Recording Methods Redesigned:
Comparison of Recording Methods and Resultant Archaeological Interpretations Using Single Context Pre-Boreal Case Studies from Blekinge, Sweden

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Abstract

This thesis aims to explore how specific digital field recording methods impact archaeological interpretation based on the case studies presented. Individual find recording, a more specialized digital point proveniencing system, was used in both case studies. The original excavation interpretations are compared against new interpretations based on the reconstructed excavation unit style recording to reveal the difference in interpretation based on methodology. Additional research goals of the thesis include: identifying under what specific conditions the individual find recording method is best suited and the impact of methodology on archaeological interpretation. Two case studies will be provided that both utilize this method for the recording of flint finds. These datasets are redesigned, applying an artificial grid over the spatial distribution of individual finds for reinterpretation. The dataset is then reanalyzed by measures of density and frequency. The findings of the redesigned excavation are compared against the original findings in an attempt to identify best practices in specific cases. Throughout the thesis there is an emphasis on the methodological value of forethought in excavation design and the thesis conclusion is meant to serve as a summation of these values.

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Table of Contents

Figures

Introduction

The following thesis explores how digital field recording methods impact archaeological interpretation based on the case studies presented. The project utilizes case studies of individual find recording or digital point proveniencing as a method of archaeological fieldwork. Individual find recording requires virtually all finds to be independently recorded digitally, then analyzed to provide a more in-depth analysis of the spatial distribution of specific artifacts using a geographic information system (GIS). The thesis project involves redistributing the spatial distribution of artifacts amongst artificial excavation units to compare how the excavation and recording methods used in archaeological investigations impact the resulting interpretation. Throughout the thesis there is an emphasis on the methodological value of forethought in excavation design and the analytical portion is intended to provide evidence for the impact of recording methods on archaeological interpretations. The consequential impact of recording and excavation methods on archaeological interpretation is clarified in the discussion section.

Aims and Research Questions

The methodology behind why decisions are made in the field is much more complex than they first appear and the variation in styles across both geographic regions and interest periods is significant though often overlooked in archaeology (Wylie 2002, Taylor 2008). There has been a recent increase in interest in the archaeology of archaeology: the study of the archaeologist and archaeological process (Olsen et al. 2012. Leighton 2015). This thesis will take two datasets provided by the original contract archaeologists and redesign an excavation plan around them. The goal of this project is to understand how the digital recording methods used in the case studies impacted the archaeological interpretation; and how more traditional excavation methods would be interpreted based on the same dataset. Additionally, the thesis aims to present some of the conditions under which individual finds recording is best suited given the parameters of the case studies. The conditions used in these case study examples have good preservation, limited surface disturbances, singular contexts, and low artifact type variation.

Materials and Methods

The following section will provide an overview of the methods and materials utilized in this project. To begin the excavation redesign and analysis process will be outlined as it pertains to the thesis project. The digital tools subsection includes a brief overview of the three main digital methods employed in the case study analysis: real-time kinematic global positioning systems (RTK GPS), total stations, and geographic information systems (GIS); this subsection will note the key benefits and limitations of these specific tools as well as the more general topic of digital tools in archaeology. To follow, the individual finds recording method, source materials and limitations are presented. Analytical methods employed only by the original archaeologists involved in the analysis of the case study datasets are outlined in the analysis section. The methods presented here apply to the thesis project directly.

ArcGIS Excavation Redesign

The excavation recording redesign was done using ESRI's ArcGIS, ArcMap tool. To begin, the dataset provided by the original excavators containing a boundary shapefile, individual point map and associated database was uploaded into the GIS program. The files were then assigned data frame properties relating to the projection method used in the original recording. The fishnet tool was used to create two grid systems representing 1metre units and 50centimetre units across the boundary shapefile for each case study. A spatial join was then used between the individually recorded find points and the new unit grid. The calculation was run counting point per grid unit polygon to measure the amount of individual finds point recorded per new unit. Graduated symbology was then applied to create a visual scale of the density variation between squares. The re-arranged finds were then displayed on a map for recording and publication purposes. Once analyzed, the new interpretation of the archaeological data based on the redesigned data was compared against the original interpretations based on the individual find recording method. This comparative analysis was selected as it provides clear results to the research questions regarding how archaeological interpretation varies as a result of methodology.

Digital Archaeology

Technological innovations have spurred on archaeological advances since the earliest days of the discipline (Daly 2006, Yarrow 2008). Archaeologists are often employing new methods and tools in an attempt to understand complex and otherwise unanswerable issues (Wheatley & Gillings 2002). Digital archaeology has become a sub-discipline within archaeology that heavily focuses on the use of digital methods – however, this approach does not operate without considerable critique (Daly 2002). The most pressing oppositional concerns towards the digital archaeology movement surround the specialist nature of using advanced technology (Morgan & Wright 2018, Huggett 2015a, 2015b, Llobera 2012). Archaeologists employing complex methods must be aware of the operations they are using rather than falling victim to the technological black box (Huggett 2015a, 2015b). By simply selecting an option, complex analytical processes may be engaged and without fully understanding the action the archaeologist can lose touch with the material (Huggett 2015a, 2015b, Morgan & Wright 2018). This can further lead to issues in accuracy and authenticity both in terms of user error and reader error (Huggett 2015a, 2015b, Morgan & Wright 2018). User error can come from a variety of sources including issues with the dataset, issues with the tools of acquisition, the software and inadvertent bias (Huggett 2015a, 2015b). Reader error, in turn, can come from the material being presented in an overly complex, unreadable way or that the data has been simplified to an extreme that renders the results less impactful (Huggett 2015a, 2015b). There are of course ways to mitigate these negative concerns. Most notably, with digital archaeology gaining traction since the 1980s and popularity throughout the 2000s archaeologists are becoming much more knowledgeable about digital methods (Daly 2006, Cobb et al. 2012). Additionally, the technology itself has developed greatly over the last several decades and now features more simplistic user interfaces, capable of much more complex analysis (Wheatley & Gilling 2002).

Global positioning systems (GPS) are navigational systems supported by a series of satellites (Fitts 2005, Deo & Joglekar 2008). These satellites connect with GPS equipped units to provide 2D and 3D positioning through longitude, latitude and altitude. For the purposes of the thesis project, 2D and 3D data was collected using GPS. Both case studies employed real-time kinematic (RTK) GPS. This specific GPS has accuracy to within 1 centimetre (Fitts 2005, Deo & Joglekar 2008). These RTK GPS systems also have very fast output processing speed which makes them especially useful for the recording of individual finds for spatial analysis and general field recording (Tripcevich & Wernke 2010). GPS have been used in archaeology for many decades as the technology is not especially new (Fitts 2005, Wheatley & Gillings 2002, Deo & Joglekar 2008). However, major advancements have been made since the 2000's allowing for higher accuracy, lower cost and a more simplistic user interface (Fitts 2005, Deo & Joglekar 2008).

The Total Station is a complex surveying tool that combines an electronic distance meter and an electronic theodolite (Schneider & Panich 2008, Kavanagh et al. 1996). The electronic distance meter reads the slope distance of a point from the location of the instrument (Kavanagh et al. 1996). The electronic theodolite, in turn, measures the horizontal and vertical plane angles (Kavanagh et al. 1996). These functions in combination with one another allow for the specific location of a point to be recorded with extremely high accuracy (Kavanagh et al. 1996, Tripcevich & Wernke 2010, Mcpherron 2005). The total station requires a clear line of sight between the instrument and the point taken (Kavanagh et al. 1996). Older models require at least two users to record a single point (Tripcevich & Wernke 2010). Newer models require only one user to record points (Tripcevich & Wernke 2010). Some newer total stations are equipped with image capture capabilities which could cut down on the need for field photos (Tripcevich & Wernke 2010). Total Station recordings can be directly inputted into mapping software such as GIS outlined below. The Swedish National Heritage Board created Intrasis as a digital data acquisition system that is able to integrate total station files into a database system available for archaeologists across the country (Tripcevich & Wernke 2010). The total station was used in both case studies when vegetation coverage became problematic.

Geographic Information Systems (GIS) are computer-based data collection systems that allow for the capture, storage, manipulation, analysis, management and presentation of geospatial data (Dickie 2019, Peterman 1992). GIS have had a tremendous impact on archaeology since the 1980s; allowing for a wide array of different mapping solutions to assist in archaeological interpretations (Hacigüzeller

2012, Tripcevich 2004). GIS are capable of fitting many different niche needs and are easily tailored to fit specialized fields such as archaeology (Wright et al. 1997, Wheatley & Gillings 2002). The most notable contributions of GIS to archaeology related to the new methods of analysis and data presentation (Gillings 2015, Verhagen & Whitley 2012). The thesis project heavily relies on GIS for analysis and data presentation.

Individual Find Recording

The fieldwork method of recording individual find has been used sporadically in Swedish archaeology (Björk et al. 2014a, 2014b). This method requires high accuracy GPS equipment or a total station to record the specific spatial data for excavated archaeological material (Björk et al. 2014a, 2014b). This method is also referred to as point proveniencing which is defined as the process of recording the absolute spatial values of an artifact (Lyman 2012). Recording point provenience has been frequently employed since the earliest Scandinavian archaeological inquiry (Lyman 2012, Worsaae 1849). These earliest applications required a known datum point to be recorded then individual finds or features would be recorded based on the relational location (Lyman 2012). Individual find recording as is discussed in this thesis employs much more advanced digital tools and methods of analysis but follows similar root structures regarding archaeological association and context. This method additionally requires archaeologists in the field to be familiar with both the methods of excavation and methods of digital recording (Huggett, 2013). Because virtual each artifact is recorded independently, the finds require an expansive database, digital storage allowance and physical storage space to ensure the maintained organization of each individual find (Gowlett 1997, Huggett, 2013, Motz & Carrier 2013).

