Spring 2003

Constructing the Cooper Model of Folsom Bison Kills on the Southern Plains

Leland Bement
University of Oklahoma, Norman

Great Plains Research 13 (Spring 2003): 27-41

CONSTRUCTING THE COOPER MODEL OF FOLSOM BISON KILLS ON THE SOUTHERN PLAINS

Leland C. Bement

Oklahoma Archeological Survey
University of Oklahoma
Norman, OK 73019
Lbement@ou.edu

ABSTRACT—The Cooper model postulates that a dichotomy exists in the size and seasonality of bison kill sites from the Folsom age (10,800-10,200 years ago). This dichotomy is a result of changing settlement and subsistence patterns, from population aggregation in the late summer and early fall for large-scale kills, to a dispersed pattern with small bison kills during all other seasons. Attendant to the change in human population aggregation and number of bison harvested are changes in bison butchering techniques, choice of camp location, and ritual activity. It is postulated that ritual activity of an aggregated group is manifest in the painted bison skull at Cooper. The evidence in support of the Cooper model is presented in summary form.

KEY WORDS: bison kills, Folsom, Paleoindians, Southern Plains

Introduction

The bison-hunting adaptation known as the Folsom culture arose in the wake of the extinction in the late Pleistocene (13,000 to 11,000 years ago) of megafaunal species such as the mammoth, horse, camel, and mastodon (Frison 1991). Centered on the Great Plains and Rocky Mountain range of North America, the Folsom culture is best known for the bison kill sites that dot the landscape (Frison 1987). Less is known of the nonhunting aspects of this culture. A distinctive projectile-point form with fluted faces and lanceolate outline serves as a ready identifier of these people (Amick 1999).

Several archeologists hypothesized that hunters of the Folsom age (10,800-10,200 years before present) followed a pattern of seasonal population aggregation and dispersal, yet evidence for such a pattern remains inconclusive (Wilmsen and Roberts 1978; Bamforth 1985, 1986; Fawcett 1987; Hofman 1994; Amick 1996). By ethnographic standards, small camps indicate widely dispersed population settlements (Binford 1978, 1979, 1980). Large camps in this analogy equate to the aggregation of groups from the small camps. This size dichotomy of the camps may also translate to a size distinction in bison kills. During the late Prehistoric period on the Northern Plains, large bison kill sites are associated with seasonal human population aggregations since large impoundments and jump kills were used to provision the hunters for the lean winter months (Reeves 1978, 1990; Reher and Frison 1980; Verbicky-Todd 1984; Frison 1991; Todd 1991). Kill-site size attributes may allow identification of a similar pattern for Paleoindian cultures.

Recent research at Folsom kill sites on the Southern Plains allows compilation of a suite of traits that can be used to address the seasonal aggregation and dispersal pattern. This evidence is reviewed with the goal of presenting the Cooper model of Folsom-age hunting organization. The Cooper model posits that a dichotomy in bison kill-site size seen during the Folsom period is the result of a seasonal, although not necessarily annual, population aggregation and dispersal mobility pattern. The model suggests aggregated hunters conducted large communal bison kills in the late summer/early fall. During the rest of the year and throughout all seasons in nonaggregation years, Folsom groups fissioned into smaller groups capable of procuring smaller numbers of bison per kill episode.

Methods

To explore the range of variation in the organization of Folsom bison-hunting activity, a suite of traits were compiled for known Folsom sites on the Southern Plains. This information was gleaned from published reports. These traits include the number of animals killed, season of death, extent of bison butchery, presence of associated camp, landform employed for the kill, tool stone types, and evidence of ritual activity.

The number of animals killed is reported as the minimum number of individuals (MNI). The MNI is usually obtained by dividing the number of a particular skeletal bone by the number of those bones in a skeleton (Bement 1999). For example, the recovery of 24 femora indicates the presence of an MNI of 12 bison since there are 2 femora in each bison. This procedure is followed for all skeletal bones. The largest value obtained for all bones analyzed is given as the MNI for the site.

The season of kill is obtained by determining the age at death of the young animals at the site and relating that age to the calving season. The age is determined by a method describing the tooth-eruption sequence and wear pattern derived from modern bison (Reher and Frison 1980; Todd 1991). This technique is generally accurate to a two-month period.

Once the age is determined, it is related to the calving season to obtain the season of death. In the Southern Plains, the bison calving season generally occurs in April. Hence, the season of death is determined by adding the age at death in months to the calving month. An animal determined to be 0.3 years (4 months) old at the time of death would have died in August or September (April plus 4 months).

