

Historic Period Faunal Remains from Mustang Springs on the Southern High Plains of Texas

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Excavations at Mustang Springs, Texas, a key freshwater source on the Southern High Plains, have produced archaeological components of various ages, dating back to Paleoindian times. This report details a historic period fauna from the site that contains both native wild (bison, coyote) and domesticated (cattle, horse, sheep) species. Radiocarbon dates on the fauna fall into three age groups: modern, 100 B.P., and 280 B.P. The assemblage is resting on a stratigraphic unconformity and shows evidence of post-depositional fluvial re-working and animal trampling, but was buried rapidly enough that the bone otherwise displays little evidence of surface weathering or carnivore action. The assemblage appears to represent an autochthonous fauna that accumulated gradually around the edge of a water hole, primarily by means of natural attrition. However, human action in the form of domestic management of cattle and sheep, and perhaps bison hunting, is also evidenced. Whether these bison were among the last of the Southern Plains bison herd killed by commercial hide hunters—as is known to have occurred near this locality—cannot be determined from the available evidence.

Keywords: *bison, Southern High Plains, Historic period, faunal remains*

The Mustang Springs site (41MT2) is located on the Southern High Plains approximately 32 km northeast of Midland, Texas, within an unusually wide and deep portion of Mustang Draw (Figure 1). At this locality springs issuing from the underlying Ogallala aquifer have provided a source of fresh water from Late Glacial times until the mid-20th century, when irrigation pumping irreversibly lowered the local water table. Because Mustang Springs was a dependable source of fresh water, even during relatively drier periods, the site saw nearly continuous human occupation, which began in Paleoindian times (Folsom-Midland), continued through the Middle Holocene (Altithermal), and extended into the Historic period when it was a regular stop for mid-nineteenth century travelers on the “emigrant road” west (Marcy 1859:265; Meltzer 1991; Meltzer and Collins 1987). It was reportedly near Mustang Springs that the last

slaughter of the Southern High Plains bison herd by commercial hide hunters took place in the winter of 1878–1879 (Dary 1974:109-110; Gard 1959:253-254).

In the course of archaeological excavations at Mustang Springs in the late 1980s, the attention of which was primarily focused on the Altithermal-age water wells discovered there (Meltzer 1991, 1995; Meltzer and Collins 1987), site deposits were examined via dozens of core and auger holes, a series of backhoe trenches across Mustang Draw, and test and block excavations. Recovered in the course of that effort was a mix of faunal remains that included a variety of domestic and wild species—including *Bison bison*.

The bulk of the faunal remains were found in the westernmost trenches and test units, in proximity to the historic pond which by then had been dry for nearly four decades. Their location, and

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the combined presence of horse, cattle, and bison, suggested an historic age for the fauna. Yet, dating of humic acids from sediments associated with these remains yielded a radiocarbon age of 1745 ± 30 B.P. (SMU-1785; Table 1). Although this age was not anomalous relative to ages obtained on the underlying and overlying strata (Meltzer 1991:Table 1), it obviously did not agree with a faunal assemblage in the same stratum that included domesticated animals. As that faunal assemblage was also clearly not a part of the Altithermal occupation at the site, its presence was merely noted in a prior publication (Meltzer 1991).

In an effort to resolve the age of this faunal assemblage, eight bones from various species, including bison, were submitted for radiocarbon dating. These results are provided in Table 1. The majority of the radiocarbon ages average 103 ± 20 B.P., confirming an historic age for the fauna. Although it cannot be confirmed that bison remains represent individuals from the final slaughter of the Southern High Plains herd, in light of this temporal association it is clear that the fauna represents a critical period in North American bison population history (Roe 1951).

Thus, a detailed analysis of this faunal assemblage was conducted in the spring of 2003 to elucidate the agency or agencies of deposition and its taphonomic history, via a reconstruction of local geomorphic history and formation processes. Much of the taphonomic history of the site is explored through comparisons of large bovid element frequencies to various indices of potential human and "natural" (i.e. non-human animal or fluvial) agency.

