REPORTS

MAPPING CLOVIS: PROJECTILE POINTS, BEHAVIOR, AND BIAS

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The distribution of Clovis projectile points across North America demonstrates distinct spatial patterning that has the potential to inform on many aspects of the colonization process. However, before accurate inferences regarding prehistoric behavior can be drawn from projectile point distributional databases, it is necessary to account for biases potentially affecting point visibility. Using county-level data for a sample of states from the western and southeastern U.S., this paper demonstrates that Clovis projectile point distribution is significantly related to modern population density, cultivated acreage, intensity of archaeological research, and measures of environmental productivity. Interpreting Clovis projectile point distribution is therefore more complex than frequently assumed.

La distribución de puntas de proyectil Clovis a través de Norteamérica muestra patrones espaciales distintivos que tienen el potencial de revelar sobre muchos aspectos del proceso de colonización. Sin embargo, antes de que se puedan obtener inferencias correctas sobre el comportamiento prehistórico a partir de los datos de distribución de puntas de proyectil, es necesario tener en cuenta los sesgos que puedan afectar el análisis distributivo. . Usando como ejemplo los datos a nivel de condados de los estados del oeste y el sudoeste de los Estados Unidos, este trabajo revela que la distribución de puntas de proyectil tipo Clovis está relacionada de manera importante con la densidad poblacional moderna, los acres cultivados, la intensidad de la investigación arqueológica, y las mediciones de la productividad ambiental. La interpretación de la distribución de puntas de proyectil Clovis, es por lo tanto más compleja que lo que frecuentemente se supone.

Archaeologists have used the spatial distribution and abundance of North American fluted-projectile points to document and interpret strategies of early Paleoindian land use for decades (e.g., Brennan 1982; Di Peso 1953; Dorwin 1966; Dragoo 1976; Kehoe 1966; Kidd 1951; Lewis 1953; McCary 1947; Mason 1958, 1962; Prufer and Baby 1963; Quimby 1958; Rolingson 1964; Seeman and Prufer 1982; Waring, Jr. 1961; Williams and Stoltman 1965). Researchers continue to assemble and update fluted-point distributional databases at various scales (e.g., Anderson and Faught 1998; Anderson et al. 2005; Blackmar 2001; Holen 2001, 2003; Taylor 2003a), using them to infer regional patterns of early Paleoindian mobility and land use (e.g., Amick 1996; Meltzer 1988; Tankersley et al. 1990; Holen 2001), or even such large-scale issues as the origin of fluted-point technology, and the mode and tempo of colonization and subsequent population spread (e.g., Anderson 1990b; Anderson and Faught 1998, 2000; Anderson and Gillam 2000; Morrow and Morrow 1999; Steele et al. 1998).

Although abundant in the literature, the inferences drawn from distributional databases are only useful if fluted-point distributions accurately reflect early Paleoindian population distributions. In order for them to do so, recorded projectile points must provide representative samples of the original populations from which they were drawn, and recent research suggests that they do not (Buchanan 2003; Schaefer 2006; Shott 2002). Therefore, rather than assuming a direct relationship between numbers of points and numbers of people who occupied a region prehistorically, it is first necessary to identify and account for existing biases in the fluted-point sample.

In this paper, I first review how researchers have used fluted-projectile point databases to interpret various aspects of the colonization process, and the potential problems associated with the uncritical use of such data. I then examine the distribution of Clovis projectile points in a sample of southeastern and western states and ask whether or not Clovis-point density is truly greater in the

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southeast than the west, as traditionally argued, or whether differential point density can be predicted by modern population, cultivated acreage, and intensity of archaeological research. After accounting for these potential biases and factoring in additional variables that measure environmental productivity during the Clovis time frame, I reexamine the distribution of Clovis points and discuss to what degree the revised distribution alters our current understanding of Clovis land use strategies.

Fluted Projectile Point Distributional Databases

Although archaeologists have conducted fluted-point surveys and assembled distributional databases for many decades, such data have not always been widely accessible to researchers. With the advent of the Paleoindian Database of the Americas (PIDBA; Anderson et al. 2005; online at http://pidba.utk.edu/main.htm), a continental-scale compilation unprecedented in scope, researchers can easily access Paleoindian projectile point data for much of the United States, Canada, and Mexico, with county-level information on numbers of Paleoindian projectile points for the United States. The database is attractive to researchers because of its detail, accessibility, and potential to reveal previously unrecognized patterns within Paleoindian projectile point distribution across the continent.

With PIDBA (Anderson et al. 2005) and its predecessors (e.g., Anderson 1990a; Anderson and Faught 1998, 2000; Faught et al. 1994; Faught 1996), it became possible to use fluted-point distributions to discuss large-scale issues relating to New World colonization. Anderson (1990b), for instance, discusses the migration pathways and land-use strategies of colonizing populations by examining fluted-point distributions across eastern North America. He notes that the densest fluted-point concentrations occur in the Ohio, lower Cumberland, and central Tennessee River valleys, and suggests that these regions served as "staging areas during the colonization process" (Anderson 1990b:187). These staging areas were attractive to colonizing populations because of their resource abundance and position along major communication and transportation corridors. According to Anderson (1990b), use of staging areas resulted in decreased residential mobility, which led to rapid population growth and increased knowledge of the landscape. As populations grew and groups fissioned, new regions were colonized.

On a larger scale, Anderson and Faught (1998) use fluted-point distribution across the U.S. to argue that the low incidence of fluted points near assumed initial North American entry points suggests that colonization occurred prior to the appearance of fluting technology. Anderson and Gillam (2000) use fluted-point distribution across the U.S., coupled with GIS-based least-cost analysis and paleoenvironmental data, to argue that early Paleoindian population movement occurred in a "leap-frog" rather than a "string-of-pearls" pattern, targeting resource rich locations (Anderson and Gillam 2000:56–60.) Such a strategy is in marked contrast to the classic wave-of-advance model proposed decades ago by Martin (1973, 1984; Mossiman and Martin 1975) in which Clovis hunters, unrestricted by environmental barriers, spread rapidly across the continent discarding Clovis points uniformly across the landscape. A leap-frog strategy would explain the "dense but widely separated clusters" of fluted points in the lower 48 states that often occur in areas of resource abundance, as well as the "more widespread low density distribution" of fluted points across the Americas (Anderson and Gillam 2000:59).

Anderson and Faught (2000) make similar arguments, noting that "concentrations of fluted points tend to occur in resource-rich areas, such as near pluvial lakes, along major drainages or near major chert sources" (Anderson and Faught 2000:509). Anderson and Faught (1998) suggest that dense concentrations of fluted points within resource-rich areas mark the centers of group ranges. According to Anderson and Faught (1998:176), although group ranges may have been extensive, people were nonetheless tied to particular resource-rich centers, and it is from these centers that subsequent technological traditions may have also sprung.

Anderson and Faught (1998, 2000) use fluted-point distributions to argue that the likely origins of the fluted-point technological tradition lie in the East rather than the West, based on much heavier fluted-point concentrations east of the Mississippi River. Anderson and Faught (2000:510) note that while fluting technology is thought by some to have originated on the Plains, over 70 percent of the total fluted-point sample occurs east of the

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Mississippi River. Greater numbers of fluted points and greater diversity of fluted-point types in the east suggests "the origins of fluting technology may well lie in this region" (Anderson and Faught 1998:176). Although fluted-point styles were conflated in the database at the time of writing, Anderson and Faught (2000) predicted that once non-Clovis fluted-point varieties were removed from the sample, "Clovis points may be most prevalent in the Southeast, reflecting our opinion ... that the technology may have originated there" (Anderson and Faught 2000:510–512). Although Mason (1962:234–235) suggested a southeastern origin for the development of Clovis technology decades earlier, modern distributional databases allow researchers to test this proposition more robustly.

