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Palaeoecological record of natural changes and human impact in a small river valley in Central Poland

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ABSTRACT

The developmental history of a mire located in the Grabia River valley, central Poland, spanning the last 9000 years, was investigated using high-resolution records of pollen, Cladocera, and geochemistry from a ^{14}C-dated core. The study demonstrates the value of Cladocera, palynological, and geochemical methods in research into human impact and natural fluvial activity, particularly for those elements that are difficult to find through sedimentological methods. Our research shows the importance of long-term reconstructions in establishing palaeohydroclimatic conditions and determining the human impact on the mire. We propose that water-level fluctuations were important in modifying biota assemblages. Periods with higher water-levels are synchronous with climatic changes, but in the Subatlantic, they also correspond to phases of human activity in the valley. The probable phases of increased fluvial activity of the Grabia River coincide in general with periods of wet climate, deforestation, and soil erosion. The main phases that show increases in the water level in the lower part of Grabia River valley are estimated at ca. 5800–5500 BC, 4500–4300 BC, 4200–3800 BC, and 400 AD. The water-level changes of 1300 AD, 1500 AD, and 1650 AD, as well as those of the last century, were most strongly influenced by a combination of natural and anthropogenic factors. Anthropogenic events were particularly significant during the Middle Ages and in the last century.

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1. Introduction

The use of the varying roles of climate and human activity in reconstructing past hydrological changes in river dynamics has been documented (Starkel et al., 1996, 2006; Dambeck and Thiemeyer, 2002; Kalicki, 2006; Macaire et al., 2006; Macklin et al., 2006; Dotterweich, 2008; Notebaert and Verstraeten, 2010). Since the Neolithic, anthropopressure on the environment has been increasing (Kalicki, 2006; Hoffmann et al., 2008). Therefore, the impact of the climate and of humans can be very difficult to distinguish, as they have both acted at the same time (Zolitschka et al., 2003; Thorndycraft and Benito, 2006; Kittel, 2014). Floodplain deposits, and especially fills of oxbow lakes and valley mires, seem to be suitable sites for studying climate change versus human impact, both on the local scale and in the wider context (Kalicki, 2006). Valley mires are sensitive to changes in humidity, including drainage (Tobolski, 2003), and so analyses of their sediments (especially palaeochannel filling deposits) are very useful in reconstructing and dating humidity changes (Rotnicki, 1991; Pawłowski, 2012). However, the response of river systems to both climate change and landscape alteration by humans is more dynamic than in the case of lacustrine and peat-bog systems (Kalicki et al., 2008). Fens in river valleys also allow us to reconstruct ongoing processes in the region (Hájková et al., 2012a,b). High water tables create favorable conditions for the accumulation of organic sediments in groundwater-fed wetlands. Remarkably, relatively long-lasting water-level changes can be revealed through palaeoecological analysis (Lamentowicz et al., 2013). Valley mires in small river valleys, such as the Grabia River valley, seem to be appropriate for such studies. Small rivers are just as sensitive to changes in humidity as large rivers, but lack the

