Organization of bison hunting at the Pleistocene/Holocene transition on the Plains of North America

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ABSTRACT

This paper focuses on the development of large scale bison hunting across the North American Great Plains. Prehistoric hunters were not merely opportunistic. An understanding of topography, environment, bison behavior, and migration patterns was necessary to perform complex, large scale bison kills. In turn, these kills required the existence of social complexity whereby multiple groups of hunters worked in unison toward a successful kill event. On the southern Plains of North America, evidence suggests large scale bison hunting arose as mammoths and other megafauna became extinct 11,000 radiocarbon years ago. We review this evidence in light of new site discoveries.

1. Introduction

During a nearly 11,000 radiocarbon-year reign devoted to bison hunting, Native American hunters added several large-scale kill techniques, including arroyo traps, dune traps, corrals, and jumps, to their more typical small-scale, pond-side, single animal kill repertoire. Many of these techniques were developed by the end of the Younger Dryas ca. 10,000 radiocarbon years before present (BP) and all were widely employed by 5000 BP. The development of these various trap techniques stems from an understanding of bison behavior. Arroyo traps are the earliest evidence for large-scale kills in North America, jumps developed later. This paper provides a general discussion of herd manipulation and bison hunting in North America with the use of two case studies to demonstrate trends in large-game hunting. The following section provides theoretical background.

In many parts of the world the development of specialized large-scale hunting of ungulates employing traps and containment systems (pounds) coincided with major environmental perturbations (Krotova and Belan, 1993; Straus, 1997, p. 166). The magnitude of environmental shifts altered vegetation structure and herd behavior, leading to the development of migration patterns. Established migration patterns enabled hunters to predict and exploit seasonal increases in prey density (Wisehart, 2005; Graves, 2010). Under these conditions, the animals were susceptible to human manipulation.

This research falls under the overarching umbrella of landscape archaeological theory. Landscape theory can simply be defined as the fundamental nature in which people relate to the ecological spaces they occupy (Anschuetz et al., 2001). The application of cyclical nucleation under the larger theoretical framework of landscape theory provides a transformatory way to view Paleoindian bison hunting that generates new hypotheses and expectations, while acknowledging the substantial resource base these kill events produced.

North American bison kill sites, once only thought to fulfill procurement and subsistence needs, are currently being reassessed from a social perspective (Hayden and Dietler, 2001; Speth, 2010). Often the bison kill is only one component of a site complex also containing a processing area, camp, and ritual area (Zedeno, 2011). One possible interpretation of these communal complexes incorporates cyclical nucleation (rendezvous or aggregations) and ritual observances with the execution of communal bison hunts that employ large bison jumps, pounds, or arroyo traps (Bement, 1999; Cooper, 2008; Bamforth, 2011; Carlson, 2011).

Cyclical nucleation is the scheduled aggregation of multiple subsets of band society at a predetermined node or location (Schaedel, 1995; Turpin, 2004). Band amalgamation allowed otherwise dispersed groups to perform acts outside their usual capacities. These acts comprised communal events such as large-scale hunting, and social networking including information exchange, feasting, mate selection, trade relations, and social bond reinforcement. To participate in macroband activities, dispersed groups required a time and place to meet. A node was needed in a predictable location and at a time of the year when a resource surplus was available to support the accumulation of a large number of people. A herd of predictably migrating bison and a topographic feature such
as an arroyo or jump provided this predictable node. This interpretation is at odds with the alternative perspective that early large-game hunters were highly dispersed groups traveling across large areas (Kelly and Todd, 1988), with few opportunities for aggregation (Hofman, 1994). This alternative perspective will be discussed further in subsequent sections of this paper.