Steele et al. (1998) use fluted-point densities for the contiguous United States as a check for their simulations of human dispersal into North America during the late Pleistocene. Assuming high rates of population growth, and that population density varied as a function of environmental carrying capacity, Steele et al. (1998) demonstrate that fluted-point distribution is consistent with an initial human entry from the northwest. Stanford and Bradley (2000), however, argue that the greater density of Clovis sites in the Southeast than the West supports their hypothesis of a Solutrean origin for Clovis, meaning that Clovis must have spread from east to west. This idea was also advanced by Boldurian and Cotter (1999).

As the research summarized above demonstrates, fluted-point distributional databases (and in particular PIDBA) lie at the heart of many interpretations of the colonization process. Without knowledge of how fluted points are distributed spatially across the continent, it is extremely difficult to test hypotheses regarding early Paleoindian land use, settlement strategies, migration pathways, and technological development. However, before we allow the patterns evident in distributional databases to influence our understanding of how the New World was colonized, it is worthwhile to ask to what degree these patterns are actually revealing prehistoric behavior, and to what degree they are simply revealing how we have sampled prehistoric behavior. For this reason, potential biases affecting PIDBA, and projectile-point distributional databases in general, are examined below.

Potential Biases

Researchers who rely on fluted-projectile-point distribution patterns generally assume that numbers of fluted points within a distributional database like PIDBA are directly related to the rate at which they were discarded prehistorically, and that discard rate is directly related to the duration and intensity of prehistoric occupation. These assumptions are rarely explicitly stated (although see Steele et al. 1998:295), and in fact there are many potential reasons why fluted-point distribution might not accurately reflect prehistoric behavior. First and foremost, while PIDBA is certainly the most complete fluted-point distributional database, it is nonetheless a work in progress, as readily acknowledged by Anderson, Miller, Yerka, and Faught (2005). The authors are still actively calling for and receiving data, and data are completely lacking for some large areas of the United States. The database is therefore incomplete in that it does not, and most likely never will, contain information on every fluted point in existence.

Additionally, as noted by Shott (2002), we have accumulated our knowledge of fluted-projectile points from many different sources. Surveys and excavations have been conducted throughout the decades at many different scales and by many different individuals with differing amounts of archaeological experience, from avocational to professional. In other words, "the aggregate fluted-biface sample is the composite of many samples that differed greatly in design, scale, and purpose, depending on who took them, how, and where" (Shott 2002:90). PIDBA and other distributional databases thus provide a sample of the existing fluted-point population, which may or may not be representative of the fluted-point population as a whole.

Leaving aside issues of missing data and sample consistency, many other sources of bias potentially affect fluted-point visibility. For instance, factors such as modern population density, urbanization, site formation processes, cultivation practices, geologic visibility, amount of ground cover, intensity of archaeological research, collector efforts, and willingness of collectors to share data with professional archaeologists could all significantly affect the recovery of fluted-point data. While the impact of all of these variables is worthy of investigation, this paper focuses on the effects

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of modern population, cultivation, and intensity of archaeological research, largely because of the relative ease with which these variables could be quantitatively measured.

While modern population density in and of itself may not directly relate to numbers of fluted points recovered, it is assumed that the more people there are in a particular area, the more collectors there will be, and the greater the chances of fluted-point recovery. However, whether or not professional archaeologists have knowledge of private collections depends on their relationships with collectors and the efforts they have made to document collections, variables that are difficult to quantify and that were not considered in this study. In addition to providing a reasonable proxy for collector efforts (although not for willingness of collectors to share their data or effort extended by archaeologists to gather such data), modern population density also relates to development associated with urban areas, which may directly result in increased fluted-point visibility through increased land clearing and associated cultural resource management projects.

If modern population is found to correlate with numbers of fluted points, it seems reasonable to argue that modern population density is at least partially driving fluted-point counts. However, modern population might also correlate with numbers of fluted points if early Paleoindians actually did preferentially choose to live in the same areas that today contain our major population centers. As noted by Lepper (1983:271) and Shott (2002:92), however, it seems unlikely that late Pleistocene and modern populations would be distributed in the same ways considering the tremendous differences in their economies, technologies, and land-use strategies.

Cultivation could also increase the probability of fluted-point discovery by increasing surface visibility. Regions with heavy cultivation and therefore increased surface exposure may produce greater numbers of fluted points than regions with little cultivated acreage. In the eastern United States, for instance, Lepper (1983) notes that "archaeological visibility is primarily a function of cultivation" (Lepper 1983:271). Intensity of archaeological research also has the potential to affect fluted-point visibility and recovery. It seems reasonable to assume that the greater the intensity of archaeological research carried out in a particular region, the greater the likelihood of fluted-point recovery.

Issues of geologic visibility such as a lack of exposed late Pleistocene surfaces due to erosion, deep alluvial deposits (Huckell 1984), or submerged coastal settings (Boldurian 2006) could also reduce the probability of fluted-point recovery, as could ground cover in the form of heavy vegetation. Geologic visibility and ground cover can vary tremendously both within and between geographic regions, and although not specifically examined in this paper, the effects of these variables should also be considered.

Finally, a potential problem relating to fluted-point distributional databases in general should be noted. In the absence of an objective method of classifying fluted-point types, including Clovis, we are to some extent at the mercy of subjective and inconsistent determinations. Haynes, for instance, has long held that "significant morphological differences" (1983:25) exist between western Clovis points and many of the points identified as Clovis in the eastern United States. If these eastern forms actually postdate Clovis, for instance, then including them as Clovis in the distributional database will inaccurately inflate Clovis-point density in the east. Until objective classification methods are routinely adopted by researchers, the potential effects of this issue will remain unknown.

Previous Investigations of Potential Biases

The suggestion of bias in fluted-point distributional databases is not new. Mason (1962:235), for instance, acknowledged decades ago the possibility that modern population distribution may affect the distribution and abundance of fluted points. Similarly, Dorwin (1966) notes that his interpretation of fluted-point distribution in Indiana assumes that he is dealing with a random sample, and thus does not consider the effects of "such factors as greater collecting activity in one area or another" (Dorwin 1966:148).

In the early 1980s, Seeman and Prufer (1982:158–159) argued that an important variable conditioning the spatial patterning of Ohio fluted points is proximity to river valleys associated with major stream confluences. They also noted, however, that the apparent spatial patterning of fluted points may be a result of "collector bias due to modern urbanism" (Seeman and Prufer 1982:160),

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because those counties that contain major river confluences also happen to contain most of the large population centers, and greater numbers of collectors can be expected in areas with greater populations. Thus, rather than monitoring Paleoindian activity, numbers of fluted points could be instead monitoring collector activity.

To argue against the effect of collector activity on fluted-point finds, however, Seeman and Prufer (1982:161) discuss informant records that document the often long distances (up to 160 km) that Ohio collectors travel from their places of residence to their target locations, suggesting that population density is not driving fluted-point finds. They therefore conclude that collector bias is unlikely, and the association of fluted points with river confluences is truly a result of Paleoindian activity.

Lepper (1983:272), however, argues that while this may at times be true, modern population *can* generally be used as an index of collector activity. Lepper (1983) examined the distribution of fluted points within physiographic provinces in a sample of Midwestern and Southern states and found significant correlations between amount of land under cultivation and numbers of fluted points, as well as between modern population and numbers of fluted points. Lepper (1983) concludes that:

> Relative density of artifacts is not an unambiguous monitor of relative occupational intensity. The archaeologically documented distribution of fluted points is a contemporary phenomenon. It may, or may not, reflect the relative occupational intensity of Paleoindians [Lepper 1983:276].

