DIFFERENTIAL USE OF SPACE: AN ANALYSIS OF THE AUBREY CLOVIS SITE

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The Aubrey Clovis site is one of the oldest late-Pleistocene sites in North America, dated to ~11,550 B.P., and contains two camps with a range of lithic debitage, numerous hearths, and excellent faunal preservation. Couched in rules of classification, a series of artifact distributions are analyzed with qualitative and quantitative techniques, including maps produced in a geographic information system (GIS) and tests of artifact associations using correlation statistics. Theoretical and methodological protocols are promoted to improve spatial analysis in archaeology.

The results support the short-term occupation interpretation and expose the differential patterning among bone, stone, and raw materials distributions. The spatial structure and diverse content of the site challenge models of Clovis-age people as strictly big game hunters.

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CHAPTER 1

INTRODUCTION

Few publications exist that analyze the spatial patterning of artifacts within a Late Pleistocene Paleo-Indian site. When properly presented, spatial analysis can yield important information about prehistoric cultures from both qualitative and quantitative perspectives. The Aubrey Clovis site is not only one of the oldest late-Pleistocene sites on record in North America, dated to ~11,550 B.P., but it contains two occupation areas ("camps" B & F) with a range of lithic debitage, numerous hearths, and excellent faunal preservation. Because of the preservation of its structure, the Aubrey site is an excellent candidate for intrasite spatial analysis. The spatial dimension of archaeological assemblages has long been appreciated for its utility in understanding human behaviors. These studies are predominately descriptive and offer only interpretations rather than explanations couched in spatial theories of human behavior or, at a minimum, structured testable hypotheses. Techniques for the spatial analysis of archaeological contexts are largely centered on classifying space into activity areas. I argue that the current quantitative processes by which activity areas are defined are theoretically flawed as classificatory tools. Rather than attempting to identify activity areas at Aubrey, I offer an alternative, albeit simple, variable association method, in which explicit devices are used to test the relationships between distributions of various sets of bone and stone artifacts. These variables are based on lithic technology, subsistence strategies, density and compositional spatial patterning, and enthnoarchaeology. The results of this analysis reveal patterns of spatial disassociation between specific artifact classes at Aubrey. Visual observations suggest that there exists a differential use of space within and between the two areas of the site. Statistical tests provide a means to quantitatively test those observations. The behavioral implications of the lithic and faunal patterns are diverse, yet set the stage for further testing.

Archaeology is an inherently spatial discipline. Therefore, particular attention has been paid over the years to the spatial dimension of archaeological data. Explorations into spatial implications of behavior have existed since the 19th century when archaeologists, such as Gustav Montelius, incorporated geographic and chronological perspectives for understanding archaeological data. His historical and geographic approach sought to investigate the European Neolithic by identifying parallels and variations in artifact and settlement patterns in different environmental settings (Trigger 1990). The Austro-German school of “anthropo-geographers” provided mapping procedures for studying artifact distributions that gave rise to formalized comparative analyses in archaeology (Clarke 1977). Although many of the early researchers couched their interpretations on subjective, qualitative interpretations of artifact distributions, they nonetheless formulated both goals for the basic tenets of modern spatial analyses.

Spatial analysis in archaeology seeks to understand patterns of human behaviors in space. Information about past cultures arrives from explaining patterns and relationships among objects in the archaeological record. Clarke (1977: 9) defined modern spatial archaeology as,

> …the retrieval of information from archaeological spatial relationships and the study of the spatial consequences of former hominid activity patterns within and between features and structures and their articulation within sites, site systems, and their environments: the study of the flow and integration of

> activities within and between structures, sites and resource spaces from the micro to the semi-micro and macro scales of aggregation.…Spatial archaeology deals with a set of elements and relationships.

This definition articulates a number of overarching goals in spatial analysis, including the study of the nature of and changes in artifact relationships in space across different scales. In general, the premise that spatial patterns of artifacts are analogous to behavioral patterns serves as the foundation to approaching spatial issues in archaeology (Binford and Binford 1966; Hillier and Hansen 1984; Rapoport 1982; Whitelaw 1991); thus, it follows that information about economic and social organization is considered to be observable in the spatial structure of the site – the basis of intrasite analysis (Clarke 1977). Researchers have developed numerous qualitative and quantitative approaches to meet different needs in spatial archaeological research based on the fundamental goals outlined by Clarke. These stress not only the description of artifacts and their locations, but also the identification of statistical trends in artifact associations. How archaeologists have approached this type of information has been based on the theories presented (or implied) about the cultural use of space, the assumed meaning of the data under investigation, and the techniques employed to capture those patterns. A brief survey of the history of spatial analysis provides a context for the spatial analysis at Aubrey.

Intrasite spatial analysis has been an area of interest to archaeologists since the late 1960s, although many rigorous quantitative techniques did not become possible until the 1970s with the increased availability of computers. To date, most modern intrasite analyses have used an array of quantitative techniques borrowed from other disciplines, such as plant ecology, in order to detect or reconstruct behavioral patterns from artifact distributions (Hietala and Stevens 1977, Hodder, 1977, Kintigh 1984, Premo 2004, see also Blankholm [1991] for an overview of techniques). Whallon's initial works using the analysis of variance and nearest neighbor techniques sparked the search for distinctive "toolkits" (1973, 1974). These methods became ways that spatial analysis could be used to support evolving typologies in the European Paleolithic. Although they were followed by waves of criticism, the introduction of quantitative techniques lifted spatial analysis to a new level.

Ethnoarchaeological research has provided a model against which prehistoric spatial patterns are often compared (Gamble and Boismier 1991; Gregg et al. 1991; Kent 1984; Yellen 1977). Binford's ethnographic work with the Eskimo gave archaeologists a wealth of testable observations and theoretical behavioral constructs, such as the differential use of space within a site and its link to regional organization (1978, 1980). Schiffer's (1983) formational approach also touched on a number of behavioral dimensions at the Joint site, including an analysis of activity areas. Parallel to these ethnographic and formational results, most of the archaeological research employing quantitative techniques are couched in cognitive or typological approaches, attempting to identify toolkits or activity areas through various forms of statistical grouping, as well as qualitative descriptions (Blankholm 1991; Carr 1984; Dacey 1973; Gamble 1986; Hietela 1984; Kroll and Price 1991; Papalas et al. 2004; Price 1978; Stutz and Easterbrook 2004). For example, computationally intense clustering algorithms have been tested against artificial, ethnographic, and archaeological data, such as the Mask site and Pincevent assemblages, respectively, for their possible utility in the interpretation of activity areas in prehistoric assemblages (Kintigh 1990; Kintigh and Ammerman 1982; Whallon 1984). Although these techniques group data within the assemblage via statistical processes, what has been missing from these publications is a formal recognition of the role of classification in spatial analysis. This issue is addressed below and is a critical consideration in the choice of technique applied to the Aubrey dataset.

Within the contexts of Clovis-era research, little work has been published addressing the spatial dimensions of these late Pleistocene groups. This problem is exacerbated by the paucity of Clovis-age sites in general. Of those sites that have been excavated, few are good candidates for quantitative spatial analysis and those addressing spatial issues do so only qualitatively. Therefore, the literature on Clovis spatial patterning is limited to short descriptive reports of general site and artifact location, mostly from sites in the northeast (e.g. Debert, Fisher, Vail, Michaud, Bull Brook) where preservation quality can be an issue influencing interpretations. However, there is much to learn about Clovis behaviors from spatial patterns at habitation areas. The Aubrey Clovis site represents an opportunity to address spatial questions about Clovis people from both qualitative and quantitative perspectives. Although informative descriptions have been offered in the original monograph (Ferring 2001), extending the spatial research at Aubrey to include quantitative procedures provides additional scientific rigor and robusticity in the interpretations

Research Questions

It is the goal of this project to visually inspect and quantitatively confirm spatial relationships between a series of behaviorally distinct bone and stone artifact classes for areas B and F at the Aubrey Clovis site (Table 1). Derived from patterns in the overall assemblage, these artifact class dichotomies are designed to measure the strength of association between behaviorally relevant artifacts across space. Theoretical tenets prompting these comparisons stem from spatial relationships between the different artifact classes, which are often assumed to be true, but are rarely tested. In the case at Aubrey, the existence of shared spatial structure between artifact classes implies associated behavioral patterns. Shared spatial structure is observed visually and confirmed by measuring the co-occurrence of artifacts in space. This comparative process is replicated for the variables listed in Table 1. For example, assumptions that bifacial and unifacial tools were used for different purposes are common—cutting and scraping activities, respectively. Archaeological, ethnographic, and experimental evidence reinforce this assumption. However, is this functional difference actually observable in the spatial structure of the Aubrey site? In other words, are bifacial and unifacial tool debitage found in different places at the site, presumably for different purposes? If so, the use of spatial analysis may provide an additional means of testing behavioral assumptions about the use of tools within a site. Furthermore, what does the spatial structure (or lack thereof) infer about the duration of occupation at Aubrey? With each bivariate set, the assumptions and questions change; thus allowing for targeted questions about the differential use of space at Aubrey without the need to identify activity areas.

The questions of spatial structure surrounding bifacial and unifacial tools are implicitly functional, whereas other bivariate combinations relate to the use of those tool types with bone or the differential locations of burned versus unburned bone. Another interesting hypothesis is one that tests for spatial association between different raw materials of the same debitage type. The presence of association between two raw materials within a specific debitage type (White Edwards Chert and Tecovas Quartzite bifacial thinning flakes, for example) suggests that tools were re-sharpened in the same locations over an unspecified amount of time. However, segregation of these raw material types, both visually and statistically, indicates that these tools were re-sharpened in separate locations. The impact of uncovering spatial associations between diagnostic debitage and faunal classes yields powerful evidence toward both use of space by Clovis inhabitants at Aubrey, as well as the temporal duration of activities at the site, under the assumption that areas are more likely to be reused when inhabited for longer periods.

The relationship between density and composition provides another line of questioning in the spatial analysis at Aubrey. Ferring (1984) discusses the utility of compositional patterning and employs it as a means of detecting additional patterns by controlling for density. Following this position, stratifying the areas at Aubrey by density is methodologically helpful and raises interesting behavioral questions concerning the intensity of use and the diversity of activities within a space. For example, how does the relationship between bifacial and unifacial debris change across areas of different densities? Do these types of artifacts (and their assumed behavioral correlates) statistically aggregate or segregate with reference to the changing intensities in the use of space? Are some classes only observed in low-density areas? What does this relationship indicate in terms of behavior, as well as in terms of the assumed meaning of the variables? Are these artifacts valid behavioral correlates, given the stated expectations about their relationships? In this analysis, I call this the process of "Density Stratification," which serves to examine bivariate relationships in density and composition.

The methodology used here is both analytical and exploratory in nature. Using a bivariate approach allows for more control over the types of archaeological questions that can be asked of the data instead of attempting to summarize the artifacts across space and trying to make sense of all of the variables at one time, such as is the case with most clustering statistics. The questions tested with each bivariate comparison reveal much about the Clovis intrasite activity and the effectiveness of variable association as a means of spatial analysis.

CHAPTER 2

CLOVIS CULTURE AND THE AUBREY CLOVIS SITE

Clovis Culture

Cultural remains of Clovis-age people have been found throughout much of continental North America. The definition of a “Clovis” culture has long been ambiguous. Common technological and cultural threads tying these distanced and highly mobile groups together include distinctive lithic assemblages, of which the centerpieces are the lanceolate, fluted bifaces. Clovis are also noted by their preference for exotic raw materials, and a generalized foraging strategy including (but not at all limited to) hunting of extinct megafauna and short term habitation sites (Collins 1999; Kelly and Todd 1988; Meltzer 1993, 2004; Meltzer and Smith 1986). Despite general similarities in lithic technology and subsistence strategies, the diversity of habitats exploited by Clovis groups, ranging from Alaska to the desert Southwest to Eastern forest environments, prompted a wide range of technological adaptations visible in the growing number of lithic and faunal assemblages (Bonnischen and Turnmire 1991; Haynes 2002). Collins (1999) and Meltzer (1993) comment on the uneven geographic distribution of specific adaptations, such as prismatic blade production and bone and ivory tools, despite the attrition of organics in the acidic soils of the Eastern United States. Furthermore, Meltzer (1993) and Meltzer and Shott (2002) question how the roles of site discovery and location bear on the widely ranging interpretations of “Clovis.” Although the common denominators of the Clovis “horizon” can be seen across the landscape, the diversity of lithic and faunal assemblages suggest little evidence for a homogenous Clovis lifeway across the continent (Meltzer

1993). Until more evidence is presented, the current perception of Clovis envisions a continent of individualized, highly mobile groups with common origins and an in-depth knowledge of the environment, geology, and fauna.

Clovis sites have been found throughout Texas, as well as a few in nearby Oklahoma, New Mexico, and Arizona that contain information on Clovis lithic and faunal resource usage (Collins 1999; Haynes 2002). These include Lewisville, Aubrey, Miami, Blackwater Draw, Kincaid, Domebo, Lubbock Lake, McFaddin Beach, Murray Springs, Lehner, Gault and possibly Bonfire Shelter and Duewall-Newberry. Mammoth, bison, and deer are found at Domebo, Lubbock Lake, Miami, Murray Springs, Lehner, and Blackwater Draw, Gault and possibly Duewall-Newberry, McFaddin Beach, and Murphey. At Aubrey, mammoth bones were found in eroding sediments after excavations had completed, but are possibly associated (Ferring 2001). However, along with large mammals, medium and small sized animals, including varieties of mammals, reptiles, and fish, were excavated at Aubrey, Blackwater Draw, Kincaid, Lewisville, and Lubbock Lake. Although extinct Pleistocene taxa have traditionally been considered a staple of the late-Pleistocene diet, Grayson and Meltzer (2002) cast serious doubt on the importance of these creatures to the in Clovis-era subsistence strategy. Their conclusions against the overkill debate suggest a more complex dietary regime in the Clovis era, as well as a necessary reconsideration of reasons for Clovis mobility. The variety of food sources found in Texas Clovis sites, particularly at Aubrey, attests to the broad-spectrum subsistence strategy employed there, with less reliance on megafauna (Collins 1999). However, structurally, Aubrey seems to have more in common with the more complicated campsites in Arizona and New Mexico, such as

Murray Springs and Blackwater Draw, where multiple areas complete with large fauna, stone tools, and lithic maintenance and resharpening debris are found (Haynes 2002). Despite some suggested similarities in the structures and contents of these sites, no spatial analyses are available for any of these sites.

The Aubrey Clovis Site: Context and Description

The Upper Trinity River basin of North Central Texas, where Aubrey was found in 1988, marks the ecological and transitional zones between the Rolling Plains to the west and the Gulf Coastal Plain to the southeast. Formed during the Cretaceous and Pennsylvanian periods, variations in the bedrock geology of the area have generated a wide range of sedimentary environments and present-day ecological subdivisions, which are dominated by prairies interspersed with riparian and discontinuous upland forests.

Understanding the geologic contexts of known Clovis sites is crucial in order to find additional sites, as well as to understand the spatial distribution of artifacts within those sites. Spatial analysis in archaeological contexts relies heavily on the preservation of site structure. Both horizontal and vertical movements of artifacts can be attributed to geologic processes and mask human behaviors. Therefore, the prime locations for finding Clovis sites are in areas where deep, rapid burial and minimal disturbances have taken place, including erosion and bio-turbation. Prehistoric stream settings are most likely to meet these criteria. Given that many Clovis sites are found in upland setting, such as on terraces, the preservation of these sites' structures and contents is often poor (Ferring 2001). In order to discover more Clovis sites that have the potential for spatial analysis, it would behoove archaeologists to consider seeking deeply buried, Clovis-age riparian settings. The Aubrey site meets these criteria and is a prime location for understanding the spatial characteristics of a Clovis-age site.

The Aubrey Clovis site is located on lag of late Pleistocene channel sands at 7.9-9 meters below the modern floodplain of the Elm Fork of the Trinity River, which began aggrading during the Clovis period. The site was discovered in an outlet channel that was created during the construction of the Lake Ray Roberts Dam. Excavations at the Aubrey Clovis site revealed five *in situ* occupation areas on the same paleo-surface (Figure 1)—two around a Clovis-age oxbow pond (A & B) and another two on the banks of a paleo-river channel (F & G). Area C is considered to be associated with Area B, which was bisected by the Lake Ray Roberts outlet channel. Approximately 170 1-m^2 units were excavated, including main blocks and test units. Analyses of stable isotopes, insects, mollusks, vertebrates, and pollen records buttress the geochronology reported from a well-recorded series of 23 radiocarbon dates coming from above, below, as well as within the Clovis occupation surface. Understanding the paleo-environment and chronology of the site helps to contextualize the behavioral interpretations of the site.

Two of the areas (B & F, accounting for ~160 units) prove most eligible for spatial analysis (Ferring 2001). In order to infer spatial relationships at Aubrey, two points are important to emphasize. First, based on the geologic evidence, it is assumed that all the artifacts are roughly contemporaneous. Vertical stratification of a site is most often considered a sign of temporal variation and is important to weed out when looking for spatial patterns. Due to what Ferring describes as “friendly” site formation processes, including a rapid deposition of clayey alluvium, the site is collapsed into one stratigraphic unit for analysis purposes. Vertical distributions of artifacts are minimal. They are scattered within one meter of the main accumulation of artifacts and attributed to pedo- and bio-turbation (Ferring 2001). Thus, artifact and bone counts were aggregated to produce one vertical stratum of data. This removed any vertical dispersion in the sample and allowed for a look at the horizontal distributions alone. In order to produce meaningful spatial relationships, it is important to control for the effects of temporal distortion of the spatial record. Second, it is assumed that all the artifacts are in their original location of deposition. Horizontal variations in the distributions are credited to cultural manipulation rather than geologic formation processes. This is important to the analysis of the site, since only two dimensions need be considered. These two assumptions allow for inferences about the spatial relationships among artifacts within the site. Although these adjustments and assumptions are made to facilitate the spatial inquiry and are more than justifiable with archaeological evidence, it is impossible to control for, for example, the effects of a rapid sequence of short term occupations in this locale. Thus, the evidence does not intractably point toward only one occupation sequence, but the evidence is compelling. The spatial analysis provides further evidence toward this interpretation.

The two occupation areas studied here are spaced approximately 100 meters apart (Figure 1) with area B located east of the paleo-lake and area F set on the western banks of the paleo-river channel. Excavations were carried out in $50cm^2$ quadrants within $1m^2$ units. Artifacts were mapped in place whenever possible, but the vast majority of the ~9,800 lithic artifacts and ~3000 faunal specimens from areas B and F were recovered by fine screen (1/16 inch), water screening, and are spatially referenced to 50cm^2 quadrants. This fact is critical to the choice of quantitative methods. In two test units, excavated without quadrats, the counts were distributed evenly to each quad. An in-depth analysis is permissible only because excavators exploited fine-screen recovery methods (1/16th inch window-screen). Otherwise, the spatial analysis presented here would be limited to the artifacts collected through a larger screen size. However, artifacts that would have been lost through larger screens dominate the Aubrey assemblage, which emphasizes the importance of this collection technique.

The majority of the lithic artifacts found in areas B and F are debitage rather than tools suggesting maintenance or re-sharpening activities of some kind. The high quantity of chips and other maintenance debitage and low number of tools, nearly all exhausted or broken, distinguishes Aubrey as a site where tool maintenance, rather than manufacture, dominated the lithic processing activities. The lack of hammer stones, exhausted cores, and minimal cortical debitage further reinforces this interpretation

In the initial site report, Ferring (2001) made a substantial effort to expose the structure, or "associational patterning," of the Aubrey site, including a density-compositional analysis of artifacts (tools, debris, and refits), raw materials, and fauna from areas B and F. This analysis was predominantly based on visual interpretations, maps, and a limited use of descriptive statistics. He identified two "debitage piles" in each area based upon their relatively high densities without deference to any explicit classificatory method. Ferring emphasized density versus compositional patterning, which he originally outlined in a previous article (1984). This approach is fundamental to the recognition of deeper compositional patterns that are often eclipsed by high-density areas. All density-composition analyses in the 2001 report acknowledge the density piles and make numerous comparisons between them and the rest of the block areas. This was a provocative approach, since low-density areas were considered along with high-density locations, revealing patterns that may have been missed had attention gravitated toward the debitage piles. I have chosen “Density Stratification” methods that incorporate this same principle.

The Aubrey Assemblage

The Aubrey assemblage is diverse in terms of lithic technology, raw materials, and faunal species. As mentioned above, the majority of the lithic artifacts recovered at Aubrey are chip-sized, although larger fragments and broken tools were also found, but in relatively fewer numbers. The large-scale collection technique and character of the lithic assemblage allow for a rare, high-resolution glimpse of Clovis behaviors through an analysis of the distribution of artifacts and fauna. The lithic assemblage characterizes Aubrey as a Clovis locality, including three Clovis biface elements found in the site. Two of these, a proximal fragment and an accompanying distal portion, refit, but were found in different parts of the site. Ferring (2001) hypothesizes that the third element, a distal spall (tip), was embedded in meat that was carried into area B. Only 64 of over 9000 lithic artifacts are tools. Of these, 64% were found in area B and 25% in area F. Although area B is nearly twice the size of F, this difference in tool abundance coincides with the spatial patterns of debitage discussed later. The resharpening debitage is of interest for the purposes of spatial analysis, since it is less likely to be relocated after it is removed. The smaller debitage is assumed to mark the location where the activity took place. However, if dumping or site cleaning were practiced at the site, the spatial structures of the artifact classes should reflect this situation (Schiffer 1982; Speth and Johnson 1976). This is especially important in regards to bifacial thinning flakes and unifacial resharpening chips, hereafter referred to as BTFs and URCs, respectively, since they are morphologically distinctive of the types of tools from which they originated (Ferring 2001). Note that URCs are a previously unpublished debitage type, which Ferring claims are important additions to the analysis of archaeological assemblages (see Variables section below).

The debitage assemblage at Aubrey provides a wealth of information about Clovis lithic technology, only a part of which is addressed in this research. Behaviorally ambiguous classes dominate the lithic debitage assemblages of both areas B and F at Aubrey (Figure 2). In area B, chip fragments, chips, flake fragments, flakes, and core trimming elements represent nearly 90 percent of the total lithic assemblage, whereas BTFs and URCs make up the remaining 10 percent. The proportions are slightly varied in area F, where the respective percentages are 93.1 and 6.9. However, in terms of proportions of BTFs to URCs and raw material distributions across these debitage types, areas B and F strikingly are divergent, evoking the question of possible activity differences between each area (Figures 3 & 4). Ferring (2001) first noticed this dissimilarity, documenting a heavier emphasis on bifacial tool use (butchery) in area F and unifacial tool use in area B (various scraping activities). Examining the associations between artifact classes tests this and other behavioral interpretations about Clovis life at Aubrey.

CHAPTER 3

SPATIAL ANALYSIS IN ARCHAEOLOGY: THEORETICAL AND PRACTICAL CONSIDERATIONS

The purpose of this section is to review the status of quantitative spatial analysis in archaeology from a theoretical and applied perspective as a background for the methodology developed for this analysis of the Aubrey Clovis site. The techniques traditionally applied in spatial analysis are either 1) qualitative and involve no statistical validation, which are therefore simply untested observations or 2) based on quantitative techniques and apply ethnoarchaeological analogies to prehistoric activity areas with no acknowledgement of systematics (i.e. classification, see below). These deficiencies are framed in processual archaeology's demand for scientific rigor in archaeology, rebelling against a long tradition of cultural history, as well as the theoretical foundations implicit in the analysis of variation (essentialist vs. materialist). Once these points have been established, the methods and analysis presented here take on greater validity and should provoke further thought in spatial analysis in archaeology.

Although there are numerous techniques that have been developed in the intrasite spatial analysis of archaeological data, there is a trend toward the use of statistical techniques (clustering algorithms, for example) as means of classifying space into "activity areas." Ethnographically, activity areas are commonly assumed to exist and often relate to the mono-functional use of space in terms of kinship behavior, economics, religion/symbolism, function, and social or gender separation (Kent 1984). These and many other topics are intuitively associated with the organization of space and are valid lines of investigation open to those interested in spatial analysis of archaeological data. However, the techniques that are currently being used to address these issues through the identification of activity areas do not explicitly consider the fact that they are actually classifying space; in which case, they are subject to the parameters of systematic research in prehistory. Whether qualitative or quantitatively derived, the premise set by intrasite analyses is often centered on the reconstruction of events at a particular site, but the protocol for addressing this type of analysis has never been articulated in accordance with classification theories. Whereas qualitative interpretations of spatial patterns serve as important observations that can be tested (Binford 1978; Gamble 1986), statistical techniques work well to organize artifacts into groups, but neither are empirically sufficient means of classifying space (Dunnell 1971). The use of statistical approaches to define areas of a site as *types of activity areas* are essentialist summaries of the actual variation within a particular location. The fact that statistically-defined “activity areas” are internally varied is evinced in the challenge spatial analysts have faced to develop techniques that are capable of testing hypotheses concerned with explaining spatial variation rather than simply interpreting groups of artifact distributions.

A systematic approach to classification precludes defining classes with the data themselves. Current statistical techniques used to identify activity areas are simply grouping mechanisms used to create definitions of activity areas that are relative to the site or assemblage being tested. The definitions of classes derived from statistical variability within a given dataset are meaningless and are subject to change if additional elements are added to the dataset (Dunnell 1971). Unconstrained clustering and k-means clustering are prime examples of this type of grouping technique (Kintigh 1982; Whallon 1984). The goal of these techniques is to cluster cells based upon the variations in their contents, creating best fit arrangements of cells into internally homogeneous—externally heterogeneous groupings. As means of exploration of the data, these techniques are quite effective, yet require post-hoc interpretations, which are often rooted in ethnographic analogies. The groups created are treated as real behavioral entities rather than simply groups whose definition is dependent on the data. With an inferential approach, these techniques aid in the general description of patterns within a site or region, but do not offer any systematic structure to explain why these patterns exist.

The ideological shift that took place in the late 1960s and early 1970s turned the discipline of archaeology from merely describing objects and patterns to explaining change empirically (Binford 1972). This paradigm change altered the way in which many archaeologists approach the material record. Perceptions of the record and culture in general remain divided, however, as seen in the literature and textbooks – between an essentialist framework to a materialist one (Lyman and O'Brien 1997). In the essentialist framework, the researcher views types, whether cultures, objects, etc, as real and the variation within those types as irrelevant. This framework functioned when the goal of archaeology was to study differences between cultures and was helpful for the communication of ideas, but not for understanding change. These two perspectives are understated in the archaeological work being done today as seen in spatial analysis, which is evidence that the paradigm shift is still taking place.

As a means of explaining relationships and change, the materialist paradigm views variation as reality and the type as merely an abstraction—an arbitrary summarization of overall variation. Rigorous attempts to capture and analyze this variation are what have lead to the influence of systematics (classification) as a means of addressing issues of difference and change in many areas of the discipline. Spatial analysis, however, has not adopted the materialist view or classificatory methods and continues to use quantitative techniques to generate types of space called “activity areas” from a given distribution of artifacts (Lipo et al. 1997). The issue here is not the quality of the statistical procedures used, but the theoretical grounds upon which they are employed and the questions they attempt to answer.

Clarke (1977) explored the nature of spatial information and its utility in archaeology at a time when processual archaeology was taking shape. He noted the deficiency of explicit spatial theories in the publications of the time. Clarke writes, “ . . . these projects still tend to be static, disaggregated studies involved in typologies of sites, patterns, distribution, as things; we get bits of individual clocks but no account of working systems and their structural principles” (1977: 7). From Clarke’s perspective, spatial analysis was still in its nascent form, attempting to describe many of the patterns at particular sites from an essentialist perspective without integrating them with a larger understanding of the variations of the cultural system. I would argue that spatial analysts in archaeology have improved conceptually by incorporating spatial variation into perspectives about the overall cultural system, but that the techniques used during analysis remain essentialist. It is the notion that types of spatial patterns (i.e. “activity areas”) exist as *real things* that relates directly to the role of classification in current intrasite spatial analysis and the current research at Aubrey.

Dunnell (1971) explained in detail the role of classification in prehistory as a tool to be used in the organization of data around a research specific question. When addressing the variation in any aspect of the archaeological record, whether it is changes in biface morphology, ceramic vessel design, or the differential use of space, it is the responsibility of the researcher to define classes into which objects can be identified to belong. Explicit definitions for these classes arise from theoretical frameworks about the subject matter, thus, giving the classes predefined meanings. Dunnell (1971) calls these “intensional” definitions. For example, in lithic analysis, one might be interested in the variation of biface reduction in an assemblage with other variables between multiple assemblages, across space, or across time. Since pre-existing knowledge (theory) about lithic reduction shows that as a biface is reduced, there is a consistent relationship produced between width and thickness of the specimen, the width-to-thickness ratio could be a useful indicator of this reduction process. Thus, the rationale for choosing this ratio is theoretically grounded and stated explicitly. Objects within an assemblage can then be identified as members of each class and the variation within those classes can then be analyzed with descriptive statistics or compared with assemblages from other time periods or spatial locations.

This systematic process applies to space as much as it does to objects. In the example of space, areas (units, quads, sites, etc.) could be identified as belonging to a particular class of space that was intensionally defined based upon theoretical expectations. For example, if one were interested in the total density of stone artifacts across space as a measure of the differential use of space, density classes could be constructed at intervals designed to obviate density patterns across the area. The implicit concept of a “high” density area is hereby strictly defined based on constructs stated by the researcher and can be replicated in other studies or again within the same dataset by a different researcher. The key to this intensional definition process is that explicit definitions of classes are designed based upon theoretically derived behavioral correlates and *not from the objects themselves*. In this manner, the same assemblage of artifacts or units could be reclassified an infinite number of times as dictated by the research question at hand. The classes themselves are not inherent in the data, but are explicitly designed by the analyst from theoretical tenets as a means of organizing data in the contexts of a particular research question. From this classification perspective it can be argued that the current methods in spatial analysis are in need of revision.

In order to explain these phenomena, the analyst must approach the spatial patterning of artifacts and bone with "theoretical" expectations. Just as evolutionary theory provides the foundation for biological and ecological research, archaeologists must adopt a theoretical, or at least hypothetical, foundation upon which to build explanatory research. This does not eliminate the study of activity areas from the repertoire of intrasite spatial analyses, but forces the analyst to develop intensional definitions of different activity areas from a theoretical or hypothetical basis; these hypotheses about activity areas can then be tested and the classifications (and their theoretical tenets) can be judged. The problem with spatial analysis in archaeology is that it remains in a descriptive phase, yet frequently finds itself incapable of explaining the patterns presented. It is the intension of this research to adopt a materialist approach, since interesting patterns of variability exists not only in high density areas, but also in the low density areas of areas within the site, where compositional patterns expose different behaviors across space. This materialist approach includes a classification scheme designed to test a series of archaeological questions, and emphasizes the benefit of an explicit approach to research design in the spatial analysis of archaeological data.

Background of Statistical Analysis

A brief exploration of previous spatial analyses in archaeology will invariably uncover a wealth of statistically based techniques designed to group artifact distributions into clusters. Approaching spatial analysis in archaeology from the perspective of systematics (classification) precludes the use of these grouping techniques. The challenge in this analysis was developing explicit protocols to answer specific archaeological questions though an examination into the spatial arrangement of artifacts. The artifact classes previously identified were chosen to serve as general behavioral correlates and are grounded in preconceived knowledge of flintknapping or bone processing. Although there are no theories in archaeology established for approaching spatial analyses, the assumptions about the artifact classes serve as bases for testing and archaeological inquiry. Determining the proper statistical techniques for this inquiry, however, was more challenging.

After abandoning my own attempts to use grouping techniques for this analysis, I first turned toward Autocorrelation (Moran's I and Getis-Ord's G statistics) as a means measuring the relative clustering of artifacts. Moran's I measures similarity across space within a given distribution and Getis-Ord's G provides a summation of values within a given neighborhood. In conjunction with one another, these two statistics provided interesting descriptions of the spatial distributions of each variable with statistical robusticity, but did not supply a concise means of measuring the clustering of artifacts or artifact associations. For example, the scale of an excavation grid (quads) plays an important role in how Moran's functions. When artifacts are concentrated "normally" on a surface, meaning that they follow a normal distribution, global Moran's I will be high, indicating a high level of similarity of values across space. However, if the values do not follow a normal, for example if a "cluster" is spatially kurtotic, Moran's I will give show low values of similarity. Although a cluster may have a high abundance of artifacts in a small area, if it is not normally distributed spatially, a map of local Moran's values will not highlight that area and an archaeologist may ignore that concentration, although it would remain behaviorally important. Thus, Moran's works to measure spatial similarity, but has its limitations. Logarithmic transformations were attempted to normalize the dataset and identify areas of similarity and high abundance, but transformation of zero values was not possible. Adding one to every observation allowed for transformation of the data, but altered the original dataset. Furthermore, transforming the data at all caused a loss of raw data and inherent variation, which was deemed too destructive. In conjunction with a map of Getis-Ord's G local statistics, one could identify areas of high abundance and similarity. This serves as a good descriptive technique for use in understanding the character of the distributions, but requires two statistics and qualitative inferences to be made. With other questions in mind, these would be useful tools for archaeologists, but were abandoned in this analysis.

Once it was determined that correlation could be used to investigate variable associations, finding the proper correlation statistic was the next step in developing a quantitative approach to the Aubrey data. Chi-square statistics were found to be unsuitable due to their assumptions about bin-minimums. The artifact classes at

Aubrey often have an average abundance of less than 1 in each area. This insufficient sample size negated the use of Chi-Squared in this analysis. Because of the assumptions of independence and normality of Pearson's r correlation coefficient, a Spearman's rho non-parametric correlation coefficient was investigated. However, Spearman's has a sample size limitation of between four and 30. Outside of that range, the statistic becomes too sensitive to combinations in the data and nearly every pair of variables will show significance. With as many as 420 quads in the Aubrey dataset, this limitation was debilitating. Another look at Pearson's correlation coefficient showed that it is not limited by case number. Upon further reflection after the research was completed, it was found that this analysis violates assumptions about Pearson's. The effects of doing so alter the true magnitude of the bivariate relationship. Earlier investigations into the data using Moran's I showed that the data are indeed spatially auto-correlated; as such, they are not independent. Histograms and Kolmogorov-Smirnoff normalcy tests indicate that the variables are not normally distributed. The effects of proceeding under these violations may have cause errors in the final numbers, but the patterns may still remain. For future reference, it would be of use to refer to Clifford et al's (1989) work on adjusting data that shows autocorrelation (spatial structure) for use in correlation analysis. Despite this effect, Pearson's was used here to test for co-occurrence of artifact proportions across the density-stratified areas.

Many of the problems inherent in spatial analysis in archaeology stem from the need to find archaeological sites that are well stratified and undisturbed, such that one can confidently control for temporal and cultural variability with a site. Occupation of a site over a long period of time creates palimpsests, or overlapping deposits of artifacts.

This temporal overlap makes deciphering spatial and behavioral patterns quite difficult. On the other hand, in well-stratified sites like Aubrey, sample sizes are often too low to meet the assumptions of many statistics, precluding the application of quantitative techniques to archaeological assemblages. Thus, we are left at a catch-22, where high sample sizes often complicate interpretation and stratification produces insufficient sample sizes.

CHAPTER 4

METHODOLOGY

The methodology applied to the Aubrey assemblage stems from both visual observations and empirical tests that are explicitly designed to examine assumptions about the spatial relationships between different types of artifacts. In this process, no attempts to define discrete activity areas are made because they are not necessary to understand the relationships between different behavioral variables across continuous space. Since there is little archaeological theory concerning spatial analysis, the variables and tests presented here are explicitly defined for the utility of the analysis. From an ecological perspective, spatial analysis involves the investigation and comparison of explicit spatial locations and their characteristics. In this analysis, explicit spatial locations are not emphasized, but rather the co-occurrence of artifact proportions is central to understanding the relationships between artifacts across varying levels of density. Whereas traditional approaches might process all of the artifact classes in one sweeping “black box” approach, in the tactic presented here the classes of artifacts and bone are strategically chosen to target important functional questions about the variations of behaviors at the site. This “materialist” perspective allows for more control over the archaeological questions and the technique produced is designed around this research design. From a practical perspective, this research looks at the relationships between density and composition in conjunction with the bivariate comparisons of artifact abundances.

The process of assessing the associations of spatial structure between pairs of artifact classes is based on 1) visual observations of artifact distributions from a series of distribution and descriptive maps, 2) descriptive statistics comparing variables at the assemblage level, including quartiles and variance-to-mean ratios, and 3) the use of Pearson's correlation coefficient as an empirical test of those visual and descriptive observations across different area subsets (total area, density stratified areas, etc.), which are explained in detail below. While visual observations are not objective measures of artifact associations, they do provide the bases for hypothesis testing with proper statistical techniques. The variables previously mentioned in Table 1 must first be introduced; at which point the visual and statistical techniques are described.

Variables

When constructing a spatial analysis, deciding which artifact classes are *relevant* to archaeological issues, as well as which classes are *sufficiently represented* in numbers suitable for statistical analysis is a crucial process. Problems occur when analyses proceed with interpretations without explicitly articulating the meaning of the variables used. The first issue regarding variables, *representation*, can be judged by beginning the spatial analysis at the assemblage level, which is inherently non-spatial. Although there are some descriptive statistics that can help elucidate certain spatial characteristics of the artifact classes at this level, raw abundance per quad is considered sample size in this analysis. Number of quads equates to the total number of cases. Considering the issue of sample size, some raw material classes of BTFs and URCs could not be included in the analysis. The explicit rules for this decision process are directly tied to the materialist theoretical perspective and need to be described.

Although there are many raw material categories of debitage, some do not occur in an abundance that is useful for quantitative analysis. In order to use only those categories that were abundant enough for statistical observations, only raw material classes of BTFs and URCs that represented greater than 7% of the relative abundance of each debitage type and had a minimum of 10 total pieces are considered in this analysis (Tables 5-9). These are arbitrary cut off points relative to the total abundance of each debitage type at each area. Both percentage and total are important factors, since a low count may represent a high percentage of the relative total. The classes are marked in bold in the data tables for each area and will hereby be referred to as BTFr and URCr (r = restricted).

The second issue, *relevancy*, is grounded in both ethnographic and archaeological theory and evidence. Of the types of artifact classes present, which serve as diagnostic behavioral correlates and how is this known? Intuitively, all artifacts at a site are indicative of behavior at some level, but diagnostic artifacts that can be shown or assumed to infer information about the locations of behaviors are the most effective. In this analysis, aggregate categories, such as total bone or total stone are used to make larger, first round interpretations of artifact relationships. Within each class, there are subdivisions whose meanings become less intuitive and must be explicitly described here.

Frison (1968, 1989) and Jelinek (1976) show how functional interpretations of lithics can be made in archaeological research. For the purposes of this analysis, the variables used are assumed to have particular behavioral correlates (Ferring 2001), which will be tested for their spatial associations in each area of the site. These assumptions do not represent all of the possible implications of a particular variable, but are explicitly constructed around the research questions exploring variable associations and spatial structure. Each variable is articulated explicitly before continuing to the analysis.

Total Debitage (DEB). This artifact class includes the total abundance of lithic, non-tool debitage in any given quad. This variable relates to the varying intensity of the use of space. Certain areas of the site were used more than others, based upon the total abundance in any location. The contents of those locations are of interest and are measured with other variables. The seven debitage classes listed in Tables 3 and 4 represent spent stone material produced during the resharpening, repair, or maintenance of lithic implements. Ferring (2001) constructed these classes as a means of organizing the lithic assemblages into morphological groups. Since I am only concerned with the total number of stone elements in this analysis, details of Ferring's classes are not required, except in a few cases (see BTFs and URCs below).

Total Bone (Bone). This class represents the total number of bone specimens in any given quad at Aubrey. In this analysis, the total count of bone within each occupation area is used in contrast with total debitage and is a measure of the intensity of the use of space in regard to bone processing. The presence of bone in an archaeological site does not immediately imply that it was culturally deposited. However, the bone present at Aubrey is in close association with stone tools and debris, thus, in this analysis it is inferred to be culturally derived. The question of isolating the natural faunal deposition is not addressed here, but an analysis of this sort would improve our understanding of the faunal distribution and its relationships with other classes at Aubrey.

Burned Bone (BND). This class represents the total number of burned bones. This is a category that does not distinguish between species, size, or any other distinctive condition of the faunal assemblage. Behaviorally, this class simply represents the burning of bone. Along with the presence of charcoal, burned bone was used by Ferring (2001) to define the location of "hearths," or surface fires. Although there are probably unforeseen alternatives, it is assumed here that, unless subsequent cultural or formative process affect a location, people did not perform activities in a hearth, but rather adjacent to them. The goals here are to 1) test the utility of using burned bone concentrations as the means of defining hearths and 2) test for associations between burned bone and other diagnostic classes, suggesting spatial co-occurrence and behavioral associations. Admittedly, the assumptions about bone may be tenuous, but it is still important to test them here.

Unburned Bone (UNB). This class represents the total number of unburned bones. Unburned bone is assumed to come from either the natural or cultural faunal records. However, for the purposes of this analysis, I assume that unburned bone is a result of butchering behavior. The natural faunal assemblage derives from non-human processes, while butchering is the dominant behavior associated with unburned bone.

The latter condition is used for testing in this research. I test unburned bone for spatial associations with other tools types, as well as burned bone.

Bifacial Thinning Flakes (Restricted Raw Materials [RMs] = BTFr). This class represents a restricted count of lithic debitage pieces belonging to a morphological class of artifacts removed from bifacial tools. The restriction is based on total abundance of any given raw material within a debitage class (see criteria below). This debitage originates from bifacial tools and is assumed to indicate locations of bifacial tool resharpening. There are too few projectile points to be used in a quantitative assessment here; otherwise, they could be included. Bifacial tools are presumed to be associated with general butchering processes, specifically the disarticulation of bones. The identification of BTFs stems from its morphological characteristics, of which the "lipped platform" serves as the primary indicator (Figure 5). The purpose of the BTF is to remove the dulled edge of a biface with minimal alteration to the overall shape and size of the object. BTFs are interpretable as resharpening and maintenance/repair debitage originating from a bifacially flaked object, such as a Clovis point.

Unifacial Resharpening Chips (Restricted RMs = URCr). A restricted count of lithic debitage pieces identified as belonging to a morphological class of artifacts removed from unifacial tools. This debitage originates from the resharpening of unifacial tools. Activities associated with unifacial tools are general scraping, including hide processing and removal of periosteum. URCs are a debitage class defined for the first time by Ferring (2001) in the analysis of the Aubrey site. However, the principal characteristic used to identify URCs arises from a distinctive bend on the distal end of the chips themselves. This bend is caused by the transfer of energy during removal across the working edge of the unifacial tool, where it then overpasses onto a pre-existing dorsal scar (Figure 6). Despite the size of the URCs, these traits are found only on complete debitage specimens. Those that break or hinge before the dorsal scar do not have this marked bend. Thus, the URCs identified at Aubrey represent a minimum number of unifacially-flaked debitage specimens.

BTFr & URCr Raw Materials (see Table 9). The restricted counts associated with BTFr and URCr categories are designed to include only those raw material categories that are abundant enough to be quantitatively tested. As variables that are examined in this analysis, types of raw materials within BTFs and URCs represent a minimum number of tools used at the site. Raw materials that are represented in each debitage category stand for at least one tool, but probably more, although this cannot be confirmed.

Testing for spatial associations between raw material categories is particularly informative about the spatial structure within and between different forms of tools. No matter how many tools were present at the site, if they were knapped repeatedly over space, then their spatial patterns would significantly overlap. However, if there is spatial segregation of raw material types within a particular debitage class, then the implication is that resharpening events are more “visible” in certain areas.

It is important to distinguish what these debitage classes are indicating. Although these smaller lithic elements are less likely to be moved than a larger tool, for example, this debitage serves as evidence of resharpening, not necessarily the specific location of a tool's use.   It is not the purpose of this analysis to identify tool use areas, but rather to observe spatial patterns between artifact classes and to statistically test those observations in conjunction with the behavioral implications of those classes. In the case of debitage classes, I am analyzing the differential distributions of resharpening evidence, which may or may not indicate the location of tool use.

Mapping and Classification

Explicitly rendering the densities of each variable is an important step in the analysis of spatial association. There are several types of maps used here to either visually or descriptively analyze spatial distributions for both univariate and bivariate approaches.

Univariate Chloropleth Maps. In order to shed light on the low- and medium-density parts of each area at Aubrey, as well as the high-density areas, I chose a "base-2" set of break values for each variable, which is so termed because it is based on the powers of two (0, 1, 2, 4, 8, 16, etc…). These break values help to reveal the density variation across the site with out having to transform the data. Other classification techniques, such as Jenk's Natural Breaks or Equal Interval do not control for this variation, since there is a high degree of clustering at the site. ArcGIS provides fast and easy processing for these types of custom classifications.

Bivariate Dot Density Maps. Dot density maps are generated by ArcGIS by randomly assigning points to locations within each quad. Although this does not represent the true location of each artifact within its assigned quad, the purpose here is to visualize the co-occurrence of artifacts within a given location, not to measure nearest neighbor distance. This is a qualitative method used to help generate hypotheses about the spatial relationships between variables.

Density Stratified Pairwise Distributions (DS). In addition to observing patterns across the entire site, the areas are stratified by density in order to further understand the relationship between density and composition relative to each pair of variables. Each pairwise comparison is set up as a combined sub-sample of the total assemblage. For example, when comparing BTFr versus URCr, the two variables are combined to form a new dataset named BTFURCr by simply adding their totals per quad together. The new distribution is then classified using the base-2 classification. This classification was used to create *empty, low, medium, and high* ordinal classes relative to the total number of base-2 classes. From a materialist perspective, this technique allows for control over the classification, which is designed specifically to look at compositional variation across differing densities. For example, if the maximum quad value for a given variable were 46, then the base-2 classification system would generate eight different classes (0, 1, 2, 4, 8, 16, 32, 46). In order to create the four ordinal groups, all of the base-2 classes above zero (seven in this case) would be divided as equally as possible. However, with seven classes, some arbitrary rules had to be created to control the density stratification process. For this analysis, I attempted to keep the low- and high-density classes equal in terms of the number of base-2 classes that were used to generate them. In the example above, quads with densities of 1 or 2 were aggregated to the low class, 4-16 to the medium class, and 32-46 to the high class. In this case, the low and high classes consist of an equal number of base-2 classes. Table 10 shows the typical aggregation system used to create the density-stratified classes.

For each pairwise comparison, the areas are stratified based on the density classification method described. Visual maps are examined individually and statistics are generated for each bivariate set on five different spatial subsets: Total Area, Restricted Area (Cells > 0), Low-, Medium-, and High-Density quads. Classifying the quads by density clarifies changes in the relationships between variables. It is important to realize that Low, Medium, and High classes of quads do not represent the overall density areas of the site, but rather are relative to the combined totals of each pair of variables. Since the density areas are relative to the pair of variables, this technique provides a means of understanding the relationship between the variables with changes in their combined density. Archaeologically, this is linked to the intensity of use of different areas within a site, relative to each variable pair. As the total number of Variable 1 and Variable 2 increases, how does their relationship change? Do they tend to separate or overlap? Where visual inspection often yields interesting hypotheses about patterning, density stratification of the area can help to elucidate relationships across density classes between the variables, which are often lost when incorporating the entire area as a whole.

Proportional Index Maps. An index was calculated for each pairwise comparison as a means of improving the visual representation of patterning between variables. This index is simply a proportion of one variable against another that, when mapped at each location, made compositional patterning clearer and helped to predict the strength of association that would be provided by the statistics. For any quad for a given set of variables, the index is written as:

$$Var1 / (Var1 + Var2)$$

The values range from 0 to 1; with a value of zero indicating that only Variable 2 exists in that location and a value of 1 indicating the presence of only Variable 1. A value of .5, in this case would show that there is an equal number of each variable in the given cell. Thus, you can see where one or the other cariable is found and where they overlap. The advantage of designing the proportional index maps stems from their applicability to bivariate comparisons. Normally, percentage maps are relative to the entire contents of a given cell. However, in this case, the process is set up so that the relationships between two variables can be considered independently of the rest of the assemblage. Since there are many behaviorally ambiguous artifact classes, this provides a targeted approach to spatial analysis, although it is more tedious than previous clustering techniques used. Despite the availability of more complex diversity indices (Grayson 1984; Magurran 1988), the important characteristic of this index is its simplicity.

Statistical Analysis

Descriptive Statistics. At the assemblage level, spatial quartiles and the variance-to-mean ratio provide a compelling assessment of the spatial structure of individual artifact classes. However, they give no measure of the number of clusters or spatial association between variables. The concept of spatial quartiles is the number of cells required to contain a certain percentage of the variable of interest. In this analysis, I use the 2nd quartile, or 50%, as a descriptive element of a variable's spatial distribution. For example, 50% of a variable containing 100 pieces within an area may be found in 20 cells (.25m^2 each) or 5m^2. Again, this does not suggest which 5 meters, but rather the clustering tendency of the particular variable. Of course, this measure is percentage and relative to sample size of a variable, so 50% of one variable might be 50 pieces, whereas in another variable it may only represent five pieces. However, this is a simply comparative measure between variables that ignores the sample size and addresses dispersion.

The Variance-to-Mean ratio (VMR) is a descriptive statistic used in quadrat analysis to measure the degree of clustering of a variable across space. The VMR "…standardizes the degree of variability in cell frequencies relative to the mean" (McGrew and Monroe 2000, 178). This is helpful in comparing the relative spatial dispersions between distributions of artifact classes. Different clustering patterns can be inferred from the VMR, where high VMR values suggest clustering, a value of zero indicates uniform patterning, and a value of one represents a perfectly random distribution (variance = mean). With reference to Aubrey, statistics were calculated for each of the individual artifact classes analyzed here and, along with visual patterns, provide a preliminary assessment of artifact associations and a basis for hypothesis testing.

Variable Association (Pearson's r, Correlation Coefficient). Although correlation coefficients have been used in the past, the method provided here presents a different way to deal with space and the intricacies of variable association in order to arrive at archaeologically informative questions.

Pearson's r is a measure of covariance between two populations of interval or ratio scale data (McGrew and Monroe 2000). The statistic ranges from –1 to +1, representing perfectly negative or positive correlation within a set of cases, respectively. Bivariate comparisons that exhibit no statistical trend have a statistic of zero. Pearson's is the most common correlation coefficient used in statistics, but has several data requirements and is sensitive to many data conditions that are relevant to archaeological research (Speth and Johnson 1976, Whallon 1984).

Correlation is a common archaeological tool and has served many purposes in archaeology, including comparing assemblages, acting as the basis for factor analysis, and identifying spatial patterns between artifacts (Clark 1979; Clarke 1978; Effland 1979; Hodder and Orton 1976; Speth and Johnson 1976). However, there have been many warnings against the improper usage of statistics, including correlation. Thomas (1978) reviewed the dangers and abuses of statistics, raising the awareness of the role of quantitative applications in archaeology. Despite their popularity, Thomas suggests that the added complexity multivariate statistics does not make them inherently better in any way. Furthermore, univariate and bivariate techniques garner more attention, since they appeal to a wider audience than their specialized multivariate counterparts (Thomas 1978). This is not to insinuate that more familiar methods are applicable to all questions or are free from impunity. On the contrary, Speth and Johnson (1976) directly address the validity of correlation techniques in archaeological typologies of space and lithic technology. Their review of factors influencing the magnitude and significance of correlation coefficients caution the haphazard use of these statistics, resulting in improper cultural interpretations. These factors that can affect the results include the presence of random zeros, variability in the frequency of items being compared per grid square, and sampling or human errors. Increasing the chance for weak positive or negative associations will influence the archaeologist's interpretations. Clifford et al. (1989) provide a possible solution to problems associated with Pearson's assumptions, as discussed at the end of the previous chapter.

I have acknowledged these limiting factors and attempted to provide methodological techniques for adapting to the errors (density stratification, variable selections, etc). The preliminary use of visual and descriptive analysis also improves the assessment of the correlations, rather than allowing them to speak for themselves. Expectations about the correlations between artifact class distributions, as stated with each bivariate association, are often foreshadowed by casual, visual inspections. The conclusions drawn by Ferring's visual inspections (2001), as well as those presented here, provide just that—a set of testable hypothesis drawn from visual observations.

The overall goals of spatial archaeology must also be considered in the use of correlation coefficients, since the issue of spatial typology has been addressed here and has been the dominant task of spatial analysts in the past. Rather than interpreting artifact associations as groups of culturally relevant types, I present a series of tests employing correlation coefficients that are designed to provide an empirical degree of measurement to accompany visual observations, as well as the assumptions behind prevalent artifact classes. Speth and Johnson (1976) attend to this issue of functional specificity, referencing the variability of retouched and non-retouched tool uses in ethnographic literature. In this analysis, it is the debitage, not the tools themselves, that is used as spatial indicators with behavioral correlates. Therefore, the scale at which the lithic use patterns are associated improves the integrity of interpretations.

Computer Software & Geographic Information Systems

Several computer programs were implemented during this research. Cartographic procedures of this analysis were performed using the ESRI ArcGIS 9.0 ® geographic information system software. The use of GIS in archaeology has opened the floodgates for spatial analysis research. It provides many cartographic and analytical tools. The use of this program greatly improved the speed, efficiency, and flexibility with which maps were made. SPSS 12.0 ® software was used to generate statistics. Data were housed in Microsoft Excel ® spreadsheets and data base format (dbf) files.

CHAPTER 5

RESULTS

Because there are numerous bivariate comparisons to present in this chapter, the results are divided into sections. Area B is described first, followed by Area F, in the order of the variables listed in Table 1. First, I consider each of the variables separately with descriptive statistics (Table 11) and three types of introductory density maps—the combined total density of the two variables (ex. BTFURCr), the Density Stratified map (Empty, Low, Medium, and High), and the densities of the individual variables (ex. BTFr and URCr, separately). Second, the bivariate dot density and proportional index maps are presented to observe the spatial associations between the variables more closely. Thus, six maps accompany each bivariate comparison (Figures 7-67 for Area B; Figures 68-127 for Area F). Finally, I review the correlation coefficients and accompanying explanations for the two variables at each Density Stratification level (Total Area, Restricted Area, Low, Medium, and High densities; Table 12). Descriptive data of the individual density-stratified sub-assemblages help to understand how sample size affects the outcomes (Tables 14-16 for Area B; Tables 20-23 for Area F). In the next chapter, I compare and contrast the spatial patterns and the behavioral implications from each occupation area. A discussion concerning Aubrey's role in Paleo-Indian archaeology is also provided.

Area B, Total Density

Before striking out into the compositional variation within the area, it is important to analyze briefly the overall density pattern at the site. The spatial distribution of artifacts without reference to their composition illustrates the intensity of the use of space across the site. Looking at the density of artifacts reveals general clustering patterns and leads to further questioning of the explanation of those patterns (or lack thereof). Before visiting the patterns of each individual artifact class, observing the density of the total distribution at the site helps to decipher the larger patterns of activity; the compositional breakdown of those patterns explains the variation within this general distribution.

The combination of total debitage plus bone represents the total density of artifacts for this analysis, with the exception of the 64 tools (Figure 7). The clustering of artifacts is evident in this map of Area B. Although there is variation across the site in terms of density, that there are very few empty quads suggests that the entire site was "used" to some degree. The descriptive statistics, such as the V/M ratio and the 50% spatial quartile (see the Methodology chapter for an explanation of these two statistics) provided in Table 11 emphasize the general clustering pattern of the artifacts in the sample. The simple observation that 50% of the ~8600 artifacts are found in $7.25m^2$ reinforces this point nicely. Understanding how this clustering pattern is distributed across space is the key to interpreting behaviors at the site.

Looking at Figure 7, there appears to be two distinct high-density areas of artifact deposition within the site, one in the north and the other in the south. Ferring (2001) identified two "debitage piles" in the high-density areas based on their overall density, content, and size. Medium-density areas are the most abundant and show two different trends—one that circumscribes the high-density areas (found in the northern and southern portions of the site) and another arrangement that does not have a high-density core (as seen in the southwestern portion of Area B). This pattern is consistent with the eight features defined by Ferring, which, from his perspective, represented observable concentrations of material, each varying in content. Without any prior knowledge about the composition of this distribution, however, it is suggested from visual inspection that the objects in Area B are spatially clustered at different scales.

Behaviorally, this is an issue of the differential use of space. Activities performed in the same space will show overlapping compositional patterns and demonstrate the repeated use of an area; if this is prolonged, the density at that location will also increase. The density stratification process of this analysis addresses this issue, which is akin to the observations made by Ferring (1984) regarding density versus compositional patterning. His examination of Aubrey compared the composition of the highest density quads with the rest of area, as well as within the clusters themselves, and found noteworthy differences. In light of the overall density patterns of the combined bone and debitage total and Ferring's previous explorations, a closer look at the differential compositions of these concentrations reveals an interesting dichotomy through both qualitative and quantitative observations.

Area B, Total Debitage vs. Total Bone

Both areas B and F contain bone and lithic debitage, but in strikingly different amounts (see assemblage description sections). Any spatial structure existing between debitage and bone classes illustrates the necessary spatial requirements of activities involving these materials, whether overlapping or separated. The distinct segregation of bone and lithic debitage at Aubrey would suggest that activities dealing with these elements required different space. Overlapping distributions could suggest a number of different activity interpretations and would require further examination of relationships in specific types of bone and stone artifacts.

Descriptive Analysis. According to the univariate measures, such as the V/M ratios and the 50% quartiles (Table 11), both bone and stone appear to be clustered across Area B. Although the debitage shows a much tighter grouping pattern than bone (e.g. V/M = 163 vs. 11, debitage and bone respectively), these descriptive elements clarify neither the spatial structure of each distribution nor their associations in space. What is evident, however, is the fact that bone appears to have a more dispersed spatial pattern than debitage. Given the horizontal integrity of the site, these clustering patterns are attributed to cultural agents for the purpose of this analysis. The highly localized distribution of debitage is indicative of an intense use of a small amount of space for the resharpening and maintenance of lithics, which deposited nearly 3000 individual stone specimens in $3m^2$. These $3m^2$ of high-density areas are not necessarily assumed to be contiguous. In other words, this does not suggest that there is one $3m^2$ pocket containing 50% of the lithic artifacts. The spatial distribution of those $3m^2$ could be in any conceivable pattern across the site. The spatial distributions of each variable, along with the bivariate relationships between these classes, are evinced further in the maps below.

Maps. Figures 8-12 illustrate the relationships between debitage and bone in Area B. Visual inspection reveals that debitage and bone are arranged quite differently in space. The observations made from the descriptive statistics are exposed in these four maps. In Figures 9 and 10, the high-density areas of both debitage and bone are in proximity to one another, but rarely overlap. Figure 9 helps to visualize the more diffuse patterning of bone expressed in the descriptive statistics. Compared to the debitage, which is more concentrated, the bone distribution shows numerous peaks of medium density across the site. This suggests that bone was processed repeatedly in the area, but does not explain this observation. This more diffuse pattern is explored later by comparing burned and unburned bone distributions.

Figures 11 and 12 illustrate the rather dissimilar patterns of bone and lithics. The dot density symbology simultaneously displays the concentrations of debitage and the comparatively diffused distribution of bone. However, surrounding the highest density areas of debitage in both the northern and southern parts of Area B, there appears to be some overlap between the two variables. The proportional index map is quite illustrative of this fact, since it is a density free measurement of the relationship between these two variables. In this map, the relative abundances of debitage to bone are shown. It is interesting that, although either bone or stone dominates in any given quad, the other is almost always present in small amounts. In other words, the bone and lithic assemblages are not absolutely segregated. This is supported by the fact that there are very few quads containing only debitage or bone. Although this may not affect the larger interpretation of the relationship between bone and debitage, it does contribute to the hypothesis that the area was occupied continuously. There is not a distinct spatial segregation between debitage and bone, neither horizontally nor vertically. Thus, the possibility that the bone and debitage deposits occurred sequentially is less likely.

From a qualitative standpoint, the disassociation hypothesis remains intact, since there are very few quads where the proportion of debitage and bone approaches parity. Where evenness does occur, it is most often in medium- and low- density portions of the area. There are a few quads that serve as an exception to this observation, all of which are close to the northern high-density debitage pile. These locations where bone and lithics are in equal proportions are of interest for later parts of this analysis, where more specific variable associations (BTFs and URCs vs. Burned and Unburned Bone) are tested to try and further understand more specific patterns where debitage and bone overlap. However, these exceptions to the debitage and bone relationship may not affect the overall disassociation hypothesis explored by quantitative analysis.

Correlation Analysis. When the quantitative measures are taken into account, the spatial relationship between debitage and bone is significantly negative. Correlation on the entire or restricted area subsets leads to the conclusion that there is no statistical trend between these two variables. The density stratification process (Figure 8; Table 12) shows that a significantly negative association persists across the density classes, supporting the visual observation that debitage and bone have different spatial distributions, regardless of density. The medium-density areas appear to have the weakest negative correlation, which is most likely due to the overlap between bone and stone in the northern section of the area. Although it is most abundant in the southern part of the site, the overall diffusion of bone and its proximity to, but not overlap with, the debitage concentration in the northern part of the site (medium-density areas) account for this lower coefficient. It is both qualitatively and quantitatively observable that the inhabitants at Aubrey physically separated activities surrounding bone and stone. However, there is an issue with proximity that is not addressed here, but is described in Ferring's report as lithic processing activities surrounding a hearth in the northern section of area B. This discontinuous and diverse spatial distribution of bone may be explainable through variations in the types of bone across the area. Nonetheless, the behavioral implications of this negative relationship between debitage and bone are on a general scale, but drive the investigation into more specific intricacies of the lithic and faunal distributions. For instance, since debitage and bone appear to be disassociated, are there spatial relationships between other specific categories within these two variables? The variables compared in the following sections address this question.

Area B, BTFr vs. URCr

Descriptive Statistics. The differential use of stone within Area B provides an interesting addition to the dispersal of total debitage in this area of Clovis activities (Figure 9). Both the BTFr and URCr distributions individually show clustered patterns in their V/M ratios and 50% spatial quartiles. There is a high abundance of both variables, but the descriptive elements show different patterns. There is a slightly stronger indication that BTFr's are more spatially kurtotic (i.e. spatially "packed"), while the URCr's show more spatial dispersion. This corresponds to the interpretations presented in the original report (Ferring 2001) and is illustrated well in the visualization of these patterns.

Maps. A map of the combined totals of BTFr and URCr is provided in Figure 13, along with the density-stratified map in Figure 14. Although the "noise" that is produced by the non-diagnostic debitage has been removed from this map, the spatial pattern of BTFs and URCs generally mimics that of the total debitage distribution. However, there are some variations that make this configuration distinct. First, there are many quads (n = 243) that do not contain any BTFr's or URCr's. Only ~40% of the quads (n = 167) contain at least one of either category. The restricted spatial extent of these two diagnostic variables illustrates the fact that the non-diagnostic materials, which dominate the assemblage in Area B (and Area F), have a more diffuse spatial pattern. Second, looking at the combined total distribution, the unifacial and bifacial resharpening events appear to concentrate in the "debitage piles" defined by Ferring (2001), but also there are relatively high proportions of these elements outside of the piles. These concentrations were not as noticeable in the overall debitage distribution, but, having restricted the sample to only BTFr's and URCr's, it is evident that something interesting is going on with these distinctive lithic elements. The density stratification map provided in Figure 14 is especially indicative of this observation.