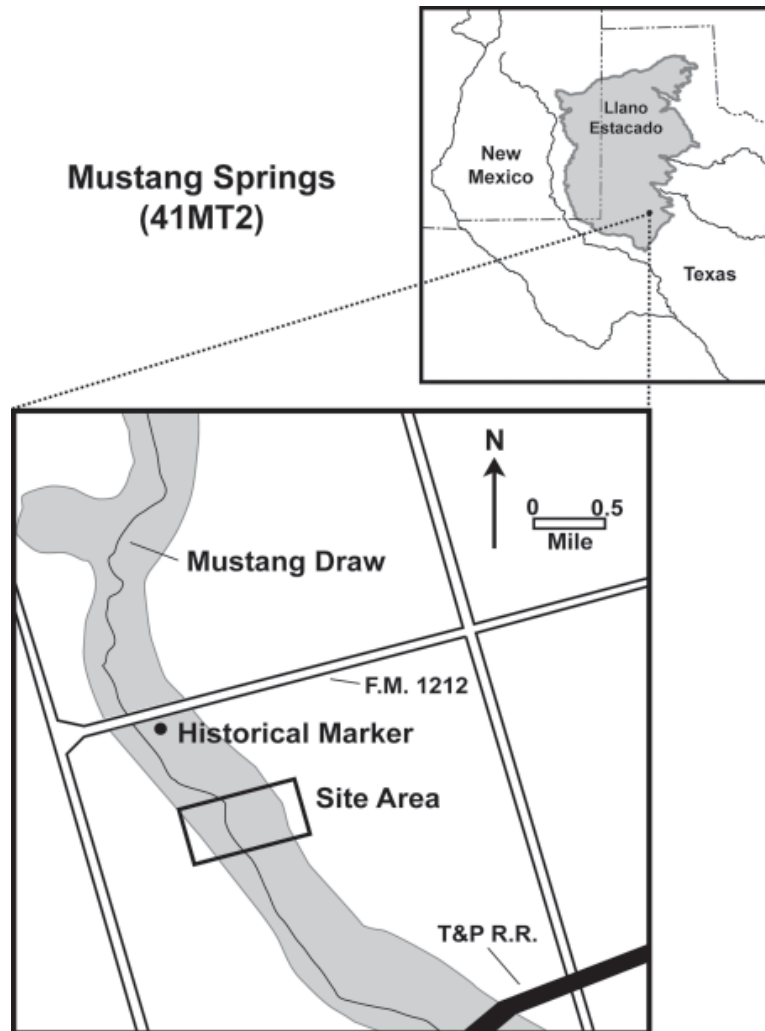


Figure 1. Location map of the Mustang Springs site.

RECOVERY, GEOLOGICAL, AND SPATIAL/TEMPORAL CONTEXT OF THE FAUNA

Excavations at Mustang Springs took place over three seasons, from 1985–1987. During the course of that work, faunal remains were recovered from different areas of the site, and from deposits of varying ages, ranging from the Early Holocene to the Historic period. All together, nearly 3000 bone specimens representing those periods were recovered from the site and have been analyzed (Byerly, unpublished data). The majority of the faunal remains were found in the same stratigraphic context in the western portion of Mustang

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Table 1. Radiocarbon dates on faunal remains from Mustang Springs, Trenches 7-9. ^aThe average of these radiocarbon ages is 102±9 B.P. (see text for discussion). ^bThe average of these radiocarbon ages is 256±26 B.P. (see text for discussion). ^cDate rejected (see text).