The extent of bison butchery is determined by characterizing the level of disarticulation and fracturing of the skeletal elements. In general, the more a skeleton is disarticulated, the more intensive is the butchering level (Todd 1987). For the purpose of this analysis, the butchering level is light if large amounts of articulations are preserved in the bonebed. The butchering level is heavy if few articulated bones remain. At the Cooper site, the presence of completely articulated skeletons did not indicate the abandonment and waste of bison, but rather the use of a gourmet style of butchering whereby the meat was filleted from the carcass (Bement 1999).

The determination of the presence of a camp in association with the kill relies on the identification of tool forms and features not usually associated with kill activities. The activities of hide processing, cooking, and tool manufacture, although sometimes ancillary to the butchering of animals, are used to identify a camp. The presence of tool fragments broken during manufacture, as well as tool forms assigned functions as hide scrapers and plant-processing implements, indicate the presence of a camp.

Landforms employed in the kill activity include pond sides, dune traps, cliff jumps, and arroyo or gully traps (Frison 1991). In some cases, the landform type, or containment system, was not identified during the excavation. In these instances, the use of barriers or impoundments constructed of perishable materials (nets, wood, or snowdrifts) is postulated.

Another variable is tool stone type, that is, the number of different stone sources represented in the artifact classes of projectile points and flaked stone butchering tools. A map is made of the distribution of specific stone source areas, which suggests the territory or range traversed by a given hunting group (Hofman 1991) or the home ranges of hunters converging to make a large-scale kill (Reher and Frison 1980). On the Southern Plains, stone sources readily identified at Folsom sites include the cherts from the Edwards Plateau region of central Texas, Alibates agatized dolomite from the Texas panhandle, and Niobrara Jasper from northwestern Kansas (Hofman 1991). Stone types with wider source distributions include the quartzites of the Ogallala formation, which typically appear in less-formal tool types associated with kills (Bement 1999).

A final attribute gleaned from the literature is an indication of ritual activity at the kill site. The purposeful alignment of skulls or other bones, association of painted elements, or the inclusion of musical instruments are among the material remains indicative of ritual activity (Verbicky-Todd 1984). The painted bison skull from the Cooper site (Bement 1999) and the bone feature at Lake Theo (Harrison and Killen 1978) are two manifestations that are assigned ritual connotations.

Results

A search of the literature on Folsom sites on the Southern Plains yielded eight sites representing 11 bison-kill localities with the requisite data. These sites (Fig. 1) and the literature scoured are Cooper (Bement 1999), Waugh (Hofman et al. 1992; Hill and Hofman 1997), Lipscomb (Hofman 1991; Todd et al. 1990; Hofman et al. 1991), Folsom (Hofman 1991; Meltzer et al. 2002), Blackwater Draw (Boldurian 1981, 1991; Hester 1972), Lubbock Lake (Johnson 1987, 1997), and Lake Theo (Harrison and Smith 1975). The bison kills at Bonfire Shelter are not included in this analysis because only a single Folsom projectile point was recovered from deposits dominated by Plainview points, and the Folsom kill could not be segregated from the Plainview kills (Dibble and Lorrain 1968; Bement 1986). Data on the eight sites are presented in Table 1.

One pattern that emerges from this data is the bimodal distribution of bison-kill MNI. The MNI clusters at 2 to 6 animals and at greater than 10 animals. The small kills include the ones at Waugh and Lubbock Lake and the three kills at Blackwater Draw. The large kills include those at the Folsom site, Lipscomb, Lake Theo, and the three kills at Cooper. If the dichotomy in kill number is used to segregate the remaining variables, then other patterns become visible (Table 2). The majority of small kills occur along pond edges, underwent heavy butchering, display a wide range of seasons of kill, and have an associated camp. Conversely, the large kills (MNI >10) are located in gullies, display light butchering, are restricted to the late summer/early fall, and generally do not have an associated camp.

