# Low Density Lithic Artefact Scatters: Consideration of the Impact of Sampling Strategy

**JOHN POUNCETT**

Institute of Archaeology, Oxford University

## ABSTRACT

*Field walking methodologies and collection policies are problem-oriented. Recent academic discourse has highlighted both intrinsic biases within surface artefact scatters and extrinsic errors introduced by sampling strategies. Methodologies have largely focused on the role of surface artefact survey as a form of archaeological prosecution, typically seeking to identify high density scatters that could be equated by "sites". Alternative approaches are required to analyse spatial differentiation in the distribution of surface artefacts. The aim of this paper is to quantify the impact of sampling strategy on the analysis and interpretation of low density lithic scatters.*

## 1. INTRODUCTION

The widespread adoption of "off-site" approaches (Foley, 1981) has witnessed a shift from methodologies based on the rigid distinction between "sites" and the "background scatter" towards those related to the interpretation of differential patterning in the distribution of surface artefacts. Discussions of sampling in surface artefact survey are dominated by consideration of optimal strategies for identifying large concentrations of artefacts, i.e. sites. Little attention has been given to the impact of sampling strategy on the interpretation of low density surface artefact scatters.

Archaeologists have increasingly recognised the potential of GIS in the analysis of the results of surface artefact survey. Geostatistical techniques and data interaction models are routinely used to investigate spatial patterning within the distribution of surface artefacts. The probability of detecting discrete lithic scatters using different sampling strategies can be assessed statistically (Sundstrom, 1993). Implications for more extensive scatters, however, are poorly understood. This paper simulates the results of grid and transect-based sampling strategies using a dataset from Toisland Wold.

## 2. SURFACE ARTEFACT SURVEY

An extensive scatter of worked flint, representing past human activity from the Mesolithic onwards, has been identified on Toisland Wold in eastern Yorkshire. Prehistoric activity in the locality is well documented. Two dispersed late Neolithic and Bronze Age barrow cemeteries were excavated on Toisland Wold during the late nineteenth century. Several of the barrows within these cemeteries were incorporated into later linear earthworks. These earthworks define a sub rectangular enclosure that has tentatively been interpreted as a "prehistoric estate".

Surface artefact survey carried out by the Wharram Research Project has focused on the area to the south of Toisland Pond (Fig. 1). Residual Neolithic occupational debris was incorporated into the fabric of the burial mound immediately to the south west of the pond. Intensive survey was undertaken along a corridor 300 m long and 100 m wide. Saturation coverage was obtained by a series of transects 2 m apart, marked at 10 m intervals. Each transect was subsequently re-walked in the opposite direction. The surface of the site had been allowed to weather after the last episode of ploughing. Surface visibility and light levels were good at the time of the survey. Experienced personnel were used to ensure maximum recovery of worked flint. Artefact locations were recorded by EDM.

## 3. METHODOLOGY

A 120 m by 80 m subset of the survey data was selected to simulate a range of sampling strategies commonly employed in surface artefact survey. This subset is typical of low density lithic scatters recorded in areas of prehistoric activity. Tools and trimming flakes within the scatter can be attributed to casual loss or impromptu knapping. The high frequency of flake debitage and exhausted cores, however, suggest more systematic stone working. Whilst spatial differentiation of these activities may be identified using statistical techniques, meaningful analysis is only possible once the biases introduced by different sampling strategies have been eliminated.

Polygons have been generated to simulate collection units for common sampling strategies using the Toisland Wold dataset. Arbitrary collection units, based on the British National Grid (OSGB36), were used to eliminate bias towards an individual phase of activity (c.f. Woodward, 1978). Artefact frequencies were calculated for each collection unit using spatial queries and were subsequently standardised by surface area. Resultant artefact densities were attached to the centroids of each collection unit. Continuous surfaces were generated from these points to allow analysis and comparison of the results of different sampling strategies.

## 4. SAMPLING STRATEGIES

A 10 m grid is considered to represent an optimal sampling strategy for identifying spatial patterning within a lithic artefact scatter (Fig. 2). Whilst larger collection units will identify broader patterning in the organisation of stone working, localised variation indicative of knapping clusters or middening activity will be obscured. Smaller collection units do not take into account the dispersal of artefacts induced by tillage-processes (Boismier, 1997). An average density of 0.0265 artefacts per m² was obtained for the 10 m grid squares. This figure is very low, however it is estimated that only 4 or 5% of material within the plough zone is visible on the surface at any given time (Ammerman, 1985).
Although grid methods provide saturation coverage of a survey area, they are time intensive and are often employed on smaller scale surveys. Sampling strategies based on transects are consequently used in more extensive surveys. Transects 10 m apart, with collection units spaced at 20 m intervals, are typically used to strike a balance between coverage and intensity (Fig. 3). Artefacts are collected from a corridor 1m either side of the centre line of each transect, equating to a 20% sample of the material exposed on the surface of the site. The average density per unit area, 0.0527 artefacts per m², generated by this sampling strategy is markedly different to that for the dataset as a whole.