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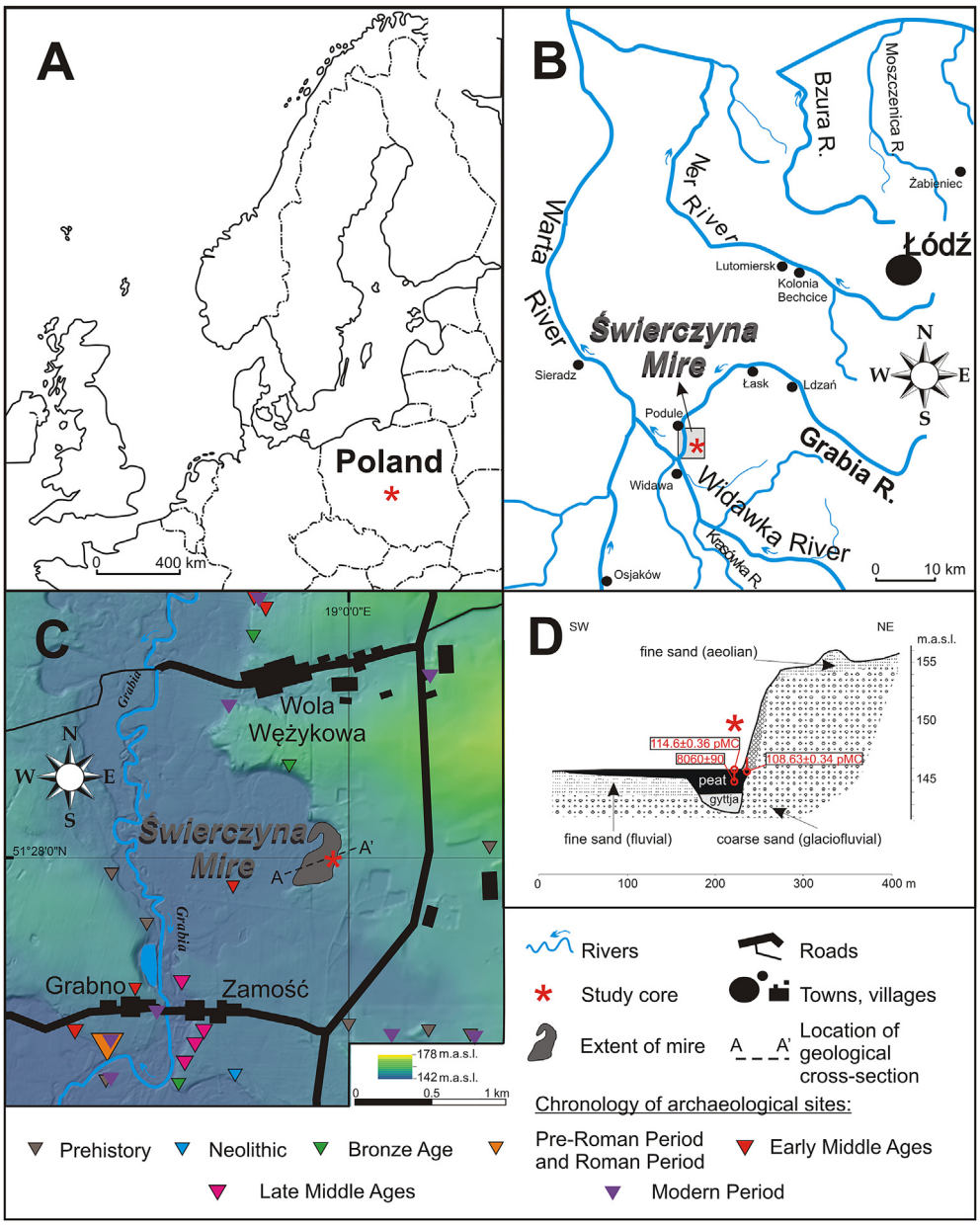

Fig. 1. Location of Świerczyna Mire in Europe (A), and in Poland (B), digital elevation model of the study area (based on LiDAR data) with archeological records (C), and geological cross-sections (A–A') of the studied mire (D). Lidar data used in this study are protected by copyright under Polish law (Dz. U. 2010, no 193, pos. 1287).

effects of the headwater section, which often have different hydrological characteristics.

The multidisciplinary studies presented here employ palaeobiological, geochemical, archaeological, and radiometric data to investigate the interrelationships between climatic changes and human impact in reconstructing the Holocene landscape of the mouth part of the Grabia River valley. The objectives of this study were (i) to recognize the changes in humidity over the last 9000 years in a small river valley, (ii) to recognize the role of human impact on the evolution of the environment in a small valley, and (iii) to estimate the usefulness of palaeoecological research into valley mires for environmental archaeology.

2. Regional setting

Świerczyna Mire is located in the central part of the Polish lowlands, in the Łódź region (Fig. 1A and B) near to the town of Łask, between the villages of Wola Wężykowa and Zamość (Fig. 1C). The mire is located on the outer part of the valley floor and occupies an abandoned palaeochannel (Fig. 1C and D). It lies in the mouth of the Grabia River and covers an area about of 0.085 km^2. Presently, it is covered with an alder swamp. The Grabia River is a natural, mostly unregulated river, inflowing to the Widawka, a tributary of the Oder (Odra). The study site is situated within an area that was covered by ice during the Wartanian Stadial of the Odranian Glaciation (Marks, 2011).

Glacial and glaciofluvial deposits are present in an area surrounding the valley. Fluvial sediments (Late Glacial and Holocene alluvium) fill the main part of the valley. General descriptions of the geological and geomorphological setting of the Grabia valley have been presented by Baliński and Gawlik (1986), Krzemiński and Bezkowska (1987)and Turkowska (2006).

Funnel Beaker Culture (FBC) settlements from the Middle Neolithic are present in the middle part of the Grabia River valley and in the Widawka River valley, close to the mouth of the Grabia River

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