Sources and Limitations

Both of the case studies included in this thesis were graciously provided by Sydsvensk Arkeologi AB and the Blekinge Museum. The datasets were recorded by the contract archaeologists and the referenced archaeological reports were published in collaboration between both parties (Björk et al. 2014a, 2014b). All other cited material was acquired through academic journals and recently published literature. Because the datasets were not recorded first hand there is a limited amount of control held over them. The datasets were recorded using RTK GPS and Total Station and analyzed largely through GIS (Björk et al. 2014a, 2014b). Both of these digital field recording methods present unique benefits and limitations to archaeology. The original excavation plan for both case studies intended to use RTK GPS to record the specific geospatial data of each artifact; however, due to the presence of vegetation the RTK GPS was not able to function appropriately and alternative methods had to be employed utilizing the Total Station (Björk et al. 2014a, 2014b).

The most notable limitations associated with the use of GPS in field archaeology are associated with signal issues (Deo & Joglekar 2008, Fitts 2005). RTK GPS requires a base site to be maintained within the range of the recording handheld device (Deo & Joglekar 2008, Chapman & Van de Noort 2001, Ladefoged et al. 1998). This signal can be obstructed in a variety of ways including atmospheric activity, physical barriers and radio interference (Chapman & Van de Noort 2001, Ladefoged et al. 1998). In addition to signal obstruction battery failure also poses a significant limitation to the use of GPS in field archaeology (Deo & Joglekar 2008, Chapman & Van de Noort 2001, Ladefoged et al. 1998.

Total stations were used in both case studies to aid in the individual recording of finds after handheld GPS were unable to record all points (Björk et al. 2014a, 2014b). Total stations are hugely beneficial surveying tools but they present several significant limitations within field archaeology applications (Kavanagh et al. 1996, McPherron 2005, Martens 2005). A total station requires a known coordinate system to work within or an artificial grid system to place points within (Kavanagh et al. 1996). This is not a common issue in Swedish archaeology as comprehensive coordinate data is available covering the country though it poses a significant issue to archaeological fieldwork in other parts of the world where such data is not freely available. The most notable limitation to the total station comes from the physical device itself. The total station is quite a fragile piece of equipment that requires considerable care and calibration (Kavanagh et al. 1996, Martens 2005). The devices additionally require physical stability and visibility to function properly (Kavanagh et al. 1996, Martens 2005). The total station is a notoriously costly piece of equipment and requires a skilled user to operate effectively

(Kavanagh et al. 1996). Beyond requiring a skilled operator, the total station does not offer a simple way to check work in the field - instead, it requires the user to upload data into a GIS to ensure points have been recorded appropriately after the fact (Kavanagh et al. 1996, Martens 2005).

Theoretical Background and Framework

The thesis relies heavily on a theoretical framework to explore the impact of methodological decision making on archaeological interpretation. The following chapter will present the theoretical framework of the thesis project and explore the digital turn in archaeology, the new archaeology movement, critical processualism and reflexive theory. These theories will be presented in a general chronological order intended to represent the academic evolution of archaeological practice. Each subsection will provide a brief overview of the history and general concept followed by the practical application of each to the case studies.

Theoretical Framework

The theoretical framework behind the thesis project touches on the following theoretical perspectives. The research questions explore how recording methods influence the archaeological interpretation of spatial distribution patterns by reanalyzing two case studies. By reviewing academic articles of field recording methods, particularly digital methods, and the consequential interpretations a conceptual framework is established of basic interpretation values. The thesis uses graduated visual density modelling to scale the values of finds per unit. This is the most common method for visualizing artifact density values in archaeology. The new interpretations of the case study data are compared against the original excavation findings to illuminate the effects of field methodology on interpretation. This framework is intended to reveal how the specific digital recording methods used in each case study impacted the archaeological interpretation by comparing the original findings against the redesigned excavation results. This comparison, in turn, serves as the basis for understanding how methodology impacts interpretation.

The digital turn in archaeology saw the introduction and adaptation of digital methods into archaeology to fit unique niche interests. This thesis further explores how digital field recording methods impact our interpretations of the archaeological record. New archaeology and critical processualism are embraced in the thesis as the project relies on an understanding of static spatial data to re-interpret the archaeological record. This reinterpretation then allows for a critical processualist outcome, citing both the benefits and limitations of such field methods as well as providing a reflexive foundation. The thesis project is reflexive in that it seeks to understand how the decisions made by the archaeologist in the field impact the interpretation of archaeological data.

The Digital Turn

The digital turn in archaeology represents a major shift in the archaeological use of digital methods (Huggett 2013). This is not a traditional theoretical standpoint but it does contribute to the interpretation of the additional theories below. There is considerable recent criticism over the potential over-application of digital methods in archaeology citing that the use of digital methods, especially in recording, separates the archaeologist from the study material which in turn creates less meaningful results (Huggett 2013). Archaeology as an academic discipline is eager to employ new digital methods in an attempt to answer questions otherwise challenging to answer (Gowlett 1997).

Both case studies employ digital field recording methods, more so than are used on most excavation projects. The individual find recording method utilizes GPS and total station to record the spatial coordinates of each archaeological find. These datasets are then analyzed and assessed using a digital database and geographic information system. The thesis project redesign further relies heavily on digital methods for the reinterpretation of a digital dataset. It is especially important when using digital methods to maintain a connection with the archaeological record to avoid the researcher distancing from the study material and broader context (Huggett 2013).

New Archaeology

New archaeology emerged under the processualist school of thought but varies slightly from the common preconception of processualism (Wylie 2002). Processualism emphasizes the use of static data to interpret archaeology finds (Binford 1968). This concept will be further developed in the following section. New archaeology stresses the value of problem-oriented, quantitative analysis as tools for interpreting the cultural and behavioural motivations behind archaeological deposits (Rice 1985, Wylie 2002). The new archaeology movement was rooted in statistical query, much like processualism, but also ethnoarchaeology which is more commonly associated with post-processual movement (Wylie 2002). This shift to the acquisition of statistical data resulted in enormous datasets requiring analysis to understand (Wylie 2002). Additionally, new archaeology stresses the importance of testing hypotheses to understand cultural history (Rice 1985, Wylie 2002).

The original excavations had a research goal surrounding the interpretation of spatial data to understand the cultural and behavioural experience of the early Mesolithic site occupants (Björk et al. 2014a, 2014b, Persson & Knarrstöm 2018). Much of the original interpretation was based on the understanding of similar sites in the region, this interpretive method echoes that of ethnoarchaeology in terms of understanding cultural traits though it does not include ethnoarchaeological practice (Björk et al. 2014a, 2014b). The thesis project sought out to test the hypothesis put forward by the original excavators regarding the visibility of spatial patterning through specific data recording methods, another key feature of new archaeological theory (Wylie 2002, Persson & Knarrstöm 2018).

Critical Processualism

Critical processualism is a theoretical subset of post-processualism that focuses on the critical approach to processualist theory (Earle et al. 1987). This theory stresses that while processualist theory has merit, without taking a reflective, critical approach the findings are less meaningful (Earle et al. 1987). Critical processualism notes that static data acquisition often cannot be used as an interpretive tool for much of the archaeological record and clouds the interpretive ability of the researcher (Patterson

1989). The thesis project took a static dataset and reinterpreted it, using a somewhat processualist approach to perform a critical analysis on the use of static datasets.

Reflexive Archaeology

Reflexive archaeology is a theoretical perspective that emphasizes the personal position of the archaeological investigator in the web of personal understanding of archaeological material (Hodder 2000). This theory requires the archaeologist to actively consider how their own position in the work impacts their interpretations (Hodder 2000). The archaeologist is required to reflect on their own academic background, personal understanding, bias and presuppositions in the process of archaeological interpretation (Hodder 2000). Approaching archaeology from this reflective perspective is meant to allow for an increase in awareness between the archaeologist, study field and material culture as well as the discourse between each party (Hodder 2000).

The original excavators attempted to employ the most objective perspective possible when approaching the excavation (Björk et al. 2014a, 2014b, Persson & Knarrstöm 2018). This is a highly reflexive consideration to apply to excavation design and research planning in that the original excavators considered how their own position within the archaeological framework could impact the results. Additionally, the thesis redesign was deeply rooted in a reflexive approach. Serious thought was given to how the excavation was originally interpreted, as well as how personal understandings of archaeological practice could be applied in a genuinely beneficial way to allow for a meaningful result.

