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ISLANDS IN THE SWAMP. LAKESCAPE-RECONSTRUCTIONS OF MESOLITHIC SITES IN THE RHINLUCH AREA (GERMANY)

Abstract

The Rhinluch area (Havelland District) in the state of Brandenburg, Germany is known for its excellent preservation of early Mesolithic sites. The use of modern remote sensing techniques in combination with detailed stratigraphic analyses provided comprehensive and extensive reconstructions of the early Holocene environment in the area. It is shown how water-level reconstructions, peat-growth models and topographical information were used to reconstruct the lakescape of early Holocene hunter-gatherers. Finally, older environmental reconstructions are compared to the modern results on the basis of water-level and landmass comparisons. The use of GIS software made it possible to simulate and evaluate the improved results and optimize the picture of the Rhinluch in the early Holocene.

Keywords

Early Holocene, Preboreal, Boreal, digital elevation model, environmental reconstruction

Introduction

This paper deals with the geophysical environment of a micro-region in Brandenburg, Germany, where early Mesolithic sites with excellent preservation were excavated at the end of the 20th century. The sites are located in the Rhinluch, which is an extensive fen area that started to form at the beginning of the Holocene. Due to the good preservation of organic artefacts these sites provided extensive information on the palaeo-environment and organic artefact spectrum of early Holocene hunter-gatherers. As several examples show (e. g. Bokelmann 2012; Jessen et al. 2015; Larsson / Sjöström 2010; Mellars 1998; Schuldt 1961; Street 1991; Zhilin 2003), wetland sites are crucial to understanding human behaviours and their interactions with the environment during that time. Therefore, it is also relevant to understanding settlement strategies so that areas with high potential for good preservation can be identified and consequently be more efficiently protected. In this study the results of two excavations were used in combination with a digital surface map to try to model the land-water-proportions during the time of early Holocene settlement.

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Introduction to the study area

The Rhinluch is a region in the state of Brandenburg, Germany characterized by extensive fens which are interrupted by some ground morainic plateaus. It is part of the Warsaw-Berlin ice-margin valley and has been overgrown by peat since the beginning of the Holocene. Until the 16th century, when first ameliorations were conducted (Fontane 1922), it was swampy and consequently not used for agricultural purposes. The area was drained by a small river, the Rhin (also known as Friesacker Rhin) which is a tributary of the River Havel, which itself drains into the Elbe.

The Rhinluch is connected in the south to the Havelländisches Luch, forming the Luchland. To the west, the Luchland opens out into the Elbe valley, where run-off water masses from the different ice-margin valleys formed at the end of the last Glaciation (Schneider 1959-1962a, 1106-1113). As a consequence, the Elbe degraded several meters into the basic moraine during the late Pleistocene and early Holocene. The postglacial sea-level rise caused the intrusion of the North Sea into formerly terrestrial areas, while the Elbe was foreshortened. As a result, materials in suspension were increasingly deposited in the middle and upper course of the stream. This led to an accumulation of 10-12 m of gravel and sand as well as 1-2 m of alluvial clay since the Atlantic period (Schneider 1959-1962b, 1189). Due to its less meandering course, the Havel river was not raised in its level to the same extent because most material in suspension had already been deposited in several lakes along its course. As the banks of the Elbe increased in size, drainage of the Havel into the Elbe reduced. The backup water finally led to increasing groundwater levels in the Luchland, which also served as a buffer area for Elbe floods (Schneider 1959-1962a, 1106-1108) (**fig. 1**).

Due to dyke construction along the Elbe the influence of high tides on the Luchland decreased in the 13th century. Until historic times, the high groundwater levels made it impossible to use these low lying areas for agricultural purposes. For this reason drainage was already undertaken in the Rhinluch in the 16th century, whereas the Havelländisches Luch was not drained until 1718 (Eisentraut 2010, 31-38; Fontane 1922, 104; Mundel 2001, 174-181; Mundel 2002, 17). These actions continue intermittently until today.