The variables of stone type, bison kill type, and landform are used to investigate the hypothesis that more than one Folsom group participated in the hunt. That premise is based on the presence of projectile points made from stone from disparate sources. For example, Folsom points in the upper

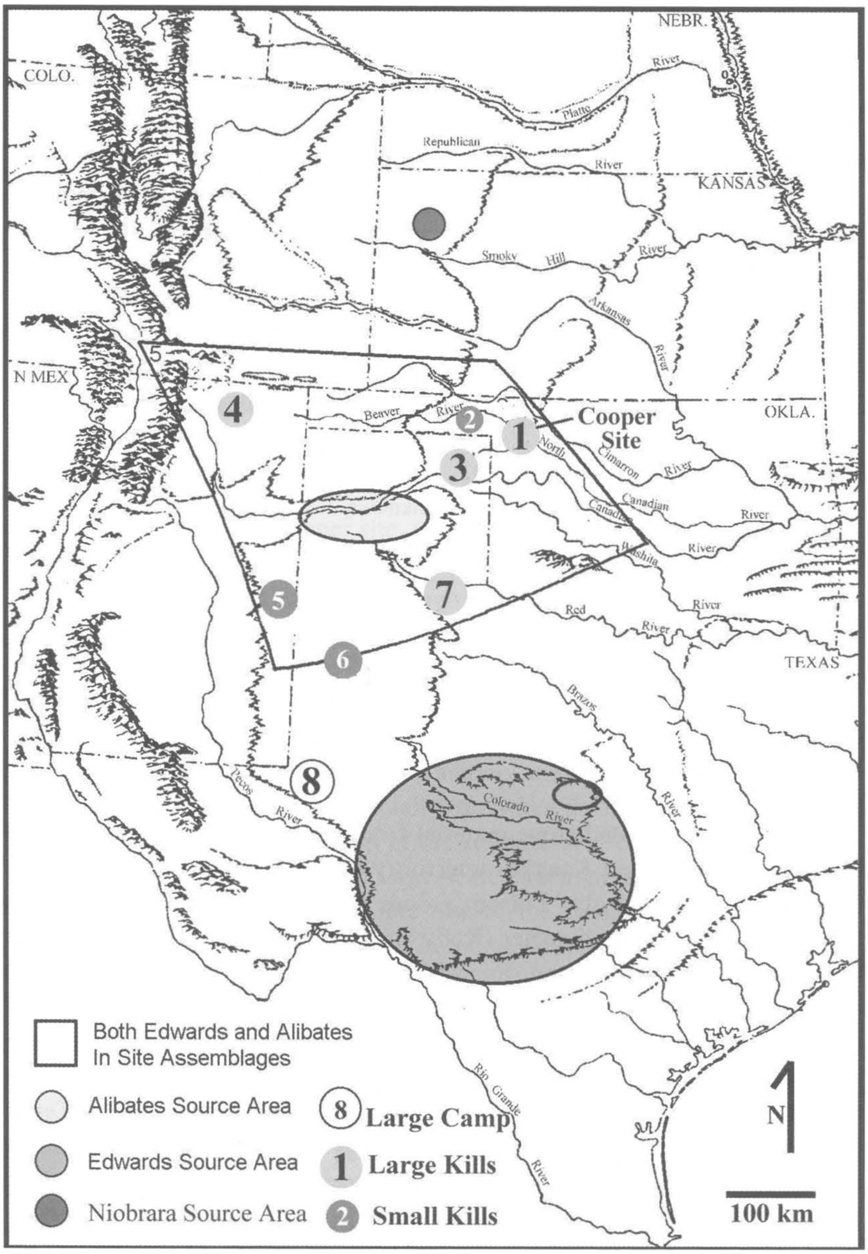

Figure 1. Map of the Southern Plains showing the location of small and large Folsom age bison kill sites, one large campsite, and the location of key stone-source areas. The numbers on the map designate sites listed in Table 1.

TABLE 1
ATTRIBUTES OF THE SOUTHERN PLAINS FOLSOM SITE

Map reference no.	Site name	Type	MNI	Season (yr)	No. of stone types	Butchery	Landform	Ritual
1	Cooper							
	Upper	Kill	29	0.3	3	Light	Gully	
	Middle	Kill	29	0.3	3	Light	Gully	Yes
	Lower	Kill	20	0.3	2	Light	Gully	
2	Waugh	Kill/camp	6	0.8-0.9	3	Mixed	Stream	
3	Lipscomb	Kill	56	0.3-0.5	3	Light	Gully	
4	Folsom	Kill	32	0.4-0.5	3	Unknown	Gully	
5	Blackwater Draw	3 kills	2-5	Unknown	3	Heavy	Pond	
6	Lubbock Lake	Kill	3	Spring	2	Heavy	Pond	
7	Lake Theo	Kill/camp	12+	0.4-0.5	3	Unknown	Unknown	Maybe
8	Shifting Sands	Camp	NA	Unknown	1	NA	Dune field	

