Regional patterns of Folsom mobility and land use in the American Southwest

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Abstract

This paper develops a regional model of Folsom land use for the American Southwest that suggests variation corresponding to seasonal patterns of resource availability. Settlement patterns and raw material movement provide an indication of the scale and intensity of Folsom land use. Comparison of these estimates with data from modern hunter-gatherers suggests that Paleoindian groups were exceptionally mobile and modern hunter-gatherers may not serve as useful analogs.

Keywords

Folsom; mobility; Great Plains; New Mexico; stone tools.

Introduction

It is generally believed that Paleoindian groups in the New World may have been the most mobile pedestrian hunter-gatherers to inhabit the globe (Kelly and Todd 1988). However, our knowledge of the scale and pattern of Paleoindian land use is often limited to the study of single assemblages or very small regions. This problem and other limitations of the archaeological record have fostered a monolithic perception of Paleoindian adaptations that do not respond to local environmental differences. This paper addresses these issues through a regional analysis comparing Paleoindian mobility and land use in two contrasting regions of the Southwestern US: the Great Plains and the intermontane Basin and Range province (Fig. 1).

In particular, this study considers the Folsom cultural complex, representing some of the earliest inhabitants in the New World. Folsom occupations are associated with the terminal Pleistocene grassland savannahs of west-central North America between 10 and 11 ka (Bonnichsen et al. 1987; Haynes et al. 1992). Folsom archaeological remains are identified by diagnostic lithic artifacts that include distinctive fluted projectile points and a variety of specialized tools oriented toward butchery and the working of hides, bone and wood (e.g. Boldurian 1991; Frison 1992; Judge 1973; Hofman et al. 1990).

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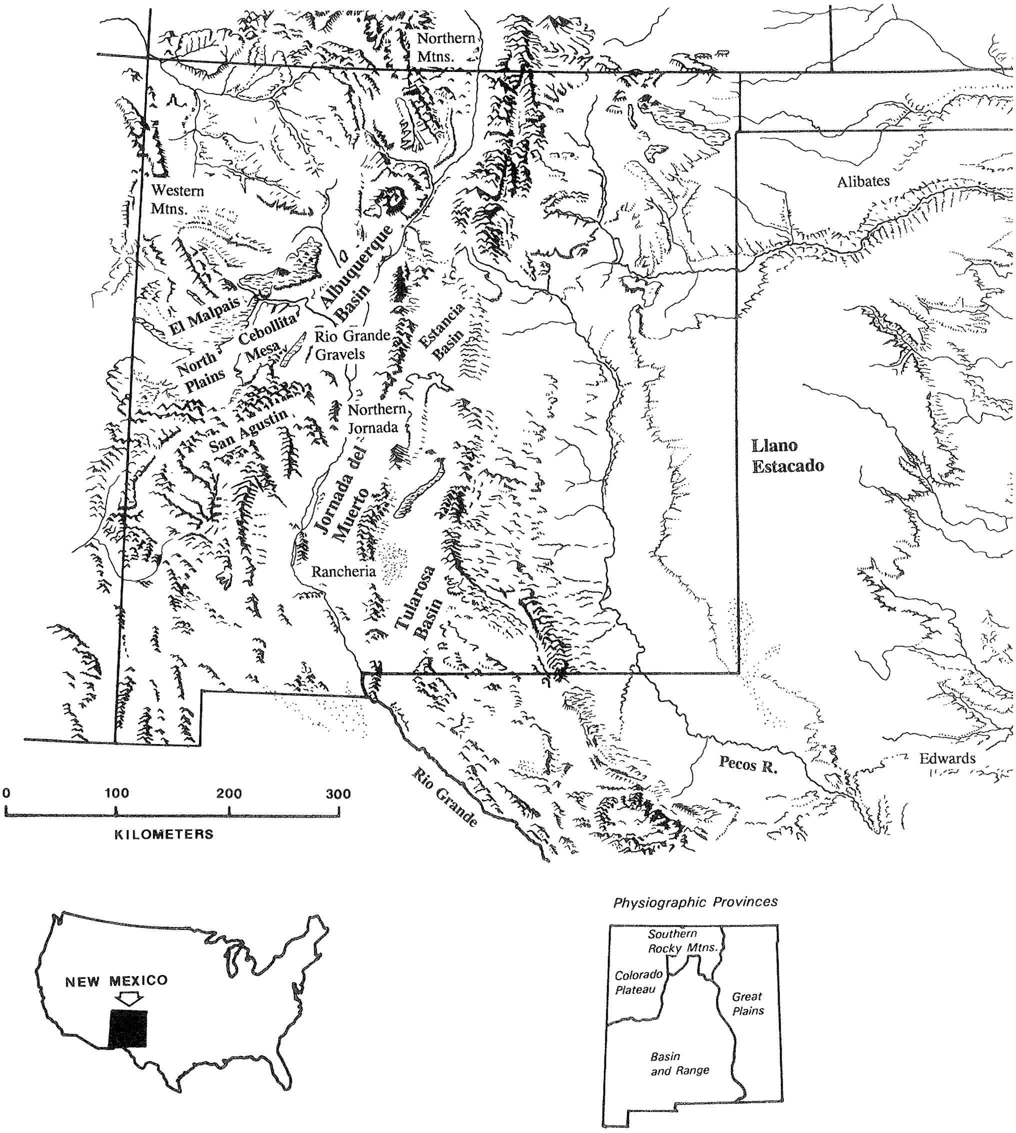