Seeman and Prufer (1984), however, disputed Lepper's (1983) analytical methods and did not find statistically significant correlations between cultivated acreage and fluted-point occurrences, or between population size and fluted-point occurrences, when examining Ohio data at the county-level. Lepper (1985) countered once again, arguing that Seeman and Prufer's (1984) critique of his (Lepper 1983) analysis and results was based on misinterpretation, and that modern population density and cultivation do indeed affect fluted-point distribution in the Midwest.

For Texas, Largent, Waters, and Carlson (1991) show that the distribution of Folsom points across the state is significantly biased by intensity of archaeological investigations (as measured by numbers of cultural resource reports and *Bulletin of the Texas Archaeological Society* publications), and therefore conclude that point distribution cannot be used to infer Folsom settlement patterns. Meltzer and Bever's (1995) update on the Texas Clovis-point survey (Meltzer 1986a, 1986b), however, did not find significant correlations between numbers of Clovis points and modern population, or numbers of Clovis points and collector activity, as measured by numbers of Texas Archaeological Society members (Meltzer and Bever 1995:52–53; see also Meltzer 1986a). They therefore argue that the uneven distribution of Clovis points across the state does indeed provide insight into Clovis land-use strategies.

In her study of regional variability among Clovis, Folsom, and Cody land use across Kansas, Oklahoma, and Texas, Blackmar (2001:75–76) notes that the patterns evident in projectile-point distribution could be influenced by factors affecting point visibility such as modern land-use practices, population, amount of ground cover, and depth of burial. Blackmar (2001) acknowledges "It cannot be positively determined whether the patterns recognized here are culturally significant or largely the result of biases in recognition, recording, and historical factors" (Blackmar 2001:76). Nonetheless, "the documented patterns are assumed to hold useful clues to evaluating and modeling differences among the Clovis, Folsom, and Cody complexes" (Blackmar 2001:76).

In terms of PIDBA, the possibility of sample bias is acknowledged by the authors, but not considered to significantly affect the apparent distributional patterns. Anderson (1990b), for instance, argues that while site visibility and collector efforts could affect the distribution of fluted points, the clusters of fluted points in particular regions:

> Are so geographically extensive as to preclude suggestions that they are entirely or largely due to cropping or collecting practices. While these factors are admittedly operating, the low incidence of Early Paleoindian artifacts in areas that are both heavily farmed and collected...suggests that prehistoric rather than contemporary phenomenon are represented [Anderson 1990b:171].

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Anderson and Faught (1998) note that the comparatively high fluted-point density found in parts of the eastern United States may be influenced by "factors such as differential geological visibility, modern population density and farming activities, and differences in lithic resource availability" (Anderson and Faught 1998:168). However, they argue that:

> While sampling bias due to differences in surface visibility, amount of prior collection or research or differential erosion conditions may influence these [fluted point] patterns...it still appears that fluted-point making peoples keyed in on some areas and minimally utilized or avoided others" [Anderson and Faught 2000:509].

Rather than acknowledging the possibility that fluted-point distribution may be affected by certain variables and accepting it, several researchers have recently tested Anderson and Faught's (2000) fluted-point database for bias. Using data from Anderson and Faught (2000), for instance, Shott (2002) examines the effects of modern population density, cultivated acreage, and intensity of archaeological research on counts of fluted points by county in a sample of seven Midwestern states. He finds that counts of fluted points correlate with modern population distribution and intensity of archaeological research, but not with cultivated acreage.

Buchanan (2003) examines Anderson and Faught's (2000) entire fluted-point database for biases, and concludes that modern population, intensity of archaeological work, and urban development correlate with the distribution and abundance of fluted points across the United States, but cultivated acreage does not. Additionally, using a regression model to account for sampling biases, Buchanan (2003) demonstrates that several eastern states have an overabundance of fluted points after sampling biases are accounted for. These states (Alabama, Ohio, Virginia, Indiana, Massachusetts, and Tennessee) encompass Anderson's (1990b) "staging areas" centered on the Ohio, Cumberland, and Tennessee River valleys. As noted by Buchanan (2003:333), the uneven distribution of fluted points also supports the "leap-frog" model of colonization and technological spread suggested by Anderson and Gillam (2000) and Anderson and Faught (2000).

Schaefer (2006) examines whether modern population density and amount of cultivation are related to numbers of fluted points in Anderson and Faught's (2000) database. After performing a variety of statistical tests, Schaefer (2006) shows how different tests can lead to different interpretations of the data. He ultimately argues that the fluted-point database is biased by both modern population and cultivation.

As the above discussion demonstrates, there is little consensus among researchers regarding the extent of bias in fluted-projectile point databases in general, and PIDBA specifically. Many researchers acknowledge the possibility of bias, but do not attempt to account for it. While some recent analyses do seem to indicate that fluted-point density is significantly biased by certain variables, different research points to different variables depending on analytic methods, and as Buchanan (2003) demonstrates, the simple presence of bias does not necessarily indicate that none of the patterns apparent in PIDBA are real.

While several studies have examined PIDBA for biases looking specifically at some of the variables of interest to this paper (Buchanan 2003; Schaefer 2006; Shott 2002), these studies used an older version of the database (Anderson and Faught 2000 versus Anderson et al. 2005), and did not separate Clovis from other fluted-point varieties. If we are concerned with inferring aspects of the colonization process from projectile-point distributions, then it would be beneficial to separate Clovis even from other fluted-point varieties. As noted by Haynes (1983:25), there is a much greater variety of fluted-point types in the Eastern than the Western United States. If most of these fluted-point types postdate Clovis (although in the absence of abundant good radiocarbon dates in the East, this is admittedly an assumption), and many occur in abundance, then it should not be surprising to see greater fluted-point densities in the East than the West. However, this will not necessarily tell us anything about colonization, the origin of fluted-point technology, or Clovis land-use strategies. In other words, we should not expect the distribution of post-Clovis Paleoindian points, generally thought to represent the beginnings of regional adaptations and the "settling in of colonizers into specific areas" (Meltzer 2002:42) within the context of an already occupied landscape, to necessarily reflect the

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behavior of the earliest widespread occupants of the United States. For this reason, non-Clovis fluted-point varieties were excluded from the sample. While possible pre-Clovis occupations that vary in age and geographic location continue to be identified across the U.S. (e.g., Adovasio et al. 1990; Gilbert et al. 2008; Goodyear 2005; Holen 2006, 2007b; Jenkins 2007; McAvoy and McAvoy 1997; Overstreet 2005), and their consideration is certainly important to issues of colonization and population dispersal, they remain outside the scope of this analysis.

Data Collection Methods

The sample of states included in this study was determined largely by the availability and accessibility of Clovis-point distributional data. As the most comprehensive Paleoindian projectile point distributional database, PIDBA was used as much as possible. However, PIDBA is a work in progress, with fluted-point data for many states incompletely acquired and coded. For instance, while a "Clovis" column is present in PIDBA, and Clovis points have been separated out from the general "fluted point" category for some states, for other states Clovis points are combined with other fluted-point types in the "fluted point" column, and are thus conflated with other fluted varieties. In some states, the "Clovis" column contains only counts of "0," even though Clovis points are known to exist in these states. This is because either data from these states has not yet been contributed to PIDBA and are therefore missing, the original site or survey reports described the points only as fluted and type determinations have not yet been made, or because the data were in the process of being evaluated and entered. Because of these potential problems, Clovis-point data from PIDBA were used only if they were relatively complete and up-to-date at the time of this research, as indicated by D. Shane Miller (personal communication, 2007), Webmaster and Project Co-Director of PIDBA.

