

How did 'bog oaks' grow?

First answers from the excavation of a mire woodland in Ypenburg, The Netherlands

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Background

Sub-fossil 'bog' oaks that grew in former mire woodlands are the main source of datable prehistoric tree-ring patterns (Leuschner 1992). They may serve as an archive to reconstruct natural variations in past climate (Baillie 1996, Leuschner *et al.*, in press). Until now the exact environmental conditions in which the oaks grew (species composition, succession, tree density, the response to hydrology and climate) is largely unknown. The detailed excavation of prehistoric woodland sites will provide information about the development, structure, and dynamics of oak supporting mire woodlands.

Research strategy

The following disciplines are involved:

- Dendrochronology: The absolute dating of (bog) oak stems provides knowledge about the period when oaks were part of the mire woodland;
- Wood anatomy: Determination of wooden species in different peat layers enables the reconstruction of forest succession;
- Palynology: Pollen analysis provides information about changes in species composition (forest succession) at the spot and in the surrounding area;
- Micromorphology: Chemical and physical soil characteristics are analysed to trace peat development, phases of decomposition (dry conditions) and inundation.

Site history

Ypenburg is located in the western part of the Netherlands only a few miles away from the current coastline. Approximately 6000 years ago the area consisted of floodplains with occasional sand dunes, where early settlers found excellent living conditions (Koot 2001). Research on waste pits shows a varied diet consisting of birds, cattle, fish and aquatic mammals. Between approx. 3800 BC and 2750 BC sand deposits cut off the floodplain from the sea and peat formation started (Beets *et al.* 1994; Clevinga 2000). At that time the human occupants abandoned the area.

Excavation of a mire woodland

In four excavation trenches, which slightly differ in height a.s.l., all wooden remains have been registered *in situ* for the purpose of enabling the reconstruction of the former position of the trees (fig. 1). Wood samples were taken for species determination and dendrochronological analysis. Peat samples were taken for pollen analysis, C¹⁴-dating, micromorphology and to look for botanical macro remains (leaves, seeds).



Fig. 1: Excavation trench

Results

C¹⁴-analysis and Palynology

C¹⁴ analysis showed that peat formation started between 3350 and 2900 BC. It turned into a raised bog after 2150 to 1750 BC. The development of the vegetation (especially trees) at the beginning of the peat formation until the switch to a raised bog is studied by pollen analysis (palynology). At first, primarily reed marshlands developed. Willow (*Salix spp.*) and buckthorn (*Rhamnus frangula*) were the first tree species that entered the reed vegetation. When alder (*Alnus spp.*), oak (*Quercus spp.*), ash (*Fraxinus spp.*) and birch (*Betula spp.*) appeared, the formation of an open mire woodland started, which later turned into a dense woodland dominated by alder. Pollen and seed records indicate that the last phase of the woodland can be characterised as an open birch forest. Subsequently a raised bog developed with heather (*Ericales*) and myrtle (*Myrica gale*) (Kooistra *et al.*, in prep.).

Determination of wood species

In total nearly 500 samples were determined. As expected, willow, alder, birch, and oak are the most frequent species. Interesting differences in species composition occur between the four trenches (fig. 2): trench 32, the lowest (a.s.l.) and thus wettest location, shows a high

percentage of willow. The higher the trenches are situated, the more the share of oak increases.

