

GRADUAL POLLEN ZONE TRANSITION FROM ALLERÖD TO YOUNGER DRYAS IN AN EASTERN NETHERLANDS' LAKE FILL¹

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ABSTRACT

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A Late Glacial lake fill in the eastern Netherlands' aeolian sand district shows a very gradual transition from the Alleröd to the Younger Dryas pollen zone. This contrasts with most pollen sections from the wide surroundings, where this transition is sharper. As, however, in most of these sections the pollen zone boundary coincides with a rather sharp lithologic change, local influences and/or time lags might have caused the sharper pollen zone transition there. Hence, the hypothesis is formulated that, as to regional vegetation history, the transition from Alleröd to Younger Dryas may indeed have been gradual.

INTRODUCTION

If regional vegetation development has to be reconstructed from a pollen section, uniform lithology is one of the desirable properties. However, in most Late Glacial pollen diagrams from the eastern, central and northern Netherlands the usually sharp and clear transition from Alleröd to Younger Dryas coincides with a change in lithology. This combination of sharp pollen zone boundary and sharp lithologic change raises the question whether there is a strong local influence and/or a sedimentary hiatus.

This paper presents a preliminary analysis of a rather uniform and thick Late Glacial lake deposit from the eastern Netherlands, especially with reference to the transition from Alleröd to Younger Dryas. The depression fill lies in the wide Weichselian aeolian coversand plain west of the Holterberg, a sandy ice-pushed ridge. The site is 2.5 km west of the foot of this low hill. For the exact location see e.g. the 1:50.000 geomorphological map of the Netherlands, sheet 28; topographic coordinates $x = 221.800$, $y = 479.175$ (Fig. 1).

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POLLEN ZONES

Zone 1 (461-403 cm below surface)

A succession from practically barren landscape via tundra to birch forest is shown here. The basal sandy samples show dominance of Cyperaceae in a treeless landscape.

Then a richer herb community develops containing several heliophyte species. Meanwhile, shrubs develop too: *Betula*, interpreted as mainly dwarf birch (*B. nana*) in view of the low pollen size value (see curve at right-hand side of Fig. 2; cf. KOLSTRUP, 1982), *Hippophäe*, *Salix* (if not *S. polaris/herbacea/reticulata*). Subsequently, there is a strong increase of *Juniperus* marshalling the approach of birch forest; this is



■ sand area of central-, eastern- and northern Netherlands

* section Holten Espelo; topographic coordinates: $x = 221.800$, $y = 479.175$

Fig. 1
Location of sampling site.