Archaeological Process and Practice

Archaeological practice pertains to the ways in which archaeology is performed; in both contract and research capacities (Olsen et al. 2012, Leighton 2015). Archaeological practice has a rich history and has evolved greatly over the last several centuries. The most notable changes to archaeological practice are evident in the shift from the 18th and 19th-century conceptions of archaeology as a means of acquiring artifacts for collection and display to the early 20th-century expansion of interest into fieldwork as a method of collecting not only artifacts but also data for further study (Abadia 2013, Fitzpatrick 2018). This focal redirection allowed for the material to be rooted in context rather than collection (Abadia 2013). With this change in archaeological practice, there was also a major shift in the approach to archaeological fieldwork (Abadia 2013). During the 18th and 19th centuries fieldwork was conducted almost entirely by unskilled labourers often in foreign parts of the world (Abadia 2013, Paynter 2003). As the desire to understand the material record contextually grew, fieldwork became more skilled coming into the 20th century (Abadia 2013, Paynter 2003). Today fieldwork is conducted entirely by skilled archaeologists both in research and contract environments (Leighton 2015). Archaeological practice now focuses largely on fieldwork and much thought is given to methods and approaches (Leighton 2015, Schadla-Hall 2018).

The archaeological process is the entire cycle of archaeological inquiry from preliminary research design and planning to publication and curation (Wood & Powell 1993). Within a research capacity, this process most often begins with the archaeologist formulating questions and designing a research plan intended to answer those questions – this includes strategizes about necessary data acquisition, methods and theories (Wood & Powell 1993). Further administration necessities regarding funding, permissions, etc must be organized well in advance of the expected excavation (Wood & Powell 1993). Once these preliminary measures are complete excavation planning and fieldwork can begin, this often includes survey work meant to provide insight before breaking ground (Wood & Powell 1993). The specific method of survey is left to the archaeologists' discretion. Fieldwork continues most often with excavation and recording of materials, structures, stratigraphy and sediment (Schadla-Hall 2018). Following excavation and recording material is analyzed and processed in a laboratory to gain further information, this is also the processual step where databases are formed (Wood & Powell 1993). The final step in the analytical sub-portion of the archaeological process results in data analysis and interpretation (Wood & Powell 1993). Once these findings are complete the research is most often compiled for publication and curation (Wood & Powell 1993). Each step of the archaeological process requires thoughtful consideration on the part of the archaeologist to ensure that the final results are both accurate and useful (Leighton 2015).

Analysis

Methodology

The case studies included below represent two instances of individual find recording being employed in Swedish contract archaeology. Each case study will be introduced with a synopsis of the original excavation methods and interpretations. To follow, the redesigned excavation plan and finds are interpreted. These interpretations are then compared to provide insight into the differences in how recording methods affect archaeological interpretation. The first case study from Bro 597 originally utilized typology, use-wear analysis, refitting and spatial distribution to create a foundation of understanding. The redesigned excavation plan relies only on the spatial distribution of finds by unit. This methodological decision allows for a comparative analysis of spatial distribution visualization at different scales. The second case study from 15090 originally utilized typology and 3D GIS spatial distribution as analytical methods. The redesigned excavation plan again utilizes only the spatial distribution of finds by unit of visual density. This method intends to allow for the spatial analysis methods to be compared, and in turn, see how the interpretations vary as a result. The overarching methodological purpose for this analysis is to provide evidence as to how interpretations vary based on recording methods and provide insight into which research and physical conditions are better suited to the individual find recording method.

Bro 597 Case Study, Blekinge, Sweden

Bro 597 was excavated as part of the Lussabacken Norr project in preparation for the expansion of the E22 motorway in Western Blekinge, Southern Sweden (Björk et al, 2014a). The excavation was conducted by Sydsvensk Arkeologi in collaboration with the Blekinge Museum in 2011 and 2012 (Björk et al, 2014a). The site has been securely dated to the pre-boreal, early Mesolithic period (Björk et al, 2014a). Though the typological findings are suggestive of Paleolithic technological traits (Björk et al, 2014a). The site is unique in that there was no archaeologically significant stratigraphy present (Björk et al, 2014a). This allowed for the entire site to be excavated using a single context method (Björk et al, 2014a). As a result, all stones and artifacts were excavated and recorded individually (Björk et al, 2014a). The lead excavators on this project felt that traditional methods of excavation and recording would have tremendously skewed had the analytical results. much of the informational value potentially lost to preconceptions and typological generalizations (Björk et al, 2014a).

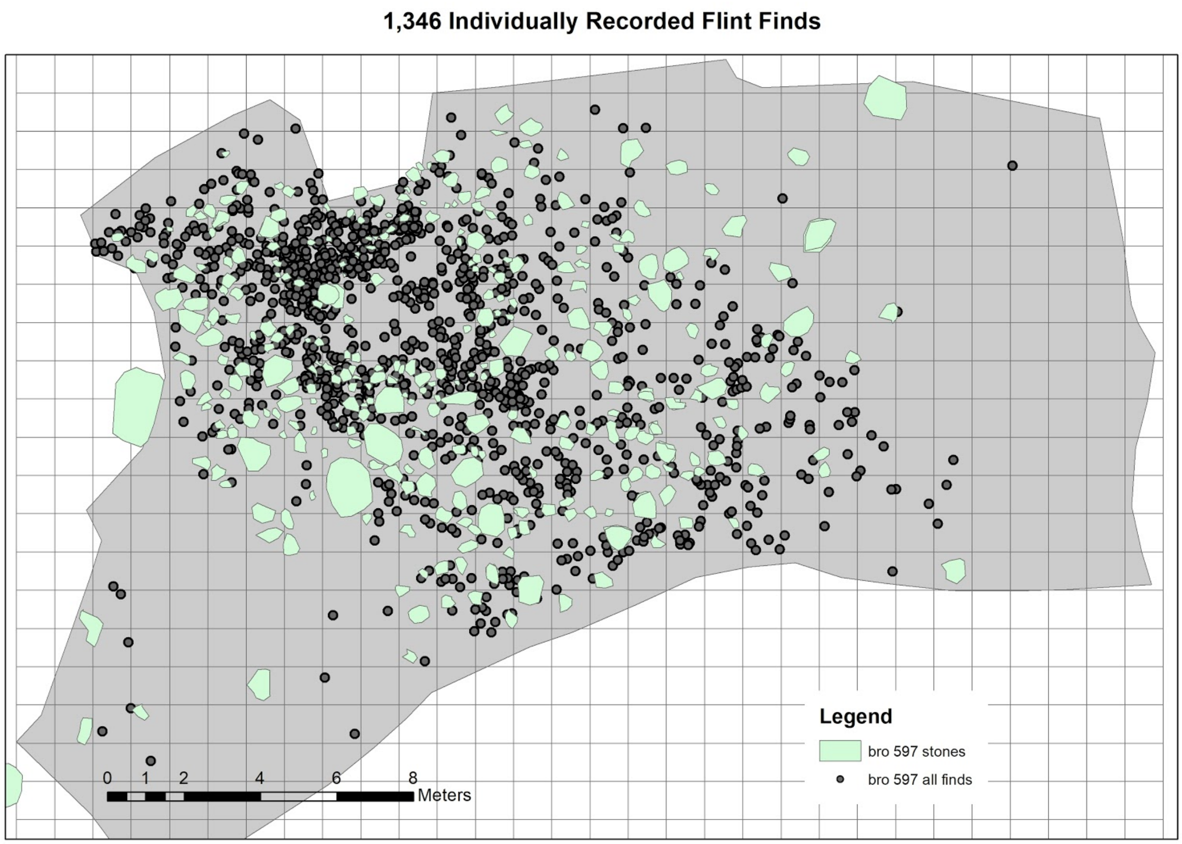

Figure 1 Bro 597 individually recorded flint finds and stones. 1,346 points representing flint finds. stones represented as green polygons. Points recorded using GPS and Total Station. Displayed using ArcGIS. Cait Dickie 2020

Bro 597 represents a 2032m2 landmass visualized in figure 1 (Björk, 2014a). The site was unexpectedly well preserved as a result of a series of prehistoric geological events including the drainage of a local basin (Björk et al, 2014a). The excavation contained a high density of surface and near-surface flint finds (Björk et al, 2014a). The intended method of field recording was to use a network GPS to record the spatial information and elevation of each flint element (Björk et al, 2014a). A total station was also utilized due to unforeseen vegetation issues but operated with the same functional goal (Björk et al, 2014a). 1,346 georeferenced spatial points were recorded representing the 1,666 flint finds found on site (Björk et al, 2014a). Virtually each individual flint object was recorded while some featuring small fragments were recorded as groups (Björk et al, 2014a). The research goal of this excavation was to illuminate the technological chronology of early Mesolithic sites in the excavation project, highlight resource division methods and most notable to outline the spatial distribution of specific artifacts across the site (Björk et al, 2014a). The two most notable structural features of the Bro 597 excavation results are the identification of a hearth burning center and a hut structure (Björk et al, 2014a).

Original Findings

Artifacts, Typology and Geologic Dating

The flint artifacts found on site are characteristic of what is commonly seen throughout late Paleolithic typological assessments (Björk et al, 2014a). However, the site would have been located on a small peninsular island along a lake outlet associated with the Yoldia Sea (Björk et al, 2014a). The site would have been fully submerged until the drainage of the Billingen Baltic Ice Lakes c. 9610bc (Björk et al, 2014a). This dating pushes the occupation of the site into the early Mesolithic period (Björk et al, 2014a). The Paleolithic trends in typology and technology suggest that Bro 597 may represent one of the earliest Mesolithic sites known in the region (Björk et al, 2014a).