Data were collected at the county-level mainly because data such as population, cultivated acreage, and artifact counts are widely available at this scale. PIDBA, for instance, contains counts of Clovis points by county, and county-level population and cultivation data are available through government census and agricultural records. Also, as noted by Shott (2002), counties provide useful units by which to measure variables of interest because they "are many in number, small in size relative to the study area, and arbitrary in location and boundaries with respect to the archaeological record" (Shott 2002:93). The sample consists of 1,401 counties in 18 states.

Clovis Point Distribution

County-level Clovis-point counts for the southeastern states of Alabama, Arkansas, Florida, Georgia, Mississippi, North Carolina, South Carolina, and Tennessee were obtained from PIDBA. These are the states for which PIDBA contained up-to-date Clovis point data. Counts of Clovis points for a sample of western states were obtained from site file searches conducted by state record keeping agencies, by examining the results of published research such as fluted-point surveys, or by contacting knowledgeable professionals who had compiled Clovis-point distribution data, even if not in published form. The sample of western states consists of Arizona, Colorado, Kansas, Nebraska, Nevada, New Mexico, Oklahoma, Texas, Utah, and Wyoming (See Figure 1; Table 1). These particular western states were chosen for inclusion in the sample because it was relatively straightforward to compile Clovis-point distributional data from them (some states, for instance, do not have searchable cultural records and lack published surveys).

To control for differences in county size, counts of Clovis points per county were converted to Clovis-point densities (points per km^2) using county area data provided by the U. S. Census Bureau (2000). Because the point-density values were extremely small, they were multiplied by 1,000 to arrive at a measure of Clovis points per 1,000 km^2. Table 1 contains counts of Clovis points totaled by state (the sum of Clovis points per county) and Clovis-point densities by state for all states in the study area.

Population

Population by county was obtained from U. S. Census Bureau records, using 2006 population estimates (U.S. Census Bureau 2006). As with counts of Clovis points per county, people per county was converted to population density (people per km^2) to control for differences in county size.

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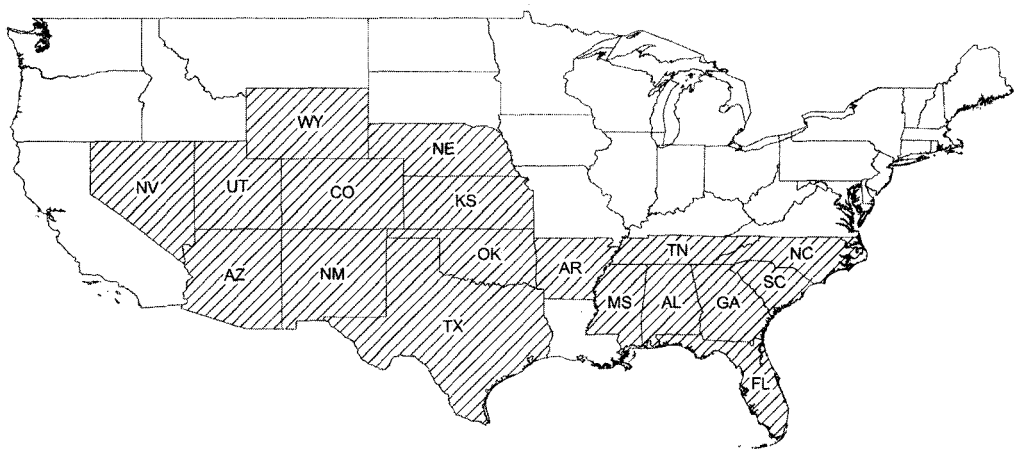


Figure 1. States included in study area.

If county population is taken as a proxy for collector efforts, it is important to consider the possibility that more collection will occur not only in counties that have relatively high population densities, but also in counties that have low population densities but that border counties with higher population densities. In other words, collectors might collect from counties with low population densities that are adjacent to their own, thus inflating fluted-point counts in low population counties. Shott (2002:98) noted this potential issue, and to deal with it he smoothed the population of each county in his sample by calculating the mean of the population of the county of interest and the population of all bordering counties. Shott (2002) found no difference in the results of his analysis by using the smoothed versus original population values, and for this study only the effect of the population of the actual county of interest on Clovis point density is considered.

Also, as noted by Lepper (1983) and Shott (2002:99), population has not remained constant through time, and by using recent census figures we are assuming that population has not significantly changed since the time the fluted points were reported. Because of this, Lepper (1983) used census records closest in time to the date of publication of the fluted-point surveys in his study. While population structure may have changed since the time fluted points were reported, it is unreasonable to attempt to account for population fluctuation on such a large scale, considering that counts of fluted points have been reported throughout many decades. While the population density of certain counties may have drastically grown or shrunk through time, it is assumed that this is unlikely to have a significant effect on the overall pattern of fluted-point recovery with a large sample size. Additionally, Shott (2002) tested for such census-age effects in his sample and concluded that "recent figures are a valid population measure whatever the date of a fluted-biface survey" (Shott 2002:104). Therefore, the effects that population fluctuation might have on Clovis point recovery are not further considered.

Cultivation

Cultivated acreage by county was measured through the U. S. Department of Agriculture (2002) National Agricultural Statistics Service most recent Census of Agriculture. Again, to control for differences in county size, cultivated acreage was converted into cultivated km^2 and divided by county area (km^2), thus providing a measure of the percent of county area under cultivation. As with population density, cultivated acreage per county has likely fluctuated through time. Again, it is unreasonable to attempt to account for such fluctuation, and it is assumed that fluctuation would not have a significant effect on the overall pattern of fluted-point recovery with a large sample size.

Intensity of Archaeological Research

As noted by Shott (2002:113), the intensity of archaeological research in particular regions cannot be directly measured without knowing the num-

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Table 1. Summary of Variables Used in Study Listed by State, and Associated References for Numbers of Clovis Points.

	Area (km^2)	Population (2006 est.)	People/ km^2	% of Land Cultivated	Arch. Sites/ 1000 km^2	Total No. of Clovis Points	Clovis Points/ 1000 km^2	References (for Total No. of Clovis Points)
Southeastern U.S.								
Alabama	131,426	4,599,030	35	11.41%	196	211	1.61	Anderson et al. (2005)
Arkansas	134,856	2,810,872	21	28.69%	307	97	.72	Anderson et al. (2005)
Florida	139,670	18,089,888	130	8.17%	1179	159	1.14	Anderson et al. (2005)
Georgia	149,976	9,363,941	62	12.23%	316	168	1.12	Anderson et al. (2005)
Mississippi	121,489	2,910,540	24	19.35%	297	81	.67	Anderson et al. (2005)
North Carolina	126,161	8,856,505	70	17.51%	339	174	1.38	Anderson et al. (2005)
South Carolina	77,982	4,321,249	55	11.65%	331	214	2.74	Anderson et al. (2005)
Tennessee	106,752	6,038,803	57	26.50%	210	671	6.29	Anderson et al. (2005)
Western U.S.								
Arizona	294,313	6,166,318	21	1.65%	226	109	.37	C. Vance Haynes (personal communication 2007)
Colorado	268,628	4,753,377	18	17.36%	467	239	.89	Brunswig (personal communication 2007); Holen (2007a); OAHP[a] (2007); Prasciunas and Denoyer (2007)
Kansas	211,900	2,764,075	13	56.41%	65	57	.27	Blackmar (2001); Hofman and Hesse (2002); McLean (2002); McLean and Peter (2004)
Nebraska	199,098	1,768,331	9	45.77%	43	82	.41	Holen (2003)
Nevada	284,448	2,495,529	9	1.34%	210	145	.51	Gary Haynes (personal communication 2007); Taylor (2003b)
New Mexico	314,311	1,954,599	6	3.26%	433	287	.91	ARMS[a] (2007); Boldurian and Cotter (1999); Hamilton (2008); Huckell (2004); Huckell et al. (2007); Huckell et al. (2008)
Oklahoma	177,847	3,579,212	20	33.58%	107	92	.52	Bement and Carter (2003); Bement (personal communication 2007); Blackmar (2001); Hofman and Wyckoff (1991); Wyckoff and Rippy (1998)
Texas	678,051	23,507,783	35	22.94%	102	536	.79	Bever and Meltzer (2007)
Utah	212,752	2,550,063	12	3.92%	417	33	.16	Copeland and Fike (1988); Taylor (2003b); UDSH[a] (2007)
Wyoming	251,488	515,004	2	4.81%	341	43	.17	Prasciunas et al. (2008)