Notes: MNI = minimum number of individuals; NA = not available.

kill at Cooper included stone material from central Texas, the Texas panhandle, and northwest Kansas—a territory with a 400 km radius. Although researchers postulate that Folsom groups were highly mobile, covering a range over 400 km in diameter (Kelly and Todd 1988; Hofman 1992), it is also known that while stone from central Texas moved north for over 800 km, stone from the central Plains is extremely rare in Texas. The paucity of Alibates and Niobrara stone in central Texas suggests hunters from these regions rarely, if ever, ventured this far south. The presence of central Texas cherts in their assemblages, however, indicates contact with central Texas groups. The co-occurrence of these various cherts at the large kills in Oklahoma and the eastern Texas panhandle opens the possibility that groups from these regions met to collaborate in large-scale kills (Bement 1999).

The increased manpower provided by the joining of two groups allowed communal hunting in which larger than usual numbers of animals could be killed, assuming a suitable trap or jump locus was available. The larger workforce allowed employment of kill techniques not possible with

TABLE 2
DICHOTOMY OF FOLSOM KILLS ON THE SOUTHERN PLAINS

Small kills	vs.	Large kills
3 to 6 animals		>10 animals
Heavy butchering		Light butchering
All seasons		Late summer/Early fall
Scattered		Plains margins
Encounter/ambush		Communal?
Pond/stream		Gully/Arroyo

smaller groups. At the Cooper site, the combined groups utilized the arroyo trap technique in killing over 50 animals.

Successful pond-side kills, arroyo traps, cliff jumps, and constructed impoundments rely on various numbers of hunters with different levels of organization (Frison 1987, 1991). While five hunters can pull off a successful ambush kill of three animals at pond side, the same five cannot execute a successful arroyo trap of 50 animals. Planning a large kill that employs drive lanes, pushers (herders), and hunters may require the addition of leaders and laborers. This is especially true when the kill technique includes construction of an impoundment or the enhancement of a natural trap. The successful completion of such a large-scale endeavor requires the synchronized activity of a group of people toward the common goal of herding, trapping, and killing a large number of animals. Such activity and organization meets the definition provided by Driver (1990) for a communal activity, in this case a bison kill. The painted bison skull recovered at the Cooper site (Bement et al. 1997) and the bone feature at Lake Theo (Harrison and Killen 1978) are consistent with an expected increase in ritual activity associated with communal activities.

Along with shifts in procurement strategies, butchering patterns changed from the complete carcass dismantling and intensive meat stripping with some marrow processing that attend small kills (Johnson 1987, 1997) to a gourmet strategy of meat filleting from nearly complete carcasses at larger communal kill sites (Bement 1999; Hofman et al. 1991). Consequently, meat transport decisions also varied. At large kills, boneless meat packages were transported to the camp, while at small kills, where the residential move lessened the distance for transport, some meat was carried still attached to the bone for further processing. Bone marrow processing may attend both small and large kills. The extent of this processing is not known. At small kills such as the one at Lubbock Lake, bone fracturing patterns have been attributed to the fashioning of bone expediency tools (Johnson 1987, 1997). The dichotomy of kill-site size, then, is at least partially attributed to the number of hunters available to make the kill. The additional variables of bison and availability of suitable landforms remain to be discussed.

Understanding the movements of the prey species, in this case bison, can aid in reconstructing human movements. If, as some have proposed, Folsom hunters followed the trail of bison herds moving across the Plains (Kelly and Todd 1988), then bison can serve as a proxy source of information on people movement. Tracking bison movements relies on the distinction between local, resident herds that stay within a relatively circumscribed territory and migrating, highly mobile herds that trek across the Plains in search of graze. Whether or not Southern Plains bison migrated is itself a research topic.

On the Northern Plains, stable carbon-isotope ratios from teeth and bone distinguish between resident herds and migrant herds (Chisholm et al. 1986). Their study builds on the premise that different regions of the Plains support different species of plants. Each region has a distinctive $^{13}C/^{12}C$ signature. Bison bone $^{13}C/^{12}C$ values match those values from their home range (once a trophic-level adjustment is made). If an animal has a $^{13}C/^{12}C$ ratio different from that expected for the graze in the area in which it was killed, then it is presumed that this animal migrated to this area from a region with a different grass composition.

