Quaternary International xxx (2016) 1–10

Contents lists available at ScienceDirect

Quaternary International

journal homepage: www.elsevier.com/locate/quaint

North American Great Plains bison bonebeds: Exploring human impacts to scavenging carnivores through carnivore utilization taphonomy

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A R T I C L E I N F O

Article history:
Available online xxx

Keywords:
Zooarchaeology
Taphonomy
Carnivore modification
Bison bonebeds
Human–animal relationships

A B S T R A C T

Data concerning carnivore modification and utilization of North American zooarchaeological assemblages have often been used to understand site formation processes and rarely discussed beyond descriptions of tooth marks present or overall percentages of elements with modifications. This paper describes the results of a taphonomic analysis concerning degree of carnivore utilization for eight bison bonebeds from Wyoming and Colorado (Casper, Jones-Miller, Horner II, Hawken, Cordero Mine, Kaplan-Hoover, Cache Hill, and Glenrock). Carnivore utilization is used to identify patterns in overall use of carrion material as opposed to recording discrete modification marks such as punctures or pits. Results demonstrate carnivore utilization varies temporally, with assemblages from the Paleoindian and Late Plains Archaic periods exhibiting abundant tooth marks and the heaviest utilization of bison carcasses, and assemblages from the Early to Middle Plains Archaic periods displaying the least amount of utilization. These results are evaluated with a consideration of carnivore scavenging behaviors to elucidate relationships between humans and carnivores, specifically with regards to changes in human population sizes. By scavenging human-produced carrion, carnivores built a reliance on humans, further demonstrating the long-term impacts humans had on carnivore behaviors.

1. Introduction

North American archaeological interests in the importance of carnivore gnawing marks often focus on descriptive statistics regarding bone subtraction or biasing of bone assemblages in human-killed bison sites. This paper seeks to broaden the goals of New World taphonomy by using carnivore modification and utilization as an explanatory tool to clarify past interactions of scavengers (non-human carnivores) and hunting predators (human groups) in Great Plains prehistory.

The Great Plains are known for an abundance of prehistoric bison bonebeds. Unfortunately, carnivore modification at these sites was seldom documented in early reports, and if recorded, rarely discussed in great detail. After significant publications by Binford (1981) and Brain (1981), however, many researchers began to describe carnivore modification at bison bonebeds (e.g., Greiser et al., 1985; Todd, 1987a; Landals, 1990; Jodry and Stanford, 1992; Kreutzer, 1996; Todd et al., 1997; Bement, 1999: 59–61; Rapson and Todd, 1999; Miller and Burgett, 2000; Todd et al., 2001; Hill, 2005, 2008; Burke, 2008). Still many researchers do not interpret how carnivore modification may be useful outside of site formation processes. A starting point to assess availability of such information is a detailed record of scavenger-produced modifications left on skeletal remains of human-hunted ungulates in mass kill sites. On the Great Plains, bison bonebeds have been used to illustrate the relationships of prehistoric humans and bison; unfortunately, limited research has been conducted to find the potential meaning behind different degrees of carnivore modification and the impact human hunting had on carnivores competing with humans for resources (Binford, 1981; Haynes, 1981, 1982, 2007; Craighead et al., 1995).

For the Bugas-Holding Paleoindian bison bonebed, carnivore modification was recorded mostly on the humeri, femora, and innominates, with some modification also reported on ulnae, patellae, and hyoids (Todd et al., 1997). Carnivore modification at Bugas-Holding is described as light with the innominate, ulna, vertebrae, ribs, and patella most heavily modified (Rapson, 1990; Todd et al., 1997). The majority of tooth marks on these skeletal elements are coded as pitting or scoring (Rapson, 1990). Additionally, Todd (1987b: 245) addresses the link between degree of

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http://dx.doi.org/10.1016/j.quaint.2016.03.023
1040-6182/

fragmentation and intensity of butchering to show that carnivore modification can influence measures of fragmentation.

In previous studies, such as the Casper site and Glenrock Buffalo Jump, figures of carnivore tooth marks, such as furrowing and scoring have been mistakenly attributed to human behaviors, unless the marks are obvious punctures (i.e. direct evidence of carnivore teeth) (Frison, 1970a). While this mode of interpretation changed dramatically after the publications of Binford (1981) and Brain (1981), previously excavated bison bonebed assemblages lay unexplored in curation facilities.

The limited information provided on carnivore modification in Great Plains bison bonebeds illustrates the need for more research and renewed analyses of sites throughout prehistory. Advances in technology, specifically with regard to neotaphonomic analyses, improve our understanding of prehistoric bison use. By increasing the frequency and details in which carnivore modification is reported, these studies could unite somewhat isolated events (i.e., individual bison kills) to an overarching understanding of human–environmental interactions, particularly with respect to the indirect impacts humans had on scavenging carnivores.