Figure 1 Regional locations and primary lithic source distributions in the study area.

Frequent occurrence of *Bison antiquus* remains at Folsom sites suggests this species was a key food resource, although Folsom subsistence included many other animals and plants (Amick 1994a). *Bison antiquus*, an extinct form about 50 per cent larger than modern bison (MacDonald 1981), was the largest game species available to Folsom hunters. *Bison antiquus* ecology differed from modern bison, with smaller herds and possible adaptation to savannah grasslands (MacDonald 1981). As a prey species, modern bison is highly mobile, dangerous and unpredictable in exact location but seasonally predictable in range location (Bamforth 1988; Epp 1988). Modern bison overwintered in the protected foothills and intermontane basins along the Rocky Mountains, and migrated onto the open grassland plains during the spring and summer (Findley 1987; Moody and Ray 1976). Studies of prehistoric bison diet and herd structure suggest similar migrations may have occurred in the past (Chisholm et al. 1986).

During the cold season, Folsom occupations may therefore have favoured the intermontane basins. In addition, most resident mammalian species, such as bison, deer, elk, and bighorn sheep, are forced to lower elevations by deep snows in the mountains (Frison 1991, 1992; Osborn 1993). In contrast, food resources associated with the grasslands and marshes of the open plains are most available during the warm season. This pattern of food availability regulated the seasonal movement of many ethnohistoric aboriginal groups who wintered in the intermontane basins and used the plains as hunting grounds during the summer and fall. Seasonality information is limited at Folsom sites on the Southern Plains but the bison assemblages at Folsom, Cooper, Lipscomb, and Lake Theo indicate summer/early fall procurement (Bement 1994; Todd et al. 1990). This pattern contrasts with late prehistoric communal bison hunts, which usually occurred during the late fall to take advantage of optimal hide and fat conditions (Frison 1991; Todd et al. 1990).

Although *Bison antiquus* hunting was a major component of Folsom subsistence, this paper suggests some variation in Folsom diet breadth and land use relating to contrasts in regional resource structure that may include seasonal patterns of availability. Patterns of lithic raw material distribution and regional variation in the manufacture and composition of stone weaponry assemblages are used to compare mobility and land use. The goal of this exercise is not to reconstruct the prehistoric system, but simply to explore some parameters that may have defined it.

Regional transportation of tool stone

Reliance on high quality stone from distant sources is a hallmark of Paleoindian technology. It is generally argued that the combination of high residential mobility and low population density, which characterized early Paleoindian times, inhibited the establishment of trading networks (Amick 1994b; Kelly and Todd 1988; Meltzer 1989; Storck and Tomenchuk 1990). Trade among hunter-gatherers usually occurs when regional population densities are high and access to resources is restricted (Bettinger 1982). Under these conditions, trade serves to reinforce social alliances among hunter-gatherer groups who maintain established territories. In the Folsom case, access to lithic resources was not limited because population densities appear to have been very low. Hofman (1994) has recently made similar arguments about low population densities inhibiting the formation of Paleoindian aggregation sites.

Parameter estimates of Folsom population densities (see below) suggest these groups did not have bounded territories or regular routes of travel. As a result, it is argued, established trading partnerships could not have been maintained. While down-the-line trade can never be excluded in an archaeological situation, direct movement of people therefore seems the most likely way to account for the bulk of lithic material transport during early Paleoindian times. Therefore, the relationship and size of lithic procurement ranges may be indicated by the spatial distribution of tool stone materials (e.g., Shackley 1990).