The base of the Rhinluch is covered almost everywhere with gyttja dating to the Preboreal. This shows a complete inundation of the area in this epoch. At the beginning of the Holocene, groundwater levels had already induced overgrowth by peat (Scholz 1962, 64). In the early Holocene the water level decreased so that elevated spots fell dry and formed islands in large lakes (Gramsch 2002a, 190-191). The overgrowth processes increased up until the late Boreal and the water level became even lower so that only low lying areas and channels provided access to open water (Kloss 1987b, 122-123; cf. Gramsch 2002a). At the same time, the already overgrown areas deteriorated and mixed deciduous forests became established there. In the Subboreal the water level rose again and peat formation increased as a consequence of paludification (Gramsch 2002a, Fig. 3; cf. Kaiser et al. 2012, 133). Several decimeters of peat were formed (Kloss 1987b, 123). Due to the dyke construction along the Elbe the drainage of the Havel was hampered, which again resulted in increasing groundwater levels and increased overgrowth rates (Scholz 1962, 64-65). Until the amelioration of the Rhinluch, the water level rose by ca. 3 m before it decreased to the modern value of 26.5 m asl (Gramsch 2002a, 190-191).

Materials and Methods

The new reconstructions of the palaeosurface are based on a digital surface model (DSM) with data provided by the Landesvermessung und Geobasisinformation Brandenburg (© GeoBasis-DE/LGB [2013]). The area under investigation was mapped by laserscanning with a gridsize of 1 measurement/m² and a height accuracy of ± 0.3-0.5 m (http://www.geobasis-bb.de/GeoPortal1/produkte/dgm-laserscan.htm).