On the Southern Plains, a similar study employing strontium (Sr) provides preliminary results that two of the herds found at the Cooper site came to the area from substantially different grassland areas (Bement et al. unpublished data). Strontium is incorporated in tooth enamel during the initial formation of enamel plates on the tooth (Hillson 1986). The amount of Sr in bones and teeth parallels the regional availability of Sr in water, soils, and plants. Comparing the levels of Sr in tooth enamel development at two-month increments with the regional distribution of Sr allows tracking an animal from area to area.

Animals that do not move during the year of enamel development will have values that reflect the seasonal availability of Sr within a small area, signaling a resident herd. Alternatively, the Sr enamel content of migrant

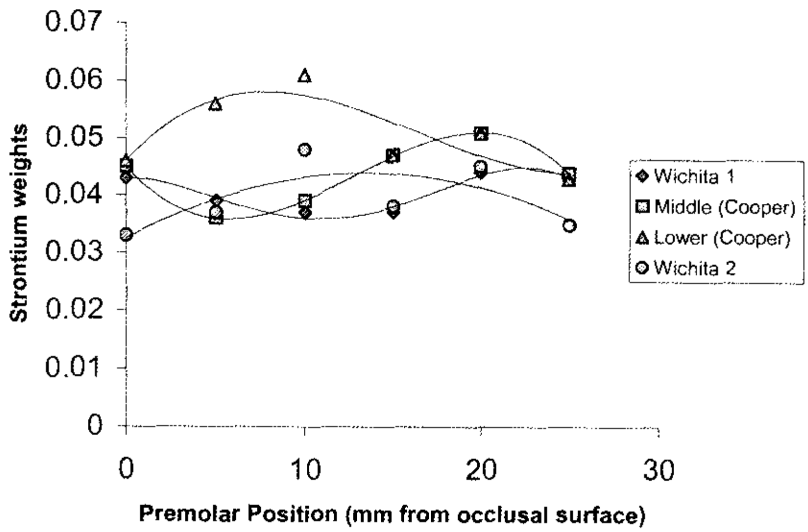

Figure 2. Plot comparing the strontium content at various positions on premolars of bison from two kills (lower and middle) at the Cooper site and from modern bison from the Wichita Mountains Wildlife Refuge. The trend lines provide a visual connection between the points for each sample. The curve defined by the lower-kill sample is different from the other samples, suggesting that the lower-kill animals may have been migrants from areas with strontium levels distinct from both the Wichita Mountains modern samples and the middle-kill animals.

animals would reflect the various Sr levels for the regions migrated through. Teeth from the modern herd at the Wichita Mountains Wildlife Preserve in southwestern Oklahoma provided the range of Sr incorporated in the enamel for a herd with restricted territory, reflecting a resident herd. Samples from the lower and middle kills at the Cooper site were then compared to the control sample (Fig. 2). The results hint that the animal from the lower kill site had spent more time in Sr-rich areas of the Southern Plains than had the animal from the middle kill site. The middle-kill animal more closely matched the Wichita Mountains sample, suggesting that it was from a resident herd or from an area with similar Sr content. Preliminary results from this analysis suggest that the animals killed at the Cooper site were from different herds, including a resident herd at the middle kill, and a migratory or highly mobile herd at the lower kill. During the late summer/ early fall, both herds came to the area of the Cooper site, where Folsom hunters trapped and killed them.

