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# Local to regional environmental changes of the northern Netherlands at the time of Neolithization inferred from the palaeobotanical record of six neighboring pingo scars

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## Introduction

One of the most important periods in human history is the transition from hunting and gathering to farming (Neolithisation). In the southern Netherlands, Neolithisation began 5300 years before Christ. Although the time of Neolithisation in the southern Netherlands is known, the pace and time of Neolithisation in the northern Netherlands are still concerned with some uncertainty (Bakker, 2003; Kooijmans et al., 2006). As a result, further research about Neolithisation in the northern Netherlands appears to be required.

## The "Pingo scar project"

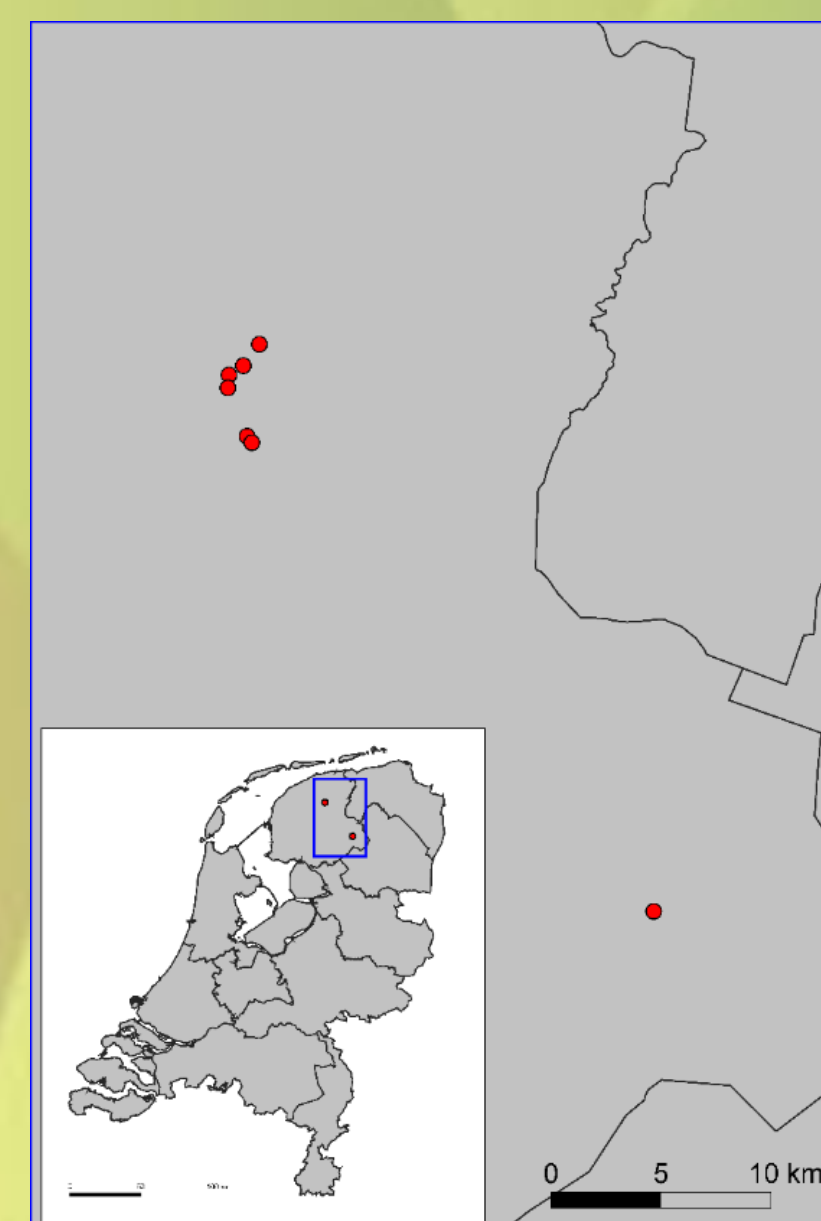
To achieve more insight into the farming transition phase in the northern Netherlands, a palynological PhD project, called "pingo scar project", started at the University of Groningen in 2017. The project's major goal has been the reconstruction of the history of cereal cultivation in the northern Netherlands at the Mesolithic-Neolithic transition phase by investigation of the peat archive of pingo scars. The project also aimed to assess the quality of the palaeo-archive of the pingo scars, as well as recreating the local and regional vegetation and fire history in this area.