Sample	Lab number	Material dated	Element (code)	δ13C	δ15N	¹⁴ C Age
TR 7-37	Beta-178756	<i>Equus caballus</i> bone collagen	Innominate (IM)	-10.0 ‰	+6.0 ‰	0±50 B.P.
TR 9-1-B	Beta-178758	<i>Bison bison</i> bone collagen	upper second molar (M2)	-9.0 ‰	+5.7 ‰	70±50 B.P. ^a
TR 9-63	Beta-178760	<i>Bison bison</i> bone collagen	humerus (HM)	-12.2 ‰	+6.9 ‰	80±40 B.P. ^a
TR7-SK1	CAMS-105767	<i>Bison bison</i> bone collagen	Occipital (CRN)	-8.8 ‰	-	95±50 B.P. ^a
TR 8-141	Beta-178757	Bos/Bison bone collagen	Scapula (SC)	-11.0 ‰	+6.8 ‰	100±50 B.P. ^a
TR 9-72	Beta-178762	<i>Equus caballus</i> bone collagen	Metacarpal (MC)	-10.0 ‰	+6.3 ‰	100±50 B.P. ^a
TR 9-66-A	Beta-178761	<i>Bison bison</i> bone collagen	upper third molar (M3)	-8.5 ‰	+5.4 ‰	150±40 B.P. ^a
TR9-SK2	CAMS-105772	<i>Bison bison</i> bone collagen	frontal (CRN)	-8.7 ‰	-	200±50 B.P. ^b
TR 9-13	Beta-178759	<i>Canis latrans</i> bone collagen	mandible (MR)	-11.1 ‰	+9.5 ‰	270±40 B.P. ^b
TR 7-9	Beta-178755	<i>Bison bison</i> bone collagen	metatarsal (MT)	-8.4 ‰	+4.1 ‰	290±50 B.P. ^b
TR 9	SMU-1785	sediment humic acids	not applicable	-17.0 ‰	-	1745±30 B.P. ^c

Draw, in Trenches 7, 8, and 9, and Unit F (Figure 2), associated with the historic-era pond. This subset of the Mustang Springs faunal assemblage is the focus of this paper.

The sampled fauna was recovered in 1986 while digging backhoe trenches to ascertain the stratigraphy and geochronology of Mustang Draw. Bones were first encountered at a depth of ~1.5 m below the surface at the junction of the ~20 m east to west trending Trench 7, and the ~10 m south to north trending Trench 8 (Figure 2)¹ A 2 m x 3 m excavation unit (Unit F; grid coordinates N 230 W 590) was subsequently put in along the west side of Trench 8, just north of where it joined Trench 7. Unit F was hand excavated in 10 cm levels, and all sediment was screened through ¼-inch (0.635 cm) mesh. The bones from these units were highly fragmented, and only a small portion was identifiable to class, genus, or species (as discussed below).

Based on the evidence from the trenches and Unit F, the majority of the skeletal remains lay on an eroded and irregular stratigraphic unconformity—here designated Z1/5 (the numbers

representing the primary underlying [Stratum 1] and overlying [Stratum 5] stratigraphic units)—the surface of which dipped gently (a slope of 10 cm/m) east and south toward the main portion of the historic pond. The Z1/5 surface was discontinuously armored by a thin lens of mostly small (<2 cm), rounded quartz and jasper pebbles, representing a lag surface. Underlying that contact was a deposit of fine to very fine speckled light gray sands (10YR 7/1), presumably a lateral facies of Stratum 1 (Meltzer 1991), the spring sands that blanket the floor of Mustang Draw at this locality, and which in portions of the locality approach 5 m in thickness. The sediment overlying the Z1/5 varied; in places, a very dark gray (10YR 3/1) loam, Stratum 5 (Meltzer 1991), rested directly atop the contact or unconformably atop the underlying Stratum 1 sands. In other exposures, an intervening zone of dark grayish brown fine sandy loam (10YR 4/2), which in places displayed subtle laminations (presumably resulting from water settling) was resting atop the Z1/5 contact.

