Quaternary International 367 (2015) 111–122

Contents lists available at ScienceDirect

Quaternary International

journal homepage: www.elsevier.com/locate/quaint

Pre-industrial charcoal production in Lower Lusatia (Brandenburg, Germany): Detection and evaluation of a large charcoal-burning field by combining archaeological studies, GIS-based analyses of shaded-relief maps and dendrochronological age determination

A. Raab [a, *], M. Takla [a], T. Raab [b], A. Nicolay [b], A. Schneider [b], H. Rösler [c], K.-U. Heußner [d], E. Bönisch [c]

[a] Brandenburg University of Technology Cottbus-Senftenberg, Research Centre Landscape Development and Mining Landscapes (FZLB), Konrad-Wachsmann-Allee 6, D-03040 Cottbus, Germany
[b] Brandenburg University of Technology Cottbus-Senftenberg, Chair of Geopedology and Landscape Development, Konrad-Wachsmann-Allee 6, D-03040 Cottbus, Germany
[c] Brandenburgisches Landesamt für Denkmalpflege und Archäologisches Landesmuseum, Außenstelle Braunkohlenarchäologie, Altnauer Straße 5, D-03205 Calau, Germany
[d] Deutsches Archäologisches Institut, Naturwissenschaftliches Referat an der Zentrale, Im Dol 2-6, D-14195 Berlin, Germany

ARTICLE INFO

Article history:
Available online 11 October 2014

Keywords:
Lower Lusatia
Charcoal production
Charcoal kiln remains
Excavation
Shaded-relief maps
Landscape history

ABSTRACT

In pre-industrial times, charcoal burning was a common source of energy across Europe. Charcoal production and its related consequences for the upland environment are well known due to historical and palaeoenvironmental research. In recent years, awareness has grown regarding the use of woods in the lowlands for charcoal production. In the last 20 years, a large charcoal-burning field in Lower Lusatia (Brandenburg, North German Lowlands) was discovered by systematic archaeological excavations of the opencast mine of Jänschwalde. However, the excavations are limited to the mine, which only covers a portion of the Jänschwalder Heide and the surrounding forests.

In this paper, we present the results of our study regarding the spatial extension and timing of charcoal production in the Jänschwalder Heide and its surrounding areas. We applied a combined approach using archaeological research results, GIS-analyses of shaded-relief maps (SRMs) and tree-ring dating of selected charcoal kiln remains. Approximately 900 excavated charcoal kiln ground plans were analysed, which provided a solid data basis for our GIS analyses. For an extensive evaluation, we enlarged our study area beyond the limits of the lignite mine. We identified and digitised the remains of the charcoal kilns by creating SRMs from digital elevation models (DEMs) that were based on high-resolution airborne laser scanning data (ALS). The data from the excavated and digitised charcoal kiln remains were analysed in terms of their sizes and spatial distributions. In addition, the dendrochronological ages of 16 selected charcoal kiln remains were determined.

This study shows that charcoal production was more extensive than initially proven by archaeological excavations. The remains of more than 5000 charcoal kilns were detected on the SRMs across an area that was twice as large as the excavated charcoal-burning field. In the Jänschwalder Heide, considerably more charcoal kiln relicts exist compared with the surrounding communal areas. Furthermore, the charcoal kiln remains in the Jänschwalder Heide have larger diameters, suggesting large-scale charcoal production for supplying energy to the nearby ironworks at Peitz. However, the charcoal production on the communal land was most likely for local crafts. The ages of the charcoal kiln remains indicated that charcoal production occurred between the 17th and 19th centuries, corresponding with the main period of charcoal burning. Overall, our study suggested that charcoal production sites are underestimated in the modern landscapes of the North German Lowlands.

* Corresponding author.
E-mail address: raabalex@tu-cottbus.de (A. Raab).

http://dx.doi.org/10.1016/j.quaint.2014.09.041
1040-6182/

1. Introduction

Prehistoric to modern charcoal production remains have been found throughout Europe (e.g., Groenewoudt, 2005; Ludemann, 2010). Evidence has shown that a particularly intensive charcoal-burning period occurred between the 17th and 18th centuries in the low mountain ranges near former mining sites, such as those in the Black Forest, the Harz Mountains and the Pyrenees (e.g., von Kortzfleisch, 2008; Pèlachs et al., 2009; Ludemann, 2010). The great need for charcoal resulted from the enormous amounts of energy required by the iron industry, other processes, and the growing population (e.g., Schirren, 2007; Ludemann, 2010). The presence of charcoal manufacturing and woodlands in the low mountain ranges during this period are well known from historical and paleoecological research (e.g., Hillebrecht, 1982; Zebedies and Marx, 1986; Meyer, 1997; von Kortzfleisch, 2008; Nelle et al., 2011).

Moreover, extensive evidence indicates that charcoal burning was not restricted to the wooded low mountain ranges. For example, large-scale, pre-industrial charcoal burning associated with iron production was identified by comprehensive studies conducted in England and Norway (Foard, 2001; Risbøl, 2005; Bond, 2007). In recent years, it has been recognized that the woodlands in the North German Lowlands were also used for charcoal production. For example, in Müritz National Park (Mecklenburg – Western Pomerania), a large charcoal-burning field with 1150 registered charcoal kiln remains (Stöckmann, 2006; Schirren, 2007) was found.