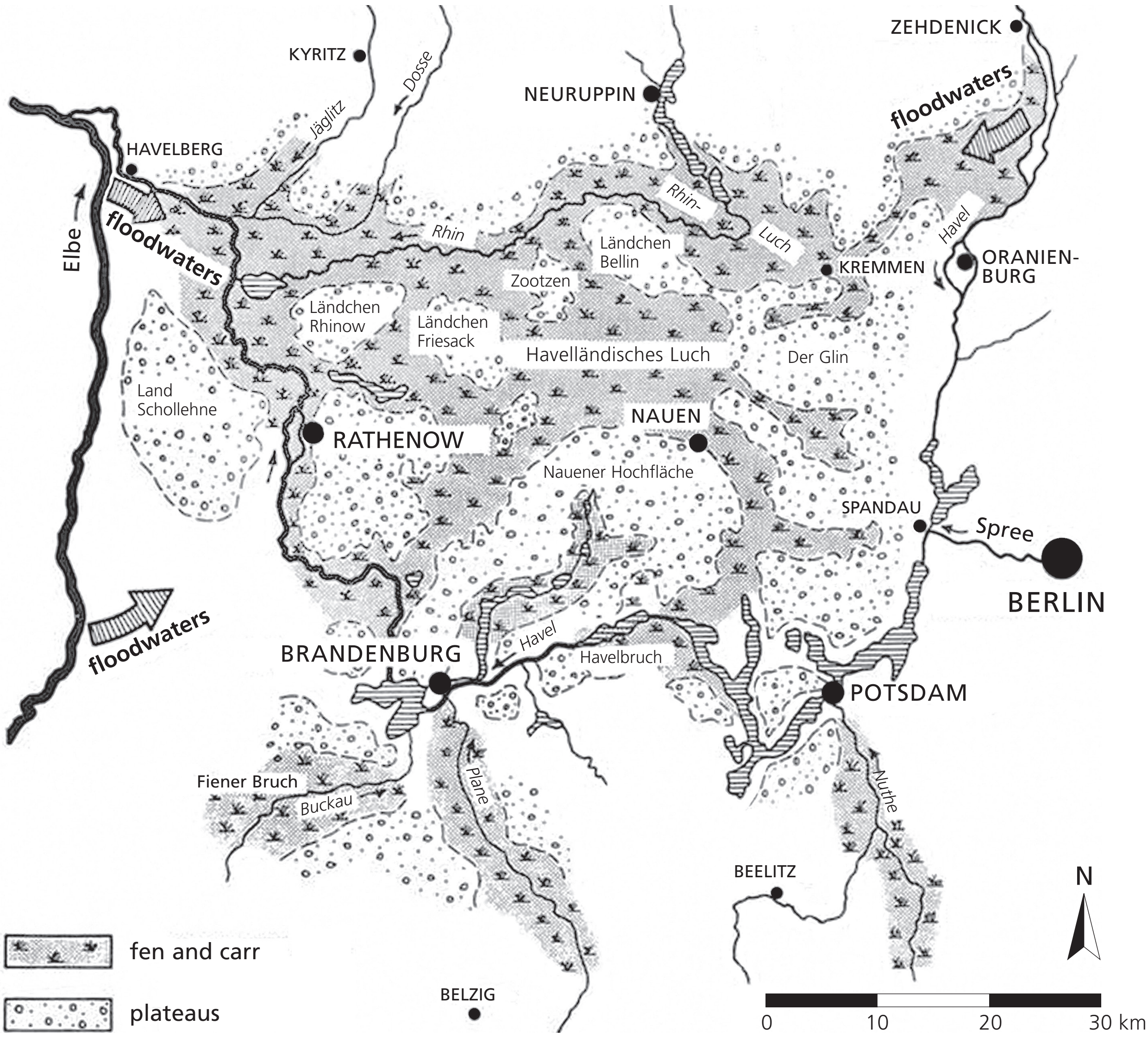

Fig. 1 The landscape of the Rhinluch. Floodwater paths are indicated as well as fen and highmoor areas. The plateaus already served as settlement areas in Medieval times whereas the low lying areas were first used in Modern times after extensive drainage. – (After Eisentraut 2010, fig. 1).

Furthermore, the Prussian *Generalmaßstabskarte* of 1880 (Klockmann 1880) was used for comparative purposes. The latter was especially used to trace the former riverbed of the Friesacker Rhin which was canalized in the 18th century (Itzerott/Kaden 2003). Additionally, the Prussian *Generalmaßstabskarte* enabled us to determine former peat cuttings and differentiate them from natural depressions.

Data such as estimations of peat thickness and its growth rates were included from cores taken during excavations. Additional information was derived from the excavation profiles (Gramsch 2002b; Groß 2017) and water level reconstructions for the area (Gramsch 2002a).

The area in the Rhinluch northwest of the town of Friesack is known for its extraordinary preservation of archaeological material. Between 1977 and 1998 modern excavations took place in the area due to renewed amelioration attempts. Excavations were mainly executed by B. Gramsch (see e.g. Gramsch 2002b), who investigated two Mesolithic sites: Friesack 4 and Friesack 27a (**fig. 2**). Both date to the early Holocene, however Friesack 4 shows a longer occupation sequence than Friesack 27a.