In Unit F, where data on the vertical occurrence of faunal remains was better controlled, the Z1/5 contact was first encountered at an elevation of 819.739 (m asl), in the upper portion of excavation Level 11. The several levels above that contact yielded, on average, more than 26 bone specimens each (just under 20 specimens were piece-plotted resting on the Z1/5 surface). Below that level, the number of recovered specimens dropped to an average of just five per level. Also resting on the Z1/5 contact in Unit F was a scatter of ~36 burned caliche cobbles, most 10–15 cm in maximum length. A small (<2 cm) unifacial flake scraper with a graver spur was also recovered on that surface; it was made of a variety of Edwards chert, the nearest outcrop of which occurs just south of Big Springs, Texas, ~ 40 km distant (Frederick and Ringstaff's (1994) Localities 32 & 33).

Because the faunal remains and artifacts encountered in Trenches 7 and 8, and Unit F, were scattered across a lag surface, and none of faunal elements were especially large or articulated, it was assumed this material was in a secondary context and had washed across this surface. Some bone elements penetrated up to 5 cm into the top of the

underlying Stratum 1 sands, further suggesting these had washed in and become embedded with the gravels.

After excavations were completed on Unit F, an approximately 10 m-long trench (Trench 9) was put in ~15 m west and along the same grid north line as Trench 7. Once again faunal remains were encountered, in this case slightly less than one meter below the surface. With the discovery of the bones, the backhoe was shifted elsewhere and the remainder of Trench 9 was excavated by hand, with all sediment screened. More than 100 individual bones were piece-plotted in the trench, although many more, smaller, fragmentary specimens were recovered.

As in the other units, the bones were resting atop the Z1/5 surface the top of which was here about 20 cm lower (819.559 m asl) than in Unit F to the east. In profile, the top of Z1/5 in Trench 9 was highly irregular and draped over a "ridge and swale" topography (Figure 3). One possible explanation for the irregularity of this surface is that the top of the Stratum 1 sands had been scoured and channeled prior to the deposition of the Z1/5 gravels. Much of the bone, including the nearly

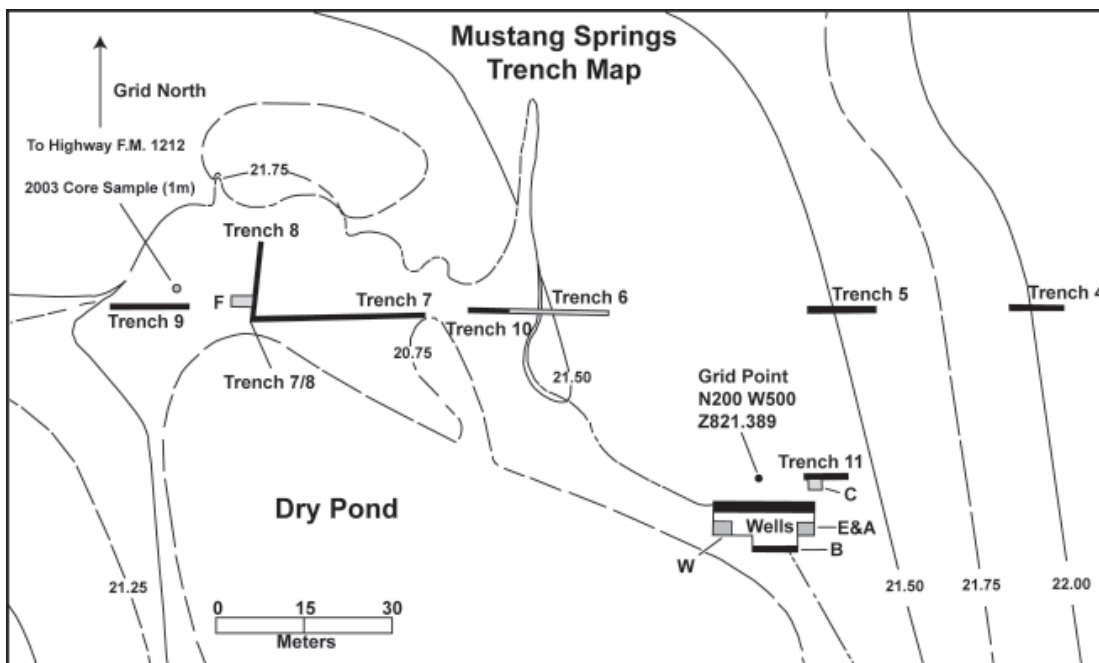


Figure 2. Location of test trenches and excavation units; redrawn from Meltzer (1991).