Use Wear Analysis and Refitting

Use wear analysis has been used in archaeology since the 1970s but has greatly expanded in recent years following the introduction of much more advanced methods and tools such as high powered microscopy and digital imaging which allow for minute traces and marks to be identified on artifacts (Masojć 2016, Shea 1987). These traces provide direct insight not only into how the objects were used but also how and why they were made in specific ways (Masojć 2016, Shea 1987).

Use Wear analysis in the example of case study Bro 597 identified well-documented traces from a variety of different activities on the site (Björk et al, 2014a). The wide array of activities visible on-site through the dispersal of artifacts with evidence of use-wear traces representing a large number of different activities without clear spatial divisions for each activity (Björk et al, 2014a). The analysis was conducted by a private contractor and resulted in a much different interpretive image of how the site was occupied during the early Mesolithic period (Björk et al, 2014a). Following the findings from the original excavation and use-wear analysis, we know that the entire site features lithic fragments and tools that provided trace analysis for a multitude of different activities on site (Björk et al, 2014a, Persson & Knarrstöm 2018). Figure 2 demonstrates the spatial distribution of flint artifacts across the site with a legend explaining each residual industry. Figure 3 shows the specific outcome of the use-wear analysis conducted as part of the original excavation and interpretation.

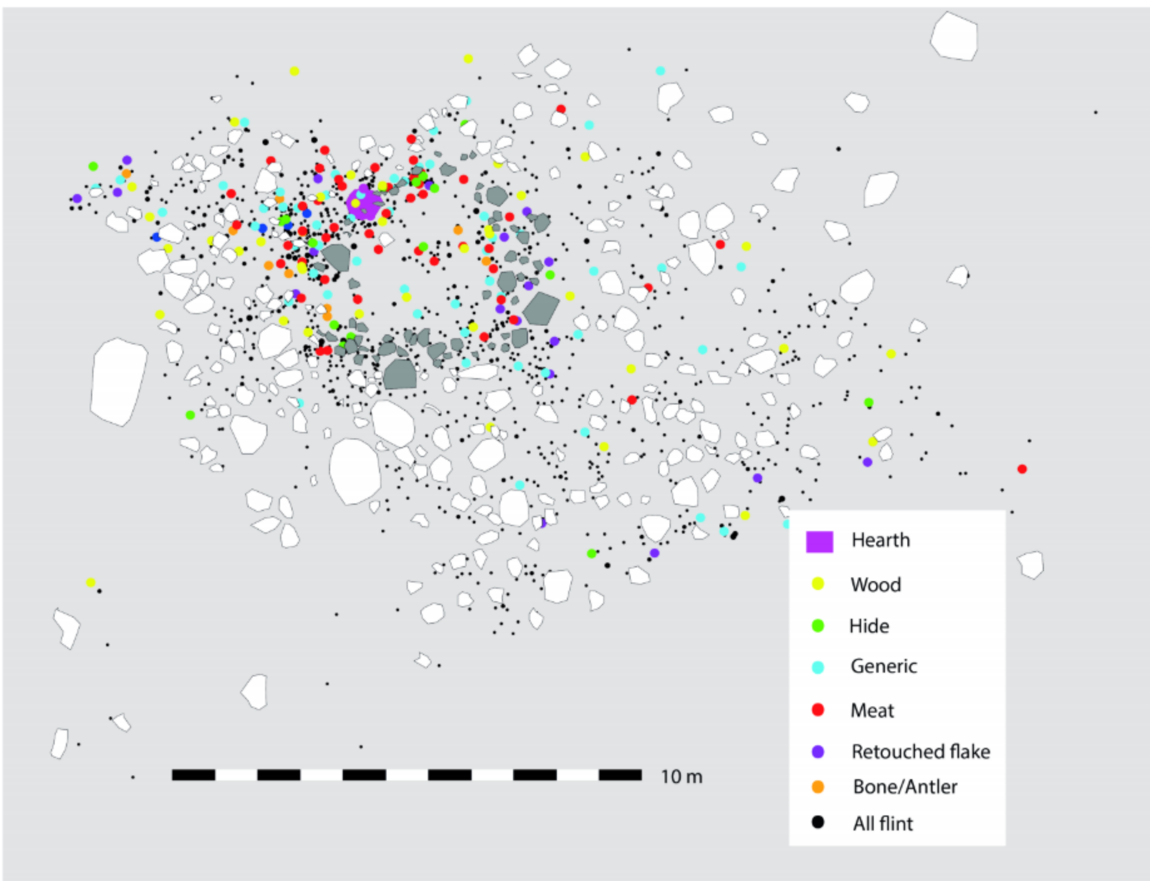

Figure 2 Bro597 spatial distribution of use-wear analysis results. hearth visualized in purple. stone clearing interpreted as the hut structured visualized in dark gray. Points recorded using GPS and Total Station. Displayed using ArcGIS. Persson et al. 2018

The refitting study conducted on the assemblage was intended to illuminate patterns of distribution and manufacturing on the site (Björk et al, 2014a). The results of the refitting study suggested that the flint tools on site were likely not recycled extensively even if functional edges remained (Björk et al, 2014a). Because of the uniform way in which the flint was utilized across the site, it was interpreted that the inhabitants likely had strict concepts of how tools were meant to be manufactured and utilized (Björk et al, 2014a). Some of the flint finds are thought to have been broken and immediately discarded while other discarded debris appears to have collected around the hut structure outlined below (Björk et al, 2014a).

	Count	Use wear (%)	Bone/Antler	Generic	Meat	Hide	Wood
Scraper	22	21 (95)	2	1	1	17	0
Burin	16	14 (88)	2	3	1	1	7
Blade	66	33(50)	1	12	14	1	4
Blade fragment	119	56 (47)	1	19	22	2	11
Flake	271	87 (32)	9	22	26	7	20
Core	10	0 (0)	0	0	0	0	0
Core fragment	9	9 (100)	0	2	0	3	4
Σ	513	220 (43)	15	59	64	31	46

Figure 3 Bro597 Use-wear analysis findings. Associated with figure 2. Persson et al. 2018

Spatial Distribution

The original excavation revealed a hearth feature visible in figure 2. The hearth feature was interpreted as a central hub of activity located slightly northeast of the entrance to the hut structure along what would have been a prehistoric shoreline (Björk et al, 2014a). The hearth was identified by the concentration of burned lithic material (Björk et al, 2014a). Unburned lithic material in immediate proximity to the hearth was interpreted as the result of minor repair activities (Björk et al, 2014a). This relates to the lack of spatial division amongst activity areas (Björk et al, 2014a). The hearth is a central figure in many archaeological interpretations as the behavioural instinct to gather around a fire has been identified as somewhat a cultural constant (Björk et al, 2014a). The original archaeologists elected to employ the individual find recording method in part to allow for the distinct identification of the spatial distribution of artifacts (Björk et al, 2014a). As noted in the use-wear analysis section, the results of that analysis suggested a spread of activity across the excavation area with little to no evidence of distinct areas assigned to specific activities (Björk et al, 2014a).

The hut structure was originally identified by the circular clearing of stones and high density of lithic fragments along the walls, both exterior and interior (Björk et al, 2014a). Circular hut structures were common during the early Mesolithic in southern Sweden (Björk et al, 2014a). The hut and associated artifacts were interpreted as evidence for the short season occupation of the site (Björk et al, 2014a). The original excavators suggested that it would have been unlikely that the hut structure would be identifiable using an excavation unit style excavation method (Björk et al, 2014a).

New Findings

To recreate the excavation finds distribution having excavated using 1-metre excavation units there are a total of 195 unique squares featuring lithic material, see figure 4. By constructing 50 cm units 480 squares contain flint material, see figure 5. There is a cluster visible using graduated symbology in the northeast corner of the excavation boundary discussed below. Graduated symbology allows for each excavation unit to be represented by an icon, the size of which indicates the number of individual points taken from each unit. The points are recorded from the original excavation. By using graduated symbology general patterning is illuminated. There appears to be a rectangular shape of higher density. Followed by several areas of slightly higher density clusters. Additionally, there is a low-density scattering of archaeological remains across the majority of the total excavation boundary.