When observed independently (Figures 15 and 16), the differences between the distributions are quite impressive. The visual representation shows the spatial structure behind the descriptive statistics mentioned earlier. While the BTFr distribution is concentrated in the northern part of the block where the most total debitage was located, the URCr's present a different pattern that is more diffuse, but not at all random. They appear to be located in numerous pockets away from the primary debitage piles. At the 50cm scale, however, this is not to say that URCr's are not in proximity to the BTFr's, but there is a spatial separation. Figures 17 and 18 reinforce this by visual inspection. The dot density map reveals the overlap just to the southeast of the northern debitage pile that is not as easily deciphered between the univariate maps. In this comparison, the proportional index is quite helpful in seeing the differential patterning. Beyond this overlap, there appears to be an increasing proportion of URCr's. These are akin to the URC clusters identified by Ferring (2001) in the original report. Overall, the visual inspection of the spatial distribution of these two categories detects a strong disassociation.

Correlation Analysis. Because of the overlapping areas in the northern part of the block, the coefficient produced when including the entire area is actually a low positive one (Table 12). This drastically changes when the empty cells are removed and the coefficients for the density-stratified classes are calculated. The strongly negative correlation that is produced across each of the density classes reinforces the spatial division of these materials as seen in the visual observations. Again, the medium density areas have a coefficient that is a bit lower than the other two classes, probably on account of the overlapping areas in the northern part of the block. There is still enough URCr dominance, however, to show significant negative correlation.

The disassociation of these two debitage classes is especially informative about the differential use of space. Since these two classes are assumed to have distinct behavioral implications, the fact that they segregate spatially shows that 1) the classes are valid measures of different activities and 2) the behaviors did not significantly overlap during the occupation at Aubrey. Thus, how the debris from cutting and scraping activities segregates from one another and perhaps associates with other elements, such as bone, are part of a larger picture of activities taking place in Area B. Furthermore, contrasting these patterns in Area B with those in Area F (see below) provides even more evidence as to the diversity of Clovis activities that took place during the Aubrey occupation. These thoughts are expanded upon later in the discussion portion of this report.

Area B, URCr's & BTFr's by Raw Material

Given that the resharpening of BTFr's and URCr's did not co-occur in Area B at Aubrey, it is possible to look at the internal spatial structure of both of these debitage classes by their relative raw material distributions. Partitioning each debitage class by raw material helps to elucidate patterns of resharpening within each class of tool. Examining the classes for spatial structure by raw material tests whether individual raw material types are disassociated from other raw materials of the same tool type. Alternatively, a more homogenous assemblage of raw materials would be more ambiguous and might suggest that tools were used repeatedly across the area where the debitage type is found. Relationships between raw materials of each debitage class are examined more closely through bivariate associations. The behavioral implications for either of these patterns are informative about the differential use of space by the Clovis inhabitants within a given debitage class, as well as the integrity of site structure.

Area B, BTFr's by Raw Material

To reiterate, the BTFr variable is a sub-assemblage of the total number of BTFs restricted by those raw material categories that were sufficiently abundant to be used in quantitative analysis. Less abundant raw materials within the BTF class were omitted from the total BTFr sample. The three raw materials included here are Tecovas Quartzite, Chalquartzite, and Point Quartzite.

Descriptive Statistics. The previous examination between BTFr's and URCr's observed the relatively higher clustering pattern of BTFr's. The map of BTFr's (Figure 15) showed two different high-density concentrations in the northern and southern portions of the site, as well as a low-density scatter to the southwest. Within this debitage class, however, the spatial patterning between raw materials shows an interesting division (Table 11). Chalquartzite (Q2) shows the highest clustering tendency, followed by Tecovas Quartzite (Q1) and Point Quartzite (PtQ). The V/M ratios and 50% spatial quartiles are indicative of the clustering trends of each raw material type, despite the fact that their total abundances differ strikingly. Although 50% of the Chalquartzite was found in $2m^2$, its total distribution covers almost $17m^2$. This contrasts with Tecovas quartzite, 50% of which is found in $1.25m^2$ and the total assemblage in only $4.75m^2$. (Note that there are nearly five times as many Chalquartzite as Tecovas BTFs.) This suggests that Chalquartzite BTFs have a wider presence across the site and may be associated with areas outside of the main cluster. The visual inspection confirms this observation (see below). Although both raw materials were intensely used in a small area, Chalquartzite shows a more spatially diffuse pattern of use across the site. Behaviorally, the resharpening or maintenance of this raw material must have been more intense overall as compared to the BTFs of other raw materials. This could be due to more tools of Chalquartzite being used or the same tool(s) being used with more frequency. Neither interpretation can be validated at this point.

Although the overall spatial concentration of Tecovas and Chalquartzite show a clustering trend, this is not the case for Point Quartzite. Sixteen of the 17 total Point Quartzite BTFs found in Area B are in separate quads. With descriptive statistics alone, it is not immediately evident whether these quads are contiguous or scattered across the site. Nonetheless, the differential patterns of these raw materials of BTFs are somewhat obviated by the descriptive statistics alone, but require further visual inspection for confirmation. Since the distribution of BTFr's has already been considered, this differential patterning based on raw materials within the class presents an interesting range of behaviors involving BTFs.

Maps. Figures 15 and 19 present the total BTFr's and the density stratified classification, respectively. The BTFr distribution parallels the total debitage density in Area B (Figure 9), with concentrations in the northern and southern sections of the block, but a diffuse scatter across the rest of the site, including lower-density areas where there is generally more bone and/or very little debitage. As noted in the BTF versus URC comparison, the area just outside of the northern concentration, particularly to the southeast, shows a fluctuating density of BTFr's. Although the highest density areas draw the most immediate attention, the fact that BTFr’s are present across the entire site is indicative of broader patterns of use within this tool class.

The distribution maps of each raw material within the BTFr class (Figures 20-23) shed light on the raw material variability within the overall distribution and support the observations made with the descriptive statistics. The majority of the Tecovas Quartzite BTFs concentrate in and around the northern debitage pile, with one stray piece in the southwestern portion of the area. This pattern reflects the descriptive statistics and suggests that the biface reduction / resharpening occurred primarily in association with the rest of the northern debitage pile identified by Ferring (2001). Overall, there are very few Tecovas BTFs in any given quad, but the fact that they are concentrating around the debitage pile shows that the material was worked in that general area. The isolated piece in the southwestern portion of the site is peculiar, given that there is not much lithic activity in that area. However, there is currently no evidence of refitting that would suggest that this lone BTF is directly related to the reduction activity in the north.

Comparing these raw material categories, several patterns emerge and are evident in the dot density and proportional index maps (Figures 24-29). The Tecovas pattern parallels the Chalquartzite pattern, which also seems to mimic the total debitage pattern, save for the scatter in the southwestern portion of the site. The pattern of Chalquartzite BTFs is coincident with the highest areas of lithic deposition, although there are a few pieces in lower density areas. This distribution implies that either the BTFs were moved to the less dense areas or were infrequently flaked (one or two at a time) in those locations. Nonetheless the Chalquartzite appears to correlate with the Tecovas, but not the Point Quartzite. This final BTF raw material category is quite distinct from the other two. The dot density and proportional index maps show that there is almost no overlap between Point Quartzite and either of the other two raw materials. Given that it is the same raw material from which the large biface found was made, the dissimilar spatial pattern of Point Quartzite provokes a number of behavioral implications to be discussed later. Along with refitting evidence of the same Point Quartzite Clovis point, it appears that although BTFs show a distinct patterns overall, the differential arrangement of the BTFs by raw materials allows for a closer look at bifacial reduction and tool use at the site.

Correlation Analysis. Table 12 shows the correlation coefficients for each bivariate combination of BTFs by raw material. One overriding issue with this particular process is the fact that there are only four quads in the high-density class of BTFr's. This problem is magnified by the sampling error caused by the fact that those four quads were actually a $1m^2$ test unit that was dug in the early stages of the investigation at Aubrey. Because of this, the artifacts collected from this unit were not given spatial reference to the quad level. The totals for the unit were divided equally among the four quads when the database was built. However, this evenness within the four quads is not manageable by the Pearson's equation. Thus, there is no way to perform the calculation for the highest density areas. This is problematic for the quantitative analysis, so this technique should be reconsidered for future applications. The interpretations for this density class will have to rely on the descriptive data and visual observations. The other classes, however, did not have this problem and can be interpreted appropriately.

When considering the total or restricted areas, the relationship between Tecovas and Chalquartzite is positive and significant. This corresponds to the general observations given above, but is probably due to the presence of many empty quads. However, when the two raw materials are considered in association with the combined density classes, the relationship appears to change. Where BTFr counts are lowest, there is a negative correlation between Tecovas and Chalquartzite. This may be a result of sample size, since there are very few Tecovas pieces in the low areas. Where they are found, they are the only BTFs in that cell. This is an effect of the limited range within the low class, where a negative correlation is quite easy to accomplish, since the total range within a low cell is only between one and two pieces. Therefore, the negative correlation is most likely a product of sampling and classification. Other density levels are not significant or impossible to generate, making the quantitative analysis of BTFr's difficult. However, with the descriptive elements, there is something to be said for the relationship between these two raw materials, it just cannot be quantitatively justified.

This problem persists with the comparison between Tecovas Chalquartzite with Point Quartzite. Although the descriptive analysis showed segregation, the quantitative results are probably due to insufficient sample size. However, it is interesting that the low areas and the restricted area total are the only density classes where Point quartzite BTFs shows a strongly negative correlation that is significant. This is a compelling parallel with the descriptive observations. This is probably the only salvageable piece of quantitative evidence contained in this process. The discussion, therefore, is limited to the descriptive elements. Unfortunately, this is not the only instance where the sampling style of the density stratification technique may have caused problems. In other words, the number of artifacts in any given low cell is limited to one or two pieces in each case. This low range may cause problems in the correlation calculation, whereas high-density cells have a much larger range and, thus, react differently in the calculation.

Except for Point Quartzite, BTFr's concentrate in the highest density parts of Area B. There are three patterns that emerge from an examination of the dominant raw materials of BTFs. First, the northern debitage pile contains both Tecovas and Chalquartzite BTFs. This may be partially due to the fact that Tecovas Quartzite material is seen to grade into Chalquartzite, even on the same flake (Ferring 2001). Thus, finding these two raw materials together could be due to the natural lithology of the raw materials. However, there is an equal percentage of tools at the site made of both materials, suggesting that it is possible to find these raw materials separately. The combination of both Tecovas and Chalquartzite in the northern part of block B could be due to either one of these situations. The presence of refitting BTFs of both raw materials in this area, however, points toward the fact that a biface of gradational lithology was reduced there. Therefore, it is possible that these BTF patterns are due to the reduction and reworking of as few as one biface and its debitage.

The second and third patterns exhibited by the BTFs are those seen in the southern part of the area, both around the debitage pile and in the southwestern portion, where Point Quartzite dominates the very low-density distribution. Flakes and smaller debitage dominate the southern debitage pile. The BTFs that are present there are only of the Chalquartzite variety. The Point Quartzite BTFs are completely disassociated from the others and are presumed to be associated with a different set of artifacts. Although this is not investigated quantitatively in this analysis, the fact that Point Quartzite appears primarily in association with bone in the southwestern part of the site suggests that it was being used in some form of faunal processing. These three patterns show the importance of using the different raw materials as points of comparison within a particular debitage class.

Area B, URCr's by Raw Material

There are four raw materials included in the URC class: Chalquartzite, Chalcedony, White Edwards Chert, and White Novachert. The only raw material shared with significant abundance between URCr's and BTFr's is the Chalquartzite. Although the patterns between BTFs and URCs has already been discussed, the examination of differential distribution of raw material categories within URCs reveals that not only are these artifacts clustered, but there are also distinguishable spatial disassociations between these raw materials.

Descriptive Statistics. All four raw materials within the restricted URC debitage class show clustering tendencies based on the V/M ratio and 50% spatial quartiles in Table 11. The two most abundant raw material types of URCs, Chalcedony and White Edwards Chert, also appear have the highest 50% spatial quartiles, meaning that more space is required to represent 50% of their respective assemblages. From this descriptive statistic alone, one can infer that these two raw material types will be more diffuse across the area than the other two. Behaviorally, this connotes a more spatially diverse usage of these materials, which may or may not overlap. White Novachert and Chalquartzite, on the other hand, show clustering tendencies and very low 50% spatial quartiles. Although there are generally fewer of both of these types, they are quite tightly packed in space at Area B. The visual observations should aid in these observations.

Maps. Figures 30 to 47 illustrate the individual bivariate comparisons between each of the four URC raw material types. Because there are sets of maps for each bivariate comparison, the number of illustrations is high. However, this tedious procedure allows for targeted comparisons between each raw material type. The overriding goal here is to determine if there is any structure or associations between the different raw materials of URCs. Since they have already been determined not to correlate with BTFs, a closer look at the internal structure of this debitage category elicits a clearer understanding of how URCs were used in the area. Just as was presumed with the BTF analysis, whether or not there is structure within the URCs helps to show the different usage of tools across the site, as well as which type of tools were used repeatedly and which have a more restricted spatial pattern.

The first step is to revisit the total URCr distribution and density stratified maps (Figures 16 and 30, respectively). There is an immediate pattern that emerges that shows six relatively high concentrations of URCs. The question is whether or not these high concentrations have homogenous compositions or are small pockets of different raw materials of URCs. Figures 31–35 show the individual raw material distributions for URCs. Similar to the inferences made from the descriptive statistics, it evident that while Chalquartzite and White Novachert have more restricted patterns in general, White Edwards Chert and Chalcedony are nearly ubiquitous throughout the total URC area. However, it appears that each raw material has its own area of concentration. The two most abundant raw materials, White Edwards Chert and Chalcedony show the most overlap, which may be detectable in the correlation analysis. The dot density and proportion index maps of each bivariate combination support these observations (Figures 36-47). Each dot density map is particularly revealing when it comes to the overlapping or non-overlapping relationships of each pair. Plus, they give a clearer representation of the spatial placement of the artifacts. The proportional index maps provide another level of interpretation surrounding the overlapping between White Edwards Chert and Chalcedony, as well as the strikingly concentrated distributions of Chalquartzite and White Novachert. These are density free maps in that the proportions of each raw material are presented. What is most useful about these maps is their utility in proportioning compositionally unique and overlapping quads in the area. When raw materials rarely overlap, there is an abundance of red and green colored quads. This is basically a presence/absence map. This type of pattern is evident in combinations involving Chalquartzite and, although less so, White Novachert. Overlapping is indicated by the ramp of colors in-between. The combination of White Edwards and Chalcedony provide an excellent example of where there is a great deal of overlap. Although these patterns of overlap and isolation have been assigned to the different raw materials with the URC class, it is difficult to say if this is nothing more than a qualitative observation only. The correlation analysis provides a more objective critique of these relationships.

Correlation Analysis. Although there were patterns observed in the visual inspection of the raw materials of URCs, the correlation tests provided either insignificant or unexpected results across the density stratification scales (Table 12). The patterns at the total area and restricted area density levels showed no significant trends, with the exception of White Edwards Chert and Chalcedony, which showed positive correlation. However, the strength of the total area coefficient is most likely due to the presence of empty quads, but the restricted area coefficient is still positive and significant. This trend does not hold when divided into the density-stratified levels, but does mimic the relationship observed in the visual inspection. In fact, the relationship between these two seemingly overlapping raw materials actually shows up negative in the low- and medium- density areas and positive in the high-density areas, where the overlap is greatest. The lack of significance may be due to the low number of cells in the highest class. This is one case where the visual inspection is not able to detect the complete of pattern indicated by the quantitative analysis.

The only expected correlation is that found in the medium density class between White Edwards Chert and White Novachert. This relationship is most likely due to the fact that there are several medium density quads that contain White Edwards Chert and not White Novachert. This negative pattern does not follow into the high-density cells simply because there are probably not enough cases to produce a significant coefficient. This is one case where the visual inspection is able to detect at least a portion of the pattern indicated by the quantitative analysis.

In the other combinations of raw materials, the visual inspection hypothesized that there would be significant disassociations based upon the differential concentrations of these raw materials. The quantitative evidence is not able to support these perceptions with statistical confidence. In terms of Clovis behaviors, because the quantitative evidence does support the visual interpretations, it is not quantitatively viable to conclude that there are distinctive concentrations of individual raw materials of URCs in Area B. There is a visual tendency, but not a quantitative one. This may be due to the combination of Pearson's sensitivity and the sampling issues created by the density stratification process. Without a reconstruction of these density classes and perhaps a reconfiguration of the correlation approach, the quantitative evidence does not support the visual hypothesis.

Area B, Bone

The previous sections have targeted several relationships within the bifacial and unifacial debitage categories, but there is more to learn about the arrangement of Clovis materials with the analysis of bone distributions and their relationships with BTFs and URCs. In this analysis of bone, there are five topics of interests involving two characteristic types of bone—burned and unburned. The first topic juxtaposes burned and unburned bone. After which these two categories will be individually compared to the specific BTFr and URCr assemblages. Although it has already been shown that the total bone and debitage distributions show distinct patterns of disassociation, a closer look at the individual specimens of stone and their relationships (or lack thereof) with burned and unburned bone is warranted. This set of topics is particularly inferential, since each debitage or bone category is assumed to be connected to specific behaviors. The visual and statistical patterns that follow are a means by which to describe and measure these relationships in the Clovis range of behaviors in Area B.

Area B, Burned and Unburned Bone

Descriptive Statistics. There are approximately 3000 pieces of bone in the faunal collection from Area B, only ~25% of which is burned. Although their V/M ratios are quite similar (9.2 for burned, 8.7 for unburned), they differ significantly in their 50% spatial quartiles. This observation suggests that burned bone is much more clustered across the site than unburned bone. Kurtosis is another descriptive statistic that reinforces this relationship. Concentrations of unburned bone imply the locations where occupants somehow manipulated or disposed of faunal material. Considering their relative abundances, there is quite a bit more unburned bone-related activity than burned bone. Spatially, the descriptive statistics imply that both bone categories are relatively clustered, but that unburned bone is more diffuse across the site. Ferring noticed this in the original report (2001:Figure 9.36). He used concentrations of burned bone, along with the presence of charcoal, to delineate the location of hearths at the site. If burned bone is a good indicator of the presence of a hearth, then there should be a disassociation between these two bone categories. These visual renderings below aid in this observation.

Maps. Figure 48 is the density-stratified representation of the total bone count in Area B. This arrangement is used to compare the relative spatial distributions of burned and unburned bone across the different density classes. From this map, as well as the original distribution map (Figure 10), it can be seen that there are three main concentrations of bone in the area. The first is in the northern part of the site, to the southeast of the high-density debitage pile. In this area, there are several discontinuous high-density bone concentrations, which may or may not be related based on content. In the northwest section, there is a very small, compact high-density area, which is noticeably disconnected from any patterns seen in the lithic distributions. Finally, the southern half of the block is dominated by bone (as shown in the debitage vs. bone comparison). On a smaller scale, however, there is variation in the density of bone in this area, as illustrated by two seemingly separated portions of medium bone density areas. There are four distinct high-density areas in the southern sections, which are the cores of this southern distribution. One last note to make is the overall ubiquity of bone in Area B, considering that only 17% of the cells do not contain bone. The differential patterning of burned and unburned bone is interesting in the contexts of this total distribution, as well as what has already been observed in the lithic analysis.

Figures 49-52 corroborate the descriptive observations of both distributions, as well as display the comparative patterns of both bone types. Viewed separately, it is easy to see how much more diffuse the unburned bone is in the area. Both burned and unburned bones are present in the three areas pointed out before, although they do not appear to overlap directly. Considering the locations of the highest-densities of each variable, they appear in close proximity to one another in each location, but perhaps this is too general of an interpretation because there are segregated exceptions. In the southwest, there is a higher abundance of unburned bone. In the southeastern part, there is a more general pattern of mixing, with a predominance of burned bone.

Unburned bone, however, is found almost exclusively in and around the small cluster in the northwest. Parenthetically, this cluster was declared to be a hearth in the original report—an interpretation that challenges the role of burned bone as an exclusive indicator of hearths. The northern bone concentration, however, contains a distinct group of burned bone adjacent to one of unburned bone. The dot density and proportional index maps buttress these accounts of disassociated burned and unburned bone. This highly varied relationship between burned and unburned bone does not work as evidence of repeated refuse dumping, but may be related to the types of bone contained in each area. Ferring noted that burned bones of large mammals were found in both the northern and southern areas, but reptile remains, such as burned turtle and snake, are predominately found in the southern portions. According to his observations, these types of compositional factors may be driving the differential patterns in the bone distributions. This variation is not tracked in this analysis, but would be a worthy endeavor to further understand the more detailed components of the spatial patterning in Area B. The quantitative evidence for the relationship between burned and unburned bone provides additional emphasis to the patterns described here.

Correlation Analysis. The correlation coefficients derived from the density stratification process correspond well with the visual interpretations (Table 13). The only sampling issue exists in the high-density class, in which there are only 11 quads. However, the spatial relationship between burned and unburned bones is strong enough that a significant pattern emerges across all the classes, including the high-density class. As noted, there appears to be a generally overlapping pattern in Area B, when the total area or restricted areas are considered. This is confirmed with low, but significant positive correlations in both of those spatial classes. When the density low-to-high classes are extracted and compared separately, the disassociation of burned and unburned bone is elucidated. It appears that, although these bone types are found in proximity to one another and that there is quite a bit of overlap, the correlation process shows they are disproportionately distributed across space. Therefore, the distribution of bone in Area B of the Aubrey site shows discrete spatial arrangement of burned and unburned bone. This is not to say that there are completely isolated pockets of both bone types. Rather, there is overlap seen visually, suggesting concurrent activities, but it is just not enough to cause a positive correlation. This behaviorally distinct separation of faunal specimens supports the position that the Area B deposits at Aubrey are temporally concurrent and intentionally created by the purposes that parallel the specific subsistence strategy of the inhabitants.

Area B, BTFr vs. Burned Bone

This comparison investigates the possibility of a relationship between bifacial (cutting) tool debitage and burned bone. It was assumed here that, unless there is observable dumping of refuse among the inhabitants, these specimens would be spatially distinct, both qualitatively and quantitatively. Both of these categories have already been discussed in terms of their descriptive individual visual patterns and will not be repeated for this bivariate comparison. However, what is lacking are the combined density maps and the correlation analysis, which will be reviewed for concomitant distributions.

Maps. Figures 53-56 illustrate the combined and bivariate spatial patterns between BTFr's and burned bone. When considered jointly, the visual pattern that emerges parallels that of the total debitage and bone comparison, in which the lithic and faunal materials are distinctly separated. The case appears to remain the same for BTFr's and burned bone. While the two lithic debitage piles remain evident in the high-density areas, the burned bone pattern is strongest in the southern portion of Area B. The dot density and proportional index maps display this disassociation well. There is, however, a certain level of overlapping going on just to the southeast of the northern debitage pile. Ferring earmarked this zone as an area where a diverse range of lithic and bone types occurred. The repetitious use of space in this location is a reoccurring observation in Area B. What is unexpected in this particular comparison is the mixture of BTFr's and burned bone in the central part of the area. This section represents the relatively lowest density between the two variables, but there seems to be a relationship occurring that is evident in their proximity rather than overlap. Despite these two situations, the disassociation of these two variables is maintained.

Correlation Analysis. The coefficients produced from this pair follow the patterns observed in the visual analysis, but are affected somewhat by sample size in the high-density class. As seen in Table 13, there is no significant relationship evident when the total and restricted areas are considered. However, the restricted area is significant to the .10 level; in which case, the negative correlation between the variables is consistent with the low-to-high observations. These density classes show negative correlations that are significant to less than the .01 level, although the high-density class is not quantifiable, since it is represented by only one quad. However, when the descriptive numbers are taken into consideration (Table 16), this one cell has a 49/1 burned bone ratio, which is suggestive of a negative correlation. It is concluded that these two classes do not correlate in any visual or quantitative sense at the given scales.

Area B, BTFr vs. Unburned Bone

Despite the fact that debitage and bone do not correlate in general, there is room to suggest that bifacial tool debris may have some association with unburned bone from the perspective that bifacial tools are assumed to have been implements used in disarticulation and general butchering of bone. The problem with this assumption is that the presence of BTFs does not necessarily denote the location of use of the tool, but rather only the reduction of the tool, whether during resharpening, maintenance, or manufacture. Again, descriptive elements of the individual distributions in this comparison are not repeated, but are in the previous discussions.

Maps. Figures 57-60 depict the relationship between BTFr's and unburned bone, which appear to be almost entirely disassociated. As was the case with burned bone, these two variables mimic the segregated patterns expressed by the general lithic and faunal total assemblages. The dot density and proportional index maps are indicative of what appears to be a negative association. However, as has been noticed in previous combinations, there may be a relationship if proximity is considered, but not in the case of overlap.

Correlation Analysis. Table 13 contains the results of the correlation analysis across the density classes. The pattern again shows no significant trend when the entire block or restricted areas are considered, but changes to a significant negative association within the density classes. The high-density area does not show a significant trend, which is odd, considering that there are 187 pieces of unburned bone and only one BTFr in those cells. However, it is evident that these two classes do not overlap spatially, but occur in dense pockets in different, though proximal quads.

Area B, URC vs. Burned Bone

The stimulus for testing URCr's against burned bone stems from 1) the use of burned bone concentrations as indicators of hearths and 2) the assumed role of URCs as scraping elements used in the processing of bone (periosteum removal). Furthermore, since the concentrations of both URCs and bone were outside of the main debitage piles, a comparison of these two classes is an attractive opportunity to understand the more detailed behavioral associations. The descriptive statistics are not presented here, as this was already done in comparisons given above.

Maps. Figures 61-64 illustrate the patters that are indicative of the relationship between URCr's and burned bone. Again, these two categories are virtually segregated, save for the previously mentioned area of overlap to the southeast of the northern debitage pile. Both burned bone and URCr's showed high densities in this area and, thus, overlap to some degree there. What is interesting is that the URCr's appear to encircle the high-density burned bone pile. Only a few URCr's are found in the burned bone concentration itself. It appears that this area of overlap is an exception to the dominant pattern of segregation of these two artifact types.

Correlation Analysis. The pattern presented by the correlation analysis mimics that of the preceding lithic and bone comparisons, wherein the total area shows low, positive correlation, but is soon eclipsed by significant, negative correlations across the density stratification classes. The high-density area is not quantifiable, due to a low number of cells, but the descriptive data (Table 16) indicate that this is the high-density burned bone square, with 49 burned bone specimens and only 7 URCr's. Although this is a medium-density area of URCr's (relative to the total number of URCr's, see Figure 30), the URCr's and burned bone are not overlapping statistically or visually.

Area B, URCr's vs. Unburned Bone

Of the lithic and faunal classes considered here, URCr's and unburned bone have the most diffuse spatial patterns, with fluctuating abundances across the area. Although the more general lithic and faunal patterns show no significant correlation, it is worth investigating the relationship between these two categories as a matter of testing the possibility of behavioral correlations between unifacial (scraping) tool resharpening and bone processing/deposition. The individual descriptions of each variable are given above.

Maps. Figures 65-68 depict the combined spatial distributions of URCr's and unburned bone. Visually, there appears to be some degree of overlap, particularly to the southeast of the northern debitage pile, where overlapping distributions have been noted. These two variables are included in this area of diversity. The highest density areas correspond to the unburned bone distribution, which is much more abundant than URCs overall. Again, there is an issue of relationship by proximity rather than overlap at this 50cm quad scale, where concentrations of these two variables do not overlap, but are often found in concentrations at neighboring locations. The dot density and proportional index maps highlight the relationships between these two variables. Note that the southern end of Area B is almost completely dominated by unburned bone, yet the relationship is rather mixed in the north, where URCr's are more abundant. That these two classes co-occur in the north may only be a visual pattern, but the fact remains that the URCr's and unburned bone share space to some degree. Whether or not this relationship is quantifiable depends on the strength of this apparent co-occurrence.

Correlation Analysis. Table 13 contains the correlations across the density classes between these two variables. The pattern that emerges is indicative of the general overlap between the variables, but when the space is classified by the relative combined density, the relationships change to significantly negative measurements. This supports the idea that the two variables do not share the same spaces, but may have a relationship due to proximity. The lack of overlap of these two variables indicates that the activities associated with them were also spatially distinct, at least, from a quantitative point of view. Resharpening of scrapers and the processing of bone may have been relegated to separate spaces to avoid their overlap. The statistical observations alone suggest segregation, yet the sense of overlap obtained from the visual interpretation verifies the fact that there is some degree of mixing, but not a statistically significant amount.

Area B Summary

The dominant pattern in Area B shows clustering within each individual artifact and bone class, but no statistically significant overlapping of those clusters. On the contrary, when significant statistical observations exist, they are negative, indicating that most of the different artifact and bone classes segregate. In the case of the various raw materials of BTFr's and URCr's, sample size appears to be the primary factor restricting the statistical portion of the analysis. Visual inspection of the raw materials, however, suggests a segregation of these materials as well, although that cannot be reinforced with statistical conclusions. Behaviorally, the segregated distributions of artifacts, bone, and hearths in Area B support a single or possibly repeated occupation history over a short period of time, since longer occupations should produce more overlapping. The spatial segregation of activity-specific artifact and bone classes reflects an intentional separation of activities. The combination of burned bone and URC concentrations reflects activities associated with processing fauna. Furthermore, the presence of high-density debitage piles reflects an efficient lithic reduction strategy, wherein lithic debitage is intentionally concentrated in one area such that usable pieces can be salvaged. Short of caching, this is a strikingly economical method of conserving raw material characteristic of known Clovis-era groups. Compared to Area F, the composition of Area B is quite different, but the spatial patterning is markedly similar.

Area F, Introduction

At the assemblage level, Area F is different than Area B (see Chapter 2). Despite differences in the size of the excavated areas and total abundance of materials, their artifact densities are quite similar. However, the scope of raw materials, lithic technology, and geologic contexts appears similar enough to suggest that these occupation areas may have been contemporaneous, or at least sequential within a short time frame (Ferring 2001). Variations exist in the relative abundances of specific artifact classes and raw materials (Table 4). Of the variables examined in this analysis, Area F is dominated by BTFs and unburned bone. Interestingly, the raw material variation within BTFs differs from those found in Area B. The assemblage diversity and the spatial patterning of these artifacts paint a different picture of Clovis activities in Area F than in Area B.

Area F, Total Density.

Area F contains about half the number of artifacts as Area B, but maintains a general clustering tendency. Looking at the descriptive statistics alone (Table 17), the artifact total shows a very high V/M ratio and localized 50% spatial quartile (nearly 2000 artifacts in ~4m^2). This provocative clustering pattern parallels the one found in Area B. The visual pattern of artifacts in Area F (Figures 69 and 70) illustrates the spatial structure of the data. Ferring's analysis identified two debitage piles (north and south), with differential patterns of BTFs and URCs, but no concentrations of burned bone or charcoal (hearths). There is also a medium density accumulation of artifacts in the eastern portion away from the areas of major artifact deposition. The density-stratified map helps to visualize the general density patterns, which are analogous to Ferring's observations and interpretations of localized, short-term activity areas. However, the differential patterns of stone and bone artifacts give rise to a different set of behavioral interpretations than those given for Area B.

Area F, Debitage vs. Bone

Descriptive Statistics. Of the ~3900 artifacts in Area F, only 285 are bones. Both of these categories show distinct descriptive and spatial patterns. Table 17 shows the clustering statistics for both debitage and bone assemblages in Area F. Although debitage displays very high clustering characteristics, the bone statistics show clustering, but at a comparatively low degree. Thus, from these numbers alone, one detects a disassociated pattern between the two variables.

Maps. Figures 71 and 72 display the spatial distributions of debitage and bone, respectively. Although they have very different abundances, the debitage and bone patterns are quite similar, with the highest area of bone correlating with the highest area of debitage (northern pile). There appears to be very little bone associated with the debitage pile to the south. The density-stratified map showed medium-density areas surrounding the debitage piles and also in the eastern portion of the area. Although, visually, both debitage and bone appear to be scattered across the site in somewhat similar locations, their detailed distributions in those density concentrations locations suggest they are disassociated. The dot density and proportional index maps illustrate the overall dominance of debitage in Area F (Figures 73-74). Only on the peripheries of the high-density areas is there a similar proportion of bone to debitage. Thus, a pattern of disassociation is emerging. The empirical test for this hypothesis drives this home.

Correlation Analysis. Table 18 contains the correlation coefficients across the density stratification classes for the debitage versus bone comparison. As seen in the variables of Area B, there is a weak, positive correlation between the debitage and bone distributions when the total area or restricted area classes are used. This changes when the density classes are employed, where either no trend (low and high classes) or a negative relationship if found. That the only significant trend exists in the medium class is understandable, given that the area of medium density of the combined totals of the two variables is dominated by debitage and there is no visual overlap of bone and debitage in the southern debitage pile (Table 20). Therefore, the only quantitative conclusions that can be garnered from this comparison are that 1) there is a general pattern of overlap in terms of (rank-ordered) location and 2) there is a negative or non-trending statistical relationship between artifacts and bone from a density-based perspective. Therefore, any behavioral conclusions about artifact associations will remain subjective and unsupportable via statistical evidence. In other words, the association is only visual and not statistical, but the artifacts and bone accumulated in proximity, nonetheless.

Area F, BTFr’s vs. URCr’s

The sample of bifacial thinning flakes and unifacial resharpening chips was restricted to raw material classes with abundances high enough to be compared quantitatively. For Area F, these raw materials are listed in Table 2. The results of the BTFr and URCr comparison show a visual overlap in the southern debitage pile, but very little URC activity beyond that, resulting in little quantitative applicability or interpretation, except when compared to Area B.

Descriptive Statistics. Both BTFr's and URCr's show univariate clustering in their V/M ratios and 50% spatial quartiles. The spatial clustering of URCr's is particularly pronounced, with more than 50% of the artifacts in less than $1m^2$. BTFr's are much more abundant, yet more concentrated in Area F than Area B, as 50% of the BTFr's are in $4m^2$.   Based on the general spatial descriptions alone, the behavioral implications of the relationship between BTFr's and URCr's is already indicative of a bifacially-dominated assemblage at Area F.

Maps. Figures 75-80 depict the spatial relationship between these two variables. Three density patterns emerge, including that the two debitage piles remain evident in these two collections, suggesting the localized knapping activities. There is also a relatively diffused medium-density distribution just to the east, which may or may not be compositionally connected to the larger piles. However, it is important to notice that there is a medium density area surrounding the northern debitage pile, suggesting typical distance decay extending from a cluster. The individual distributions (Figures 77 and 78) illustrate the dominance of BTFr's and the tight clustering of URCr's, although the latter debitage type is found in a few other areas of the site, but only in single counts. The dot density and proportional index maps reiterate these same observations. What is behaviorally relevant is the noted infrequency and of URC events, however the highest concentration of these elements is found in conjunction with BTFr's making up the southern debitage pile. This spatial correlation is visually striking, but may not be sufficiently abundant to show statistical significance. However, this does not preclude interpretation, but rather statistical confidence of those interpretations.

Correlation Analysis. The correlations that emerge form this variable association process are most likely due to the spurious nature of the coefficient in certain conditions, as well as the complications of insufficient sample size. The total area measure is positive, but can be ignored due to the mass number of random zeros in the paring. Given the visual pattern of URCr's, the statistics would have been significantly negative with an increased sample size, but in this case remain insignificant. The quantitative measures of BTF and URC relationship in Area F are, thus, not applicable to meaningful statistical interpretation. The visual pattern, however, is not without value and, incidentally, should reinforce the striking difference between Areas F and B in terms of these two distinct debitage classes.

Area F, BTFs by Raw Materials

The raw materials chosen for analysis are listed in Table 2. Notable to the BTF distribution in Area F is the inclusion of White Edwards chert and White Novachert in the dominant BTF assemblage. The use of these raw materials for bifaces is not seen in Area B and emphasizes the different tool collection and use pattern found in Area F.

Given that the BTFr's are relatively more diffuse in Area F than URCr's, but still clustered, suggests the localized deposition of these specimens. A detailed inspection of the descriptive, visual, and statistical attributes indicates that these raw materials cannot be correlated with any statistical significance.

Descriptive Statistics. Table 17 shows that except for Point Quartzite, each of the BTFr raw materials is spatially clustered except for Point Quartzite. Note that this situation existed in Area B as well, suggesting an all-together different use of Point Quartzite from any other material. This will be addressed later in the synthesis. Nonetheless, the descriptive statistics are consistent with the culturally-derived clustering patterns seen in Area B, with Tecovas quartzite showing the most localized distribution (50% in .5m^2) and the lowest count and White Novachert showing the most diffuse pattern (50% in 2.75m^2) and the highest abundance. It is interesting that these two materials have different sample sizes, but still show clustering in relative degrees.

Maps. There are three patterns that emerge within the BTFr raw materials (Figures 81-107). Figures 81-87 show the individual distribution maps of these BTFs by raw material. The first pattern includes those raw materials that concentrate within and around the northern debitage pile (Chalquartzite, White Edwards Chert, and White Novachert), suggesting the repetitious use of that space with different tools. Point Quartzite is also found there, but in very low quantities. Thus, at least four different bifacial tools were resharpened in that small location. The second pattern involves the southern debitage pile, which contains mostly Tecovas Quartzite, but also some White

Novachert. One BTF of Point Quartzite and a few of White Edwards are found just outside of the core of this debitage pile. Thus, no Chalquartzite was found in or around that location, which is strange, since Tecovas and Chalquartzite are lithologically related and often grade into one another. However, if the general area in and around the southern debitage pile is considered, there were also four different bifaces reduced in that locale. The spatial and compositional contiguity between the two debitage piles points towards their creation during contemporaneous or closely situated time periods. The third compositional pattern seen in the BTFr distribution is in the eastern portion of the site, where each of the five raw materials are found in very low abundances. Since there is no evidence of horizontal shifting of the artifacts, a cultural explanation is assumed and suggests only a very light, yet diverse use of this area in terms of bifacial reduction or resharpening. In the initial report (Ferring 2001), the geology of the eastern portion of Area F shows a gradual slope toward the Paleo-channel. This may account for the minimized use of this area. These three patterns correlate with Ferring's observations (2001), which suggested that the heavy use of bifaces in this area stems from a predominant focus on butchering, as seen at Murray Springs (Haynes. Combined with the prevalence of unburned bone and few URCs, this interpretation is supportable. The acknowledged relationships between the raw material types of BTFs suggest a contained pattern of use of multiple tools in a localized area.

The relationships between each raw material type are evinced in the series of dot density and proportional index maps in Figures 88-107. These maps essential reiterate the descriptions given above, concerning the three different patterns and the raw materials contained within each. However, what should be noted again at this point is the presence of artifacts between these three areas. There are no distinct spatial breaks that might suggest discrete boundaries between activity areas. The proportional relationships between artifact classes are distinct, yet converge primarily in high density areas. This is evident in the proportional index maps where there are high numbers of squares that contain either raw material, but not both. (red vs. green). These maps, along with the individual distributions and the descriptive elements point toward a continuous use of BTFs in this area and relationships where diversity is driven by raw material and total density.

Correlation Analysis. The statistical tests used to characterize these relationships do not show very many significant relationships. Those that do exist may be the products of sampling errors, but it is difficult to say in some cases. The density stratification process produced only two high-density quads, both spatially located in the northern debitage pile. Statistically, the results are tenuous in this class, largely due to the low sample size in any given raw material. I do not believe there are any salvageable trends in this dataset, simply due to low counts in the samples. Although this puts a damper on the effectiveness of the density stratification and variable association techniques, this is the challenge faced by archaeologists when dealing with clustering data and the application of statistics. The interpretations, therefore, must rely on the visual observations alone.

Area F, URCs by Raw Material

It is unfortunate that within the URC category in Area F, only White Edwards Chert is sufficiently abundant for quantitative analysis, negating the possibility of any bivariate comparisons. The descriptive elements of this category are the same as the general total URCr class. Thus, to reiterate, there is clustering of this class within the southern debitage pile, as well as several isolated instances of its use around the rest of the area. Interpretations that follow will have to rely on descriptive aspects.

Area F, Bone

The total abundance of bones in Area F is far smaller than that of Area B. Furthermore, out of the 285 bone specimens excavated from F, there are only 19 burned bones. The paucity of burned bones makes quantitative analysis challenging, if not impossible. Therefore, the burned and unburned bone assemblages were compared, after which the burned bone sample was ruled too small to be used in any other quantitative comparisons. Assuming their cultural origin, however, this small number of burned bones suggests that the emphasis of activities there did not include hearth construction (i.e. bone burning). However, this low percentage may suggest that this is a sample of naturally burned bone. The dominance of unburned bone indicates processing activities, perhaps related to mammoth bones that were found in situ post-excavation, but also perhaps in conjunction with the small and medium sized fauna identified by Ferring (2001). However, rodents dominate this faunal sample and reinforce the argument that this may be a natural occurrence. Again, based on the quantitative technique used here, there appears to be a trend of spatial disassociation between lithic and faunal elements. This lack of overlap emphasizes the localized concentration of behaviors rather than consistent overlapping of activities. Proxemic analyses are still necessary to quantify relationships based on neighboring values rather than overlap. The behavioral implications for this faunal assemblage and its association with lithic debitage is strikingly different from that found in Area B and, thus, provide an interesting juxtaposition for comparison of Clovis behaviors at Aubrey. On a technical note, the descriptions of the individual categories are not reiterated during the comparison of bone with stone categories to avoid repetition.

Area F, Burned vs. Unburned Bone

Descriptive Statistics. Despite the low abundance of burned bone, it is still possible that all of its 19 specimens are clustered in one place; thus the descriptions are important. The descriptive statistics for burned bone indicate very little clustering. The low average count per quad and V/M ratio suggest a diffuse pattern across space. The 50% spatial quartile appears to reflect spatial clustering; however, it is plausible that this is a product of the low sample size. On the other hand, the unburned bone shows a clustering pattern based on the V/M ratio, but is spatially diffuse. This was also the case in Area B and, therefore, links the two areas by their comparable patterns of unburned bone.

Maps. Figures 108-112 describe the spatial patterns of total bone, including the differential patterning of burned and unburned bone. As evident in the total faunal assemblage, there appears to be a localized concentration near the northern debitage pile and a diffused pattern throughout the rest of the site. In the eastern part of the site, there is a medium-density pocket of bone that is more scattered than that found in the north. The maps of burned and unburned bones distinctly show how unburned bone dominates the assemblage, and the diffuse nature of the bone in general. The dot density and proportional index maps illustrate the relationships between burned and unburned bone where there appears to be the most overlap in the northern portion of the site.

Correlation Analysis. The density stratification process of variable association provides a clear picture of distinction between burned and unburned bone. At the total area and restricted area levels, no significant conclusions can be made about the variables' relationship, which suggests a random pattern, but may be due to the effects of empty cells and sample size issues, respectively. In the low and medium classes, there is a significantly negative correlation, confirming the disassociation pattern seen in the descriptive and visual analysis. The high-density pattern is not quantifiable, since the classification process did not create more than one high-density quad. The classification could be modified to provide more cells for comparison, but the meaning (in terms of density) of the "high" class would then change. However, in this instance, the low abundance of burned bone is most likely distorting the correlation process and should be considered carefully during interpretation.

Area F, BTFr vs. Unburned Bone

Maps. Figures 113-116 display the maps comparing the BTF sample with the unburned bone distribution. Given that these are the two most abundant lithic and faunal categories addressed here, it is interesting to note their fluctuating co-occurrence in the three primary deposition areas in Area F—the northern and southern debitage piles, as well as the eastern medium-density area. Their segregation is not as pronounced as other bivariate categories. However, it is difficult to tell how their differing abundances in these locations might affect quantitative measures of their relationship. With a close look at the dot density and proportional index maps, it seems as though there is a proxemic relationship between these two categories, with quite a bit of low-density overlap, but localized high-density pockets where the relative abundances differ. Because the map shows neighboring clusters of each variable the map might insinuate an overlapping relationship at a smaller scale (e.g. at the unit [1m^2] level).

Correlation Analysis. The associations detected by the correlation analysis are similar to what have been found in previous comparisons, where at the total area there appears to be a general pattern of overlap, but when the areas are stratified by density, a non-overlapping pattern emerges. The fact that BTFr's are being produced in areas disassociated from unburned bone shows that there was localized, intentional use of space for the needs of a particular activity. This not only improves the picture of activities, but also strengthens the argument of a short-term occupation. A look at raw material differences with bone would be interesting, but would not provide the sample size needed for quantitative analysis.

Area F, URCr's vs. Unburned Bone

Maps. Although unifacial tool use was minimal in Area F, it is distinctly separated from unburned bone (Figures 117-120). In the density-stratified map, the debitage piles and eastern deposit remain clearly visible (driven by the unburned bone distribution), but there is also a concentration to the west. In the individual distribution maps, a low concentration of unburned bone is visible on the western edge of the site, but only one URCr. The dot density and proportional index maps illustrate the divergent concentrations of URCr's and unburned bone. This non-overlapping distribution is distinct and indicative of the fact that unburned bone processing and what little URC resharpening that occurred were not spatially associated activities. A closer look at unburned bone composition would clarify this observation.

Correlation Analysis. Table 17 shows the strongly negative correlation between URCr's and unburned bone. The high-density quads are few, so the results at that level are less trustworthy, but overall, it is safe to say that there is no statistical relationship between these two variables.

Area F Summary

The spatial patterning in Area F parallels that seen in Area B, with debitage piles and the overall segregation of individual artifact and bone classes. However, Area F indicates activities dominated by butchering and or bifacial tool maintenance, as indicated by the larger presence of BTFs compared to URCs. Burned bone is both rare and not clustered. On the other hand, unburned bone is common and is spatially clustered. The same debitage and faunal classes are found in the two camps, but they differ in relative proportions. Individual raw material classes of BTFs and URCs are too infrequent to provide a trustworthy statistic, but visual descriptions indicate structure within those classes. Just as in Area B, the record from Area F indicates a short-term occupation. Whether it represents a single occupation or repeated visits is not discernible, however the presence of segregated distributions of different artifact classes is compelling evidence for a short-term camp occupation.

CHAPTER 6

ANALYSIS AND DISCUSSION

Analyzing the spatial distributions of diagnostic artifact classes offers a chance to address the spatial arrangement of behaviors at Aubrey. Looking at the variation across space instead of an activity area approach emphasizes the materialist perspective of analysis, which uses classification as a tool to structure the inquiry. Traditional spatial analysis has focused on description and interpretation rather than an explicit, scientific foundation in which to test archaeological questions. Interpretations associated with these descriptive analyses fall within the realm of plausible inferences supported by ethnographic records. However, the classificatory approach provides a theoretical framework from which to draw conclusions. Spatial analysis in archaeology remains a challenging endeavor, yet understanding the theoretical approach is just as important as the applied techniques. The technique used here allows visual observations to be made and tested with statistical evidence. The bivariate approach is effective because it targets questions at relationships between two behaviorally relevant variables. Because there are many units with no artifacts, using the total area for correlating the variables results in spurious interpretations, a density stratification process was generated. This technique was designed to detect changes in these bivariate relationships controlling for the relative density of the variables.

During this analysis, several conclusions surfaced from both methodological and behavioral perspectives. Methodologically, there were issues that stemmed from sampling errors in some cases that prevented the production of quantitative results. In terms of behavioral interpretations, every set of classes with sufficient sample size analyzed here showed positive correlations when the entire block was considered, but significant negative correlations across each of the density classes (low, medium, high). This was an unexpected phenomenon, but speaks toward the spatially distinct nature of the artifact classes and the results of Pearson's correlation analysis on different permutations of the dataset. Thus, the final discussion of this research centers on these two perspectives in terms of how the overall analytical approach can be improved, as well as how the results enhance our understanding of the spatial character of the Aubrey site.

Summary of Spatial Patterning and Artifact Associations

The most outstanding observation that was made repeatedly throughout the bivariate tests in both areas was the spatial distinctiveness of most diagnostic artifact classes. This could be seen both through visual inspections and verified in statistically significant negative correlations. Because the variables were picked as measures of discrete behavioral activities, their relative disassociations connote a distribution of activities that were also spatially distinct.

There are a number of statistical outcomes and associated behavioral interpretations stemming from the results from the bivariate comparisons listed in Tables 1 and 2. In some cases, the total sample size of the individual variables was insufficient for statistical analysis. The density stratification process sub-sampled the data spatially and resulted in smaller sample sizes and restricted ranges of values. When sample size influenced the quantitative procedure, only descriptive and visual inspections were used to interpret the behavioral patterns, although these do not have the robusticity as those with statistical support. In other cases, where sample sizes were sufficient, the visual and statistical variable association process showed significant disassociation between variables. Along with simple descriptive and visual inspections, the correlation statistics helped to demonstrate the clustered spatial patterning of different artifact types. Interpretations of each case reinforce the perspective of Aubrey as a short-duration camp with different activities in each area.

The results from the analysis of Area B showed that each individual variable is relatively clustered across the site (Table 24). The variance-to-mean ratios and 50% spatial quartiles were used to test the clustering tendencies of each variable independent of the others. Numerous maps produced for each bivariate comparison illustrated the different density patterns for each variable with reference to the other (Figures 121-124). In many cases, the patterns suggested a distinct spatial segregation between the variable pairs. Correlation analyses across the density stratified distributions provided a means of testing these observations. In Area B, there is a statistically supportable spatial separation of numerous variable pairs, including debitage vs. bone, BTFs vs. URCs, and burned vs. unburned bone (Table 25). The raw material categories of BTFs and URCs showed no significant patterns, which is most likely due to sample size issues (Table 26). In other words, the criteria that were used to determine which artifact classes were sufficiently abundant for quantitative analysis were not sensitive enough and allowed classes of lower abundances to be included. This technique could be improved by decreasing the tolerance levels to include fewer classes.

Despite reoccurring positive correlations at the scale of the total area, when the distributions are stratified by density and the empty cells are removed, the nature of the segregating relationship between these variables is apparent. This strengthens the conclusions drawn by Ferring (2001) surrounding the spatially localized, yet neighboring activities of bifacial maintenance, scraper resharpening, and bone processing, both burned and unburned. The distribution of bone in the southern section is not statistically associated with any lithic distributions, but there is a scatter of Point Quartzite BTFs in the southwestern portion of the area and bone concentrations adjacent to the smaller debitage pile in the southeastern part of Area B. The patterning of Point Quartzite BTFs, along with refitting evidence from the Clovis point in Area B (Ferring 2001), insinuates a unique role of this material at the site. Although a few URCs of Point Quartzite are present in the Aubrey assemblage, this material appears to have been reserved for use in bifacial tool manufacture. In both areas, Point Quartzite BTFs are less common than BTFs of other raw materials, but it rarely occurs in URCs. Its association with bone concentrations in the southern part of the site makes this interpretation more feasible. On the other hand, bone concentrations are found in proximity to both debitage piles in Area B. Because they do not overlap in similar proportions, the statistical results often show negative results, although the concentrations may be in proximity to one another. Thus, these statistical results are only useful for interpretation when used in conjunction with distribution maps.

The raw materials of BTFs and URCs, however, do not show a statistically significant spatial distribution, but a visual interpretation posits a pattern within each of the raw material categories. Given that the BTFs and URCs are shown to be segregated statistically, there is visual evidence that suggests that the raw materials within these tool classes are being used in spatially distinct areas as well, although there is minimal overlap in a few types (i.e. Tecovas / Chalquartzite BTFs vs. White Edwards / Chalcedony URCs). Along with the geologic evidence, this raw material distinctiveness reinforces the lack of horizontal movement of artifacts.

Area F contains a strikingly different assemblage of materials than Area B, including a predominance of biface rather than unifacial tool maintenance and differing proportions of raw materials within those debitage categories (Table 27). In Area B, bifaces and scrapers are primarily fashioned from quartzites and cherts, respectively, while in Area F biface manufacture includes both materials; while chert dominates what little scraper debris is found. There is also a marked reduction in bone abundance in Area F, particularly burned bone. The relatively low quantity of bone and higher use of BTFs of various raw materials suggests a different activity pattern in this area, some 100 meters from Area B. Ferring postulated that this area was the site of major butchering activities, perhaps related to the mammoth bone found after the excavations, since almost no large mammal remains and very few URCs were found.

Despite these differences at the assemblage level, the spatial arrangement of those materials in Area F mimics the clustered pattern seen in Area B. The individual artifact classes maintain concentrated patterns, as seen by the variance-to-mean ratios and 50% spatial quartiles (Table 28), as well as in the descriptive maps (for example, see Figures 125-128). However, the maps also help show the differential clustering patterns of the bivariate comparisons and prompt further statistical tests. In all cases except for the specific raw material classes, the quantitative correlations analysis reinforces the interpretations that these classes have non-overlapping relationships (Tables 29 and 30). This is consistent with Ferring's report, which suggests an overall strategy of localized lithic reduction behavior, particularly in the case of BTFs.

The most significant difference between the spatial arrangements of Areas B and F is the paucity of bone and URCs in area F. Although they do not show any statistical correlation with BTFs across the relative density classes (most likely due to sample size issues) the URCs present in Area F are concentrated in the southern debitage pile along with a small portion of the BTFs. Thus, the interpretations about these classes can only be made on a descriptive basis with no evidence of statistical confidence. The same goes for raw material categories of BTFs and URCs in both areas, where statistical evidence is restricted due to sampling issues, but descriptive statistics and density maps of each raw material category show a clustering tendency for each raw material class (Tables 24, 27-28; Figures 129-132). These distributions are behaviorally compelling insofar as they may represent the locations of individual resharpening events, as well as a minimum number of tools used at the site.

Although behavioral characteristics at this "event" scale are difficult to perceive, the distributions of artifacts provide interesting glimpses into activity patterns at Aubrey, particularly in terms of the differential use of space and within a Clovis campsite, as well as the adaptive nature of the Clovis-age group(s) represented. The use of debitage piles provides substantial evidence toward the economical nature of Clovis technology in conjunction with spatial patterning of activities. However, outside of the densest portions of each area, other lower-density concentrations of various compositions are detectable. These peripheral areas indicate a diversity of activities going on within the campsite. Furthermore, the diversity of the Clovis occupants is emphasized by the adaptability portrayed by the different behaviors evident in each camp. Whether or not the two camps were occupied simultaneously or sequentially does not affect this interpretation, since the Clovis groups created two sites with apparently different uses in a quite brief, if not coeval time frame. The similarity of the spatial structure emphasizes the similarity with which the occupants efficiently organized space. This similarity is one of the most compelling pieces of evidence that suggests that the two camps were occupied simultaneously or at least by the same group of people. Thus, the adaptability of these people is reinforced by the compositional and spatial structure of each individual area within the Aubrey site.

Occupation History

The approach taken here attempts to look at spatial associations of artifacts that have behavioral correlates. If the inhabitants of Aubrey had spent an extended amount of time in these locations, it is assumed that palimpsests of artifacts would be evident and debris from different types of activities would overlap. Although some artifact classes, including the specific raw materials of BTFs and URCs, were less likely to show any statistically significant patterns in each area (probably due to sample size in most cases), the non-overlapping distributions of bone and stone artifacts support a short-term occupation from the spatial perspective. However, this may also be interpreted as a consequence of subsequent visits to each area over a short time period. The statistical disassociation of artifacts alone might also lead one to consider the multiple-occupation possibility. In other words, overlapping clusters of artifacts would imply repeated and/or prolonged occupation, whereas discrete patterns lead to an interpretation of a single occupation. This is where the visual analysis and evidence of refitting tools (Ferring 2001) provides a compelling case against multiple occupations within each Area. Under the assumption that there is no horizontal movement of materials through geologic means, the visual distribution of artifacts shows that, despite the significantly negative correlation, most of the artifacts overlap to some minimal degree. Thus, artifact classes are often statistically segregated, but not so totally segregated that would point toward multiple occupations in the same area. Despite their assemblage-level differences, this interpretation of occupancy applies to both Areas B and F because both areas show a general tendency toward activity segregation. Although there is no specific evidence linking the two areas, the overall consistencies in lithic, faunal, and (now) spatial assemblages are compelling.

No matter whether the areas were occupied simultaneously or sequentially, the archaeological record at Aubrey points toward a highly adaptable Clovis culture. If the camps were simultaneously occupied, their compositional differences point toward a division of specific activities. On the other hand, if the two areas represent repeated occupations of this location over a short period of time, the Clovis folks were obviously flexible enough to focus on different activities in each separate visit. The diversity inherent in the record at Aubrey implies a broader, more flexible lifestyle for the Clovis-era groups than is depicted by previous interpretations of them as strictly big game hunters.

Methodological Issues

Upon further reflection after the research was completed, it was found that this analysis violates assumptions about Pearson's. The effects of doing so alter the true magnitude of the bivariate relationship. Earlier investigations into the data using Moran's I showed that the data are indeed spatially auto-correlated; as such, they are not independent. Histograms and Kolmogorov-Smirnoff normalcy tests indicate that the variables are not normally distributed. The effects of proceeding under these violations may have cause errors in the final numbers, but the patterns may still remain. For future reference, it would be of use to refer to Clifford et al's (1989) work on adjusting data that shows autocorrelation (spatial structure) for use in correlation analysis. Despite this effect, Pearson's was used here to test for co-occurrence of artifact proportions across the density-stratified areas.

Although visual interpretations are quite effective at interpreting patterns of artifacts, quantitative statistics are helpful insofar as they help to objectively measure these observed patterns. However, they are limited by mathematical requirements, such as sample size and case number. This was detrimental in some bivariate associations and should be reconsidered in future analyses. For example, in Area B, URCr's versus unburned bone, both classes appeared diffuse relative to their lithic or faunal counterparts, respectively. The maps (e.g. the proportional index map) suggested some degree of overlap, particularly adjacent to the northern debitage pile. Despite this visual observation, the density-stratified statistics were negative. Thus, the statistical technique used here only provides a general approach to the relationships. There is room for improvement here, since better spatial controls would be capable of observing more localized patterning. Nonetheless, this approach provides a methodological starting point from which to build a better technique.

The source of the low case numbers was the density stratification of a series of highly clustered artifact classes. This classification process was useful for observing changes of artifact relationships in relation to their relative density patterns. Although it deals with spatial data, the results are generalized, since each density class has no real spatial meaning. Furthermore, the limited range within a density class (e.g. low =1-2 specimens) was also the likely cause for significance in certain categories. However, the purpose of this analysis was to look at artifact associations across space, as well as to observe how those relationships changed with the relative densities. Therefore, the density stratification process was not necessarily invalid, but does have issues to be addressed before moving on to more localized methods.

Conclusions

So what do the results convey about Clovis activities at Aubrey? What does this tell us about the differential use of space both within and between the occupation areas? Granted, the evidence presented here is not the complete picture, since there are many other artifact categories, including tools, ambiguous debitage classes, and refitting pieces that help to demonstrate the range of activities that occurred at Aubrey. However, based solely upon the classes analyzed here, several general patterns were evident both visually and statistically, many of which correlate with Ferring's original interpretations. On the other hand, other interpretations must be made only on visual evidence, since the sample sizes are not high enough to perform quantitative tests. It is apparent that the artifacts at Aubrey are clustered. For many individual categories, there is no statistically significant overlapping occurring in either Area, despite their compositional differences. However, there are relationships visible at other scales where objects do not overlap, but are clustered in proximity to one another. The theoretical framework was critical to the construction of the analysis. It emphasized the role of classification and allowed for the variations in artifact densities across space to be manageable and targeted the analysis toward behaviorally-relevant questions and provided a foundation for understanding the results from and archaeological perspective.

It appears that the Clovis inhabitants had specific areas of distinct activities. The discrete arrangement of behaviorally significant artifacts presents a strong argument for site structure. This configuration is akin to those seen in other Clovis campsites, such as Blackwater Draw (Hester 1972) and Murray Springs (Haynes 1981). The diversity of artifacts suggests an array of activities centered on a highly mobile subsistence strategy where the conservation of raw material and space were important elements of camp life. These visual and quantitative assessments of the overall density patterns correlate with the localized “activity areas” seen in the ethnographic literature, where lithic and faunal processing activities are spatially concentrated, albeit beyond the scope of this analysis to clarify the local patterns quantitatively. Ferring’s report on the spatial patterning remains a crucial element in the understanding of some of the fine-scale patterns evident in the area, since many of these are not abundant enough to be tested quantitatively. The subsistence strategy of a foraging group dealing with the processing of animal, plant (?), and lithic materials is supported by the spatial integrity and patterns of artifact association in the area. Further development of this technique, as well as localized testing procedures, remain important steps to creating a more rigorous methodology for use in the spatial analysis in archaeology. However, archaeologists concerned with spatial analysis must be aware of the role of classification (and its assumptions) in order to produce valid and testable interpretations about spatial patterns of archaeological artifacts and their behavioral analogies. Due to its preservation and uniqueness, the Aubrey Clovis site is the perfect setting for further testing of spatial analysis techniques behavioral interpretations.