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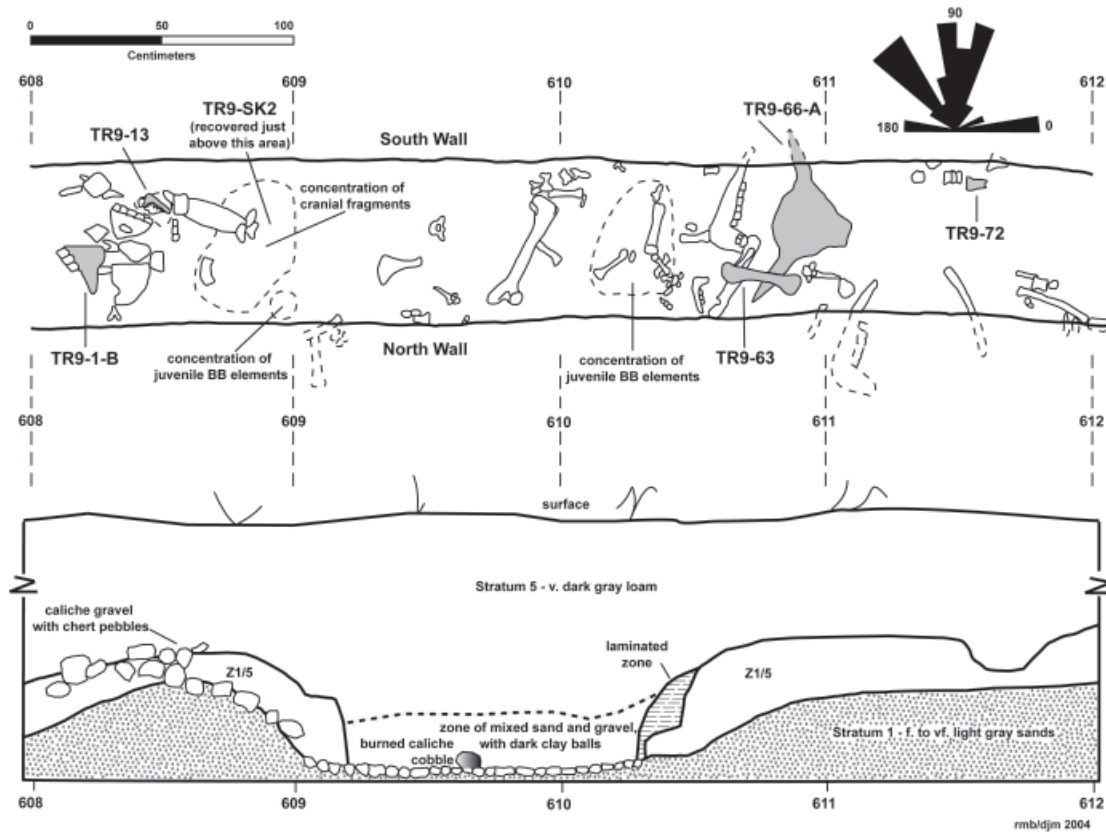


Figure 3. Profile and plan map of Trench 9; shaded items are radiocarbon-dated samples. Vertical exaggeration for Trench 9 profile = 2x.

complete crania, were concentrated atop these "ridges," almost giving the appearance they were atop pedestals (Figure 3), with only small bone scraps in the "swales" in between. This raises the alternative possibility that scouring occurred following the deposition of those gravels and the bones, the latter perhaps serving to anchor the underlying sediment.

