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AN ARCHAEOLOGICAL PREDICTIVE MODEL FOR LOCATING ROCK SHELTER SITES IN HESSE (GERMANY)

containing both Final Palaeolithic archaeology and Laacher See tephra

INTRODUCTION

Laacher See Volcano erupted c. 13.000 years ago in the Allerød-Interstadial at the end of the Weichselian. Its caldera is located in the East Eifel Volcanic Field in the state of Rhineland-Palatinate in Germany. While the thickest fallout deposits of the settled to the immediate East, traces of Laacher See Tephra (LST) could be found as far as Poland, Lithuania and Northern Italy (Fig. 1).

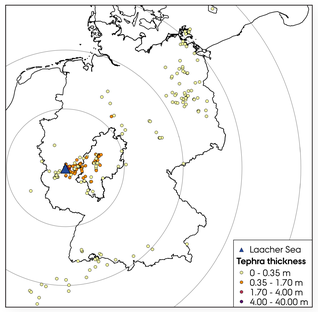

Fig. 1: The Laacher See and the distribution of Laacher See Tephra throughout Central Europe.

The wide dispersal of LST across much of Europe bears whitness to the intensity of the eruption and its potentially strong influence on the environment and human life (Riede 2017).

During the Allerød-Interstadial and the Dryas III, Central Europe was populated by foragers of the arch back point (ABP; 12,000 – 9700 cal BC) technocomplex who (re-)settled the Central Uplands after the Last Glacial Maximum . In the Neuwied Basin, relatively close to the Laacher See caldera, numerous well-preserved ABP sites are known. The pumice-cover protected the open-air sites in the region from post-depositional processes. Elsewhere, these factors damaged or de-stroyed most traces of occupations. Thus, well-stratified Late Glacial open air sites in the Central Uplands of Germany are primarily known from the Middle Rhine Basin.

Fig. 2: The Final Palaeolithic site of Bettenroder Berg IX, Lower Saxony.

In other areas, well-preserved sites are typically restricted to rock shelters and caves. These rock features were frequently used by foragers throughout prehistory. A good example is the site of Bettenroder Berg IX (Grote 1994) in the south of Lower Saxony (Figs. 2, 6F). Here, strata of the ABP were overlaid by tephra of the Laacher See eruption. We applied archaeological predictive modelling based on a legacy dataset with the aim to find comparable sites in Hesse. Subsequently two field surveys were conducted to evaluate the potential sites for conducting test excavations.

MATERIAL AND METHODS

H. Hofbauer compiled a database of more than 700 potential rockshelters in the early 1990s with the explicit goal of finding sites comparable to Bettenroder Berg (Hofbauer 1995). For use in a geospatial analysis, scans of the database were digitzed with an automatic algorithm and checked manually for errors and inconsistencies.

To predict traces of occupation in the locations of the dataset, a predictive model was developed based on a digital elevation model (DEM) with a 25 m resolution (European Environment Agency) and a vector map of the main watercourses (digital German topographic map; DLM250; river width > 12 m). The *weighted layer overlay* approach (van Leusen et al. 2002) was used to analyse the topographic framework of 140 Final Palaeolithic reference sites (cave and open-air) in the German Central Uplands.

THE ARCHAEOLOGICAL PREDICTIVE MODEL

Three topographic predictors were used to estimate relevant conditions in the Final Palaeolithic reference sites:

1. Aspect (Fig. 3)

Orientation of every raster cell; eight different classes of orientation were used.

2. Distance to water (Fig. 4)

Cost distance estimated with a hiking function of slope-determined walking time (van Wagtendonk & Benedict 1980)n in relation to rivers > 12 m width; 30 min classes.

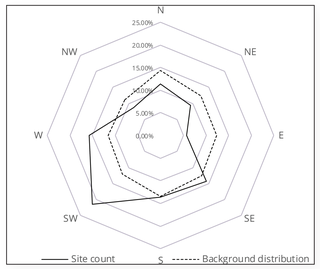

Fig. 3: Comparison of site orientation and background values in the study area.

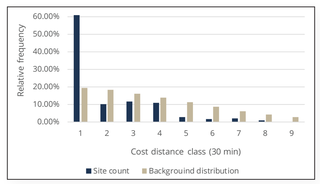

Fig. 4: Comparison of site distance to water and background values in the study area.