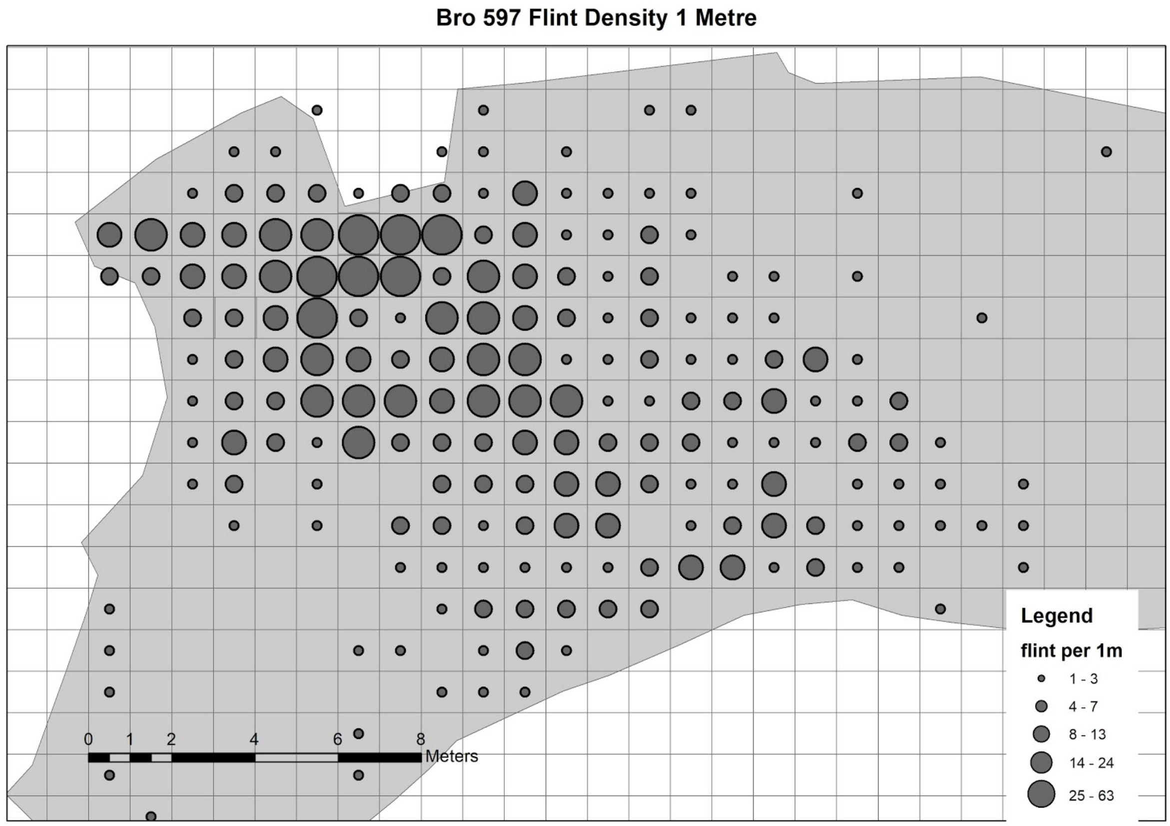

Figure 4 Bro597 redesigned excavation with 1metre units. Density of flint per unit displayed with graduated symbology. Points recorded with GPS and Total Station. Displayed using ArcGIS. Cait Dickie 2020

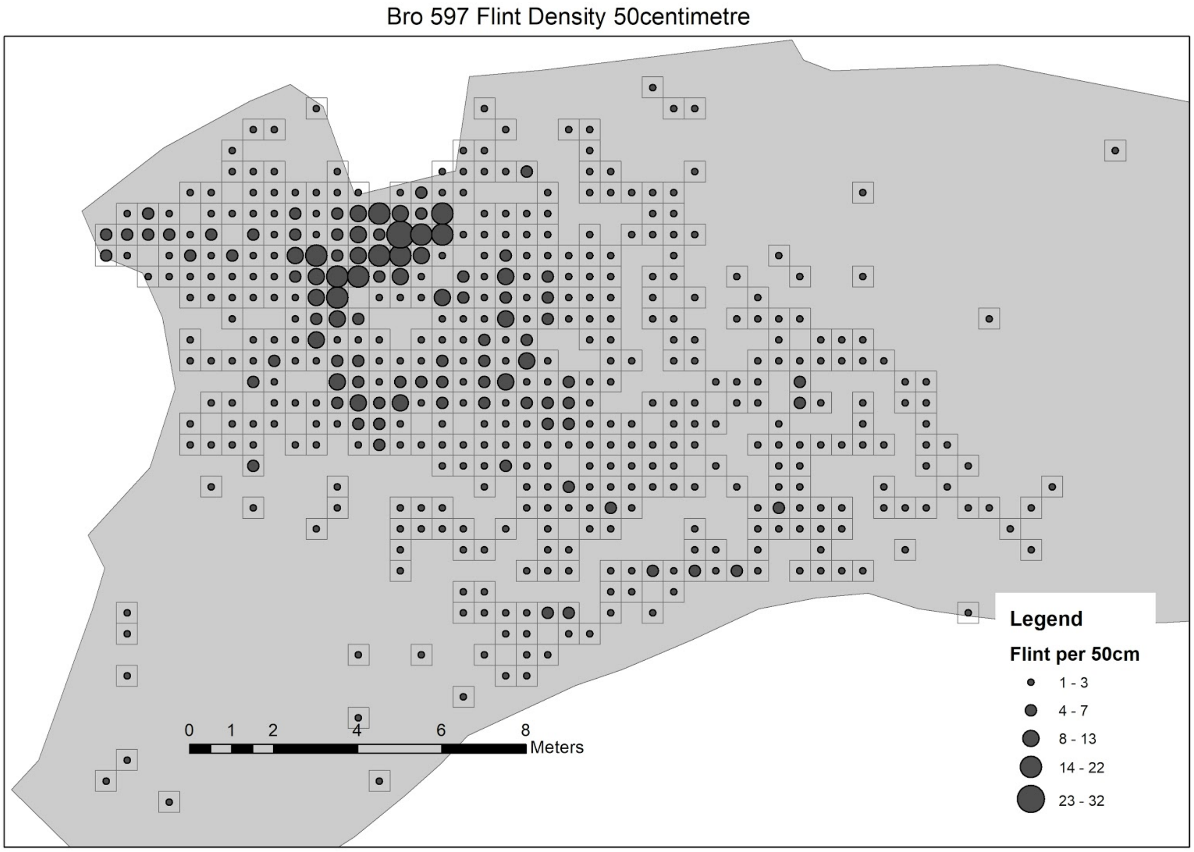

Figure 5 Bro597 redesigned excavation with 50-centimetre units. Density of flint per unit displayed with graduated symbology. Points recorded with GPS and Total Station. Displayed using ArcGIS. Cait Dickie 2020

The hearth was not visualized in the redesigned excavation plans as the geospatial data points were not provided. However, to combat this exclusion, the density of burned flint material was measured per 1metre square unit, see figure 6. It was redundant to run this analysis again at the 50centimetre scale as this result was only intended to provide a general concept of the distribution of burned material. The redesigned excavation results would have indicated a burning event as the logical explanation for the burned flint however a hearth would not have been identified. The hut structure is visible in both the 1metre and 50centimetre grid scales but takes on a rectangular shape.

Burned Flint per 1m Square

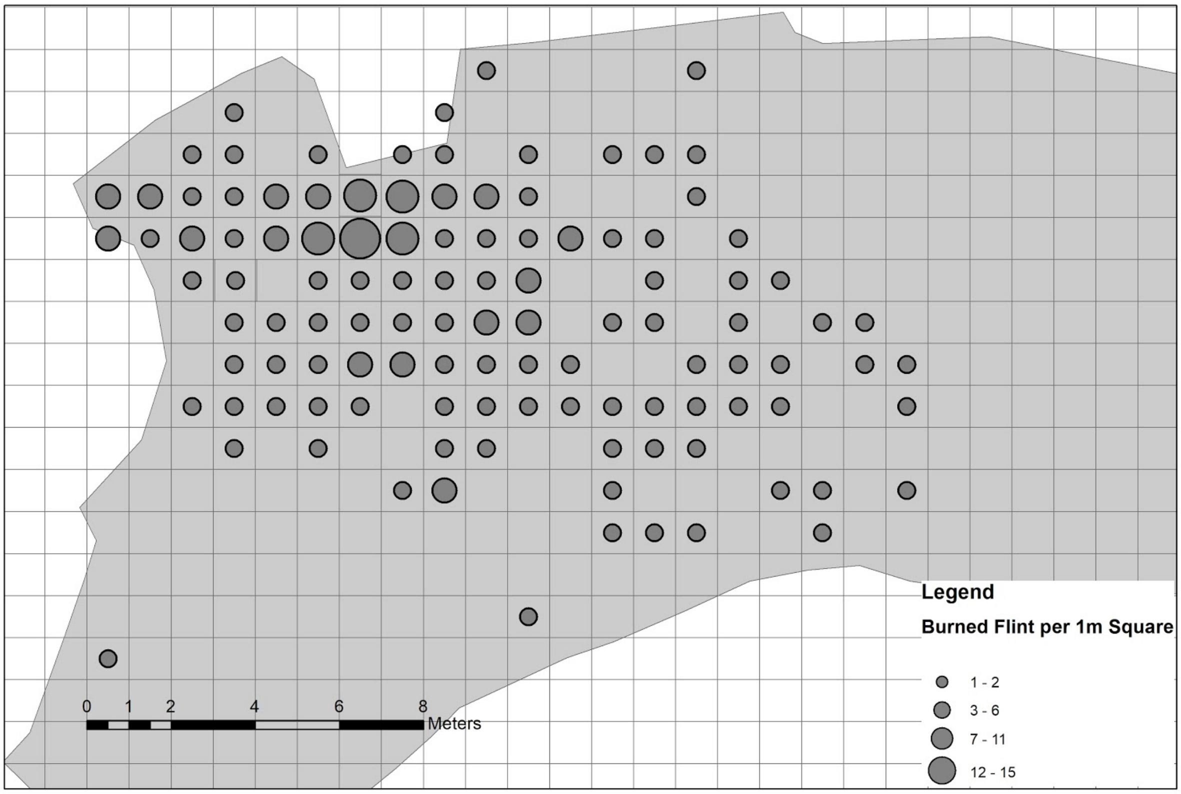

Figure 6 Bro597 redesigned excavation with 1metre units. Density of burned flint per unit displayed with graduated symbology. Points recorded with GPS and Total Station. Displayed using ArcGIS. Cait Dickie 2020

Comparison

The hearth would have been impossible to locate using an excavation unit grid method due to the presence of burned material covering much of the site. Burned flint remains were found in 112 1 meter squares in density values between 1-15 pieces. This density is visualized in figure 4. The hut structure was identified during the original excavation through evidence of a stone clearing with a higher density of flint finds along what is interpreted as the north-facing entrance (Björk et al, 2014a). The stone clearing and associated flint are visible in figures 1 and 2. However, the hut structure takes on a much more rectangular visualization when using grid squares to organize the finds. This is in direct contrast with the circular structure identified originally and supported through other early Mesolithic hut features of a similar circular shape (Björk et al, 2014a). It appears that very little of the spatial understanding of the hut feature is lost when the dataset is reanalyzed using an excavation unit grid system however the shape is visualized with significant differences. The hearth feature would be very challenging to identify based on the distribution of burnt material alone.