Furthermore, in our investigation area in Lower Lusatia (Brandenburg, Germany), systematic archaeological excavations conducted over 20 years have revealed the largest archaeologically excavated pre-industrial charcoal production area in Central Europe (Rösler et al., 2012). Approximately 900 ground plans of circular upright kilns (*Platzmeiler*) are recorded in the area of the opencast lignite mine of Jänschwalde. In addition to the high number of charcoal kiln remains, the large sizes of several kiln remains (up to 29 m in diameter) are remarkable. However, the excavations were limited to the territory of the lignite mine, an area that covered only a small portion of the charcoal-burning field. Improvements in airborne laser scanning (ALS) technology, particularly the high-resolution data acquired by ALS flights for mine surveying in our investigation area, enabled us to use digital elevation models (DEM) to prospect for kiln remains in the lignite mine area and extend the study area beyond its previous boundaries. The identification of kiln remains using ALS data was recently demonstrated by Hesse (2010), Deforce et al. (2013) and Risbøl et al. (2013).

The objective of our study is to gain comprehensive knowledge regarding charcoal production in the Jänschwalder Heide, a previously unnoticed area of land use history in Lower Lusatia. Our study addresses several thematic issues, including the scale of charcoal production, charcoal manufacturing, socio-economic causes and the environmental legacy of charcoal burning. In this paper, we present the results of our study regarding the spatial extent and timing of charcoal production in the Jänschwalder Heide and its surrounding areas. Furthermore, the potential physio-geographical, socio-economical and historical relationships are shown and discussed.

2. Regional setting

2.1. Physio-geographical setting

The research area is located in Lower Lusatia (Brandenburg, Germany) within the North German Lowlands, which are approximately 150 km southeast of Berlin and 15 km northeast of Cottbus (Figs. 1a, b). The climate in the research area is continental, with a mean annual air temperature of 8.9 °C and a mean annual total precipitation of 549 mm at the Peitz climate station (Potsdam-Institut für Klimafolgenforschung, 2009). The low precipitation and periodic extreme droughts in this region result in partially restricted forest growth, drought damage and an increased risk of forest fires (Milnik, 2007).

The geology and geomorphology of this region were affected by Quaternary glaciations. The research area is located in the transition area between young and old drifts (Lippstreu et al., 1994), and the soils in this area are mainly classified as Cambisols and Podzols. Because of the sandy substrates, the soils are nutrient-poor. The area has a flat topography in which the terrain rises from west to east. The lowest elevations are found in the lowlands of the Spree and Malxe Rivers (60–62 m a.s.l.) and in the very sandy and dry areas of the Taubendorfer Sandur (73–85 m a.s.l.). Towards the east, the landscape becomes more elevated in the Hornoer Plateau (village Grießen ~100 m a.s.l.), and the edge of the Hornoer Plateau drops abruptly to the valley of the Neiße River (~56 m a.s.l.) (Figs. 1b, c).

The study area is located east of the village of Peitz (Fig. 1b). The core area is located in the northern part of the active opencast lignite mine of Jänschwalde, where most of the charcoal kiln remains were found and archaeologically excavated. We extended the investigation area for the SRM analyses based on archival research results and the examination of historical maps. Therefore, the surveyed area comprises the Jänschwalder Heide based on the historical boundaries from the Preußische Urmeßtischblätter (1845) and portions of the surrounding communal forests of Grießen, Horno, Heinersbrück and Jänschwalde Kolonie. The boundaries of the analysed areas are displayed in Fig. 1b. Since the 15th century, the Jänschwalder Heide was in royal-electoral possession and was part of the royal forest district (königlich Tauersches Forstrevier), which included the woodlands north of Peitz (Fig. 1b). Permission for charcoal burning was granted by the rulers of Brandenburg – Prussia to the nearby ironworks at Peitz (Nawka, 1966; Krausch, 2008).

2.2. Pre-industrial charcoal burning in the study area

Information on pre-industrial charcoal burning mainly stems from systematic archaeological research in the opencast lignite mine of Jänschwalde (Lipsdorf, 2001; Rösler, 2008). At this site, archaeological excavations were ongoing as the mining activity moved north.

The charcoal kiln relicts (CKRs) were first detected by field surveys. In contrast with the charcoal-burning sites on slopes in mountainous regions, where kiln platforms were prepared on small terraces (e.g., Ludemann, 2003), the levelling of circular areas across the flat landscape required less effort. Thus, the kiln platforms are considerably less marked than the kilns in the mountainous regions. Nevertheless, the CKRs in our study area emerged as microtopographic surface features. Furthermore, charcoal pieces may suggest the existence of CKRs. Following the archaeological excavation of the surface, the charcoal kilns are evident in the light-coloured sands as distinct, black circles (Fig. 2a) that resulted from the construction of circular upright charcoal kilns (*Platzmeiler*). After building the wood stacks, the kilns were sealed with brushwood and soil. To prevent forest fires, ditches that were approximately 40 cm deep were dug around the wood stacks. The soil material from the ditch was probably used to seal the stack. Following the carbonisation process, the charcoal was raked out and the ditches were filled with the charcoal to form the black circles (Fig. 2b). The ground