Note: [a]State record keeping agencies: OAHP=Colorado Office of Archaeology and Historic Preservation; ARMS= Archaeological Records Management Section of New Mexico Historic Preservation Division; UDSH=Utah Division of State History, IMACS Database Query Results

ber of person days worked on every archaeological project that ever occurred in every county. Since these data are not available, intensity of investigation must be measured in some other way. Following Shott (2002), the total number of recorded archaeological sites of all periods per county was used to indirectly measure intensity of archaeological effort. This provides an admittedly coarse measure of research effort because it assumes that archaeological sites are distributed more or less evenly across the landscape, and therefore that more sites will be found in areas where more effort has been directed towards finding them.

Total numbers of archaeological sites by county for all states in the study area were obtained through site-file searches conducted by state record-keeping agencies (counts for all states were compiled in 2007, with the exception of Oklahoma whose counts were compiled in 2004 and are available online through the Oklahoma Archaeological Survey at http://www.ou.edu/cas/archsur/Atlas/atlas.htm). Total number of archaeological sites per county was then divided by county area (km^2) and multiplied by 1,000 to provide a measure of site density (sites per 1000 km^2) and to be consistent with the other variables. Table 1 provides a summary of the variables considered in this study and their associated values, by state.

Environmental Productivity

In order to assess whether patterns in Clovis-point distribution can be explained by the presence of greater prehistoric hunter-gatherer population densities in regions capable of supporting them, data relating to environmental productivity and carrying capacity (Binford 2001) were also gathered. Using Binford and Johnson's (2006) EnvCalc2 program, various variables pertaining to environmental productivity were generated at the county-level from input weather station data taken from the U.S. Monthly Climate Normals 1971–2000 (available for purchase from NOAA/NCDC at http://ols.nndc.noaa.gov/plolstore/plsql/olstore.prodlist?category=C&subcatc=01&groupin=CDV). In cases where multiple weather stations were present per county, the values generated by EnvCalc2 were averaged. If no weather stations were present for a particular county, the values from adjacent counties were averaged to arrive at values for the county of interest.

It is assumed that measures of environmental productivity calculated from modern climatic values, while certainly not identical to those of the terminal Pleistocene (Adams 1998; Williams et al. 2004), would nonetheless correlate, at least in terms of the major climatic variables examined in the analysis. In particular, this may be a reasonable assumption considering that glaciation, potentially affecting areas of the northern U.S. during the terminal Pleistocene, would not be a complicating factor in the sample of western and southeastern states. While the use of paleoenvironmental data would have been preferable, in the absence of detailed county-level paleoenvironmental reconstructions containing the climatic data of interest and spanning the breadth of the study area, it was not possible. Explicitly factoring environmental variables into the analysis also accounts for the potential concern that demonstrated correlations between Clovis-point density and the variables of interest (population, cultivation, and total numbers of archaeological sites) are ultimately controlled by a measure of environmental productivity like annual precipitation, and therefore mask the real source of Clovis-point variability.

Results

Prior to examining the relationship between Clovis-point density and modern population, cultivation, and total numbers of archaeological sites at the county-level, the data were transformed to normalize the distributions. Clovis-point density, modern population density, and site density were transformed using a natural log transformation. Percent of land cultivated was transformed by taking the square root of the cultivation values. After logging Clovis-point density values, "0" values were eliminated, resulting in the loss of 735 counties from the sample (only 666 out of 1,401 counties had at least one Clovis point recorded). The analysis was conducted with the "0" values eliminated, but was also conducted with a constant ("1") added to the Clovis-point values so that counties with zero values would be represented as well. The differences in Clovis point density resulting from the addition of "1" to Clovis point values in the sample were in most cases negligible.

Using the Clovis-point data with all counties represented (i.e., with constant added), Pearson's

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product-moment correlations indicate that Clovis-point density correlates significantly and positively with all of the variables of interest (for population density $r = .390, p << .001$; for cultivation $r = .131$, $p << .001$; and for total site density $r = .185, p << .001$). Similarly, a multiple linear regression forward procedure to test the significance of population density, cultivation, and total site density on variation in Clovis-point density indicates that all variables are significant predictors of Clovis-point distribution (adjusted $r^2 = .181$; Table 2.) A binary logistic regression also indicates a significant relationship between presence or absence of Clovis points and the variables of interest (likelihood ratio test, $p << .001$.)

Using the Clovis-point data without all counties represented (i.e., without constant added), Pearson's product-moment correlations also indicate that Clovis point density correlates significantly and positively with all of the variables of interest (for population density $r = .409, p << .001$; for cultivation $r = .255, p << .001$; and for total site density $r = .092$, $p = .018$). However, in this case the correlation with total site density is weak, and a multiple linear regression forward procedure to test the significance of population density, cultivation, and total site density on variation in Clovis-point density indicates that while population and cultivation are significant predictors of Clovis-point distribution (adjusted r^2=.232), total site density is not (Table 3.) It should not be entirely surprising to find that Clovis-point density is not clearly related to intensity of archaeological research (as measured by total numbers of archaeological sites), because our current sample of Clovis points is largely a result of surveys specifically designed to identify fluted points, and not a result of random discovery during the course of routine archaeological investigations.

To determine to what degree Clovis-point distribution can be further predicted by environmental productivity, environmental variables were next factored into the multiple linear regression. The residuals from the first regression (i.e., the residuals resulting from regressing Clovis-point density on population, cultivation, and total sites) were regressed in a forward procedure on the environmental variables generated by EnvCalc2 (Binford and Johnson 2006). Of these environmental variables (defined in Table 4), at least eight were significant predictors of the residual variation (with constant added adjusted $r^2 = .161$, Table 5; without constant added adjusted $r^2 = .184$, Table 6). These include various measures and combinations of monthly and mean annual rainfall, temperature, and solar radiation used to anticipate plant and animal productivity (see Binford 2001 for equations used in the calculations of environmental variables).

Table 2. Multiple Linear Regression Results for Clovis Point Density (with Constant Added) Regressed on Population Density, Total Site Density, and Cultivation.

Predictor	Coefficient	Standard Error	*t*	*p*
Constant	-1.357	.140	-9.697	.000
Population	.221	.018	12.365	.000
Total Sites	.080	.024	3.273	.001
Cultivation	.923	.127	7.262	.000

Table 3. Multiple Linear Regression Results for Clovis Point Density (without Constant Added) Regressed on Population Density, Total Site Density, and Cultivation.

Predictor	Coefficient	Standard Error	*t*	*p*
Constant	-1.540	.258	-5.975	.000
Population	.297	.030	9.937	.000
Total Sites	.041	.043	.942	.347
Cultivation	1.611	.229	7.041	.000

In sum, the above analyses show that modern population, cultivation, and environmental productivity are all significant predictors of variation in Clovis-point density, regardless of whether Clovis-point density is calculated for all counties (with the addition of a constant to Clovis-point values) or for only those counties containing at least one Clovis point (without addition of a constant). Intensity of archaeological research is also a significant predictor of Clovis-point density when all counties in the sample are considered (with the addition of a constant). It is worthwhile here to point out that correlation does not necessarily imply causation, and that just because Clovis-point density is significantly related to the variables examined in the study does not necessarily mean that these variables are *directly* affecting Clovis-point visibility. For instance, environmental productivity, population centers, and farmland may co-vary with ecological zones or physiographic provinces that contained additional resources or geographic features that were important to prehistoric popula-

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Table 4. Definitions of Environmental Variables Calculated with EnvCalc2 Used in Multiple Linear Regression (from Binford and Johnson 2006 and Binford 2001; see Binford 2001 for Equations Used in Calculations).