APPENDIX A

TABLES

Table 1. Pairwise Artifact Comparisons, Area B

1. Total Debitage vs. Total Bone

2. Bifacial Thinning Flakes (BTFr) vs Unifacial Resharpening Chips (URCr)

3. BTFr Raw Materials (RMs)

    a. Tecovas Quartzite (Q1)
    b. Chalquartzite (Q2)
    c. Point Quartzite (PtQ)

4. URCr Raw Materials (RMs)

    a. Chalquartzite (Q2)
    b. Chalcedony (Chalc)
    c. White Edwards Chert (WhEds)
    d. White Novachert (WhNov)

5. Burned Bone (BND) vs. Unburned Bone (UNB)

6. Burned Bone (BND) vs. Bifacial Thinning Flakes (BTFr)

7. Burned Bone (BND) vs. Unifacial Resharpening Chips (URCr)

8. Unburned Bone (UNB) vs. Bifacial Thinning Flakes (BTFr)

9. Unburned Bone (UNB) vs. Unifacial Resharpening Chips (URCr)

Table 2. Pairwise Artifact Comparisons, Area F

1. Total Debitage vs. Total Bone

2. Bifacial Thinning Flakes (BTFr) vs Unifacial Resharpening Chips (URCr)

3. BTFr Raw Materials (RMs)

    a. Tecovas Quartzite (Q1)
    b. Chalquartzite (Q2)
    c. Point Quartzite (PtQ)
    d. White Edwards Chert (WhEds)
    e. White Novachert (WhNova)

4. URCr Raw Materials (RMs)

    a. White Edwards Chert (WhEds) **
        i. **With only one dominant raw material, no bivariate comparisons are possible**

5. Burned Bone (BND) vs. Unburned Bone (UNB)

6. Unburned Bone (UNB) vs. Bifacial Thinning Flakes (BTFr)

7. Unburned Bone (UNB) vs. Unifacial Resharpening Chips (URCr)

Table 3. Raw Materials and Debitage Classes, Area B

Raw Materials	Debitage Types
1. Tecovas Quartzite (Q1) 2. Chalquartzite (Q2) 3. Point Quartzite (PtQ) 4. Yellow Quartzite (YQ) 5. Purple Quartzite (PQ) 6. Brown Quartzite (BnQ) 7. Red Quartzite (RQ) 8. Chalcedony (Chalc) 9. White Edwards Chert (WhEds) 10. White Novachert (WhNov) 11. Buff Edwards Chert (Buff) 12. Dark Gray Edwards Chert (Dgeds) 13. Mottled Edwards Chert (Mott) 14. Amber Chert (AmbC) 15. Alibates (Alib) 16. Brown Chert (BnC)	1. Chip Fragment (CF) 2. Chip (C) 3. Flake Fragment (FF) 4. Flake (F) 5. Bifacial Thinning Flake (BTF) 6. Unifacial Resharpening Chip (URC) 7. Core Trimming Element (CTE)

Table 4. Raw Materials and Debitage Classes, Area F

Raw Materials	Debitage Types
1. Tecovas Quartzite (Q1) 2. Chalquartzite (Q2) 3. Point Quartzite (PtQ) 4. Yellow Quartzite (YQ) 5. Purple Quartzite (PQ) 6. Brown Quartzite (BnQ) 7. Red Quartzite (RQ) 8. Chalcedony (Chalc) 9. White Edwards Chert (WhEds) 10. White Novachert (WhNov) 11. Buff Edwards Chert (Buff) 12. Dark Gray Edwards Chert (Dgeds) 13. Mottled Edwards Chert (Mott) 14. Amber Chert (AmbC) 15. Alibates (Alib) 16. Brown Chert (BnC)	1. Chip Fragment (CF) 2. Chip (C) 3. Flake Fragment (FF) 4. Flake (F) 5. Bifacial Thinning Flake (BTF) 6. Unifacial Resharpening Chip (URC) 7. Core Trimming Element (CTE)

Table 5. Cross-Tabulation of Debitage Classes by Raw Material, Raw Data, Area B

	CF	C	FF	F	BTFs	URCs	CTEs	BLT	Total
Q1	246	81	69	14	32	0	2	0	444
Q2	2526	832	343	103	149	39	9	0	4001
PtQ	118	69	25	4	17	1	0	0	234
YQ	54	29	6	1	6	0	0	0	96
PQ	4	10	0	0	1	4	0	0	19
BNQ	1	1	0	0	1	4	0	0	7
RQ	13	3	0	0	0	0	0	0	16
CHALC	204	98	6	3	3	102	0	0	416
WHEDS	135	70	4	2	1	119	0	0	331
WHNOV	114	55	10	12	5	50	0	0	246
BUFF	23	15	3	1	1	19	0	0	62
DGEDS	10	9	0	0	0	14	0	0	33
MOTT	4	2	0	0	0	7	0	0	13
AMC	9	27	1	0	0	8	0	0	45
ALIBS	13	6	0	0	1	9	0	0	29
BNC	1	1	1	1	0	1	0	0	5
Total	3475	1308	468	141	217	377	11	0	5997
% of Total	57.95	21.81	7.8	2.35	3.62	6.29	.2	0	100%

Table 6. Cross-Tabulation of Debitage Classes by Raw Material, Raw Data, Area F

	CF	C	FF	F	BTF	URC	CTE	BLT	Total
Q1	92	65	29	5	15	2	0	0	208
Q2	565	329	75	18	43	1	0	1	1032
PTQ	85	62	25	5	20	1	0	0	198
CHALC	72	42	10	4	8	1	0	0	137
WHEDS	227	225	42	26	35	30	0	19	604
WHNOV	641	385	138	49	73	3	1	2	1292
BUFF	9	9	0	0	0	1	0	0	19
DGEDS	11	5	2	4	0	9	0	0	31
MOTT	10	4	2	5	0	3	0	0	24
ALIB	0	1	0	1	0	0	0	0	2
YCH	38	41	4	7	7	0	0	0	97
TOTAL	1750	1168	327	124	201	51	1	22	3644
% of Total	48.02	32.05	8.97	3.40	5.52	0.03	1.40	0.60	100

Table 7. Cross-Tabulation of Debitage Classes by Raw Material , %, Area B

%	CF	C	FF	F	BTFs	URCs	BLTs	CTEs
Q1	7.08	6.19	14.74	9.93	14.75	0	0	18.18
Q2	72.69	63.61	73.29	73.05	68.66	10.34	0	81.82
PtQ	3.40	5.28	5.34	2.84	7.83	0.27	0	0
YQ	1.55	2.22	1.28	0.71	2.76	0	0	0
PQ	0.12	0.76	0	0	0.46	1.06	0	0
BNQ	0.03	0.08	0	0	0.46	1.06	0	0
RQ	0.37	0.23	0	0	0	0	0	0
CHALC	5.87	7.49	1.28	2.13	1.38	27.06	0	0
WHEDS	3.88	5.35	0.85	1.42	0.46	31.56	0	0
WHNOV	3.28	4.20	2.14	8.51	2.30	13.26	0	0
BUFF	0.66	1.15	0.64	0.71	0.46	5.04	0	0
DGEDS	0.29	0.69	0	0	0	3.71	0	0
MOTT	0.12	0.15	0	0	0	1.86	0	0
AMC	0.26	2.06	0.21	0	0	2.12	0	0
ALIBS	0.37	0.46	0	0	0.46	2.39	0	0
BNC	0.03	0.08	0.21	0.71	0	0.27	0	0
Total	100	100	100	100	100	100	100	100

Table 8. Cross Tabulation of Debitage Classes by Raw Material, %, Area F

	CF	C	FF	F	BTF	URC	BLT	CTE
Q1	5.26	5.57	8.87	4.03	7.46	3.92	0	0
Q2	32.29	28.17	22.94	14.52	21.39	1.96	4.55	0
PTQ	4.86	5.31	7.65	4.03	9.95	1.96	0	0
CHALC	4.11	3.60	3.06	3.23	3.98	1.96	0	0
WHEDS	12.97	19.26	12.84	20.97	17.41	58.82	86.36	0
WHNOV	36.63	32.96	42.20	39.52	36.32	5.88	9.09	100
BUFF	0.51	0.77	0	0	0	1.96	0	0
DGEDS	0.63	0.43	0.61	3.23	0	17.65	0	0
MOTT	0.57	0.34	0.61	4.03	0	5.88	0	0
ALIB	0	0.09	0	0.81	0	0	0	0
YCH	2.17	3.51	1.22	5.65	3.48	0	0	0
TOTAL	100	100	100	100	100	100	100	100

Table 9. Debitage Types by Raw Material

Area B, Debitage Types by Raw Material	Area F, Debitage Types by Raw Material
BTFr • Q1 • Q2 • PtQ URCr • Q2 • Chalc • WhEds • WhNov	BTFr • Q1 • Q2 • PtQ • Chalc • WhEds • WhNov URCr • WhEds

Table 10. Base-2 Aggregation Process for Density Stratification

# of Base-2 classes	# of Base-2 Classes in each DS Class		
	Low	Med	High
3	1	1	1
4	1	2	1
5	2	2	1
6	2	2	2
7	2	3	2
8	3	3	2
9	3	3	3
10	3	4	3
11	4	4	3

Table 11. Descriptive Statistics, Area B

Total Area General Descriptive Statistics

Total Area									Total Assemblage				50% Quartile			
		Sum	Avg	Var	StdDev	V/M	Kurt	Skew	N	Cells	m2	% Area	N	Cells	m2	% Area
Total		8609	20.5	2415.1	49.143	117.82	50.65	6.71	8609	399	99.75	95.00	4305	29	7.25	6.9
Total Stone		5997	14.28	2332.67	48.30	163.37	57.17	7.24	5997	379	94.75	90.24	2999	12	3.00	2.86
BTFr		198	0.47	3.09	1.76	6.54	58.23	7.18	198	89	22.25	21.19	99	11	2.75	2.62
	Q1	32	0.08	0.17	0.41	2.18	46.65	6.52	32	19	4.75	4.52	16	5	1.25	1.19
	Q2	149	0.35	2.10	1.45	5.91	56.51	7.12	149	67	16.75	15.95	75	8	2.00	1.90
	PtQ	17	0.04	0.04	0.21	1.08	31.78	5.45	17	16	4	3.81	9	8	2.00	1.90
URCr		310	0.74	3.38	1.84	4.58	27.51	4.61	310	124	31	29.52	155	22	5.50	5.24
	Q2	39	0.09	0.41	0.64	4.40	208.91	13.17	39	22	5.5	5.24	20	4	1.00	0.95
	Chalc	102	0.24	0.82	0.91	3.39	47.43	6.08	102	50	12.5	11.90	51	11	2.75	2.62
	Wheds	119	0.28	0.74	0.86	2.61	39.23	5.39	119	72	18	17.14	60	17	4.25	4.05
	WhNov	50	0.12	0.36	0.60	3.01	122.72	9.55	50	30	7.5	7.14	25	7	1.75	1.67
Total Bone		2612	6.22	66.83	8.18	10.75	13.72	3.17	2612	351	87.75	83.57	1306	61	15.25	14.52
	Bnd	552	1.31	12.08	3.48	9.19	88.15	7.59	552	157	39.25	37.38	276	21	5.25	5.00
	Unb	2060	4.90	42.69	6.53	8.70	18.89	3.60	2060	341	85.25	81.19	1030	63	15.75	15.00

Table 12. Bivariate Correlations 1, Area B

Density Stratified Bivariate Correlations

Deb_Bone		Bivariate Combinations		Tot_Area	Area_r	Low	Med	High
	Pearson's r	Deb_Total	Bone_Total	0.02	0.008	-0.282**	-.166**	-.446*
	Sig			0.687	0.874	.000	.016	.049
	N			420	399	167	212	20

BTFURCr		Bivariate Combinations		Tot_Area	Area_r	Low	Med	High
	Pearson's r	BTFr	URCr	.122*	-0.051	-0.756**	-.472**	-.857**
	Sig			0.012	0.513	0	01	0
	N			420	167	111	43	13

BTFr		Bivariate Combinations		Tot_Area	Area_r	Low	Med	High
	Pearson's r	Q1_BTF	Q2_BTF	.686**	.628**	-0.288*	-0.423	n/a
	Sig			0	0	0.012	0.257	
	Pearson's r	Q1_BTF	PtQ_BTF	-0.008	-0.166	-0.136	n/a	n/a
	Sig			0.866	0.121	0.242		
	Pearson's r	Q2_BTF	PtQ_BTF	-0.048	-.275**	-0.679**	n/a	n/a
	Sig			0.331	0.009	0		
	N			420	89	76	9	4

URCr		Bivariate Combinations		Tot_Area	Area_r	Low	Med	High
	Pearson's r	Q2_URC	Chalc_URC	0.006	-0.098	-.207*	-.199	-.6
	Sig			0.898	0.28	.048	.32	.208
	Pearson's r	Q2_URC	Wheds_URC	0.048	-0.08	-.241*	-.247	-.464
	Sig			0.331	0.377	.022	.215	.354
	Pearson's r	Q2_URC	WhNov_URC	-0.1	-0.086	-.147	-.189	-.27
	Sig			0.834	0.345	.165	.346	.605
	Pearson's r	Chalc_URC	Wheds_URC	.426**	.274**	-.420**	-.416*	.391
	Sig			0	0.002	0	.031	.444
	Pearson's r	Chalc_URC	WhNov_URC	.215**	0.101	-.274**	-.115	-.225
	Sig			0	0.265	.009	.567	.669
	Pearson's r	Wheds_URC	WhNov_URC	0.097	-0.074	-.271**	-.383*	-.46
	Sig			0.048	0.416	.009	.048	.359
	N			420	124	91	27	6

Table 13. Bivariate Correlations 2, Area B

Bnd_Unb Bone

	Bivariate Combinations		Tot_Area	Area_r	Low	Med	High
Pearson's r	Burned	Unburned	.266**	.226**	-.199*	-.419**	-.736**
Sig			0	0	.001	.000	.01
N			420	351	256	84	11

BTFr to Bone

	Bivariate Combinations		Tot_Area	Area_r	Low	Med	High
Pearson's r	BTFr	Burned Bone	-0.008	-0.122	-.343**	-.877**	n/a
Sig			0.865	0.077	.000	.000	
N			420	211	192	18	1
			Tot_Area	Area_r	Low	Med	High
Pearson's r	BTFr	Unburned Bone	-0.033	-.074	-.204**	-.513**	0.284
Sig			0.501	.163	.001	.000	.716
N			420	355	275	76	4

URCr to Bone

	Bivariate Combinations		Tot_Area	Area_r	Low	Med	High
Pearson's r	URCr	Burned Bone	.147**	0.03	-.380**	-.792**	n/a
Sig			0.002	0.647	0	0	
N			420	234	215	18	1
			Tot_Area	Area_r	Low	Med	High
Pearson's r	URCr	Unburned Bone	.188**	.142**	-.210**	-.461**	-.620
Sig			0	0.007	0	0	0.189
N			420	355	273	76	6

Table 14. Density Stratified Descriptive Statistics 1, Area B

Density Stratified Descriptive Stats, Debitage & Bone

Deb_Bone	Tot_Area			Area_R			Low			Med			High		
	DebBone	Deb	Bone	DebBone	Deb	Bone	DebBone	Deb	Bone	DebBone	Deb	Bone	DebBone	Deb	Bone
Sum	8609	5997	2612	8609	5997	2612	850	497	353	3995	1999	1996	3764	3501	263
Average	20.50	14.28	6.22	21.58	15.03	6.55	5.09	2.98	2.11	18.84	9.43	9.42	188.20	175.05	13.15
Variance	2415.06	2332.67	66.83	2519.15	2444.43	68.21	4.76	3.73	2.87	147.51	106.41	69.64	19393.01	21408.79	320.03
Stdev	49.14	48.30	8.18	50.19	49.44	8.26	2.18	1.93	1.69	12.15	10.32	8.34	139.26	146.32	17.89

BTFURCr	Tot_Area			Area_R			Low			Med			High		
	BTFURCr	BTFr	URCr	BTFURCr	BTFr	URCr	BTFURCr	BTFr	URCr	BTFURCr	BTFr	URCr	BTFURCr	BTFr	URCr
Sum	508	198	310	508	198	310	145	58	87	187	50	137	176	90	86
Average	3.04	1.19	1.86	3.04	1.19	1.86	1.31	0.52	0.78	4.35	1.16	3.19	13.54	6.92	6.62
Variance	12.69	6.94	6.64	12.69	6.94	6.64	0.21	0.38	0.48	2.23	1.66	2.49	12.44	46.91	3.42
Stdev	3.56	2.63	2.54	3.56	2.63	2.54	0.46	0.62	0.69	1.49	1.29	1.58	3.53	6.85	5.87

BndUnb	Tot_Area			Area_R			Low			Med			High		
	BndUnb	Bnd	Unb	BndUnb	Bnd	Unb	BndUnb	Bnd	Unb	BndUnb	Bnd	Unb	BndUnb	Bnd	Unb
Sum	2612	552	2060	2612	2060	552	955	807	148	1189	914	275	468	339	129
Average	6.22	1.31	4.90	7.44	5.87	1.57	3.73	3.15	0.58	14.15	10.88	3.27	42.55	30.82	11.73
Variance	66.83	12.08	42.69	70.89	45.43	14.06	4.04	3.78	1.06	22.28	23.89	13.33	106.47	210.76	191.22
Stdev	8.18	3.48	6.53	8.42	6.74	3.75	2.01	1.94	1.03	4.72	4.89	3.65	10.32	14.52	13.83

Table 15. Density Stratified Comparative Statistics 2, Area B

BTFr Density Stratified Descriptive Stats

BTFr	Tot_Area				Area_R			
	BTFr	Q1	Q2	PtQ	BTFr	Q1	Q2	PtQ
Sum	198	32	149	17	198	32	149	17
Average	0.47	0.08	0.35	0.04	2.22	0.36	1.67	0.19
Variance	3.09	0.17	2.10	0.04	10.74	0.69	7.74	0.18
Stdev	1.76	0.41	1.45	0.21	3.28	0.83	2.78	0.42

BTFr	Low				Med				High			
	BTFr	Q1	Q2	PtQ	BTFr	Q1	Q2	PtQ	BTFr	Q1	Q2	PtQ
Sum	91	12	62	17	43	8	35	0	64	12	52	0
Average	1.20	0.16	0.82	0.22	4.78	0.89	3.89	0	16.00	3.00	13.00	0
Variance	0.16	0.13	0.37	0.20	4.44	2.11	5.11	0	0	0	0	0
Stdev	0.40	0.37	0.60	0.45	2.11	1.45	2.26	0	0	0	0	0

URCr Density Stratified Descriptive Stats

URCr	Tot_Area					Area_R				
	URCr	Q2	Chal	Whed	WhNov	URCr	Q2	Chal	Whed	WhNov
Sum	310	39	102	119	50	310	39	102	119	50
Average	2.5	0.31	0.08	0.98	0.41	2.5	0.31	0.084	0.98	0.41
Variance	7.07	1.32	2.35	1.88	1.12	7.07	1.32	2.35	1.88	1.12
Stdev	2.66	1.15	1.53	1.37	1.06	2.66	1.15	1.53	1.37	1.06

URCr	Low					Med					High				
	URCr	Q2	Chal	Whed	WhNov	URCr	Q2	Chal	Whed	WhNov	URCr	Q2	Chal	Whed	WhNov
Sum	122	16	32	53	21	115	12	43	43	17	73	11	27	23	12
Average	1.34	0.18	0.35	0.58	0.23	4.26	0.44	1.59	1.59	0.63	12.17	1.83	4.5	3.83	2
Variance	0.23	0.17	0.36	0.36	0.25	1.74	1.18	2.64	3.02	1.09	7.37	20.17	13.5	8.97	13.2
Stdev	0.48	0.41	0.60	0.60	0.50	1.32	1.09	1.62	1.74	1.04	2.71	4.49	3.67	2.99	3.63

Table 16. Density Stratified Descriptive Statistics 3, Area B

Density Stratified Statistics, Diagnostic Debitage vs. Burned & Unburned Bone

BTFr_Bnd	Tot_Area			Area_R			Low			Med			High		
	BTFr_Bnd	BTFr	Bnd	BTFr_Bnd	BTFr	Bnd	BTFr_Bnd	BTFr	Bnd	BTFr_Bnd	BTFr	Bnd	BTFr_Bnd	BTFr	Bnd
Sum	750	198	552	750	198	552	458	114	344	242	83	159	50	1	49
Average	1.79	0.47	1.31	3.55	0.94	2.62	2.39	0.59	1.79	13.44	4.61	8.83	n/a	n/a	n/a
Variance	15.07	3.09	12.08	23.74	5.72	20.69	3.27	0.84	3.63	10.61	45.55	39.56	n/a	n/a	n/a
Stdev	3.88	1.76	3.48	4.87	2.39	4.55	1.81	0.92	1.91	3.26	6.75	6.29	n/a	n/a	n/a

BTFr_Unb	Tot_Area			Area_R			Low			Med			High		
	BTFr_Unb	BTFr	Unb	BTFr_Unb	BTFr	Unb	BTFr_Unb	BTFr	Unb	BTFr_Unb	BTFr	Unb	BTFr_Unb	BTFr	Unb
Sum	2258	198	2060	2258	198	2060	1005	77	928	1065	120	945	188	1	187
Average	5.38	0.47	4.90	6.36	0.56	5.80	3.65	0.28	3.37	14.01	1.58	12.43	47.00	0.25	46.75
Variance	45.02	3.09	42.69	47.01	3.60	45.30	4.25	0.33	4.41	29.64	14.43	39.77	60.67	0.25	58.25
Stdev	6.71	1.76	6.53	6.86	1.90	6.73	2.06	0.58	2.10	5.44	3.80	6.31	7.79	0.50	7.63

URCr_Bnd	Tot_Area			Area_R			Low			Med			High		
	URCr_Bnd	URCr	Bnd	URCr_Bnd	URCr	Bnd	URCr_Bnd	URCr	Bnd	URCr_Bnd	URCr	Bnd	URCr_Bnd	URCr	Bnd
Sum	862	310	552	862	310	552	556	215	341	250	88	162	56	7	49
Average	2.05	0.74	1.31	3.68	1.32	2.36	2.59	1.00	1.59	13.89	4.89	9.00	n/a	n/a	n/a
Variance	17.34	3.38	12.08	25.15	5.29	19.25	3.48	1.77	3.64	14.46	33.63	35.88	n/a	n/a	n/a
Stdev	4.16	1.84	3.48	5.02	2.30	4.39	1.86	1.33	1.91	3.80	5.80	5.99	n/a	n/a	n/a

URCr_Bnd	Tot_Area			Area_R			Low			Med			High		
	URCr_Unb	URCr	Unb	URCr_Unb	URCr	Unb	URCr_Unb	URCr	Unb	URCr_Unb	URCr	Unb	URCr_Unb	URCr	Unb
Sum	2370	310	2060	2370	310	2060	1043	130	913	1054	151	903	273	29	244
Average	5.64	0.74	4.90	6.68	0.87	5.80	3.82	0.48	3.34	13.87	1.99	11.88	45.50	4.83	40.67
Variance	50.58	3.38	42.69	52.95	3.88	45.30	4.40	0.86	4.35	26.20	9.16	33.09	76.30	44.17	123.87
Stdev	7.11	1.84	6.53	7.28	1.97	6.73	2.10	0.93	2.09	5.12	3.03	5.75	8.73	6.65	11.13

Table 17. Descriptive Statistics, Area F

Total Area General Descriptive Statistics

Total Area									Total Assemblage				50% Quartile			
		Sum	Avg	Var	StdDev	V/M	Kurt	Skew	N	Cells	m2	% Area	N	Cells	m2	% Area
Total		3929	14.88	1695.22	41.17	113.91	52.14	6.86	3929	219	54.75	82.95	1965	15	3.75	5.68
Total Stone		3644	13.80	1641.03	40.51	118.89	52.89	6.91	3644	213	53.25	80.68	1822	12	3.00	4.55
BTFr		186	0.70	2.76	1.66	3.92	25.56	4.38	186	80	20	30.30	93	16	4.00	6.06
	Q1	15	0.06	0.18	0.42	3.09	157.10	11.63	15	9	2.25	3.41	8	2	0.50	0.76
	Q2	43	0.16	0.33	0.57	2.01	31.13	5.04	43	29	7.25	10.98	22	8	2.00	3.03
	PtQ	20	0.08	0.09	0.31	1.23	20.01	4.36	20	17	4.25	6.44	10	7	1.75	2.65
	Wheds	35	0.13	0.28	0.52	2.08	40.90	5.72	35	23	5.75	8.71	18	7	1.75	2.65
	WhNov	73	0.28	0.65	0.81	2.35	23.39	4.24	73	42	10.50	15.91	37	11	2.75	4.17
URCr		30	0.11	0.56	0.75	4.90	123.24	10.25	30	13	3.25	4.92	15	3	0.75	1.14
	Wheds	30	0.11	0.56	0.75	4.90	123.24	10.25	30	13	3.25	4.92	15	3	0.75	1.14
Total Bone		285	1.08	3.30	1.82	3.05	9.65	2.69	285	118	29.50	44.70	143	26	6.50	9.85
	Bnd	19	0.07	0.10	0.31	1.35	36.98	5.46	19	16	4.00	6.06	10	7	1.75	2.65
	Unb	266	1.01	3.11	1.76	3.09	9.17	2.72	266	113	28.25	42.80	133	23	5.75	8.71

Table 18. Bivariate Comparisons 1, Area F

Density Stratified Bivariate Correlations

		Bivariate Combinations		Tot_Area	Area_r	Low	Med	High
Deb_Bone	Pearson's r	Deb_Total	Bone_Total	.346**	.320**	-0.12	-.239*	.405
	Sig			0	0	0.179	.031	.280
	N			264	219	128	82	9

		Bivariate Combinations		Tot_Area	Area_r	Low	Med	High
BTFURCr	Pearson's r	BTFr	URCr	.263**	0.169	.628**	-.437	-.889
	Sig			0	0.118	0	0.061	0.111
	N			264	87	64	19	4

		Bivariate Combinations		Tot_Area	Area_r	Low	Med	High
BTFr	Pearson's r	Q1_BTF	Q2_BTF	0.025	-0.073	-.197	-.129	n/a
	Sig			0.689	0.519	.137	.587	
	Pearson's r	Q1_BTF	PtQ_BTF	0.055	-0.025	.026	-.104	n/a
	Sig			0.37	0.828	.844	.662	
	Pearson's r	Q1_BTF	WhEds_BTF	.208**	0.142	-.126	.161	n/a
	Sig			0.001	0.207	.345	.497	
	Pearson's r	Q1_BTF	WhNov_BTF	.077	-.036	-.099	-.272	n/a
	Sig			0.211	0.75	.460	.246	
	Pearson's r	Q2_BTF	PtQ_BTF	.125*	-0.046	-.337**	-.065	1**
	Sig			0.042	0.687	.01	.784	
	Pearson's r	Q2_BTF	WhEds_BTF	.460**	.353**	-.174	-.04	1**
	Sig			0	0.001	.191	.866	
	Pearson's r	Q2_BTF	WhNov_BTF	.438**	.276*	-.263*	-0.293	-1**
	Sig			0	0.013	.046	.209	
	Pearson's r	PtQ_BTF	WhEds_BTF	.222**	0.09	-.216	0.076	1**
	Sig			0	0.426	.104	.751	
	Pearson's r	PtQ_BTF	WhNov_BTF	0.116	-0.103	-.299*	-0.208	-1**
	Sig			0.061	0.365	.023	.380	
	Pearson's r	WhEds_BTF	WhNov_BTF	.264**	0.081	-.234	-.554*	-1**
	Sig			0	0.477	.077	.011	
				264	80	58	20	2

Table 19. Bivariate Comparisons 2, Area F

Bnd_Unb Bone								
		Bivariate Combinations		Tot_Area	Area_r	Low	Med	High
	Pearson's r	Burned	Unburned	0.082	-0.11	-.498**	-.527**	n/a
	Sig			0.185	0.237	0	.001	
	N			264	118	83	34	1
BTFr to Bone				Tot_Area	Area_r	Low	Med	High
	Pearson's r	BTFr	Unburned Bone	.318**	.151	-.742**	-.559**	-0.521
	Sig			0	.07	0	0	.186
	N				145	88	49	8
URCr to Bone				Tot_Area	Area_r	Low	Med	High
	Pearson's r	URCr	Unburned Bone	0.066	-.056	-.355**	-.616**	-.933
	Sig			0.287	0.55	0.001	0	0.235
	N			264	118	79	36	3

Table 20. Density Stratified Statistics 1, Area F

Density Stratified Descriptive Stats, Debitage & Bone

Deb_Bone	Cells	**Tot_Area**		Cells	**Area_R**	R	Cells	**Low**	R	Cells	**Med**	R	Cells	**High**	R
	264			219		>0	128		1-8	82		9-64	9		65+
	DebBone	Deb	Bone	DebBone	Deb	Bone	DebBone	Deb	Bone	DebBone	Deb	Bone	DebBone	Deb	Bone
Sum	3929	3644	285	3929	3644	285	31	475	95	107	1507	156	78	1662	34
Average	14.88	13.80	1.08	0.99	16.64	1.30	0.24	3.71	0.74	1.30	18.38	1.90	8.67	184.67	3.78
Variance	1695.22	1641.03	3.30	4.63	1932.37	3.69	0.25	5.15	1.18	2.34	168.98	4.83	22.25	16396.75	17.19
Stdev	41.17	40.51	1.82	2.15	43.96	1.92	0.50	2.27	1.09	1.53	13.00	2.20	4.72	128.05	4.15

BTFURCr	Cells	**Tot_Area**		Cells	**Area_R**	R	Cells	**Low**	R	Cells	**Med**	R	Cells	**High**	R
	264			87		>0	64		1-2	19		3-8	4		9+
	BTFURCr	BTFr	URCr	BTFURCr	BTFr	URCr	BTFURCr	BTFr	URCr	BTFURCr	BTFr	URCr	BTFURCr	BTFr	URCr
Sum	216	186	30	216	186	30	82	75	7	81	72	9	53	39	14
Average	0.82	0.70	0.11	2.48	2.14	0.34	1.28	1.17	0.11	4.26	3.79	0.47	13.25	9.75	3.50
Variance	3.97	2.76	0.56	7.97	5.35	1.62	0.21	0.34	0.10	2.43	2.62	1.60	4.25	16.25	20.33
Stdev	1.99	1.66	0.75	2.82	2.31	1.27	0.45	0.58	0.31	1.56	1.62	1.26	2.06	4.03	4.51

BndUnb	Cells	**Tot_Area**		Cells	**Area_R**	R	Cells	**Low**	R	Cells	**Med**	R	Cells	**High**	R
	264			118		>0	83		1-2	34		3-8	1		9+
	BndUnb	Bnd	Unb	BndUnb	Bnd	Unb	BndUnb	Bnd	Unb	BndUnb	Bnd	Unb	BndUnb	Bnd	Unb
Sum	285	19	266	285	19	266	113	10	103	159	8	151	13	1	12
Average	1.08	0.07	1.01	2.42	0.16	2.25	1.36	0.12	1.24	4.68	0.24	4.44			
Variance	3.30	0.10	3.11	4.16	0.20	4.16	0.23	0.11	0.31	2.71	0.43	3.59			
Stdev	1.82	0.31	1.76	2.04	0.45	2.04	0.48	0.33	0.55	1.65	0.65	1.89			

Table 21. Density Stratified Statistics 2, Area F

BTFr & URCr Density Stratified Descriptive Stats

BTFr — **Tot_Area**; Cells 264

	BTFr	Q1	Q2	PtQ	Whed	WhNov
Sum	186	15	43	20	35	73
Avg	0.70	0.06	0.16	0.08	0.13	0.28
Var	2.76	0.18	0.33	0.09	0.28	0.65
Stdev	1.66	0.42	0.57	0.31	0.52	0.81

Area_R; Cells 80; Range > 0

	BTFr	Q1	Q2	PtQ	Whed	WhNov
Sum	186	15	43	20	35	73
Avg	2.33	0.19	0.54	0.25	0.44	0.91
Var	5.39	0.56	0.88	0.27	0.78	1.57
Stdev	2.32	0.75	0.94	0.52	0.88	1.25

BTFr — **Low**; Cells 58; Range 1-2

	BTFr	Q1	Q2	PtQ	Whed	WhNov
Sum	75	4	20	12	12	27
Avg	1.29	0.07	0.34	0.21	0.21	0.47
Var	0.21	0.07	0.23	0.20	0.20	0.36
Stdev	0.46	0.26	0.48	0.45	0.45	0.60

Med; Cells 20; Range 3-8

	BTFr	Q1	Q2	PtQ	Whed	WhNov
Sum	85	11	14	7	17	36
Avg	4.25	0.55	0.70	0.35	0.85	1.80
Var	2.51	1.94	1.17	0.45	1.19	1.85
Stdev	1.59	1.39	1.08	0.67	1.09	1.36

High; Cells 2; Range 9+

	BTFr	Q1	Q2	PtQ	Whed	WhNov
Sum	26	0	9	1	6	10
Avg	13.00	0	4.50	0.50	3.00	5.00
Var	2.00	0	0.50	0.50	8.00	8.00
Stdev	1.41	0	0.71	0.71	2.83	2.83

URCr

	Tot_Area	**Area_R**	**Low**	**Med**	**High**
Cells	264	13	9	3	1
Range		>0	1-2	3-8	9+

	URCr (Tot_Area)	URCr (Area_R)	URCr (Low)	URCr (Med)	URCr (High)
Sum	30	30	9	11	10
Avg	0.11	2.3077	1.00	3.67	
Var	0.56	6.7308	0	0.33	
Stdev	0.75	2.5944	0	0.58	

*All Are White Edwards Chert URCs

Table 22. Density Stratified Statistics 3, Area F

Density Stratified Statistics, Diagnostic Debitage vs. Burned & Unburned Bone

BTFr_Bnd	Cells	**Tot_Area**		Cells	**Area_R**	R	Cells	**Low**	R	Cells	**Med**	R	Cells	**High**	R
	264			89		>0	65		1-8	22		9-64	2		65+
	BTFr_Bnd	BTFr	Bnd	BTFr_Bnd	BTFr	Bnd	BTFr_Bnd	BTFr	Bnd	BTFr_Bnd	BTFr	Bnd	BTFr_Bnd	BTFr	Bnd
Sum	205	186	19	205	186	19	84	73	11	95	87	8	26	26	0
Average	0.78	0.70	0.07	2.30	2.09	0.21	1.29	1.12	0.17	4.32	3.95	0.36	13.00	13.00	0
Variance	2.91	2.76	0.10	5.15	5.33	0.26	0.21	0.36	0.14	2.51	3.28	0.62	2.00	2.00	0
Stdev	1.71	1.66	0.31	2.27	2.31	0.51	0.46	0.60	0.38	1.59	1.81	0.79	1.41	1.41	0

BTFr_Unb	Cells	**Tot_Area**		Cells	**Area_R**	R	Cells	**Low**	R	Cells	**Med**	R	Cells	**High**	R
	264			145		>0	88		1-2	49		3-8	8		9+
	BTFr_Unb	BTFr	Unb	BTFr_Unb	BTFr	Unb	BTFr_Unb	BTFr	Unb	BTFr_Unb	BTFr	Unb	BTFr_Unb	BTFr	Unb
Sum	452	266	186	452	186	266	121	47	74	231	94	137	100	45	55
Average	1.71	1.01	0.70	3.12	1.28	1.83	1.38	0.53	0.84	4.71	1.92	2.80	12.50	5.63	6.88
Variance	7.74	3.11	2.76	9.73	4.30	4.15	0.24	0.48	0.43	3.08	3.58	3.42	19.43	26.55	8.70
Stdev	2.78	1.76	1.66	3.12	2.07	2.04	0.49	0.69	0.66	1.76	1.89	1.85	4.41	5.15	2.95

Table 23. Density Stratified Statistics 4, Area F

URCr_Bnd	Cells	**Tot_Area**		Cells	**Area_R**	R	Cells	**Low**	R	Cells	**Med**	R	Cells	**High**	R
	264			28		>0	23		1-2	4		3-8	1		9+
	URCr_Bnd	URCr	Bnd	URCr_Bnd	URCr	Bnd	URCr_Bnd	URCr	Bnd	URCr_Bnd	URCr	Bnd	URCr_Bnd	URCr	Bnd
Sum	49	30	19	49	30	19	25	9	16	14	11	3	10	10	0
Average	0.19	0.11	0.07	1.75	1.07	0.68	1.09	0.39	0.70	3.50	2.75	0.75			
Variance	0.65	0.56	0.10	3.45	4.37	0.52	0.08	0.25	0.31	0.33	3.58	2.25			
Stdev	0.80	0.75	0.31	1.86	2.09	0.72	0.29	0.50	0.56	0.58	1.89	1.50			

URCr_Unb	Cells	**Tot_Area**		Cells	**Area_R**	R	Cells	**Low**	R	Cells	**Med**	R	Cells	**High**	R
	264			118		>0	79		1-2	36		3-8	3		9+
	URCr_Unb	URCr	Unb	URCr_Unb	URCr	Unb	URCr_Unb	URCr	Unb	URCr_Unb	URCr	Unb	URCr_Unb	URCr	Unb
Sum	296	30	266	296	30	266	103	4	99	159	15	144	34	11	23
Average	1.12	0.11	1.01	2.51	0.25	2.25	1.30	0.05	1.25	4.42	0.42	4.00	11.33	3.67	7.67
Variance	3.84	0.56	3.11	5.12	1.22	4.16	0.21	0.05	0.24	2.71	1.11	4.29	4.33	30.33	20.33
Stdev	1.96	0.75	1.76	2.26	1.10	2.04	0.46	0.22	0.49	1.65	1.05	2.07	2.08	5.51	4.51

Table 24. Summary Descriptive Statistics, Area B

Total Area General Descriptive Statistics

Total Debitage + Bone				Total Assemblage				50% Quartile			
		Sum	V/M	N	Cells	m2	% Area	N	Cells	m2	% Area
Total		8609	117.82	8609	399	99.75	95.00	4305	29	7.25	6.9
Total Stone		5997	163.37	5997	379	94.75	90.24	2999	12	3.00	2.86
BTFr		198	6.54	198	89	22.25	21.19	99	11	2.75	2.62
	Q1	32	2.18	32	19	4.75	4.52	16	5	1.25	1.19
	Q2	149	5.91	149	67	16.75	15.95	75	8	2.00	1.90
	PtQ	17	1.08	17	16	4	3.81	9	8	2.00	1.90
URCr		310	4.58	310	124	31	29.52	155	22	5.50	5.24
	Q2	39	4.40	39	22	5.5	5.24	20	4	1.00	0.95
	Chalc	102	3.39	102	50	12.5	11.90	51	11	2.75	2.62
	Wheds	119	2.61	119	72	18	17.14	60	17	4.25	4.05
	WhNov	50	3.01	50	30	7.5	7.14	25	7	1.75	1.67
Total Bone		2612	10.75	2612	351	87.75	83.57	1306	61	15.25	14.52
	Bnd	552	9.19	552	157	39.25	37.38	276	21	5.25	5.00
	Unb	2060	8.70	2060	341	85.25	81.19	1030	63	15.75	15.00

Table 25. Summary of Correlation Statistics for Variables with Sufficient Sample Size, Area B

Density Stratified Bivariate Correlations								
Deb_Bone		Bivariate		Tot_Area	Area_r	Low	Med	High
	Pearson's r	Deb_Total	Bone_Total	0.02	0.008	-0.282**	-.166**	-.446*
	Sig			0.687	0.874	.000	.016	.049
	N			420	399	167	212	20
BTFURCr		Bivariate		Tot_Area	Area_r	Low	Med	High
	Pearson's r	BTFr	URCr	.122*	-0.051	-0.756**	-.472**	-.857**
	Sig			0.012	0.513	0	01	0
	N			420	167	111	43	13
Bnd_Unb Bone								
		Bivariate		Tot_Area	Area_r	Low	Med	High
	Pearson's r	Burned	Unburned	.266**	.226**	-.199*	-.419**	-.736**
	Sig			0	0	.001	.000	.01
	N			420	351	256	84	11
BTFr to Bone		Bivariate		Tot_Area	Area_r	Low	Med	High
	Pearson's r	BTFr	Burned Bone	-0.008	-0.122	-.343**	-.877**	n/a
	Sig			0.865	0.077	.000	.000	
	N			420	211	192	18	1
				Tot_Area	Area_r	Low	Med	High
	Pearson's r	BTFr	Unburned Bone	-0.033	-.074	-.204**	-.513**	0.284
	Sig			0.501	.163	.001	.000	.716
	N			420	355	275	76	4
URCr to Bone		Bivariate		Tot_Area	Area_r	Low	Med	High
	Pearson's r	URCr	Burned Bone	.147**	0.03	-.380**	-.792**	n/a
	Sig			0.002	0.647	0	0	
	N			420	234	215	18	1
				Tot_Area	Area_r	Low	Med	High
	Pearson's r	URCr	Unburned Bone	.188**	.142**	-.210**	-.461**	-.620
	Sig			0	0.007	0	0	0.189
	N			420	355	273	76	6

Table 26. Summary of Correlation Statistics for Variables with Insufficient Sample Size, Area B

		Bivariate Combinations		Tot_Area	Area_r	Low	Med	High
BTFr	Pearson's r	Q1_BTF	Q2_BTF	.686**	.628**	-0.288*	-0.423	n/a
	Sig			0	0	0.012	0.257	
	Pearson's r	Q1_BTF	PtQ_BTF	-0.008	-0.166	-0.136	n/a	n/a
	Sig			0.866	0.121	0.242		
	Pearson's r	Q2_BTF	PtQ_BTF	-0.048	-.275**	-0.679**	n/a	n/a
	Sig			0.331	0.009	0		
	N			420	89	76	9	4

		Bivariate Combinations		Tot_Area	Area_r	Low	Med	High
URCr	Pearson's r	Q2_URC	Chalc_URC	0.006	-0.098	-.207*	-.199	-.6
	Sig			0.898	0.28	.048	.32	.208
	Pearson's r	Q2_URC	Wheds_URC	0.048	-0.08	-.241*	-.247	-.464
	Sig			0.331	0.377	.022	.215	.354
	Pearson's r	Q2_URC	WhNov_URC	-0.1	-0.086	-.147	-.189	-.27
	Sig			0.834	0.345	.165	.346	.605
	Pearson's r	Chalc_URC	Wheds_URC	.426**	.274**	-.420**	-.416*	.391
	Sig			0	0.002	0	.031	.444
	Pearson's r	Chalc_URC	WhNov_URC	.215**	0.101	-.274**	-.115	-.225
	Sig			0	0.265	.009	.567	.669
	Pearson's r	Wheds_URC	WhNov_URC	0.097	-0.074	-.271**	-.383*	-.46
	Sig			0.048	0.416	.009	.048	.359
	N			420	124	91	27	6

Table 27. Assemblage Comparisons, Area B vs. Area F

	AREA B	AREA F
Debitage	5997	3644
BTFr	198	186
Q1	32	15
Q2	149	43
PtQ	17	20
WhEds	N/A	35
WhNova	N/A	73
URCr	310	30
Q2	39	N/A
Chalc	102	N/A
WhEds	119	30
WhNov	50	N/A
Bone	2612	285
Burned	552	19
Unburned	2060	266

N/A = This raw material class may exist in the total Aubrey assemblage, but was not used in this analysis because of low abundances.

Table 28. Summary Descriptive Statistics, Area F

Total Area General Descriptive Statistics											
Total Area				Total Assemblage				50% Quartile			
		Sum	V/M	N	Cells	m2	% Area	N	Cells	m2	% Area
Artifacts		3929	113.91	3929	219	54.75	82.95	1965	15	3.75	5.68
Total Stone		3644	118.89	3644	213	53.25	80.68	1822	12	3.00	4.55
BTFr		186	3.92	186	80	20	30.30	93	16	4.00	6.06
	Q1	15	3.09	15	9	2.25	3.41	8	2	0.50	0.76
	Q2	43	2.01	43	29	7.25	10.98	22	8	2.00	3.03
	PtQ	20	1.23	20	17	4.25	6.44	10	7	1.75	2.65
	Wheds	35	2.08	35	23	5.75	8.71	18	7	1.75	2.65
	WhNov	73	2.35	73	42	10.50	15.91	37	11	2.75	4.17
URCr		30	4.90	30	13	3.25	4.92	15	3	0.75	1.14
	Wheds	30	4.90	30	13	3.25	4.92	15	3	0.75	1.14
Total Bone		285	3.05	285	118	29.50	44.70	143	26	6.50	9.85
	Bnd	19	1.35	19	16	4.00	6.06	10	7	1.75	2.65
	Unb	266	3.09	266	113	28.25	42.80	133	23	5.75	8.71

Table 29. Summary of Correlation Statistics for Variables with Sufficient Sample Sizes, Area F

Deb_Bone		Bivariate		Tot_Area	Area_r	Low	Med	High
	Pearson's r	Deb_Total	Bone_Total	.346**	.320**	-0.12	-.239*	.405
	Sig			0	0	0.179	.031	.280
	N			264	219	128	82	9
BTFURCr		Bivariate		Tot_Area	Area_r	Low	Med	High
	Pearson's r	BTFr	URCr	.263**	0.169	.628**	-.437	-.889
	Sig			0	0.118	0	0.061	0.111
	N			264	87	64	19	4
BTFr to Bone				Tot_Area	Area_r	Low	Med	High
	Pearson's r	BTFr	Unburned Bone	.318**	.151	-.742**	-.559**	-0.521
	Sig			0	.07	0	0	.186
	N				145	88	49	8
URCr to Bone				Tot_Area	Area_r	Low	Med	High
	Pearson's r	URCr	Unburned Bone	0.066	-.056	-.355**	-.616**	-.933
	Sig			0.287	0.55	0.001	0	0.235
	N			264	118	79	36	3

Table 30. Summary Correlation Statistics for Variables with Insufficient Sample Sizes, Area F

		Bivariate		Tot_Area	Area_r	Low	Med	High
BTFr	Pearson's r	Q1_BTF	Q2_BTF	0.025	-0.073	-.197	-.129	n/a
	Sig			0.689	0.519	.137	.587	
	Pearson's r	Q1_BTF	PtQ_BTF	0.055	-0.025	.026	-.104	n/a
	Sig			0.37	0.828	.844	.662	
	Pearson's r	Q1_BTF	WhEds_BTF	.208**	0.142	-.126	.161	n/a
	Sig			0.001	0.207	.345	.497	
	Pearson's r	Q1_BTF	WhNov_BTF	.077	-.036	-.099	-.272	n/a
	Sig			0.211	0.75	.460	.246	
	Pearson's r	Q2_BTF	PtQ_BTF	.125*	-0.046	-.337**	-.065	1**
	Sig			0.042	0.687	.01	.784	
	Pearson's r	Q2_BTF	WhEds_BTF	.460**	.353**	-.174	-.04	1**
	Sig			0	0.001	.191	.866	
	Pearson's r	Q2_BTF	WhNov_BTF	.438**	.276*	-.263*	-0.293	-1**
	Sig			0	0.013	.046	.209	
	Pearson's r	PtQ_BTF	WhEds_BTF	.222**	0.09	-.216	0.076	1**
	Sig			0	0.426	.104	.751	
	Pearson's r	PtQ_BTF	WhNov_BTF	0.116	-0.103	-.299*	-0.208	-1**
	Sig			0.061	0.365	.023	.380	
	Pearson's r	WhEds_BTF	WhNov_BTF	.264**	0.081	-.234	-.554*	-1**
	Sig			0	0.477	.077	.011	
				264	80	58	20	2

*Note, Raw materials of URCs are not included, since there was only one class.

APPENDIX B

FIGURES

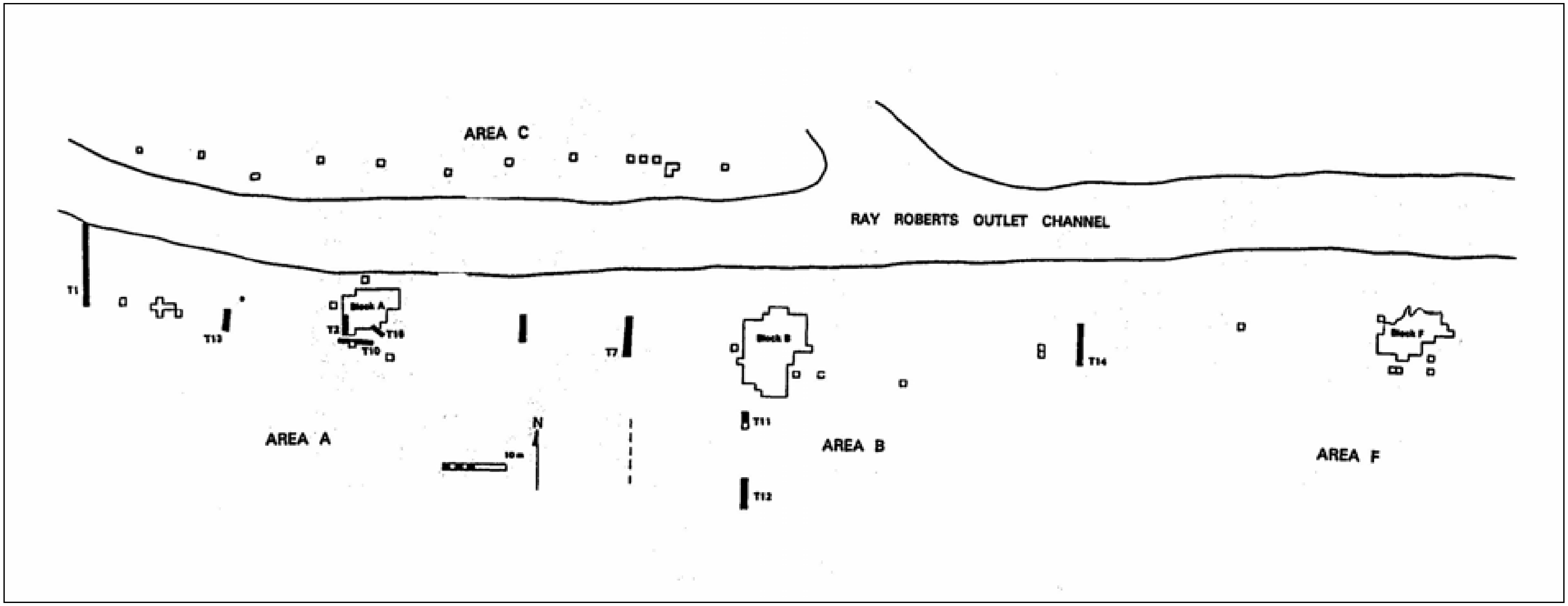


Figure 1. Map of Aubrey Excavation (Ferring 2001)

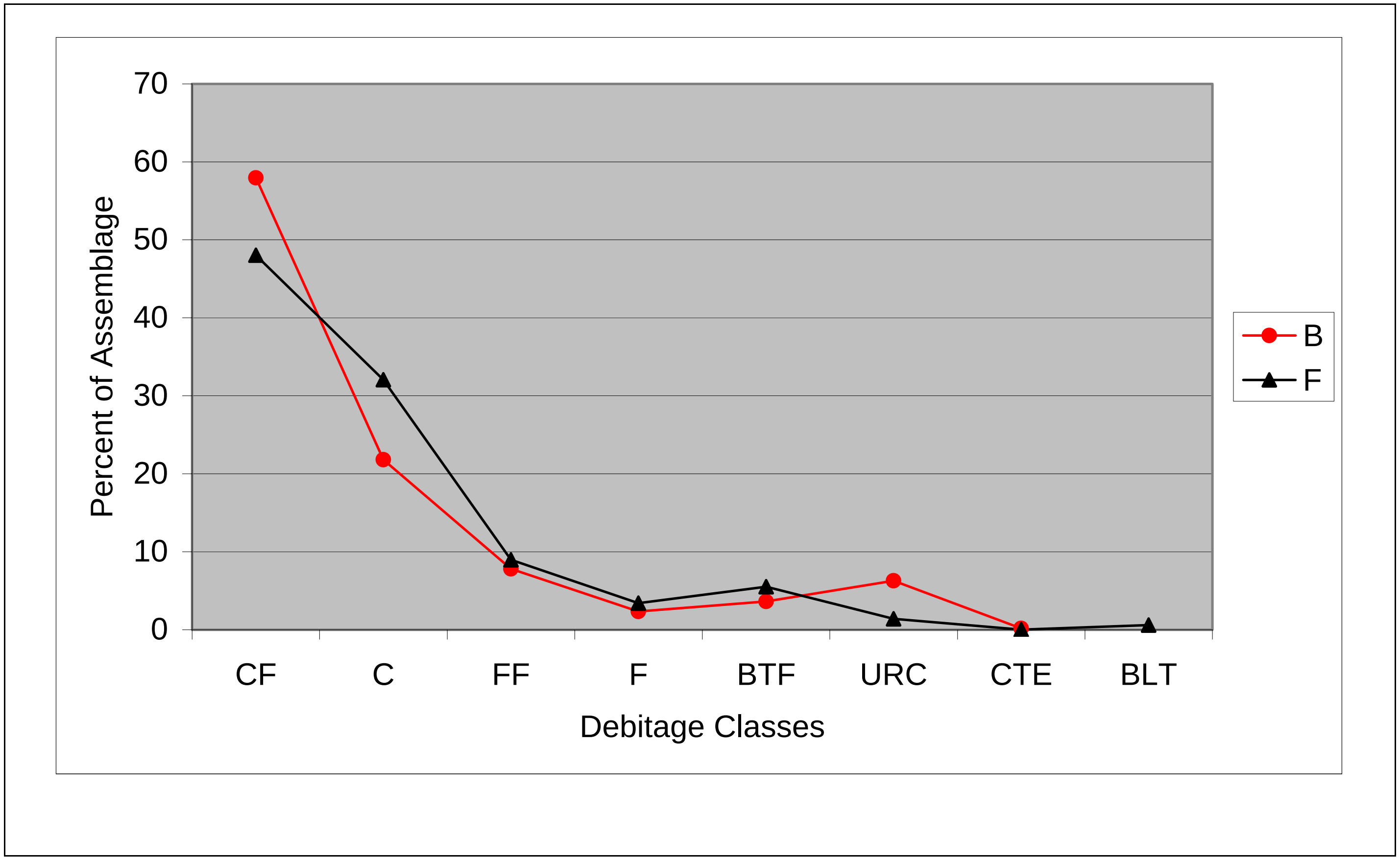


Figure 2. Debitage Class Frequencies for Areas B & F

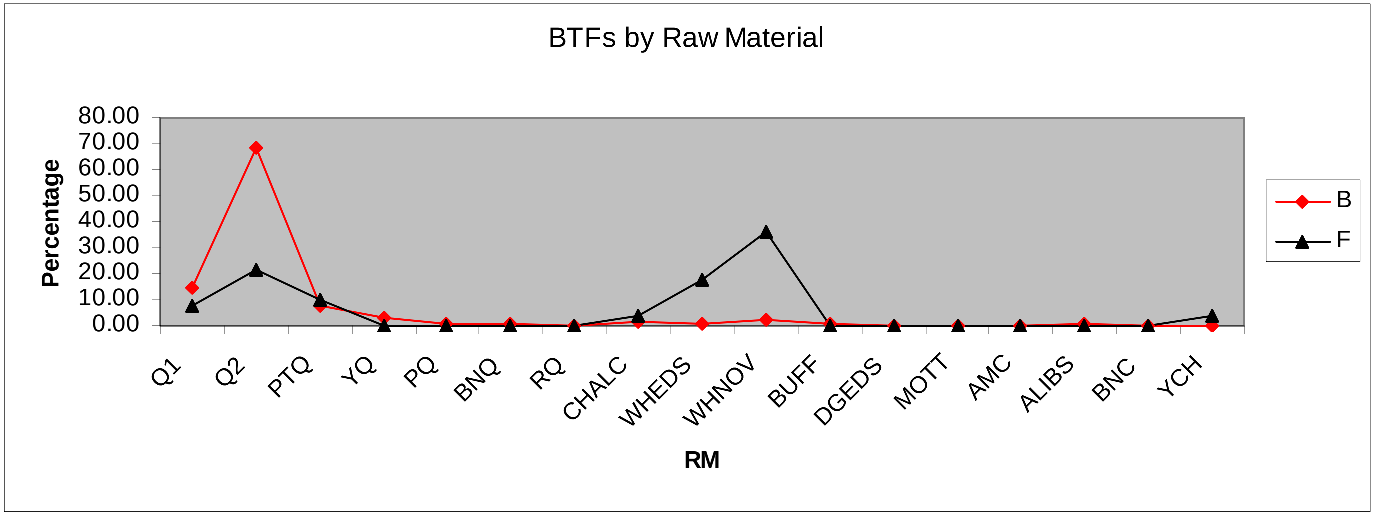


Figure 3. BTFs by Raw Material, Areas B & F

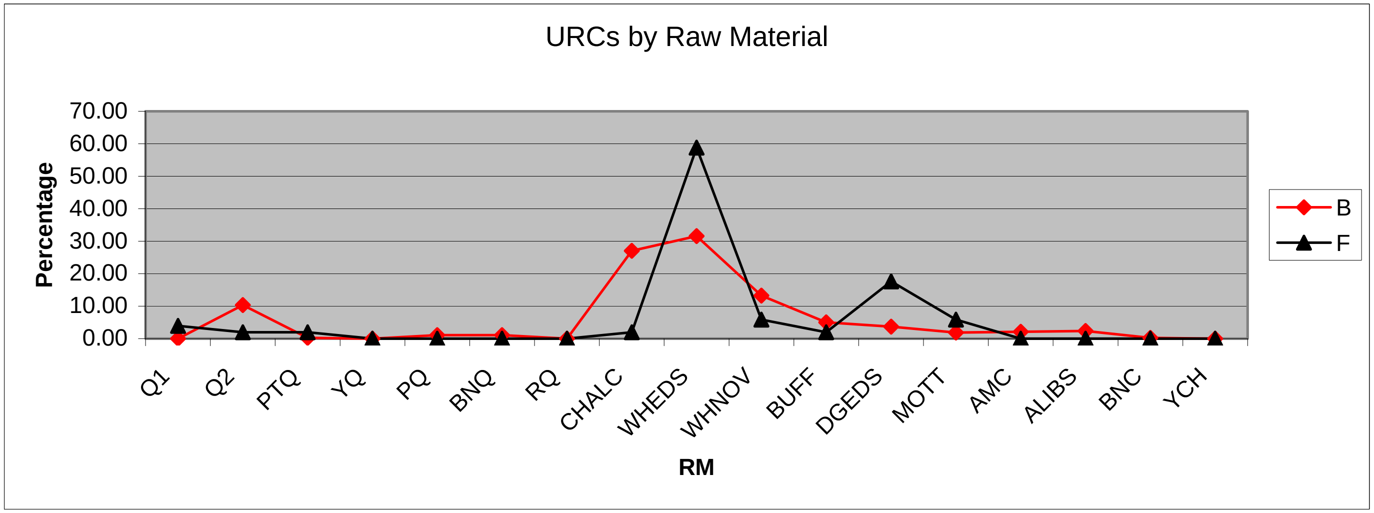
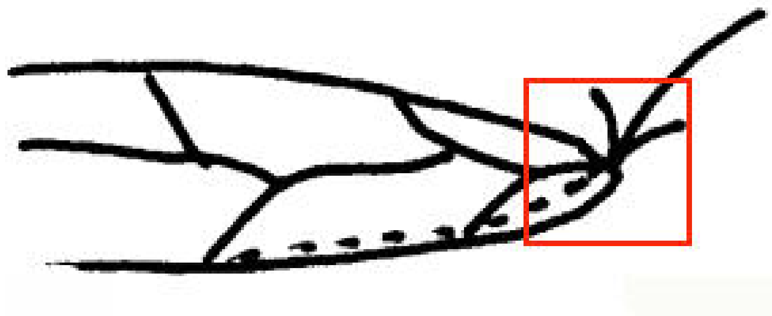


Figure 4. URCs by Raw Material, Areas B & F

a.



b.

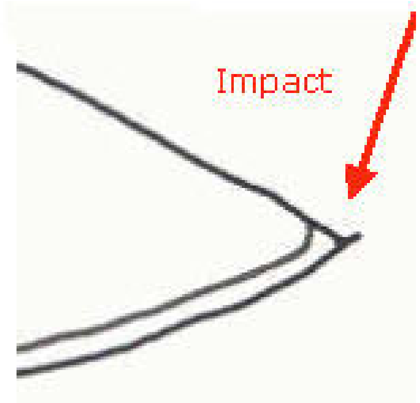
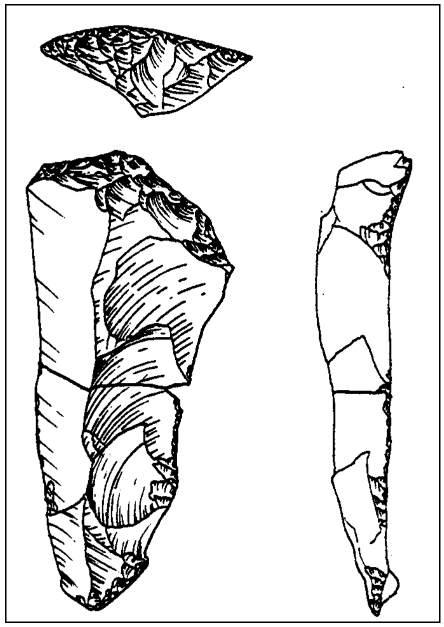
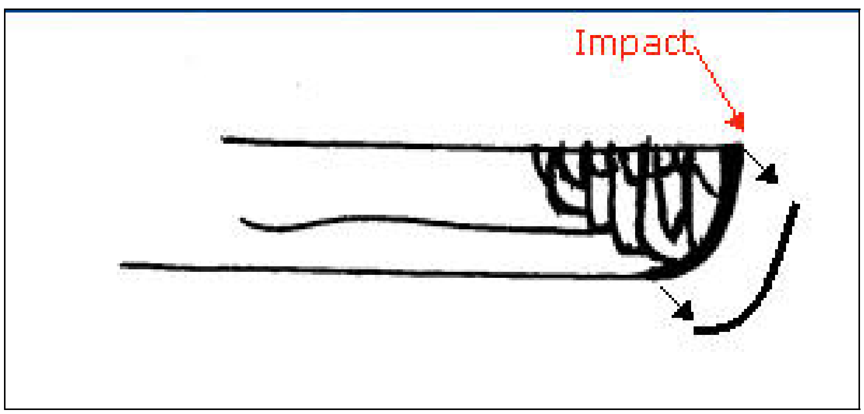


Figure 5. BTF Diagrams. A) BTF Removal (after Waldorf 1993) b) Distinctive Impact “Lip” of BTF



a.



b.

