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Paleoenvironmental changes during the last 8,500 years recorded in annually laminated sediments from Lake Szurpiły, NE Poland

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Annually laminated (varved) lake sediments provide a precise time scale for high-resolution paleoenvironmental reconstructions of climatic change and human impact. We reconstructed the environmental changes from Lake Szurpiły (NE Poland) using varve chronology and multi-proxy interdisciplinary approach. Our reconstruction is one of the few for NE Poland and extends the geographical network of laminated lacustrine sediments. This research was supported by the Polish Ministry of Science and Higher Education grants (N N306 275635, N N306 009337, N N306 291639). It is a contribution to the bilateral scientific program “Northern Polish Lake Research” (NORPOLAR).

Parallel overlapping sediment cores with total length of 12.38 m and extending back to the Late Glacial were retrieved in 2007. The geochemical (X-ray Fluorescence, CNS, stable isotopes), microscopic (varve thickness and structure), biological (diatoms, pollen) and statistical analyses were applied and combined in an annual scale based on the varve chronology, which was verified by independent radiometric dating (Pb-210, Cs-137 and AMS radiocarbon dating). Due to the large slump, this study focuses on the almost continuously varved uppermost 7.58-m long section of the profile, covering the last 8,500 years.

The climate fluctuations were the main cause of the environmental changes during the first 6,000 years. The geochemical record is mainly driven by the lake productivity, oxic conditions and minerogenic input. Although the first evidence of the anthropogenic impact is documented in pollen record at 8,000 BP, the environmental conditions were relatively stable until 2,500 BP, when the human activity increased significantly. Since that time the climatic and human influence are combined and more difficult to disentangle. Three settlement phases separated by natural regeneration of the environment occurred between 2,500-400 BP. The variation of geochemical and pollen data at 400-100 BP reflects climate fluctuations during Little Ice Age. The synchronous distinct change in the variability of δ13C, lithogenic elements, C/N ratio and pollen (high percentage of Bryales) may be interpreted as the allochtonous organic matter enrichment related to forest clearing and soil erosion. The lake productivity increased possibly due to the peat bogs drainage and agriculture development. The lake become eutrophic in the last period (since 150 BP).