## 5. POTENTIAL CONSIDERATIONS

### 5.1. TRANSECT VARIABILITY

Discrepancies introduced by sampling strategies can have a dramatic impact upon the interpretation of data from surface artefact survey. It is important to realise that the artefact distribution obtained using a sampling strategy is not representative of the total population. Even where saturation coverage has been obtained, experiments have shown that an area must be surveyed on multiple occasions to obtain a representative sample of the material within the plough zone. Vertical offsets were applied to the transect simulation above. Correlation coefficients for the resultant continuous surfaces show marked variation in the interpolated data (Table 1).

TABLE 1
Correlation coefficients for vertical offsets applied to transect simulation

| | 0 m | 1 m | 2 m | 3 m | 4 m | 5 m | 6 m | 7 m | 8 m | 9 m |
|---|---|---|---|---|---|---|---|---|---|---|
| **0 m** | 1.00 | 0.36 | 0.17 | 0.19 | 0.27 | 0.38 | 0.24 | 0.02 | -0.19 | 0.05 |
| **1 m** | 0.36 | 1.00 | 0.33 | -0.03 | -0.08 | 0.07 | 0.10 | 0.01 | -0.20 | -0.17 |
| **2 m** | 0.17 | 0.33 | 1.00 | 0.54 | 0.09 | 0.29 | -0.04 | 0.01 | 0.01 | 0.06 |
| **3 m** | 0.19 | -0.03 | 0.54 | 1.00 | 0.70 | 0.48 | 0.05 | -0.17 | -0.06 | 0.20 |
| **4 m** | 0.27 | -0.08 | 0.09 | 0.70 | 1.00 | 0.47 | 0.09 | -0.15 | -0.23 | 0.00 |
| **5 m** | 0.38 | 0.07 | 0.29 | 0.48 | 0.47 | 1.00 | 0.66 | -0.18 | -0.22 | 0.35 |
| **6 m** | 0.24 | 0.10 | -0.04 | 0.05 | 0.09 | 0.66 | 1.00 | 0.23 | -0.09 | 0.21 |
| **7 m** | 0.02 | 0.01 | 0.01 | -0.17 | -0.15 | -0.18 | 0.23 | 1.00 | 0.60 | -0.05 |
| **8 m** | -0.19 | -0.20 | 0.01 | -0.06 | -0.23 | -0.22 | -0.09 | 0.60 | 1.00 | 0.38 |
| **9 m** | 0.05 | -0.17 | 0.06 | 0.20 | 0.00 | 0.35 | 0.21 | -0.05 | 0.38 | 1.00 |

### 5.2. GEOSTATISTICAL TECHNIQUES

The potential of geostatistical techniques, such as kriging, for the analysis of surface artefact data has been widely recognised (Ebert, 2001). Kriging of the transect data produced dramatically different results to the grid data, despite the use of identical parameters. This difference can in part be attributed to pronounced "spiking" in the semivariogram generated as part of the kriging process as a result of the use of different intervals between transects and collection units. "Spiking" can be eliminated by calculating weighted averages for intermediate points along transects before kriging, or by using raster algebra to average interpolated values obtained from alternative transects (Fig. 4).

### 5.3. DATA INTERACTION MODELS

Underlying spatial structures within the distribution of lithic artefact scatters can be identified using data interaction models. These models employ distance decay curves based on interaction intensity (Taylor 1975). Interaction intensity is a function of distance. Abstract centred interaction fields were created for the sampling strategies simulated using the Toisland Wold dataset (Fig. 5). Points were generated from the centroids of each collection unit. The frequency of sample points relative to distance, and consequently the interaction intensity, is different for the two sampling strategies. Distance decay curves should therefore be modified to fit the sampling strategy.

## 6. CONCLUSION

Simulation of sampling strategies using the Toisland Wold dataset has identified a series of considerations for the analysis and interpretation of low density lithic artefact scatters. Transect-based sampling strategies are commonly employed in surface artefact survey. In contrast to grid-based strategies, transects only recover a proportion of the material visible on the surface of a site. Transect data is nevertheless useful, providing that the errors introduced by sampling are properly understood.

## REFERENCES


AMMERMAN, A. (1985) – Plow-zone experiments in Calabria, Italy. *Journal of field archaeology*. 12(1), p.63-88.

BOSIMIER, W. (1997) – Modelling the effects of tillage processes on artefact distribution in the ploughzone – a simulation study of tillage-induced pattern formation. British Archaeological Reports British Series 259. Oxford: *Archaeopress*.