Much of the spatial distribution argument put forward by the original excavators is reliant on the use-wear analysis and refitting of lithic fragments (Björk et al, 2014a). These further analytical methods were not explored in the thesis but remain important arguments and it would be detrimental to the overall interpretation to exclude these as valuable methods (Björk et al, 2014a). These methods would lose much of their impact if run on material excavated with generalized spatial information like that of material excavated using excavation units (Björk et al, 2014a). Refitting is reliant on proximity to understand the relationships between fragments, while the use-wear analysis, in this case, revealed a very wide array of activities occurring on-site without activity-specific boundary areas (Björk et al, 2014a).

15090 Case Study, Blekinge, Sweden

Site 15090 was excavated as part of the Lussabacken Norr Excavation for the E22 Highway in Blekinge, Sweden in 2011 and 2012 (Björk et al, 2014b). This is the same project as Bro 597 noted above. This site was located along the same small island chain as Bro 597, associated with the Yoldia Sea (Björk et al, 2014b). This site would have also been submerged until c. 9610 BCE, the time of the Baltic Lake drainage (Björk et al, 2014b). As a result of C14 carbon dating samples taken from the site are dated to c. 8300 BCE (Björk et al, 2014b). These dates suggest that 15090 represents a younger occupation still within the early Mesolithic. 1,299 individual flint finds were recorded on-site see figure 7 (Björk et al, 2014b). This site has been interpreted as an early Mesolithic multi-seasonally occupied site (Björk et al, 2014b). The lithic assemblage underwent typological analysis and was divided into two separate deposits thought to represent a summer occupation and winter occupation (Björk et al, 2014b). These concentrations are visualized in figure 8. The finds were found in a light charcoal rich sand deposit which made the identification of stratigraphic relations in the field very challenging (Björk et al, 2014b). By individually recording the finds for later analysis using digital methods, the archaeologists were able to identify unique strata from post-excavation laboratory analysis (Björk et al, 2014b).

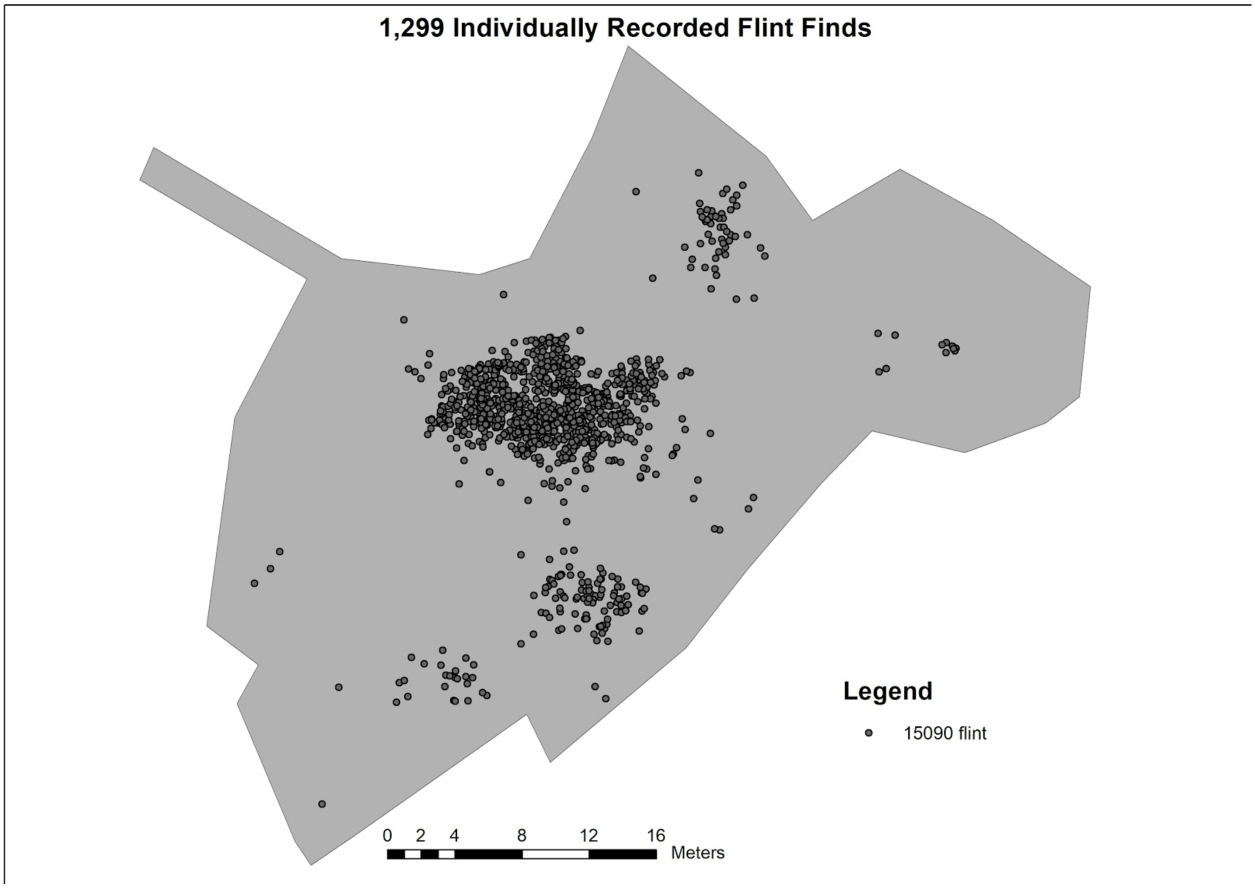

Figure 7 15090 individually recorded flint finds. 1,299 points representing flint finds. Points recorded using GPS and Total Stations. Displayed using ArcGIS. Cait Dickie 2020

Original Findings

Spatial Distribution

The original excavation consisted of 1,299 individually recorded flint finds (Björk et al, 2014b). The high-density cluster in the center of the excavation area was then further divided into concentrations representing separate deposits (Björk et al, 2014b). This separation of concentrations is visible in figure 8. There are additional higher density clusters found northeast of the main cluster and directly south of the main cluster. There is a tertiary smaller cluster visible further southwest of the central cluster.

The additional points distribution outside of the prominent clusters extends around the central cluster as well as toward the far east, south and west of the excavation area.

Within the central cluster, two unique concentrations were identified labelled E and F visible in Figure 8(Björk et al, 2014b). Concentration F underwent a comprehensive analysis based on spatial distribution and elevation point recording (Björk et al, 2014b). Concentration F was interpreted as a likely circular hut structure, similar to that identified in the Bro 597 case study (Björk et al, 2014b). In addition to the hut structure, represented by finds with elevation points between 1.06 and 1.45m, the adjacent scattering was attributed to the functional use of the hut structure during a cold season (Björk et al, 2014b). Concentration E was interpreted as being deposited during the following warmer season (Björk et al, 2014b). This is evident in the higher deposit of flint further from the structure (Björk et al, 2014b).

