Site definition possibilites: Features excavated in a transect

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Linear excavation projects as for street or pipeline construction offer a glimpse into the archaeological record for long but slim areas, cutting through past environments, burial grounds and settlements. Traditionally these continuous excavations have been divided into sites by Heritage Management for excavation organisation and individual analyses. In this talk I take the excavations along a transect as a sample of the archaeological record in the area and explore the possibility of defining settlements and typical settlement sizes using the features along the whole of the transect disregarding Heritage Management’s site definitions. There is a long-standing discussion on site and non- or off-site in survey archaeology, upon which this talk draws, but instead of using finds as units of observation, excavated features are used. The data base consists of features along the street B6n, a 13 km long strip of mostly 40 m width near the city Köthen in Saxony-Anhalt. They date from the middle Neolithic to the early Iron Age. As typical cluster detection analysis algorithms as the F-, G- or Ripley’s K-functions are heavily influenced by edge effects, simple distance measurements between all features of one period are taken as a proxy for clustering. Kernel density estimations and cumulative distributions of these distance values compared to values generated by random points (CSR) are used to gain an understanding of the settlement structures of the different periods. Statistical analyses have been realised with R.

# About

This is my talk at the CAA international, 22nd March 2018.

# Title slide

Thank you for the invitation to speak in this session. My name is Sophie Schmidt, I am research assistant in Cologne.

In this talk I will present a method for defining site sizes by means of features excavated along a street construction, a project, which developed out of my Masters thesis in Prehistoric Archaeology, which was realised at the Free University Berlin with data by the Heritage Management Saxony-Anhalt.

# Introduction

Linear excavation projects as for street or pipeline construction offer a glimpse into the archaeological record for long but slim areas, cutting through past environments, burial grounds and settlements. They have been praised to turn up many new sites that were not identifiable by surface collection and thus are an important corrective to preconceived notions about settlement developments, especially in rural areas.

My take on the transect analysis was inspired by the idea that a long excavation may yield more information if seen as a continous trench in contrast to understanding it as a line of distinct sites.

In essence this is similar to the non- or off-site archaeology, that was developed by Foley, Thomas and others in the seventies and eighties in the USA.

# Outline

In the following minutes I will begin with an introduction to my data set as to facilitate the explanation of theoretical and methodical aspects. I’ll present my analyses and results, hopefully in a way that encourages critical review and draw a conclusion based on the discussion of the results.

# Dataset

In the 2000s, in Saxony-Anhalt, middle Germany, a street was build, called “Bundesstraße 6n”. As is the law in that state, the area of the street, approach roads, exits and retention reservoirs were machine test trenched by the Heritage Management to find archaeological sites. Along the ca. 13 km long and mostly 40 m broad part of the street I analyse, 52 different sites were delimited by the Heritage Management, of which 24 contained features dating to the periods which I focused on. The time frame I look at begins around 4000 B.C., which is the middle Neolithic, and ends with the early Iron Age about 50 B.C.

# Dataset slide 2

There are 4770 features catalogued as belonging to these periods or as undated and you can see the specific number of settlement features belonging to the periods in this table. It is easy to see, that only with the beginning of the late Neolithic enough features for statistical analysis were excavated.

Because of the test trenching I assume that all features and sites along the transect have been found, even though there are gaps between the actual excavation areas. Machine trenching has been shown to be the most effective way to find sites Hey 2006. Admittedly even then not all sites are discovered. Especially neolithic ones have the least probability to turn up, which may be one reason for the small number of middle neolithic features in the transect.

The working area belongs to a fertile flatland area between the Kreisstadt Köthen and Bernburg. As the street avoids settlements, it mostly crosses agricultural land, and only few sites that were known before the excavation. It was not build with archaeological research questions in mind so I dare to say it is a random sample of the archaeological record. Nonetheless we must note, that the number of undated features is high in relation to the dated features: 66 % of the features couldnot be dated precisely. Therefore we are working with a subsample of about 34 % of the features inside the transect. This sub-sample most probably is not random, as the identification probabilities of the different periods may vary.

The late Bronze age and the early Iron Age are not easily seperable in the settlements, because the ceramics are very similar. Researchers agree that there seems to be a settlement continuation between the two phases, while the burial practices change. Consequently many features have been dated in both periods. I deal with this by adding the uncertainly dated features to the late bronze age analysis as well as to the early iron age analysis.