Variable	Definition
AE	Actual evapotranspiration (mm; Binford 2001:74)
CMAT	Mean annual temperature (degrees Celsius)
CRR	Mean annual rainfall (mm)
ET	Effective temperature (Binford 2001:58–59)
LAT	Latitude (decimal degrees)
LN_CRRPREY	Mean ungulate body mass calculated from CRR (kg/km^2; Binford and Johnson 2006); logged value
LN_HIRX	Rainfall index (Binford 2001:477); logged value
MI	Moisture Index (Binford 2001:477)
NAGP	Net above-ground productivity (kg/km^2 per year; Binford 2001:79)
PET	Potential evapotranspiration (mm; Binford 2001:75)
PGROW	Weighted measure of simultaneous presence of water and solar radiation available to plant community (Binford 2001:85)
TEMP	Temperateness (Binford 2001:59)
TERMD2	Hunter-gatherer population density expected at a particular location (persons/100 km^2; Binford 2001:187)

tions. Nonetheless, the regressions do demonstrate a significant relationship between the variables of interest and Clovis-point density that should not be ignored. It is now possible to examine whether accounting for these variables appreciably alters the previously apparent patterns of point distribution, and how much variation in Clovis-point density remains unexplained.

As noted previously, researchers have argued for many decades that more fluted points are present in eastern than western North America (e.g., Mason 1962:235), and that the densest concentration of eastern fluted points occurs in the south (e.g., Dragoo 1976:9; Williams and Stoltman 1965:674). Dragoo (1976:9) noted this not just for fluted points in general, but for Clovis specifically. Figure 2 shows the study area with Clovis-point density mapped by state ([total number of Clovis points/state area] times 1000). At face value, this figure does appear to indicate that the southeastern U.S. as a whole contains a much higher density of Clovis points than the west, with Clovis-point density particularly high in Tennessee and South Carolina.

How do these patterns change after the effects of modern population, cultivation, intensity of archaeological research, and environmental productivity are taken into account? Figure 3 shows the residuals at the state level remaining after

Table 5. Multiple Linear Regression Results for Residual Variation in Clovis-Point Density Regressed on Environmental Variables (with Constant Added.)

Predictor	Coefficient	Standard Error	t	p
Constant	13.088	2.39	5.457	.000
CMAT	.541	.053	10.294	.000
CRR	-.004	.001	-5.059	.000
ET	-.959	.200	-4.800	.000
LAT	.090	.018	4.876	.000
LN_CRRPREY	-.364	.072	-5.066	.000
LN_HIRX	-2.110	.377	-5.595	.000
MI	.014	.004	3.740	.000
NAGP	.001	.000	2.654	.008
PET	-.004	.001	-3.310	.001
PGROW	-.067	.018	-3.800	.000
TERMD2	.193	.041	4.745	.000

Table 6. Multiple Linear Regression Results for Residual Variation in Clovis-Point Density Regressed on Environmental Variables (without Constant Added.)

Predictor	Coefficient	Standard Error	t	p
Constant	16.925	2.311	7.325	.000
AE	.002	.001	2.283	.023
CMAT	.688	.107	6.419	.000
LN_CRRPREY	-.306	.070	-4.344	.000
LN_HIRX	-1.132	.315	-3.595	.000
PET	-.018	.003	-7.055	.000
PGROW	-.121	.028	-4.238	.000
TEMP	-.163	.030	-5.392	.000
TERMD2	.223	.069	3.216	.001

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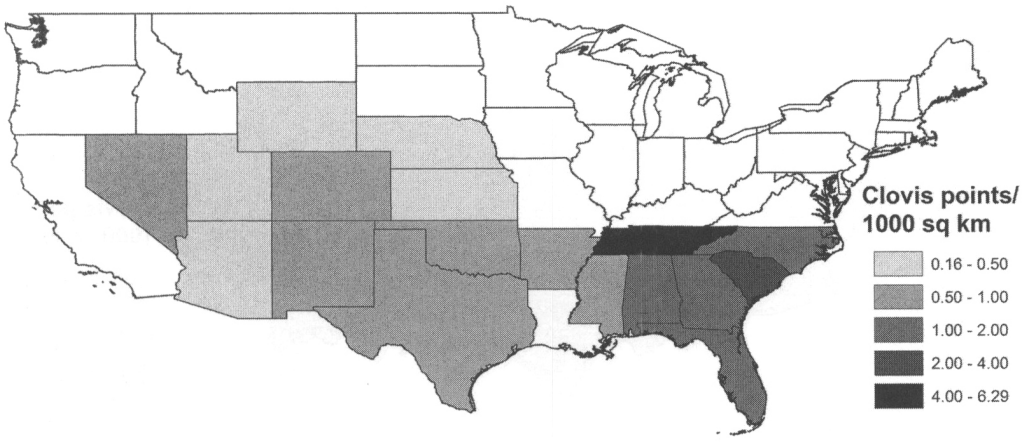


Figure 2. Clovis-point density by state for states in the study area.

regressing Clovis-point density on all variables (county-level residuals were summed within each state; Clovis-point density values are those without constant added). Figure 3 therefore shows the variation in Clovis-point distribution *not* accounted for by the variables examined in the multiple linear regressions. Residuals are shown mapped by standard deviations of the residual distribution (all residual values fall within two sigma). States that are the medium shade of gray in Figure 3 indicate a Clovis-point density predicted to within one sigma by the independent variables examined in the regression. States that are lighter gray (New Mexico and North Carolina) indicate a lower Clovis-point density than that predicted by the regression, and states that are darker gray (Colorado and Tennessee) indicate a higher Clovis-point density than that predicted by the regression.

How does this compare to the density of Clovis points apparent prior to analysis (Figure 2)? Once the differential effects of the variables examined in the regression are taken into account (Figure 3), Clovis-point density is not simply greater in the southeast than in the west. Only one southeastern state has more Clovis points than predicted (Tennessee) and one state actually has fewer points than predicted (North Carolina). In the west, most states also have a Clovis-point density well-predicted by the regression (within one sigma; all medium gray states). As in the southeast, one state has fewer

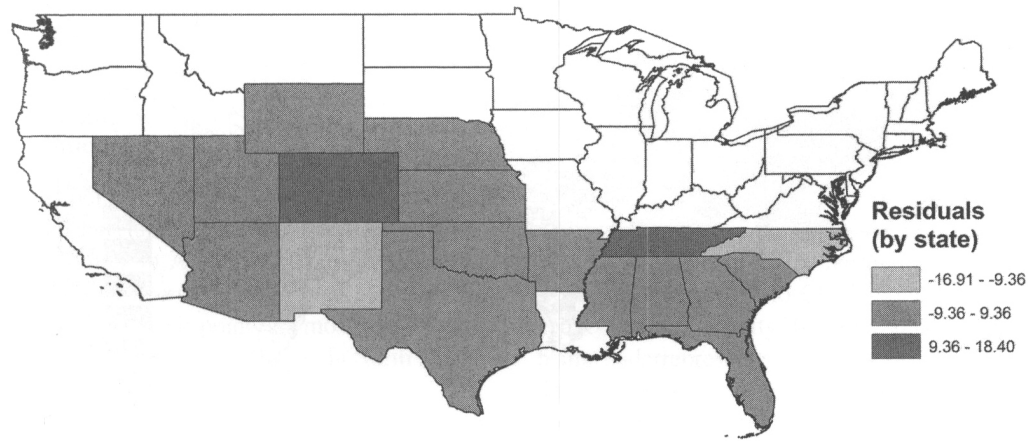


Figure 3. Residuals (by state) remaining after regressing Clovis-point density on all variables. One standard deviation = 9.36.