Table 1 Use of some regional tool stone sources among weaponry parts from the Rio Grande Valley and Southern Plains

Tool stone source	*Region*			
	Albuquerque Basin	*Jornada del Muerto*	*Tularosa Basin*	*Southern Plains*
Rio Grande gravels	79.0% (n = 226)	39.5% (n = 230)	26.9% (n = 201)	0.0%
Northern Jornada	4.5% (n = 13)	25.2% (n = 147)	7.9% (n = 59)	0.0%
Rancheria chert	6.6% (n = 19)	26.4% (n = 154)	57.6% (n = 430)	0.0%
Western mountains	9.4% (n = 27)	6.7% (n = 39)	0.7% (n = 5)	0.0%
Edwards chert	0.3% (n = 1)	2.2% (n = 13)	6.8% (n = 51)	84.0% (n = 278)
Misc. plains sources[1]	0.0%	0.0%	0.0%	6.0% (n = 20)
Unknown cherts and chalcedonies[2]	0.0%	0.0%	0.0%	9.7% (n = 32)
Total	286	583	746	331

Notes

1 Alibates agatized dolomite, Tecovas jasper, Potter chert, Notrees chert, Morrison quartzite, quartz crystal.

2 Data from Broilo (1971) and Hester (1972) in which sources are not distinguished for some cherts and chalcedonies. These materials may include some of the lithic sources found west of the Plains.

Most of the data in this study are derived from first-hand study of dozens of Folsom artifact collections. The record of exposed Paleoindian occupation in the American Southwest was largely recovered through intensive artifact hunting by avocationals prior to the implementation of archaeological protection programs. This conclusion is confirmed by the failure to locate many new Paleoindian localities of any significant magnitude under subsequent large-scale survey programs conducted by professional archaeologists. Since many of the artifacts are in private hands, the data collection method is considered opportunistic rather than systematic. While these data are inherently incomplete, it is the largest sample of Folsom weaponry artifacts yet assembled and I believe it is representative of regional patterns in the American Southwest.

This analysis is limited to weaponry artifacts, i.e., projectile points, point preforms, and channel flakes, since these distinctive forms are unique to the Folsom and most collections are biased toward these categories. As a result, inferences from this study are biased toward the hunting activities. Most of the projectile points recorded are fragments, presumably broken on impact during use as atlatl dart tips. Folsom point preforms represent manufacturing failures discarded before completion, although they may also have served as hafted knives (Boldurian and Hubinsky 1994; Judge 1973). Channel flakes are the distinctive flakes produced during fluting of the Folsom preform.

Table 1 compares tool stone sources represented in Folsom weaponry assemblages in four regions: the southern Great Plains and three intermontane basins. These are the Albuquerque Basin, the Jornada del Muerto, and the Tularosa Basin, which are sequential portions down the Rio Grande Valley (Fig. 1). Rio Grande gravel is available in all three, but is most abundant in the Albuquerque Basin. Rancheria chert from the southern Jornada del Muerto shows an upstream decrease; it represents only 6.6 per cent in the Albuquerque Basin, compared to 57.6 per cent in the Tularosa Basin.

The Folsom weaponry in each of these regions is characterized by a dependence on locally available tool stone, although some stone is transported more than 500 km. Although frequent use of nonlocal tool stone may (as argued above) suggest movement across large geographic regions, reliance on certain sources within each region reflects considerable knowledge of specific lithic resources. These patterns are probably the result of repetitive use of a region that may represent a hunting territory.

If the argument that frequent use of nonlocal stone indicates highly mobile groups that frequently moved between regions is correct, then these hunting territories most likely represent short-term occupations. Stone transport up to 200 km is common, and provides the maximum size of the procurement range. A distance of 80 km (average width of two basins) is a likely minimum size, since tool stone use is often similar in adjacent basins (Amick 1994a, 1995a). These distances imply that Folsom hunters along the Rio Grande may have commonly operated within territories of about 16,000 square km. This expanse is larger than any single basin.

In contrast, Folsom artifacts on the Southern Plains exhibit a larger pattern of tool stone distribution, which may indicate different land use strategies. Although alternative stone sources are available, Edwards chert accounts for 84 per cent of the Folsom weaponry assemblages on the Southern Plains (Amick 1994b, 1994c, 1995b; Hofman 1991). The primary sources of Edwards chert are found on the Edwards Plateau in the southeastern plains (Fig. 1) yet it accounts for 72 per cent of the Folsom weaponry assemblage from Blackwater Draw, 440 km northwest (not the kind of pattern likely to result from down-the-line trade). In contrast, the earlier Clovis assemblages at Blackwater Draw are dominated by Alibates from sources about 220 km northeast (Hester 1972). Major Folsom workshops and lithic procurement stations occur at Edwards sources (e.g., Tunnell 1977; Wooldridge 1981). This pattern may suggest a regular strategy of gearing up at Edwards sources before exploiting the Southern Plains. The wide distribution of Edwards chert across the Southern Plains shows Folsom groups may have frequently exploited a territory of almost 120,000 square km while occupying that region.