Bison were a key component to the life of Plains hunters (Frison, 2004). Bison are herd animals, travel in groups, tend to pack together to avoid predators, and flee as a herd rather than scatter, making them a prime target for human hunters. High bison populations were necessary for hunters to manipulate herds into traps. The extinction of mammoths and other large grazing animals may have contributed to increased bison population levels and range expansion by reducing competition for resources (Lewis et al., 2010). Environmental shifts may have had consequences for bison carrying capacity. Paleo-environmental reconstructions for the Younger Dryas indicate the development of expansive grasslands sufficient to support greater bison densities (Holloway, 1993; Cummings, 1996; Connin et al., 1998; Larson et al., 2001; Hoppe, 2006; Melzer, 2006; Bement et al., 2007; Holliday et al., 2011).

Bison behavior plays a crucial role in a successful hunt. Herd composition varies seasonally (Brink, 2008). Cows and bulls converge during the rutting season. The rest of the year, cows and bulls split into bull herds and cow/calf herds. The rut occurs from July through early August. Calving occurs in April or May after a nine-month gestation period. Animal condition also varies seasonally (Brink, 2008). Females carry the most fat throughout the year, making them the prime hunting target. Bulls carry the most fat during the rutting season, but in that season hormones render the meat undesirable (Audubon and Bachman, 1846; Brink, 2008).

The final factor of the hunting system is the hunters. Group aggregations may have been necessary to amass the necessary manpower to carry out these complex drive systems (Frison, 2004; Brink, 2008; Kornfeld et al., 2010). The rise of social complexity was hypothesized that Folsom groups utilizing the Edwards Plateau as needed along seasonal rounds. The other interpretation posits the direct procurement of various sources by a single group was summarized by Jack Hofman (1991). Hofman hypothesized that Folsom groups utilizing the Edwards Plateau cherts from central Texas followed an east–west annual round, turning northward on the Llano Estacado in west Texas. Minor amounts of Tecovas and Alibates chert from sources in the Texas panhandle signaled that central Texas Folsom groups visited those source areas directly and refurbished their tool stores as Edwards chert supplies dwindled. The recovery of Folsom points made from distant stone sources fit with the highly mobile lifestyle reconstruction for these early Paleoindians.

The paucity of Alibates points and tools in central Texas assemblages, however, was enigmatic. The alternative argument for separate home ranges is also apparent in this same study. Hofman raised the possibility that a separate Alibates territory existed based on the Folsom, New Mexico, site assemblage and dominance of Alibates chert in Oklahoma panhandle surface collections (1991, p. 343). The investigation of new Folsom sites in northwestern Oklahoma has identified some assemblages dominated by Alibates chert (Table 1; Bement, 1999; Bement et al., 2012), possibly supporting the existence of a separate Alibates Folsom home range. A separate Alibates home range would account for the lack of Alibates chert Folsom artifacts in central Texas. Alibates chert Folsom material usually moves north, east, and west of the source area (Hofman, 1991), a pattern established during the Clovis Period (Holen, 2001, p. 177).

### Table 1

<table>
<thead>
<tr>
<th>Site/component</th>
<th>Alibates chert</th>
<th>Edwards chert</th>
<th>Morrison Quartzite</th>
<th>Smoky Hill Jasper</th>
<th>Petrified wood</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jake Bluff – Clovis</td>
<td>55.6% (5)</td>
<td>66.7% (2)</td>
<td>33.3% (3)</td>
<td>11.1% (1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jake Bluff – Folsom</td>
<td>42.9% (3)</td>
<td>57.1% (4)</td>
<td>9.1% (1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooper – Lower</td>
<td>9.1% (1)</td>
<td>81.8% (9)</td>
<td>5.3% (1)</td>
<td>9.1% (1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooper – Middle</td>
<td>68.4% (13)</td>
<td>21% (4)</td>
<td>5.3% (1)</td>
<td>12.5% (1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooper – Upper</td>
<td>75% (6)</td>
<td>12.5% (1)</td>
<td>93% (9)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Badger Hole</td>
<td>75% (6)</td>
<td>12.5% (1)</td>
<td>93% (9)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The idea that the amalgamation of disparate lithic source materials in a site assemblage may indicate the aggregation of groups from different regions has been previously proposed (Wilmsen and Roberts, 1978; Reher and Frison, 1980; Jodry, 1999). A case for the simultaneous occupation of the same site by different Folsom groups based on lithic stone types can be made at the Lindenmeier site in Colorado (Wilmsen and Roberts, 1978; LaBelle, 2012). This has been postulated by Jodry (1999) as well as Stewart’s Cattle Guard site in the San Luis Valley of Colorado.