## Material and methods

"Pingo scars" are a well-known feature of the landscape of the northern Netherlands. Pingo scars are semi-circular periglacial landforms of the Holocene age that are found in northern latitudes (Kluiving et al., 2012). The natural process of peat deposition in the pingo scars created an archive of organic material suitable for palaeoenvironmental reconstructions in these small lakes.

To meet the goals of the research, seven pingo scars from the northern Netherlands were selected (fig 1). The peat archive of the pingo scars was sampled for palynological and 14C dating analyses at Groningen Institute of Archaeology. In this document, a summarized result of the palynological analysis of the six adjacent pingo scars is presented.

**Figure 1:** The inset map: under study areas, northern Netherlands; main map: the location of seven pingo scars.



## Results and conclusion

### Land occupation history and prehistoric land selection

Our research showed that within a small area of assumed homogeneous landscape of the northern Netherlands, land selection was done from prehistory. Our research showed that land occupation and subsequent vegetation modification began in northern locations of the studied area. Pollen examination of the sections also showed that cereal cultivation began in the northern locations too. Our findings suggest that local geology could have strongly affected land selection and land use in prehistoric times. The most favorite locations, e.g. the northward locations in our study, may have been able to provide the prehistoric people with a more flat and higher ground with a lower groundwater level. The favorite locations also might have had sandy soil, which would have allowed for better drainage and simpler plowing. Accordingly, stratigraphic examination of the retrieved peat section of the pingo scars showed more sand in some of the northern locations.

This evidence suggests that despite the northern Netherlands' environment being considered to be homogeneous, there has been a substantial difference across the nearby sites. Our research also shows that suitable sites have been utilized for the same purpose throughout the studied time.

### Crop cultivation and animal husbandry

Our data showed that before the introduction of cereals to the area, herbivores were present there. Herbivorous signals can be linked to live stock-keeping since the presence of herbivores indicators in pollen records nearly usually coincides with local fire signals. However, the land could also have been prepared by prehistoric people to attract large herbivores for easier hunting access.

According to our findings, the Mesolithic animal husbandry was limited to the most suitable locations. With the intensification of human activities and perhaps growing population, all the locations were occupied in the Neolithic period. It could also be owing to the later development of new tools and techniques for environment modification.

Although there is evidence of cereal farming in the late Mesolithic record of northward locations, up until the middle Neolithic, only evidence of animal husbandry has been found in southern locations. It suggests that each region was initially given over to animal husbandry, and then cereal cultivation was introduced to the same location.

### Capability of pingo scars pollen record for vegetation reconstruction

The remarkable difference between the paleobotanical record of the adjacent locations showed a) the importance and usefulness of local pollen records for environmental reconstructions; b) the extent that which a small lake may record and reflect the environmental changes c) the dispersal potential of cereal pollen and coprophilous fungi spores as well as the charcoal produced by a small fire.

Remarkably, our data revealed that the majority of our pollen records are incomplete and the majority of the peat archive of the pingo scars of the northern Netherlands has been destroyed by natural processes and/or human activities. This demonstrates both the scarcity of intact/complete archives and the importance of preservation of the current archives.

## References

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Kluiving, S., Guttman-Bond, E., 2012. Landscape Archaeology between Art and Science, Landscape and heritage studies proceedings, From a Multi- to an Interdisciplinary Approach. Amsterdam university press: 560  
Louwe Kooijmans, L. P., Van Den Broeke, P.W., Fokkens, H., Van Gijn, A. L., 2006. The Prehistory of the Netherlands. University of Chicago Press: 844



- Close woodland**  
Characterized by domination of a mixtures of woody vegetation; Inferred from the percentage of arboreal pollen of the pollen sum that calculated based on the total terrestrial plants
- Open woodland**  
Characterized by mixtures of woody and herbaceous vegetation to woody pasture; Inferred from the percentage of arboreal and non-arboreal pollen of the pollen sum that calculated based on the total terrestrial plants
- No data available**  
Due to the natural hiatus in peat deposition and/or man-induced disturbance of the deposits
- Fire**  
Inferred from the percentage of microcharcoal particles in pollen slides that calculated based on the pollen sum of total terrestrial plants
- Herbivorous**  
Inferred from the presence of coprophilous fungal spores in pollen slides
- Cereal**  
Inferred from the presence of cereal-type pollen in pollen slides