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Did Norway Spruce Survive in Refuges During the Last Ice Age?

Norway's forest industry accounts yearly for production equivalent to more than 50 billion NOK. Researchers at NIBIO at Ås are using molecular technologies to characterize current and ancient populations of Norway spruce (1), the most important forest species in Norway.

For years, plant ecologists assumed that Norway was devoid of vegetation during the last Ice Age and that pine and Norway spruce trees established themselves here from eastern regions 9000 and 3000 years ago, respectively. The Swedish forest researcher Leif Kullman had earlier reported on 11,000 year old remains of Norway spruce near Kongsvinger, Norway but his findings (2) were considered as inconclusive evidence for the existence of Norway spruce in Scandinavia during the last Ice Age.



The study reported in the Science article (1) was conducted by Mari Mette Tollefsrud at NIBIO together with several national and international partners, including major co-authors at Universities in Tromsø, Uppsala and Copenhagen. More than 100 Norway spruce forests across Europe were screened as well as ancient DNA extracted from sediments in Trøndelag and Andøya, Norway (Fig. 1).

Mitochondrial DNA variation was scored using 11 different PCR pairs. One of these pairs (designated mh05) gave a clear distinction between 2 haplotypes (haplotype A versus haplotype B) which were

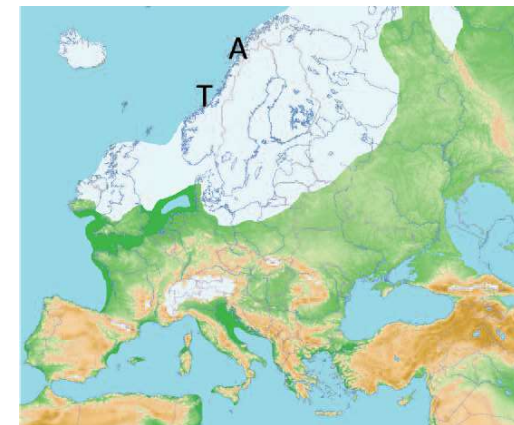


Fig. 1. Extent of glacial ice coverage in Europe 60,000-15,000 years ago. A and T represent Andøya and Trøndelag sites, respectively, where ancient DNA samples were found. Wikipedia.

identical except for a 21 bp deletion in haplotype A. Haplotype A individuals are found only in Scandinavia with the highest frequencies occurring in western Norway, suggesting that trees with this genotype may have been responsible for recolonization of Norway spruce from refuges after the last Ice Age.

Further evidence for Ice Age refuges of forest trees in Norway are: 1) identification of haplotype A mitochondrial DNA in 6,500-10,300 year old sediments from Trøndelag and 2) findings of pine chloroplast DNA and spruce chloroplast DNA in 20,000 year old and 17,700 year old sediments, respectively, from Andøya.

After its publication, a group of international scientists, including 2 affiliated with the University of Bergen, criticized the report's conclusions, saying that inadequate protocols were used to exclude contamination in sediment samples

(3). In answering this criticism, Parducci et al. (4) pointed out that for the results to be caused by contamination would require that different pieces of collection equipment would have had to be similarly contaminated in 2 independently collected samples, a coincidence they consider to be unlikely.

Forest researchers at NIBIO are optimistic that individuals with haplotype A might be important for breeding trees that show 'flexibility to survive under changing climatic conditions'.

References:

1. Parducci, L et al.: Science 335 (2012) 1083-1086
2. Kullman, L: J. Biogeogr. 29 (2002) 1117
3. Birks, HH et al.: Science 338 (2012) 742a
4. Parducci, L et al.: Science 338 (2012) 742b