The geomorphic history of Mustang Springs is discussed in Meltzer (1991), but there the focus is on the depositional and erosional sequence in the main axis of Mustang Draw where the Early and Middle Holocene stratigraphic and archaeological record is preserved, deeply inset into Stratum 1 sands (see Meltzer 1991:Figure 3). The faunal material described here comes from trenches dug on the valley margins, where the depositional, erosional, and archaeological sequence is considerably foreshortened. In this area of the site, Late Holocene and Historic period pond sediments rest

unconformably atop Z1/5, draped over Late Pleistocene sands (Stratum 1).

The geomorphic sequence of events in this part of Mustang Draw is as follows. In latest Holocene times, the Stratum 1 surface was exposed or sparsely vegetated (as it was during the Middle Holocene). Surface exposure was likely the result of drought, for which there is ample evidence across the Plains of repeated episodes, starting most recently around 2000 B.P. and continuing into the Historic period (Forman et al. 2001; Fritz et al. 2000; Holliday 2001). The most severe of these episodes, the so-called megadroughts, occurred in the last few decades of the 13th century and in the second half of the 16th century (Woodhouse 2003; Woodhouse and Overpeck 1998). The 16th century drought was perhaps the worst of the last 2000 years (Stahle et al. 2000; Woodhouse and Overpeck 1998:2703). A series of shorter and less-extreme droughts occurred in the early nineteenth century

(Muhs and Holliday 1995; Woodhouse 2003). In all instances, corresponding evidence of dune re-activation testifies to drought, de-vegetation, and erosion (Forman et al. 2001; Holliday 2001; Muhs and Holliday 1995).

Sparsely vegetated surfaces are highly susceptible to erosion and runoff, and the upper surface of Stratum 1 during these drought episodes would have been readily and effectively scoured. Coarser clastic material washed off the nearby valley walls or carried down the draw would have lagged onto and formed that Z1/5 surface. This process would continue until such time as drought conditions ameliorated, and the surface was stabilized by vegetation and/or covered by the rising waters of a spring-fed pond—the latter marked by the organic-rich muds of Stratum 5. However, that pond was intermittent and, as is known from historic sources, declined in the early 20th century and then disappeared altogether in the early 1940s (Brune 1981).

RADIOCARBON DATING

From the stratigraphic position of the bones atop a lag surface, it was evident that they were not in primary context, which complicated efforts to determine the age of that surface and the age or ages of the remains on it. Initial estimates came from a radiocarbon date on humic acids derived from the Stratum 5 loam of 1745±30 B.P. (Table 1; also Meltzer 1991:Table 1). As noted, that age made little chronological sense given that it came from an area of Trench 9 immediately adjacent to a horse mandible and below a bos/bison innominate. Although such a combination of fauna might be expected in the Late Glacial, or in post-Contact times, it would not be expected to date to 240–340 cal A.D. (calibrated range at 68.2% confidence interval). Ages derived from organic acids in sediment can be biased by multiple factors, not the least being mean residence time, and the inclusion of material that might not be directly associated with the target event (which in this case is the fauna in or atop that unit).

Therefore, a sample of eight bison, horse, and coyote bones from Trenches 7, 8 and 9 was submitted for radiocarbon analysis (Table 1). In all cases, there was sufficient collagen for dating, although in several instances (Beta-178759, Beta-178761, CAMS-105767, and CAMS-105772)

AMS counting was necessary. The results range from modern to nearly 300 B.P., and fall into three statistically-distinct chronological groups, as determined by chi-square analysis (using the procedure of Hietala 1989).

The youngest, a single modern age of an *Equus caballus* innominate (Beta-178756) is clearly from a different radiocarbon population than the other dated specimens. This particular specimen was excavated from dark brown pond sediments in Trench 7, from a stratum above the Z1/5 surface on which the bulk of the faunal remains were recovered. Thus, this material was probably deposited in very recent (twentieth century) pond sediments inset into the historic basin.