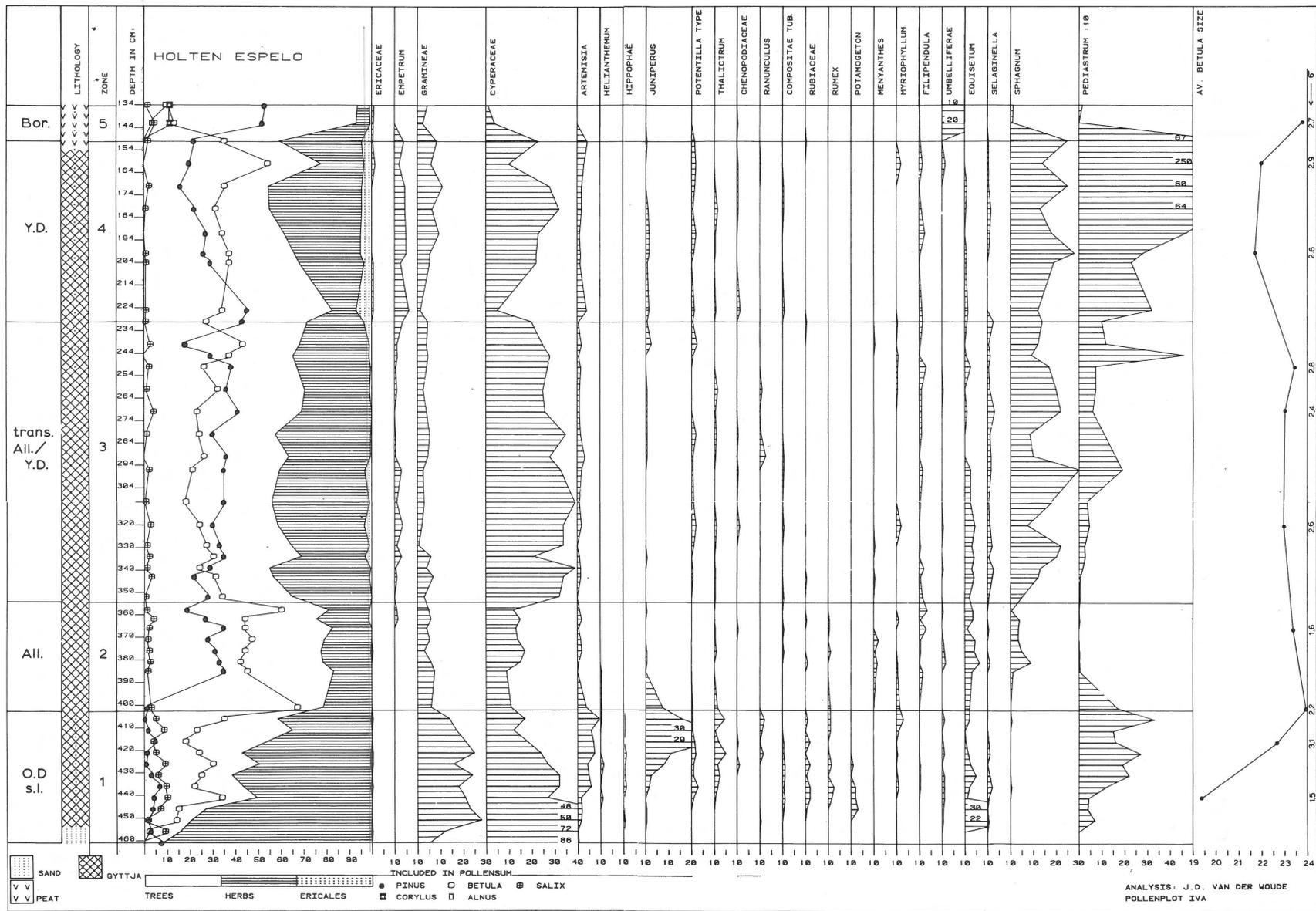


Fig. 2
Pollen diagram Holten Espelo. From left to right: bio-chronostratigraphic interpretation, lithology, local pollen zones, depth below surface, percentage pollen curves, curve of average *Betula* pollen size in micrometers (mass mean of $\Sigma = 50$; with standard deviations). Iverson pollen sum = 200. For location see Figure 1. O.D.s.l. = Older Dryas sensu lato; All. = Allerød; trans. = transition; Y.D. = Younger Dryas; Bor. = Boreal.

inferred from present observations of juniper shrub communities at the transition from open tundra to birch forest. Increase of average *Betula* pollen size corroborates this succession. Finally, *Betula* strongly increases and most herbs of the open tundra disappear: birch forest has been formed in the immediate surroundings of the lake.

Zone 2 (403-355 cm)

In the birch forest *Pinus* soon invades. At the lake border shadow-tolerant *Filipendula* corroborates the enclosing of the lake by forest.

Zone 3 (355-230 cm)

Clearings appear in the birch-pine forest. Cyperaceae expand at the cost of especially *Betula*. At the open places, apart from Cyperaceae, some elements of the open vegetation of zone 1 reappear: *Potentilla* type (*P. crantzii?*), *Thalictrum* (*alpinum?*), *Selaginella*.

Empetrum heath shrubs also develop. This would be partly a result of leaching and hence acidification of the soil. In view of the rise of *Sphagnum*, acidification might have occurred at the lake border too. Cyperaceae might also have formed part of the now probably more open shore vegetation.

Zone 4 (230-150 cm)

The clearings in the birch-pine forest widen considerably, as shown by the increase of *Empetrum*, *Ericaceae*, *Artemisia*, *Potentilla* type, Gramineae and *Juniperus*. Attributing the *Betula* pollen, which even increases in this zone, to *B. nana* for a larger part than in the preceding zones 2 and 3 (see curve *Betula* pollen size), and explaining the remaining *Pinus* pollen percentage as largely supraregional, even a rather open tundra landscape would have reappeared; this applies especially to the upper part of the zone.