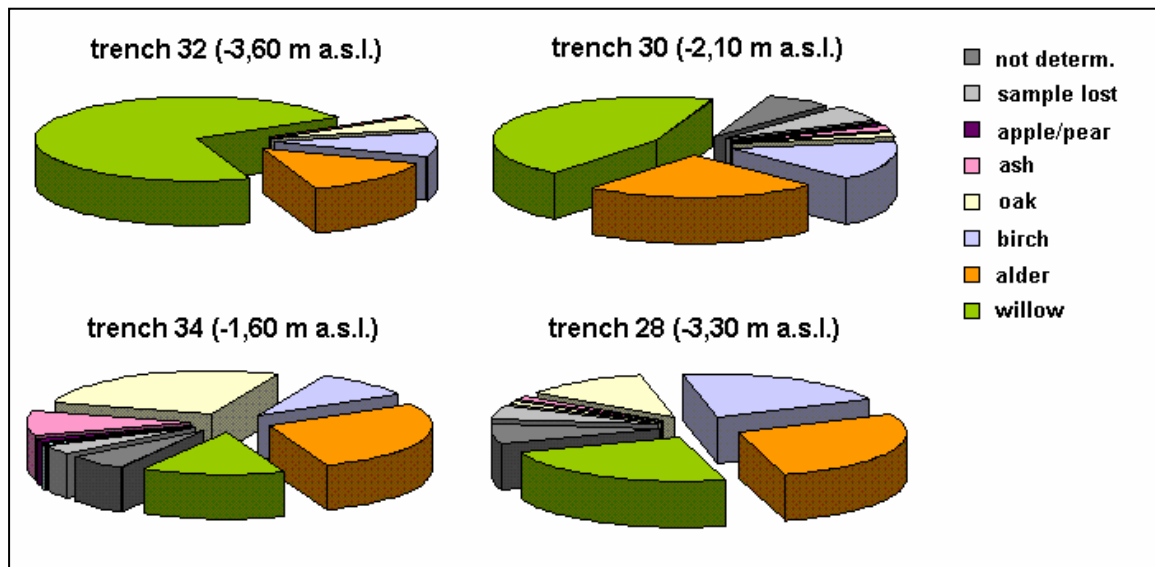


Figure 2: Species distribution in the four excavation trenches

Dendrochronological results

Suitable species for dendrochronological dating are oak (*Quercus spp.*) and ash (*Fraxinus spp.*); attempts with willow (*Salix spp.*), birch (*Betula spp.*) and alder (*Alnus spp.*) failed. Finally, twelve oaks from the excavation trenches were dated. Additional dates are achieved from 51 oaks that were collected outside the trenches (fig.3).

The results show that the oaks reached a mean age of 155 years; the oldest tree got 303 years old. A mean tree-ring width of 1.44 mm indicates that the oaks were not growing as slow as it is known for bog oaks from other locations. Moreover they lack the typical bog-oak pattern showing long-lasting growth depressions. The oaks grew (and were preserved!) in the period between 3030 BC and 2533 BC. The temporal distribution of the dated oak stems indicates no obvious periods of tree germination or die back.

Conclusions

In the prehistoric woodland of Ypenburg we found oaks growing along with other species which can normally be found in mire woodlands, i.e., willow, alder, ash, and birch. The oaks were preferably growing on somewhat higher and dryer locations. However, the oaks do not show any indication that they suffered from (temporarily) high or low ground-water levels. There are no distinct changes in their population dynamics (germination/die back) that may point to sudden changes in for instance site hydrology.

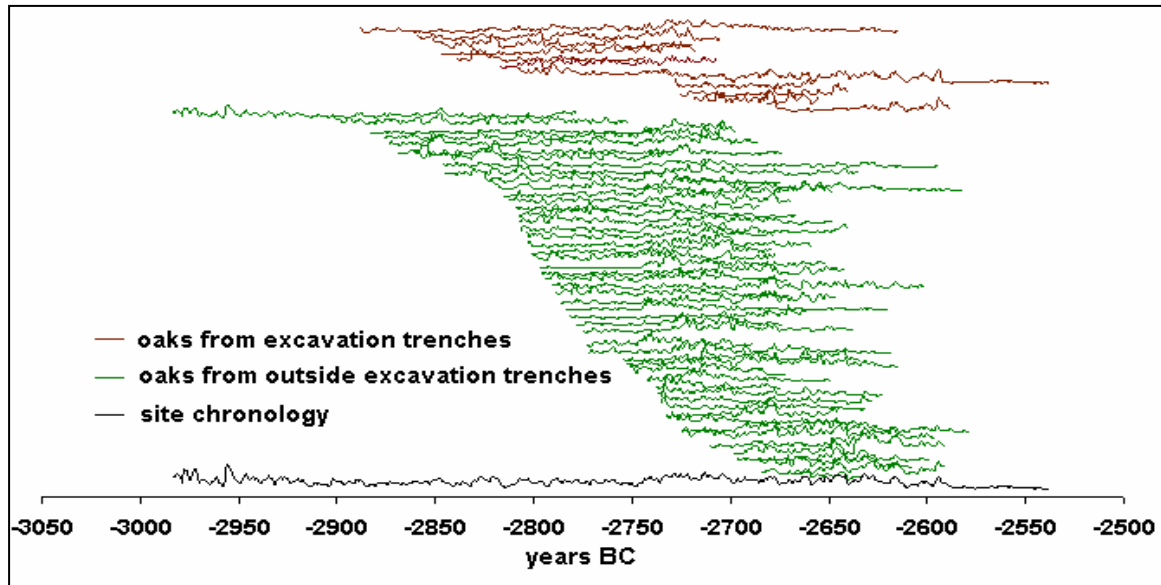


Figure 3: Tree-ring series from 12 oaks excavated from trenches 34 and 8, with site chronology. The tree-ring series lack the typical bog-oak pattern with long-lasting depressions

Future perspectives

The dendrochronological and wood-anatomical results will be supplemented with data from micromorphology. Combined with results from another excavation realised in Zwolle, Overijssel, it will be possible to evaluate hydrology as a growth-limiting factor for oaks in mire woodlands and to identify the ecological conditions that determine the development and conservation of oak supporting mire woodlands.

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