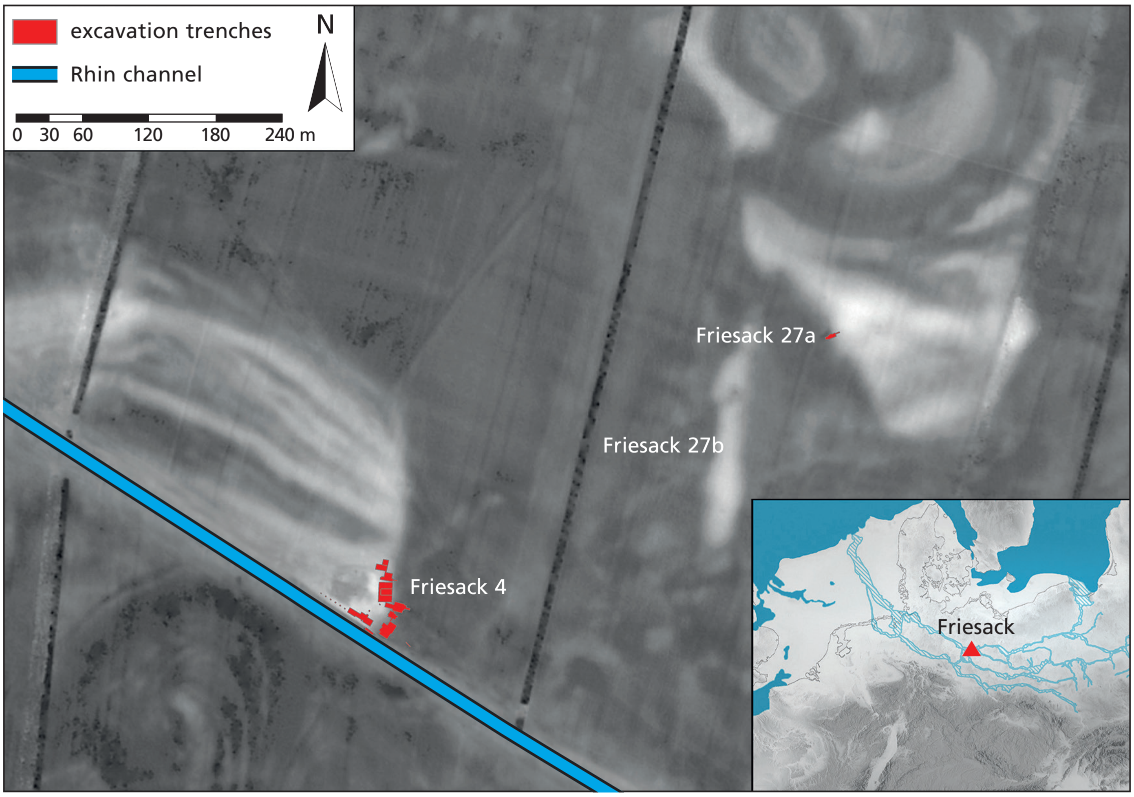

Fig. 2 Location of the excavation trenches of Friesack 4 and Friesack 27a. Friesack 27b is not excavated. The lighter the colour, the higher the surface (range between lowest and highest point: ca. 1.5 m; geobasisdata: © GeoBasis-DE / LGB [2013]). Inset: Location of Friesack in the Preboreal landscape at the Pleistocene / Holocene border. – (Base map: Grimm 2009 after Björck 1995a; Boulton et al. 2001; Brooks 2006; Clarke et al. 2004; Ivy-Ochs et al. 2006; Lundqvist / Wohlfahrt 2001; Weaver et al. 2003; added by Anonymus 1992; Björck 1995b; Björck 1996; Coope et al. 1998, fig. 4H; Gaffney / Thomson / Fitch 2007, 3-7 and 71; Kobusiewicz 1999, 190; Woldstedt 1956).

Synchronous palaeoecological analyses (Kloss 1987a; 1987b) made it possible to gain detailed insights into the environment facing early Holocene hunter-gatherers in that area (see Groß 2017, 79-82). Further understanding was recently achieved by the use of modern remote sensing techniques and its combination with the previous results.

Foremost known is the site Friesack 4, which has been extensively published by B. Gramsch (e. g. 1987; 1992; 2002a; 2002b). The site of Friesack 27a was published recently (Groß 2017). It is located, more or less in a straight line, some 400 m northeast of Friesack 4. At both sites the shorelines of former lakes have been excavated. This resulted in an excellent preservation of archaeological material because it had remained waterlogged since deposition.

Furthermore, it was possible to differentiate several sandy layers that must be connected to human activity at the sites which caused erosion of the sediment. These layers were intercalated with peaty layers which seem to represent times of human absence (Gramsch 2002b, 59-65; Groß 2017, 63-67). Another important aspect for the water-level reconstructions is the fact that the excavations provided evidence of different shorelines and a water-level of 27.5 m asl at the beginning of the Holocene (Gramsch 2002b, 62; 2002b, 62-91; Groß 2017, 58-67).

Apart from the on-site investigations, the botanist in charge, K. Kloss, conducted an extensive coring program with the aim of reconstructing the palaeosurface (Kloss 1987b). Additionally, he carried out extensive palynological analyses (Kloss 1987a). Between 1977 and 1982 K. Kloss managed to record 315 profiles in an area of ca. 7 ha (Kloss 1987b, 121). He concentrated his actions on the area between the sites of Friesack 4 and Friesack 27a and differentiated between peat and the subjacent gyttja. Since he did not differentiate between surface soil and peat, the depths he described have to be used carefully. Additionally, it has to be kept in mind that the peat is still subject to decomposition so that it is not appropriate to use the modern surface heights in combination with the results from more than 30 years ago.

For transferring K. Kloss' peat depths into the new model it was crucial to use height values which are as close to the former level of the surface as possible. For this purpose the initial measurements of Friesack 4 and Friesack 27a were used and compared with the plane survey sheet from 1985 (Militärtopographischer Dienst 1988). In combination with the modern DSM it was possible to approximatively reconstruct the surface level at the time when coring took place. The groundwater levels used in the reconstructions were adopted from B. Gramsch (2002a), who developed a curve based on several archaeological features from the Rhinluch and in the town of Friesack.