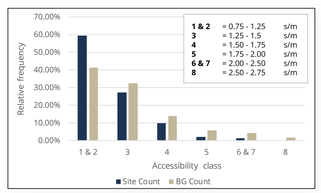

Fig. 5: Comparison of site mean 2 km accessibility and background values in the study area.

3. Mean accessibility in a 2 km radius (Fig. 5)

Mean walking speed (s/m) estimated by hiking function in 2 km radius as a representative of landscape accessibility; 9 classes in 0.25 s/m intervalls starting at a speed of 0.75 s/m were generated.

All three layers showed independent values (X^2 test) with regard to the respective background distribution and showed good predictive performance:

1. Aspect (Fig. 3)

X^2 test: highly significant (p=0.005) preference of areas with SW and W orientation.

2. Distance to water (Fig. 4)

X^2 test: highly significant (p=0.001) preference of areas within the 30 min isochrone around major rivers.

3. Mean accessibility in a 2 km radius (Fig. 5)

X^2 test: highly significant (p=0.001) preference of areas of highh accessibility (0.75-1 s/m).

The three individual layers were combined in a predictive mapset. Kvamme's Gain test showed a value of 0.78, indicating a large number of positively predicted sites on a small proportion of the study area. The sites in the rock shelter database were then sampled with respect to the standardized predictive power.

To highlight tephra occurence in the rock shelter sites, the distance to the closest known LST record was plotted in the map. This indicates the likelihood of finding LST in the respective site and shows areas, were currently no Tephra are known due to a sampling gap.

FOLLOW-UP SURVEY

In late November 2017 and March 2018 surveys were conducted based on the model predictions.

The surveys showed, that in the western parts of Hesse the volcanogenic baserocks rarely form sheltering features sufficiently large for the use by prehistoric foragers.

The most viable sites are situated in northern and eastern Hesse, were layers of Permian and triassic limestones provide a carstic environment. Here, several cave sites are known as well. These features provide a setting, which, in other regions like the Swabian and Franconian Alb, was favoured by prehistoric foragers.

Among the 80 sites, which were visited in the two surveys, several sites were selected for further investigations (Fig. 6).

PLANNED EXCAVATIONS

For the summer of 2018, keyhole excavations are planned for the sites which were selected for further investigation. Among these, three locations stand out:

Alraft, Waldeck-Franckenberg District

The two south-facing overhang situations (Figs. 6B, C) in the village of Alraft near the small river Werbe provide morphological features similar to Bettenroder Berg. Several sediment-filled overhangs provide good conditions for the preservation of archaeological material. Also, the topographical setting is typical for Final Palaolithic occupation. Furthermore, the proximity to known occurences of LST is particularly promising for finding traces of Late Glacial occupation in the context of the eruption. The excavation of several test-pits is planned for Juli 2018.

Baumbach, Hersfeld-Rotenburg District

This limestone rock shelter is situated in the Fulda-valley near the town of Rotenburg (Figs. 6D, 7). The feature is oriented southwards and westwards and provides two overhang locations.

A: The small rock shelter "Ellerstein" near Orferode, Bad Sooden-Allendorf.

B: Rock shelter in the village of Alraft, Vöhl in the Werbe-valley. The limestone feature shows several overhang situations currently filled with sediment.

C: Second rock shelter in the village of Alraft, Vöhl in the Werbe-valley.

D: Rock shelter near Baumbach in the Fulda-valley.

E: Rock shelter near Hergershausen in the Fulda-valley.