The joining of otherwise autonomous groups has implications for the social organization of early Paleoindians during the Folsom period and is considered in the following discussion. Archaeologically, aggregation sites contain larger-than-normal artifact assemblages. These assemblages are often accompanied by a higher diversity or richness of cultural items, exotic materials, curated and recycled tools, and artifacts in late-stage reduction (Hofman, 1994; Veth, 2006, p. 270). Further discussion on aggregation and lithic materials will be discussed below; but first the organization of the structure of bison jumps on the northwestern Plains is presented as an example linking social organization with bison behavior in large-scale kill events.

A comparison of bison jumps across the northwestern Plains and an arroyo trap complex on the southern Plains provides an opportunity for understanding multiple factors pertinent in the manipulation of large herds for large-scale bison kills. The success of a large-scale bison kill relies on the knowledge and ability of hunters to intercept herds of bison and maneuver those herds to kill areas. The following section outlines the importance of herd manipulation and topographic understanding among large-game
2. Herd manipulation on northwestern Plains jumps

Herd manipulation is apparent on the northwestern Plains where cairn-lined drive lanes delineate preplanned routes leading to jump precipices. Aggregated groups of large-game hunters would gather typically in the late fall to carry out complex bison jumps (Verbicky-Todd, 1984; Frison, 2004; Brink, 2008; Zedeno, 2011). These bison jump systems appear in the archaeological record for over 5000 years. People of the northwestern Plains employed communal bison hunting strategies that required inter-band cooperation, topographic understanding, and a sophisticated knowledge of animal behavior. A bison jump is a communal hunting method employed by prehistoric hunters that involves running the lead animals in a stampeding bison herd over a cliff. Bison jump sites occur from Alberta, Canada, to Texas, United States. Bonfire Shelter in Texas (Fig. 1) could be the oldest known bison jump site at 10,230 ± 160 BP (TX153; Dibble and Lorrain, 1968:33), predating Head-Smashed-In (in Alberta, Canada) by 5000 years (Bement, 1986; Byerly et al., 2005; Brink, 2008).

In any large-scale hunt, bison must first be moved from their grazing basin, often referred to as a milling area, to the kill area. In the case of arroyo traps, the steep arroyo walls marked the path to move animals from the milling area to the trap. In the case of jumps, hunters marked the paths, referred to as drive lanes, with rock cairns. Prehistoric rock cairns create a map of drive lanes across the landscape. For example, at Head-Smashed-In, prehistoric hunters constructed more than 500 drive lane cairns to help guide bison herds to the critical jump point (Reeves, 1978, p. 154).

The working of the cairns lining the drive lanes is a source of ongoing debate among Plains archaeologists. The initial assumption was that people positioned themselves along either side of the drive lanes near the cairns or in some cases hiding behind them in order to keep the bison within the drive lanes. As the bison ran through the drive lane, the hunters may have flapped hides and shouted to direct the bison through the lane (Schaeffer, 1978). Ongoing research however has dismissed this theory (Brink, 2008). Ethnographic accounts indicate that cairns were likely used in conjunction with twigs, brush, and flags creating a path of moving objects that a bison with poor eye sight could not distinguish from a real person. This method of cairn use requires far fewer individuals in order to drive bison to the kill point.