EBERT, D. (2001) – The potential of geostatistics in the analysis of fieldwalking data. In WHEATLEY, D.; EARL, G., POPPY, S. (eds.) – *Contemporary themes in archaeological computing*. University of Southampton Department of Archaeology and Prehistory Monograph 3. Oxford: Oxbow Books, p. 82-89.

FOLEY, R. (1981) – A model of regional archaeological structure. *Proceedings of the prehistoric society*. 47, p. 1-17.

SUNDSTROM, L. (1993) – A simple mathematical procedure for estimating the adequacy of site survey strategies. *Journal of field archaeology*, 20 (1), p. 91-96.

TAYLOR, P. (1975) – Distance decay models in spatial interactions. Norwich: Geo Books.

WOODWARD, P. (1978) – A problem-orientated approach to the recovery of knapped flint debris – a fieldwalking strategy for answering questions posed by site distributions and excavation. In CHERRY, J.; GAMBLE, C.; SHENNAN, S. (eds.) – Sampling in contemporary British archaeology. British Archaeological Reports British Series, 50. Oxford: *British Archaeological Reports*, p. 121-128.


## FIGURES

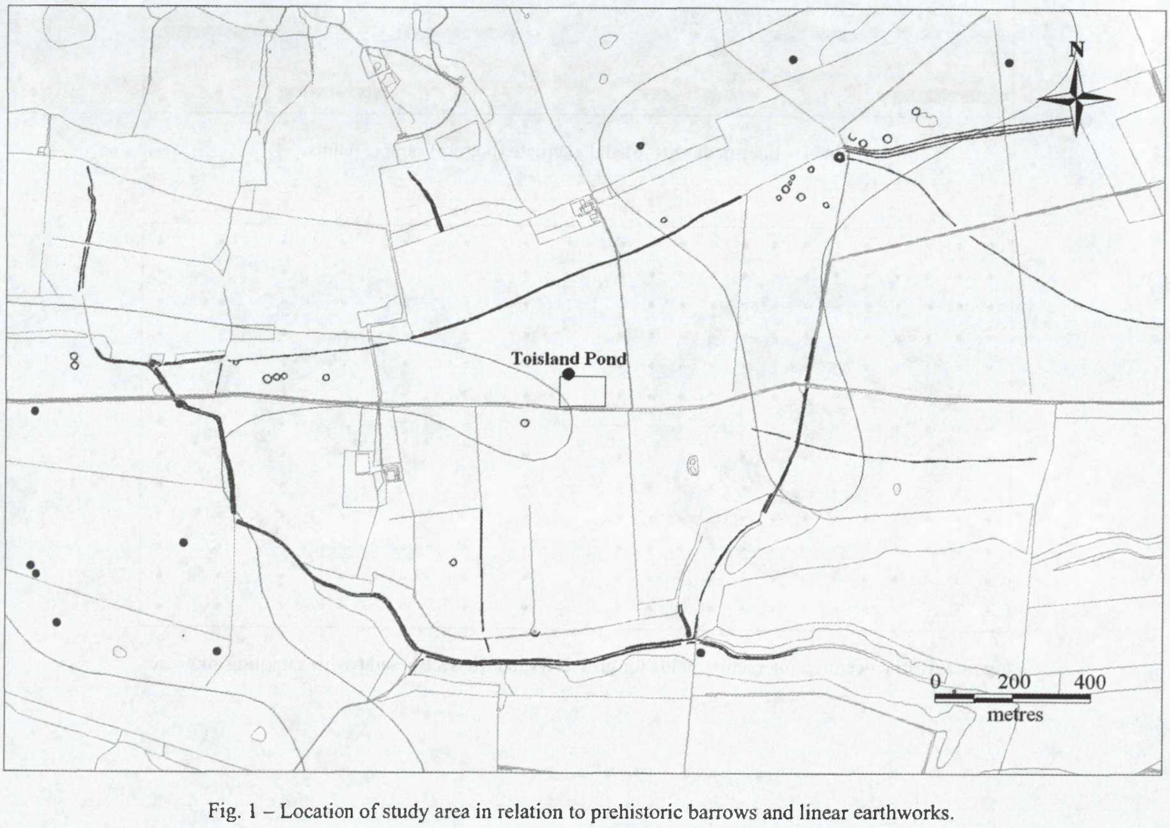


Fig. 1 – Location of study area in relation to prehistoric barrows and linear earthworks.