Results

The reconstruction of the palaeo-surface was undertaken by subtracting the values for peat depths determined by K. Kloss from the surface at the time of coring. No reconstruction was necessary for areas above 27.5 m asl since these spots were lying above the groundwater level in the early Holocene and hence were overgrown by peat later than the phases in focus. For the deeper areas the peat depths were subtracted so that the palaeo-surface at the beginning of the Holocene could be reconstructed.

Apart from the changing water-level in the Rhinluch during the Preboreal and Boreal chronozone, the overgrowth processes had to be considered in the reconstructions. For this purpose the detailed stratigraphic analyses of site Friesack 27a were used, where up to seven occupations could be differentiated. The intercalations of peat between the sandy occupation layers enabled us to apply a simple age-depth model. For this model a supposed peat accumulation rate of 1 mm per year (1 mm/a) is used (Kloss 1987b, 123) even though K. Dierßen (1990, 145) points out that the peat accumulation rates in fens lags behind those in highmoors (0.12 mm/a to 1.6 mm/a), due to their higher decomposition and density (cf. Rickert 2003, 116-118; Mundel/Trettin/Hiller 1983, 260-261; Overbeck 1975, 49-52). The constantly changing water level might have caused a discontinuous peat growth as well (cf. Kloss 1987b, 122-124). Hence the given peat growth rates and timespans have to be understood as model-like and it is recommended to use the expression of time units (Δt) instead of years (**tab. 1**).

Changes in water-levels were not the only factors affecting overgrowth processes in the area, the surface area changed too. Shallow pools disappeared and larger lakes diminished in size due to peat growth. To include these aspects into the reconstructions, the determined chronological gaps (Δt) were integrated into the reconstructions as peat

# of occupation at Friesack 27a	Δt to previous occupation	water-level asl.	chronozone
7	undetermined	26.75	
6	140	27.10	early Boreal
5	150	27.20	
4	20-50	>27.15	
3	150		late Preboreal
2	50	27.50	
1	—		

Tab. 1 Reconstructed water levels and corresponding occupation events at site Friesack 27a.