Bison will not stampede over an obvious cliff. The drive lane topography must therefore obscure the bison’s view of the drop-off point. If the herd detects the trap or cliff early, the animals will shift away, posing a substantial risk to hunters. In a successful jump the inertia of the herd pushes the lead animals over the cliff after which some hunters gather at the base to slaughter bison that survive the fall. Successful jumps require herds of 50–100 animals (Frison, 1987, p. 196). The development and function of these hunting methods suggests not only high levels of coordinated human activity, but also a deep understanding of bison behavior as well as complex decision-making by hunters in response to bison behavior (Brink and Rollans, 1990:164).

2.1. Methods

In a study of eight bison jumps spanning a distance of 1280 km (800 miles) across the northwestern Plains similarities arose that provide insight into the way large-scale kills occurred (Fig. 1: Carlson, 2011). All eight sites have milling areas, drive lanes, and cliffs. The cliff is hidden from view by the topography in all eight cases. The relatively short drive lanes when mapped and assessed by Least Cost Path Analysis, illustrate herd manipulation from milling area to jump.

Least Cost Path Analysis is applied through a geographic information systems (GIS) program such as Esri GIS. A digital elevation model (DEM) is used as a base map. This DEM is then ranked with a cost based on topographic slope. Low relief topography incurs a lower ranking while high relief topography gets a higher ranking. The Least Cost Path Analysis will locate the route outlined by least ranking values between two points to determine a path of least resistance. With the use of Least Cost Path Analysis Carlson (2011) determined that six of the eight jumps compared had marked drive lanes that followed a path of least cost across the landscape (Fig. 2). The drive lane systems at the other two sites were too poorly preserved for GIS analysis. The conclusion of Least Cost Path Analysis indicates that prehistoric hunters applied extensive knowledge of the landscape to aid in moving bison. Hunters carried out these complex and difficult drives by using the topography to their advantage in drive lane construction.

2.2. Conclusions

After conducting GIS analysis, visiting eight sites, and surveying the landscape, Carlson (2011) concluded that bison drive lanes were determined by the use of natural topography in conjunction with knowledge of bison behavior. Cairns lines occurred where control of the bison appears to be the most important in the drive, for example, in tight turns, and along ridge edges. The cairns draw a clear map of where the bison needed to run in order to have a successful jump. The use of modern geographic information systems illustrates that prehistoric hunters on the northwestern Plains had a sophisticated knowledge of topography and animal behavior. Cairns-lined terrain maps were built to guide large bison herds at a stampede over a cliff sometimes no wider than 20 m. The cliffs were ingeniously chosen with bison behavior in mind, hiding...
the precipice from view until the last 10–15 m of the drive. Topography is a key element in these successful bison jumps, but bison behavior clearly was taken into consideration during the entire process from milling area to cliff.

3. The Beaver River Complex on the southern Plains

On the southern Plains, arroyo traps replace jumps as the most common large-scale bison killing system (Cooper, 2008). On the southern Plains the drive lane systems (arroyo walls) are absent, having washed away after thousands of years of erosion. What remains are remnants of intact bonebeds. The Beaver River Complex illustrates herd manipulation in a different setting and time period than northwestern Plains jumps. Arroyo traps are the earliest-known form of large-scale bison hunting dating back to the Clovis period (Bement, 1999; Kornfeld et al., 2010). Three arroyo traps along the Beaver River comprise the Beaver River Complex (Bement et al., 2012). All three employ steep-walled dead-end arroyos that open onto the floodplain of the Beaver River (Fig. 3).