Figure 6. URC Diagrams (a) Canted End Scraper (Ferring 2001). (b) URC Diagram

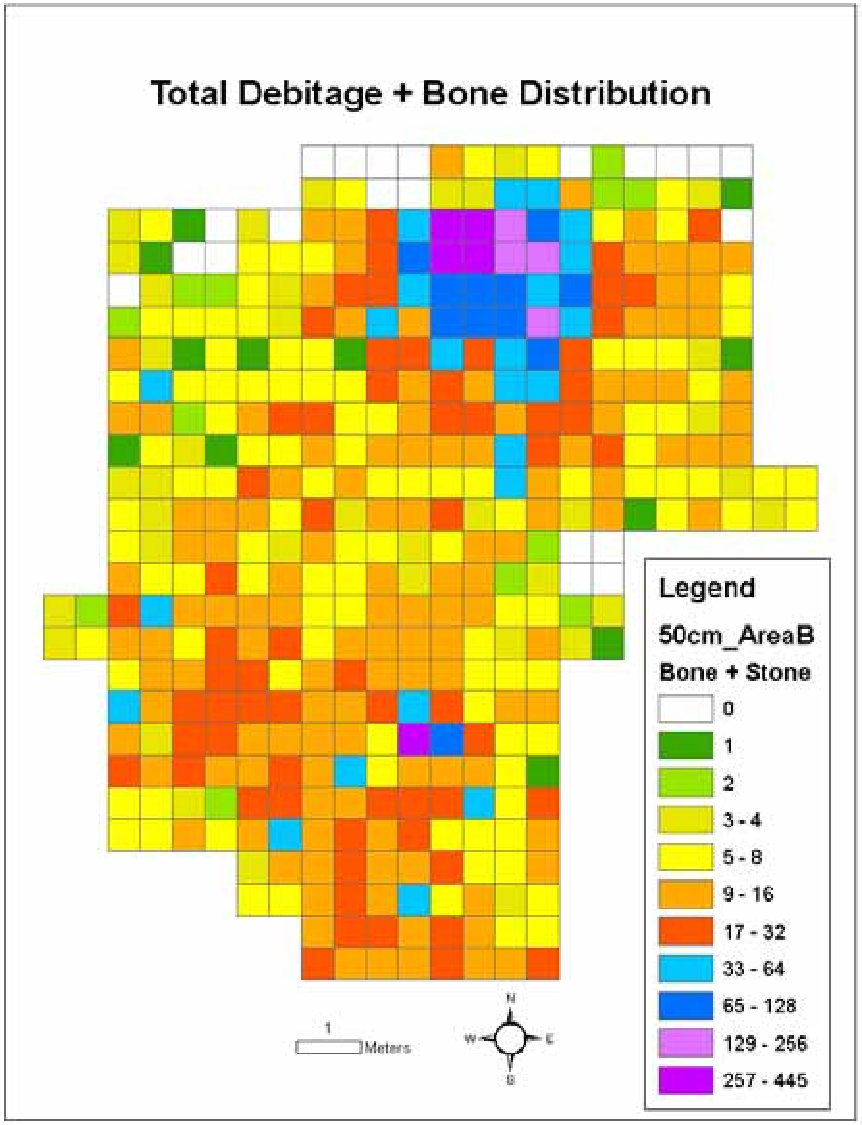


Figure 7. Debitage + Bone Combined Distribution

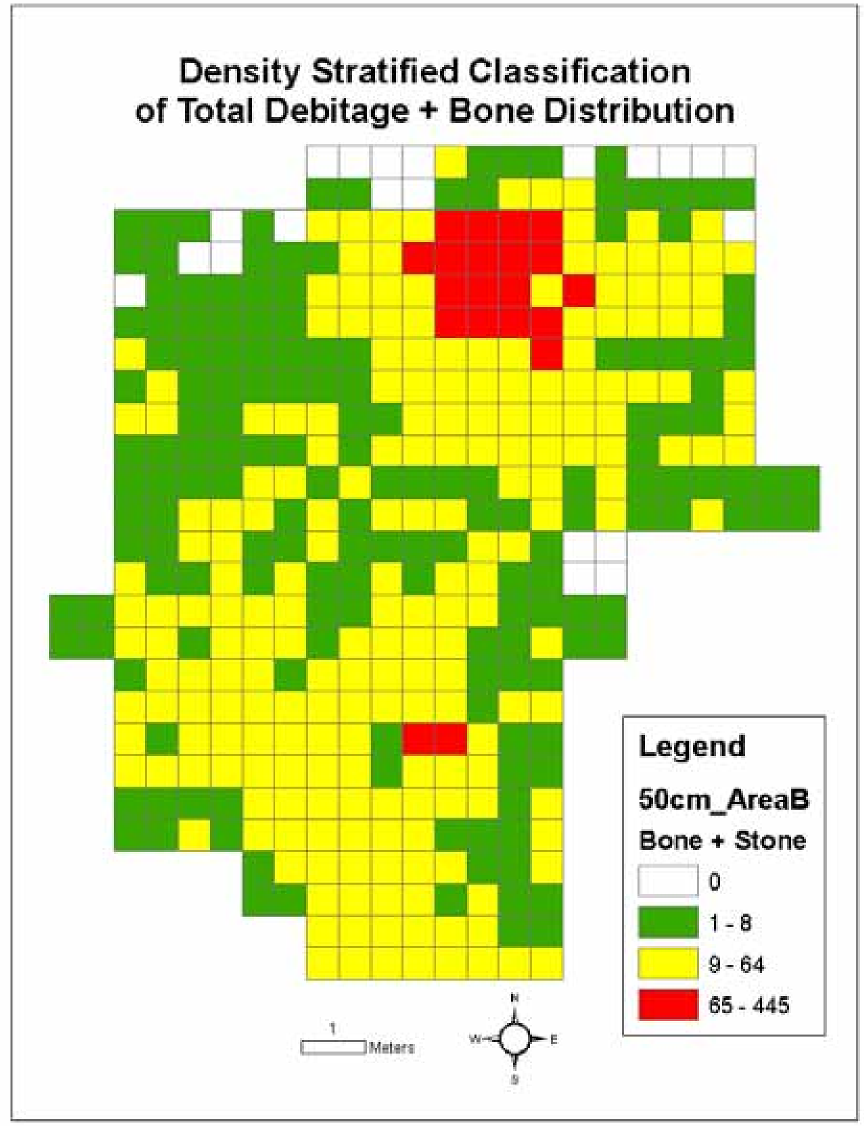


Figure 8. Debitage + Bone Density Stratified Distribution

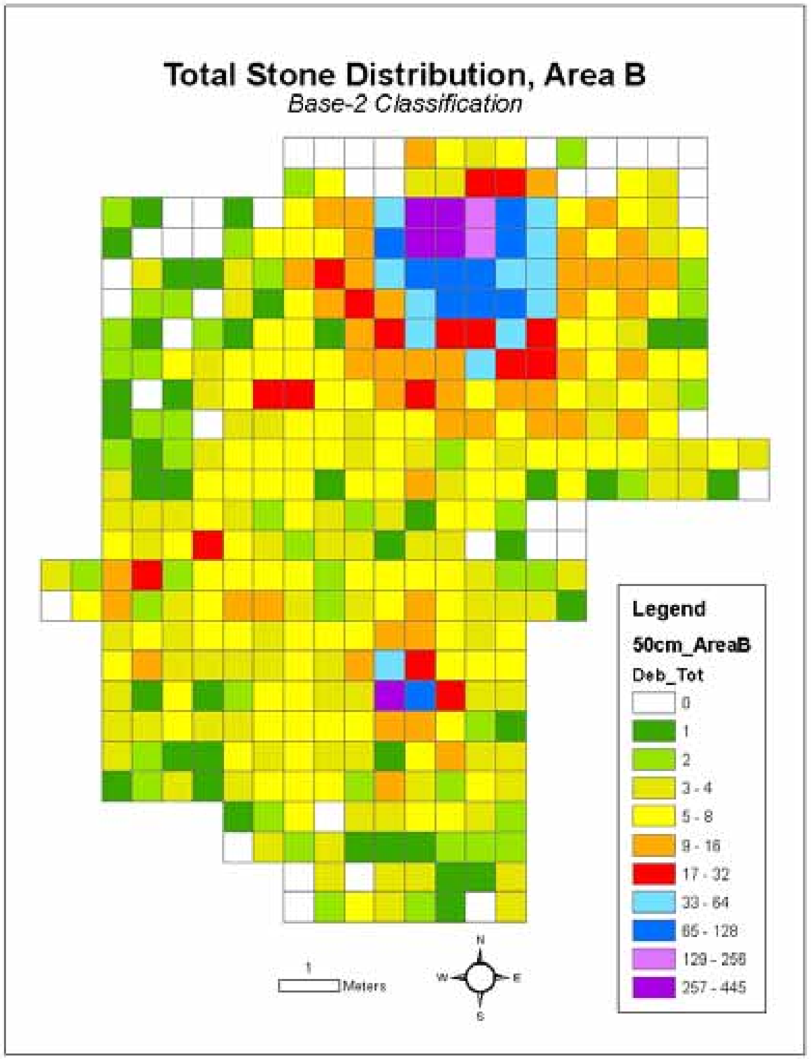


Figure 9. Debitage Distribution Map, Area B

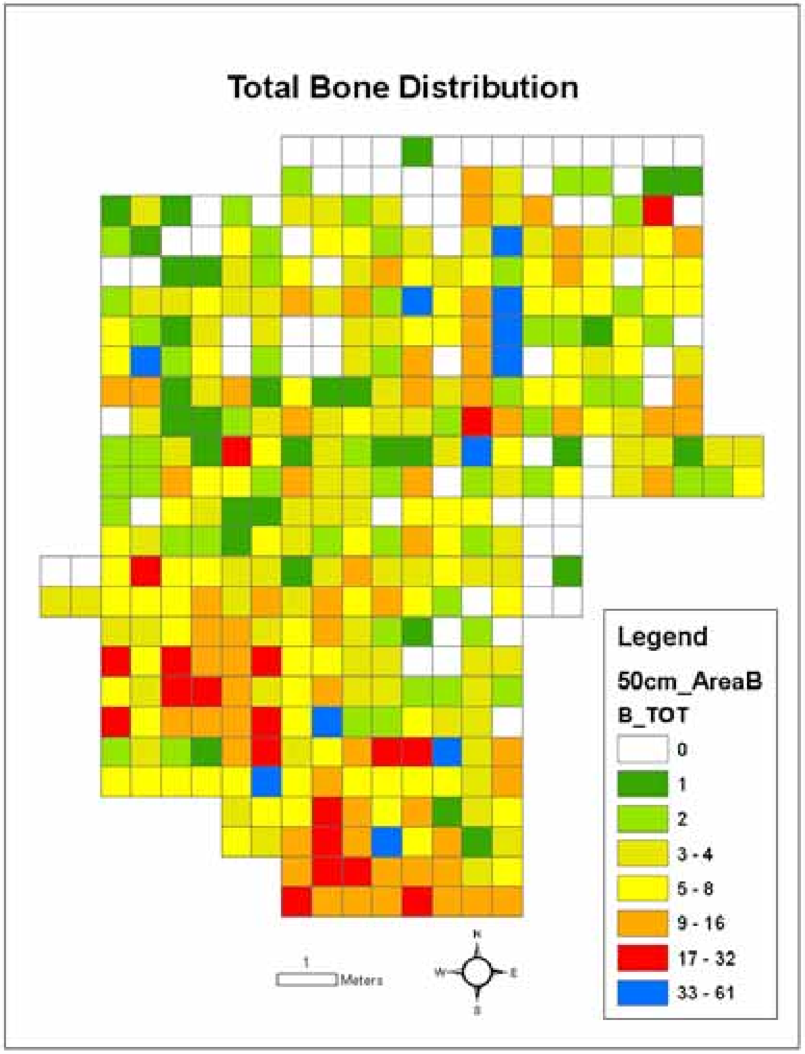


Figure 10. Total Bone Distribution Map, Area B

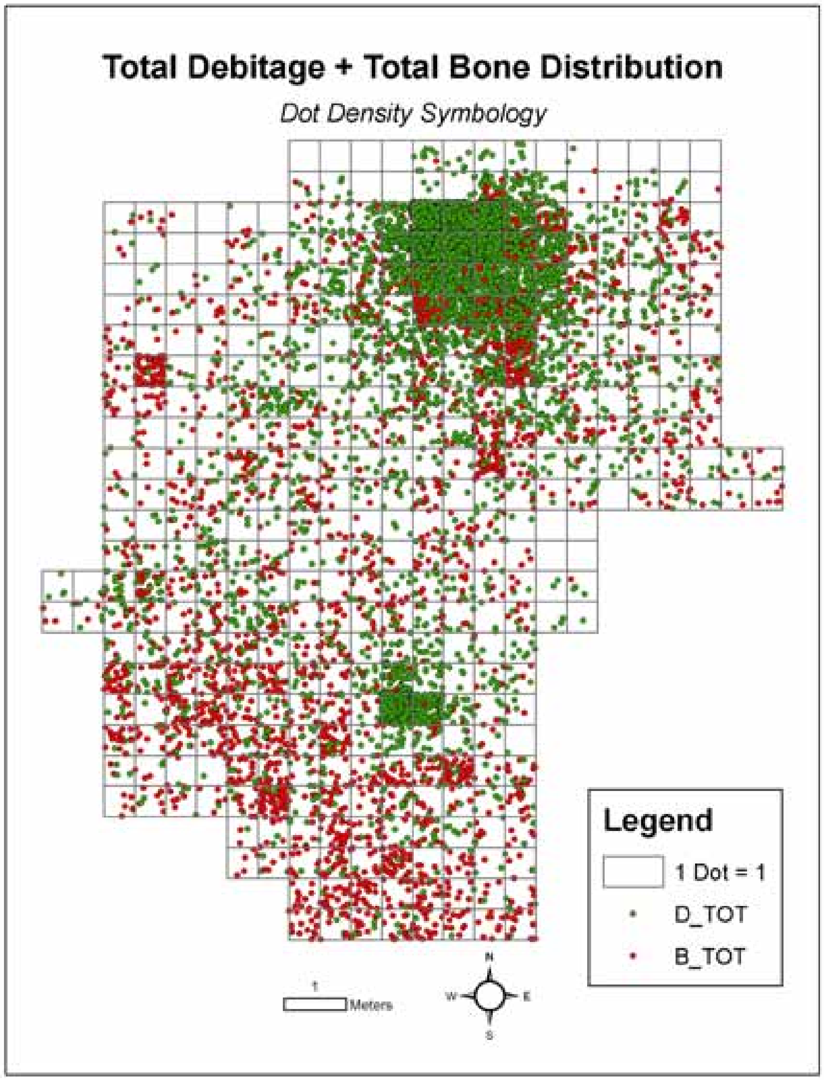


Figure 11. Total Debitage & Total Bone Dot Density Map, Area B

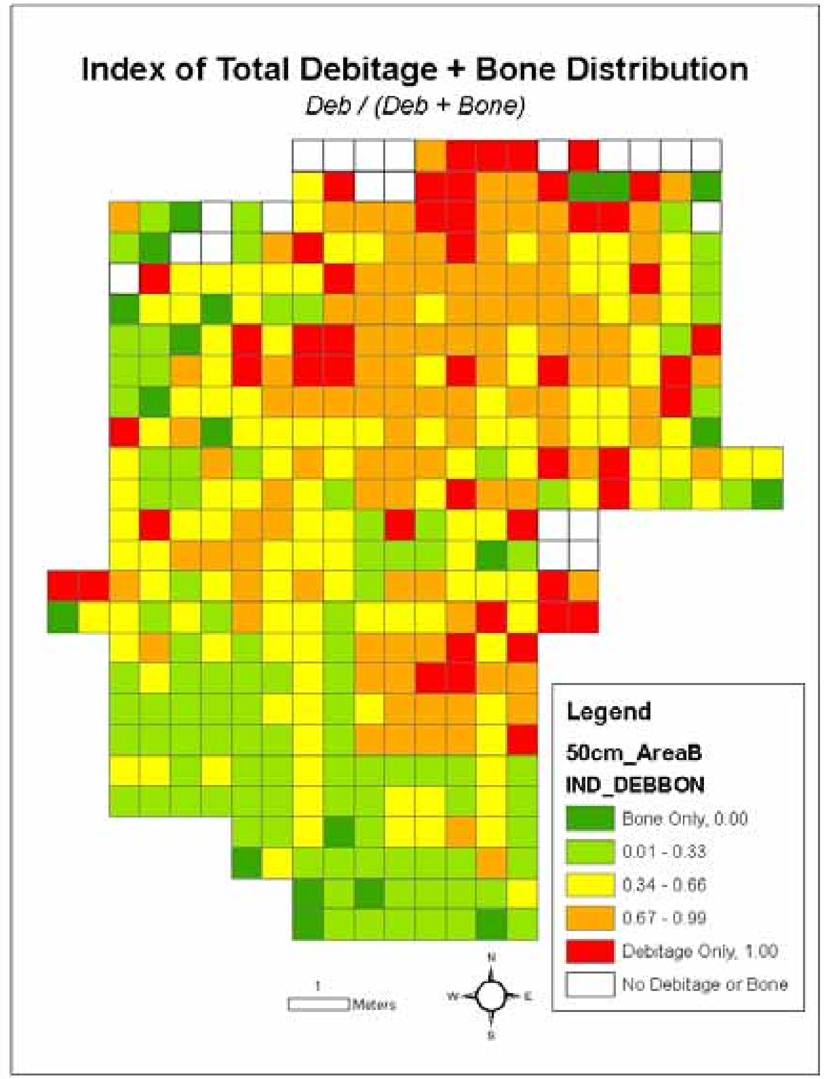


Figure 12. Debitage & Bone Proportional Index Map, Area B

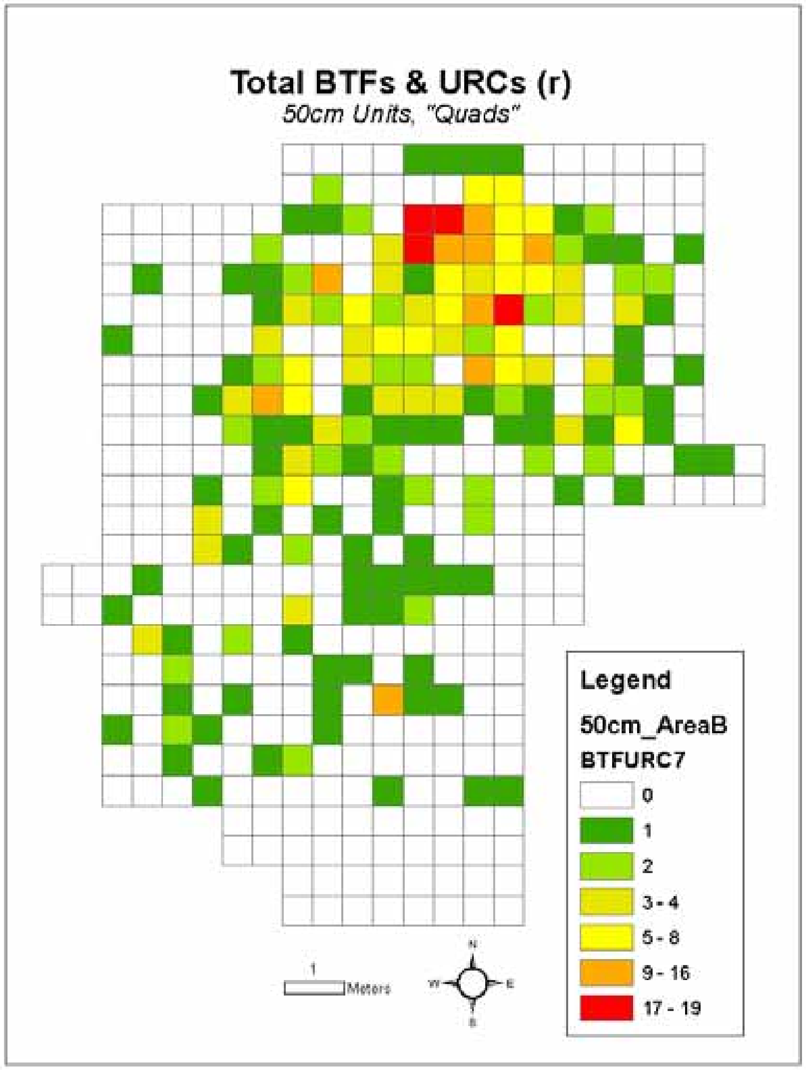


Figure 13. BTFr + URCr Combined Distribution, Area B

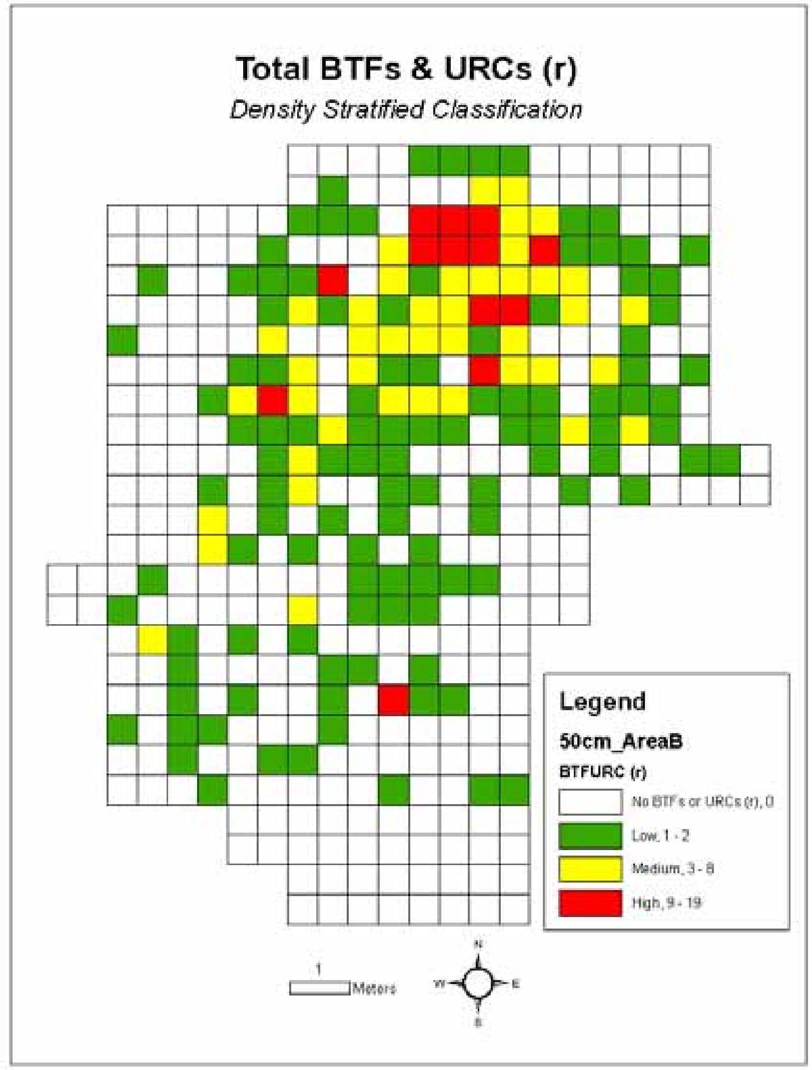


Figure 14. BTFr + URCr Density Stratified Map, Area B

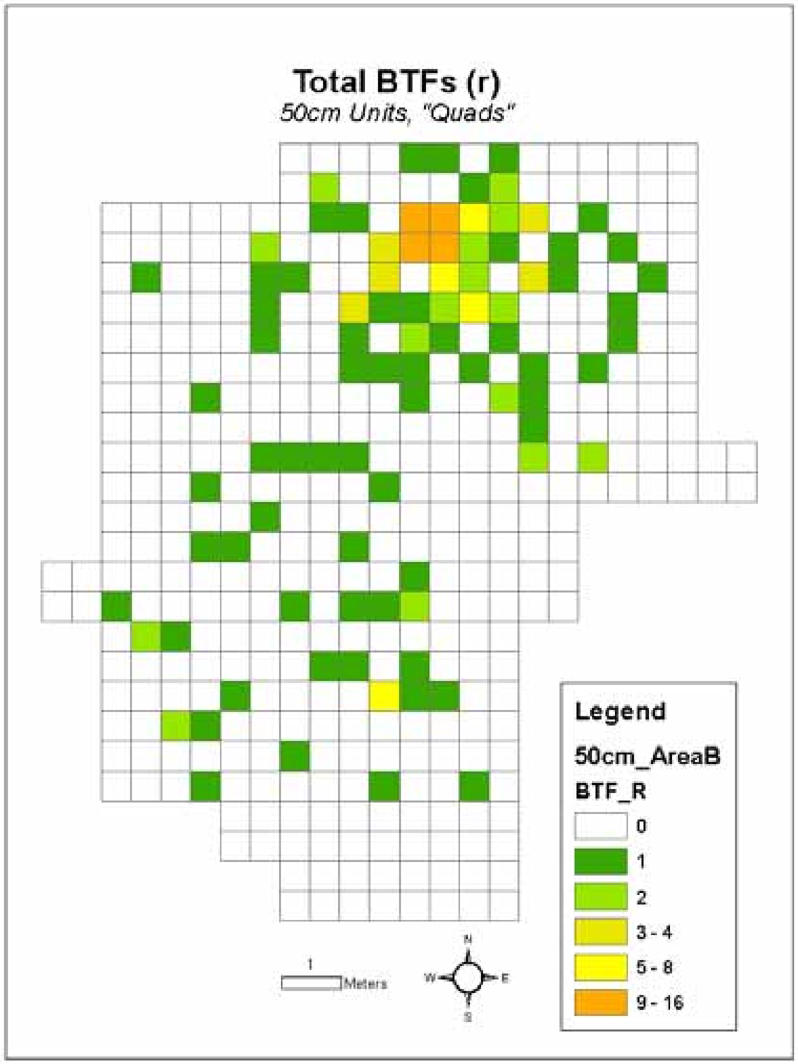


Figure 15. BTFr Distribution Map, Area B

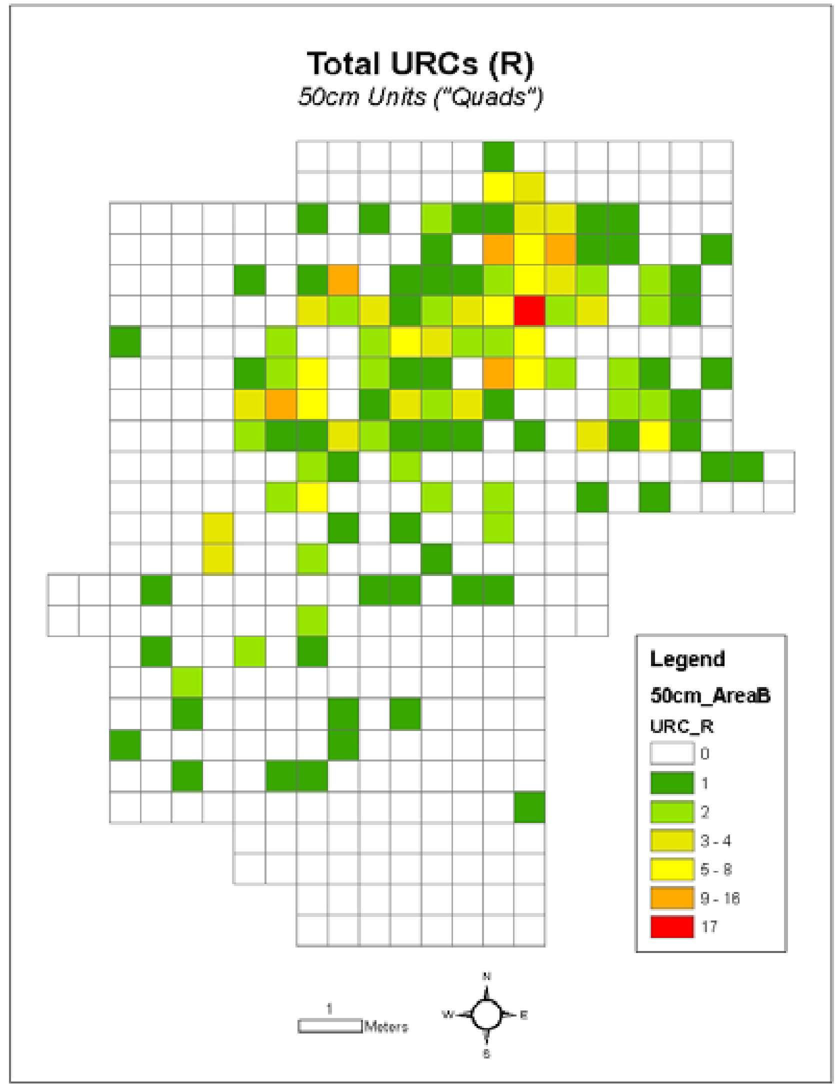


Figure 16. URCr Distribution Map, Area B

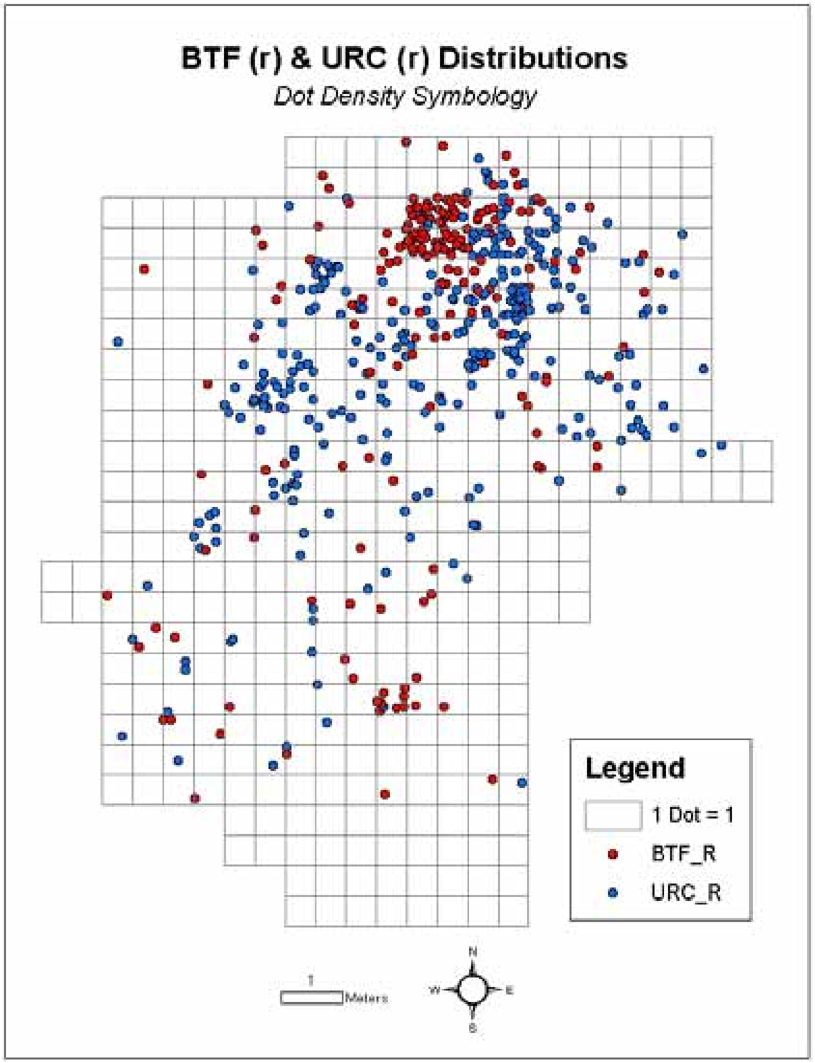


Figure 17. BTFr & URCr Dot Density Map, Area B

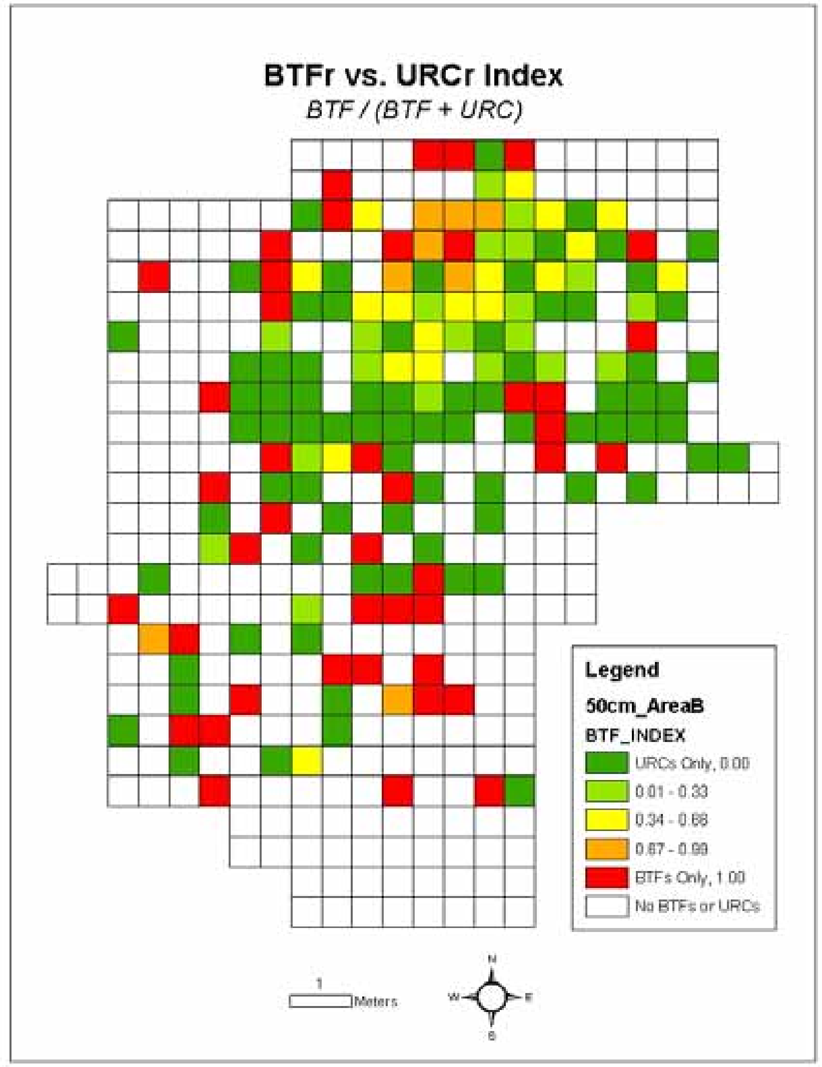


Figure 18. BTFr & URCr Proportional Index Map, Area B

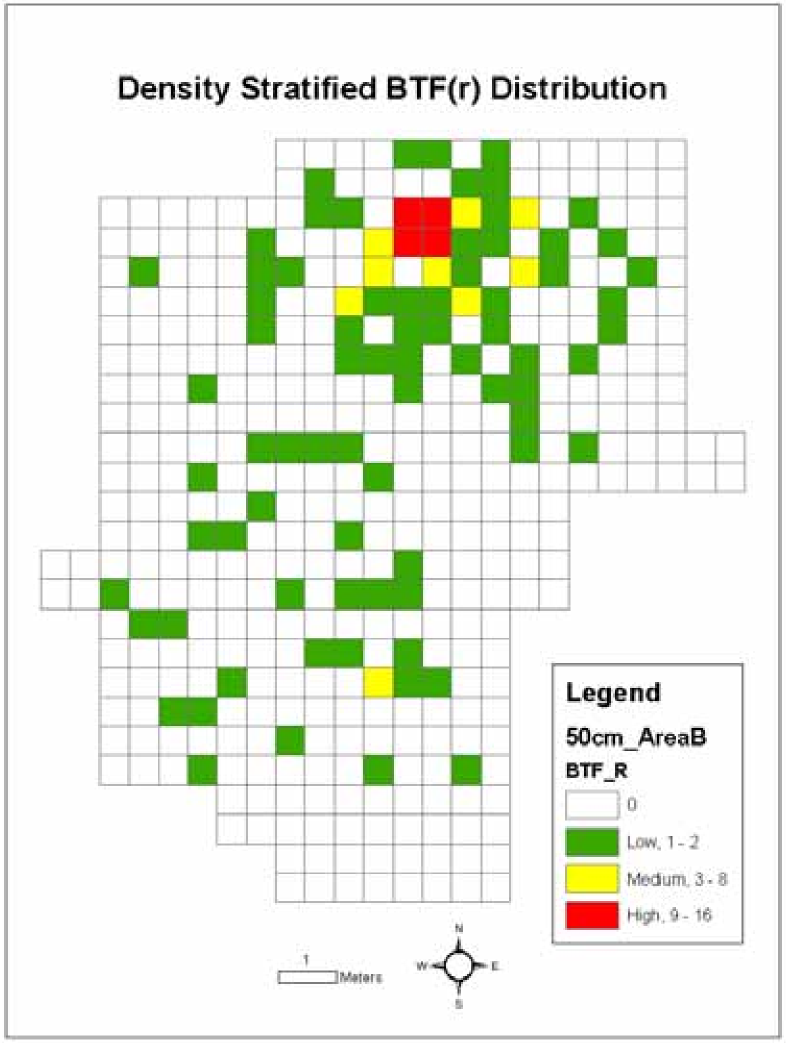


Figure 19. BTFr Density Stratified Map, Area B

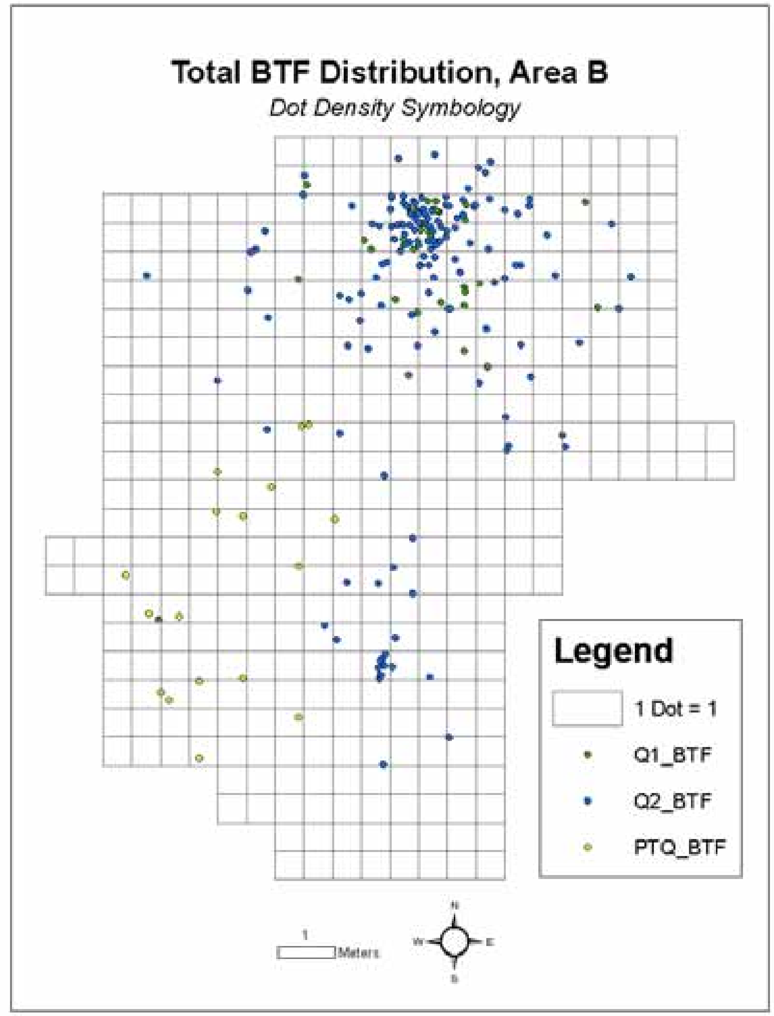


Figure 20. Dot Density Map of BTFr's by Raw Material

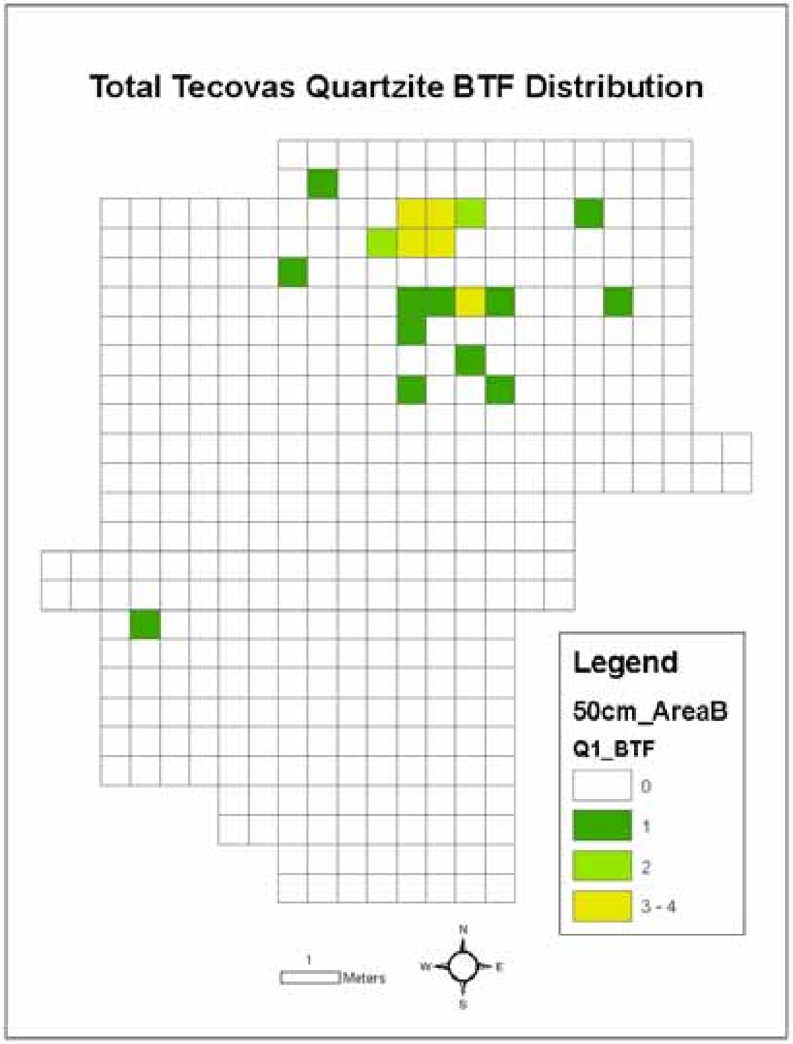


Figure 21. Tecovas Quartzite BTF Distribution, Area B

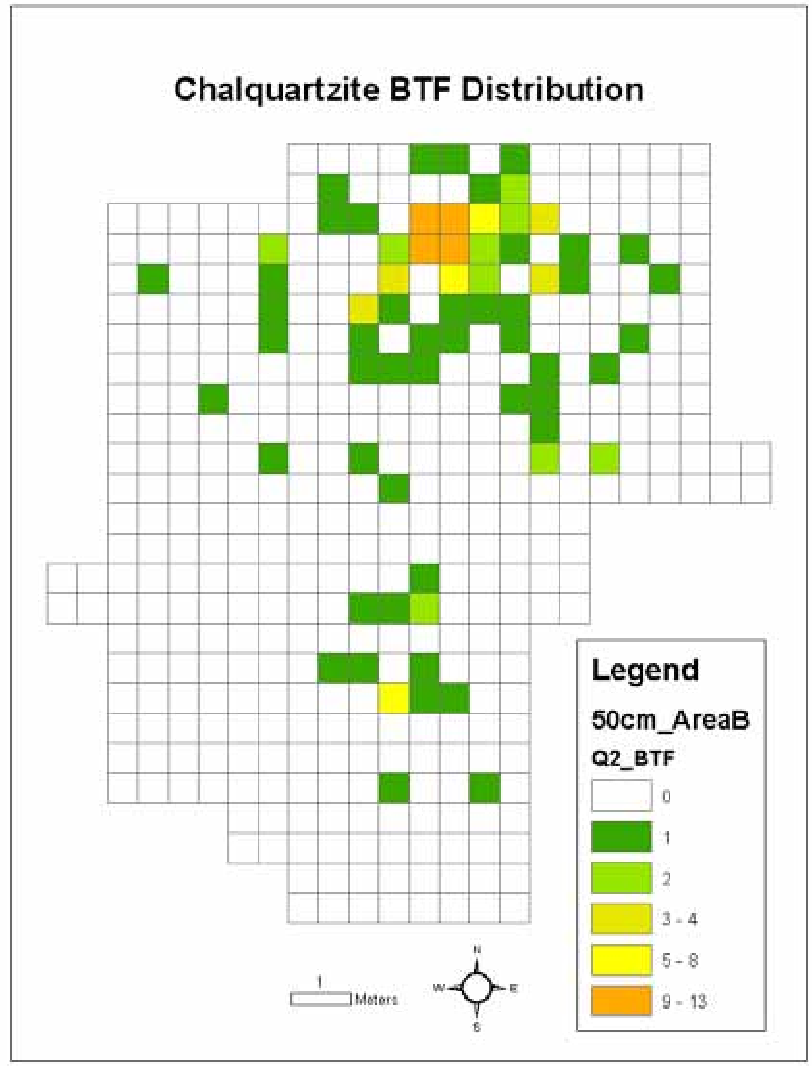


Figure 22. Chalquartzite BTF Distribution, Area B

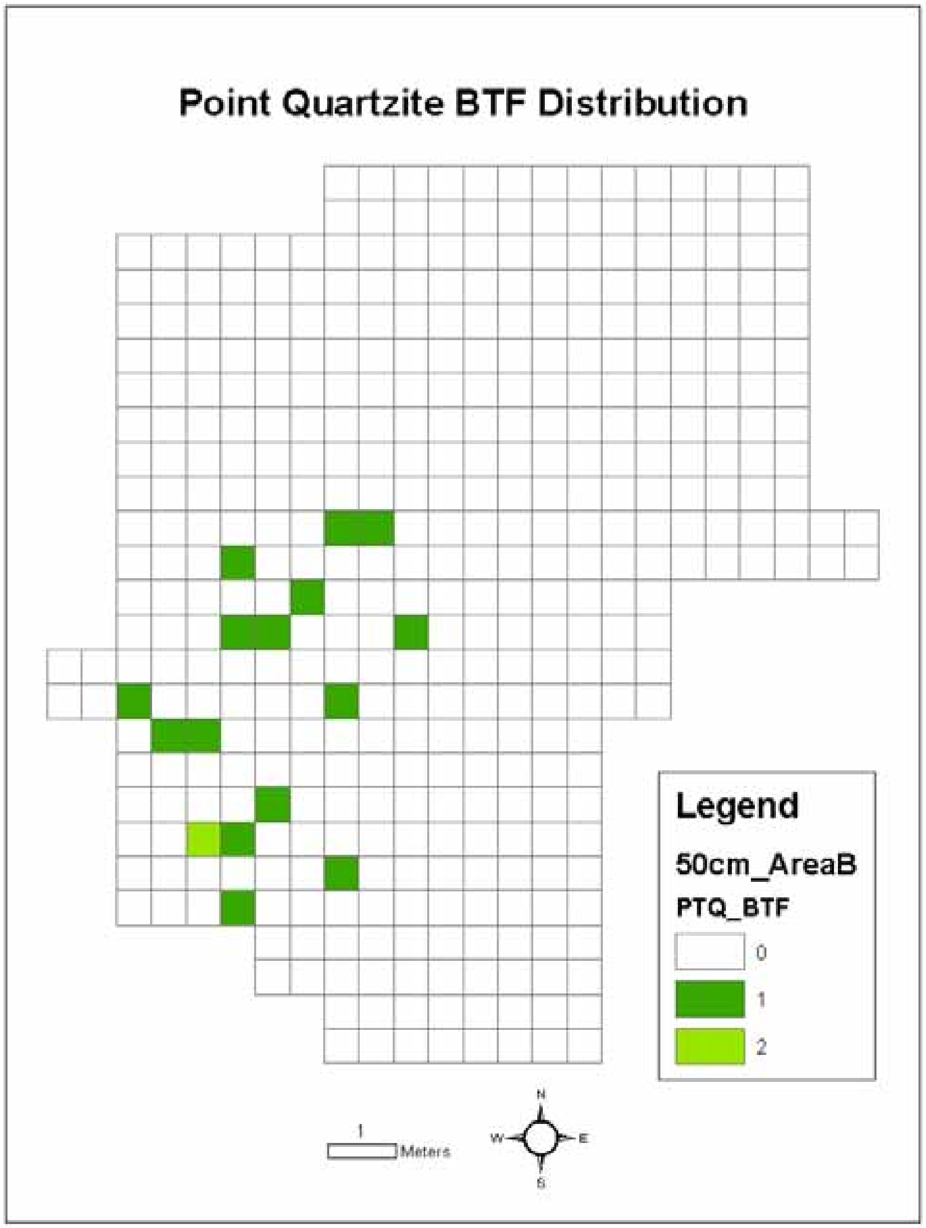


Figure 23. Point Quartzite BTF Distribution, Area B

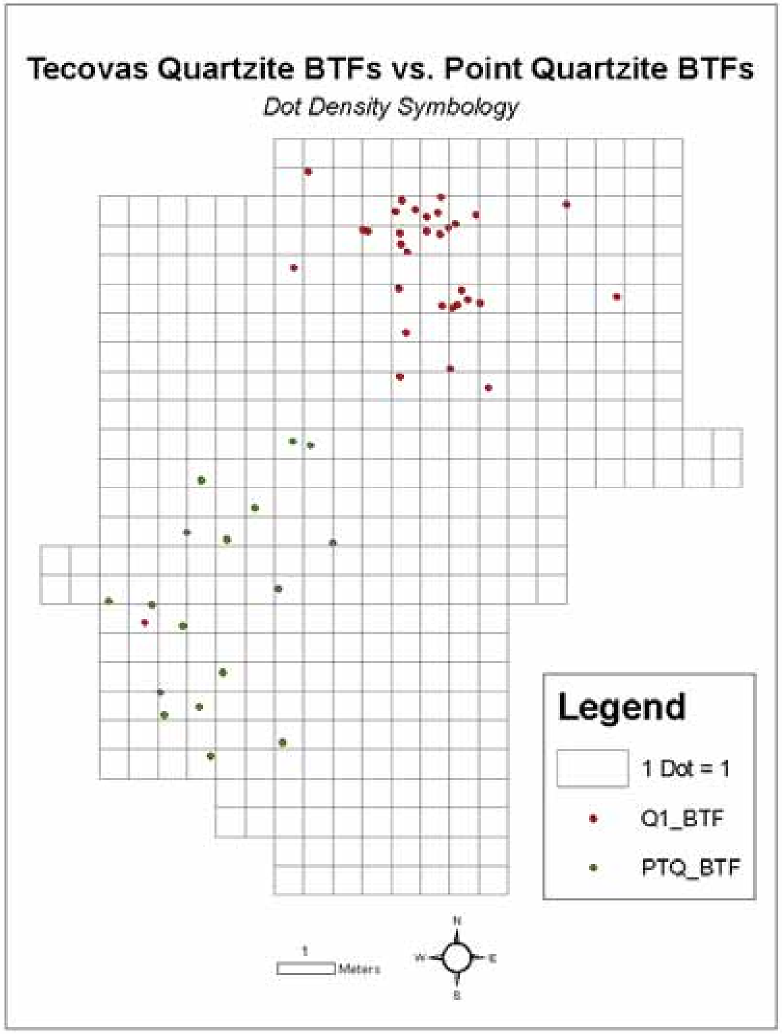


Figure 24. Tecovas & Point Quartzite BTF Dot Density Map, Area B

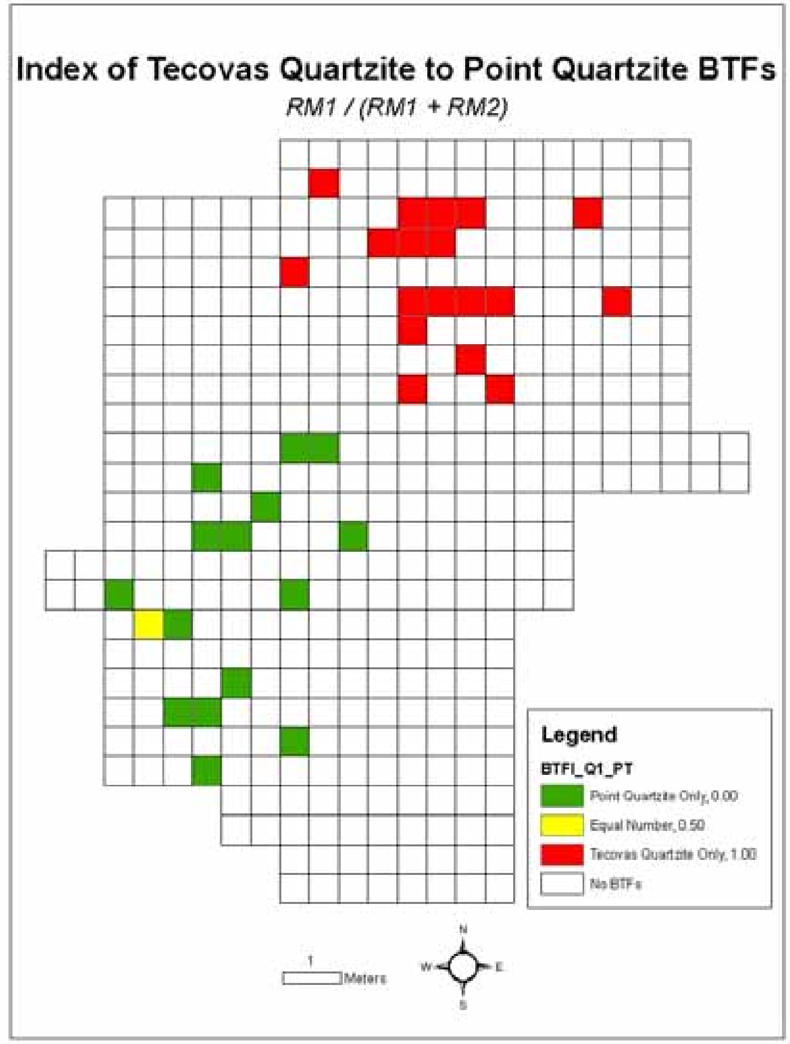


Figure 25. Tecovas & Point Quartzite BTF Proportional Index Map, Area B

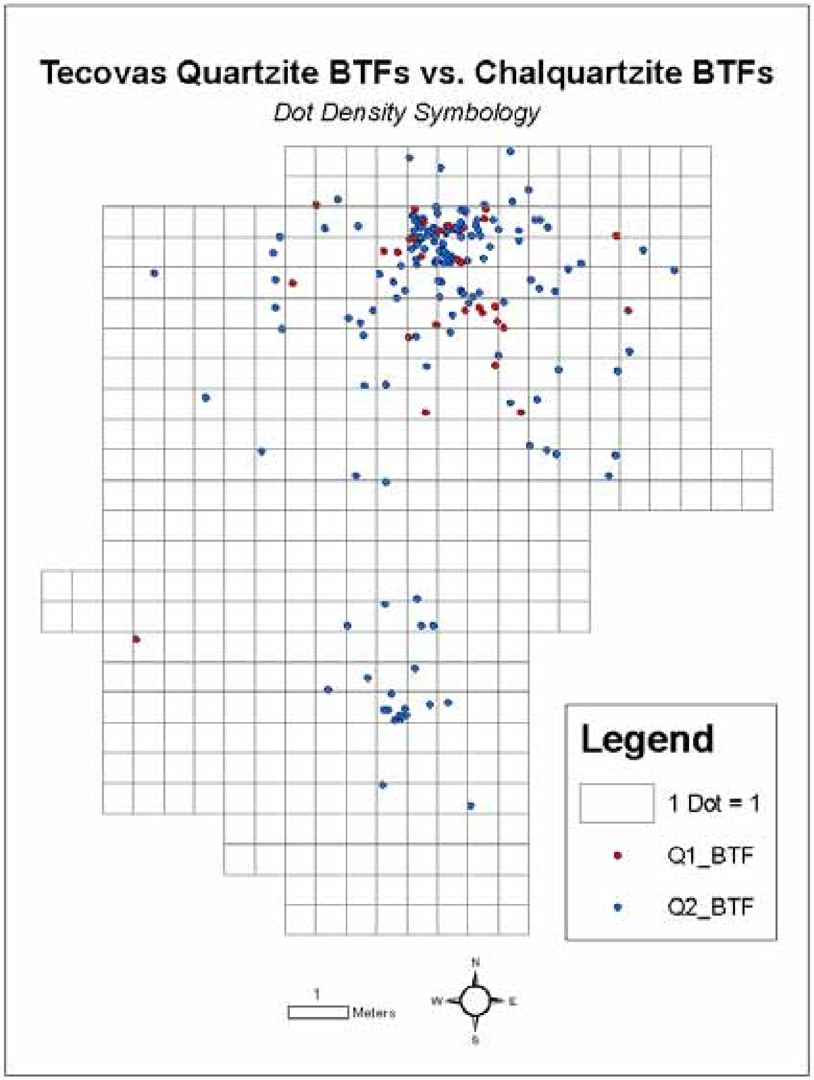


