gauldalen (Site 1), respectively, to the southern and western outskirts of the present spruce area, where the spruce forest establishment did not take place until late Mediaeval time (Sites 5 and 6, Trillerud 1983).

In some places in Trøndelag, e.g. at Hoset (Site 12) and Skage (Site 27), the *Picea* pollen curve shows two well-defined steps, indicating that the local spruce forest establishment was hampered and not completed until several hundred years after the initial occupation of the area had started. At Hoset this interruption in the spruce forest advance lasted from about A.D. 600 to 1000 (Halvorsen 1977), and at Skage in Namdalen, from about A.D. 200 to 1000 (Vorren 1969). This stagnation in local spruce establishment may be explained e.g. by a shift in climate conditions or, more probably, by an advance in human settlement or other human activity affecting natural vegetation successions (Hafsten & Solem 1976, Hafsten 1979).

The SE-Norwegian spruce province — In SE Norway the crossing of the border and initial establishment of spruce forest seems to have occurred within a rather short period along most of the spruce's N-S range, viz. during the centuries just before and after the birth of Christ (late Celtic and early Roman Iron Age). During early Roman Iron Age the spruce forest establishment had reached as far west as Hurdal and V. Toten, which today represent some of the most luxuriant spruce forest regions in SE Norway, see Site 25 at Skrukkelisjøen and Site 26, Stormyra, just south of Einavatnet,

which both reflect a very sudden spruce forest establishment, dating at A.D. 140 ± 80 and A.D. 65 ± 35 , respectively. Not more than about 200 years later, at the end of the Roman Iron Age, the entire SE-Norwegian lowland area had been occupied as well. At this time also the initial phase in the migration westward up Hallingdalen or Valdres may be seen, viz. Lykkrosmyr west of Sperillen (Site 27), which provided an age for the local spruce forest establishment of A.D. 400 ± 110 .

The advancement further to the west, up the valleys towards the western boundary of the SE-Norwegian spruce province, lasted according to the data presented here for a period of 500—600 or more years, viz. Beitostølen (Site 30) and Fystro seter (Site 31) in Ø. Slidre, Vetremyrene in Hol (Site 34), and Åsen in Tinn (Site 52), none of which were reached earlier than during late Viking Age or Mediaeval time. It is interesting to notice that the migration up Hallingdalen, which was initiated already during late Roman Iron Age, seems to have been completed as early as during the Migration Period, see Granheim in Hemsedal (Site 33) which reflects a very sudden establishment of spruce forest dating at A.D. 530 ± 80 .

Also in Aust-Agder county, furthest south in the SE-Norwegian spruce province, ones obtains ages for the local spruce forest establishment referring to Mediaeval and even Recent time, see Sites 55, 56 and 57. The spread of spruce within this part of the country might have followed an inland route parallel with the coast, westward to the Byglandsfjord region (Site 56). From here the spruce stream seems to have taken a straight southerly direction approaching the Skagerrak coast by way of the Otra valley. According to the age obtained from the Fredsmyr peat column (Site 57), the extensive spruce populations in Birkenes, situated only a short distance from the coast, were not established until Recent time, i.e. after A.D. 1530. — The lowlying strip of land bordering the sea in this part of the country has still a very luxuriant growth of oak and other nemoral tree species, which certainly must have been an effective obstacle for the spread of spruce southward along the outer Skagerrak coast.

Western Norway — The only site being analysed so far within the isolated, west-Norwegian spruce populations, Istadmyrene in Voss (Site 58), has provided a date for the local spruce establishment which is comparable with the younger ones obtained for the SE-Norwegian spruce province, viz. A.D. 1400 ± 40 . The *Picea* pollen curve displays in this diagram a low »tail» below the final rise, which has been dated to start at A.D. 270 ± 110 . It is reason to believe that this tail is due merely to long-distance pollen transport from the east and is thus a reflection of the establishment of spruce forest in eastern Norway.

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