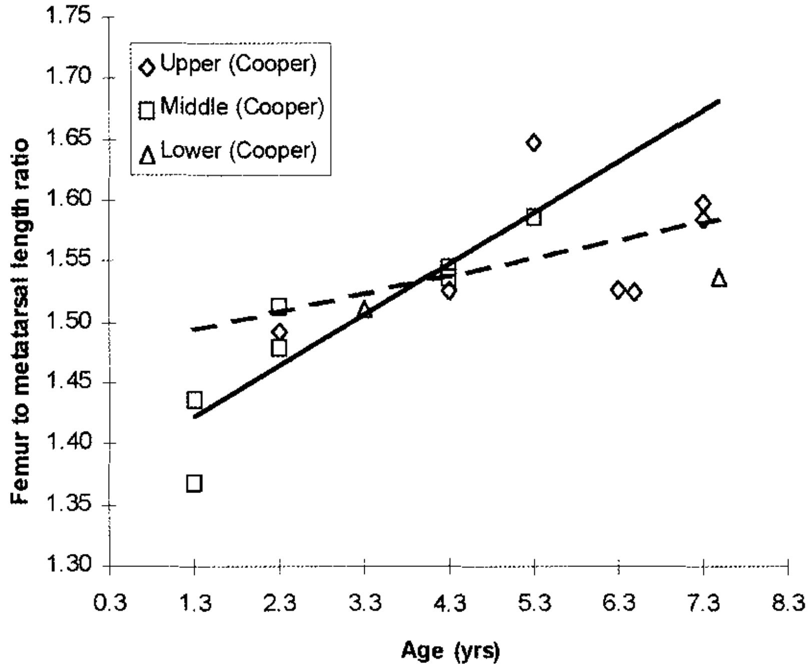

Figure 3. Lines defined by the ratio of femur to metatarsal length by age illustrate the divergence in animal growth seen between the upper- and middle-kill animals from the Cooper site. This divergence suggests that the two herds came from different nutritional areas of the Plains.

Another distinction between herds is defined by the femur/metatarsal length ratio of animals in the upper and middle kills (Fig. 3). This ratio quantifies body size and developmental differences between animals subsisting in areas with distinct nutritional characteristics (Bement 1998). The morph-range differences between these groups indicate that the herds did not graze within the same grassland pastures during the growth years and that the members of one herd were distinct from those of another, indicating that members of distinct herds did not intermingle. Instead, the two distinct herds appeared in the same region during the same season of the year.

In addition to their different patterns of migration, bison herds undergo seasonal shifts in size and composition (McHugh 1958, 1972). These shifts generally follow along age and sex lines and are often driven by the reproduction cycle. The largest congregation of animals occurs during the rut, when bachelor groups mingle with nursery herds. This aggregation is seen during the summer, although large groups may persist into the early fall. During other seasons of the year, bison can be found in smaller groups numbering less than a dozen. Hence, small kills could be the result of hunting during seasons when the bison herds had dispersed into smaller groups and large kills during seasons when the herds were aggregated. But this alone does not account for the apparent clustering of large kills along the periphery of the Plains. This geographical factor deserves further mention.

The featureless plain of the Llano Estacado and the High Plains physiographic unit described for the Oklahoma and Texas panhandles provide few opportunities for hunters to trap large numbers of bison. Arroyos suitable for such traps are limited in number and are available only along the dissected riparian zones of the Red, Canadian, Beaver, and Cimarron Rivers. Possible precipices suitable for jumps are also limited to the caprock canyon areas bordering the Llano Estacado and High Plains. Other features suitable for trapping animals include sand dune areas and playas. The vast majority of geographical features of the Southern Plains lend themselves to ambush or encounter-style hunts that kill only small numbers of bison. Thus, the distributional aspect of the size dichotomy in bison kill numbers could be the result of the availability of suitable landforms.

Arising from this discussion is a hypothesis that is best described as the Cooper model. This model posits that a dichotomy in bison kill-site size during the Folsom period is the result of a seasonal, although not necessarily annual, population aggregation-and-dispersal mobility pattern. The model suggests that large (>10 animals) communal bison kills were conducted in the late summer/early fall by aggregated hunters. During the rest of the year and throughout all seasons in nonaggregation years, Folsom groups fissioned into smaller groups employing an encounter hunting strategy of bison procurement with kills of up to six animals per episode. At small kills, the group moved residentially to the vicinity of the kill site, while at large kills the aggregated population maintained a camp established before the kill, and only a butchering task group frequented the kill site. Large kills may be the only representation of group or communal activity (Davis and Wilson 1978; Frison 1987; Driver 1990).

Conclusion

The Cooper-model hypothesis that bison kills during the Folsom period (10,800-10,200 years before present) reflect a pattern of hunter aggregation and dispersal is presented. Within this pattern, small kills occur during any season of the year and result from the ambush of bison near water sources. Large kills are seasonally restricted to late summer or early fall to capitalize on recurring high numbers of bison (due to aggregation or migration) in areas with arroyos suitable for trapping the animals. The dichotomy defined in kill-site size is also reflected in changing butchering patterns. Animals at small kills receive extensive butchering, while light butchering characterizes the large kills. Maintaining a highly mobile pattern of population movement, Folsom groups occasionally if not cyclically joined to provide the manpower capable of conducting communal bison kills when the requisite number of animals and a suitable trap (arroyo or cliff) were available. The joining of multiple groups offered the opportunity for their members to conduct social activities, one of which led to the painting of a bison skull at the Cooper site. The dichotomy expressed by bison kill-site size, seasonality, and butchering techniques may be the most visible evidence for communal activity available during Folsom times.