Figure 26. Tecovas & Point Quartzite BTF Dot Density Map, Area B

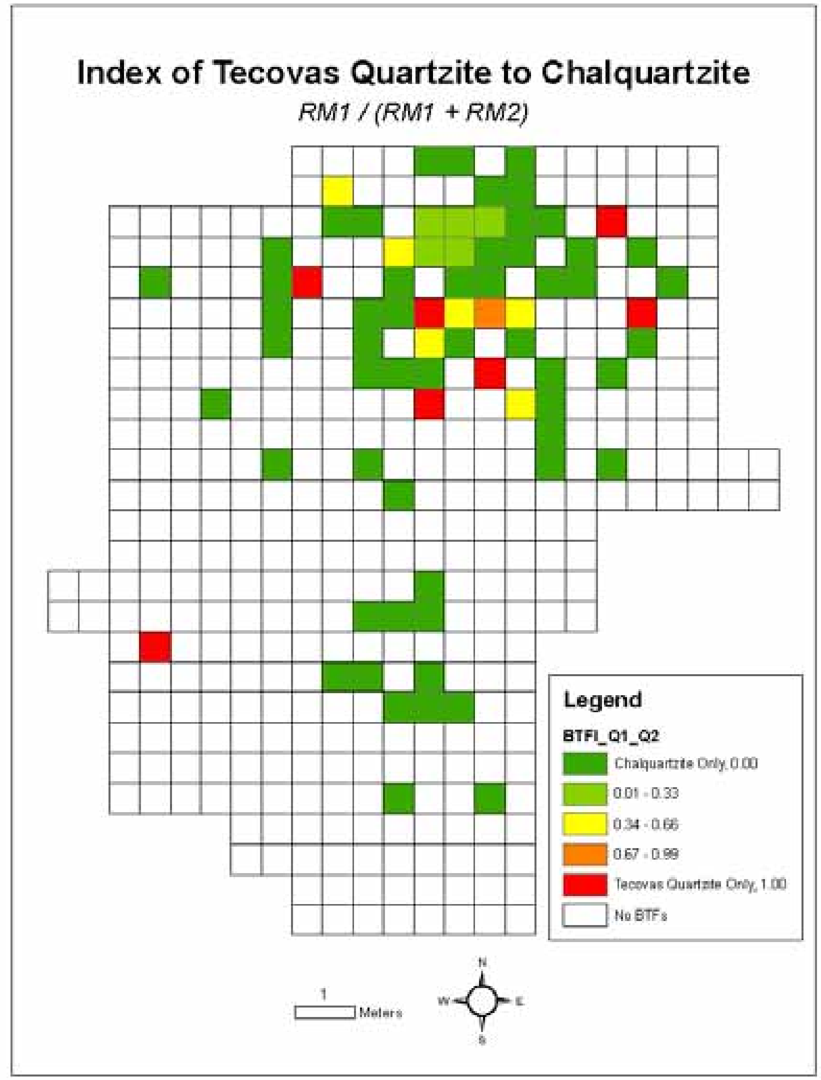


Figure 27. Tecovas & Point Quartzite BTF Proportional Index Map, Area B

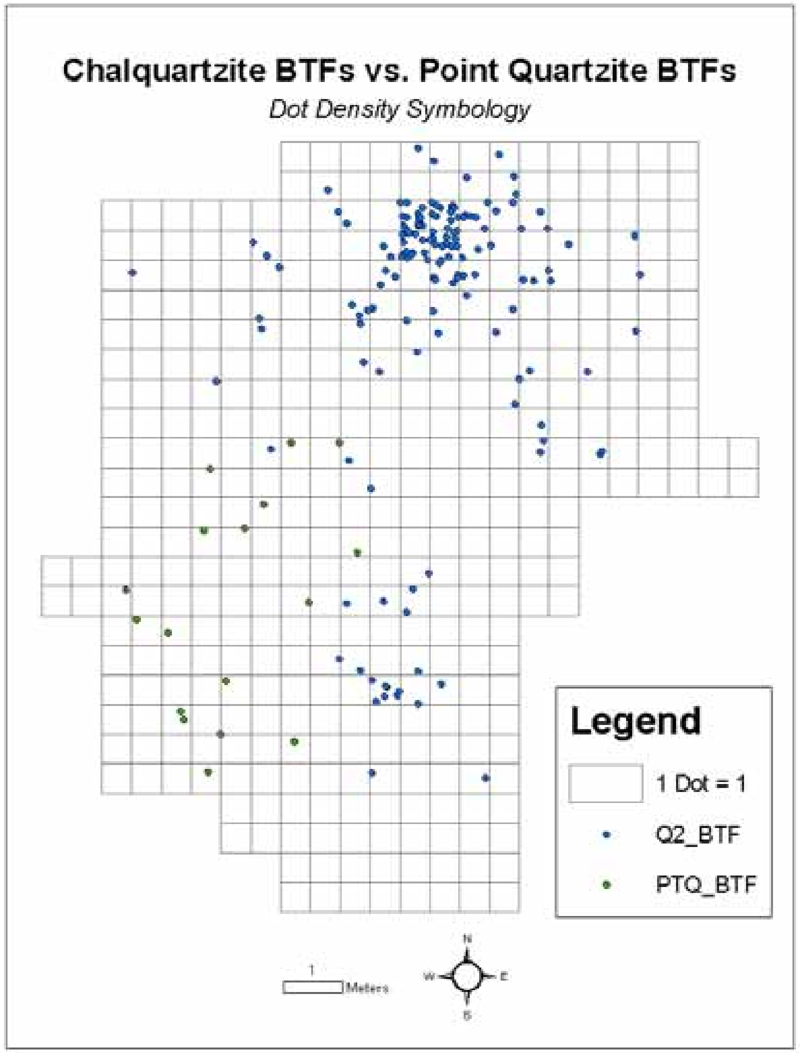


Figure 28. Chalquartzite & Point Quartzite Dot Density Map, Area B

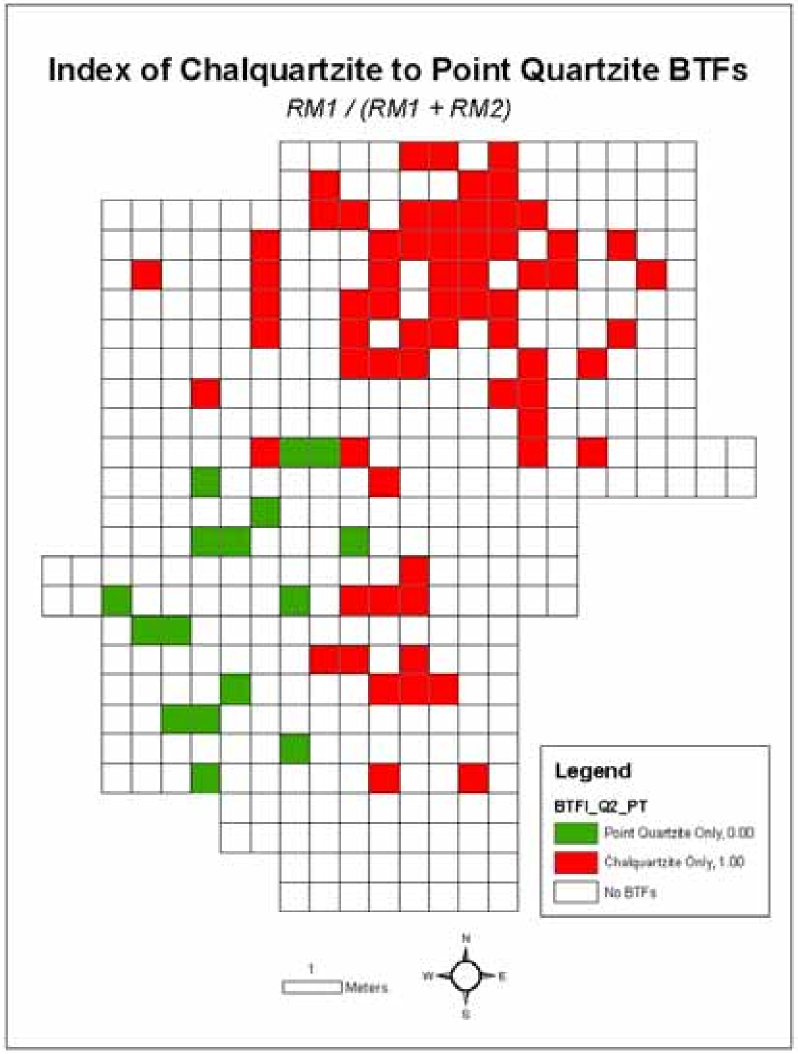


Figure 29. Chalquartzite & Point Quartzite Proportional Index Map, Area B

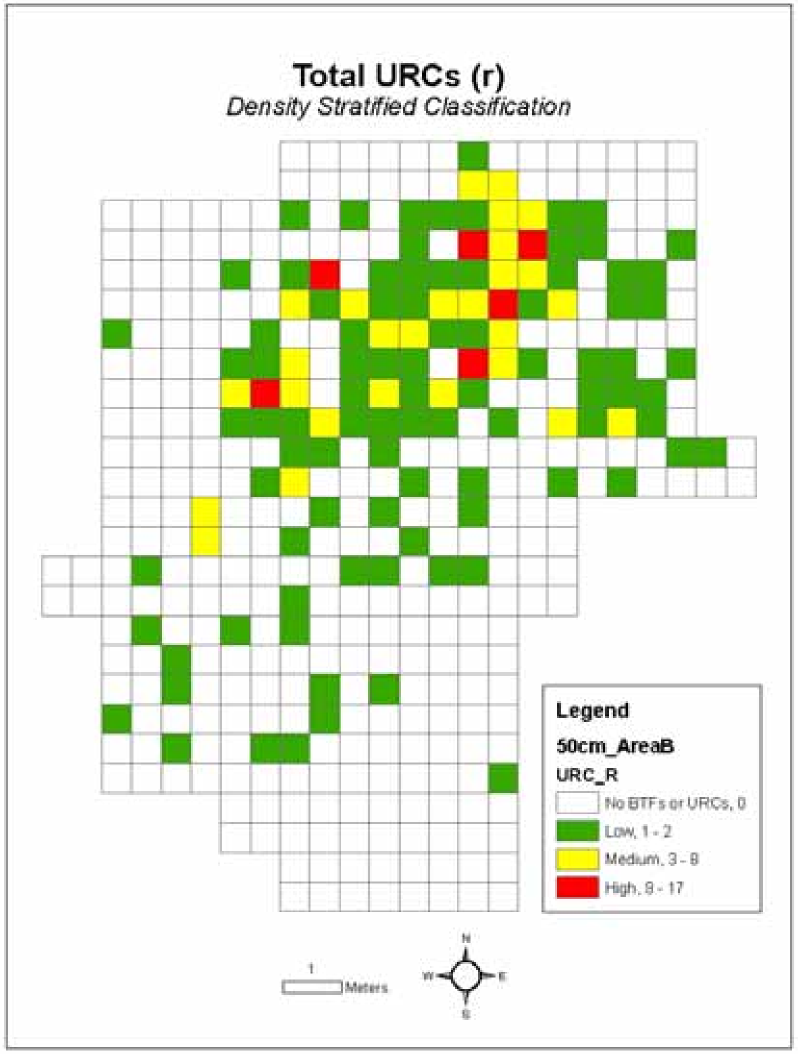


Figure 30. URCr Density Stratified Map, Area B

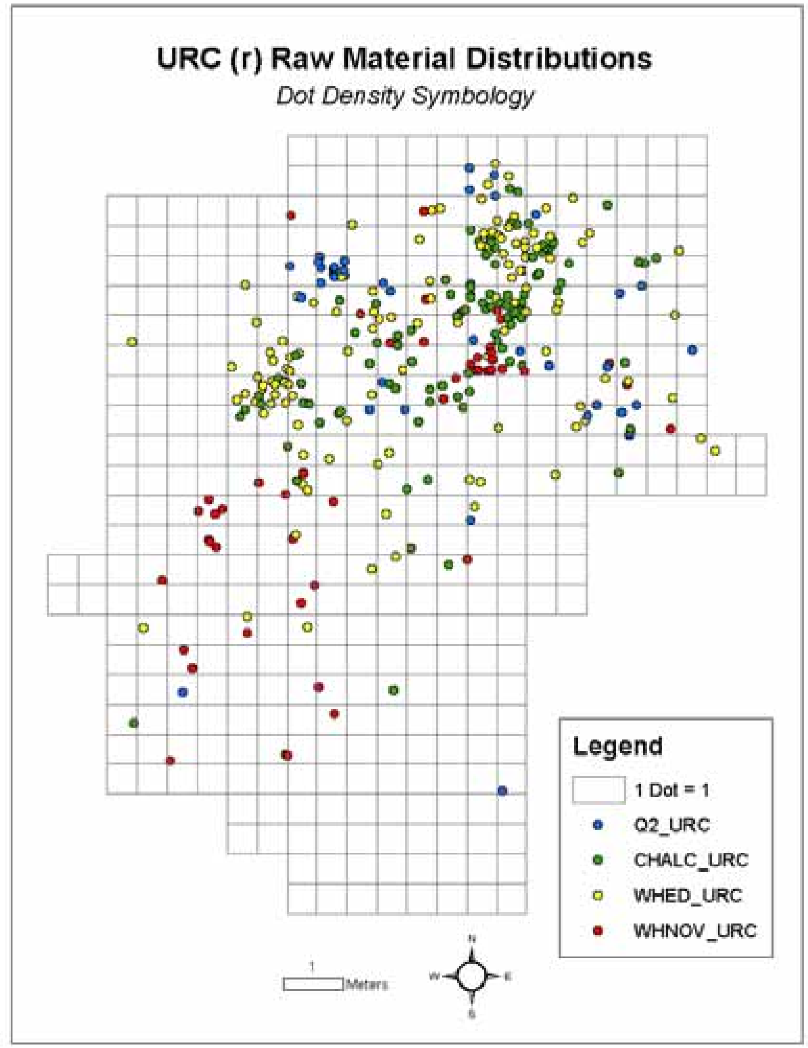


Figure 31. Dot Density Map of URCs by Raw Material, Area B

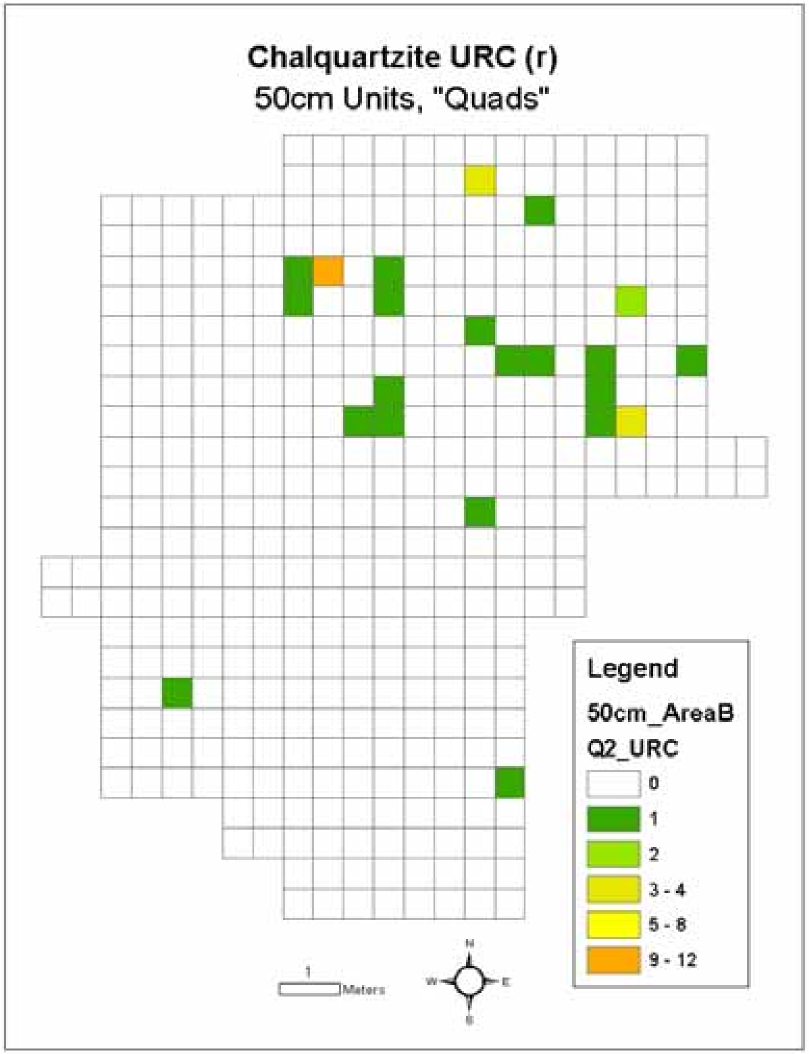


Figure 32. Chalquartzite URC Distribution Map, Area B

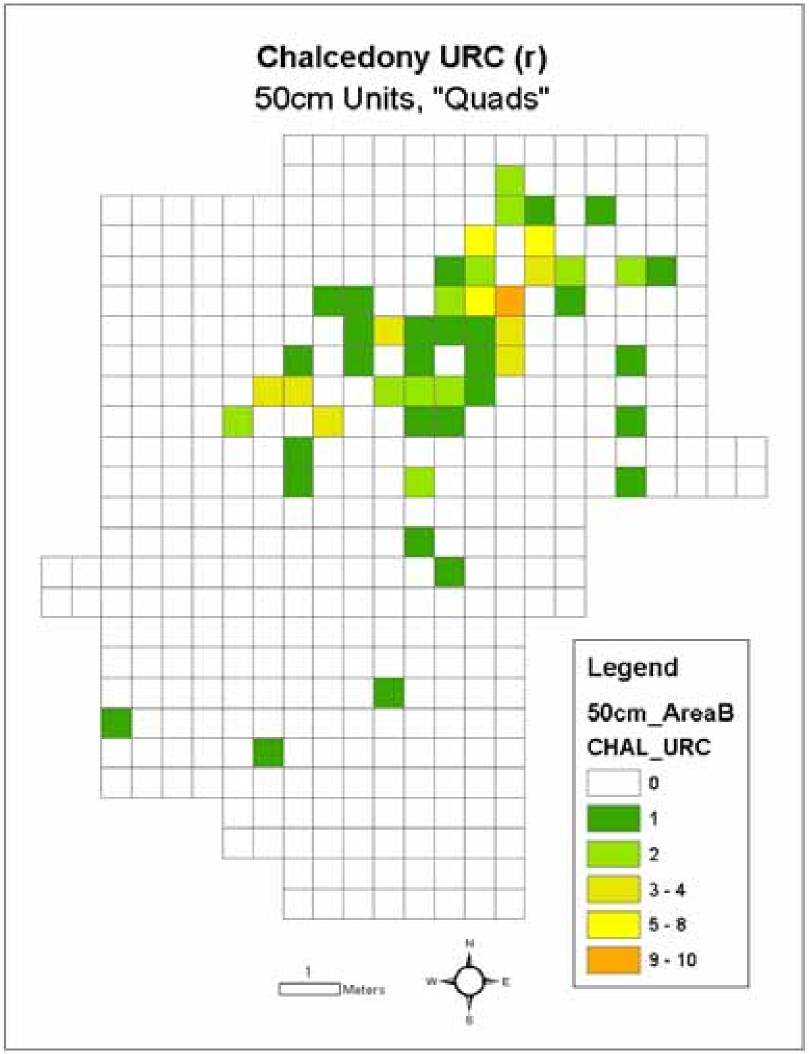


Figure 33. Chalcedony URCs Distribution Map, Area B

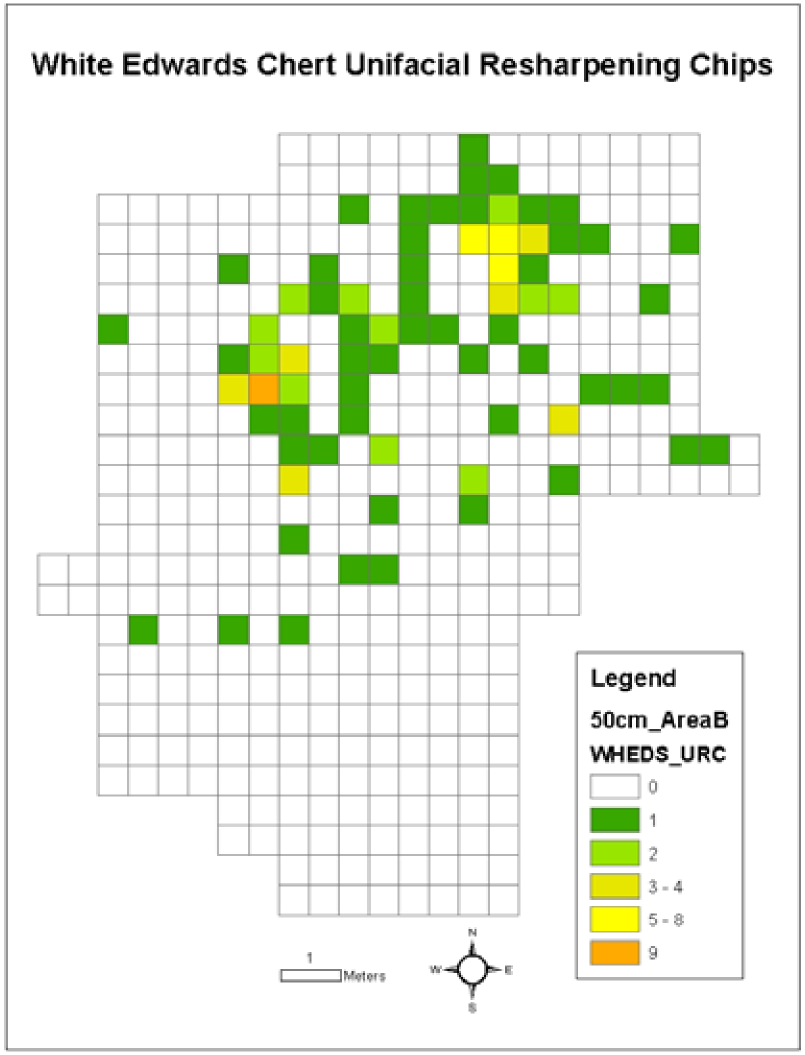


Figure 34. White Edwards Chert URCs Distribution Map, Area B

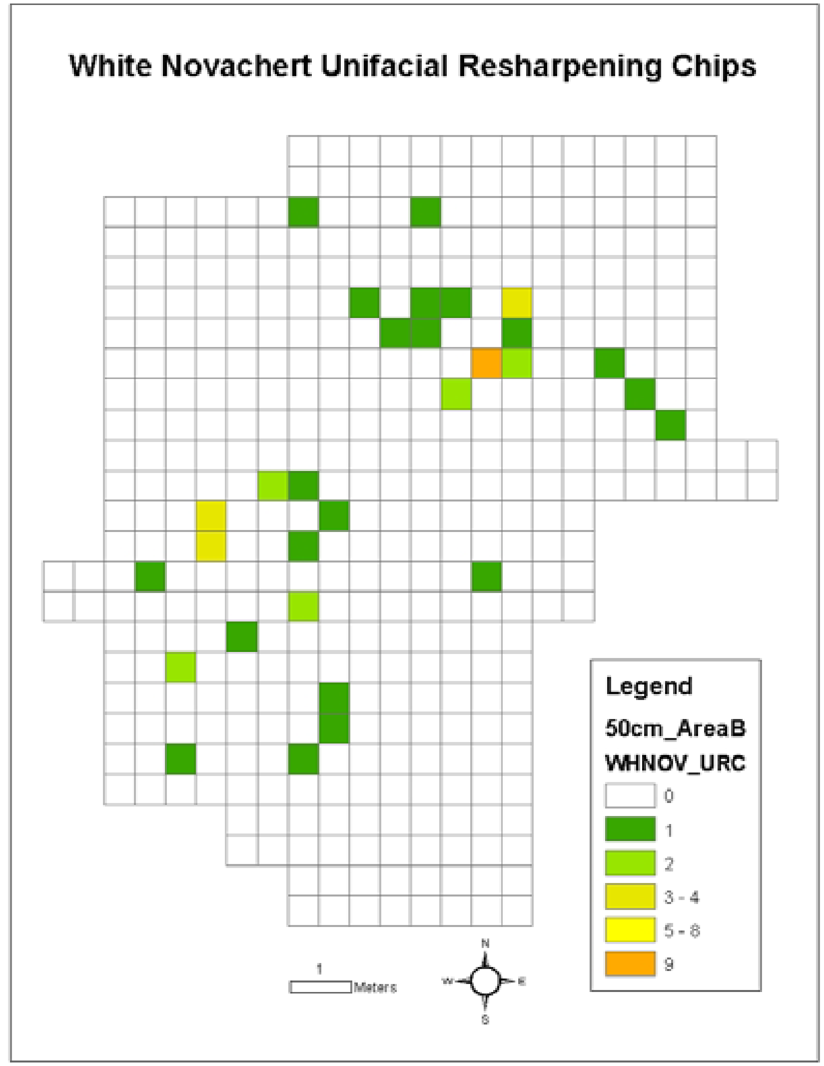


Figure 35. White Novachert URC Distribution Map, Area B

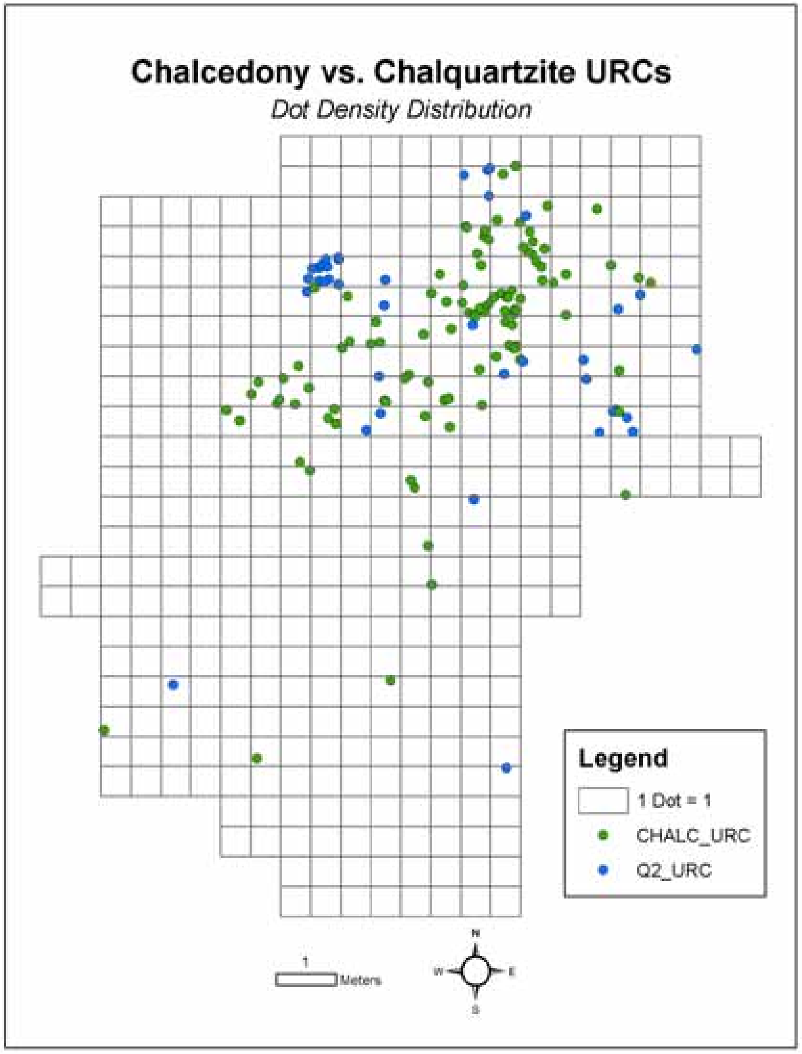


Figure 36. Chalcedony + Chalquartzite URC Dot Density Map, Area B

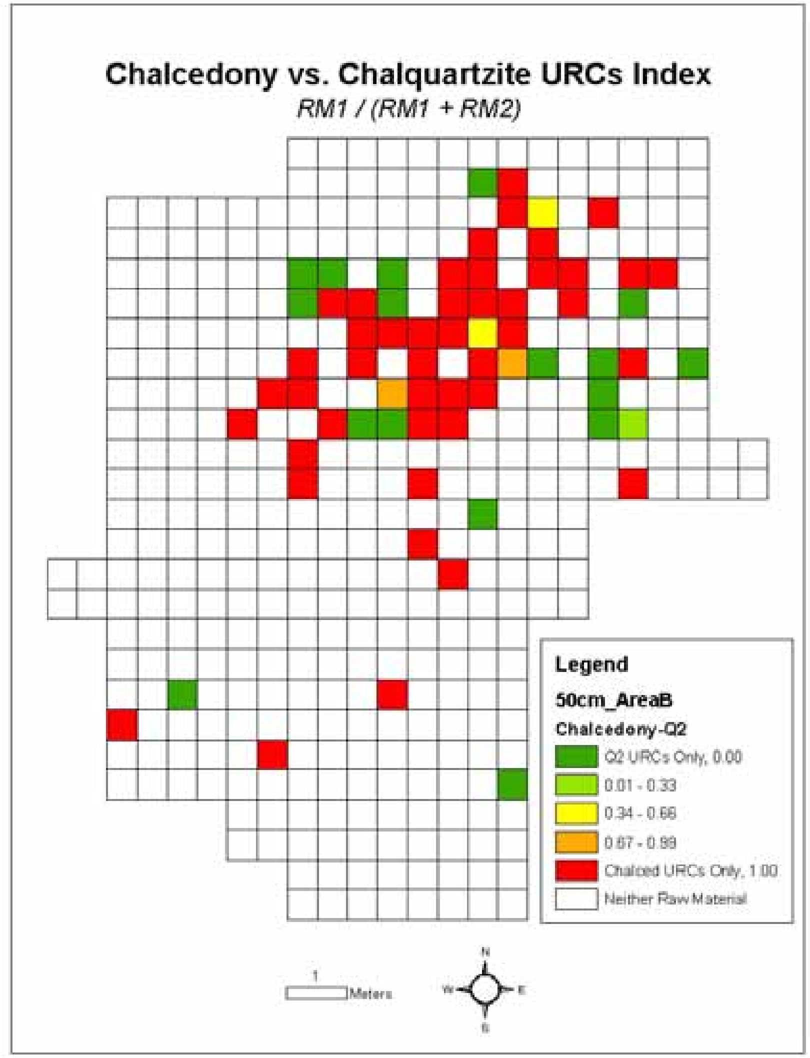


Figure 37. Chalcedony & Chalquartzite URC Proportional Index Map, Area B

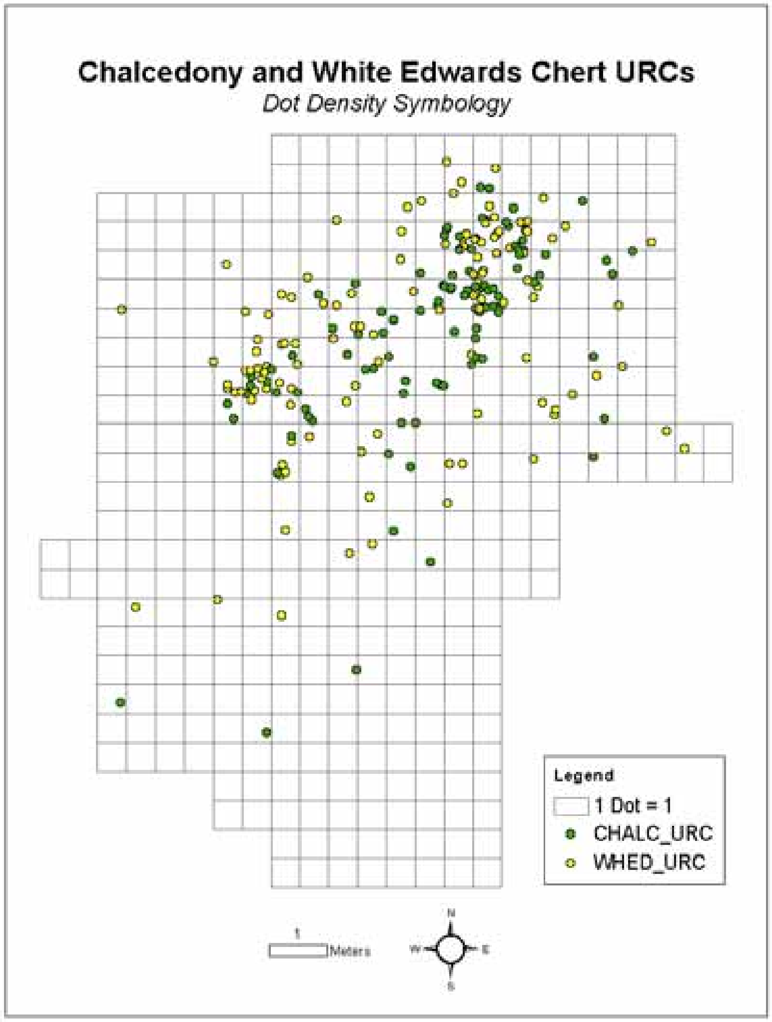


Figure 38. Chalcedony & White Edwards Chert Dot Density Map, Area B

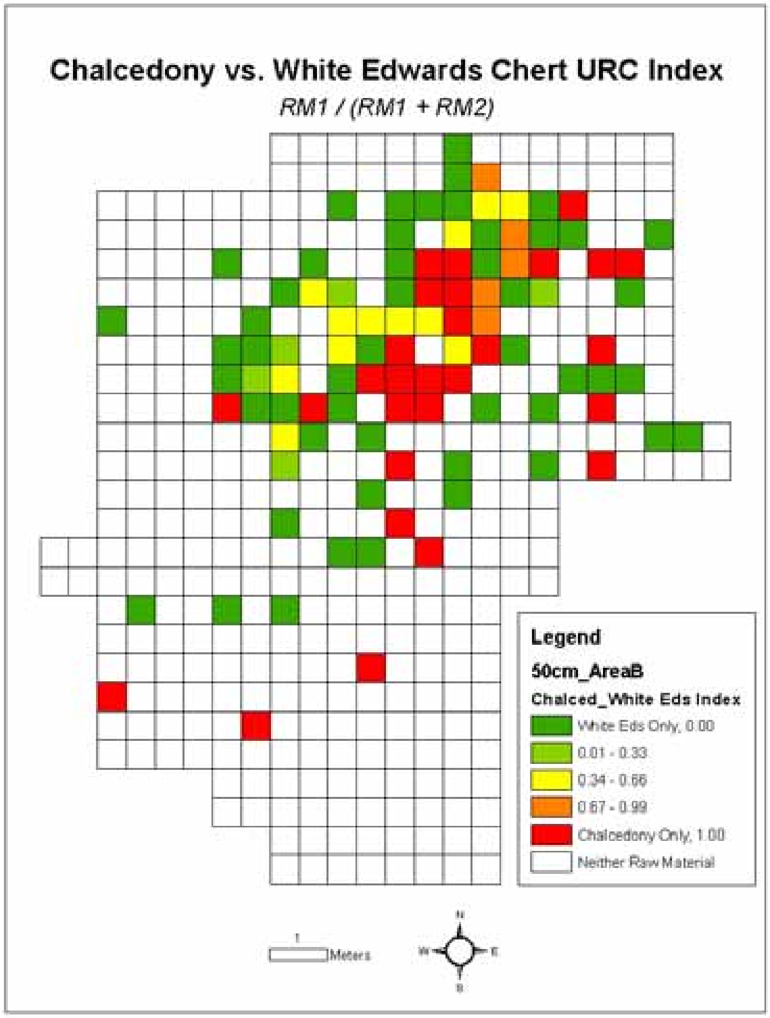


Figure 39. Chalcedony & White Edwards Chert URC Proportional Index Map, Area B

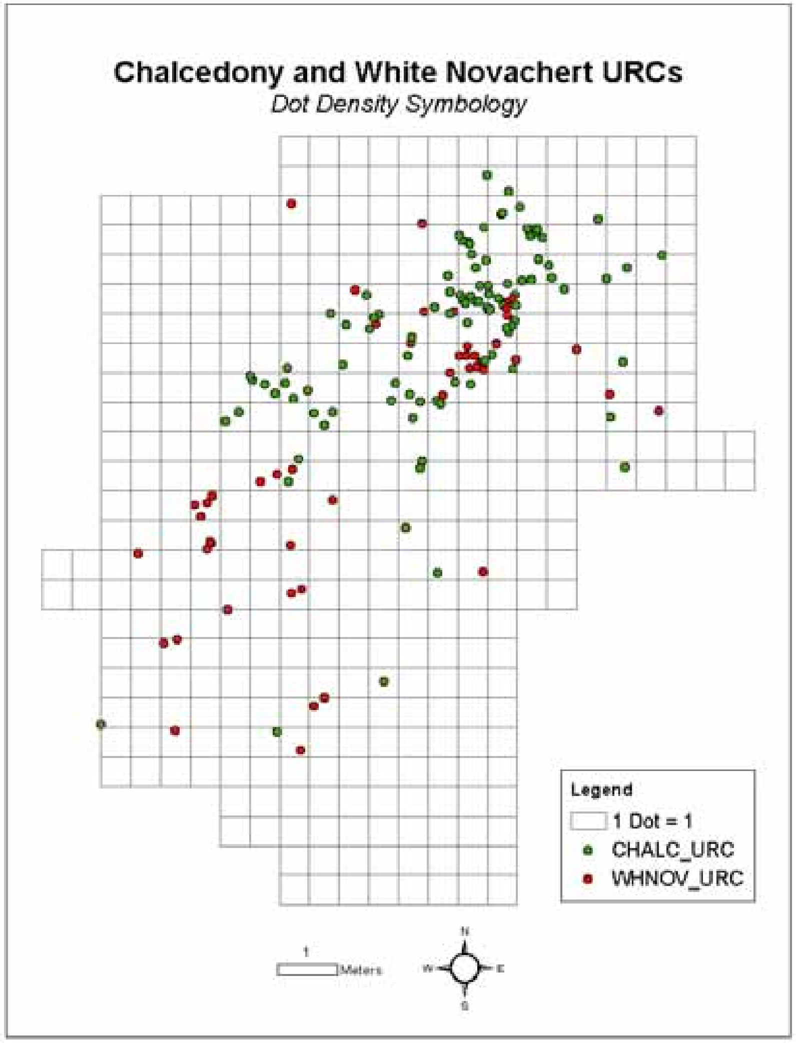


Figure 40. Chalcedony & White Novachert URC Dot Density Distribution, Area B

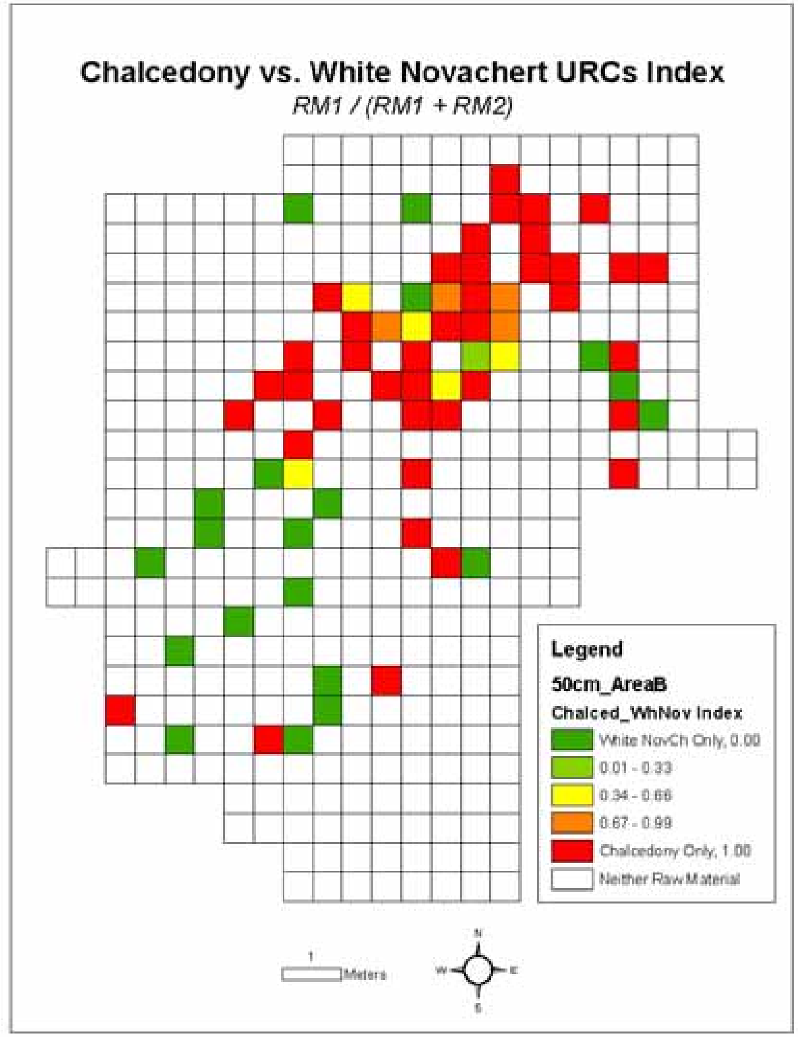


Figure 41. Chalcedony & White Novachert URC Proportional Index Map, Area B

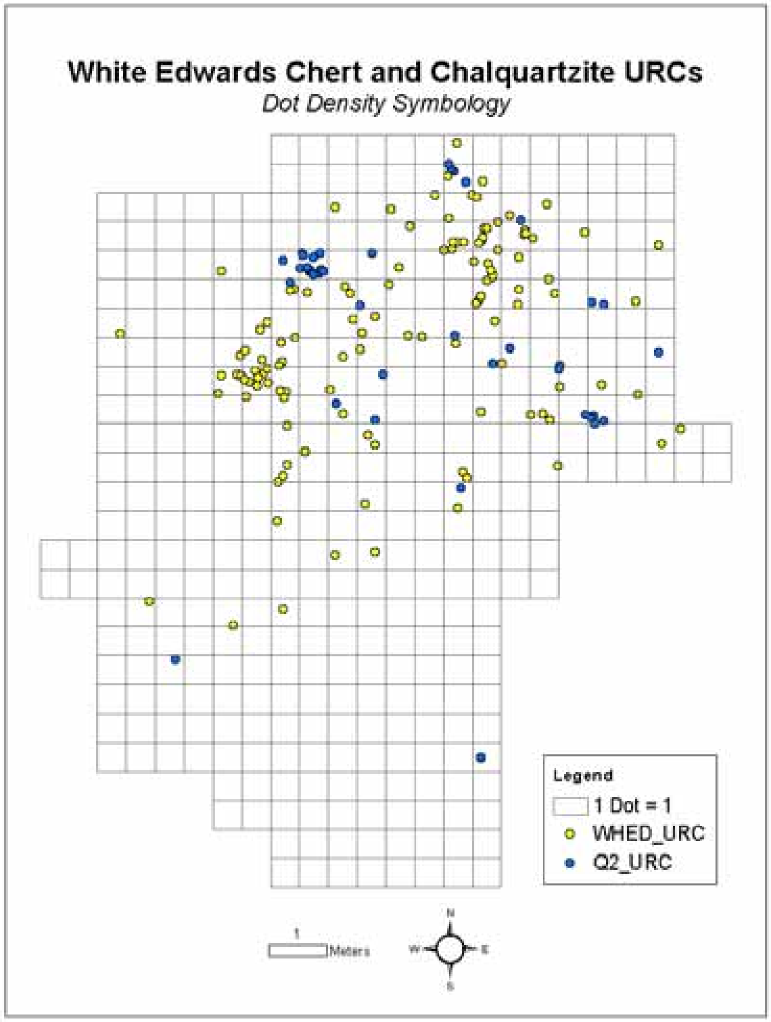


Figure 42. White Edwards Chert & Chalquartzite URC Dot Density Map, Area B

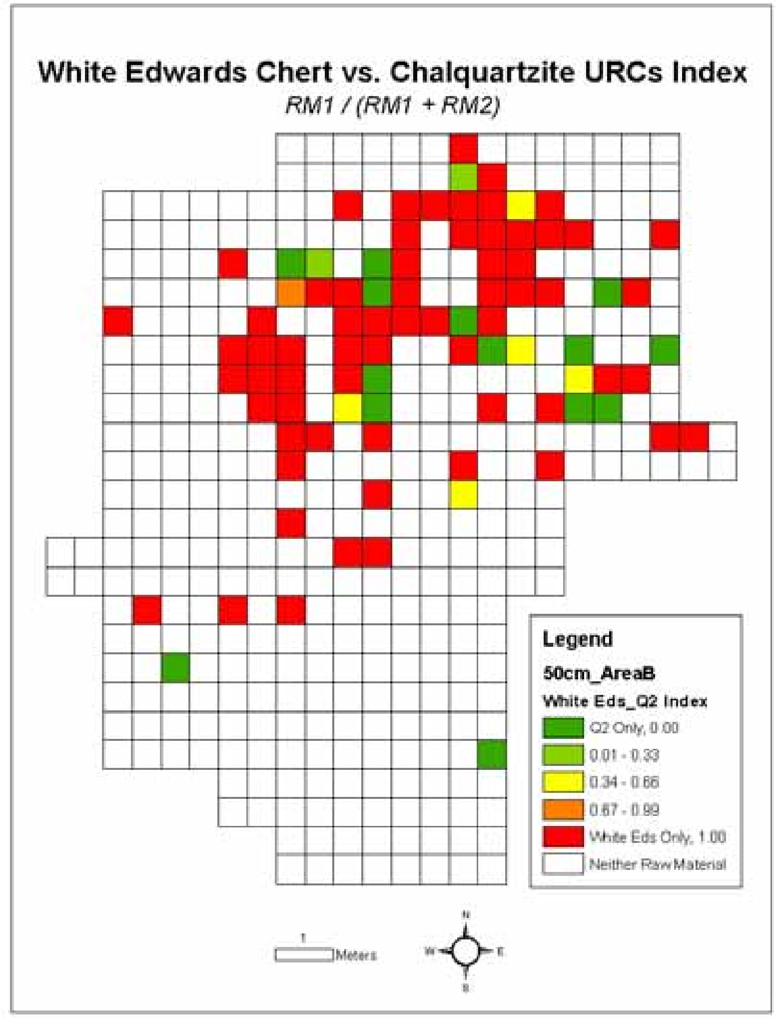


Figure 43. White Edwards Chert and Chalquartzite URC Proportional Index Map, Area B

