

# Subfossil Chironomidae and other palaeoecological proxies in the reconstruction of the Late Vistulian environmental history in central Poland: case study of oxbow fill in Luciaża River valley

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**ABSTRACT.** The fast sedimentation rate of Rozprza palae-oxbow deposits gives a chance for tracking environmental changes in the end of the Late Vistulian very thoroughly. The range of palaeoecological analyses were done, resulting in reconstructions of vegetation history, climate and habitat changes. The chironomid-inferred summer temperatures indicate the short cooling in the late Allerød, confirmed by the plant macrofossils. It may correspond to 'Gerzensee oscillation', recorded mainly from western Europe. The studied oxbow was a truly aquatic ecosystem until the end of Younger Dryas, with diverse invertebrate fauna. The second phase of the oxbow-lake was characterised by its systematic overgrowing and, finally, mire development with overbank deposition in the Holocene. The wide range of used proxies provided a reliable picture of the Late Glacial oxbow evolution in Central Poland.

**Keywords:** climate, Late Glacial, palaeoecology, palaeolimnology, multi-proxy study

## 1. Introduction and methods

Multi-proxy studies are getting recently more and more attention, as they are the most comprehensive way to achieve a reliable, holistic reconstruction of the past environments. Plant macrofossils serve as good indicators of local habitat character, while pollen is useful to reflect the environment in the regional scale. However, vegetation often respond with some delay to a rapid and short-term climate changes, while Chironomidae (Diptera) are sensitive to even minor, local signals. They are ubiquitous and ecologically diverse, so they play a vital role in palaeoenvironmental reconstructions. Midges are useful mostly in the truly

aquatic conditions, whether other insects, mainly beetles (Coleoptera), are a good environmental indicators also in peatlands. Cladocera are good indicators of local hydrological conditions.

Our study at Rozprza (51°18'07" N; 19°40'04" E; 183 m a.s.l.) was conducted as a part of archaeological and palaeoenvironmental investigations of the Medieval ringfort remnants (Kittel et al., 2018a,b; Sikora et al., 2019). The site is located in Central Poland, in the Luciaża River valley floor (the 3rd-order river in the Vistula River Basin). In order to choose proper sampling sites in the field, not only was topography and geomorphology of studied area

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thoroughly mapped, but also the combination of other non-destructive methods along with geological hand augering was used (Sikora et al., 2015, Kittel et al., 2018a). The results of geophysical prospections and later the geological survey confirmed the existence of a large-size palaeochannel filled with organic (gyttja and peat) and partially inorganic deposits (sands and silts with organic mud) (Kittel et al., 2018a). In order to recognise the palaeochannel fill and overbank alluvium cover, the trench (2×10 m) was excavated. The core of organic deposits for palaeoecological analyses was collected as monoliths into metal boxes, as to preserve the undisturbed structure of the sediments, and dated with the radiocarbon (<sup>14</sup>C) method. Two selected samples of bulk of organic deposits were dated using the liquid scintillation technique (LST) and three samples of selected terrestrial plant macrofossils - using accelerator mass spectrometry (AMS).

The samples for pollen and Cladocera analyses were taken at 2 cm intervals in 1 cm slices, whereas for sedimentological, geochemical, plant macrofossils, Chironomidae and other insect analyses – as contiguous 2 cm slices. The laboratory procedures followed standard techniques. The chironomid-inferred mean July air temperature was reconstructed using East-European and Swiss-Norwegian-Polish Training Sets, with the application of WA-PLS and Artificial Neural Network (ANN) methods.

## 2. Results and conclusions

The aquatic invertebrates (Chironomidae and Cladocera) in the oxbow lake underwent significant fluctuations, delineating the periods of local and regional palaeoenvironmental changes. After the favourable conditions in the Allerød and Younger Dryas, their number suddenly dropped in the Holocene. For this reason, the climate reconstructions were focused on the Late Glacial part of the sequence (214-180 cm b.g.l.). Both invertebrate assemblages were dominated by macrophyte/sediment-associated taxa. Among chironomids the highest share represented collectors, followed by grazers. They were largely associated with a clastic matter. In turn, within Cladocera assemblages

dominated taxa known to occur over a wide range of conditions, and they are tolerant of environmental stress, including cold climate.

The Chironomidae-inferred quantitative reconstructions reveal low mean summer temperatures in the late Allerød (up to 11.9°C), which can be referred to the ‘Gerzensee oscillation’ (ca. 13,200-12,900 BP), so far recorded mainly from western Europe. The cool conditions are confirmed by the plant macrofossils record (mainly *Betula nana* and *Arctostaphylos uva-ursi*). In the end of the Younger Dryas the oxbow started to paludify, the aquatic invertebrates and plants were replaced by the telmatic taxa. According to the pollen stratigraphy, the oxbow surroundings were constituted mainly by pine and birch forests.

The results of our multi-proxy palaeoecological study on the Luciąża River palaeo-oxbow fill at Rozprza are essential for further research on palaeoenvironmental changes in the Late Glacial, and particularly in the Late Allerød, in Central Europe.

## Acknowledgements

The research project has been financed by grants from The Polish National Science Centre based on the decision No. “DEC-2013/11/B/HS3/03785”.

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