The Edwards procurement range extends to the Tularosa Basin and Jornada del Muerto, where some of the weaponry assemblages contain more than 25 per cent Edwards chert – again, not the kind of pattern likely to result from down-the-line trade (Amick 1994b, 1995a). Edwards sources are 500–600 km east-southeast of the Tularosa Basin yet represent 6.8 per cent of all the Folsom weaponry in the region. Edwards procurement ranges suggest Folsom groups along the Rio Grande are part of a very large land-use system involving movement from the Southern Plains to the Basin and Range.

The reliance on Edwards chert on the Southern Plains thus suggests a system of planned logistical mobility (as defined by Binford 1980), with procurement and transport taking place via extended mobility. In contrast, tool stone use in the Basin and Range does not approach the scale of Edwards movement. In part, this difference is probably because

Table 2 Variation between regional assemblage collections of points and preforms (ranked by point : perform ratio)

Region	*Ratio of projectile points : preforms*	*Ratio of point bases : tips*
North Plains/El Malpais	1.38 (11:8)	1.75 (7:4)
Albuquerque Basin	1.41 (97:69)	1.85 (63:34)
Northern Jornada del Muerto	1.77 (113:64)	1.46 (67:46)
Tularosa Basin	2.90 (383:132)	1.14 (204:179)
San Agustin Plains	3.38 (27:8)	0.80 (12:15)
Southern Jornada del Muerto	6.63 (53:8)	0.61 (20:33)
Southern Plains	10.54 (137:13)[1]	0.80 (56:70)[2]
Estancia Basin[3]	15.00 (15:1)	0.36 (4:11)
Cebollita Mesa	15.00 (15:0)	0.50 (5:10)

Notes

[1] Hester (1972) and Broilo (1971) report 143 points from Blackwater Draw. This study has not verified these artifacts are points rather than preforms so they are omitted.

[2] Fragment data are unavailable for 72 points in this sample and the condition of 83 points from the Blackwater Draw area is unverified. The recommended figure in the table omits these data. Inclusion of the 83 unverified points yields a point base : tip ratio of 1.68 (131 : 78) for the Southern Plains.

[3] Lucy Site collection at the Maxwell Museum of Anthropology, University of New Mexico, Albuquerque.

lithic sources are more widespread in the Basin and Range. However, it may also reflect a more residential land-use strategy (also as defined by Binford 1980) while groups were in the intermontane areas.

Regional variation in weaponry assemblages

Differences in regional weaponry assemblages provide a useful means of identifying functional variation in Folsom settlement and land-use strategies. Table 2 compares the weaponry assemblages in nine regions ranked by the ratio of projectile points to point preforms. The more than tenfold difference in this ratio suggests that some regions are used differently. Although differential recovery biases may account for some of this variation, most collections used in this study failed to discriminate against either point preforms or broken point fragments.

Low point to preform ratios indicate relatively high manufacturing activity and frequent replacement of broken projectile points. This is arguably associated with reduced mobility under a residential pattern of land use. Since the logistical requirements of high mobility are relaxed, points are replaced because of immediate need and are not dependent on material carried from far away. Weaponry replacement is expected to be more continuous when land use does not involve planned logistical movement. Five regions are characterized by low ratios of points to preforms: North Plains/El Malpais (1.38), Albuquerque

Basin (1.41), northern Jornada del Muerto (1.77), Tularosa Basin (2.90), and San Agustin Plains (3.38).

High point to preform ratios imply high discard rates of broken points with minimal on-site manufacture of replacements. This pattern occurs where points are made at the lithic sources and then transported far away. Four regions contain high ratios of points to preforms: Cebollita Mesa (15.00), Estancia Basin (15.00), Southern Plains (10.54), and southern Jornada del Muerto (6.63). Hunting a very mobile and unpredictable resource such as bison under a strategy of high mobility is expected to cause high ratios of points to preforms because access to tool stone sources for point replacement may be reduced. Tool stone conservation strategies are visible on the Southern Plains. Reduction in preform frequencies is partly achieved by lowering the incidence of fluting (Amick 1995b), a risky procedure that often results in manufacturing failure. Other practices include reliance on very large bifacial cores; frequent use of multipurpose tools; and regular tool recycling (Boldurian 1991; Boldurian and Hubinsky 1994; Hofman 1991; Hofman et al. 1990).

Projectile points are mostly broken by impact, and are classified as bases or tip fragments. Point bases were probably generally discarded at residential camps where they were removed from the foreshaft and replaced (Keeley 1982). On the other hand, point tips were most likely lost at killing grounds although occasionally returned to residential camps in animal carcasses (Flenniken 1991). Thus, the ratio of point bases to tips may distinguish hunting versus residential activities. Four regions have high ratios of point bases to tips (Table 2): Albuquerque Basin (1.85), North Plains/El Malpais (1.75), northern Jornada del Muerto (1.46), and Tularosa Basin (1.14). These high ratios indicate the emphasis on weaponry retooling expected to occur at residential locations. In contrast, five other regions have low ratios of point bases to tips: Estancia Basin (0.36), Cebollita Mesa (0.50), southern Jornada del Muerto (0.61), Southern Plains (0.80), and San Agustin Plains (0.80). Here, an emphasis on hunting is inferred since the evidence of projectile point discard exceeds the rate of weaponry replacement.