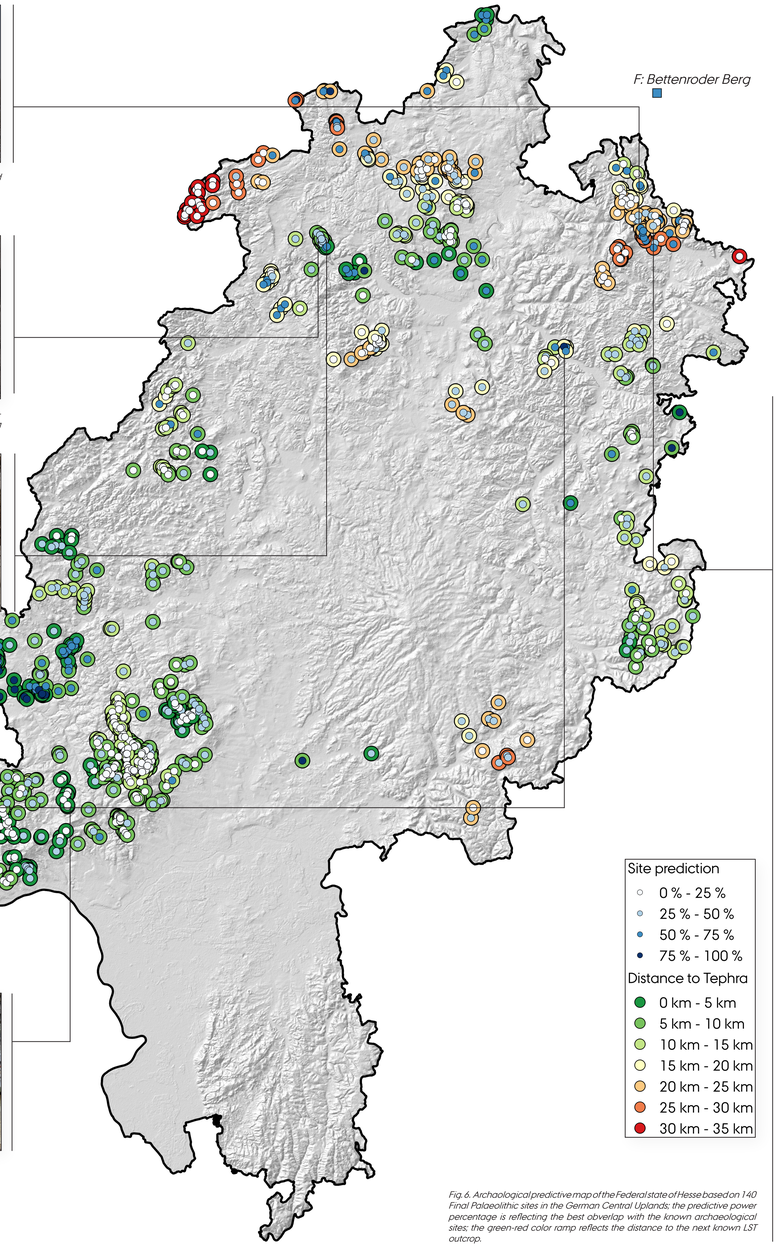

Fig. 6. Archaeological predictive map of the Federal state of Hesse based on 140 Final Palaeolithic sites in the German Central Uplands; the predictive power percentage is reflecting the best obverlap with the known archaeological sites; the green-red color ramp reflects the distance to the next known LST outcrop.

The topographical setting is comparable to other Final Palaeolithic sites. Particularly, the flood plain context of the site has to be noted. The excavation of several test-pits is planned for September 2018.

Fig. 7: Two aerial fotos of the Wetterstein in the Werra Valley near Kleinvach.

Wetterstein, Werra-Meißner District

This large rock spine comprises a south-facing rockshelter and a large sediment pile in front of the overhang (Figs. 8-10). The topographical setting is comparable to sites typically used by Final Palaeolithic hunter-gatherers. The excavation is planned for late August 2018.

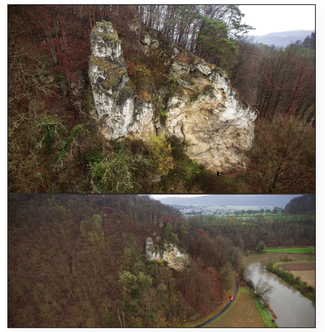

Fig. 8: Two aerial fotos of the Wetterstein in the Werra Valley near Kleinvach.

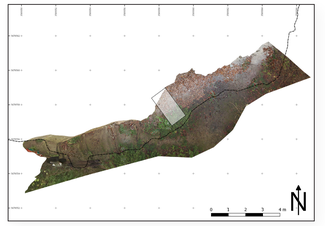

Fig. 9: Orthofoto of the sheltered area at Wetterstein and the planned excavation area.

Fig. 10: The rockface at the planned escavation area. In the highlighted area, solidified sediments are still clinning to the wall.

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