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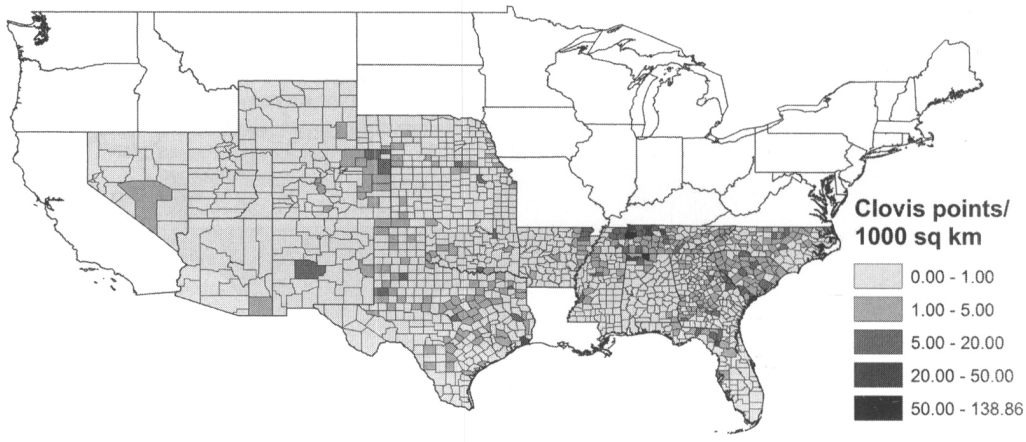


Figure 4. Clovis-point density by county for states in the study area.

points than predicted (New Mexico), and one state has more points than predicted (Colorado).

Do these patterns change if we examine Clovis-point distribution at the county level? A map of Clovis-point density at the county level for all states in the study area (Figure 4) shows that while Clovis-point density is greater in many areas of the southeastern U.S. compared to that of the west, it is not consistently greater in all areas of the southeast. Rather, the greater point densities in some southeastern states appear to be driven by only a few select counties (e.g., Alabama), and by far the greatest point density lies in Tennessee. How do county-level patterns change after the effects of modern population, cultivation, intensity of archaeological research, and environmental productivity are taken into account? Figure 5 shows the residuals at the county level remaining after regressing Clovis-point density on all variables. (Clovis-point density values are those without constant added, so counties with "0" values for Clovis points were eliminated during log transformation.) Figure 5 therefore shows the variation in Clovis-point distribution *not* accounted for by the variables examined in the multiple linear regressions. Residuals are once again shown mapped by standard deviations of the residual distribution. Light gray indicates a lower Clovis-point density than predicted by the regression, and

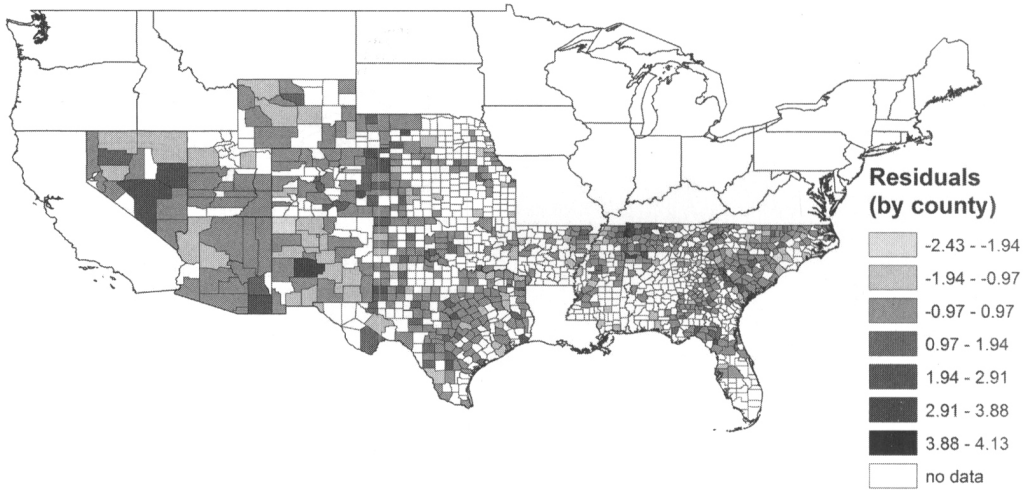


Figure 5. Residuals (by county) remaining after regressing Clovis-point density on all variables (without constant added.) One standard deviation = .97.

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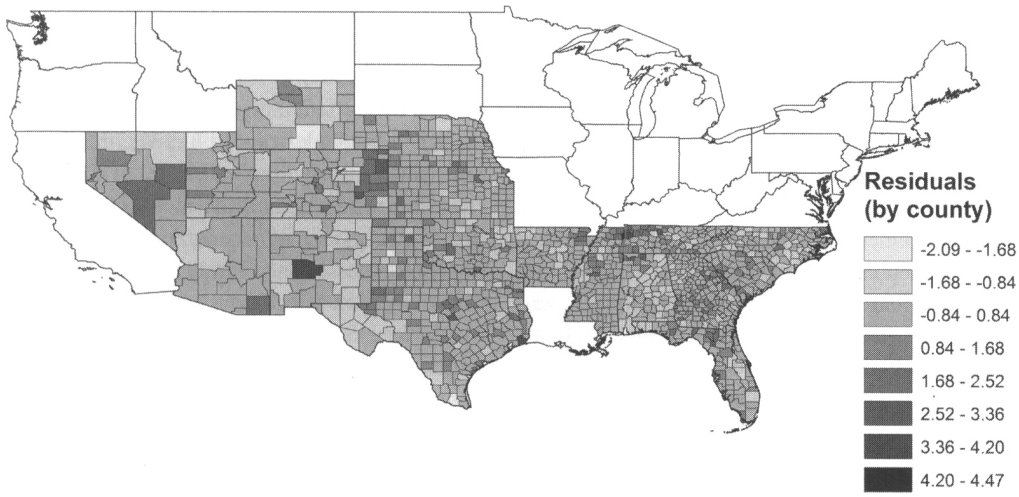


Figure 6. Residuals (by county) remaining after regressing Clovis-point density on all variables (with constant added.) One standard deviation = .84.

dark gray indicates a higher Clovis-point density than predicted by the regression.

Once the effects of the variables examined in the regression are accounted for (Figure 5), Clovis-point density is more complicated and variable within and between regions than suggested by the map of Clovis-point density by county prior to analysis (Figure 4). There are "hot spots" where Clovis points are overrepresented and "cold spots" where Clovis points are underrepresented within most states in both regions. A Moran's *I* test of spatial autocorrelation indicates departure from spatial randomness (Moran's $I = .13$; $Z = 14.07$; $p < .01$.), meaning that the residual variation is clustered to some degree. However, the Moran's *I* statistic is only slightly positive, indicating a weak correlation. Clovis points are most heavily overrepresented in Benton County, Tennessee. Other counties where Clovis points are heavily overrepresented include Stewart and Humphreys counties in Tennessee, Colbert County in Alabama, Gilchrist County in Florida, and Socorro County in New Mexico. Counties in which Clovis points are most heavily underrepresented are Robeson County in North Carolina and San Juan County in New Mexico.