The ratios of projectile points to preforms, and of point bases to tips, appear to co-vary along a single axis. On the one hand are cases where point base to tip ratios are greater than 1.0, but where the ratio of points to preforms is relatively low and constant. It is proposed that this pattern reflects the stable maintenance of weaponry when mobility is reduced through a strategy emphasizing residential land use. On the other hand are cases where the point base to tip ratios are less than 1.0, and the ratio of points to preforms is relatively high and variable. This variation may reflect the less predictable consumption of tool stone under conditions of high logistical mobility.

Mobility estimates and annual range reconstruction

In modern hunter-gatherer studies, 'range' usually refers to a specific geographic area exploited during an annual settlement round. This study relies on hunting weaponry, so estimates of procurement range probably reflect the most mobile aspect of land use. It is suggested that Folsom hunters in the Southwestern US geared up at Edwards chert sources, then exploited the grasslands of the Southern Plains during summer and early fall, and then moved on to winter in the intermontane Rio Grande Valley. Estimated tool

Table 3 Comparison of various regional locations in New Mexico with territory size and population density among the Nunamiut Eskimo[1]

Location	*Area in square km*	*Lifetime number of minimal bands*	*Annual number of minimal bands*	*Lifetime number of persons*	*Number of breeding units*
New Mexico	311,281	12.0	53.7	311	0.62
Llano Estacado	120,000	4.6	23.2	120	0.24
San Juan Basin	30,514	1.2	5.9	31	0.06
Tularosa Basin	14,042	0.5	2.7	14	0.03
Albuquerque Basin	12,030	0.5	2.3	12	0.02
Jornada del Muerto	11,329	0.4	2.2	11	0.02
San Luis Valley	8,095	0.3	1.6	8	0.02
Estancia Basin	6,147	0.2	1.2	6	0.01
San Agustin Plains	5,363	0.2	1.0	5	0.01
North Plains	2,712	0.1	0.5	3	0.01

Note

1 These figures are adapted from Binford (1983a: Table 1) and include the following estimates for the Nunamiut: band size is 25–35 persons; lifetime range is 25,900 square km per band; annual range is 5,180 square km per band; population density for the lifetime range is 0.001 persons per square km; population density for the annual range is 0.006 persons per square km; 500 people comprise a breeding unit.

discard rates among Paleoindian foragers indicate that tool stone may be completely consumed when transported without replacement for six months (Hofman 1991, 1992). This estimate of lithic consumption is clearly not relevant to all prehistoric hunter-gatherers, but it provides a useful baseline for approximating Folsom mobility rates. Edwards chert moved at least 700 km to reach the Tularosa Basin, and if (as is suggested here) this movement was part of a seasonal exploitation pattern it could have taken less than six months. Therefore, the total annual mobility of some Folsom groups in the American Southwest may have exceeded 1,400 km.

Nunamiut population densities and land-use patterns (Binford 1983a: Table 1) provide a basis for estimating Folsom regional demography. Table 3 uses Nunamiut territory size and population density to compare the scale of various regions in New Mexico. For example, twelve Nunamiut bands can use a territory the size of New Mexico within one lifetime. The Tularosa Basin would not support a single lifetime band but might support two or three bands for one year. Under the Nunamiut land use system, the lifetime number of persons in the Tularosa Basin is estimated at fourteen. The entire area of New Mexico could contain only two-thirds of a single breeding unit (500 persons) using the Nunamiut estimates.

The Nunamiut have the highest mobility rates reported for modern hunter-gatherers, with an estimated annual range of 5,180 km^2 per band. Nunamiut settlement organization is not recommended as a model for Folsom groups, but placement of Folsom within the context of a known hunter-gatherer adaptation is important for several reasons. Most important, the prehistoric record provides a source of additional information about the

Table 4 Comparative data on residential and logistical mobility among hunter-gatherers with large territories

Group	*Average residential moves per year*	*Average distance per move*	*Total distance per year*	*Total area per year*
Cheyenne	33	12 km	396 km	–
Montagnais[1]	13	36 km	470 km	–
Mistassini	10	51 km	510 km	–
Crow	38	19 km	640 km	61,880 km^2
Nunamiut	10	70 km	725 km	63,700 km^2
Piegan	28	30 km	840 km	–
Hypothetical	24	40 km	960 km	90,402 km^2
Hypothetical	30	40 km	1200 km	113,002 km^2
Hypothetical	12	120 km	1440 km	135,603 km^2
Hypothetical	24	60 km	1440 km	135,603 km^2
Hypothetical	36	40 km	1440 km	135,603 km^2