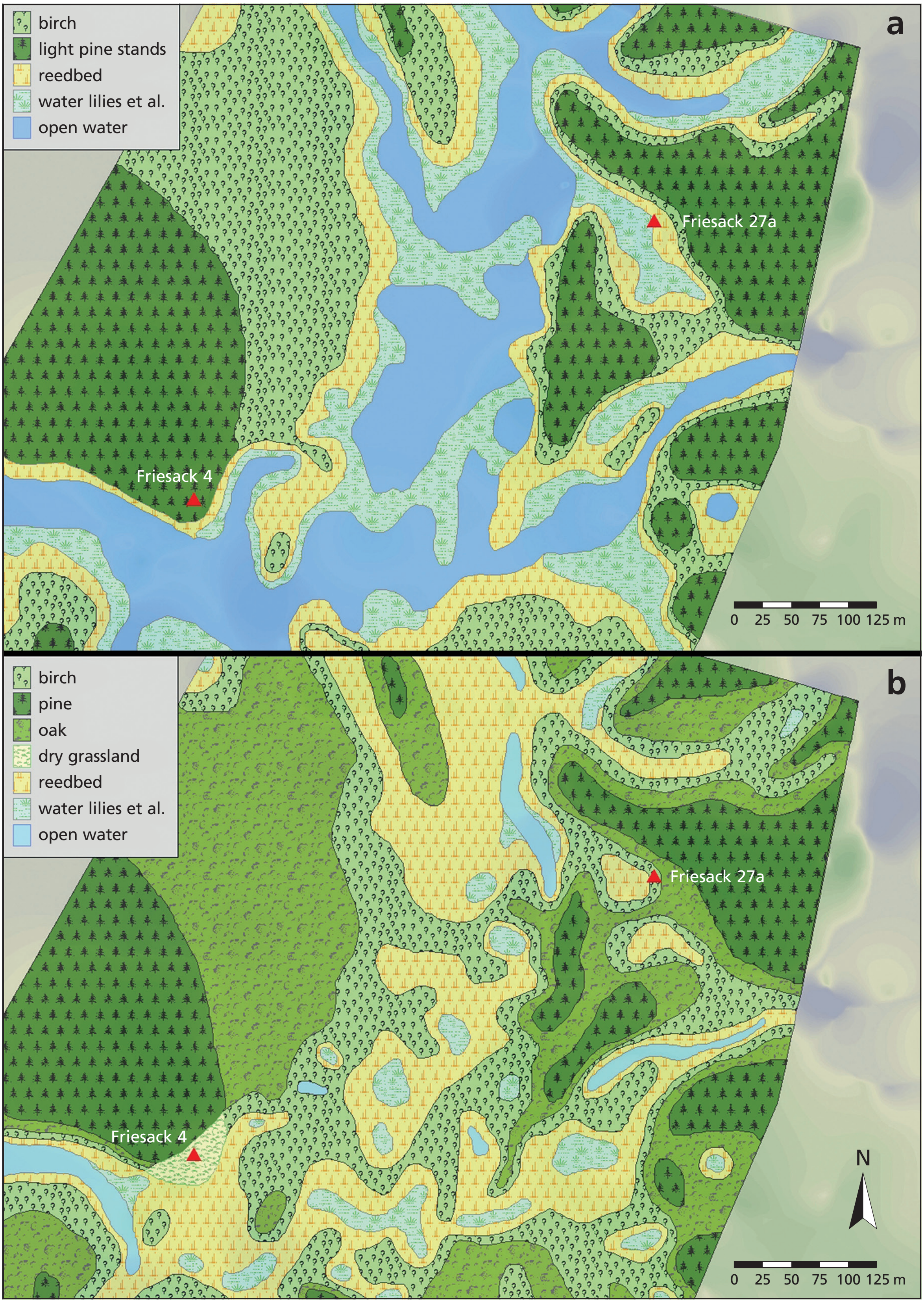

Fig. 3 The vegetation maps by K. Kloss. a) Preboreal, b) Boreal. – (After K. Kloss).

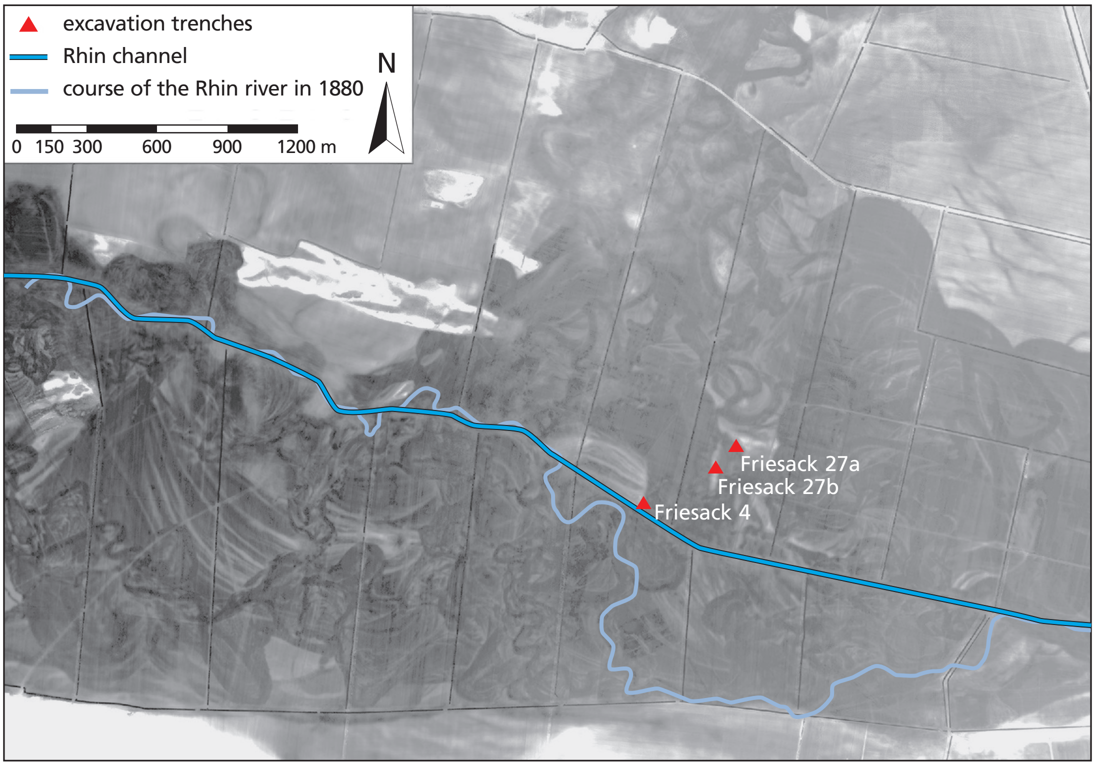

Fig. 4 The DSM clearly shows depressions and former river courses. – (Geobasisdata: © GeoBasis-DE / LGB [2013]).

aggregation. This was basically done by adding the values translated into growth of peat mass to the reconstructed palaeo-surface.