In this zone, the lake deposit contains some silt, probably derived from wind erosion in the surroundings. The increase in silt content in the upper part of the zone agrees with the then most open character of the landscape as postulated above. The green alg *Pediastrum* flourished abundantly then; this would have caused the greenish-grey appearance of this upper part of the lake deposit.

Zone 5 (150-134 cm)

The completely different nature of this pollen zone and of its lithology indicate a considerable time hiatus at the transition from zone 4 to zone 5. A pine forest with hazel, birch and alder surrounds the lake. Umbelliferae would have formed important part of the shore vegetation.

DISCUSSION AND CONCLUSIONS

General chronology

The lower part of the organic lake fill (zones 1 and 2) shows the typical Late Glacial return of vegetation on the Weichselian coversand landscape. Light-demanding pioneer herbs, tundra shrubs and subarctic forest successively colonise the area. The establishment of birch-pine forest (zone 2) can be placed in the Alleröd period. In zone 1, the slight regression in the *Betula* curve after its first rise need not be interpreted by a Bölling oscillation. It is caused by the strong increase of *Juniperus*, passing as a shrub zone between open tundra (with dwarf birch) and birch forest.

The open park tundra of zone 4 and its (aeolian) silt accumulation can be dated with confidence as Younger Dryas. This leaves zone 3 to be placed either in the Alleröd or the Younger Dryas period. However, in most aspects this thick pollen zone (125 cm!) is truly transitional between zones 2 (clearly Alleröd) and 4 (clearly Younger Dryas). Therefore, with respect to vegetation development, a long gradual transition from Alleröd to Younger Dryas has to be concluded for this area. The overlying zone 5 apparently can be dated as Boreal. Thus, there must be a considerable time hiatus at the top of zone 4 and this might include an important part of the Younger Dryas period.

Regional significance

Most Late Glacial pollen diagrams from the wider region show a rather sharp transition from the Alleröd to the Younger Dryas pollen zone. Most authors hence (implicitly or explicitly) postulate a rather sharp regional vegetation change going from the Alleröd to the Younger Dryas period. Briefly reviewing published diagrams (VAN DER HAMMEN, 1951; CASPARIE & VAN ZEIST, 1960; BEHRE, 1967; CLEVERINGA ET AL., 1977; PARIS ET AL., 1979; BIJLSMA & DE LANGE, 1983; diagram Bleekemeer in WIJMSTRA ET AL., in prep.) some phenomena should be pointed out which are important for this discussion.

Firstly, in most diagrams a clear lithologic transition coincides with the pollen zone boundary between Alleröd and Younger Dryas. Mostly this implies a strong increase in sand content which is indicative of (wind) erosion elsewhere (see below). Furthermore, the zone boundary is generally placed at the clearest decline in the tree pollen percentage, but in several diagrams curves of *Empetrum* and some herbs rise already well below the zone boundary. This indicates gaps in the forest cover, where *Empetrum* was favoured by the previous leaching of soil (see above). Finally, in some sections charcoal has been found right above the zone boundary.

It is questionable if the pollen zone boundary Alleröd-Younger Dryas is of the same age in all these diagrams (there

are no C-14 dates). Aeolian activity, inferred from the strong increase of blown-in sand in the Younger Dryas zone of the sections, need not have started everywhere at the same time. Deflation usually starts locally. Local gaps in the forest cover existed already before the start of deflation at several of the sites (see above). They may have been widened and become susceptible to wind erosion at different moments in this broad region. In view of the charcoal in some sections local forest fires may have played a role in this continuous process; this agrees partially with VAN DER HAMMEN'S (1951) explanation of the slight increase of herb pollen in the upper part of the Alleröd zone.

Another argument against isochronism of the zone boundary in these diagrams is the possibility of depositional hiatuses. The sharp nature of the pollen zone boundary and the concomitant, often drastic change in local sedimentary circumstances may indicate a time hiatus in several of the diagrams.

In indeed the Alleröd-Younger Dryas pollen zone boundary in the diagrams mentioned were diachronous then a long time span for the pollen zone transition is conceivable. Then, the very gradual, long transition in vegetation development from Alleröd forest to Younger Dryas park tundra, as reconstructed from the diagram shown in this paper, would have a wider significance than just for the region around the site.

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