Note

[1] Most figures are derived from Kelly (1983: Table 1). Binford's (1990: Table 12) figures are used for the Piegan (Blackfoot) and Montagnais. Kelly's (1983: Table 1) recommendation of 50 moves per year and 64 km per move for the Montagnais appear to be aberrant in comparison to all other cases.

capabilities and limitations of hunter-gatherers. Mobile hunter-gatherers can use territories that are much larger than archaeologists are accustomed to envisioning. Most of the regions in this study are not large enough to support the lifetime band territory used by the Nunamiut. Folsom populations may have been even more mobile and less dense. As a result, Folsom groups may have incorporated the use of several of these regions within a single year.

Table 4 compares the residential and logistical mobility rates of various hunter-gatherer groups with some hypothetical estimates of Folsom mobility. It was suggested above that some Folsom groups may have moved up to 1,400 km per year. Patterns of tool stone use may thus suggest that the annual range for Folsom groups in New Mexico was two to three times larger than that of the Nunamiut (Binford 1991: Table 12). The average distance of residential movement is at least 40 km when sequential residential territories contain no overlap. These figures result in average estimates of thirty-six residential moves per year and ten days spent at each site. Table 4 contains several hypothetical mobility estimates based on various rates and distances of residential movement. These estimates are not intended to represent Folsom mobility parameters but to illustrate some potential constraints.

Figure 2 compares the mobility rates of twenty-one modern hunter-gatherers with these hypothetical assessments of Folsom mobility. The shaded area represents proposed Folsom movement parameters based on an annual distance of 1,200–1,600 km. The most mobile ethnographic groups are the Nunamiut, Mistassini Cree, Piegan, and Crow (nos 1, 2, 3, and 4 in Fig. 2). In this group, Mistassini Cree are the only pedestrian 'serial foragers' with high residential mobility and little food storage (Binford 1980: 16–17). The Folsom estimates fall outside the range of modern variability; if the reality lay within the estimates,