K. Kloss prepared two illustrations which show environmental reconstructions for the area between the sites Friesack 4 and Friesack 27a (**fig. 3**). For these he also used the results of his coring and the pollen samples he analysed (Kloss 1987a). The illustrations show the vegetation zones and the corresponding water level in the Preboreal and Boreal, respectively. In a synopsis of the reconstructions based on the DSM and K. Kloss's corings two observations can be made.

First, it becomes obvious that the depressions he revealed are also visible in the modern data. Even though the depressions and differences in height are hardly visible to the naked eye on-site, the DSM shows former channels and depressions very clearly (**fig. 4**). In addition, modern disturbances, like peat cuttings, can be observed and quite accurately determined, especially when historic maps are also considered. The DSM perfectly fits with the coring results but provides much greater detail of the landscape.

Second, the palaeo-vegetation maps drawn by K. Kloss show fairly different water-levels to those in the reconstructions. To reach the levels he used for his maps, values of 25.86 m asl and 25.05 m asl. had to be applied for the Preboreal and Boreal, respectively. As a consequence, there is a water-level difference of 1-1.8 m between the reconstructions and K. Kloss's assumptions.

Since the water levels used in the new reconstructions are based on several archaeological proxies (ancient shorelines, watering holes, wells [Gramsch 1998; Gramsch 2002b]) from different sites they have a high level of confidence. Because of this, the water-levels K. Kloss used for his reconstructions have to be considered as too low. As a consequence, in the early Holocene, especially the Preboreal, Friesack 4 and 27a site were located on an island. The continuous lowering of the water-level until the late Boreal enhanced the overgrowth processes and consequently the reduction of open waters.

Another aspect worth mentioning is the DSM provided indications for the reconstruction of palaeo-rivers. The representation of minimal depressions in the surface enabled a more extensive reconstruction of the palaeo-landscape with respect to K. Kloss' coring results. Starting from the core area of research (the area between Friesack 4 and 27a), former riverbeds which were synchronous to the occupations were deduced. By application and correlation of the morphology of the rivers, such as measures of the meanders, breadths of the rivers, and intersections, a relative chronology of the meanders was applied (cf. Stewart/Lonergan/Hampson 2013, Fig. 6; Mangelsdorf/Scheurmann/Weiß 1990, 93-122) (**fig. 5**).

Discussion

In the case of the water-level reconstructions it could be shown that the water levels K. Kloss assumed were too low. The new reconstructions clearly show that the Mesolithic settlement sites were located on islands, at least during the first occupations. With respect to the more detailed chronology of the sites, radiocarbon datings revealed that the occupation of Friesack 27a probably ceased when the small pond in front of the settlement was completely overgrown by peat (cf. Groß 2014, 3). As a result, the connection to the larger watercourses was interrupted, so that the people settling on the islands had no possibility to easily access open water anymore.

We assume that infrastructural aspects have to be regarded as important for the location of early Mesolithic settlements (cf. Mahlstedt 2015; Mellars 1998; Sergant/Crombé/Perdaen 2009; Terberger 2002). This applies particularly to ice margin valleys and water rich environments since these comprised wide and open spaces in an otherwise forested environment (cf. De Bie/Van Gils 2009, 286; Mellars 1998, 229). Additionally, wetlands and marshes are the most productive landscapes in Central Europe