# Theoretical Issues

The term “site” has been at the center of a lively debate in survey archaeology over the last 40 years. Until the 70’s it has mostly been defined as a place - a findspot, which is similar to German archaeology, where the term used, “Fundplatz”, means exactly that. In the German archaeological inventories, though, a site may contain several culturally distinct loci “Fundstellen”, which are ususally catalogued as a settlement, a burial ground, a hoard or as a single find spot of a period.

In the American processual discourse a site has been a spatial relationship between archaeological finds Binford 1992. Post-processually it has been argued, that it is nothing but a modern analytical category, without any archaeological meaning by itself Dunnell 1992.

Since the middle of the 1970s there has been the discussion of a non- or off-site archaeology. The terms were introduced by Thomas 1975 and Foley 1981 and describe the analysis of finds inbetween sites. The archaeological record was now understood as a continual distribution in space, with spots of higher densities, the so-called “sites”, and areas of lower density, which are worthwhile to research as well. With this view on the archaeological record the discussion about the identification of the spatial boundaries of a site arose anew.

As mentioned before, in German archaeology the discussion was not so much focused on “sites” in general but more specifically on the detection of “settlements”. Next to the problem of qualitatively deciding “What kind of finds or features do I need to call this a settlement”, one problem of site detection by survey that has been discussed is the question of how far apart two “sites” are supposed to be. So if I find two sherds of the same time period 50 m apart - are these two sites or belong the sherds together? In every larger settlement or landscape archaeological study this topic is being discussed and in the end a decision felled, which the authors agree, is kind of arbitrary and should actually rely on empiric studies Malmer 1962; Mischka 2007.

So, me, thinking about my transect, thought I might be able to work out an approach to look for distances between settlements and typical settlement sizes. I work with features, which would of course only comprise the “built space” of a settlement. Features in-between settlements will exist, like traps, wells or temporary storage facilities. I’m ignoring the sites delimited by the Heritage Management and take the transect as a continual distribution of archaeological features, as in the off-site archaeological approach.

## Theory slide 2

I draw upon the thoughts of Plog et al to define boundaries. They say, sites are \*„a discrete and potentially interpretable locus of cultural materials. By discrete, we mean spatially bounded with those boundaries marked by at least relative changes in artifact densities. By interpretable we mean that materials of sufficiently great quality and quantity are present for at least attempting and usually sustaining inferences about the behavior occurring at the locus. By cultural materials we mean artifacts, ecofacts, and features“\*. Plog u. a. 1978

As I am focussing on settlement sizes here, I only use those features, that do not belong to a burial or hoard context. As I am not including find distributions, places like working areas or fields which may be detected by off-site archaeology, won’t be included.

The “relative changes in artifact densities” are in my case transferred into “relative changes in feature densities”. As proxy for density I use the distance between features. This measure is well known from cluster analysis, which is in a way what I want to detect: cluster of features that are interpretable as sites.

Formal cluster detection analyses as Ripley’s K, the F- or G-function Nakoinz – Knitter 2016 would rely heavily on edge correction to compensate for the slimness of my transect. I tested them and depending on the different correction algorithms you receive quite different curves. Instead I’m not correcting for the edge at all, because admittedly, a transect is all edge. Fully knowing that I only have a very narrow glimpse into the archaeological record, I rely on the length of the transect to give my results credence.

# Analysis

I worked with the spatstat-package of R, which offers the possibility to create point-pattern datasets within a window, which can take complex forms. This was needed as the trench boundaries were multiple polygones. After subsetting my points for different periods I calculated the distances to each other using pairdist.ppp. These distance-vectors are the basis for all further calculations. You will note I always cropped them at a distance of 1000 m. Otherwise the scale of the analysis becomes too large to detect site sizes.

For comparison of the dated features with an random distribution I created a complete spatial random and independent and identically distributed points (CRS and iid) distribution within the excavated areas.

Two different approaches are used to find settlement sizes, a cumulative and a density approach. The exact code I used is available on github. This way I don’t need to bore you with details here.

## Cumulative analysis

First, I cumulatively sum how often features have a certain distance to each other. This means on the y-axis you have the proportion of features that have a distance of x or smaller to another.

The turning point at which the curve flattens – meaning the increase drops, meaning the distances grow larger – can in my opinion be interpreted as settlement boundaries.

Already in this simple analysis different settlement patterns emerge.

## Density

On the other hand I am interested in typical cluster sizes, in a way “minimal sizes” of a settlement. For this I use a kernel density estimation on top of the distance measures to find the most common distances (peaks in the KDE) and the least common distances (minima in the KDE). The most common distances may be understood as a radius, because we do not know in which direction the features lie.

