Intrasite Spatial Analysis of the Cemeteries with Dispersed Cremation Burials

Marge Konsa
University of Tartu, Estonia

Abstract:
The aim of this study is to find appropriate methods for the analysis of dispersed cremation burials in order to understand the funerary rituals and the formation of cemeteries. The point pattern data from the 10th–13th century AD cemetery at Madi in Estonia were analysed using several intrasite spatial and geostatistical methods such as autocorrelation, nearest neighbour analysis, point density analysis, and minimum distance analysis. As a result, a new understanding of the funerary rituals performed on the burial place and formation process of the dispersed cremation cemetery is presented.

Keywords:
GIS, Intrasite Spatial Analysis, Point Pattern Analysis, Cremation Burials

1. Introduction

The essential characteristic of dispersed cremation burials is their collective nature and intentional indistinguishability of the individual burials. Burned bones and artefacts are usually scattered over the whole cemetery area in an irregular manner, although some cremation burials may have been put into pit as well. Most of the cremations are not placed in any kind of a container. The intrasite spatial and quantitative methods which are commonly applied for cemeteries with separate individual burials are not suitable for the analysis of dispersed cremations because of the specific nature of the latter.

Cemeteries with dispersed cremation burials were one of the main burial type in Estonia during the Iron Age (500 BC – AD 1225). The structure of the cemeteries varies a lot. Different types of above-ground stone constructions are represented, as well as burials under level ground. Previous research has been mainly concentrated on dating of grave goods and regional overviews of morphology or distribution of the cemeteries (e.g., Laul 2001; Mandel 2003). Intrasite analyses of burial places in Estonia have been made manually relying on simple visual inspection and restricted range of data. Attempts (e.g. Mägi 2002) to distinguish individual burials according to “gendered” artefacts have been unsuccessful because of unreliable methodology.

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2. Madi Cemetery: a Case Study

This research is based on the case study of the 10th–13th century AD cremation cemetery at Madi in Estonia. The cemetery is characterized by the extensive area covered by sparsely located stones which were only weakly visible above the ground. The total area of the cemetery is 1600 square meters of which 65% is excavated. Excavations in Madi were carried out in the 1920s and 1960s, and results remained unpublished. However, the excavations in the 1960s (977m²) were well recorded and can be used for spatial analysis (Figs 1-2). On the excavation plans (scale 1:25) the distribution of artefacts, bones and charcoal was marked with dots that allowed to digitize them as a point data. There was altogether 2477 findspots of artefacts (including 1225 findspots of potsherds), 1603 findspots of bones and 1242 findspots of charcoal (Fig. 3). Amongst the grave goods were iron weapons, tools and
utensils, as well as jewellery of bronze, metal parts of clothing, horse harnesses and riding gear. Most of the artefacts have been fired, and some of them were deliberately damaged (ritually killed). Bones are highly fragmented and calcined. In addition to humans, animal bones are also represented (Engbring 2011). Even though the distribution of bones and charcoal was recorded as point data during excavation, they were collected by 1-m squares.

3. Research Methods

Spatial data of artefacts, bones and charcoal were studied on two levels. First, the material from the cemetery was analysed as point pattern data with the aim to find regularities in spatial distribution. After that, smaller clusters and concentration areas of finds and bones were taken into closer consideration. Different analysis methods were used: autocorrelation, nearest neighbour analysis, point density analysis, and minimum distance analysis. Most of them are historically important methods in spatial archaeology, and they have not lost their value even today (Hodder and Orton 1976; Conolly and Lake 2006).

4. Results of the Intrasite Spatial Analysis

One of the primary methods of point pattern analysis is tests for randomness. The most proven statistic for this is the nearest neighbour index. It compares the distances between the nearest points with the distances that would be expected on the basis of chance (Ripley 1981). According to the nearest neighbour statistic the distribution of artefacts, bones, and charcoal in Madi cemetery was clustered (Table 1).

Density analysis allows one to describe and visualise the changing frequency of observations that occur within a given area,
often to compare different phenomena within the same area or against the same phenomenon in different areas (Conolly and Lake 2006, 173). As a visualisation method the point density with kernel density estimation gives a smooth and easily interpreted continuous surface for cluster identification (op cit, 177). The kernel density maps (Fig. 4) enable comparisons between the locations of clusters of artefacts, bones and charcoal in Madi cemetery. The general distribution area of bones was considerably smaller than those of artefacts and charcoal. Bone finds were situated closer to each other compared with artefacts or charcoal. The mean nearest neighbour distance between bone findspots was 8 cm, between charcoal and artefact findspots respectively 11 cm and 23 cm (table 1). The correlation between distribution of artefacts and charcoal \( (r = 0.5) \) was moderate. A few high density clusters of artefacts and charcoal were overlapping with each other. There was a partial overlap also in the location of high density clusters of bones and charcoal.

The most striking discovery, however, is the difference in distribution pattern of bones and artefacts. The correlation between general distribution of bones and artefacts was very weak \( (r = 0.1) \). Their distribution areas of high intensity clusters don’t overlap with each other. Described results reveal that the cremated bones have been distinguished from the rest of the pyre remains and treated separately from grave goods. This inference does not support the interpretation of funerary rituals expressed in previous studies according to which individual burials could be identified based on distribution of the artefacts (Mägi 2002). The northwest-southeast orientation of the high intensity clusters area of bones in Madi coincides with the general orientation of the cemetery (Fig. 1). Thus, the bones were placed mainly in the central part of the cemetery while the highest concentration of grave goods was along the edge areas.