3.1. Jake Bluff site

The earliest site of the Beaver River Complex is the Clovis-age Jake Bluff site (Fig. 3; Bement and Carter, 2010). The activity at Jake Bluff dates to 10,838 ± 17 BP (Bement and Carter, 2010), post-dating all known Clovis mammoth kills and earning Jake Bluff a position as one of the latest Clovis sites in North America (Waters and Stafford, 2007; Holliday and Meltzer, 2010). The Clovis kill consisted of a cow/calf herd of at least 22 individuals (Table 2) driven up the arroyo to the knickpoint. A single black bear was also killed by the Clovis hunters. The kill took place during early fall. The associated projectile points, flake knife, and resharpening flakes are made of lithic raw material from the Texas panhandle and far western Oklahoma panhandle at distances of 250 km and 350 km, respectively (Table 1). In addition to the Clovis kill, a Folsom layer occurs 1 m above the Clovis kill. Small fragments of bison bone are scattered within the deposit and the lithic assemblage consists of one Folsom projectile point, several resharpening flakes, and caliche cobbles of undetermined use. The lithic material comes from central Texas at a distance of 400 km (Table 1; Bement and Carter, 2010).

3.2. Cooper site

A distance of 400 m separates Jake Bluff from the three kills in the Cooper site arroyo (Bement, 1999). The Cooper bonebeds are characterized by dense accumulations of overlapping articulated skeletons. These bones are adjacent to the knickpoint or headward end of the paleoarroyo. Orientation of the articulated skeletons indicates the bison were herded up the arroyo to the dead-end knickpoint where the lead animals attempted to turn around, only to be stalled by the animals coming up the arroyo. The three bonebeds contained minimum numbers of individuals (MNI) of 29, 29, and 20, respectively (Table 2). Each group consisted of cows, calves, and juveniles. All three kills occurred in late summer/early fall. The selective butchering targeted the hump and ribs of animals of all ages (Johnson and Bement, 2009). The combined lithic assemblage of projectile points, flake knives, and resharpening flakes consisted of raw materials from central Texas, Texas panhandle, northwest Kansas, and possibly the Colorado foothills at distances of 450 km, 250 km, 300 km, and 600 km, respectively (Table 1).

Table 2

<table>
<thead>
<tr>
<th>Site</th>
<th>Radiocarbon date</th>
<th>MNI</th>
<th>Seasonality</th>
<th>Herd demographics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jake Bluff Clovis</td>
<td>10,838 ± 17</td>
<td>22</td>
<td>Late Summer/early fall</td>
<td>Cow/calf</td>
</tr>
<tr>
<td>Cooper-upper</td>
<td>10,505 ± 40</td>
<td>29</td>
<td>Late Summer/early fall</td>
<td>Cow/calf</td>
</tr>
<tr>
<td>Cooper-middle</td>
<td>10,535 ± 40</td>
<td>29</td>
<td>Late Summer/early fall</td>
<td>Cow/calf</td>
</tr>
<tr>
<td>Cooper-lower</td>
<td>10,600 ± 45</td>
<td>20</td>
<td>Late Summer/early fall</td>
<td>Cow/calf</td>
</tr>
<tr>
<td>Badger Hole</td>
<td>10,300 ± 25</td>
<td>10</td>
<td>Late Summer/early fall</td>
<td>Cow/calf</td>
</tr>
</tbody>
</table>
3.3. Badger Hole site

The third arroyo trap is found at the Folsom-age Badger Hole site (Bement et al., 2012). It is located 300 m upstream from Jake Bluff and 700 m upstream from Cooper. The Badger Hole bison (MNI = 10; Table 2) are not at the knickpoint of the arroyo, but instead are closer to the mouth of the arroyo. The knickpoint of the arroyo has been washed away by later cut and fill sequences and only a small remnant of the original kill remains intact. The animals indicate a cow/calf herd was slaughtered during the end of summer/early fall, mirroring the seasons at Jake Bluff and Cooper.

At Badger Hole, the skeletons do not overlap. The difference between Badger Hole and Cooper may be the result of the position of the excavated areas in relation to the knickpoint. Carcasses jammed against the knickpoint provide little room for subsequent butchering activities. Bison farther down-arroyo from the knickpoint where the arroyo broadens, may not be so densely packed, allowing butchers more mobility around the carcasses. The presence of broken skulls and spirally fractured long bones at Badger Hole may signify that butchers were better able to access the carcasses and more fully butcher the animals. Cutmarks, however, are only found in the hump and rib areas, identical to the distribution in the Cooper site kill episodes which is consistent with the selective butchering patterns discussed elsewhere (Johnson and Bement, 2009).