Minima may be interpretable as distances between settlements, as these are the “gaps” between features.

Density was plotted with ggplot. The band width was derived by Silverman’s rule of thumb, which is the standard set within the density-function of stats.

It is notable that the random distribution also has a peak in the beginning. This is a result of the slimness of the transect and the sizes of the excavation areas. Nonetheless all cultures show that they are more densely clustered than a random distribution by showing higher peaks. Also they all have a distinct mimum contrarely to the random point pattern.

# Results

Following I will present the results and a condensed interpretation. I took the calculated values and researched published large scale excavations in Middle Germany to see whether there are any settlements that have comparable sizes.

The 32 features of the **Corded Ware Culture** are loosely scatterted in clusters of about 120 m. At 300 m the distance to the next features rises rapidly and as a distance between settlements I propose about 530 m.

There is one site in Thuringia, called Luckaer Forst (published by Höckner 1957), which revealed house steads of the Corded Ware. They are distributed in an triangle with a sidelength of about 125 m, which fits quite well with my results, though the houses there are much closer to each other. I could not find a larger Corded Ware settlement in Middle Germany, which could be compared to the 300 m turning point of the cumulative analysis.

The **Early Bronze Age or Unetice Culture** has only 25 features in this analysis, which are all found in the Western part of the transect. There are five houses and it is notable, that the distances the houses have to each other dominate the distribution. The turning point of the cumulative analysis about 220 m, which correlates quite well with the sizes two known Unetice ring ditches in Schloßvippach, Thuringia Walter u. a. 2007 and Zwenkau-Eytrah, Saxony Huth – Stäuble 1998. Ditches are often interpreted as settlement boundaries. The distance between settlements which I propose here has an equivalent (430 m) at the excavation of the same street B6n further west, between Benzigerode and Heimburg, where two early bronze age settlements are cut.

We need to keep in mind though, these two data sets are very small and especially in the cumulative analysis you can see the influence of every feature on the curve. For the later periods much more features could be excavated.

As you can see, the **late bronze age** features are those that cluster most densely. The minimal settlement size of about 65 m diameter is comparable to individual late bronze age / early iron age farmsteads that have been recorded at Zwenkau, Saxony Huth – Stäuble 1998. The cumulative distribution has an insidious slow change of slope, which makes it difficult to determine a turning point. I think this as a sign of not being able to differentiate between different settlements well. This might be due to alternating settlements, meaning people rotated their settlement places faster than we can track archaeologically and several settling events overlap each other. For the settlement in Zwenkau this has been assumed. There the single farmsteads lie more closely together than the miminum calculated by the kernel density estimation.

**Late Bronze and early Iron Age**: As mentioned before, it is very difficult to seperate the late bronze age and the early Iron age in a settlement context. In this context it seems interesting to me that the early Iron Age features actually do have an influence on the distribution. We have a more widely spread distribution and the minimum in the KDE is by far the smallest value. There are two possible explanations: Either a number of the late bronze age features actually belong into the early iron age and thus the distances recorded here are larger than they should be

or

it is a sign, that settlements grow in the early Iron Age and move closer to each other. But because of the mentioned dating problems I’d rather be careful not to overinterprete this result.

The farmsteads in Zwenkau don’t compare well in size with these values, but better in regards to the distances between settlements.

So, to conclude: Different settlement strategies can be recorded and except for dating problems the suggested site sizes are comparable to known large scale excavations.

# Discussion

To discuss this approach I’ll summarize positive and negatives of this approach.

Positively, transect data is in my opinion a more precise data set to define site sizes than what a survey may offer, because it is independent of visibility issues and less dependant on geomorphology. A direct comparison of the two approaches might be helpful to understand the connection better.

This method is an approach to help with the quantification problem that the German settlement archaeology has discussed. It showcases, that “a site” is not the same as “a settlement”, which, I think, is still quite often conflated.

It can easily be adapted to other kinds of features, e. g. graves, ovens, small-scale settlement shifts by using feautres of consecutive periods or similar.

Of course there are some difficulties remaining:

Especially the dating of the features remains a problem. For statistical analysis, enough features need to be dated as finely as possible as to minimize the time depth in each “time slice” analysed. We need to be aware of seasonally changing settlements within one period.

And of course the “boundary” of a settlement, as defined by the prehistoric people may well lie outside of the built space.

Also, the length of the transect and the number of features might not be enough for reliable calculations, therefore I suggest to test this on different and larger data sets.

# Thank you

Thank you for your attention. I’d be happy to hear your thoughts and questions.

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### Colophon

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