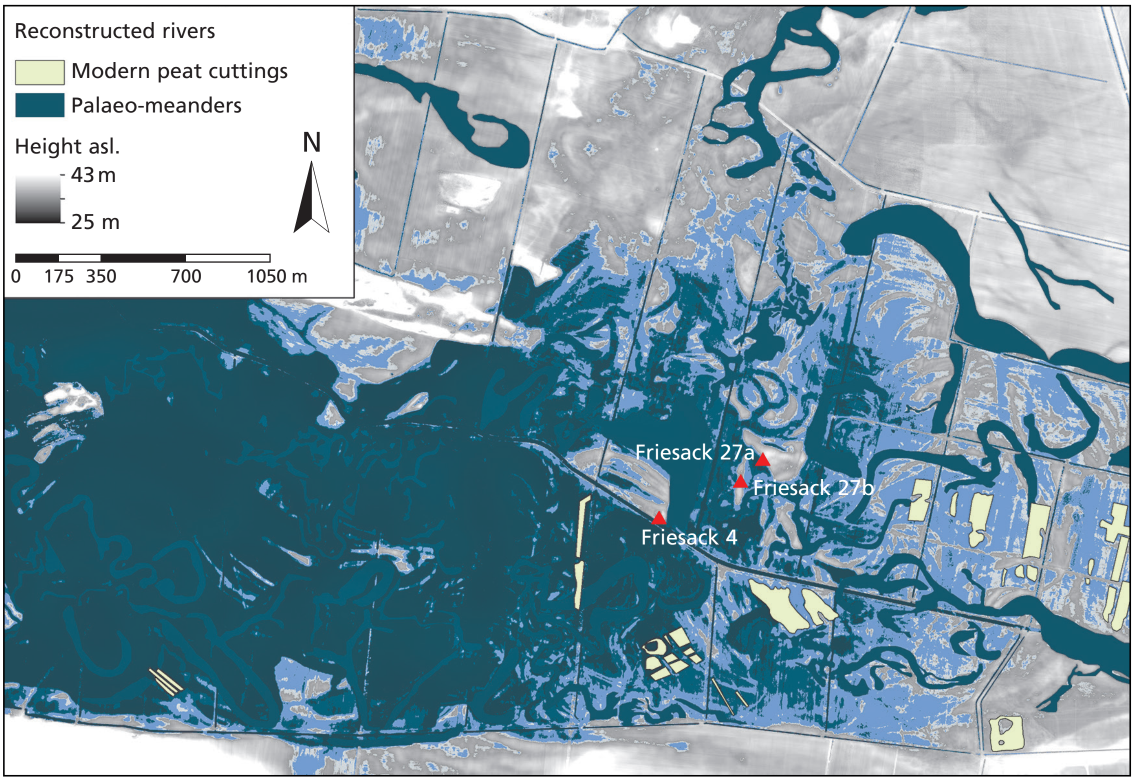

Fig. 5 The morphology of the rivers depict which palaeo-meanders might have existed during times of occupation. – (Geobasisdata: ©GeoBasis-DE/LGB [2013]).

Fig. 6 Extensive agricultural use of the ameliorated fen causes the destruction of archaeological sites. At Friesack 27a the former excavation is not covered by grass due to the constant trampling of browsing cows. The destruction of the site is constantly progressing as a consequence.

(Mellars 1998, 227-230; Whittaker 1970, Tab. 4.2) so they might have been preferred for settlement.

As was shown, the use of modern remote sensing techniques is a valuable tool for archaeological investigations. Especially in rural fen areas they bear great potential for survey purposes and environmental reconstructions. For scanning an area of 7 ha K. Kloss needed several field campaigns and 315 corings for his reconstructions (Kloss 1987b). Using airborne laser scanning techniques, efforts can be reduced and much more extensive areas can be surveyed. Even though the use of DSMs and GIS software enhanced the scope of the area under consideration and provided possibilities to prove former assumptions, it still remains useful to apply some corings for dating and stratigraphic purposes. The faster techniques develop, the better and more detailed our reconstructions will become. Nonetheless, it remains important to verify the data by fieldwork.

Conclusion

The analyses showed an aspect that has to be recognized as being a mixed blessing: The reconstruction of former river beds and palaeo-meanders was done well by analysis of the DSM. This was possible due to the deterioration processes that advanced in the area as a result of intensive amelioration attempts and related groundwater lowering. As a result, the peat deteriorated and still deteriorates with increasing speed. Apart from changes in the chemical milieu that might affect the archaeology, as shown in Star Carr (Milner et al. 2011), the sites themselves are subject to visible destruction because they lose their protective cover (**fig. 6**). On the other hand, the decreased peat cover increases the possibility of discovering such wet-land sites. As a consequence it is important to use modern techniques and possibilities to survey and, contrary to many other kinds of archaeological sites, finally excavate wet-land sites. Particularly in extensively used rural areas this becomes an urgent task, as such sites often provide far more insight into prehistory, due to the possibility of organic preservation, than terrestrial sites.

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