The stone assemblage of four Folsom points, two flake knife fragments, and several resharpening flakes is dominated by stone from the Texas panhandle with lesser amounts of central Texas and western Oklahoma panhandle sources also included. These source areas lie 250 km, 400 km, and 300 km, respectively, from the Badger Hole site (Table 1).

3.4. Interpretation of the Beaver River Complex

The development of the arroyo trap technique in this area of the southern Plains was possible because of the existence of suitable short, steep-walled arroyos, large numbers of bison – at least seasonally – and the requisite numbers of hunters with the knowledge of arroyo trap hunting methods. The presence of artifacts from distant lithic raw material sources raises the possibility that hunters from different regions came together to conduct large-scale bison hunts (Bement et al., 2012), similar to the group aggregation apparent in northwestern Plains bison jumps.

The Beaver River Complex provides the opportunity to understand the development of herd migration as it relates to large-scale hunting. In order to track bison herd movement the use of stable isotope analysis and trace element analysis were applied (Chisholm et al., 1986; Graves, 2010; Julien et al., 2012). A resident herd was indicated if all individuals yield a tight cluster of stable δ¹³C and δ¹⁵N results (Chisholm et al., 1986). A migrating herd would display greater variability in stable δ¹³C and δ¹⁵N isotopic results than a resident herd (Chisholm et al., 1986; Tieszen, 1998; Hoppe and Koch, 2007; Julien et al., 2012).

Just as geologists collect hand samples as they walk across different geologic formations, ungulates pick up trace amounts of elements as they graze across the landscape. Bison ingest trace elements dissolved in water, adhering to plants, or directly through geophagy (ingestion of sediment). Some of these elements are incorporated in tooth enamel during amelogenesis (Hillson, 2005). This minute geologic signal can be extracted from the enamel in down-tooth increments representing known time slices, and, when tied to known geographical source areas, provide a map of the areas traversed by the animal during enamel formation (with a slight time delay from consumption to amelogenesis).

The down-tooth results can be used to map the movement of the individual across the landscape if the geographical distribution of signature elements is known. On the southern Plains, the area signatures are provided by analysis of tooth enamel from modern bison born and raised within small ranches in disparate locations. By using modern bison teeth, trace element signatures were demonstrated to be incorporated in bison tooth enamel, thereby circumventing the expensive and drawn out arduous task of tracking the movement of each trace element through the ecological system/food chain. The modern teeth provide a geo-reference against which the prehistoric samples can be compared and plotted to approximate movement. The fourth premolar enamel forms over the course of approximately 12 months while the third molar enamel forms over 18 months (Niven et al., 2004; Graves, 2010; Widga et al., 2010; Julien et al., 2012) making it the ideal sample for comparison.

State-of-the-art laser ablation time of flight inductively coupled plasma mass spectrometry of tooth enamel sampled down the tooth at set intervals starting at the crown provides chemical characterization of the areas traversed by the animals during the time of tooth enamel amelogenesis. Down-tooth sampling provides a time stamp; 5 mm increments reflect every 2 months (Graves, 2010), 1.5 mm increments reflect every 2 weeks (Graves and Bement, 2012) on the mandibular p4.