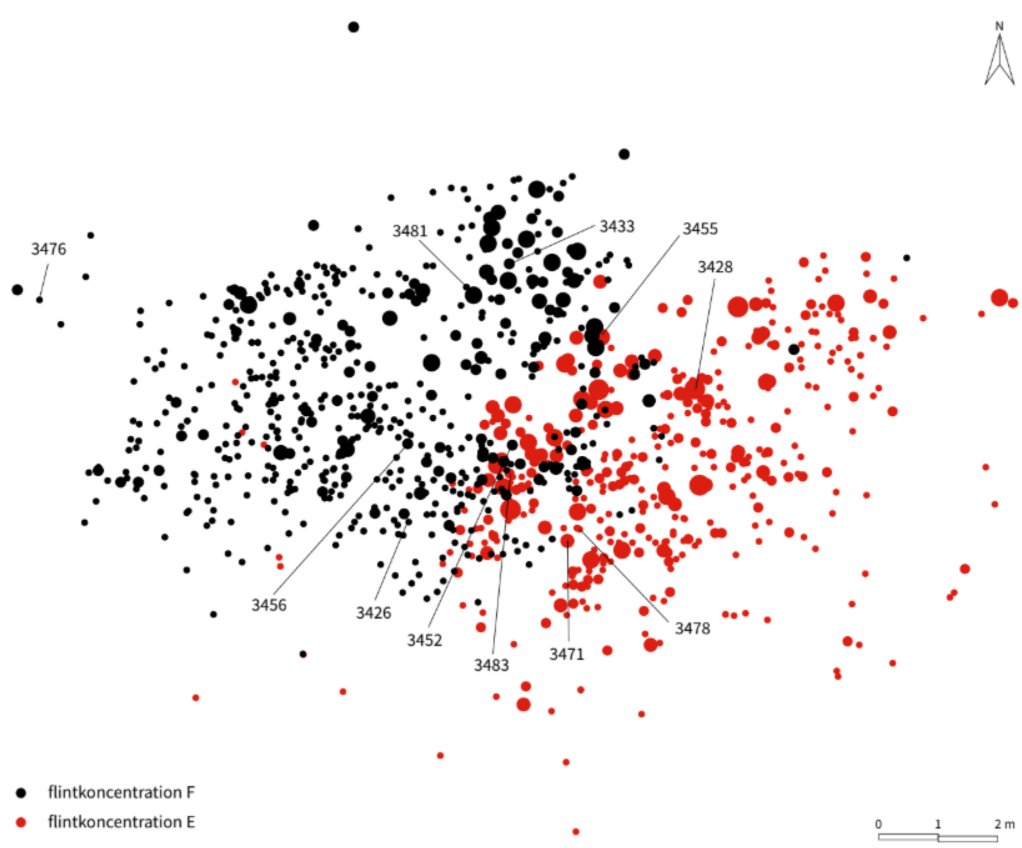

Figure 8 15090 separate flint deposits identified using 3DGIS to divide elevation recordings. Black represents concentration F. Red represents concentration E. Bjork et al. 2014b

Stratigraphic Division

The site was originally approached as a single context site though through typological analysis and measurements of individual finds elevation and spatial distribution two separate concentrations were identified (Björk et al, 2014b). These concentrations were interpreted as two separate archaeological deposits made in close succession to one another (Björk et al, 2014b). The succession represents a reoccupation of the site most likely as an original occupation and return occupation during the following year during a different season (Björk et al, 2014b). The similar seasonal occupation interpretation was rooted in the similarity of typological finds, suggesting that specific tools were used for specific activities prevalent only during a specific season, likely spring or summer (Björk et al, 2014b).

Typology

A typological analysis was conducted on the assemblage from 15090 (Björk et al, 2014b). The technological results of this analysis indicated late Paleolithic and early Mesolithic traditions (Björk et al, 2014b). Most notably the typological assessment showed a small degree of variation between the two concentrations. The typological analysis of findings attributed to the hut structure of concentration F was representative of a wide array of tasks performed on-site regularly. Findings included flint cores, repaired tools, retouched elements and arrowheads. These finds were linked not only to hunting but also to many daily activities (Björk et al. 2014b). This assemblage did not undergo further use-wear analysis.

New Findings

By using 1metre excavation units the redesigned excavation requires 209 units to cover all of the recorded points. The value of points per unit ranges from 1-52. The 1meter distribution reveals a major central cluster with two secondary clusters to the northeast and south. Additionally, there is still a visible presentation of a tertiary cluster to the southwest of the central cluster. There are additional units scattered across the excavation area. This distribution is visible in figure 9. By using 50centimetre excavation units the redesigned excavation requires 460 units to cover all recorded points. The value of points per unit ranges from 1-23. At this scale, the central cluster is visible and the secondary and tertiary clusters noted above are again visible. The additional lithic features across the site are again visible. This distribution is visible in figure 10.

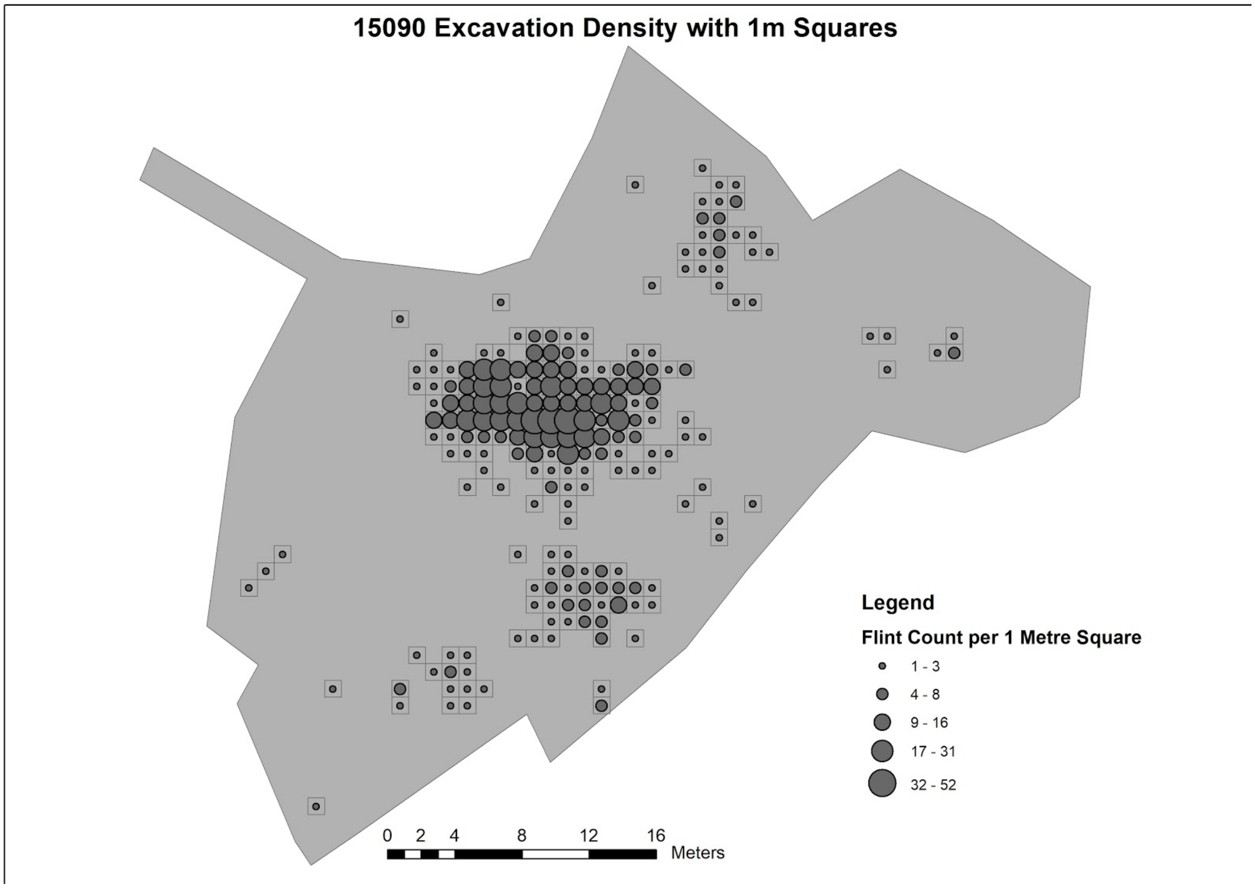

Figure 9 15090 redesigned excavation with 1metre units. Density of flint per unit displayed with graduated symbology. Points recorded with GPS and Total Station. Displayed using ArcGIS. Cait Dickie 2020

15090 Excavation Density with 50cm squares

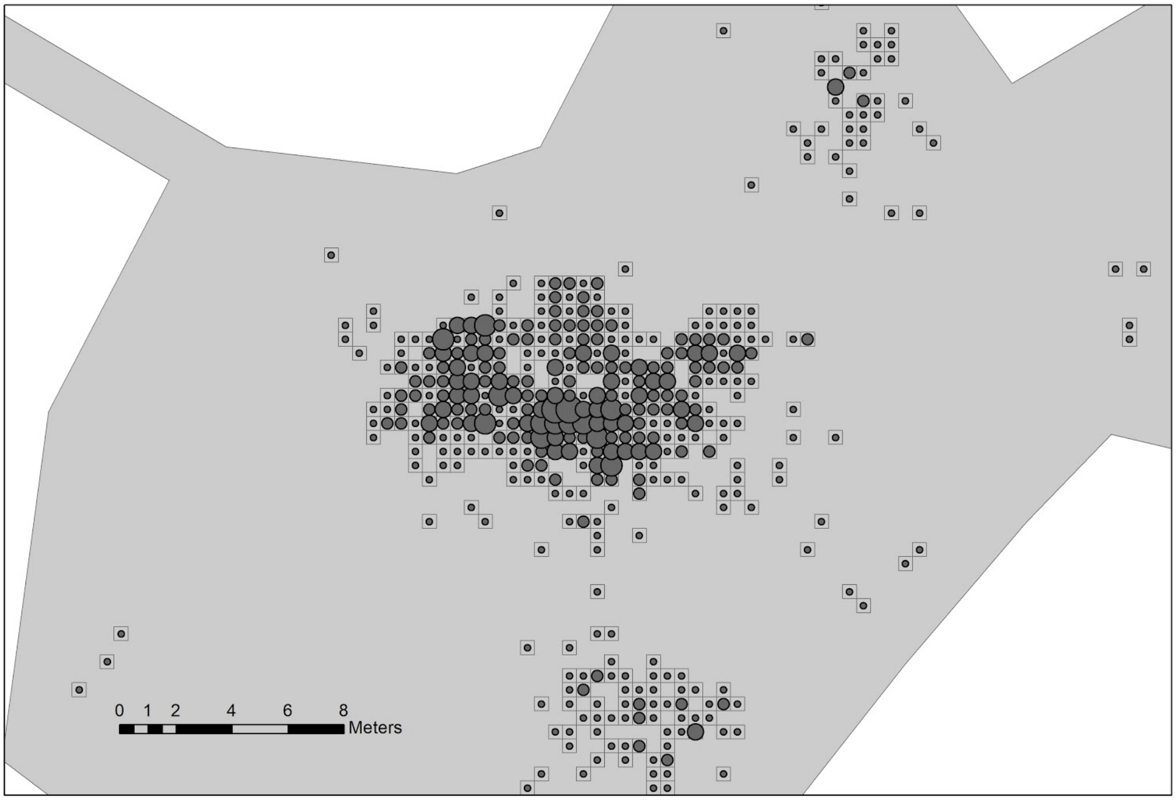

Figure 10 15090 redesigned excavation with 50-centimetre units. Density of flint per unit displayed with graduated symbology. Points recorded with GPS and total station. Displayed using ArcGIS. Cait Dickie 2020