References

Amick, D.S. 1996. Regional patterns of Folsom mobility and land use in the American southwest. *World Archaeology* 27:411-26.

Amick, D.S., ed. 1999. *Folsom Lithic Technology: Explorations in Structure and Variation*. International Monographs in Prehistory. Ann Arbor: University of Michigan Archaeological Series 12.

Bamforth, D.B. 1985. The technological organization of Paleo-Indian small-group bison hunting on the Llano Estacado. *Plains Anthropologist* 30:243-58.

Bamforth, D.B. 1986. Technological efficiency and tool curation. *American Antiquity* 51:38-50.

Bement, L.C. 1986. *Excavation of the Late Pleistocene Deposits at Bonfire Shelter, 41VV218, Val Verde County, Texas, 1983-1984*. Texas Archeological Survey. Austin: University of Texas, Archeology Series 1.

Bement, L.C. 1998. *Bison antiquus* skeletal growth and development at the Cooper site. In *International Symposium on Bison Ecology and Management in North America*, ed. L.R. Irby and J.E. Knight. Bozeman: Montana State University.

Bement, L.C. 1999. *Bison Hunting at Cooper Site: Where Lightning Bolts Drew Thundering Herds*. Norman: University of Oklahoma Press.

Bement, L.C., A. Graves, and G. Morgan, unpublished data. Preliminary results of strotium analysis of bison teeth. Oklahoma Archeological Survey, University of Oklahoma, Norman.

Bement, L.C., M. Hyman, M. Zolensky, and B.J. Carter. 1997. A painted skull from the Cooper site: A Folsom bison kill in NW Oklahoma. *Current Research in the Pleistocene* 14:6-9.

Binford, L.R. 1978. *Nunamuit Ethnoarchaeology*. New York: Academic Press.

Binford, L.R. 1979. Organization and formation processes: Looking at curated technologies. *Journal of Anthropological Research* 35:255-73.

Binford, L.R. 1980. Willow smoke and dogs' tails: Hunter-gatherer settlement systems and archaeological site formation. *American Antiquity* 45:4-20.

Boldurian, A.T. 1981. An analysis of a Paleoindian lithic assemblage from Blackwater Draw locality no. 1 in eastern New Mexico. Master's thesis, Eastern New Mexico University, Portales.

Boldurian, A.T. 1991. Folsom mobility and organization of lithic technology: A view from Blackwater Draw, New Mexico. *Plains Anthropologist* 36:281-95.

Chisholm, B., J. Driver, S. Dube, and H.P. Schwarcz. 1986. Assessment of prehistoric bison foraging and movement patterns via stable-carbon isotopic analysis. *Plains Anthropologist* 31:193-205.

Davis, L.B., and M. Wilson. 1978. *Bison Procurement and Utilization: A Symposium.* Plains Anthropologist Memoir 14.

Dibble, D.S., and D. Lorrain. 1968. *Bonfire Shelter: A Stratified Bison Kill Site, Val Verde County, Texas*. Texas Memorial Museum, Austin. Miscellaneous Papers no. 1.

Driver, J.C. 1990. Meat in due season: The timing of communal hunts. In *Hunters of the Recent Past*, ed. L.B. Davis and B.O.K. Reeves, 11-33. London: Unwin Hyman.

Fawcett, W.B. 1987. Communal hunts, human aggregations, social variation, and climatic change: Bison utilization by prehistoric inhabitants of the Great Plains. Ph.D. diss., University of Massachusetts, Amherst.

Frison, G.C. 1987. Prehistoric, plains-mountain, large-mammal, communal hunting strategies. In *The Evolution of Human Hunting*, ed. M.H. Nitecki and D.M. Nitecki, 177-211. New York: Plenum.

Frison, G.C. 1991. *Prehistoric Hunters of the High Plains*. 2d ed. New York: Academic Press.

Harrison, B.R., and K.L. Killen. 1978. *Lake Theo: A Stratified, Early Man Bison Butchering and Camp Site, Briscoe County, Texas*. Canyon, TX: Panhandle-Plains Historical Museum, Special Archeological Report 1.

Harrison and Smith 1975. Excavations at Lake theo Site, PPHM-A917, Briscoe County, Texas. *Panhandle-Plains Historical Reviews* 48:70-106.