Autocorrelation Moran’s I statistic was used to examine the spatial formation of the cemetery at Madi. Spatial autocorrelation indices identify whether point locations are spatially related. If neighbouring locations tend to have similar values to each other, then the spatial variable is said to exhibit positive spatial autocorrelation. On the other hand, if they tend to be different, then the variable is said to exhibit negative spatial autocorrelation (Wheatley and Gillings 2002, 118). At Madi cemetery there was a negative autocorrelation in the spatial distribution of well-dated artefacts. It could mean that the majority of the cemetery area was in constant use and grave goods from different time periods were lying next to each other.

Spatial co-occurrence of artefact types was studied with minimum distance analysis. With the help of the distance calculator tool the pairs of objects with closest distance were identified. Within distance\(^2\) up to 20 cm the most frequently occurring combination was pairs of

<table>
<thead>
<tr>
<th>Data set</th>
<th>Sample size</th>
<th>Mean nearest neighbour distance (m)</th>
<th>Mean random distance (m)</th>
<th>Nearest neighbour index ( (R) )</th>
<th>Z – test statistic</th>
<th>Distribution pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Artefacts</td>
<td>2477</td>
<td>0.23</td>
<td>0.34</td>
<td>0.6766</td>
<td>-30.7958</td>
<td>clustered</td>
</tr>
<tr>
<td>Bones</td>
<td>1603</td>
<td>0.08</td>
<td>0.37</td>
<td>0.2151</td>
<td>-60.1227</td>
<td>clustered</td>
</tr>
<tr>
<td>Charcoal</td>
<td>1242</td>
<td>0.11</td>
<td>0.48</td>
<td>0.2224</td>
<td>-52.4930</td>
<td>clustered</td>
</tr>
</tbody>
</table>

Table 1. The result of the nearest neighbour analysis.

\( ^2 \) The studied distance was determined on the basis of comparative data from other cremation cemeteries (Mandel 2003).

![Figure 4. Kernel density estimates of the artefact (1), bone (2) and charcoal (3) distribution in Madi cemetery. Diameter of 2-m radius.](image)
different types of jewellery (fragments of breast chains, bracelets, neck rings, decorative pins, and brooches), as well as a combination of a knife and jewellery. These items were probably together on the same pyre and were placed afterwards into the burial ground as one unit. Similar combinations of artefacts are common grave goods in inhumation burials from the same time period.

The distribution pattern of different artefact types was studied with nearest neighbour statistic. Their distribution was mainly clustered or random. Within this general pattern there were only two exceptions – the distribution of knives and strike-a-lights was regular. Altogether 77 knives and 22 strike-a-lights have been found in Madi. The high number of knives is not surprising as they are the most common grave-goods found in 10th–13th century AD burials in Estonia, while a large quantity of strike-a-lights in Madi is exceptional compared to the other cemeteries. The phenomenon of regularity in distribution of grave goods is difficult to explain.

With smaller data sets, it was possible to draw conclusions based on simple visual inspection. For example the location of the dog bones and bear claws is noteworthy (Fig. 5). They were distributed only in a certain part of the cemetery. Seven bear claws out of ten were found in the same cluster with dog bones. It is likely that the bear claws could originate from bear-skin shrouds as there are no other bear skeletal elements present (Engbring 2011; Schönfelder 1994). Dog bones are found in many Estonian cremation cemeteries, while bear claws are rare (Maldre 2003).

The total number of burials must unfortunately remain open. There were a minimum of seven individuals buried, based on the osteological analysis (Engbring 2011). It is a very small number compared to the amount of grave goods found in the cemetery. It is possible that the missing bones have been deposited elsewhere, or some artefacts could be additional offerings besides grave goods, although the amount of artefacts which have not been in the fire is modest.

5. Conclusions

There is a long tradition of successful applications of point pattern analysis in settlement site studies. This paper was the first attempt to use similar methods in the research of the cemeteries with dispersed cremation burials.

The results of the case study show that the distribution of artefacts, bones, and charcoal was clustered in the cemetery at Madi. The correlation between general distribution of bones and artefacts was very weak. Apparently the cremated bones have been distinguished from the rest of the pyre remains and treated separately from grave goods. The bones were placed mainly in the central part of the cemetery while the highest concentration of grave goods was along the edge areas. There was a negative autocorrelation in the spatial distribution of well-dated artefacts, which could mean that the majority of the cemetery area was in constant

Figure 5. Distribution of dog bones and bear claws.
use over two centuries. Artefacts with closest distance were different types of jewellery, and combination of a knife and jewellery. These items were probably together on the same pyre and were placed afterwards into the burial ground as one unit.

Thus, with the help of intrasite analysis it was possible to identify general patterns in the treatment of cremains (i.e. pyre remains), as well as to find out the variability in burial practices. As a result, we now have a better understanding of the formation of this type of cemetery and more information of the funerary rituals performed at this burial place. The methods used for the analysis of the cemetery at Madi can be applied to other similar sites as well.

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References