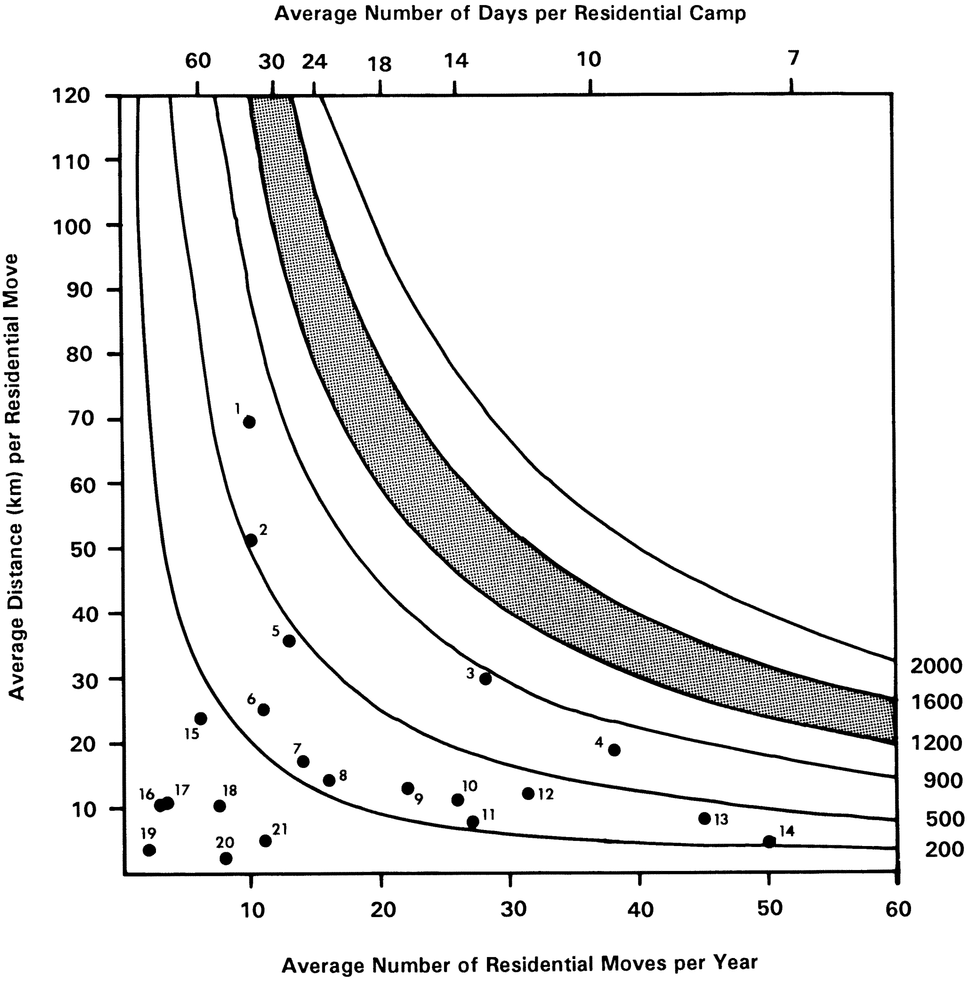

Figure 2 Relationship of annual mobility to the average distance and frequency of residential mobility among modern hunter-gatherers. The shaded area is suggested to represent the hypothetical range of Folsom annual mobility. Key to modern groups identified in this chart: 1 = Nunamiut; 2 = Mistassini Cree; 3 = Piegan; 4 = Crow; 5 = Montagnais; 6 = G/Wi; 7 = Netsilik; 8 = Sirionо; 9 = Aeta; 10 = Semang; 11 = Hadza; 12 = Cheyenne; 13 = Punan; 14 = Guayaki; 15 = Dobe !Kung; 16 = Vedda; 17 = Chenchu; 18 = Birhor; 19 = Ainu; 20 = Andamanese; 21 = Mbuti.

Folsom mobility rates might therefore help expand current knowledge about hunter-gatherer capabilities.

Modern hunter-gatherers require some form of transportation aid when mobility rates are high (Binford 1990). Use of dog travois by pedestrian foragers on the Southern Plains is described by members of the Oñate expedition around AD 1599 (Winship 1896: 570–1). The exceptionally high rates of mobility suggested for Folsom groups could have been facilitated by dogs. Bone attrition patterns at some Folsom sites is consistent with canid ravaging (Jodry and Stanford 1992: 116–17; Zeimens 1982: 215–16) and a dog ulna bearing butchery marks is reported from the Folsom level at Agate Basin (Walker 1982).

Variation in group size

Hunter-gatherer group size is influenced by subsistence benefits and mobility costs. Stuart (1977) suggests group size among the Ona of Tierra del Fuego changed in response to seasonal subsistence strategies: bands numbered about fifty persons when the primary subsistence resource was a large mammal (guanaco or seal), but group decreased to family size and diet breadth increased during seasons when large mammals were not the primary resource. Reducing group size is also viewed as a significant means of lowering mobility costs among hunter-gatherers (Perlman 1985).

Folsom group size may have responded to both factors. High mobility resulted in generally low group size, which may however have increased when subsistence strategies emphasized logistical hunting, e.g. during bison hunting forays on the Southern Plains. The occurrence of a few large sites on the Southern Plains like Shifting Sands (Hofman et al. 1990) may support this idea. Lack of large sites in the Basin and Range may imply smaller groups and broader diets in that environment.

In this analysis, Folsom sites are defined arbitrarily as discrete collections that contain more than one point or preform. Among seventy-two Folsom sites in the intermontane region, the average assemblage contains three to six projectile points and two to five preforms. Site structural studies at Stewart's Cattle Guard in southern Colorado suggest each Folsom hunter maintained five to six projectile points (Jodry 1992; Jodry and Stanford 1992). Assuming each hunter replaced about one to three points per occupation, the average weapon assemblage along the Rio Grande suggests that typical Folsom groups contained only two or three hunters.

Binford (1991: 108) notes that young Nunamiut males travel an average of about six times further than hunting parties that include older males, and concludes that 'hunting is a young man's activity when it is organized logistically'. Logistical hunting is largely a response to scarce and unpredictable game. Day-trip hunting is usually conducted by active, older individual males when game is dense near residential locations. In addition, group size limits the number of young males available for logistical hunting. Thus, Binford (1991: 114) reports that contrary to conventional views of the relationship between labour organization and prey density and patchiness:

> logistical hunting expeditions are most common during the summer months when mobile game is widely dispersed and overall game density is low, but scattered in clumps. . . . Thus, if a hunting party locates and successfully kills game they are apt to obtain several animals. Although search time is great and the actual location of game is uncertain, once the animals are located, risk is reduced, and the chances of obtaining considerable quantities of meat are high . . . and pursuit time is minimal. Coupled with the general lack of alternative foods in sufficient quantity to supplement the dried meat stores, these conditions favor an intensification of labor: individuals participate in increasing numbers of multiperson hunting expeditions that use a 'saturation' strategy. These parties are organized from a large encampment, where the potential labor force of young men is greatest.