Comparison

Without taking into consideration the typological or elevation height separation used to identify the separation of concentrations in the central major density it would be impossible to identify two separate deposits. The overall similarities in typological and technological trends found within the lithic assemblage would not have indicated any significant deviation from the two separate stratigraphic assemblages identified using the individual artifact recording method. The individual find recording method allowed for the two separate assemblages to be identified and separated in the post-field lab based on the geographic elevation points recorded for each independent artifact. A 3D GIS would have been required for the redesign of the elevation points which is beyond the practical scope of this project (Forte 2014). The finds would be interpreted from a 1m unit excavation method as a single larger assemblage of flint finds with virtually no distinguishable differences. Had the site been excavated in single units the very small difference in elevation between the two assemblages would most likely have been ignored, especially given the poor soil conditions. The overall site instead would have been interpreted incorrectly as a larger site occupied for a short period of time rather than two smaller occupation periods existing at separate points in time. The close temporal relationship between the two assemblages would have been entirely lost to traditional excavation.

Discussion

The following section will discuss the effect of methodology on interpretation in relation to the case studies provided. Additionally, some of the case-specific benefits and limitations to individual find recording will be addressed. The value of the thesis research project will be discussed in conjunction with the overall findings. Limitations across the entire thesis project from the source material to the thesis approach and analytical methods will be explained. Recommendations are made for future research plans to expand on the thesis topic. As expected, excavation and recording methods have a significant impact on archaeological interpretation. More notably, however, it appears that the research questions held by the investigator in advance carry an even more significant impact on archaeological interpretation.

Case Study Interpretations

The findings of the thesis analysis were quite unexpected, as the expert contract archaeologists had noted that they felt it was unlikely that traditional excavation and recording methods would be able to visualize archaeological features through the spatial distribution of lithics as was disproven in both case studies. However, it is clear that the original excavations utilized individual find recording as a field method to fit the specific research questions. Bro 597 case study used individual find recording with the intention of mapping the spatial distribution of use-wear analysis proven activity areas. The original excavators were successful in this goal and demonstrated evidence for a wide array of varied activities happening across the site, unbounded by traditional activity hub parameters (Persson et al. 2018). Use-wear analysis results were not included in the redesigned excavation as it is beyond the scope of the thesis project but it is logical that the loss of specific geographic data regarding activity evidence would have hampered the findings of the original excavation. Additionally, as refitting was done on much of the assemblage from Bro 597, the specific geographic data for each point allows for a much clearer visualization of the dispersal of associated flint elements across the site.

The results from the analysis of site 15090 were more expected as the 2D spatial distribution of finds, at both the 1metre and 50-centimetre scales were unable to detect a stratigraphic division in the deposit. Though, it was clear that there was some sort of structural feature present in both redesigned distribution maps. Traditional excavation methods using units would have been inappropriate if not impossible to conduct accurately on-site given the soil conditions. This instance of the application of individual find recording appears very useful in allowing for post-field interpretation that would likely have otherwise been interpreted incorrectly.

Case Study Specific Benefits and Limitations of Individual Find Recording Method

In both case studies, there are clear benefits to the use of individual find recording in the field. The Bro597 case study allowed for discrete spatial analysis for refitting and further use-wear analysis that would have been smeared using traditional methods. Because the goal of the project was to identify the specific spatial relations between points taken, the method employed allowed for an interpretation that suited the research goals. The most notable benefit to individual find recording method in the 15090 case study comes from the unfavourable excavation field conditions. The soil conditions made the identification of unique strata very challenging. While this thesis did not explore the 3D spatial distribution of points by elevation levels, traditional excavation units would not have been optimal. Additionally, the individual find recording method can prove to be a time-saving method if appropriate planning conditions are met before excavation. By delaying analysis until after the excavation, archaeologists are able to simply collect and record finds in the field in an expedited manner, requiring less time and less personnel.

Value of Research

The findings of this thesis are valuable to archaeological inquiry as it provides multiple case study examples of the field application of individual find recording and subsequent interpretation variability. This provides clear evidence as to what specific research and physical conditions are suitable for this method. Additionally, by incorporating the comparison between traditional methods and newly emergent methods, the value of traditional archaeological practice remains clear.

Limitations

It is important to make note of the limitations present in this research project. The analysis conducted on the redesigned excavation plans was not as in-depth as many actual archaeological analyses are. This was because the purpose of the thesis was to provide a generalized overview of the impact of methodology on interpretation. Additionally, the thesis project relied on the use of secondary source material datasets to reanalyze and reinterpret. While the original archaeologists are highly capable, it is important to note that the material was not collected first hand; as a result, some of the nuances within the material may have been missed. The datasets and field reports used for both case studies were available only in Swedish which posed a minor translational issue which was overcome with the use of an online translation application.

Future Research

The thesis intended to provide a relatively basic overview of the redesigned excavation plan so it was not necessary to evaluate the elevation values is 3D. The thesis only utilized the 2D (longitude and latitude) spatial distribution of finds in both case studies. However, the 3D analysis would have provided an interesting insight into the division between the case study 15090 flint concentrations seen in figure 8. The thesis project used spatial density modelling to reveal the distribution of finds through excavation units. This is a very common method for analyzing the distribution of archaeological finds as it provides a visual overview of values. Different typological values could have been visualized on the redesigned map plan to allow for a more in-depth interpretation but again the goal of the thesis was to provide a preliminary analysis of the impacts of methodology on interpretation. This research would benefit tremendously with further study. A more advanced, complex analysis of the spatial distribution of flint finds related to the use-wear analysis results or refitting techniques would secure the arguments further. These seem to be instances where the individual find recording method is particularly useful and a direct comparison between the finds of the aforementioned analytical methods in comparison with visualization of 2D spatial distribution by unit would be very insightful.

Conclusion

The goal of this thesis was to identify how digital recording methods impact archaeological interpretation based on the case studies presented. The project also sought to illuminate specific circumstances where the individual find recording method is more suitable for an impactful interpretation. The original archaeologists hypothesized that it was unlikely that traditional means of excavation using grid units would be able to reveal the specific spatial relations of the material found on site (Persson et al. 2018). However, the comparative analytical results identified basic structural features in both case studies.

The case studies presented provide practical applications of the individual find recording method. The Bro 597 case study benefited from the individual find recording to display the specific spatial distribution of the use-wear analysis findings (Björk et al, 2014a). And the visualization of features was clearest when visualizing each point rather than within a 1metre or 50centimetre grid. However, the visualization of the hut structure and general distribution pattern was visible to an extensive degree at both the 1 meter and 50-centimetre grid scales. The hut structure is visible in both instances. The 15090 case study represents another example of the benefit of individual find recording (Björk et al, 2014b). The stratigraphic division between concentrations or deposits was identified post-excavation through a 3D visualization capable GIS. However, by using ArcMap to redesign the excavation plan, the elevation of points was not considered. This made for a very murky result. The individual find recording method in this case study allowed for the clearest interpretation of the archaeological record possible (Björk et al, 2014b).

While traditional excavation methods were entirely sufficient for the identification of structural features, the individual find recording method was of special benefit in both case studies. Individual find recording is especially well suited to projects where research questions focus on the exact spatial distribution of artifacts such as those involving refitting or use-wear distribution. Additionally, individual find recording is of benefit when the soil conditions are unfavourable and do not allow for the identification of stratigraphic divisions. Both case studies shared additional characteristics that enabled the archaeologists to explore nontraditional excavation and recording methods. These shared features include a single context, near-surface, low variation archaeological sites.

Overall, the individual find recording as a method for fieldwork carries huge benefits if the specific small scale geospatial relationship between points is part of the excavation objective. However, for the visualization of general structures as displayed in both case studies, traditional excavation unit excavation provides adequate information. The research aims and questions of the archaeologist appear to have a much more pronounced impact on the interpretation of archaeological material, despite methodology providing the tools for interpretation. The findings of this project have a minimal impact on archaeological theory however it would be imprudent to ignore how this research could aid in future excavation design. This does provide guidance for making more reflexive decisions regarding excavation planning and serves as preliminary evidence for the applicability of individual find recording as an excavation technique. The impact of the individual find recording method in comparison to more traditional excavation methods using excavation units has been demonstrated. More advanced future methodological comparison would aid in the overall understanding of how methodology impacts archaeological interpretation. This research project has proven that methodological decisions impact interpretation significantly, though research questions appear to be of greater impact.

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