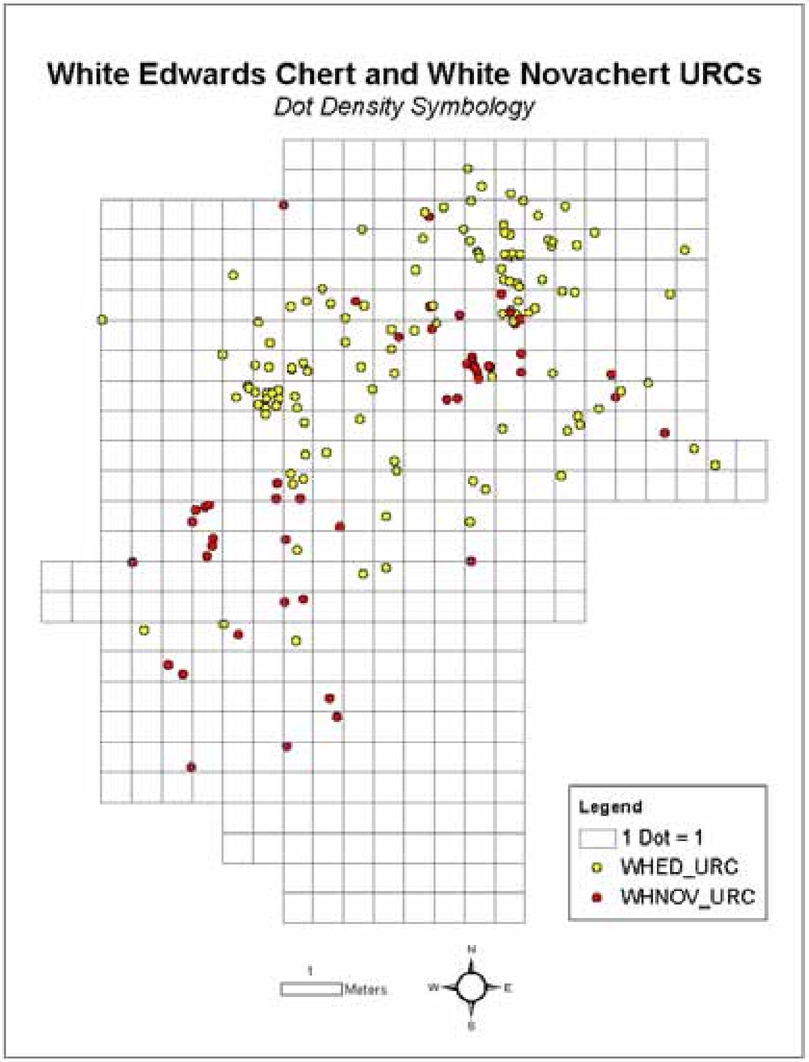


Figure 44. White Edwards & White Novachert URC Dot Density Distribution, Area B

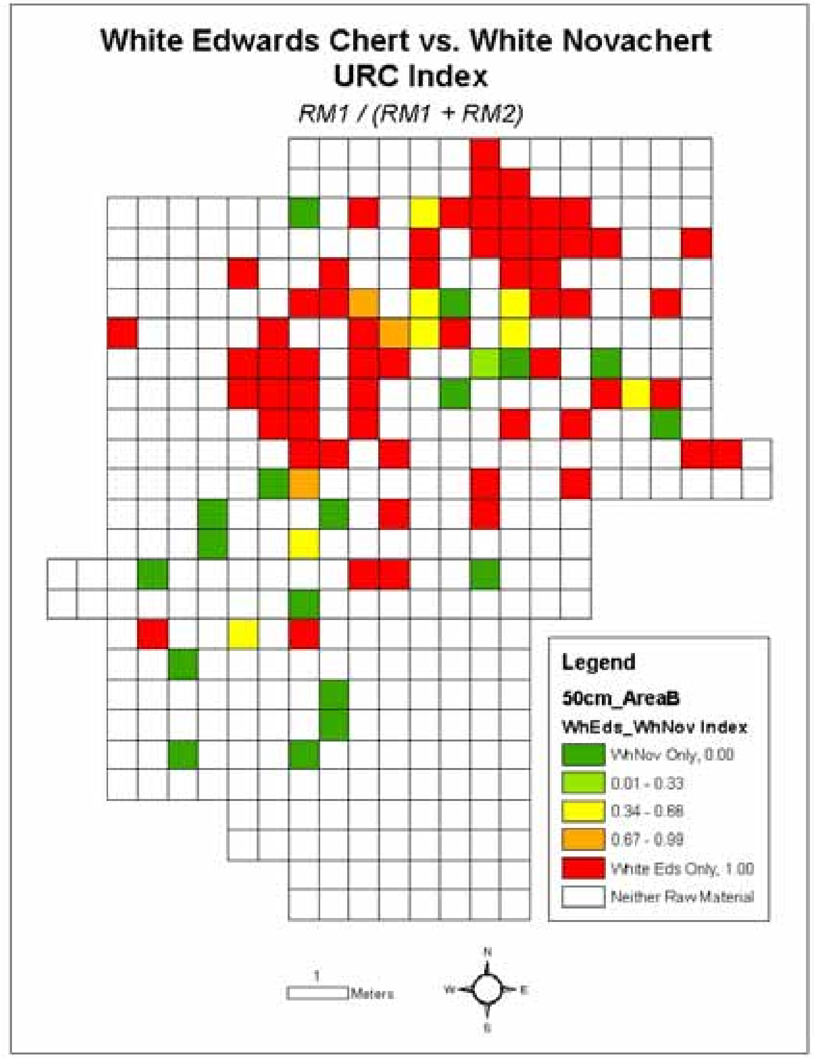


Figure 45. White Edwards & White Novachert URC Proportional Index Map

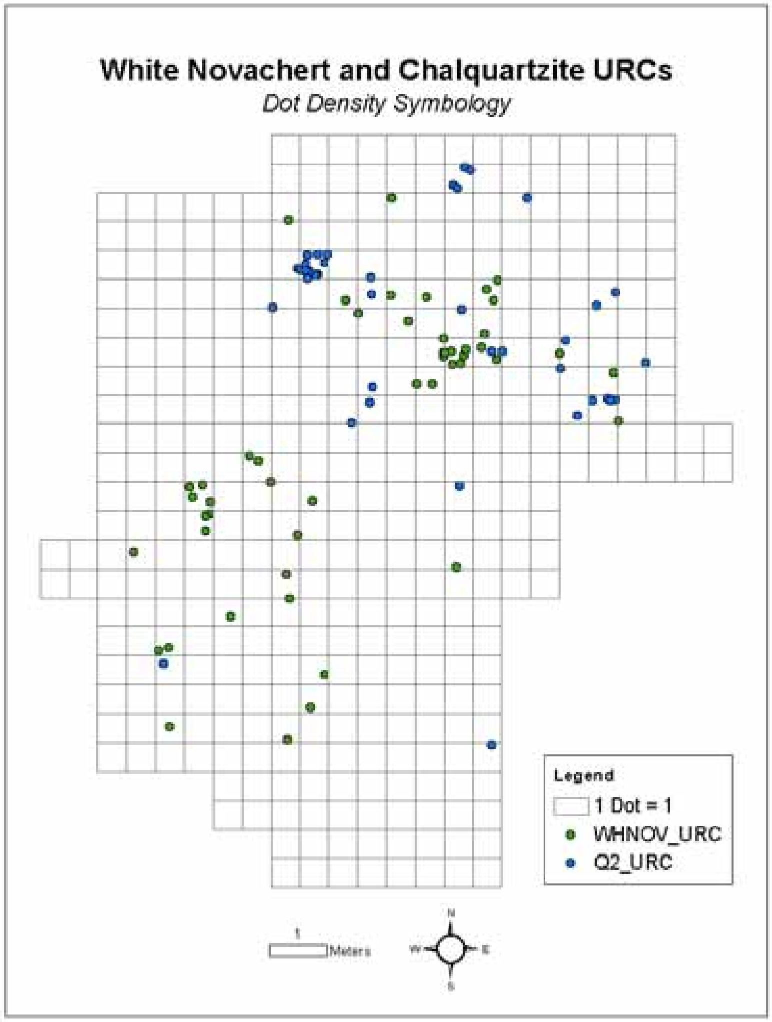


Figure 46. White Novachert & Chalquartzite URC Dot Density Distribution, Area B

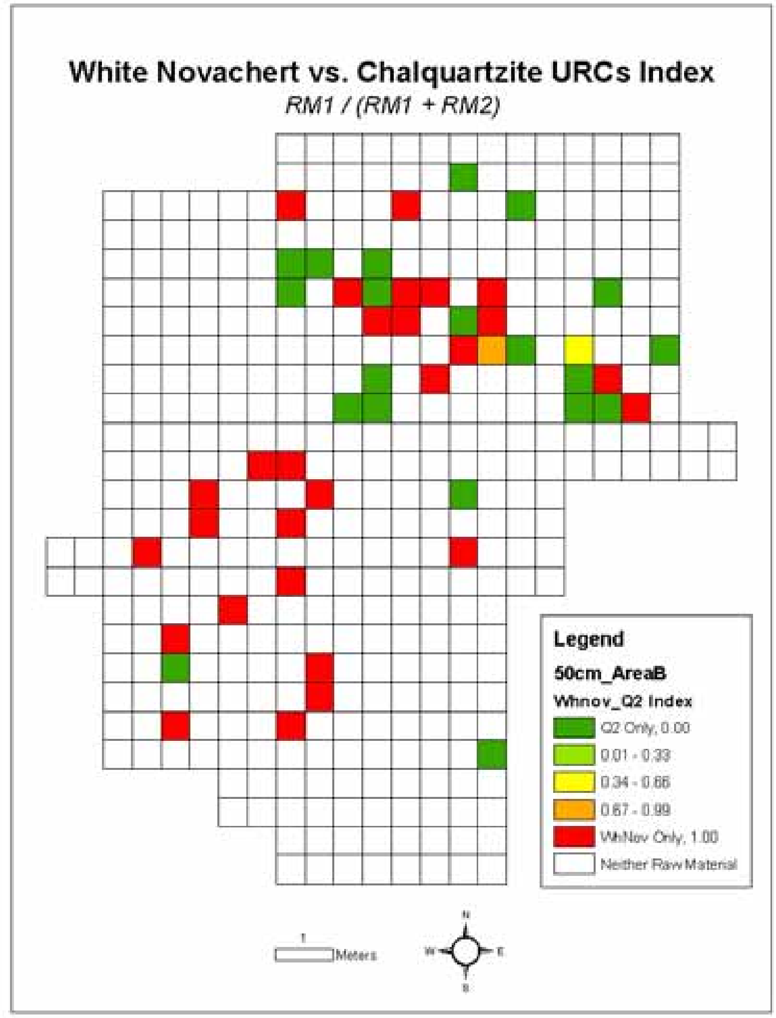


Figure 47. White Novachert & Chalquartzite URC Proportional Index Map, Area B

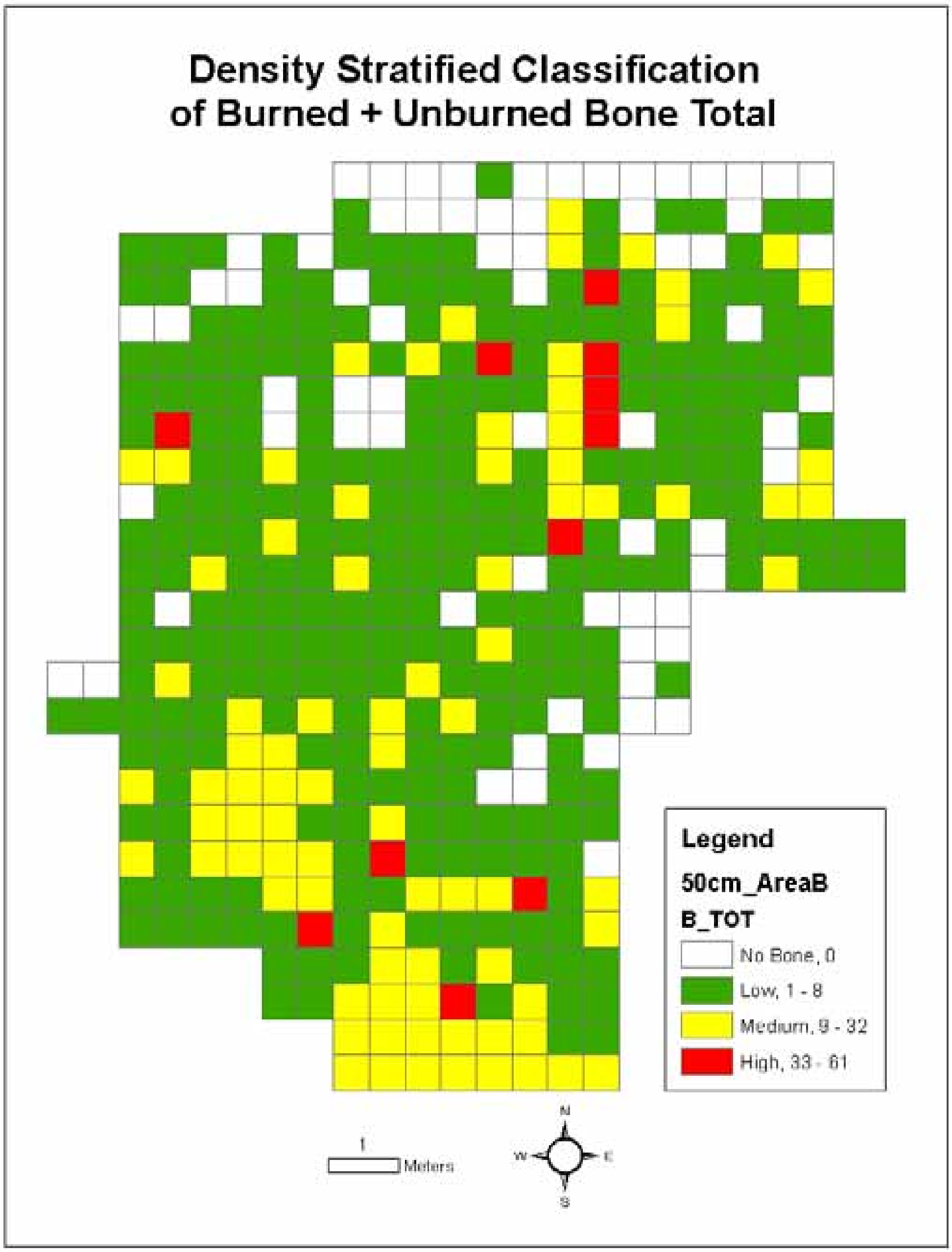


Figure 48. Burned + Unburned Bone Density Stratified Map, Area B

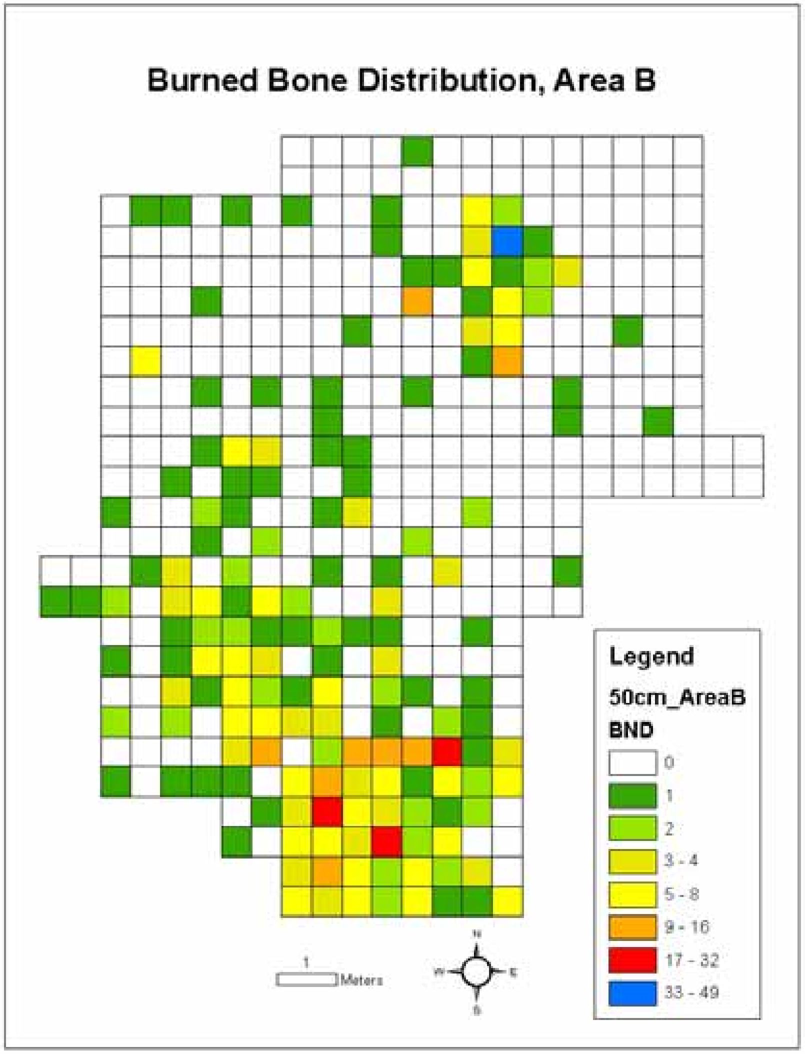


Figure 49. Burned Bone Distribution Map

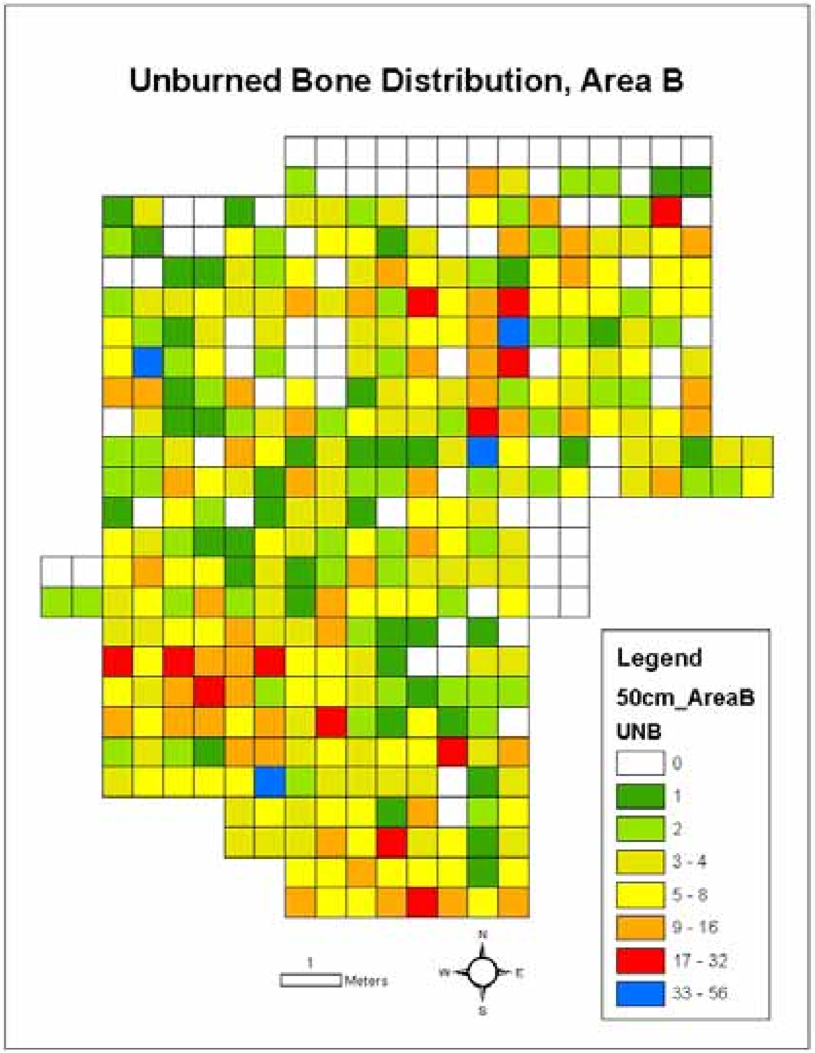


Figure 50. Unburned Bone Distribution Map

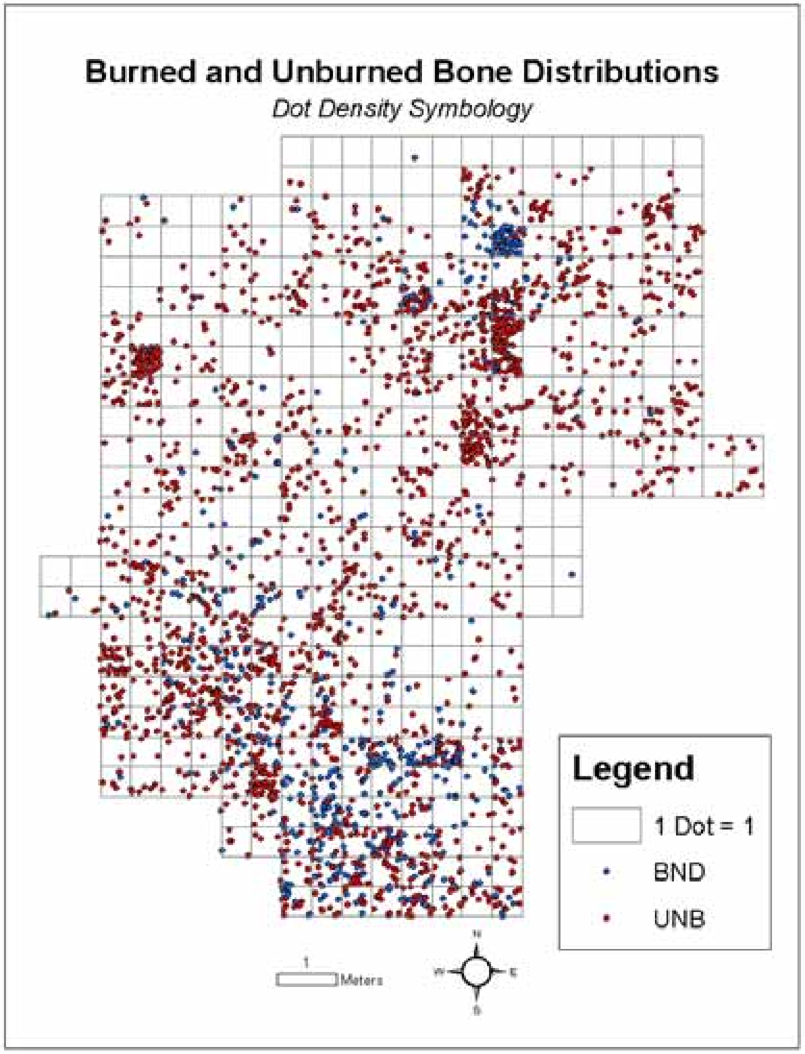


Figure 51. Burned & Unburned Bone Dot Density Map, Area B

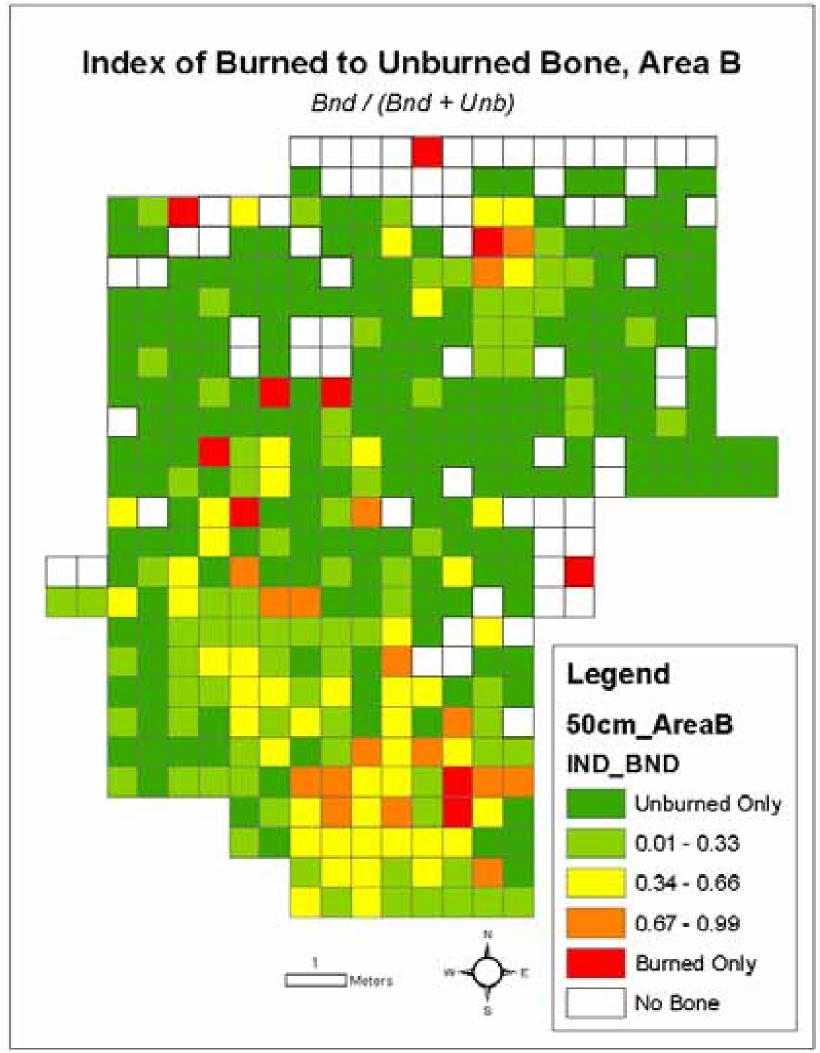


Figure 52. Burned & Unburned Bone Proportional Index Map, Area B

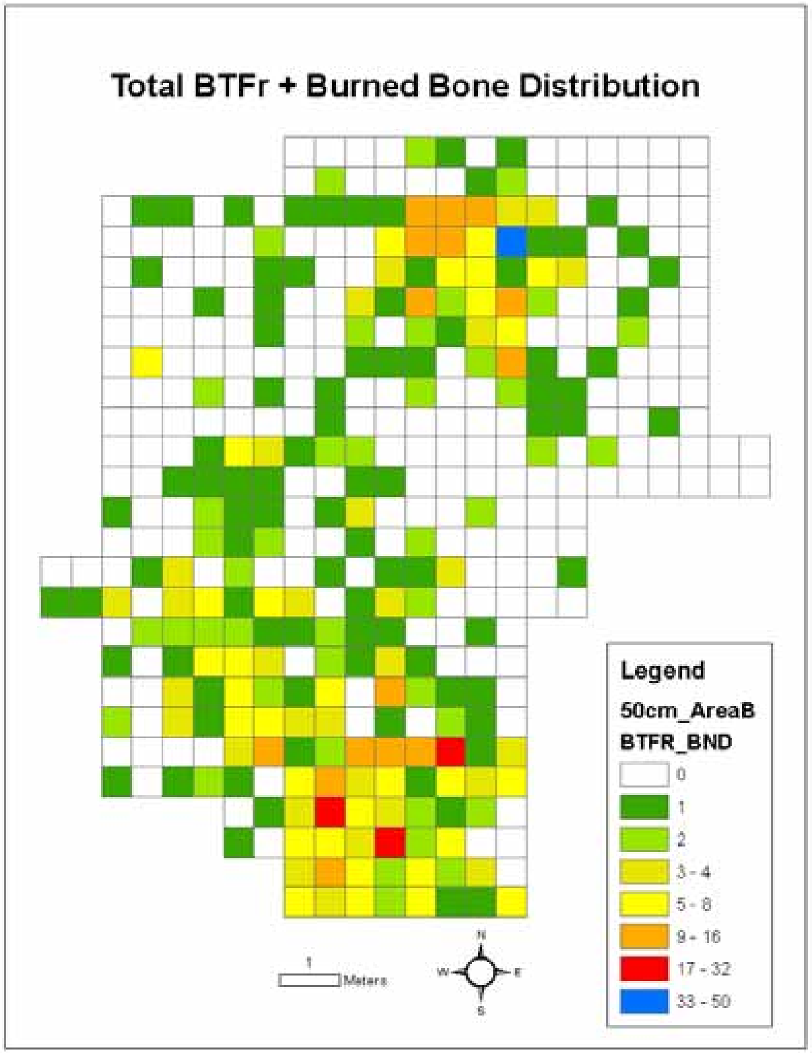


Figure 53. BTFr + Burned Bone Combined Distribution Map, Area B

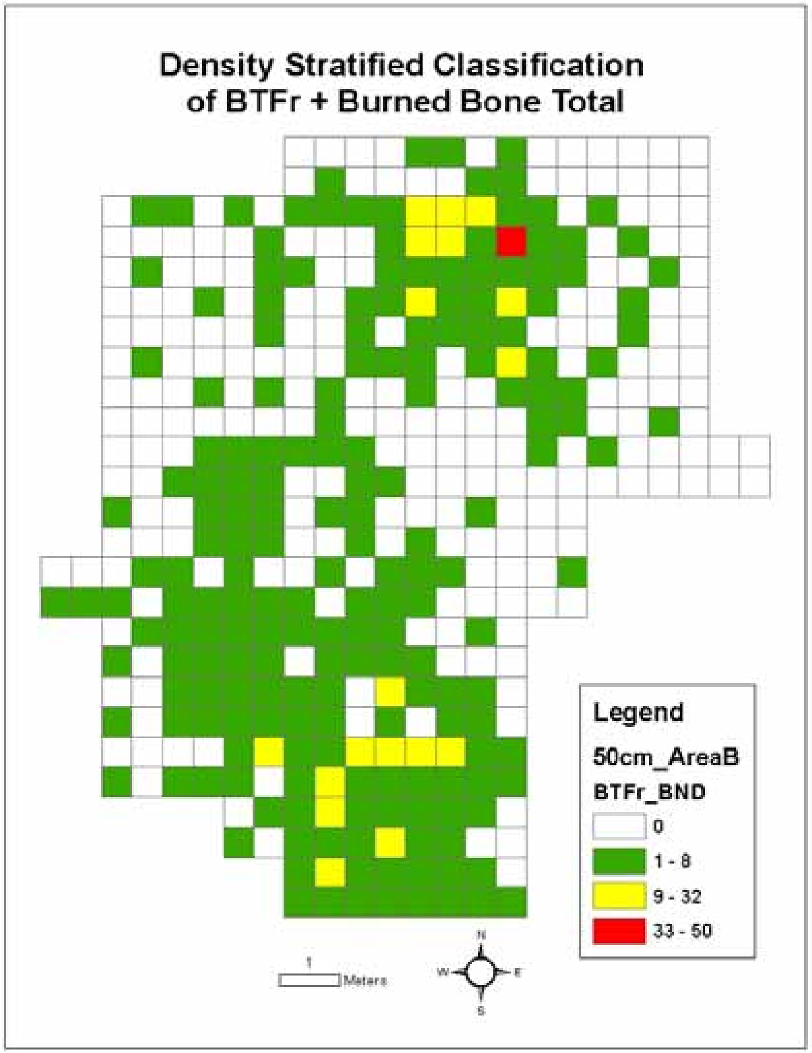


Figure 54. BTFr + Burned Bone Density Stratified Map, Area B

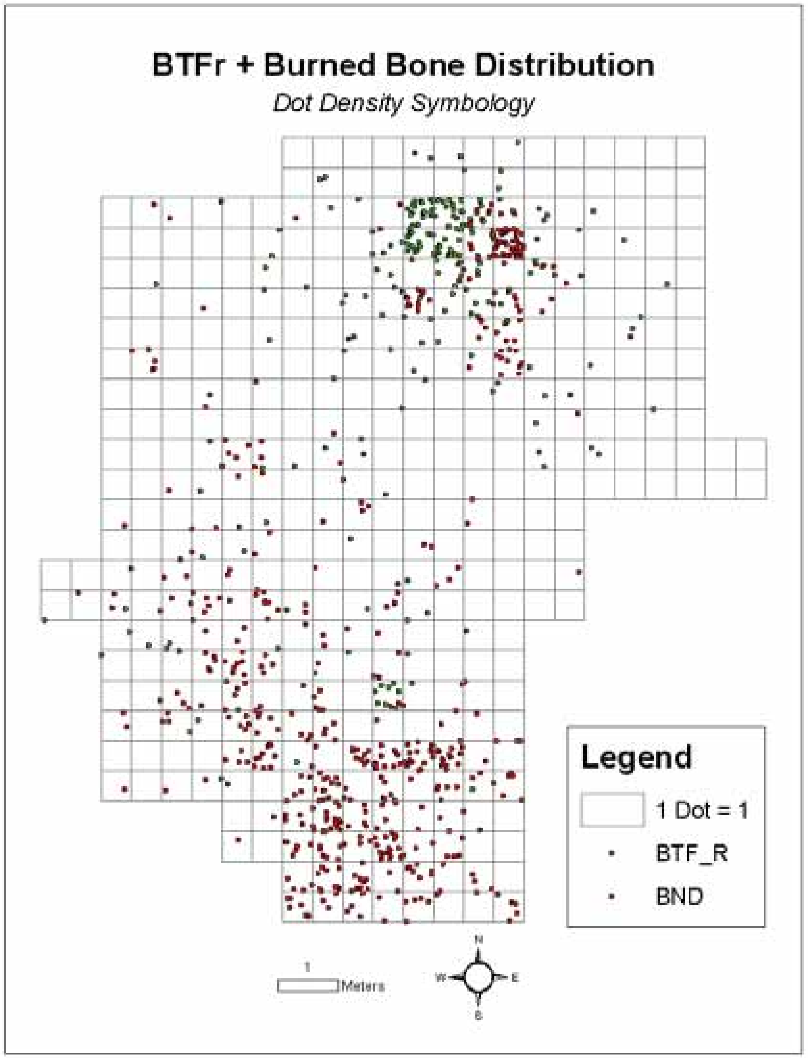


Figure 55. BTFr + Burned Bone Dot Density Map, Area B

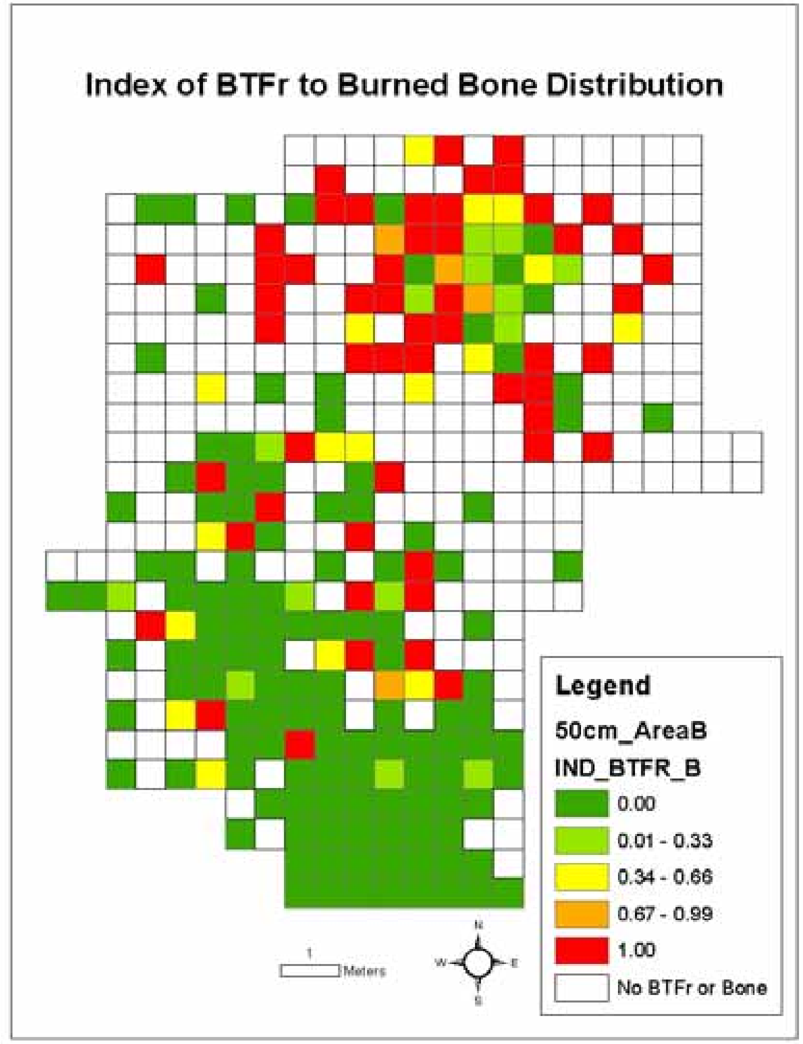


Figure 56. BTFr + Burned Bone Proportional Index Map, Area B

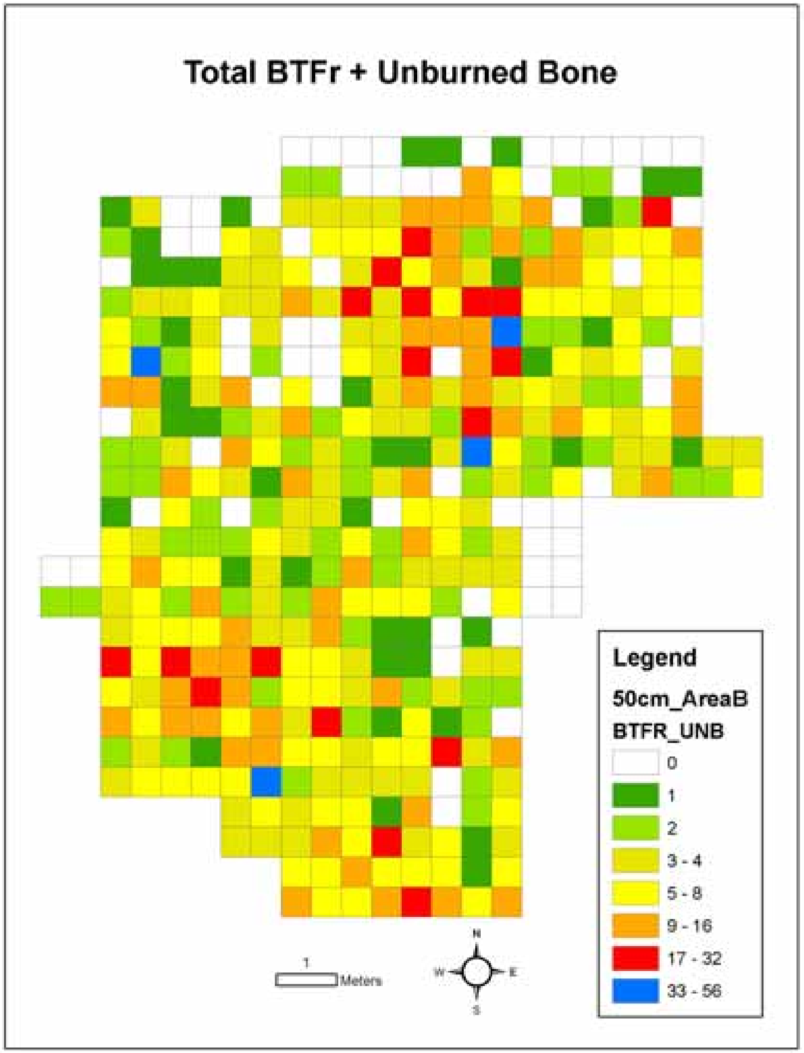


Figure 57. BTFr + Unburned Bone Distribution Map, Area B

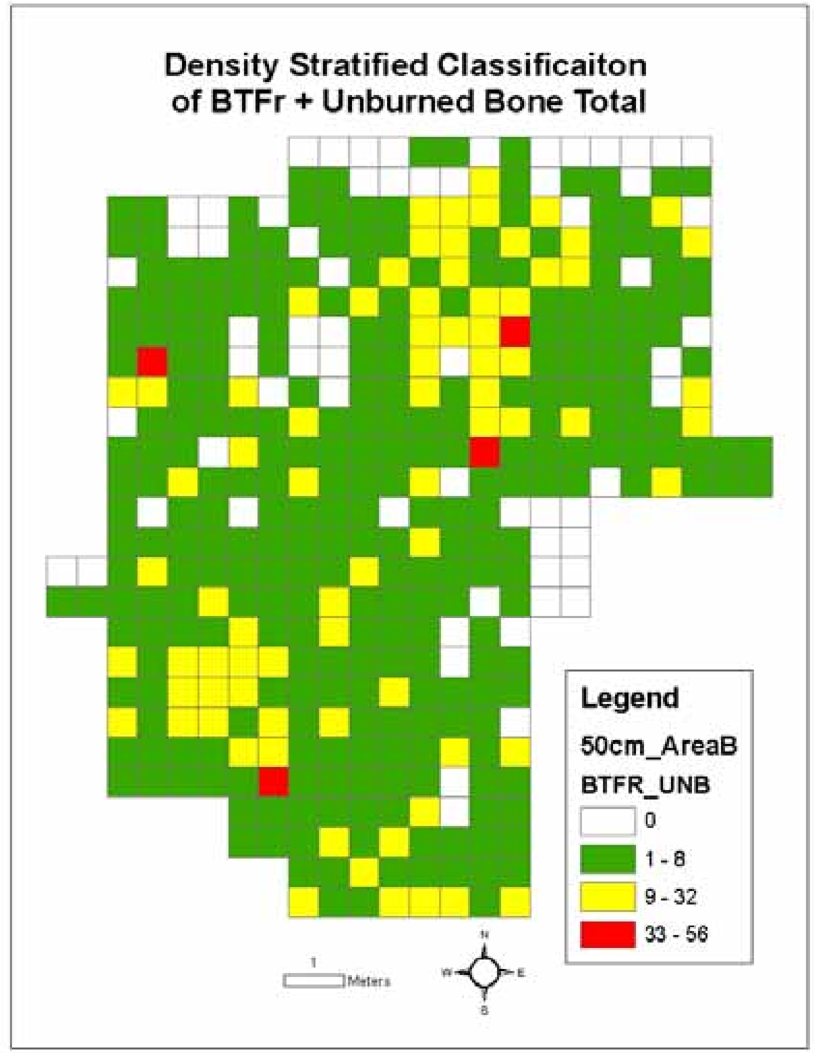


Figure 58. BTFr + Unburned Bone Density Stratification Map, Area B

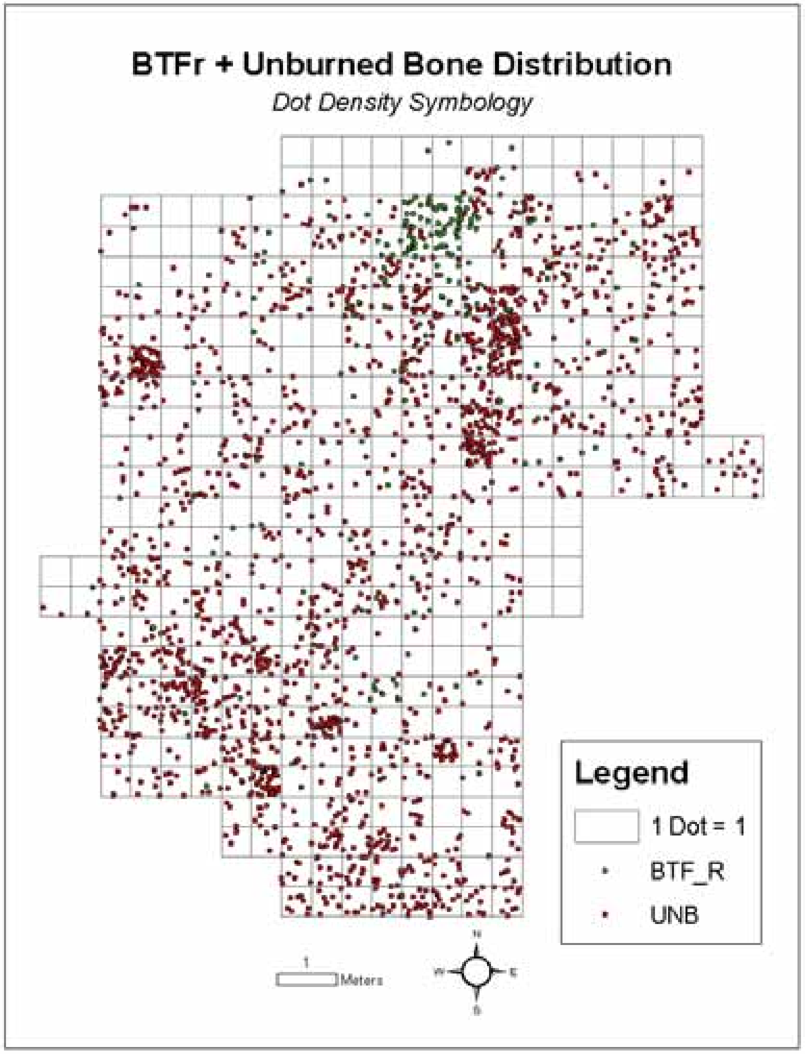


Figure 59. BTFr & Unburned Bone Dot Density Map, Area B

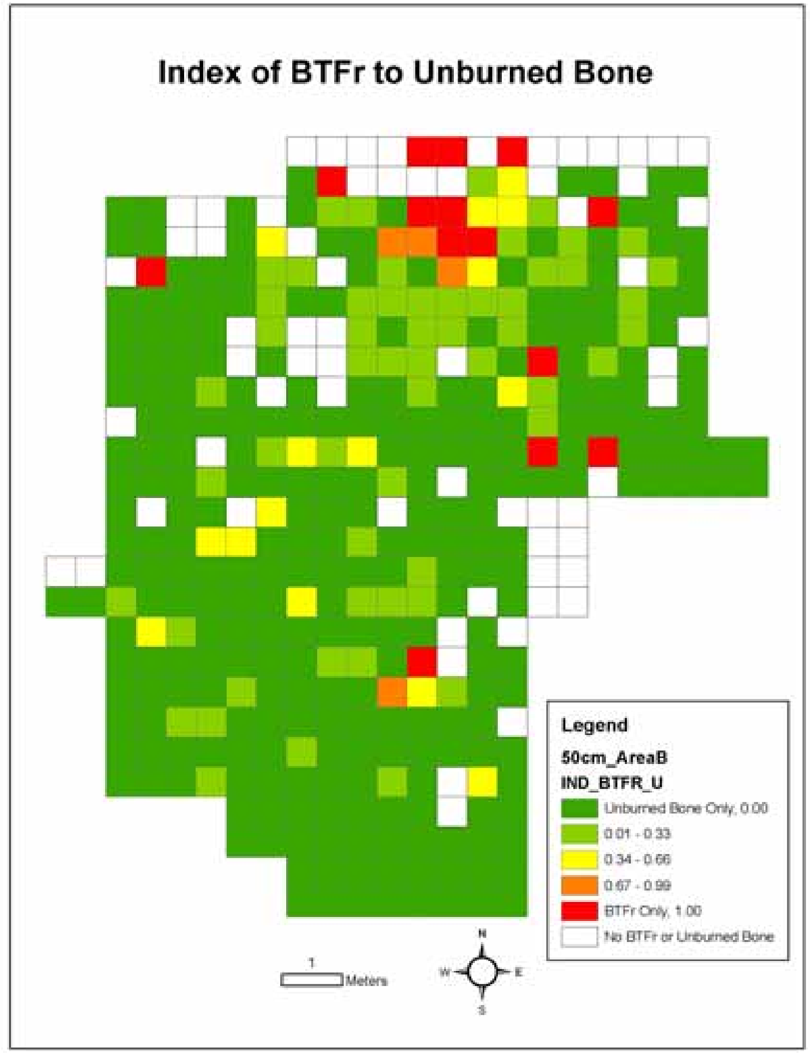


Figure 60. BTFr & Unburned Bone Dot Density Map, Area B

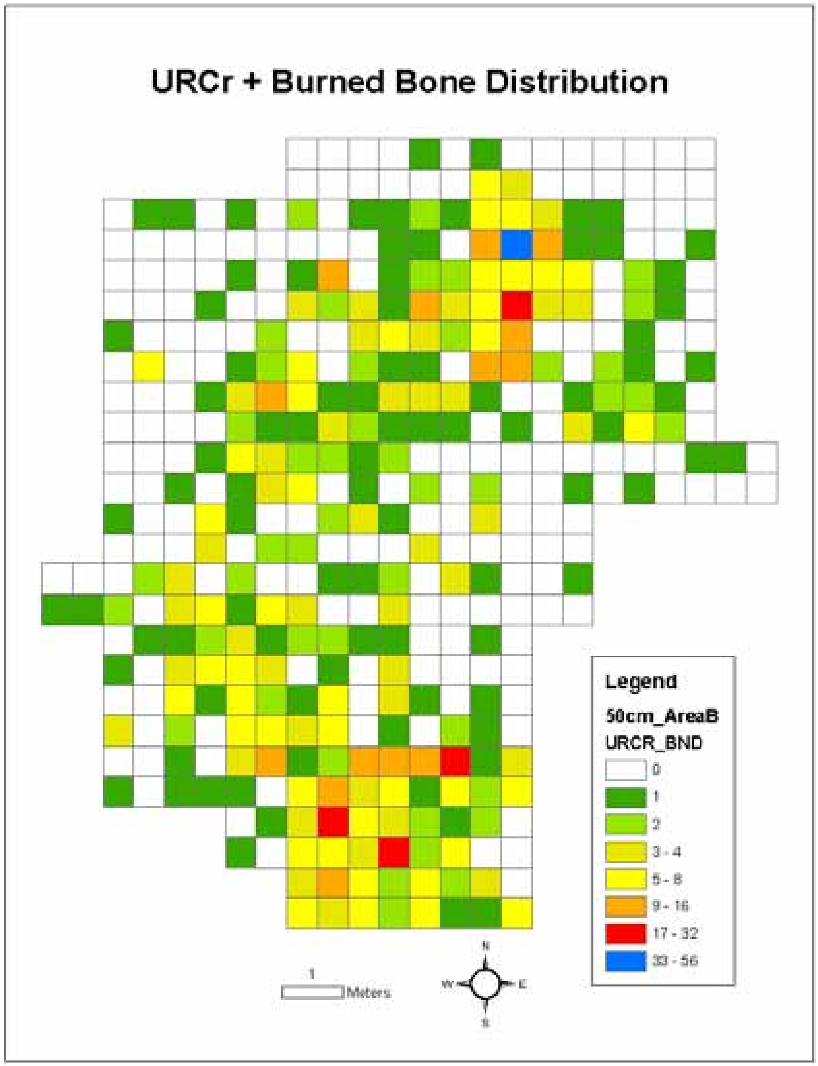


Figure 61. URCr + Burned Bone Distribution Map, Area B

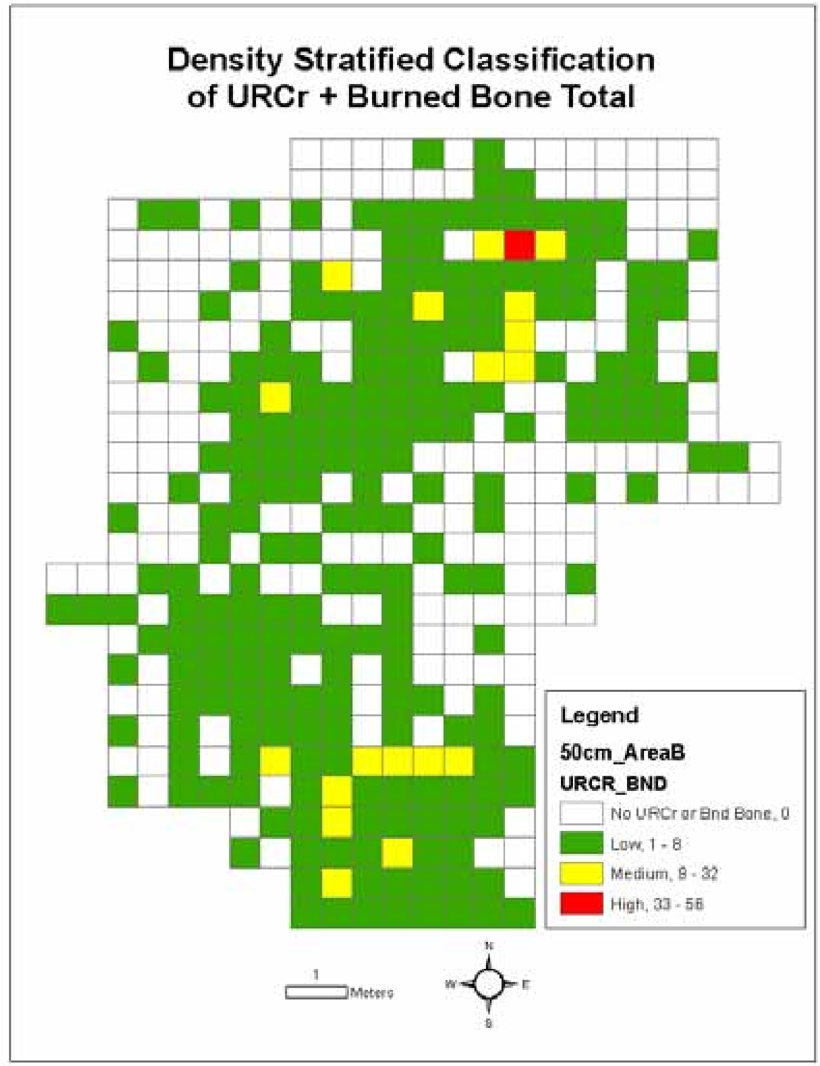


Figure 62. URCr + Burned Bone Density Stratified Map, Area B

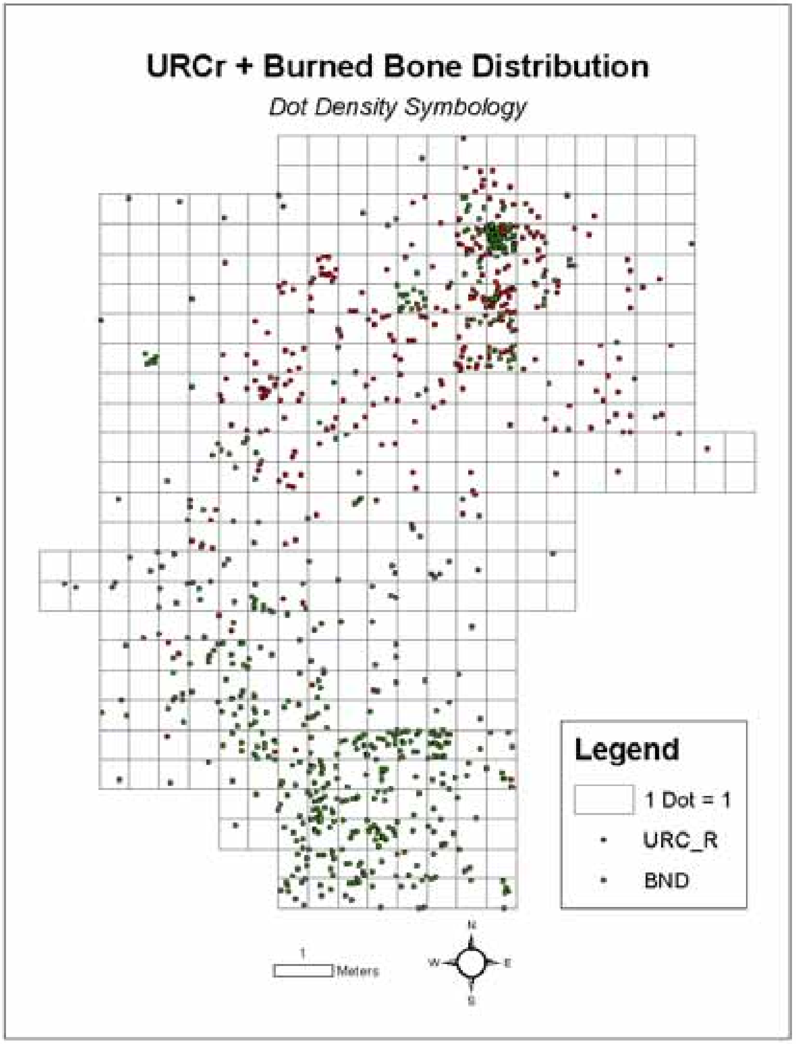


Figure 63. URCr + Burned Bone Dot Density Map, Area B

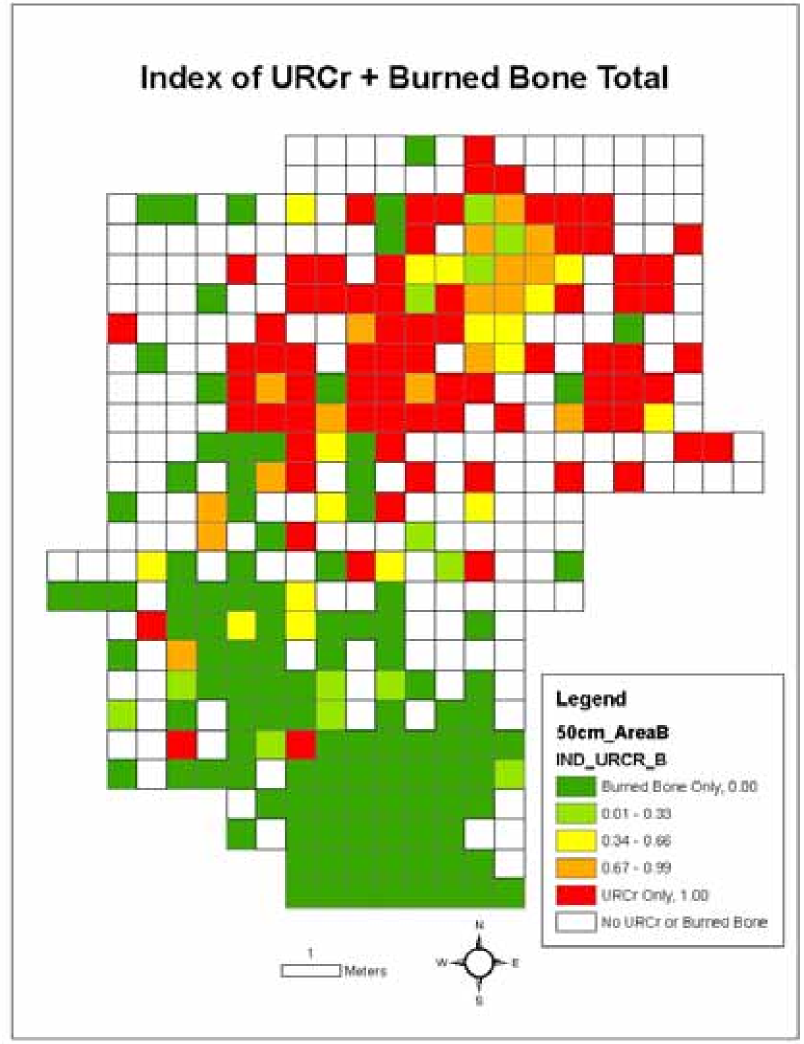


Figure 64. URCr + Burned Bone Proportional Index Map, Area B

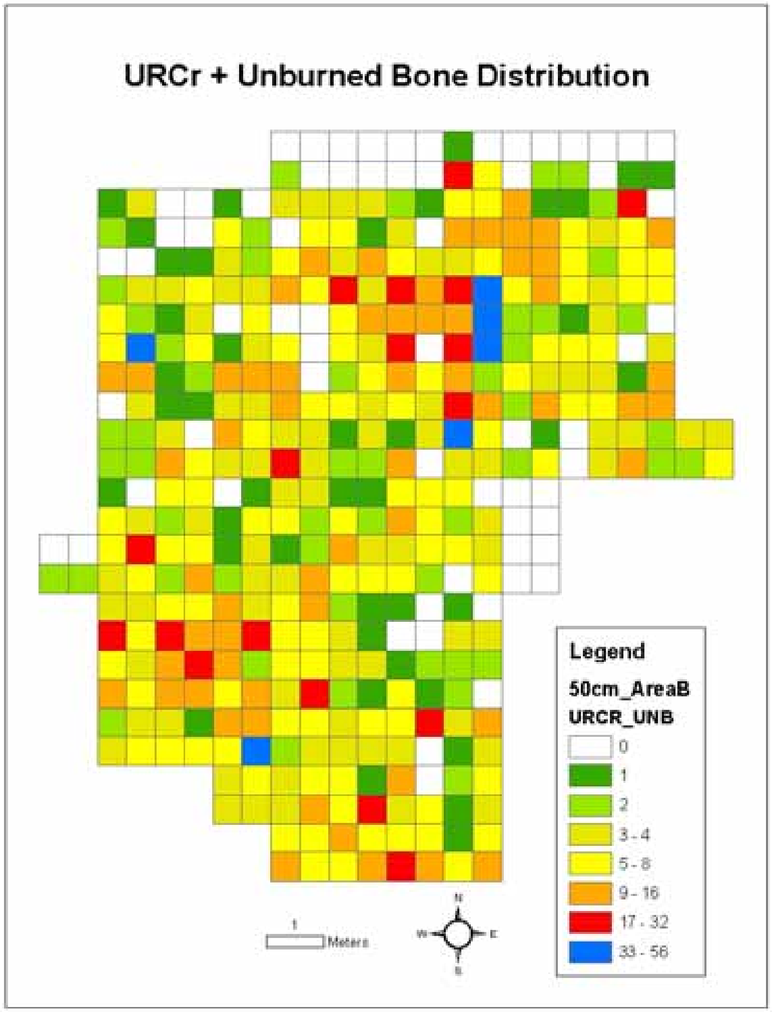


Figure 65. URCr + Unburned Bone Distribution Map, Area B

Figure 66. URCr + Unburned Bone Density Stratified Map, Area B

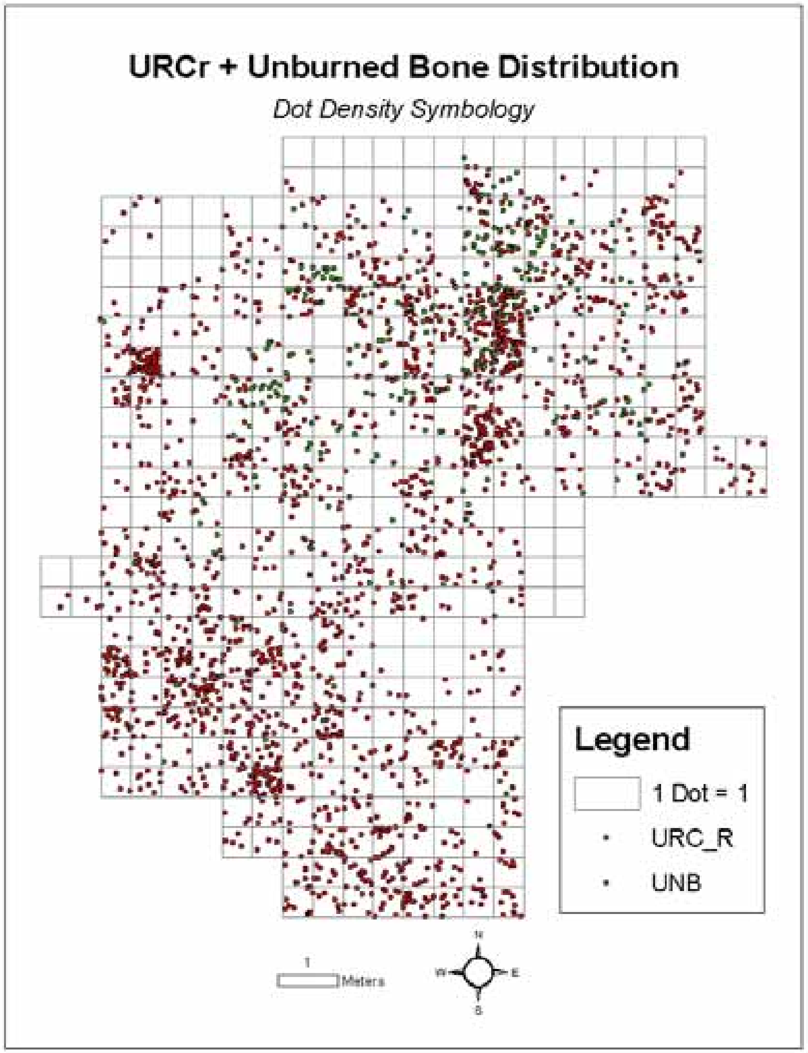


Figure 67. URCr + Unburned Dot Density Map, Area B

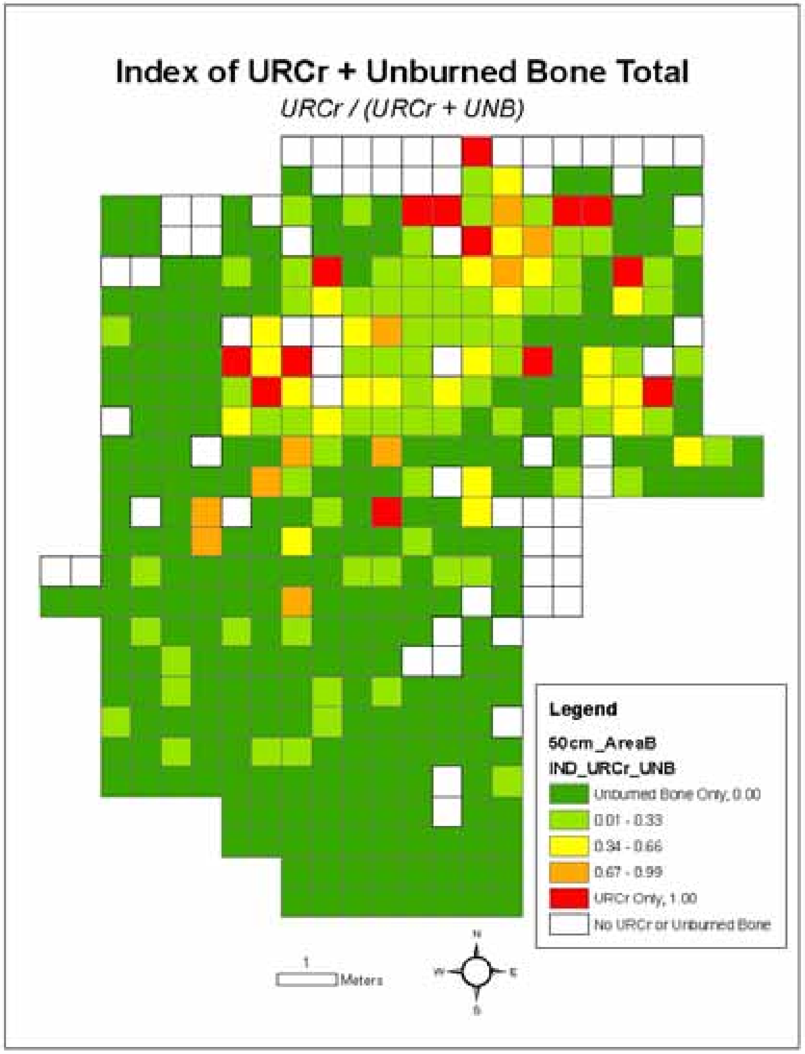


Figure 68. URCr + Unburned Bone Proportional Index Map, Area B

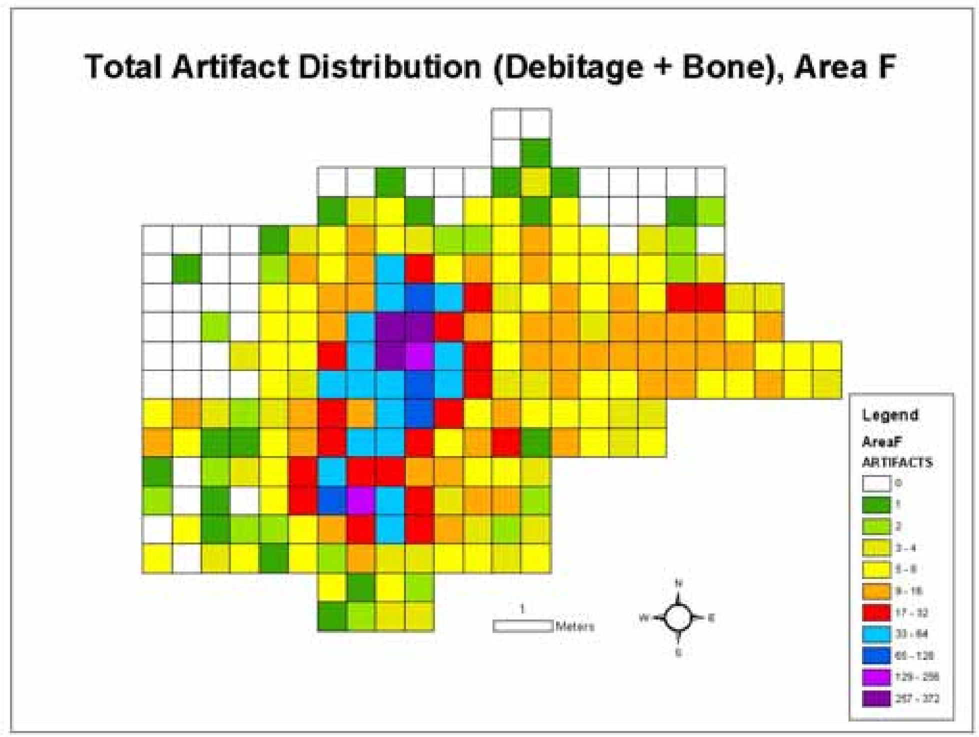


Figure 69. Total Debitage + Total Bone Combined Distribution, Area F

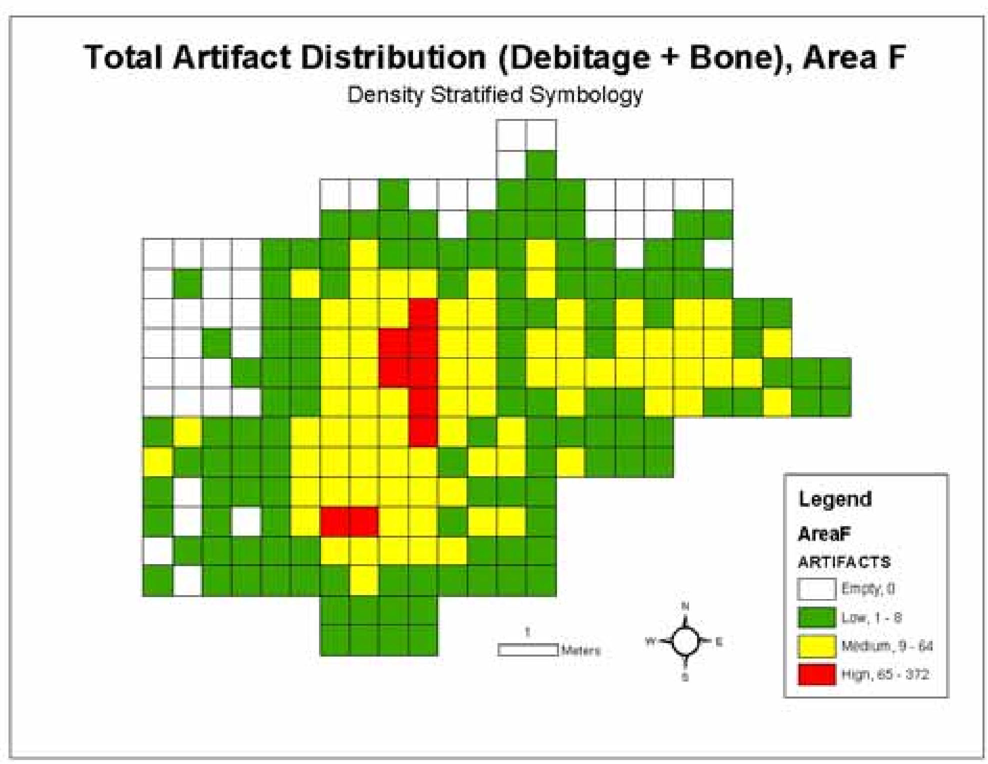


Figure 70. Debitage + Bone Density Stratified Map, Area F

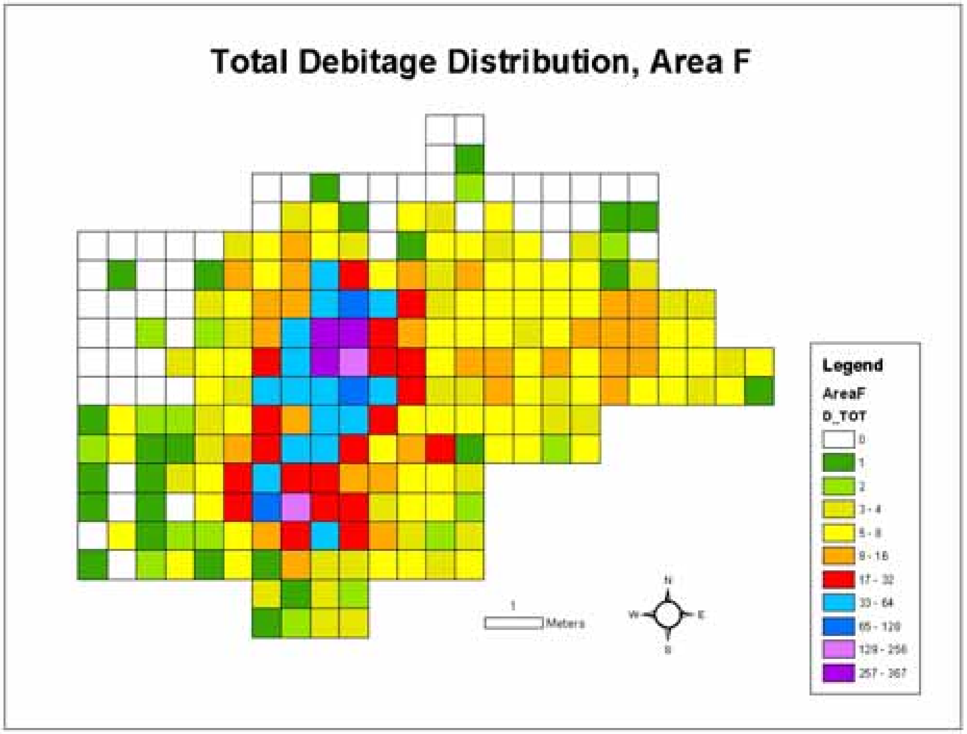


Figure 71. Debitage Distribution Map, Area F

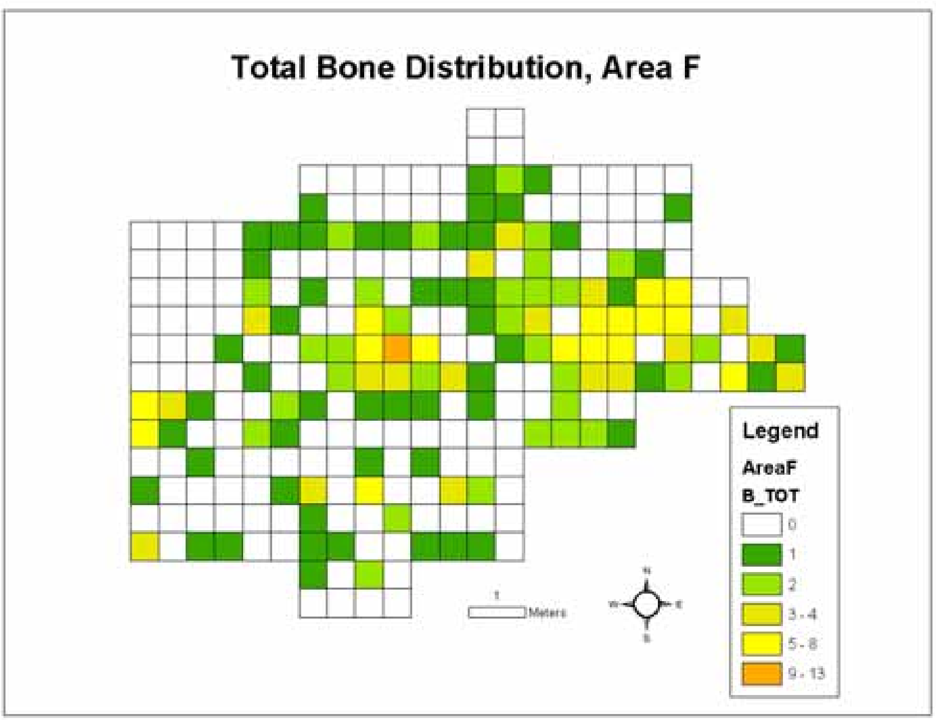


Figure 72. Bone Distribution Map, Area F

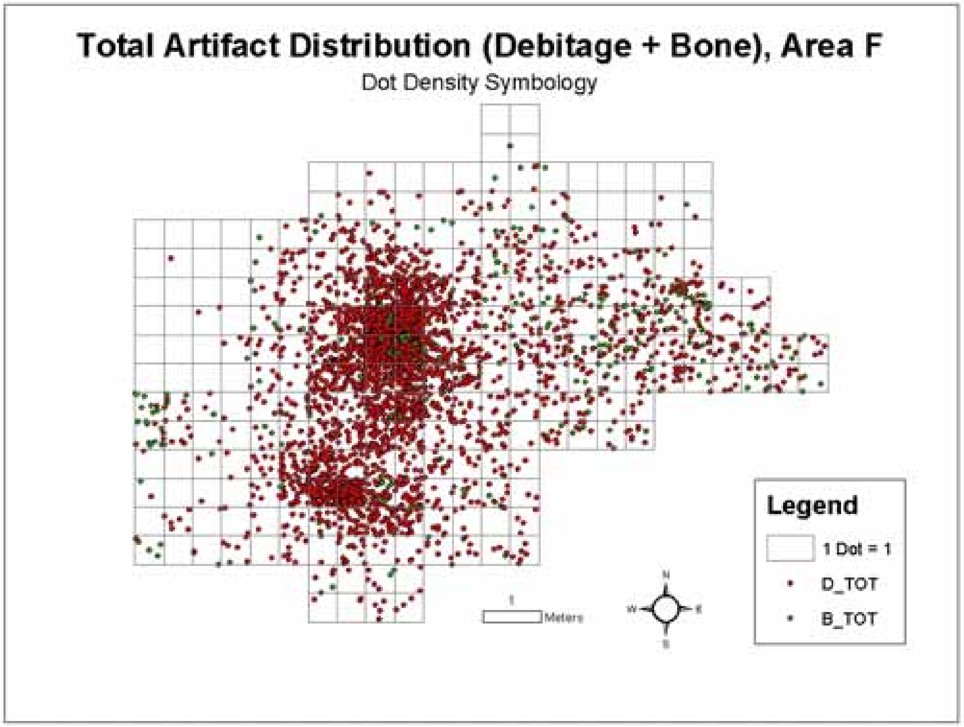


Figure 73. Debitage & Bone Dot Density Map, Area F

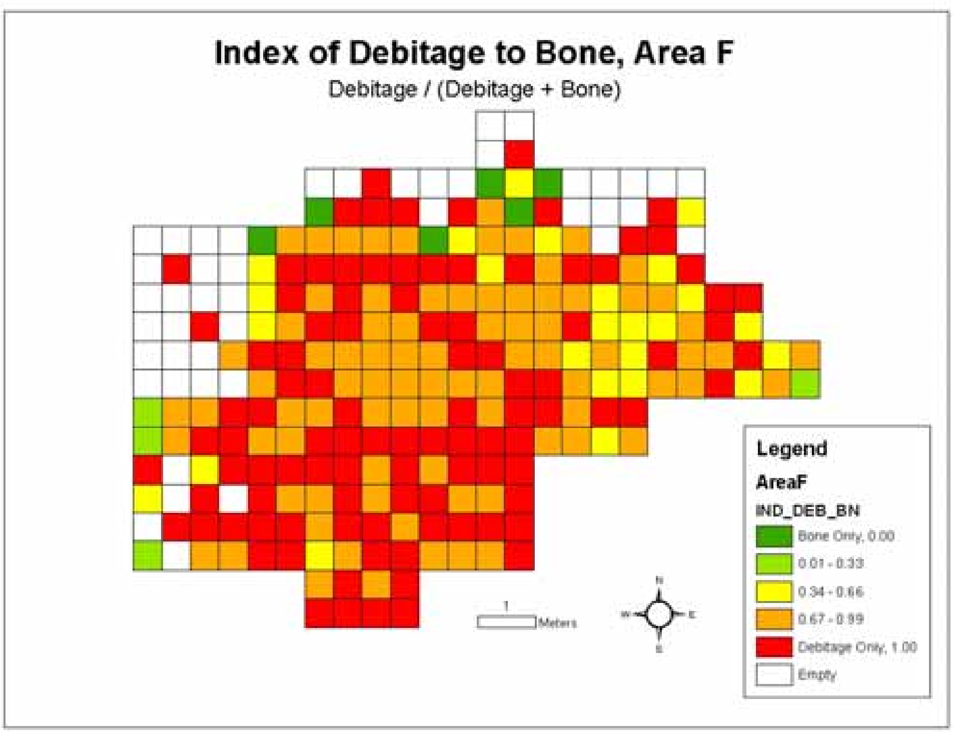


Figure 74. Debitage & Bone Proportional Index Map, Area F

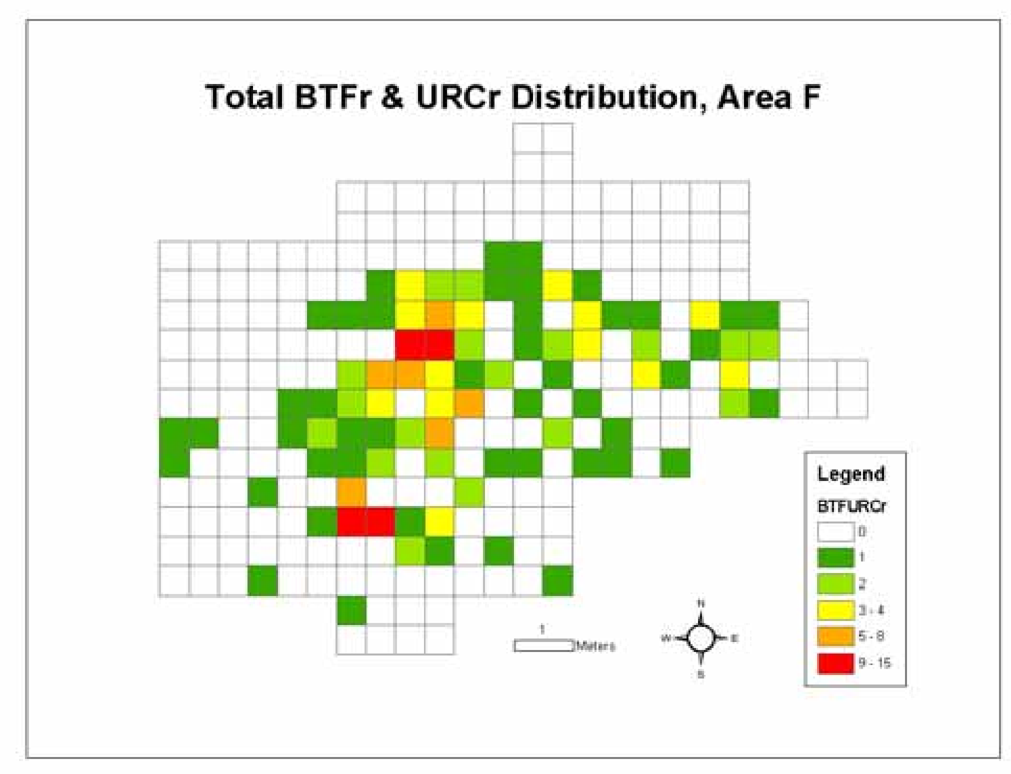


Figure 75. BTFr + URCr Combined Distribution, Area F

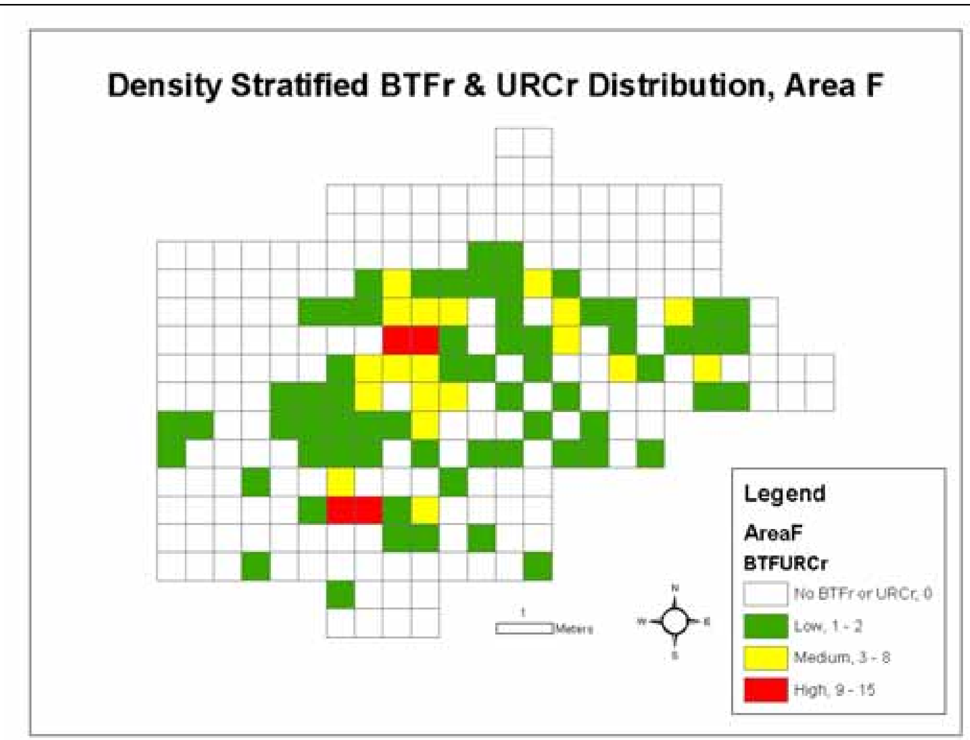


Figure 76. BTFr + URCr Density Stratified Map, Area F

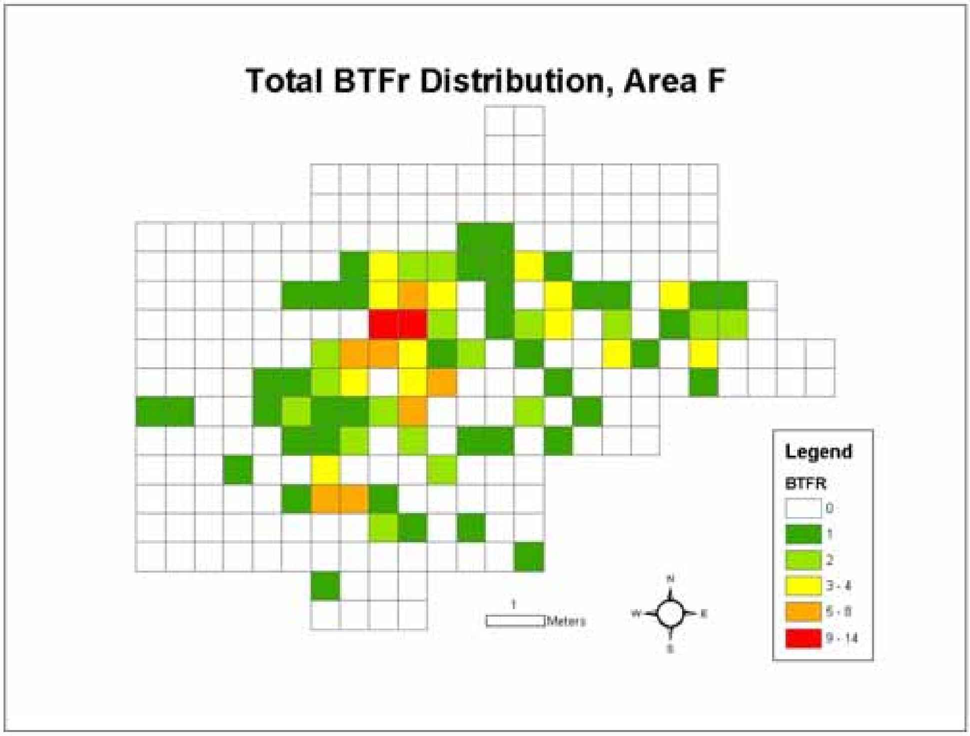