Hester, J.J. 1972. *Blackwater Locality No. 1: A Stratified Early Man Site in Eastern New Mexico*. Ranchos de Taos, NM: Fort Burgwin Research Center, Publication no. 8.

Hill, M.E. Jr., and J.L. Hofman. 1997. The Waugh Site: A Folsom-age bison bonebed in northwestern Oklahoma. In *Southern Plains Bison Procurement and Utilization from Paleoindian to Historic*, ed. L.C. Bement and K.J. Buehler. *Plains Anthropologist Memoir* 29:63-83.

Hillson, S. 1986. *Teeth*. Cambridge: Cambridge University Press.

Hofman, J.L. 1991. Folsom land use: Projectile point variability as a key to mobility. In *Raw Material Economies among Prehistoric Hunter-Gatherers*, ed. A. Montet-White and S. Holen, 335-56. Lawrence: University of Kansas, Publications in Anthropology 19.

Hofman, J.L. 1992. Recognition and interpretation of Folsom technological variability on the southern Plains. In *Ice-Age Hunters of the Rockies*, ed. D.J. Stanford and J.S. Day, 193-224. Niwot: University Press of Colorado.

Hofman, J.L. 1994. Paleoindian aggregations on the Great Plains. *Journal of Antrhopological Archaeology* 13:341-70.

Hofman, J.L., B.J. Carter, and M. Hill. 1992. Folsom occupation at the Waugh Site in northwestern Oklahoma. *Current Research in the Pleistocene* 9:22-25.

Hofman, J.L., L.C. Todd, C.B. Schultz, and W. Hendy. 1991. The Lipscomb bison quarry: Continuing investigation at a Folsom site on the southern Plains. *Bulletin of the Texas Archeological Society* 60:149-89.

Johnson, E., ed. 1987. *Lubbock Lake: Late Quaternary Studies on the Southern High Plains*. College Station: Texas A&M University Press.

Johnson, E. 1997. Late Quaternary bison utilization at Lubbock Lake on the southern High Plains. In *Southern Plains Bison Procurement and Utilization from Paleoindian to Historic*, ed. by L.C. Bement and K.J. Buehler. *Plains Anthropologist Memoir* 29:45-61.

Kelly, R.L., and L.C. Todd. 1988. Coming into the country: Early Paleoindian hunting and mobility. *American Antiquity* 53:231-44.

Meltzer, D.J., L.C. Todd, and V.T. Holliday. 2002. The Folsom (Paleoindian) type site: Past investigations, current studies. *American Antiquity* 67:5-36.

McHugh, T. 1958. Social behavior of the American buffalo (*Bison bison bison*). *Zoologica* 43:1-40.

McHugh, T. 1972. *The Time of the Buffalo*. New York: Alfred A. Knopf.

Reeves, B.O.K. 1990. Communal bison hunters of the Northern Plains. In *Hunters of the Recent Past*, ed. L.B. Davis and B.O.K. Reeves, 168-94. London: Unwin Hyman.

Reeves, B.O.K. 1978. Head-Smashed-In: 5500 years of bison jumping in the Alberta Plains. In *Bison Procurement and Utilization: A Symposium*, ed. by L.B. Davis and M. Wilson. *Plains Anthropologist Memoir* 14:151-74.

Reher, C.A., and G.C. Frison, 1980. The Vore Site, 48CK302, a stratified buffalo jump in the Wyoming Black Hills. *Plains Anthropologist Memoir* 16.

Todd, L.C. 1987. Analysis of kill-butchery sites and the interpretation of Paleoindian hunting. In *The Evolution of Human Hunting*, ed. M. Nitecki and D. Nitecki, 225-66. New York: Plenum Press.

Todd, L.C. 1991. Seasonality studies and Paleoindian subsistence strategies. In *Human Predators and Prey Mortality*. ed. M.C. Stiner, 217-38. Boulder: Westview Press.

Todd, L.C., J.L. Hofman, and C.B. Schultz. 1990. Seasonality of the Scottsbluff and Lipscomb bonebeds: Implications for modeling Paleoindian subsistence. *American Antiquity* 55:813-27.

Verbicky-Todd, E. 1984. *Communal Buffalo Hunting among the Plains Indians*. Edmond, AB: Archaeological Survey of Alberta, Occasional Paper no. 24.

Wilmsen, E.N., and F.H.H. Roberts Jr. 1978. *Lindenmeier, 1934-1974: Concluding Report on Investigations*. Washington, DC: Smithsonian Institution, Contributions to Anthropology 24.