Figure 6 shows residuals at the county level with all counties included in the regressions (i.e., using Clovis-point density values with constant added, so counties with "0" values for Clovis points are represented). This map is also useful because it provides information about whether Clovis-point density is underrepresented in those 735 counties where no Clovis points have been documented within one sigma. This map must be interpreted somewhat cautiously, however, because in several cases the addition of a constant results in counties well predicted by the regression (within one sigma in Figure 5) appearing slightly overrepresented in Figure 6.

Additionally, in the case of a few very small counties (in terms of area) in which no Clovis points have been found, the addition of a constant results in Clovis-point densities appearing overrepresented. In these instances where the addition of only "1" results in overrepresentation, the regression has predicted a value close to "0" for Clovis-point density. Therefore, Clovis-point density within these counties can actually be considered accurately predicted by the regression. Similarly, if the addition of "1" to Clovis-point values per county that are in reality "0" still results in a county being underrepresented in terms of Clovis-point density, we know that Clovis-point density in that county is also underrepresented with a value of "0."

Residuals at the county level without and with a constant added (Figures 5 and 6, respectively) dif-

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fer in terms of how much under- or overrepresented Clovis-point densities are in certain counties, but exhibit similar overall patterns. The counties in which Clovis points are most heavily overrepresented in Figure 6 differ slightly from Figure 5. Clovis points are still most heavily overrepresented in Benton County, Tennessee, followed by Humphreys County in Tennessee, Jefferson County in Texas, and Socorro County in New Mexico. Other areas of heavy overrepresentation include Stewart and Smith counties in Tennessee, Colbert and Limestone counties in Alabama, Gilchrist County in Florida, Lampasas County in Texas, and Yuma and Crowley counties in Colorado. Counties in which Clovis points are most heavily underrepresented are Box Elder County in Utah, Carbon and Laramie counties in Wyoming, Adams County in Colorado, and Randall, Hale, and Hidalgo counties in Texas.

Regions in which overrepresented Clovis-point densities occur in clusters in both Figures 5 and 6 include north-central Tennessee, the border between Georgia and South Carolina, northern Florida, western Texas, eastern Colorado, southeastern Arizona, and central-southern Nevada. Regions of clustered underrepresentation include large portions of North Carolina, Alabama, Arkansas, eastern Oklahoma, southwestern Texas, New Mexico, northwestern Arizona, northern Nevada, northern Utah, and Wyoming.

Discussion

The distribution of Clovis points across the southeastern and western U.S. is significantly related to modern population density, cultivation, intensity of archaeological research, and environmental productivity. After accounting for the differential effects of these variables on Clovis-point visibility, it is apparent that Clovis-point density is not simply greater in the southeast than in the west, as frequently argued. Areas of over- and underrepresentation occur in nearly all states in the study area. The most extreme overrepresentation occurs in the southeast, but is limited to only a few counties. While many parts of the west are underrepresented, the west contains areas of major overrepresentation as well. What additional variables might explain these patterns?

In some cases, it appears that collector bias is at least in part driving point visibility. While modern population provided a proxy for collector efforts, no variable was factored into the analysis that measured how intensely collector efforts have been documented. Perhaps including such a variable would significantly reduce residual variation. As noted by Anderson (1990:167), the Southeast has seen a much longer history of fluted-point recording projects, and the fact that the areas of greatest point overrepresentation in the Southeast include Tennessee and Florida, where much PIDBA documentation effort has been focused, cannot be overlooked. Similarly, eastern Colorado exhibits a major overrepresentation of points, and it is in this region that Holen (2007a) has conducted intensive surveys of private collections. Another example is Socorro County, New Mexico, where Hamilton (2008) has documented Clovis-point collections from the Mockingbird Gap site.

However, some entire states like Texas have been the focus of intensive Clovis point surveys (Bever and Meltzer 2007; Meltzer 1986a, 1986b; Meltzer and Bever 1995), and contain not only hot spots, but many cold spots as well. Other examples are North and South Carolina, where Clovis-point density is not consistently overrepresented in spite of abundant collector activity and surveys of private collections throughout the states (e.g., Charles and Michie 1992; Daniel and Goodyear 2006; Goodyear 2006; Goodyear et al. 1990; Peck 1988; Perkinson 1971, 1973). Instead, Clovis points appear to be overrepresented only in certain spots, suggesting that intensity of collector effort cannot entirely explain these patterns. It is likely that issues of geologic visibility, ground cover, and other variables not examined in this study are also affecting Clovis-point visibility.

However, if the current post-analysis distribution of Clovis points does more accurately reflect variation in prehistoric population density, then perhaps we are seeing greater population densities in regions capable of providing better access to critical resources. As argued by Anderson (1990b; Anderson and Faught 1998; Anderson and Gillam 2000), perhaps people preferentially occupied certain environmentally productive areas associated with major rivers or chert sources, in order to maximize resource availability. Clustered hot spots are also consistent with Anderson and Gillam's (2000) and Anderson and Faught's (2000) "leap-frog" settlement pattern, in which populations targeted

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resource rich locations. The high density of Clovis points clustered in the Tennessee and Savannah River valleys support Anderson's arguments, but there is much variation left unexplained in both the Southeast and the West. Additionally, it is important to remember that projectile points represent only one part of Clovis technological organization (e.g., Collins 1999). As such, points inform us only about those locations where Clovis populations discarded or lost projectile points, and not about the locations where other activities may have occurred. In other words, projectile points alone are capable of providing only a limited window into Clovis land-use patterns and settlement strategies.

Conclusions

What can Clovis-point distribution tell us about the geographic origin of fluted-point technology? There is no clear evidence supporting the argument that Clovis technology originated in the Southeast, as some researchers have suggested. Following Haynes (1983), I would argue that fluted-point distribution maps alone are incapable of determining the origin of fluted-point technology. Without enough good radiocarbon dates to provide chronological control, it really does not matter where the greatest concentrations of fluted points lie, because the densest concentrations do not necessarily represent the oldest points. As Purdy (1982:29) noted long ago, the assumption that numbers of points in any way relates to their origin is an "old diffusionist theory that is no longer accepted" (Purdy 1982:29). Even if there was one and only one particular spot on the landscape that stood out above all others in terms of the magnitude of Clovis-point density (and there is not), why would this necessarily indicate the location of invention, rather than the settling in of foragers already possessing the technology into an ecologically rich region capable of supporting more of them for longer periods of time? And even if density is somehow related to technological origin, to argue (once again in the absence of chronological control) that this necessarily means anything about the origin of populations or the direction in which colonization occurred (e.g., the trans-Atlantic migration from the Iberian peninsula of Stanford and Bradley [2000]) is also unsubstantiated.

To better understand Clovis land-use strategies, it would be informative to examine the distribution of Clovis versus later Paleoindian sites to see if clear differences in land-use strategies are apparent. Meltzer and Bever (1995) for instance, show that in Texas, Clovis point distribution is not related to the distribution of later Paleoindian sites, suggesting Clovis land-use strategies differed from those of later Paleoindian groups. Unique land-use strategies would be expected among the earliest widespread occupants of North America (Kelly and Todd 1988), and if found on a large scale could help test the hypothesis that Clovis, whether "first" or not, was in essence a colonizing population. Additional directions for future research include assessing the impacts on Clovis-point density of variables such as geologic visibility, ground cover, avocational activity, and unique landscape features such as rivers and raw material sources.

In sum, this study has demonstrated two important facts: that the patterns visible in projectile point databases cannot be used uncritically to infer prehistoric behavior; and that the distribution of Clovis points across the United States is more complex than many archaeologists assume. It is also apparent that the discovery or addition of a single new site rich in points could substantially alter existing county- and state-level point density patterns. As noted repeatedly by numerous researchers, the continued compilation of fluted-point data is essential to furthering our understanding of early Paleoindian settlement and land-use strategies.

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