Figure 77. BTFr Distribution Map, Area F

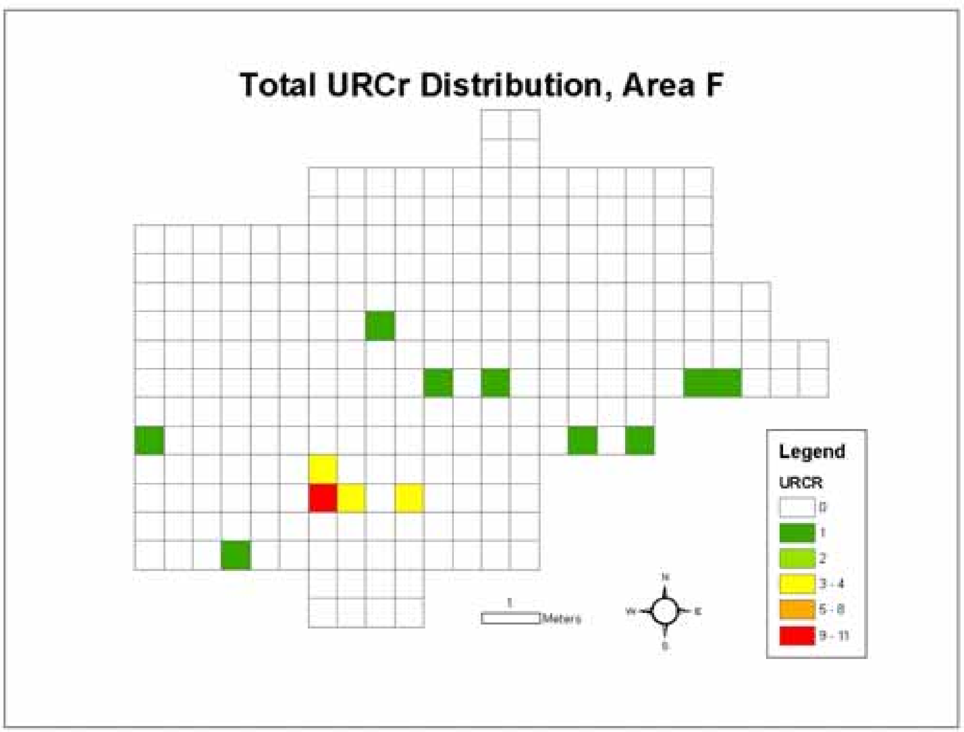


Figure 78. URCr Distribution Map, Area F

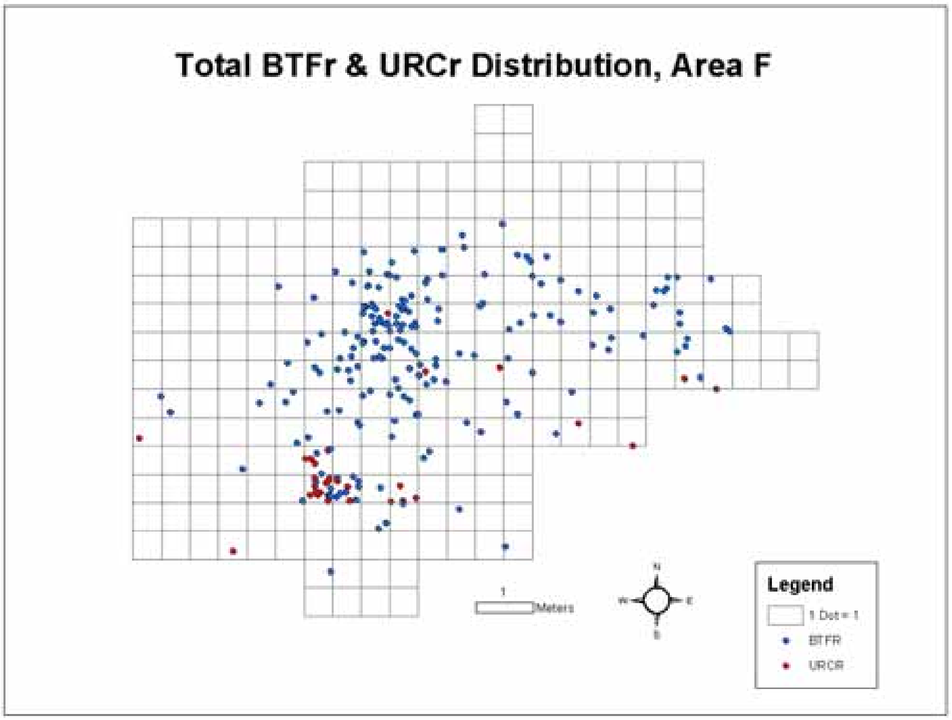


Figure 79. BTFr & URCr Dot Density Map, Area F

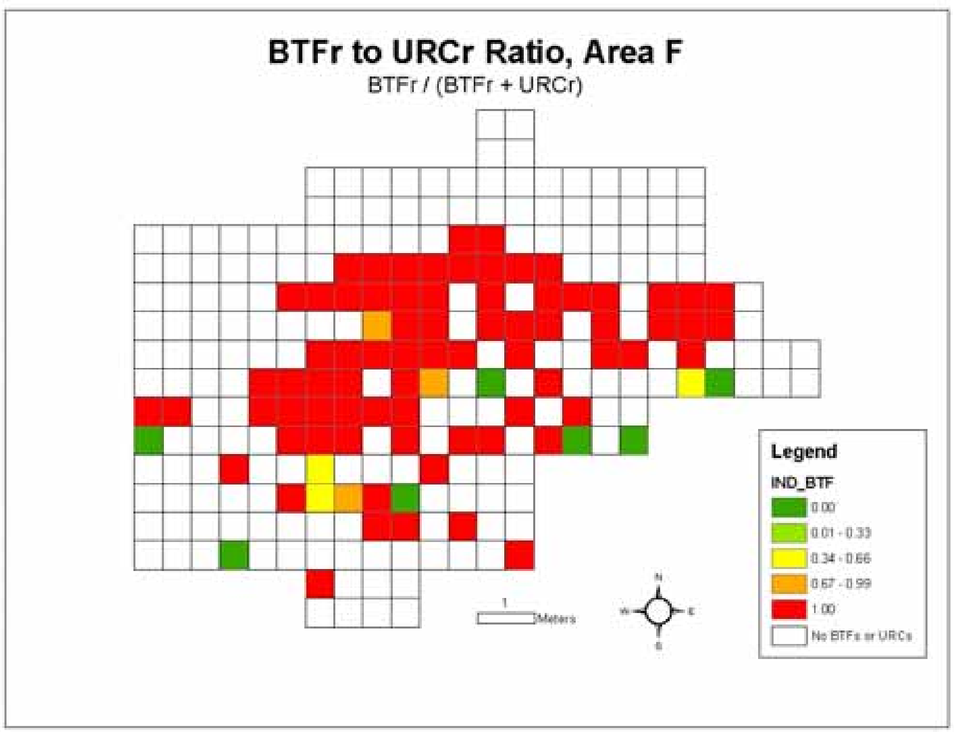


Figure 80. BTFr & URCr Proportional Index Map, Area F

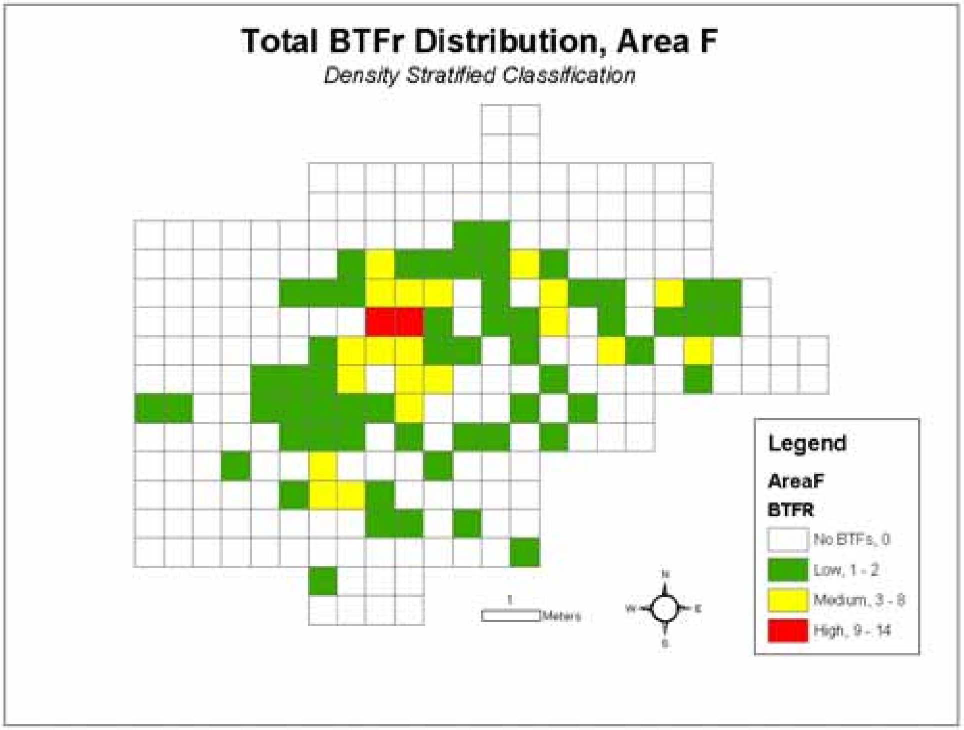


Figure 81. BTFr Density Stratified Map, Area F

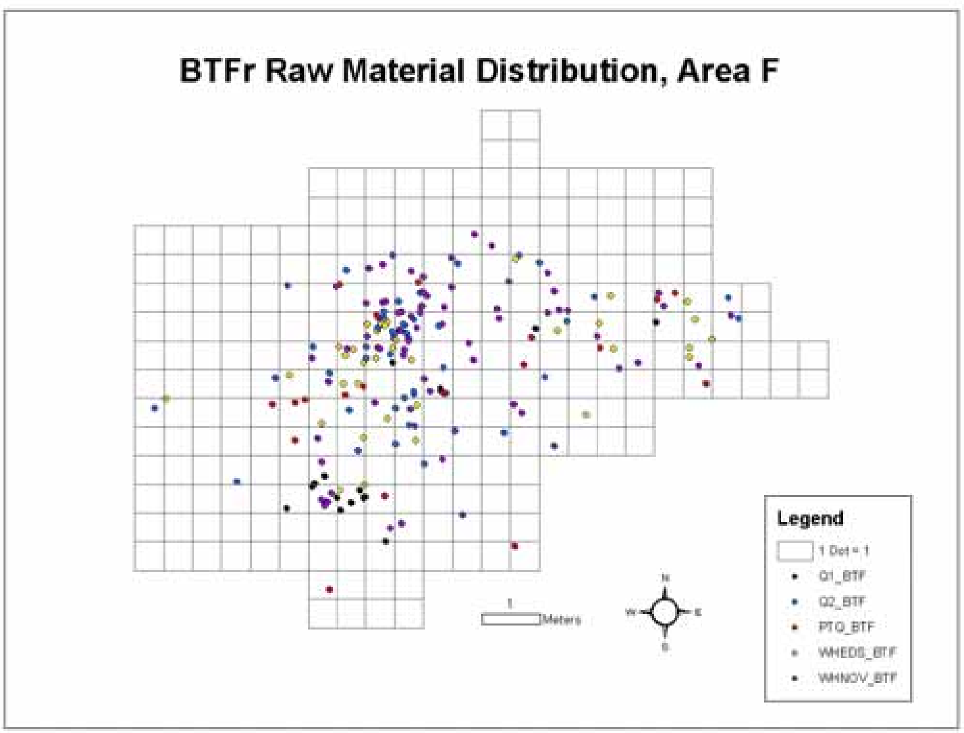


Figure 82. Dot Density Map of BTFr's by Raw Material, Area F

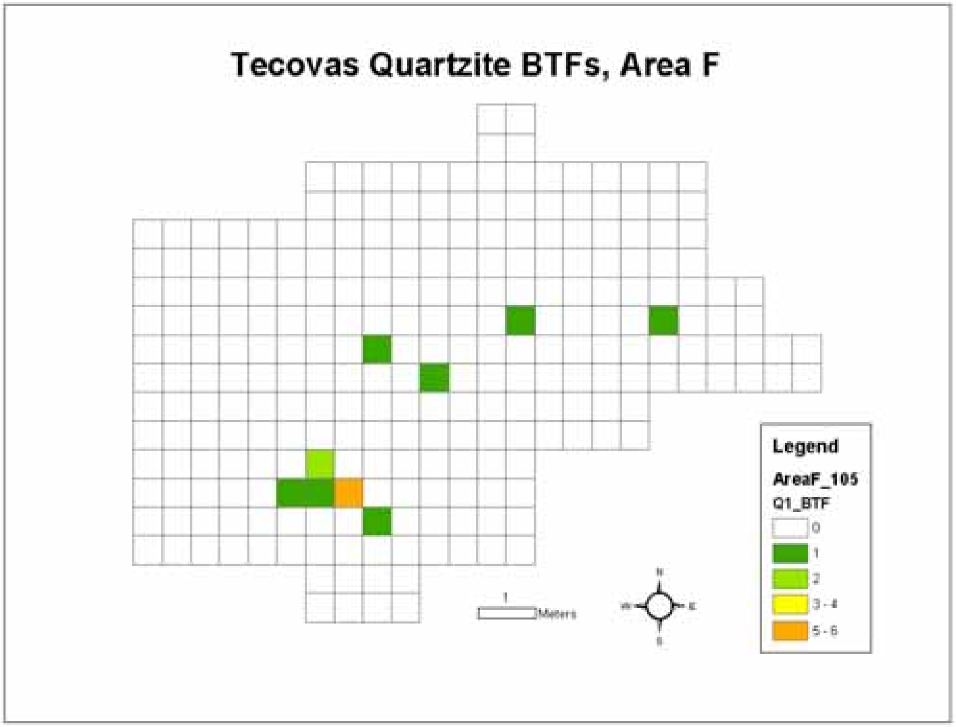


Figure 83. Tecovas Quartzite BTFs, Area F

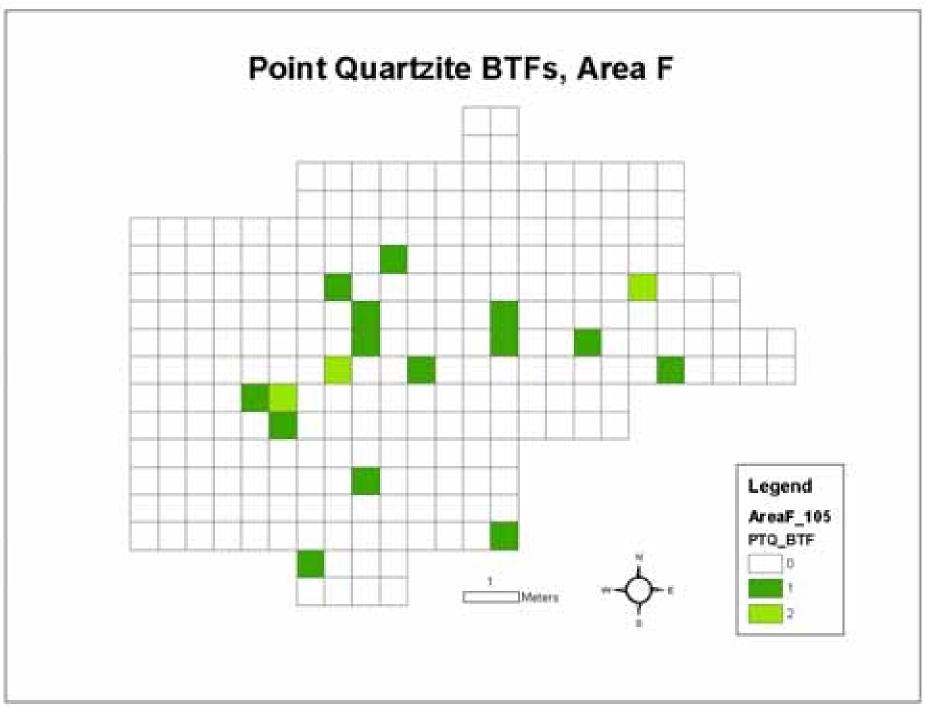


Figure 84. Point Quartzite Distribution, Area F

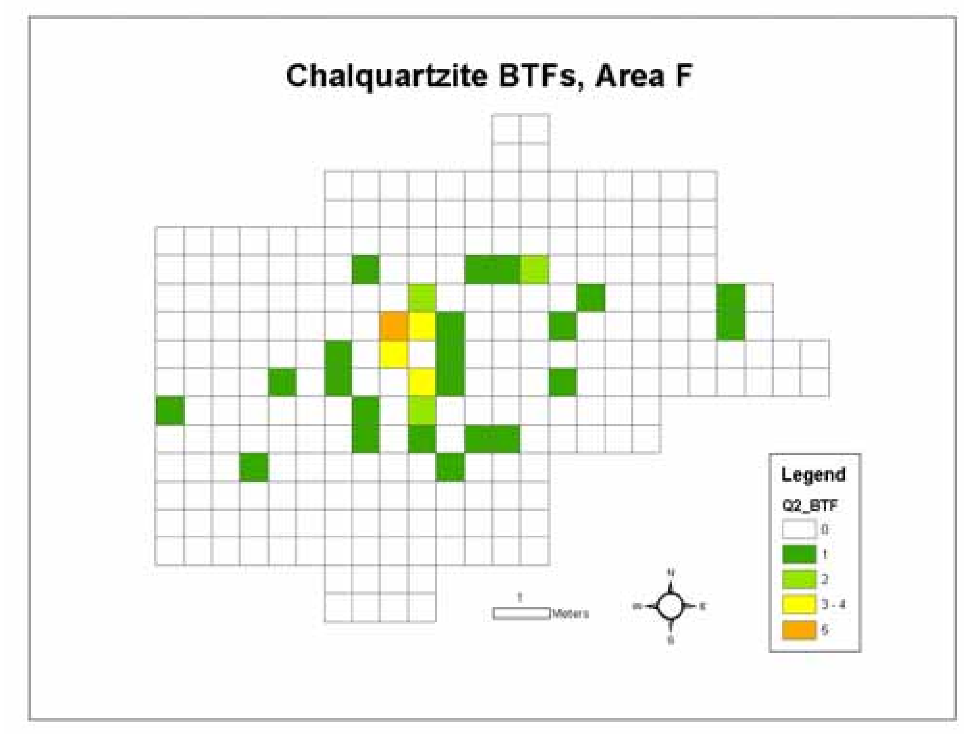


Figure 85. Chalquartzite BTFs, Area F

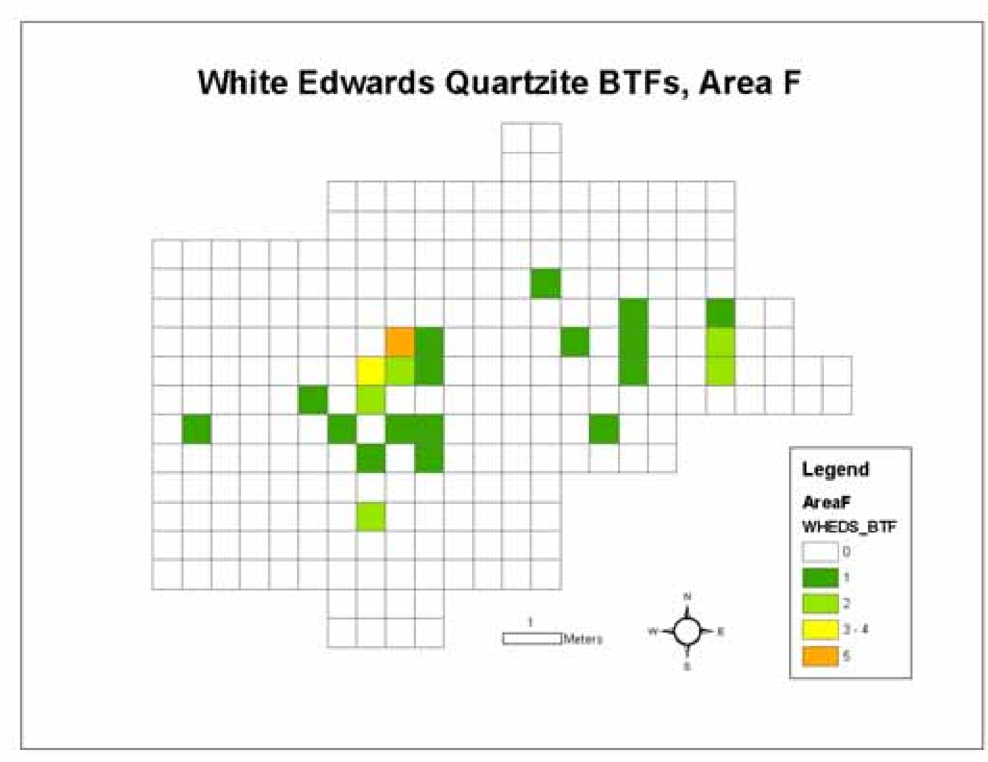


Figure 86. White Edwards Chert BTFs, Area F

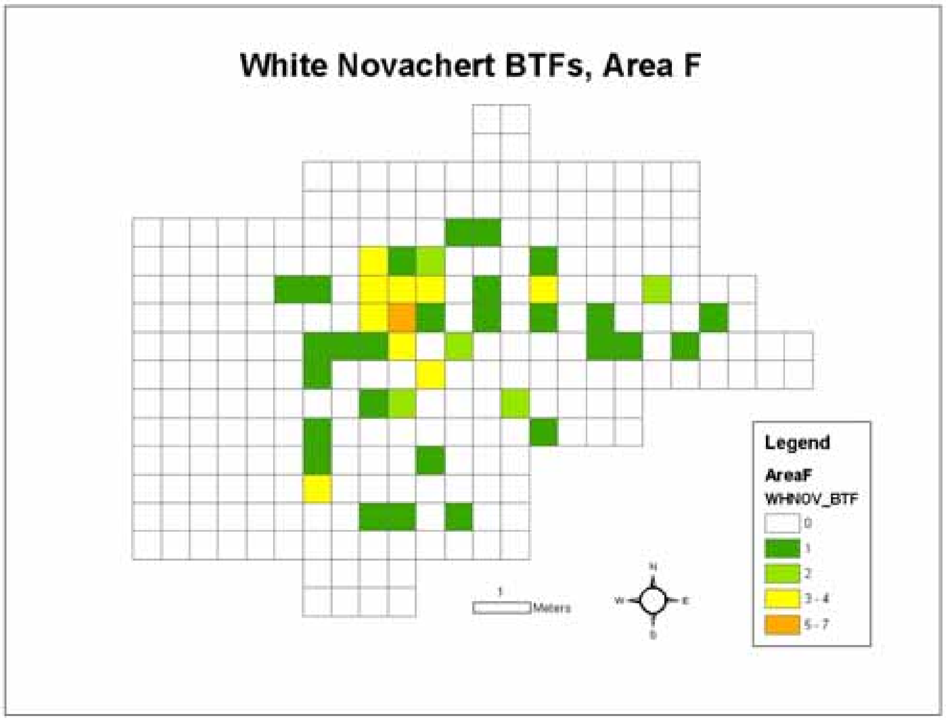


Figure 87. White Novachert BTFs, Area F

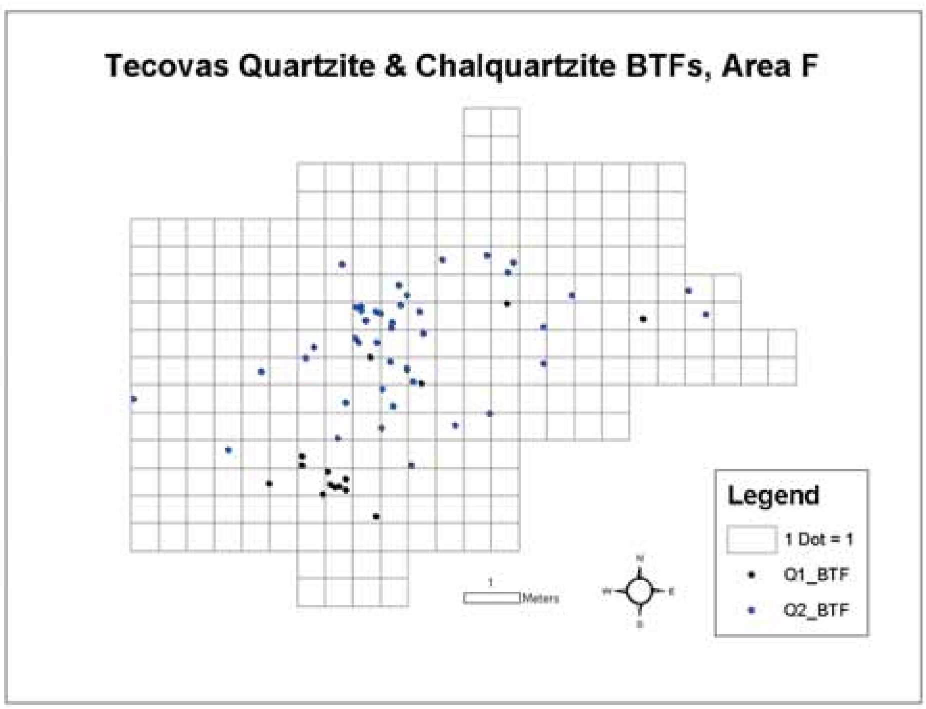


Figure 88. Tecovas Quartzite & Chalquartzite BTFs Dot Density Distribution, Area F

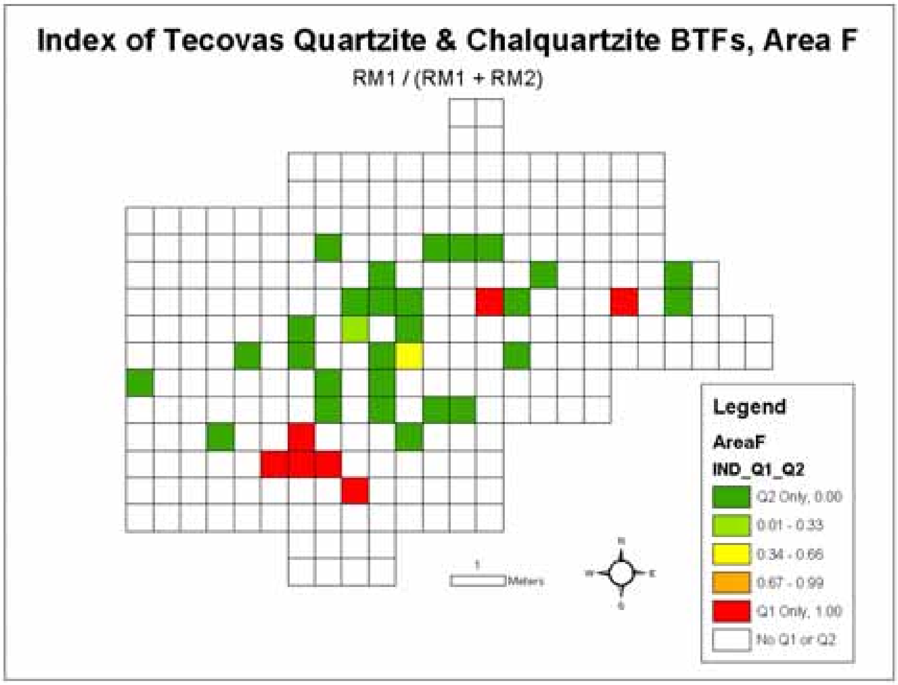


Figure 89. Tecovas Quartzite & Chalquartzite BTF Proportional Index Map, Area F

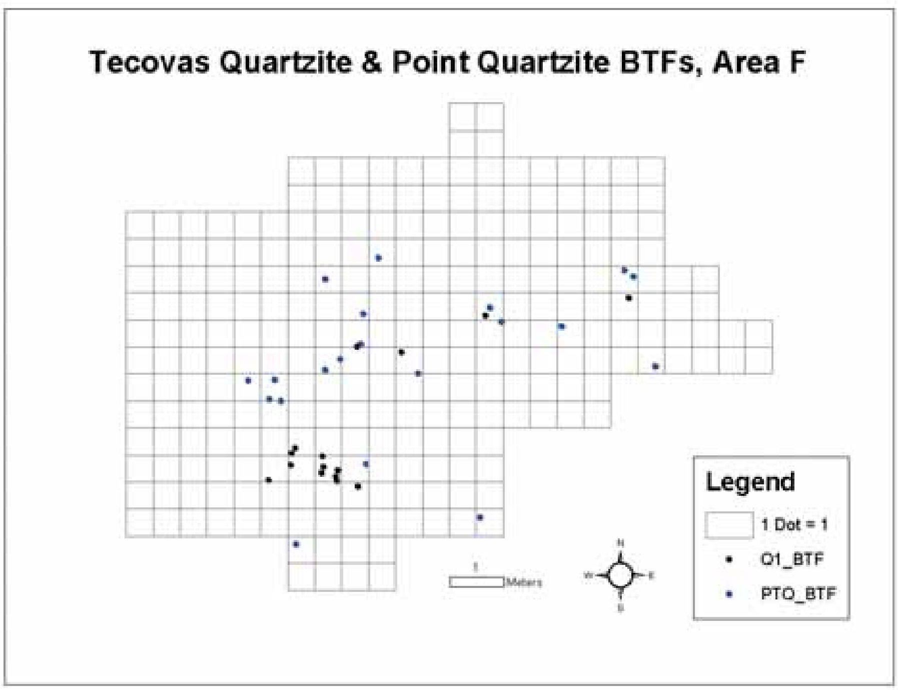


Figure 90. Tecovas & Point Quartzite BTF Dot Density Distribution, Area F

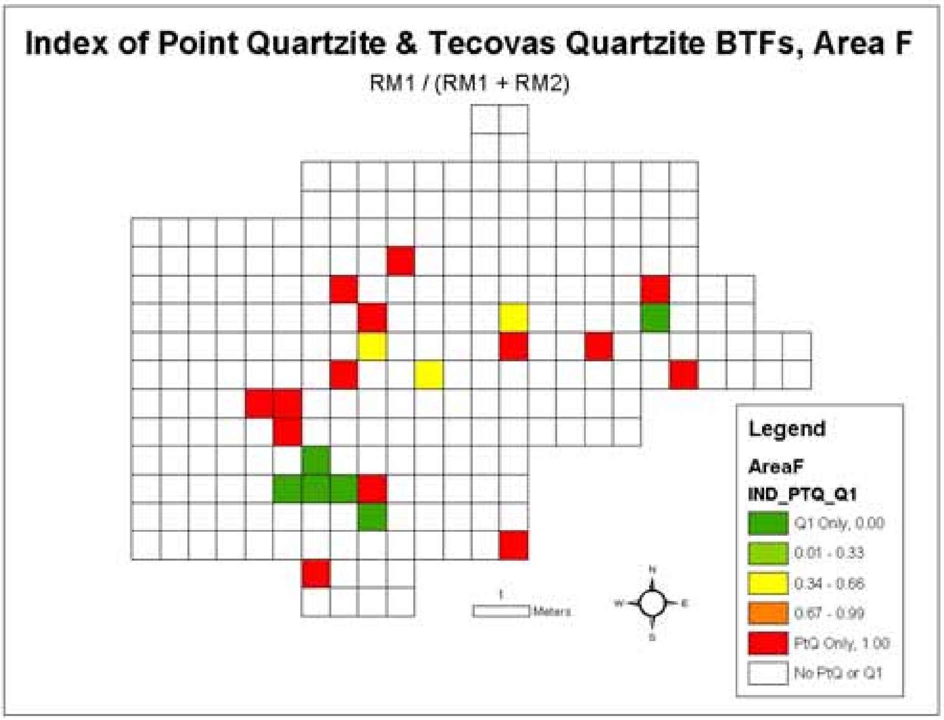


Figure 91. Tecovas & Point Quartzite BTF Proportional Index, Area F

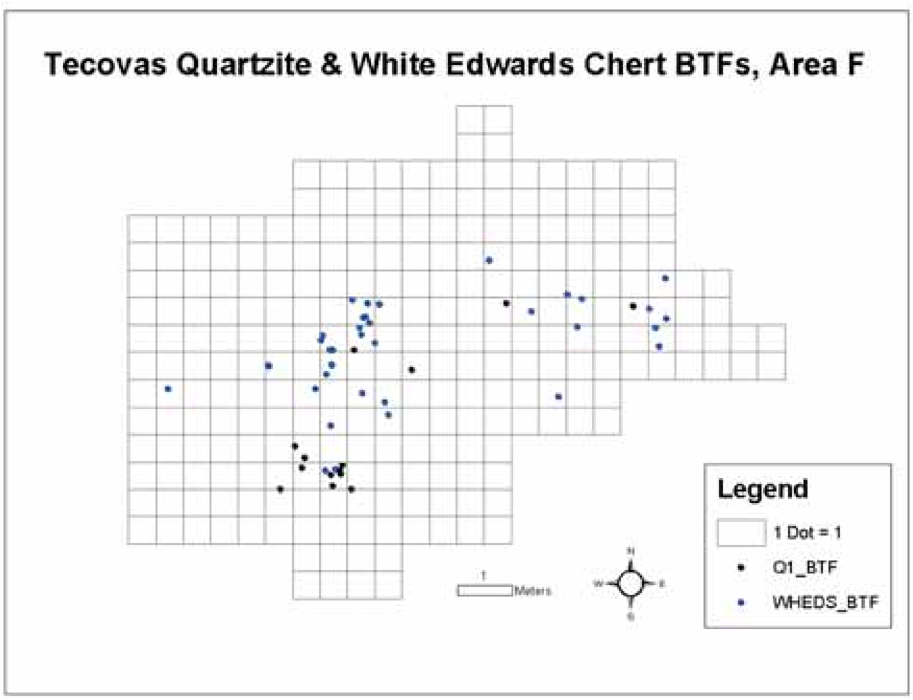


Figure 92. Tecovas Quartzite & White Edwards Chert BTFs Dot Density Map, Area F

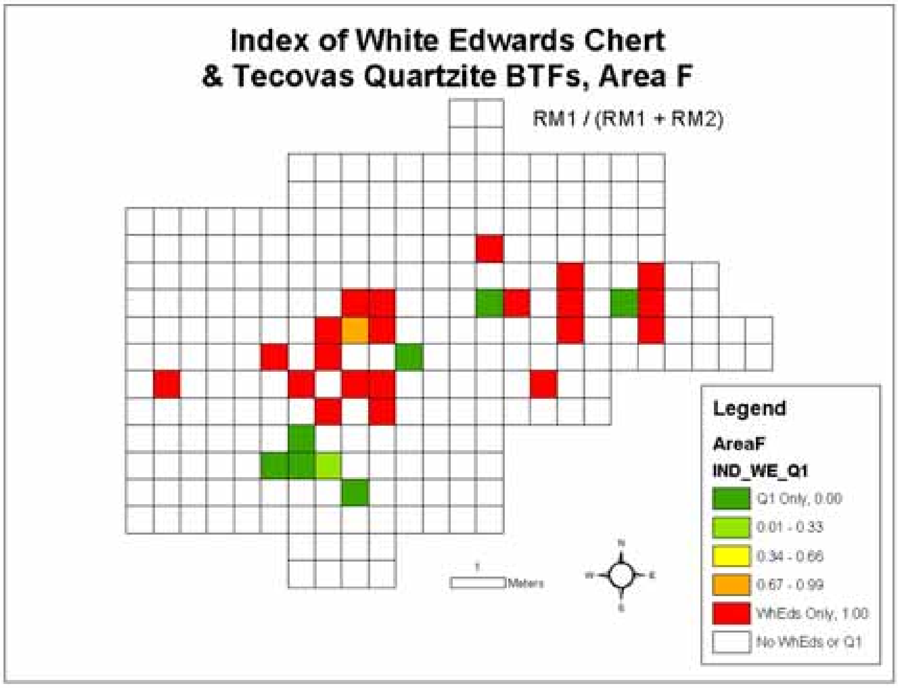


Figure 93. White Edwards & Tecovas Quartzite Chert BTF Proportional Index Map, Area F

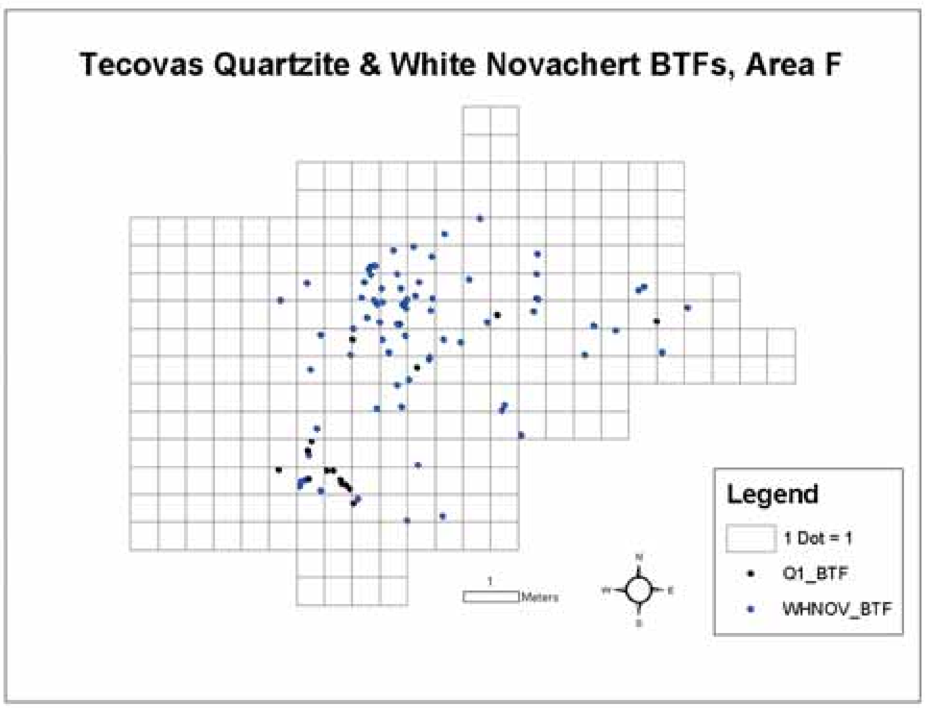


Figure 94. Tecovas Quartzite & White Novachert BTF Dot Density Distribution, Area F

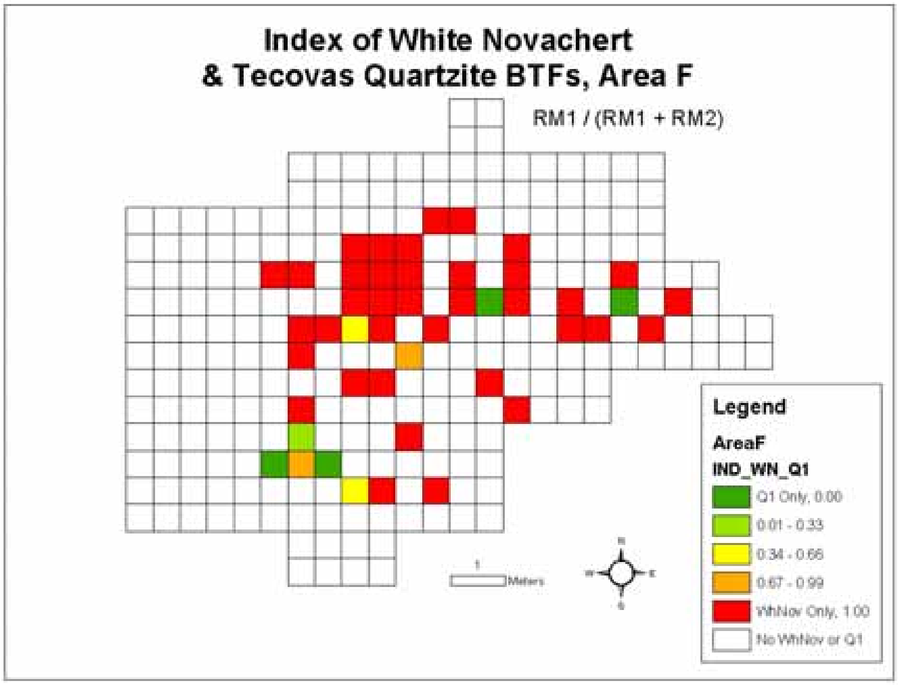


Figure 95. White Novachert & Tecovas Quartzite BTF Proportional Index Map, Area F

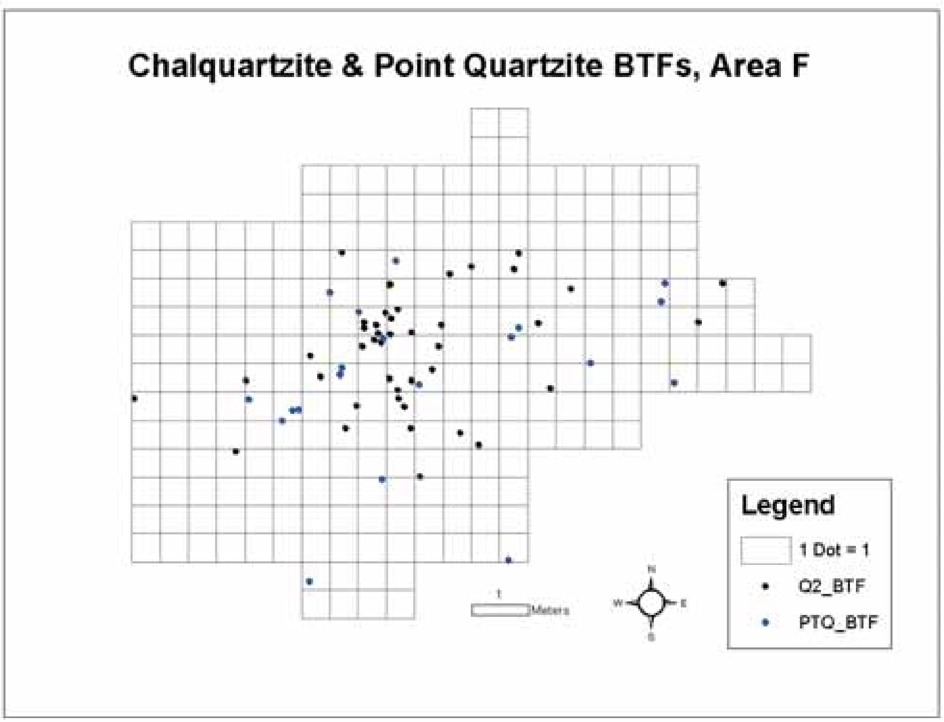


Figure 96. Chalquartzite & Point Quartzite BTF Dot Density Map, Area F

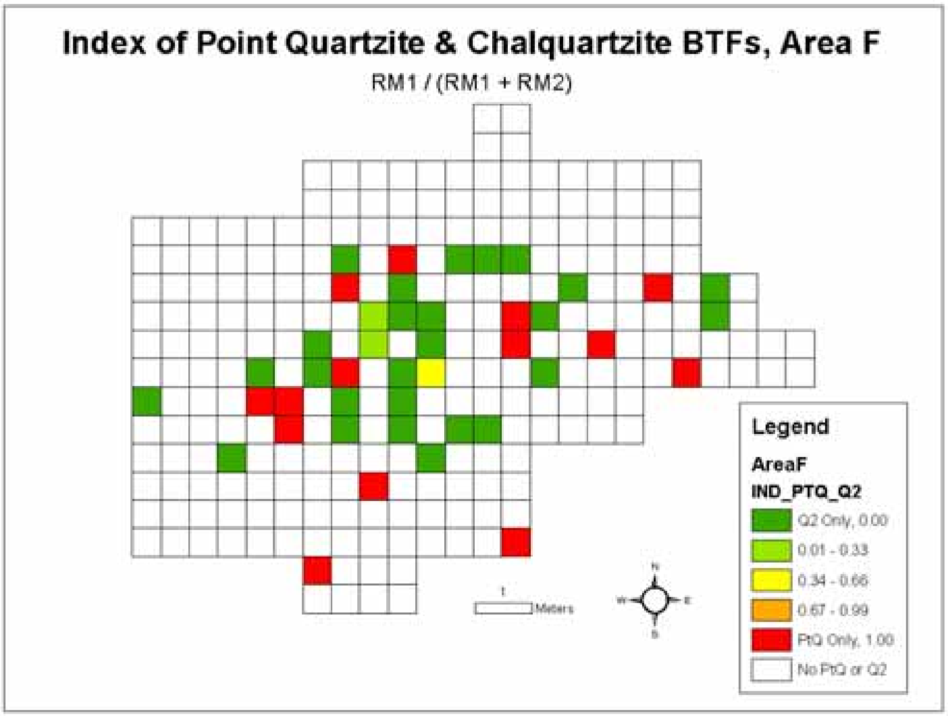


Figure 97. Point Quartzite & Chalquartzite BTF Proportional Index Map, Area F

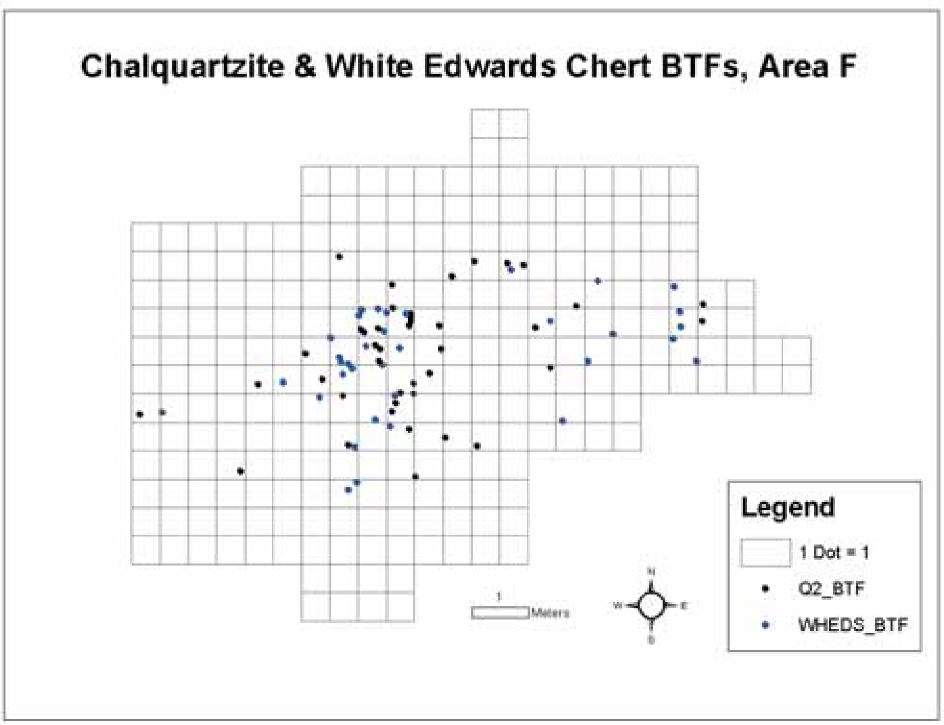


Figure 98. Chalquartzite & White Edwards Chert BTF Dot Density Map, Area F

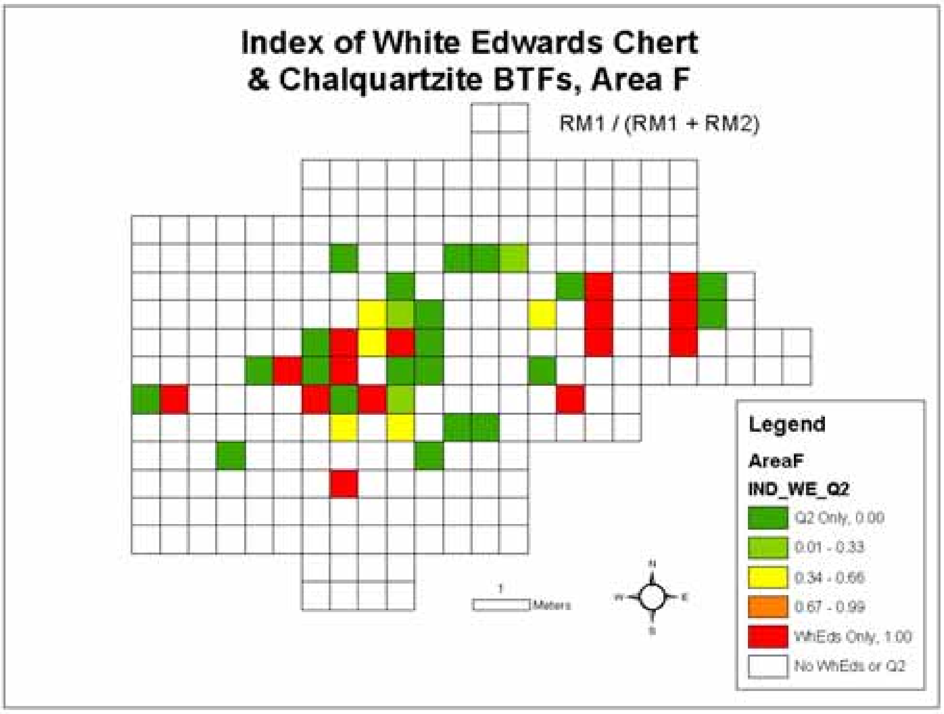


Figure 99. White Edwards Chert & Chalquartzite BTF Proportional Index Map, Area F

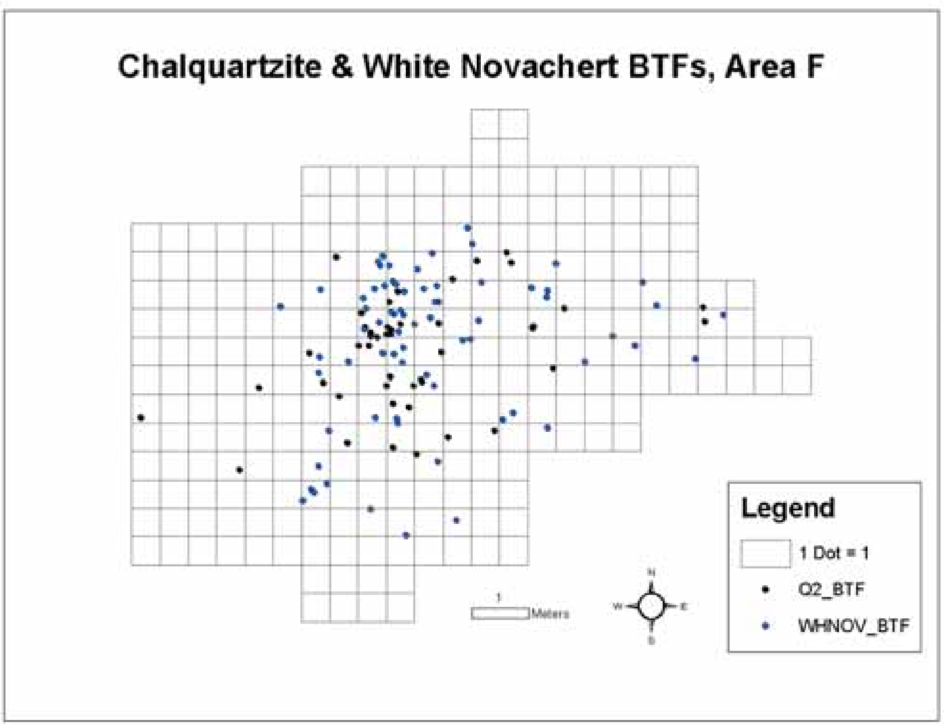


Figure 100. Chalquartzite & White Novachert BTF Dot Density Map, Area F

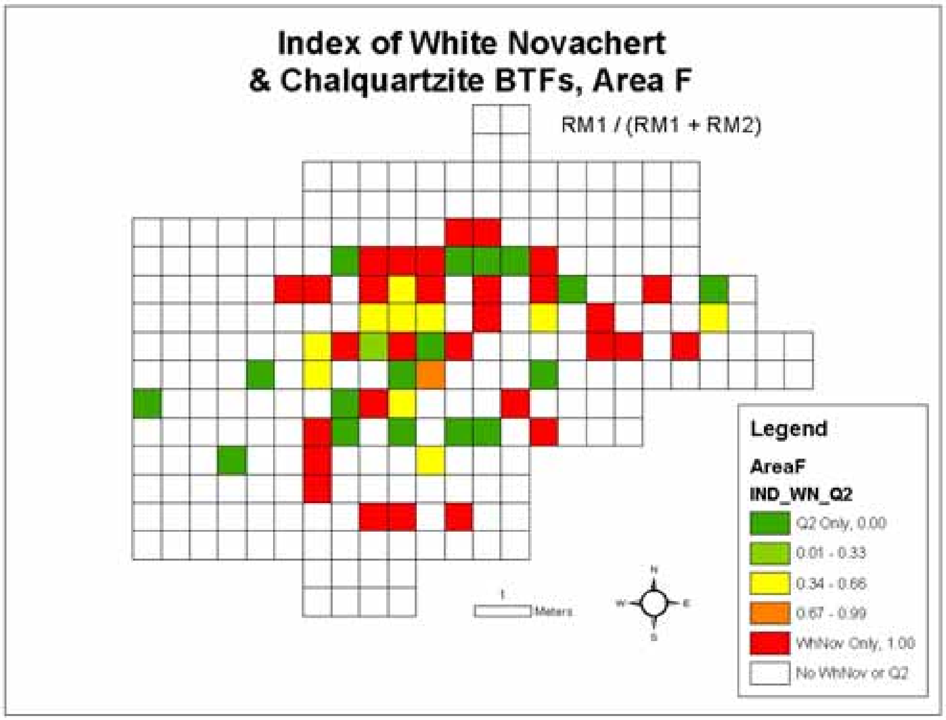


Figure 101. White Novachert & Chalquartzite BTF Proportional Index Map, Area F

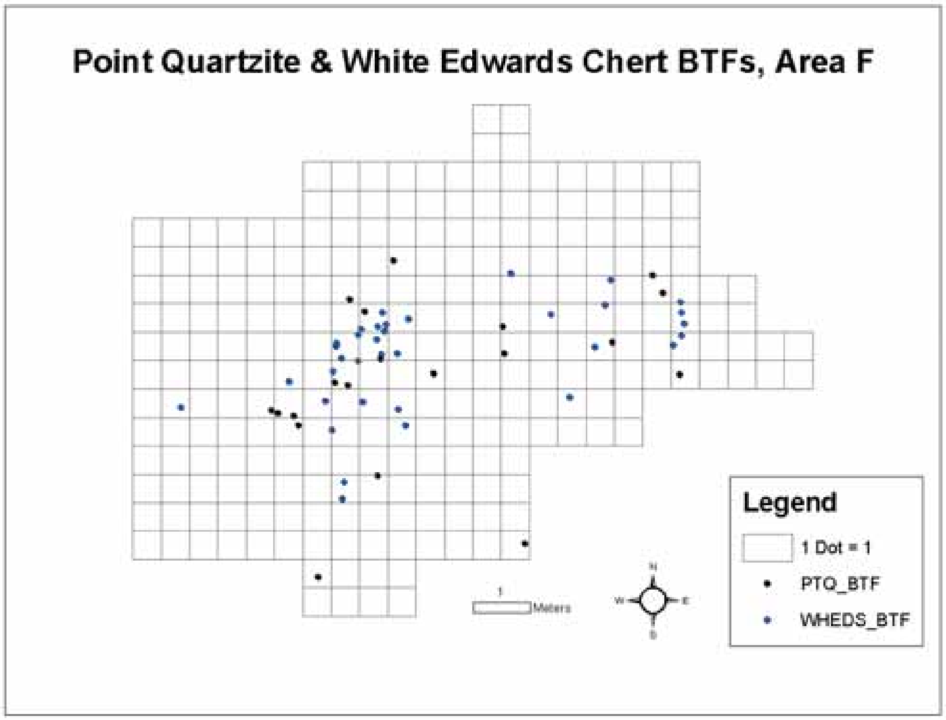


Figure 102. Point Quartzite & White Edwards Chert BTF Dot Density Map, Area F

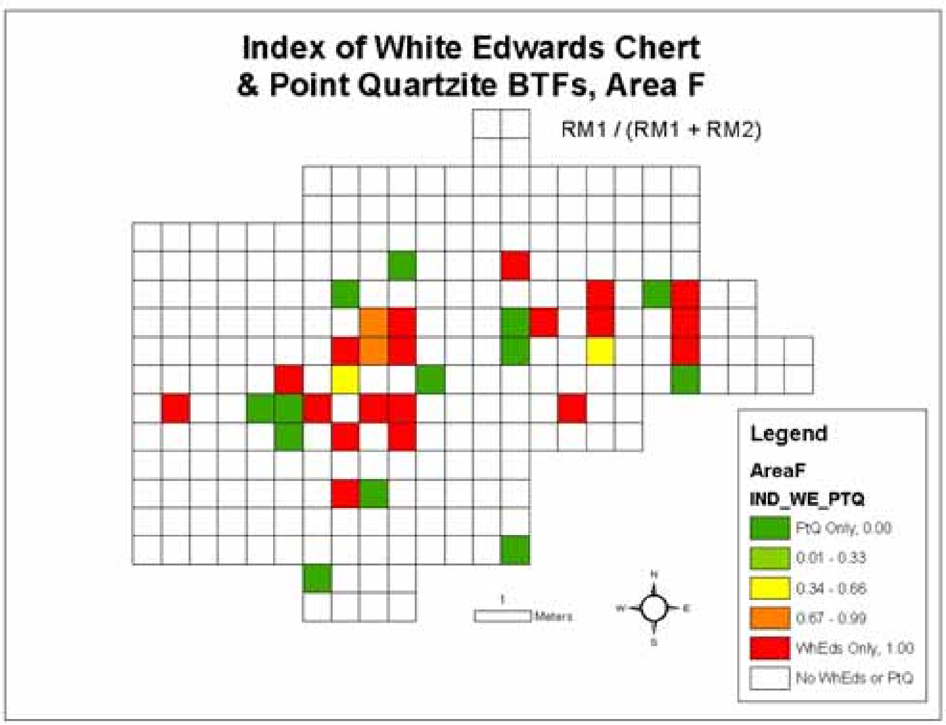


Figure 103. White Edwards Chert & Point Quartzite BTF Proportional Index Map, Area F

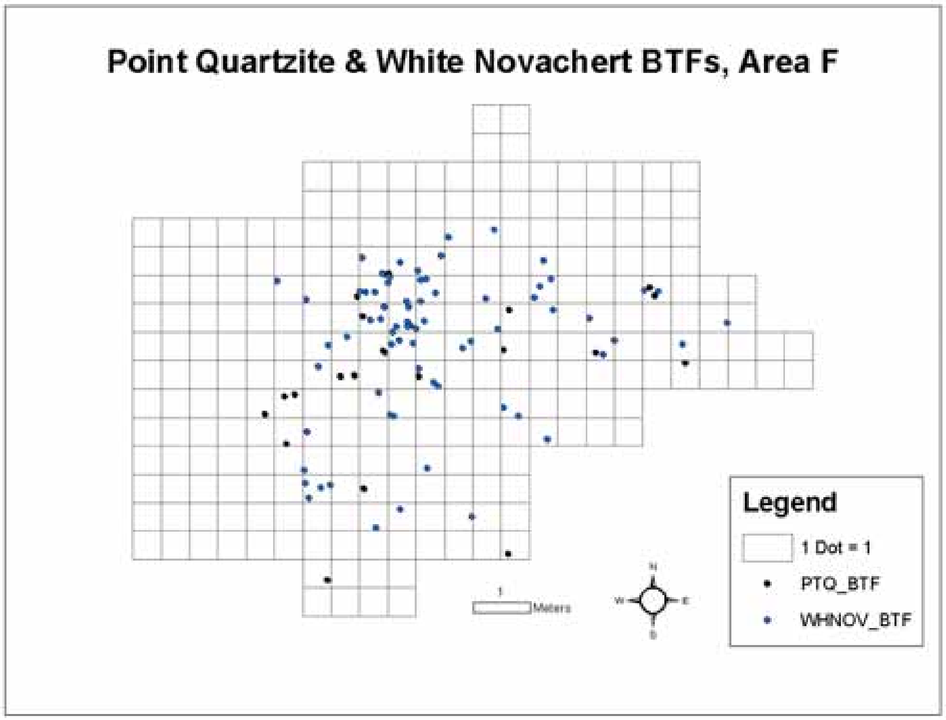


Figure 104. Point Quartzite & White Novachert BTF Dot Density Map, Area F

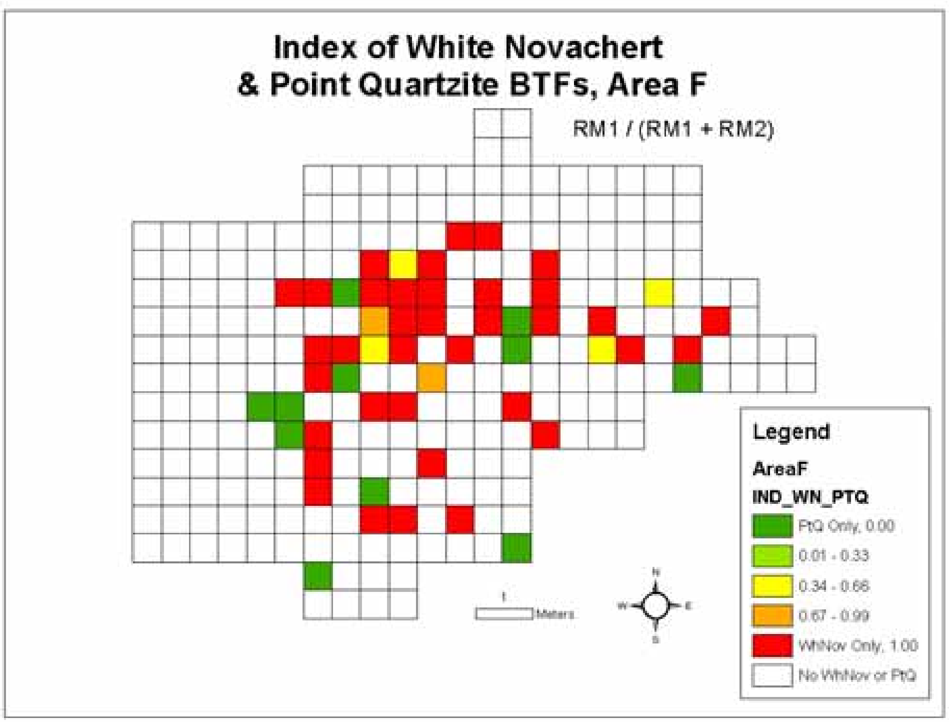


Figure 105. White Novachert & Point Quartzite BTF Proportional Index Map, Area F

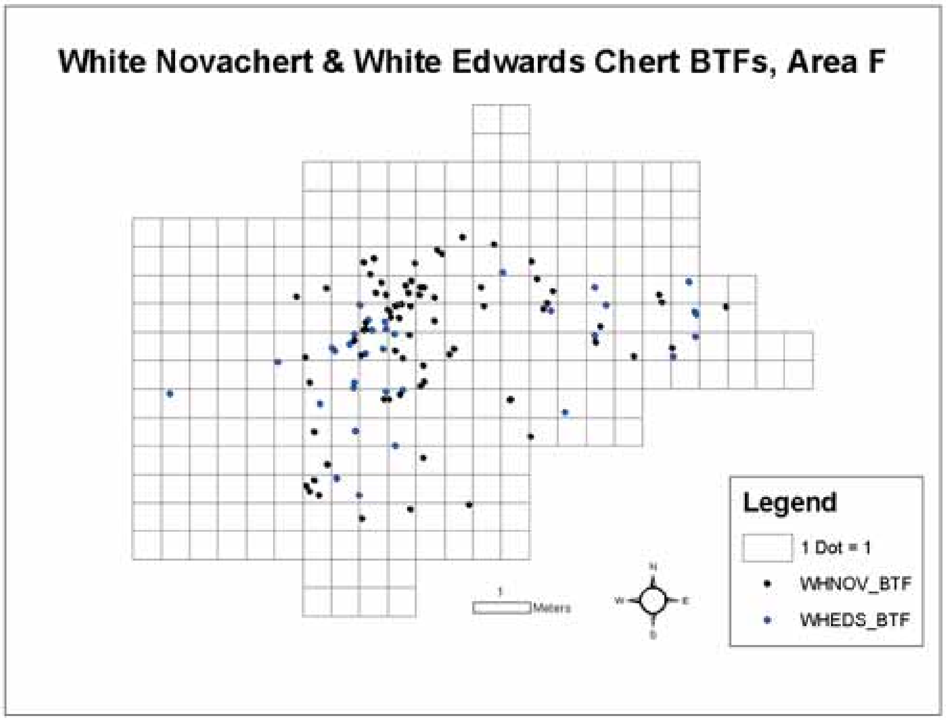


Figure 106. White Novachert & White Edwards Chert BTF Dot Density Map, Area F

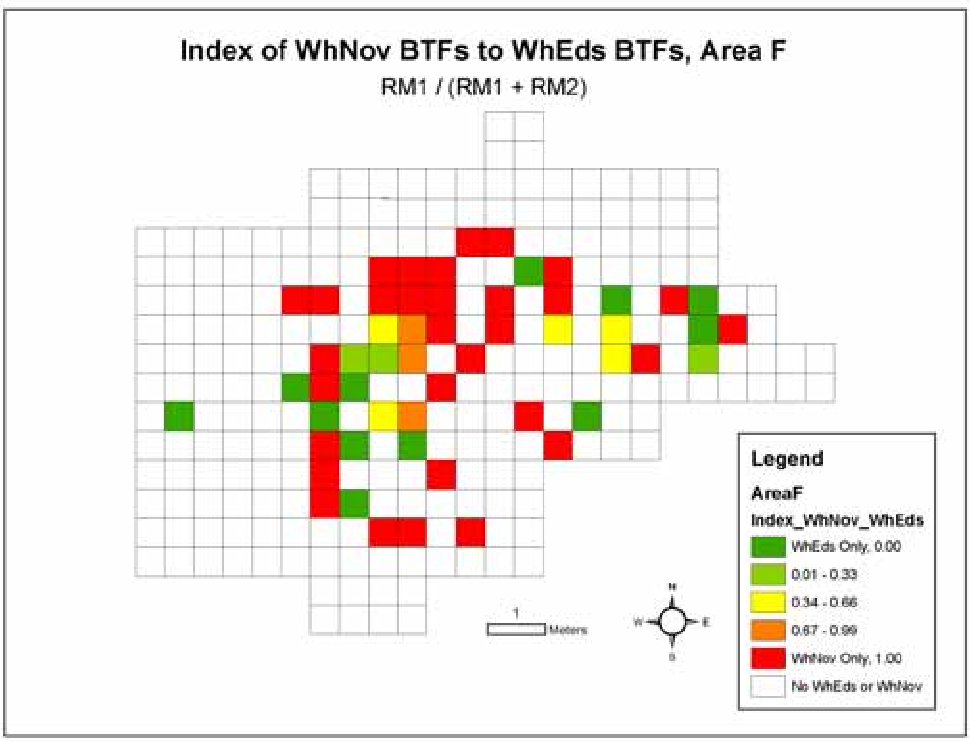


Figure 107. White Novachert & White Edwards Chert BTF Proportional Index Map, Area F