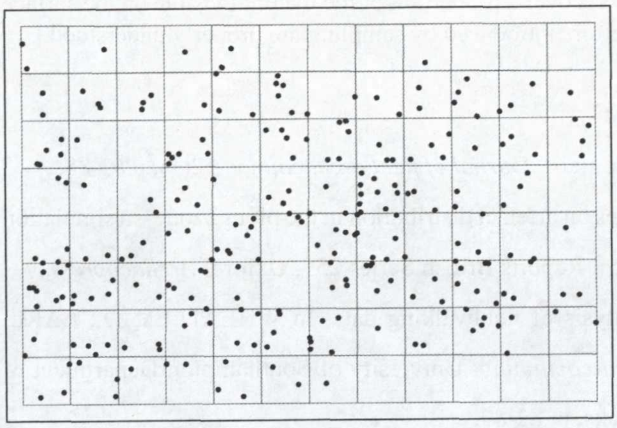
Fig. 2 – Grid simulation for the Toisland Wold dataset.

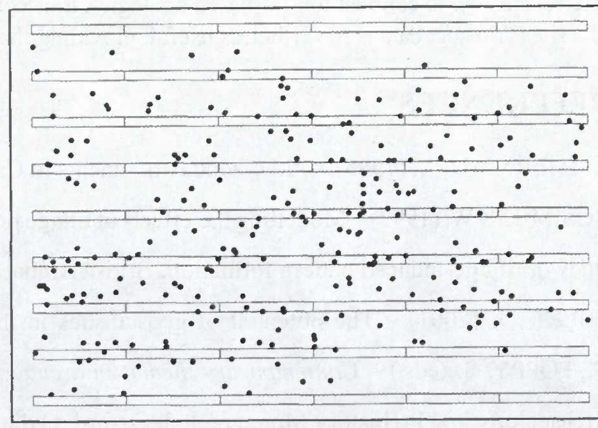
Fig. 3 – Transect simulation for the Toisland Wold dataset.

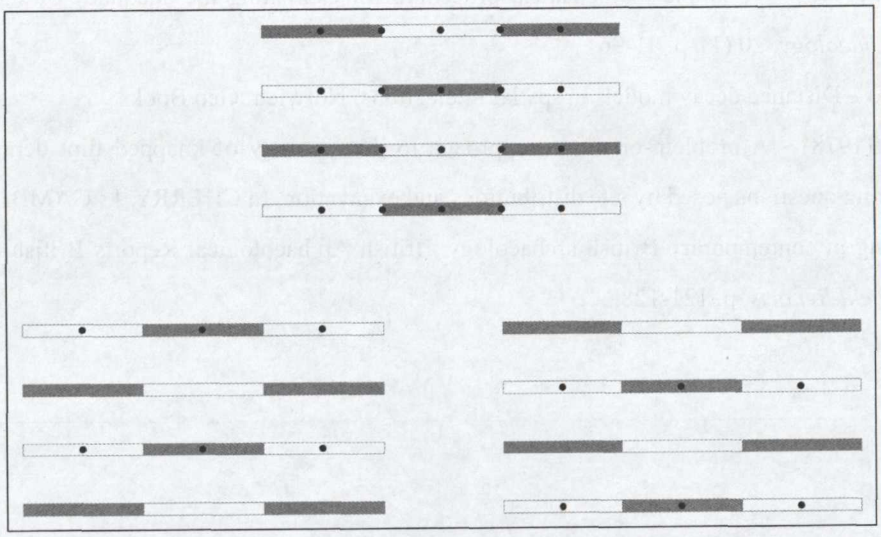
Fig. 4 – Intermediate (top) and alternate (bottom) sample points.

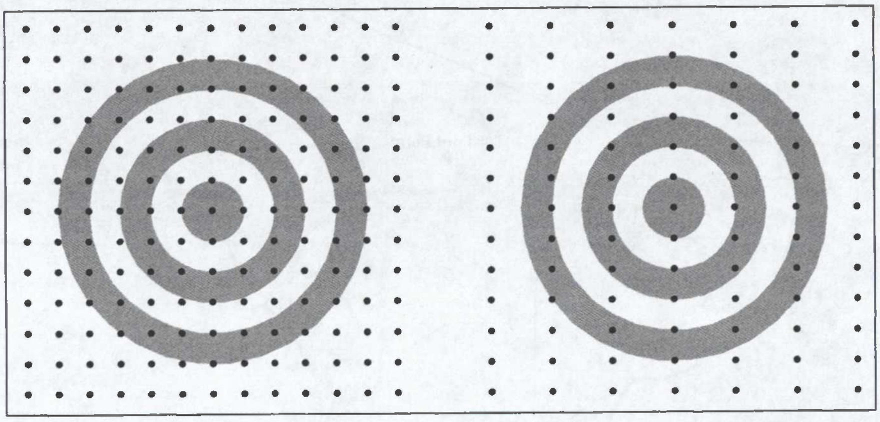
Fig. 5 – Abstract centred interaction fields for grid (left) and transect-based (right) sampling strategies.