In an effort to determine the extent of bison mobility during early Paleoindian times on the southern Plains, Graves (2010) matched trace element signatures obtained from known tooth enamel developmental stages with the distribution of select geographically restricted trace elements. The results: Bison mobility patterns ranged from resident/restricted movement covering ca. 100 km during Clovis times (10,850 BP), to migrations across an area with a 300 km diameter during middle Folsom times (ca. 10,500 BP); and finally covering a maximum migration diameter of 600 km by late Folsom times (10,300 BP) (Fig. 4). Migration followed east-west trajectories; calving during spring in the west, rutting during summer in transit from west to east, wintering in the east and then...
completing the cycle back to the west for spring calving (Fig. 4). At its greatest migration during late Folsom times, calving occurred in north central New Mexico, rut in the Oklahoma and Texas Panhandles, and wintering in eastern Oklahoma/southeastern Kansas; a one-way straight-line distance of 600 km (Graves and Bement, 2012).

The use of the arroyo bison trap technique along the Beaver River began by 10,838 ± 17 BP at Jake Bluff. Cooper kills date to 10,620 ± 45 BP at the lower kill, 10,535 ± 40 BP at the middle kill, and 10,505 ± 40 BP at the upper kill level (Johnson and Bement, 2009). Badger Hole now extends the arroyo bison trap hunting complex to at least 10,300 ± 25 BP. The 500 radiocarbon-year duration of the Beaver River bison hunting complex transitions from Clovis to Folsom periods. This suggests that conditions persisted from late Clovis through Folsom times, enabling arroyo trap kills to continue in this region. Folsom people elaborated on the Clovis adaptation to make arroyo kills one of Folsom hunters’ hallmark attributes.

The seasonality of the Beaver River Complex consistently indicated these kills occurred in the late summer/early fall. The repeated late summer/early fall season for the Beaver River Complex and other large-scale Folsom-age bison kills in the region (Bement, 2003) suggests patterning in the movement of bison, mobility strategies of hunting groups, or both made bison hunting predictable and reliable in this area. That all three sites date to the Younger Dryas chronozone following the initial cold snap ca. 10,900 BP but before the ending warm-up ca. 9800 BP indicates the conditions for the development and continuation of this style of bison hunting persisted for hundreds of years. Continued refinement of the paleoenvironmental reconstruction for this area will elucidate the context of this adaptation. Initial results from stable carbon and nitrogen isotope analysis of bison bone collagen and trace element analysis of bison tooth enamel suggest the grassland structure and bison mobility patterns evolved during this interval, leading to development of set migration patterns (Graves, 2010; Graves and Bement, 2012). These hunters may have planned their hunts to intercept the migrating herds (Fig. 4).

In summary, the Beaver River bison hunting complex consists of large (>20 bison), late summer/early fall, arroyo traps manned by groups from various southern Plains regions or alternatively a single group carrying multiple raw material types from western Oklahoma panhandle, Texas panhandle, and central Texas. Occasional inclusion of individuals or the visitation of lithic sources at even greater distance within the central Plains is suggested by the occasional occurrence of tools or points made from sources in northwestern Kansas and eastern Colorado (Bement, 1999). The Beaver River Complex has the highest-density Folsom site concentration in this area of the southern Plains. Together these sites belie a Folsom bison hunting complex that is structured on bison concentration, arroyo formation, and seasonally redundant intercept patterns by Folsom hunters.

4. Concluding remarks

In conclusion the archaeological record of bison kill systems is complex. The interplay between environment, landform, bison mobility, and hunter mobility are just a few of the variables that must be considered before large-scale bison hunting adaptations can be understood. Based on this research it is reasonable to assume that Paleoindian and later hunters could predictably intercept migrating bison. By combining hunting band aggregations, seasonal movement of bison, and locations or nodes containing the requisite landforms for traps or jumps, Paleoindian and later hunters developed successful large-scale hunting adaptations. The success of this adaptation ultimately rested on the hunters’ ability to manipulate bison groups from milling areas to the kill areas. The southern Plains Beaver River Complex is proposed to be an example of a node where various early Paleoindian groups converged to conduct communal bison kills. This cursory view of northern and southern Plains bison hunting strategies sets the stage for expanding the investigation into large-scale hunting adaptations in other areas of the world and incorporating other ungulate species.

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References