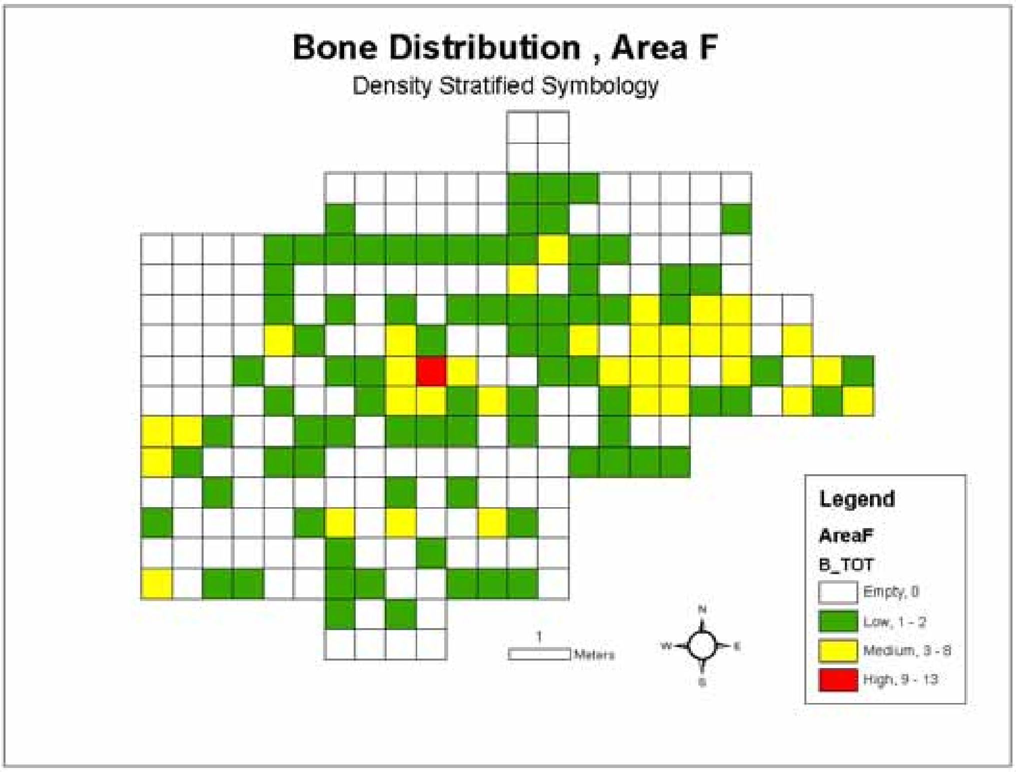


Figure 108. Bone Density Stratified Map, Area F

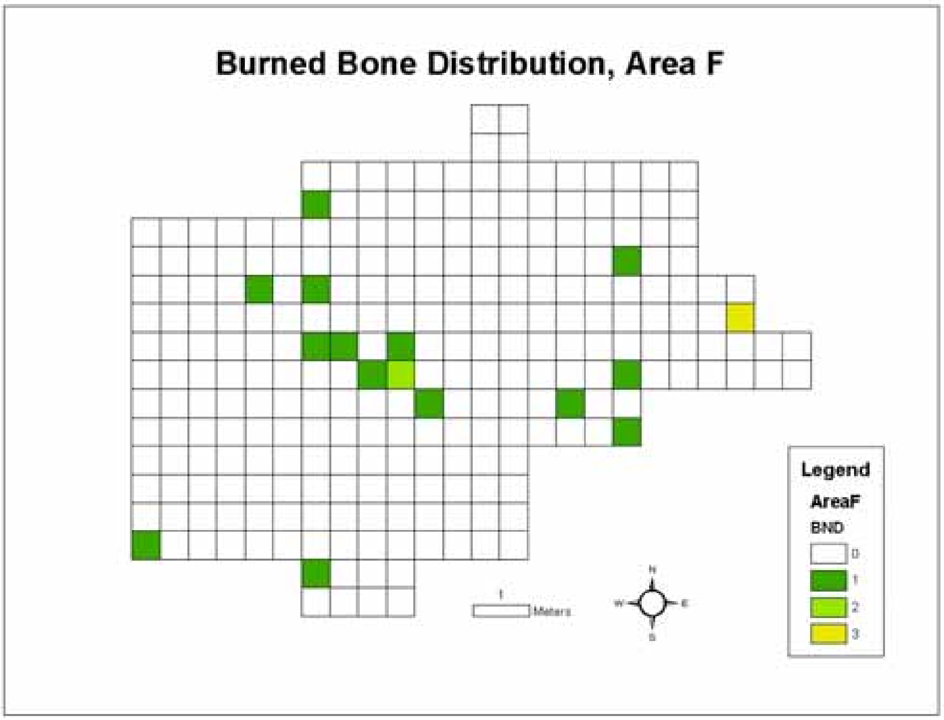


Figure 109. Burned Bone Distribution, Area F

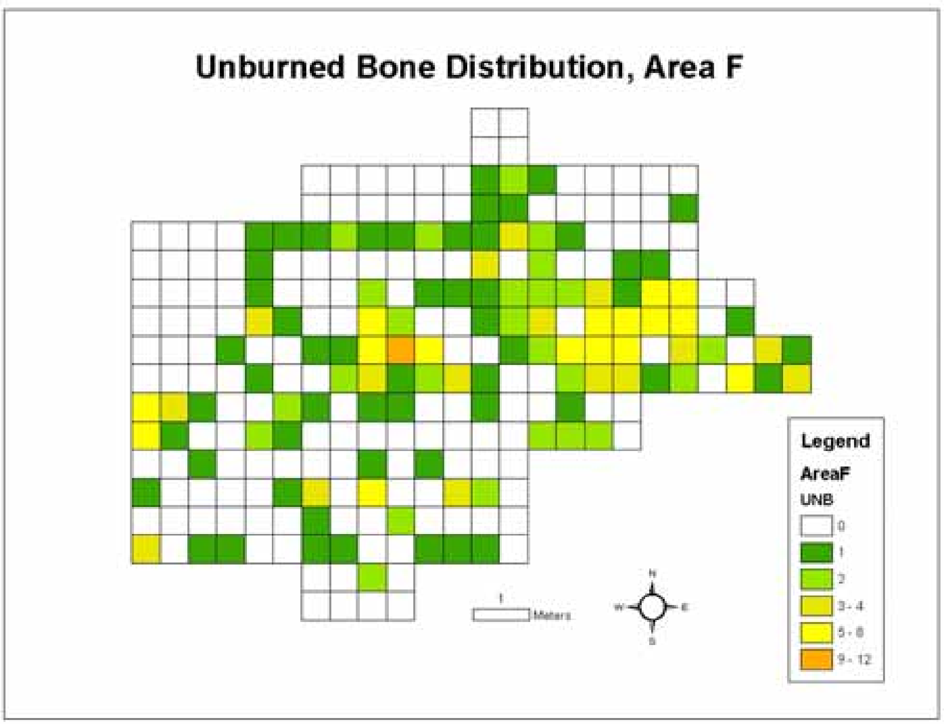


Figure 110. Unburned Bone Distribution, Area F

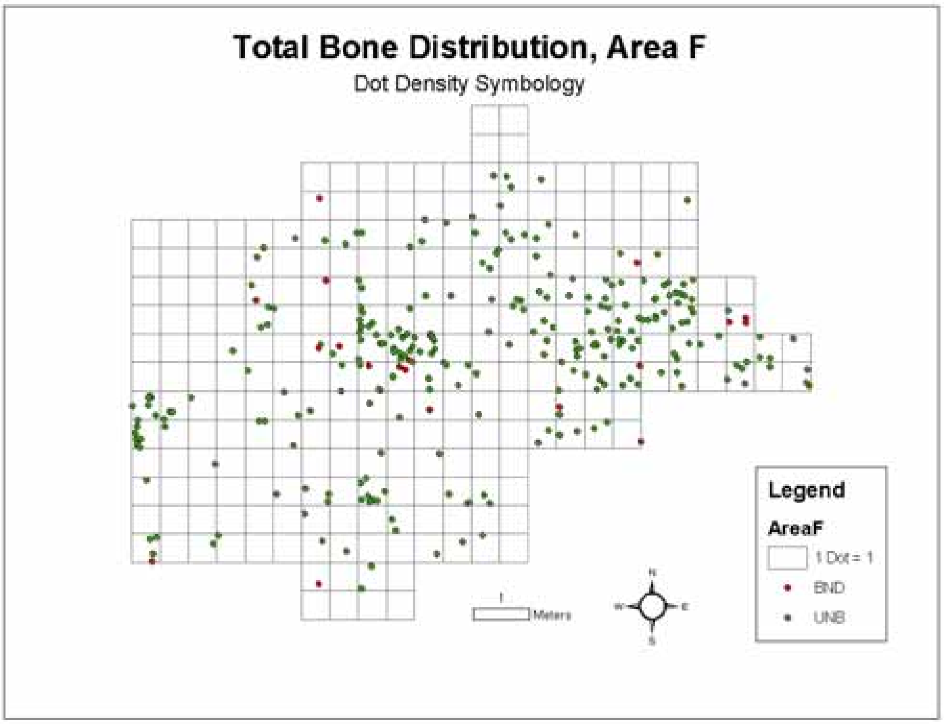


Figure 111. Total Bone Dot Density Map, Area F

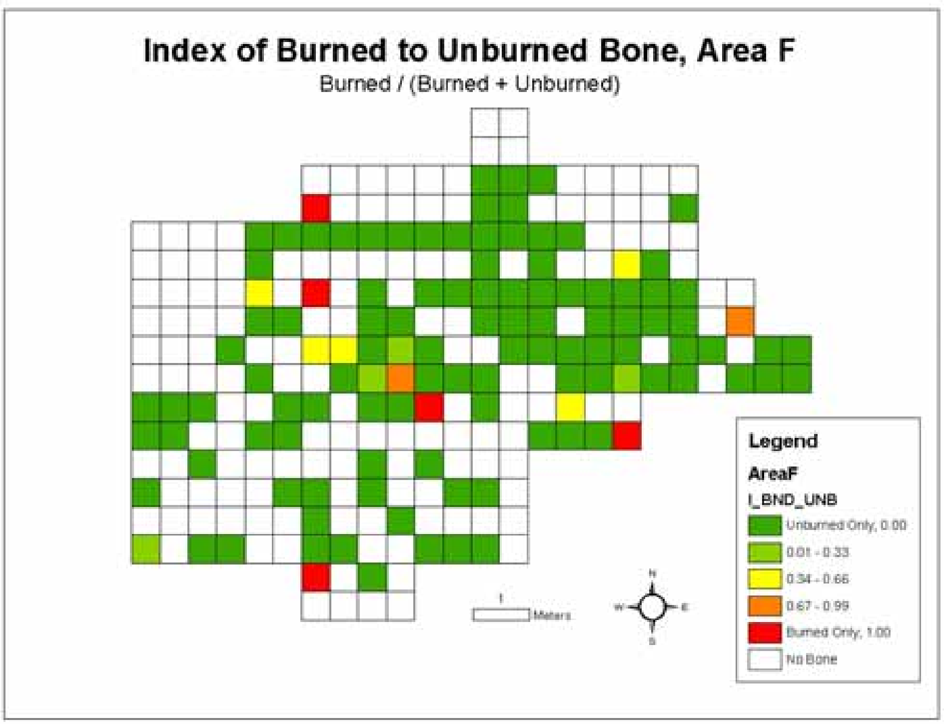


Figure 112. Total Bone Proportional Index Map, Area F

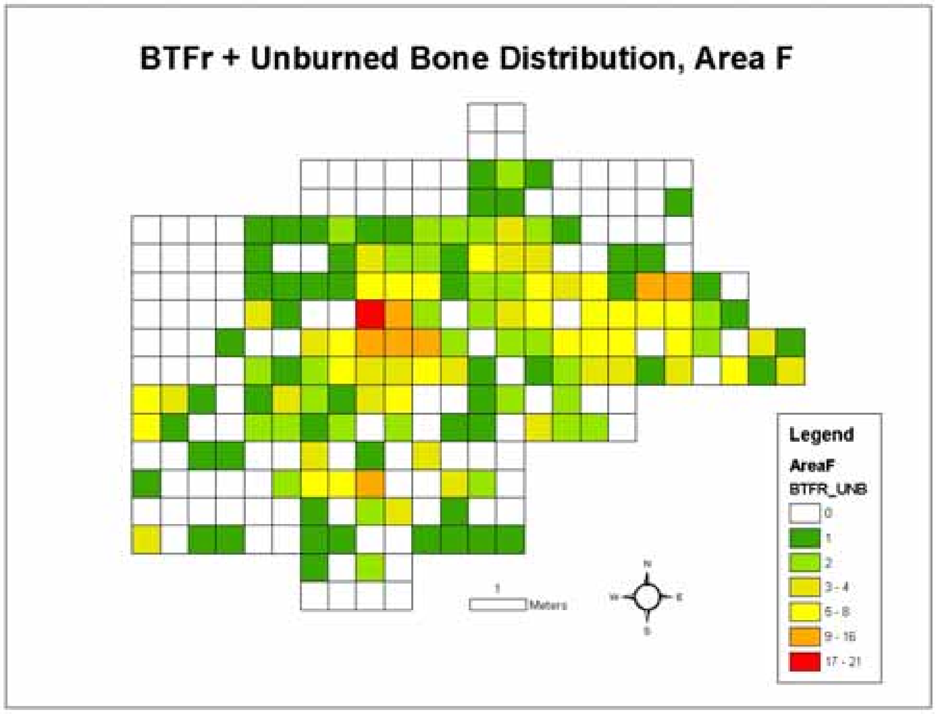


Figure 113. BTFr + Unburned Bone Distribution Map, Area F

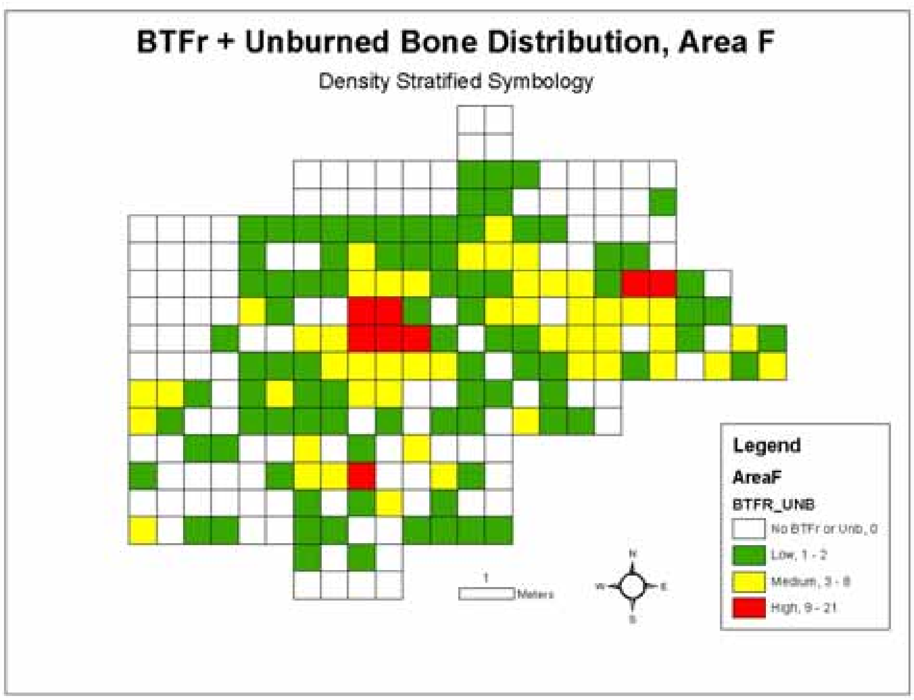


Figure 114. BTFr + Unburned Bone Density Stratified Map, Area F

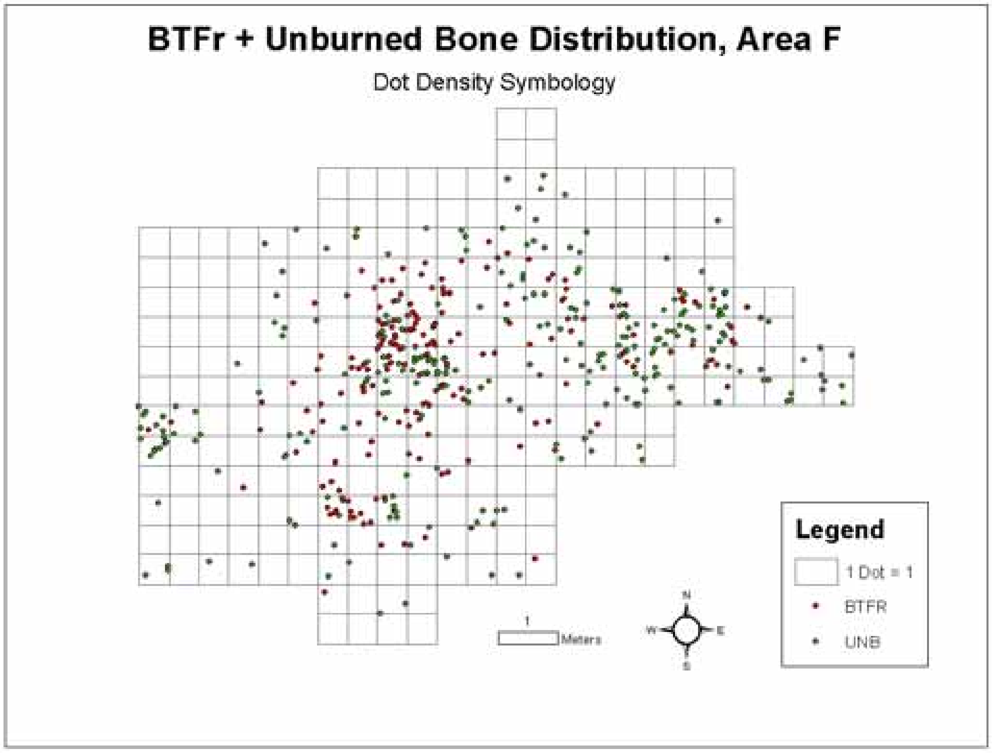


Figure 115. BTFr + Unburned Bone Dot Density Map, Area F

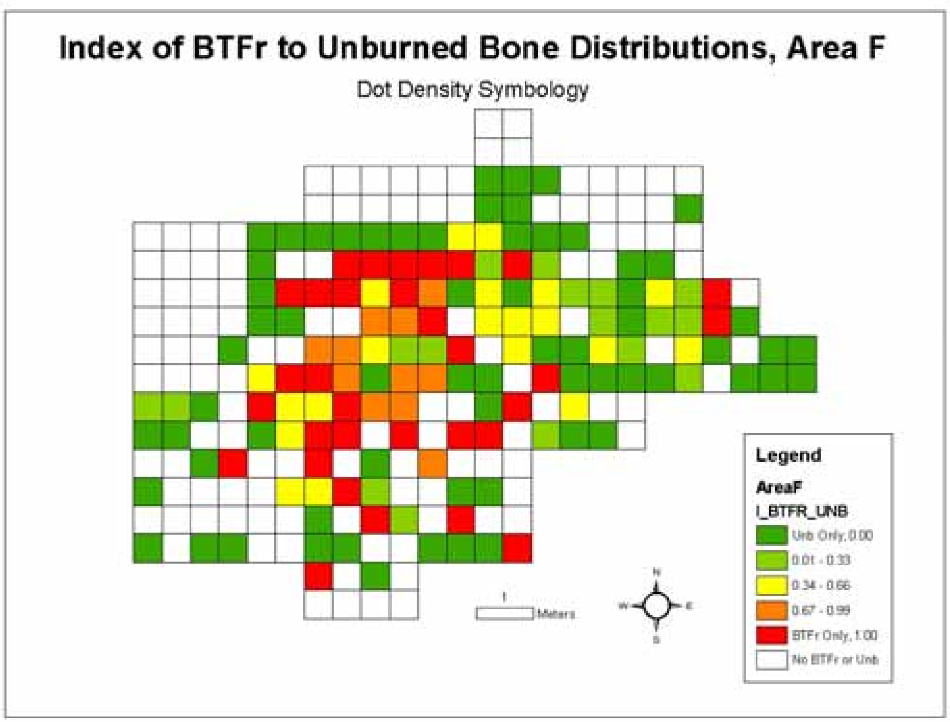


Figure 116. BTFr + Unburned Bone Proportional Index Map, Area F

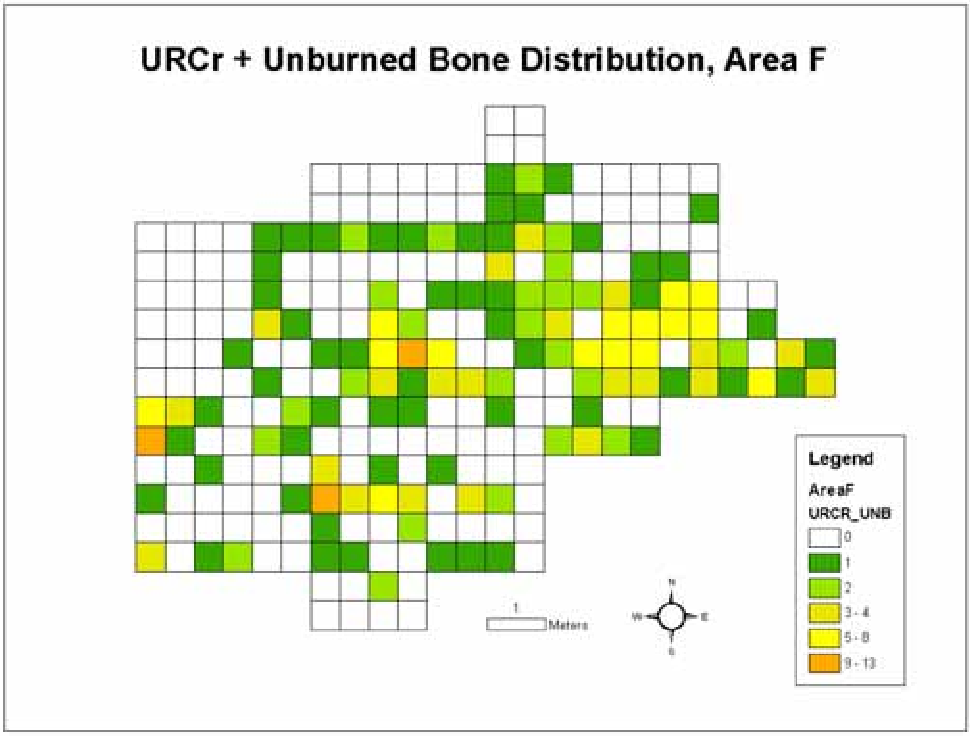


Figure 117. URCr + Unburned Bone Distribution Map, Area F

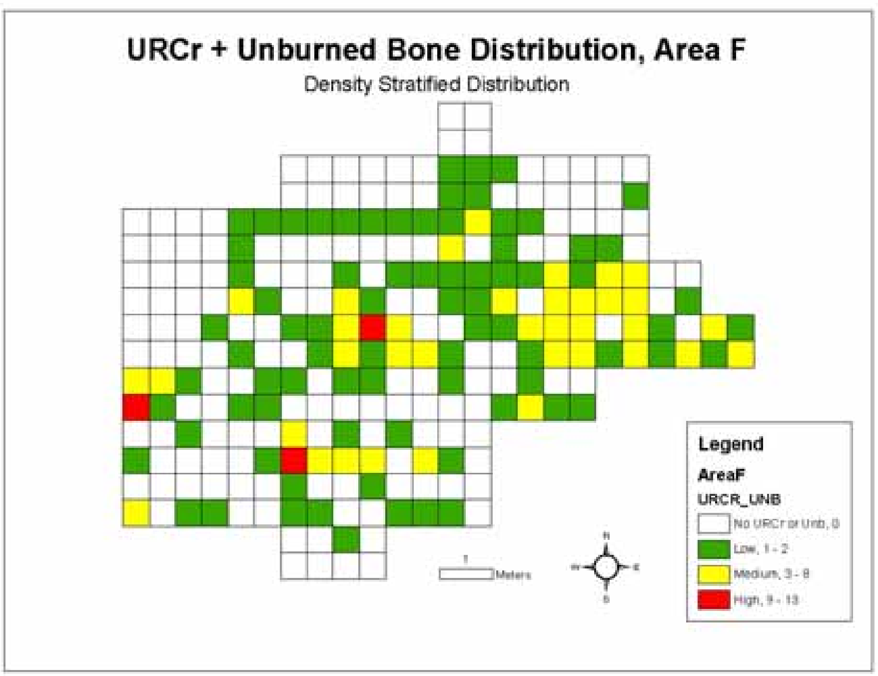


Figure 118. URCr + Unburned Bone Density Stratified Map, Area F

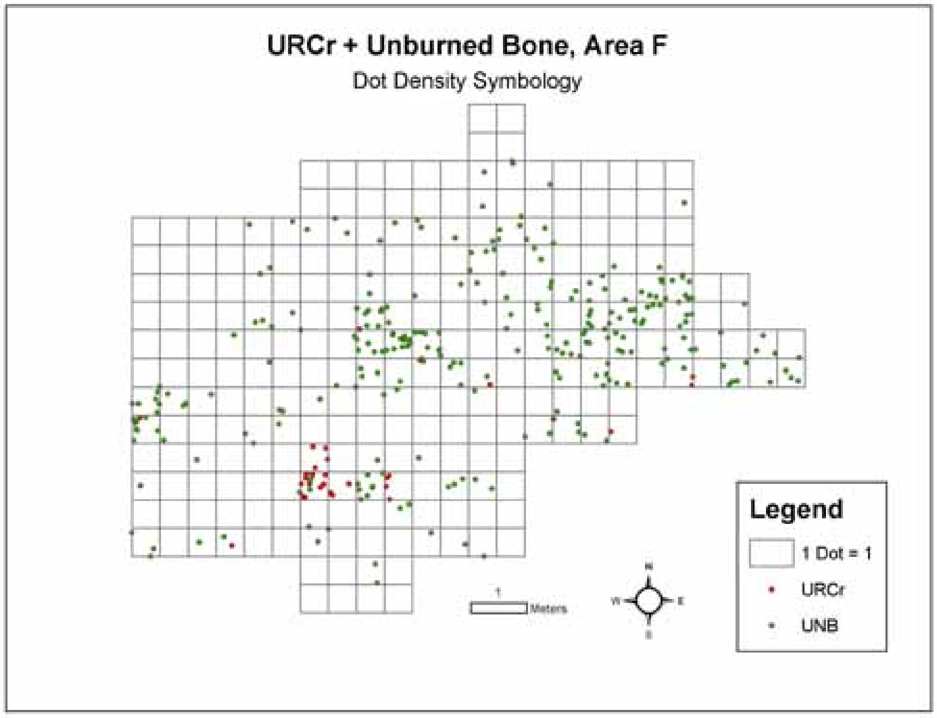


Figure 119. URCr + Unburned Bone Dot Density Map, Area F

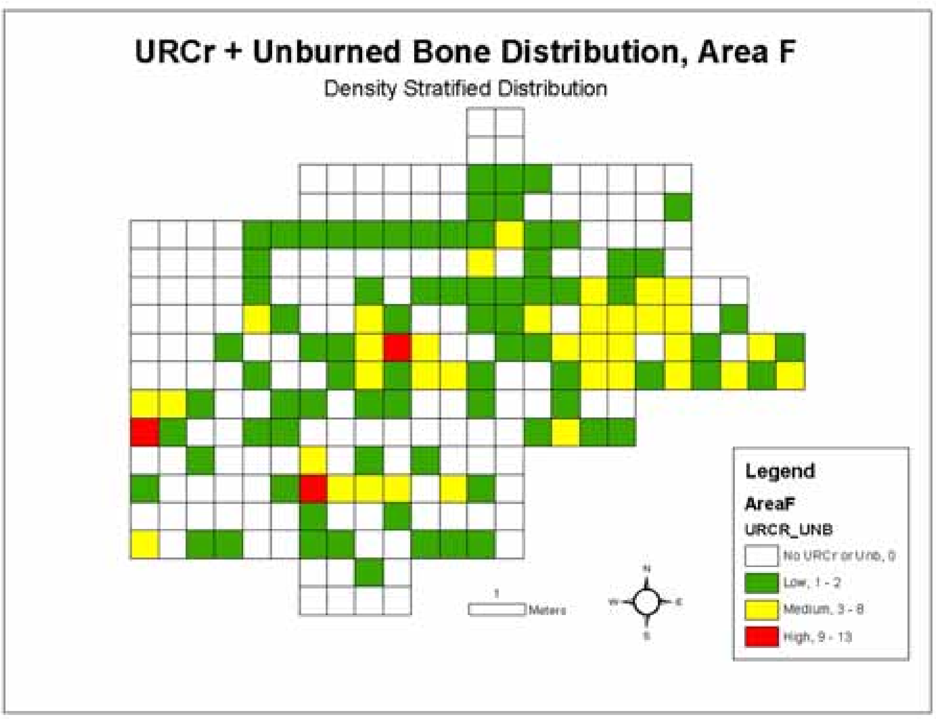


Figure 120. URCr + Unburned Bone Density Stratification Map, Area F

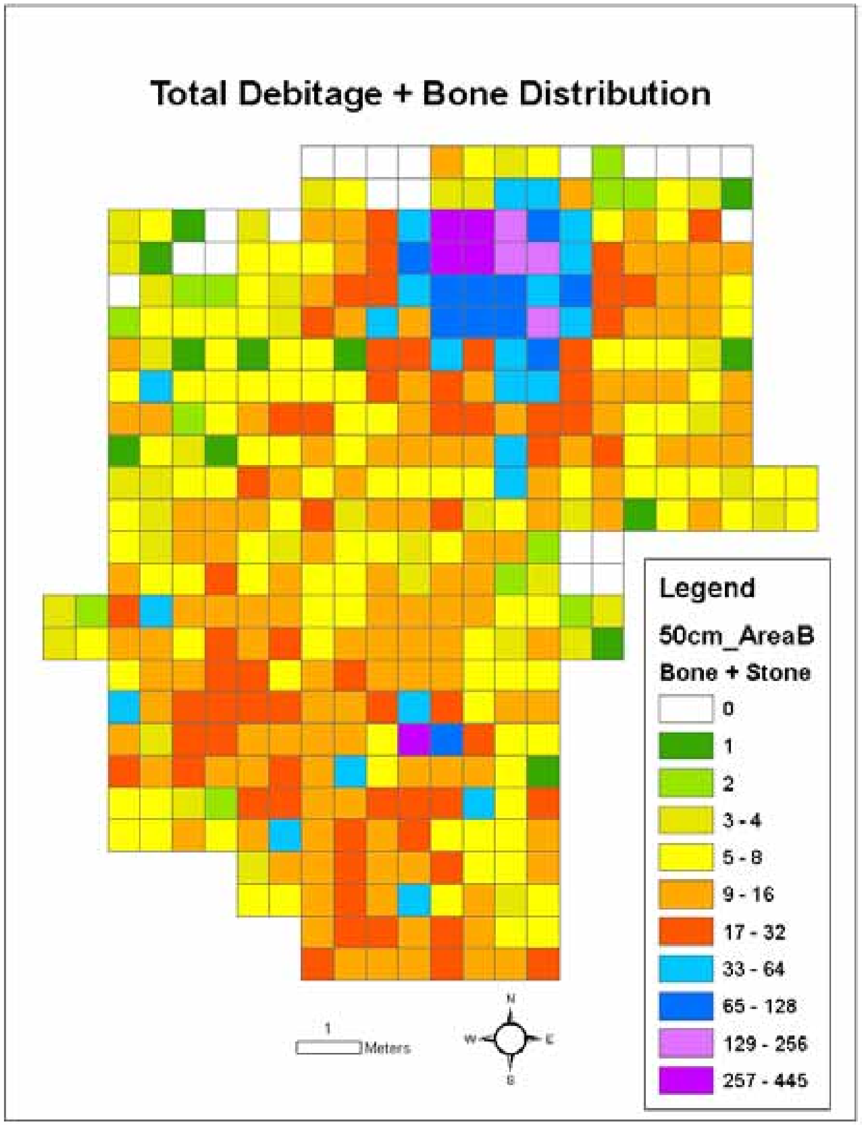


Figure 121. Debitage + Bone Combined Distribution

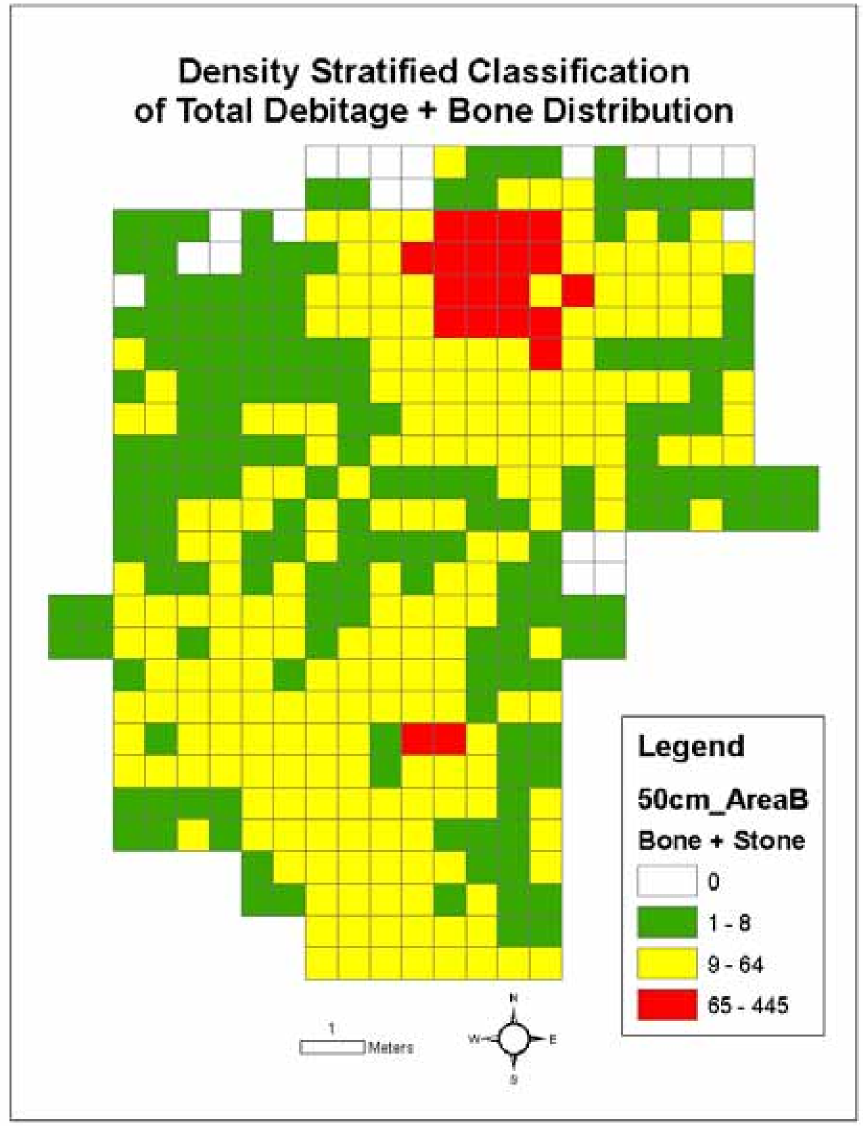


Figure 122. Debitage + Bone Density Stratified Distribution

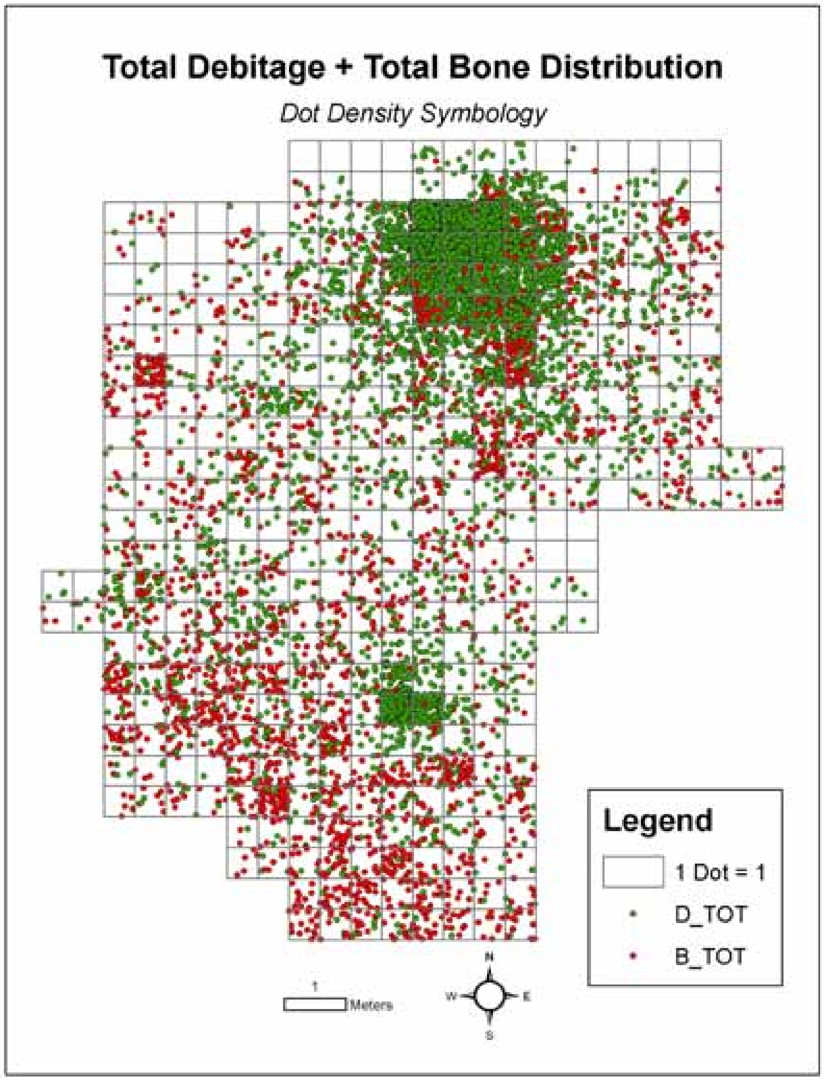


Figure 123. Total Debitage & Total Bone Dot Density Map, Area B

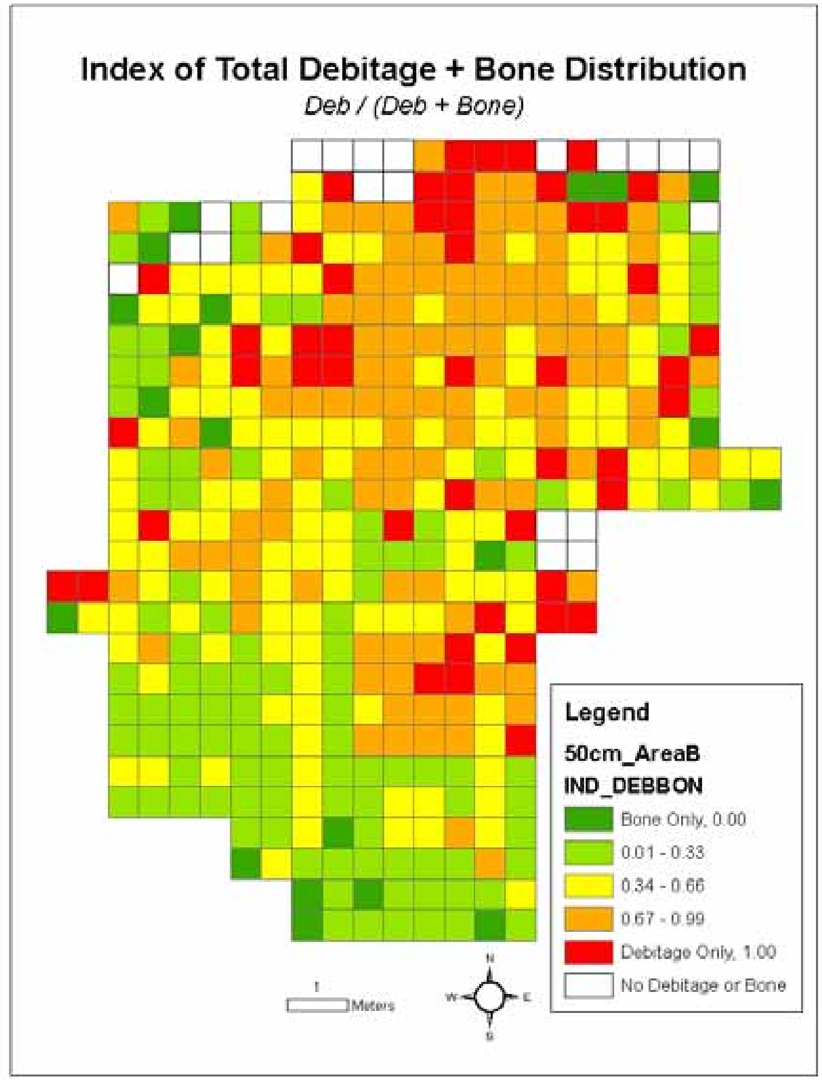


Figure 124. Debitage & Bone Proportional Index Map, Area B

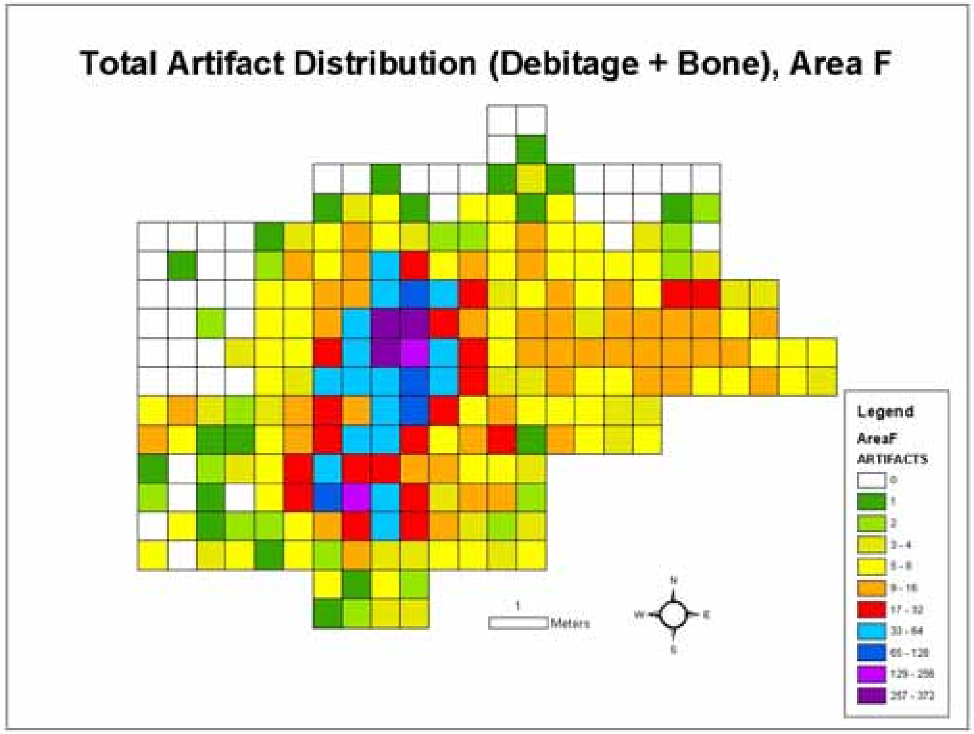


Figure 125. Total Debitage + Total Bone Combined Distribution, Area F

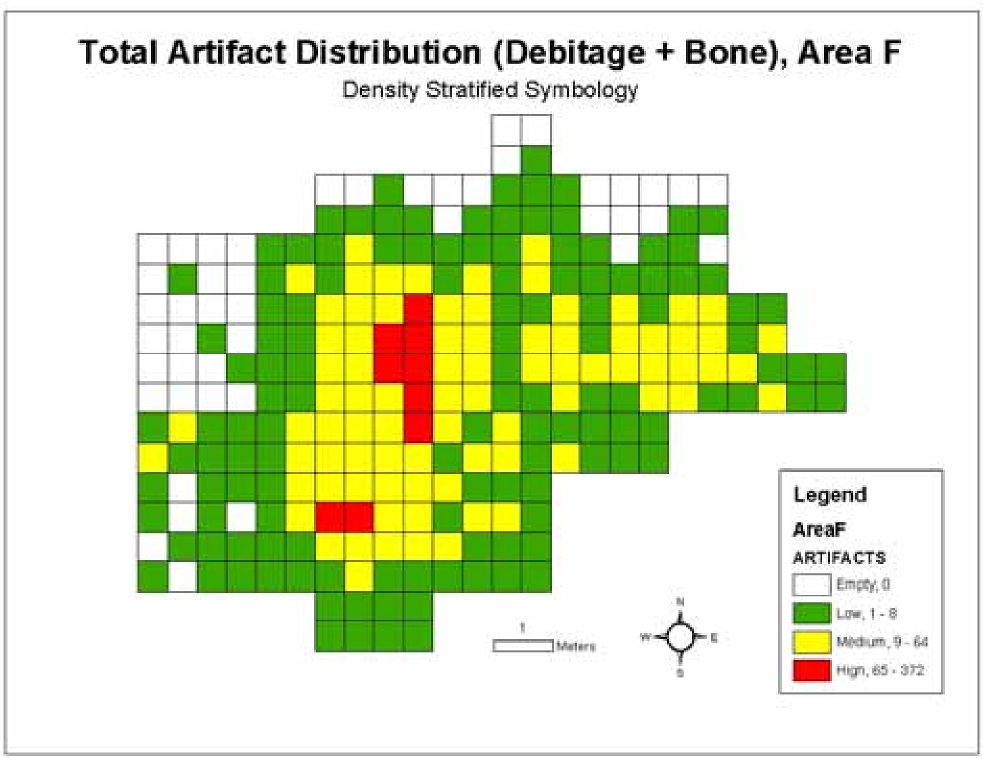


Figure 126. Debitage + Bone Density Stratified Map, Area F

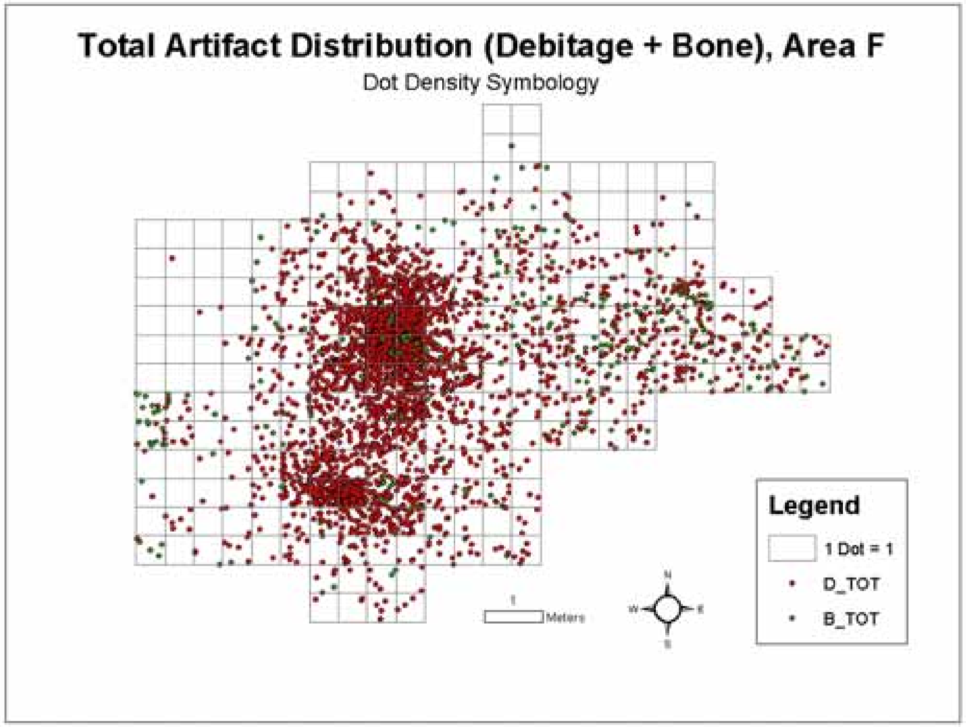


Figure 127. Debitage & Bone Dot Density Map, Area F

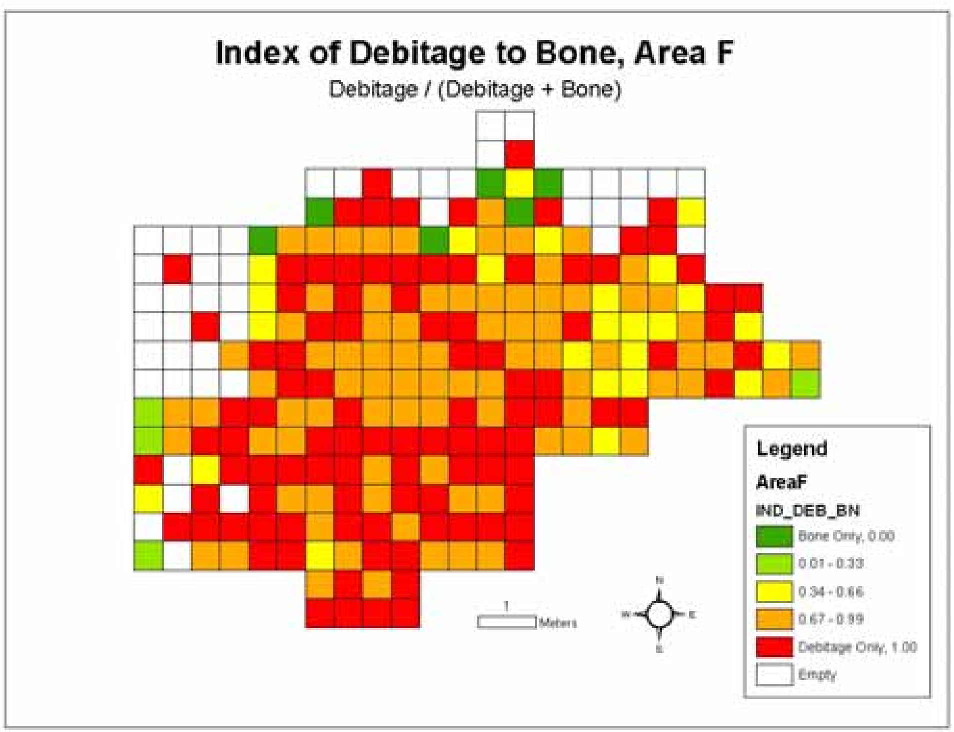


Figure 128. Debitage & Bone Proportional Index Map, Area F

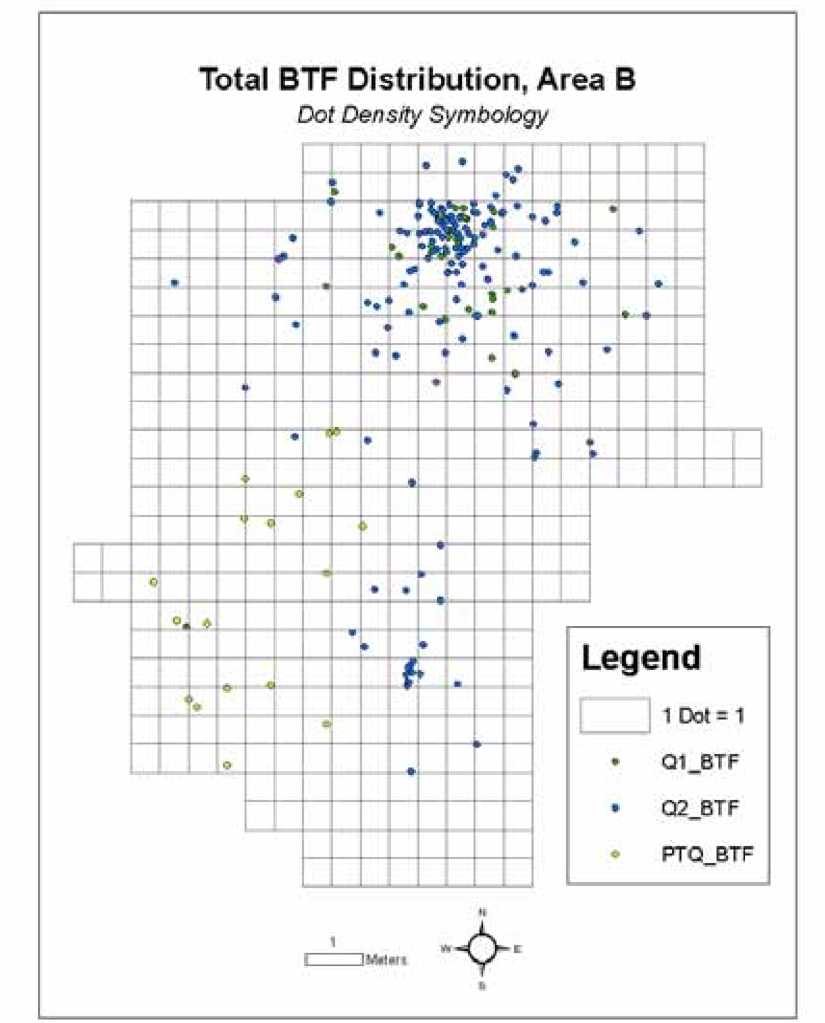


Figure 129. Dot Density Map of BTFr's by Raw Material, Area B

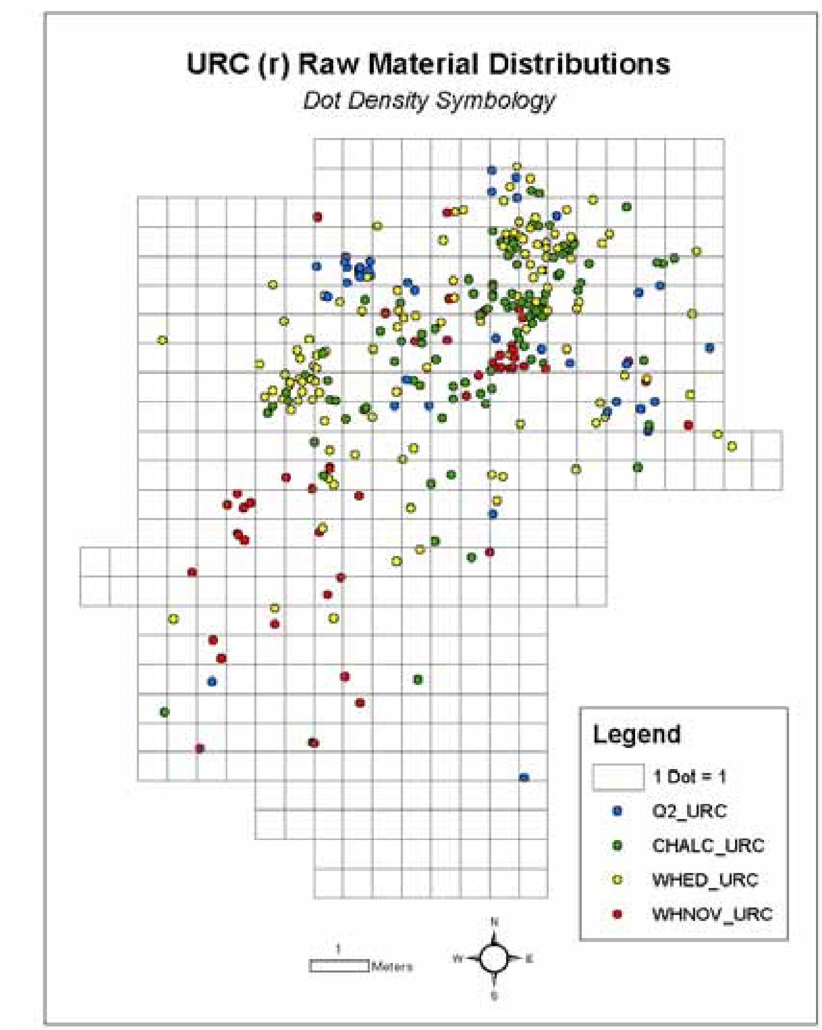


Figure 130. Dot Density Map of URCr's by Raw Material, Area B

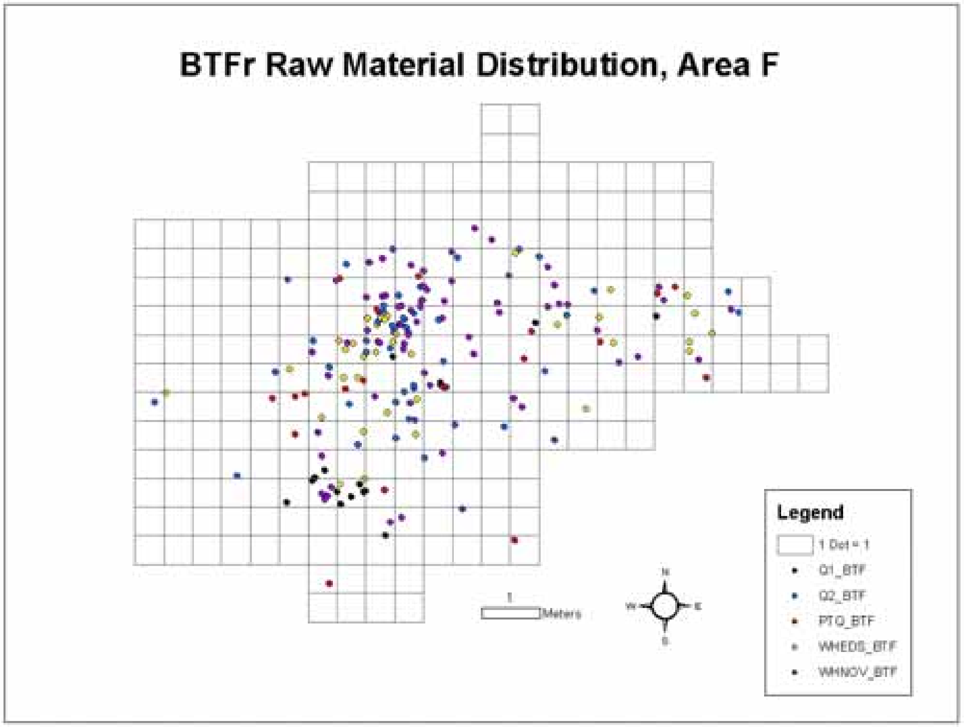


Figure 131. Dot Density Map of BTFr's by Raw Material, Area F

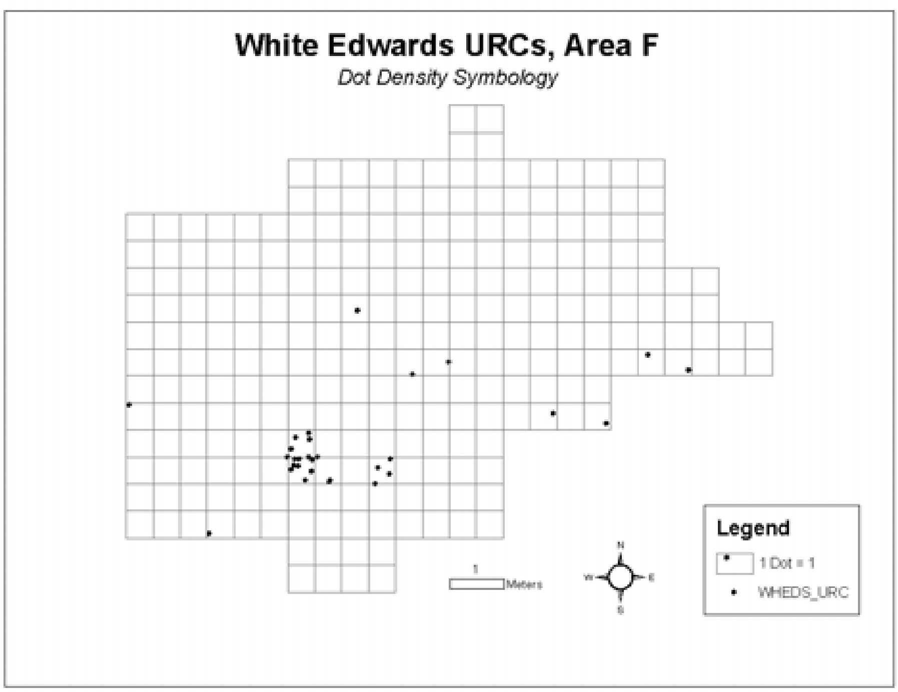


Figure 132. Dot Density Map of URCr's by Raw Material, Area F

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