This observation has important implications for expectations about Folsom land use. During the summer, bison migrated onto the plains where they were distributed in clumps.

Folsom responses to this pattern might include increasing group size while engaging in logistical hunting. Bison and other game animals were common in the intermontane basins and foothills during the winter. An expected response might be to limit group size and conduct residentially based hunting by individuals.

Archaeological patterns support this model. Large Folsom assemblages and bison kills are generally confined to the Southern Plains, for example, the extensive kill/butchery camp at Shifting Sands (Hofman et al. 1990), and large bison kills at Lipscomb and Folsom (Todd et al. 1990). In the Basin and Range, Folsom bison kills and site sizes are not as large and the occurrence of isolated points is much higher, which may indicate a significant emphasis on individual hunting of single or dispersed game animals (Amick 1991, 1995a; Amick and Stanford 1993).

Intensity and redundancy of Folsom land use

Estimates of the average occupation span of Folsom sites may be suggested from previous archaeological work and comparison with modern hunter-gatherers. Hester (1975; Hester and Grady 1977) suggests Folsom sites on the Llano Estacado were occupied for an average of twenty-two to thirty-two or more days. Mobility studies of modern hunter-gatherers by Binford (1990: Table 12) and Kelly (1983: Table 1) show average occupation lengths for terrestrial hunters that range from six to sixty-one days. Equestrian bison hunting groups such as the Piegan, Cheyenne, and Crow exhibit an average occupation span of ten to thirteen days per residential site. Wheat (1972) suggests fresh bison meat may last for thirty days under average weather conditions. The average occupation span of Folsom sites is estimated to be about thirty days based on these considerations. This figure is probably a long estimate that lessens the possibility of overestimating Folsom mobility.

The Albuquerque Basin contains eighteen Folsom sites and covers an area of 12,030 km^2. Assuming the Folsom period lasted 700 years (Haynes et al. 1992), it is estimated that one known site was formed every thirty-nine years. If each Folsom site in the Albuquerque Basin was occupied for an average of thirty days, the total occupation span would be 540 days for all eighteen sites. This total represents only 0.2 per cent of 700 years. These estimates are limited by site reoccupation and the incomplete survey and exposure of Folsom sites in the Albuquerque Basin. However, if the current sample represents only one-third of the total population of Folsom sites in the Albuquerque Basin, then one site was formed every thirteen years. This rate of sampling error would suggest three more sites in the Albuquerque Basin as large as Rio Rancho, one of the largest Folsom campsites known in New Mexico (Dawson and Judge 1969; Judge 1973). Intensive surveys of the Albuquerque Basin for Paleoindian sites during the past thirty years (Judge 1973; Stuart and Gauthier 1988) make it unlikely that sites of this size remain undiscovered.

Although this exercise is flawed, it demonstrates that Folsom occupation in the basins of New Mexico was limited. Assuming tenfold underestimation of the length of occupation, the total occupation span still would account for only fifteen years. Folsom groups probably used these regions for a few weeks or months at a time before moving on. Eventually, the region may have been reoccupied years, decades, or centuries later.

Summary and discussion

Various lines of evidence and estimation have been used to argue for long-distance seasonal movements between the Great Plains and the Basin and Range areas. Short occupation spans and large territories characterize Folsom land use, and these may not be cyclically patterned. For example, the low frequency of Edwards chert in the Tularosa Basin suggests a connection that is not systematic or long term. Thus, the overall organization of Folsom settlement mobility is forager-based, although the subsistence strategy embraces a logistical hunting strategy. These contrasting strategies suggest that Folsom groups were organized differently in response to different environments. Residential patterns of land use seem characteristic during the winter occupation of the large basins along the Rio Grande Valley. Logistical patterns of land use may distinguish the summer and fall occupation of the Southern Plains, and also the small basins and uplands adjacent to the Rio Grande Valley.

The scale of Folsom land use is inferred to have been enormous in comparison with modern hunter-gatherers. Low human population densities and reliance on hunting mobile bison herds may have expanded the scale of Folsom land use to vast proportions. The archaeological record represented in various individual regions of the American Southwest is only a partial view of the long-term Folsom land use patterns. Investigation of the organizational patterns of Folsom settlement and mobility requires the consideration of territories much larger than those to which archaeologists are usually accustomed (see Binford 1983b: 114–17 regarding this point). Recognition of the immense capacity for residential mobility among Folsom groups reinforces the suggestion that modern hunter-gatherers may not serve as useful ethnographic analogues in Paleoindian studies (Hofman 1994; Kelly and Todd 1988). Conversely, archaeologists can contribute to anthropological theories of hunter-gatherer land use. From the Folsom case, it appears that humans can maintain effective social systems under conditions of very high residential mobility and very low regional population density.

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