Current interpretations of bison bonebeds are generally restricted to basic descriptions of the kills' remains. The interest here is to identify the extent to which humans impacted the behaviors of scavenging carnivores and to understand if temporal patterns of carnivore utilization exist. It is argued here that prehistoric human hunters, the producers of numerous and oftentimes large carrion-rich bison kills, indirectly affected the behaviors of scavenging carnivores. The carnivores, instinctively attracted to easy sources of food, utilized these human-produced resources leaving behind tooth marks as evidence of their behaviors.

If carnivore utilization is shown to be temporally distinctive, with more or less existing during certain periods, a fuller view may be gained of the variable paleoecological interplay of humans with other predators and scavengers in the past. Given that the intensity of bison hunting fluctuated during prehistory (Fig. 1) (Frison, 1991, 2004; Kornfeld et al., 2010), any changes in carnivore utilization could be responses to human hunting behaviors, reflecting the adaptable and opportunistic behaviors of carnivores.

2. Research questions

An important objective of this research is to determine if observed patterns in types of tooth marks, presence of carnivore modification, and intensity of carnivore gnawing damage (i.e., carnivore utilization) on bison bonebed assemblages change over time. Specific questions for this research include: (1) do specific types of modification marks present on the humeri, radius-ulnae, innominates, femora, and tibiae, vary between the eight Great Plains bison bonebed sites?; (2) does the frequency of carnivore modification on these same elements vary between the sites?; (3) does the degree of utilization, namely light, moderate, heavy, or some gradation therein, vary between elements and sites?; and (4) what are the possible explanations for these patterns or differences with regards to the relationships between carnivores and humans?

3. Materials and methods

To address whether carnivore modification and utilization varied temporally, data from eight temporally distinct but seasonally similar bison bonebeds in the Northern Great Plains were collected and analyzed for carnivore modification and utilization. The sites chosen include: Casper (Frison, 1974; Reher, 1974; Todd et al., 1997), Jones-Miller (Stanford, 1978, 1999; Todd, 1987b), Horner Bonebed II (Frison and Todd, 1987), Hawken (Frison et al., 1976), Kaplan-Hoover (Todd et al., 2001; Burke, 2008), Cordero Mine (Reher et al., 1985; Niven and Hill, 1998), Cache Hill (Miller and Burgett, 2000), and the Glenrock Buffalo Jump (Frison, 1970a) (Fig. 2, Table 1).

Table 1
Summary of information on bison bonebeds analyzed for this paper. MNI is based on all available appendicular elements only and not representative of prior research on all elements possible.

Bison bonebeds							
Name	State	Time period	Date BP (uncalibrated)	MNI	Herd	Season of kill	References
Casper	WY	Paleoindian	10060 ± 170; 9830 ± 30	52	nursery	fall/winter	Frison, 1974; Reher, 1974; Todd et al., 1997
Jones-Miller	CO	Paleoindian	10020 ± 320	126	nursery	fall/winter/spring	Stanford, 1978, 1999
Horner II	WY	Paleoindian	10,060 ± 220; 9875 ± 85	95	mixed	fall/winter	Frison and Todd, 1987
Hawken	WY	Early/Middle Plains Archaic	6470 ± 140; 6270 ± 170	43	Mature male	winter	Frison et al., 1976
Cordero Mine	WY	Middle Plains Archaic	3520 ± 150	15	Mature female	fall/winter	Reher et al., 1985; Niven and Hill, 1998
Kaplan-Hoover	CO	Late Plains	2690 ± 60	64	mixed	early fall	Todd et al., 2001; Burke, 2008
Cache Hill	WY	Late Prehistoric	260 ± 100	17	mixed	late fall	Miller and Burgett, 2000
Glenrock	WY	Late Prehistoric	210 ± 100; 280 ± 100	139	mixed	late fall	Frison, 1970a

The sites discussed below, with the exception of Cordero Mine, were selected because of (1) ease of access; (2) prior comment or published discussion on potential for or evidence of carnivore modification; and (3) representation of each cultural period in the Great Plains. Cordero Mine was selected primarily because of accessibility while at the University of Wyoming curation facility. These sites may not be representative of all time periods; however, research time restraints required collecting data from bison bonebeds housed within few facilities and with carnivore modification documentation. The radiometric dates referenced in this paper are uncalibrated as originally reported in ^{14}C yrs BP.

To identify overall patterns in modification and utilization, appendicular elements were selected due to their increased robustness, greater preservation, and extensive use in taphonomic analyses – with regards to tooth mark placement and element damage stages (Lyman, 1994). Although ribs and vertebrae are often cleaned of meat and gnawed heavily, they are not frequently gnawed for as long as limb elements as they have fewer nutrients and are limited in soft tissue mass. Additionally, appendicular elements are generally gnawed in clearly consistent stages over the whole feeding sequence, reflecting the intensity of carnivore feeding, while ribs and vertebrae are often damaged only early in the feeding sequence (Haynes, 1982). Finally, all available appendicular elements were analyzed for this study, resulting in a 100% sample of appendicular elements from each site.

Please cite this article in press as: Burke, C.C., North American Great Plains bison bonebeds: Exploring human impacts to scavenging carnivores through carnivore utilization taphonomy, Quaternary International (2016), http://dx.doi.org/10.1016/j.quaint.2016.03.023