The remainder of the samples come from bone resting on the erosional contact, and they can be divided into two groups based on their ages. One consists of five dates, primarily from specimens in Trench 9, which range in age from 70±50 to 150±40 B.P. (Beta-178757–178758, Beta-178760–178762, and CAMS-105767). As a group, these are statistically contemporaneous ($\chi^2=2.18$) and yield an average age of 102±19. When calibrated, the intercept ages at 1-sigma fall between 1694–1726 cal A.D. ($p=0.337$), 1813–1848 cal A.D. ($p=0.348$), 1872–1892 cal A.D. ($p=0.211$), and 1907–1918 cal A.D. ($p=0.104$; calibration with CALIB 4.4 using the INTCAL98 data set [Stuiver et al. 1998]).

The other group is comprised of three samples from Trenches 7 and 9 (Beta-178755, Beta-178759, CAMS-105722; $\chi^2=1.83$), and these yield a mean age of 256±26 B.P. When calibrated, intercept ages at 1-sigma fall primarily between 1637–1665 cal A.D. ($p=0.957$) and 1784–1788 cal A.D. ($p=0.043$)².

With the stratigraphic evidence of erosion and sheet wash, it is not surprising that bones on the same Z1/5 surface are of significantly different ages. Indeed, the youngest and oldest radiocarbon ages from Trench 9 are separated by 200 radiocarbon years, yet are on the same surface only ~25 cm apart (Beta-178758 and Beta-178759). Given that the older specimens are mixed indiscriminately with the younger specimens on a lag surface, these specimens are not in primary context. However, the chronological evidence would also suggest that the Z1/5 surface on which they are resting was cre-

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ated as recently as just a few centuries ago—perhaps following the sixteenth century megadrought?

Whether that surface and the remains on it were subsequently buried, then exposed by later drought episodes, is unclear. Given the age of the younger remains, however, it would appear that this surface was ultimately buried by Stratum 5 sediments in just the last century. If so, there has been substantial deposition in Mustang Draw—some 1 to 1.5 m of sediment—in the relatively brief period of time since then. That rapid rate of sedimentation may result from the fact that even at times when there was a pond present at Mustang Springs, much of Mustang Draw had an ephemeral flow. Any sediment eroded upstream of Mustang Springs and transported as suspended load or bed load during occasional flooding, would settle out when reaching this wider and deeper portion of Mustang Draw.

THE HISTORICAL RECORD

Given the age of the deposits and the presence of both wild and domesticated fauna, understanding the historic record associated with Mustang Springs may shed light on the type, abundance, and frequency of fauna that have been known or might be expected from the sampled locality. Such information might further help interpretation of the archaeological record.

Early Spanish entradas passed through this part of west Texas in the seventeenth and eighteenth centuries, although there is no record of any visits to the area of Mustang Springs (Brune 1981). As such, written accounts specifically describing local fauna, flora, and water conditions around Mustang Springs only begin in the mid-nineteenth century, with the various United States military and exploring expeditions that passed by (Meltzer 1991; Meltzer and Collins 1987).

On April 2, 1849 Captain Randolph B. Marcy received orders to command an expeditionary escort comprised of men from the 1st dragoons and the 5th infantry, sent out from Fort Smith, Arkansas to Santa Fe, New Mexico to provide protection and guidance for emigrants of newly acquired territories there (Marcy 1850:169). It was on the return trip of this expedition that Marcy came upon and named “Mustang Pond,” now Mustang Springs. An excerpt from his journal, from Octo-

ber 1, 1849, reads:

We marched seventeen miles in a course N. 67° E. over a firm high prairie, and are encamped near a pond on the plain. About half way between this place and our last camp, we discovered a small lake about one mile north of our road, where it is thought there will be water in all seasons; it is about three feet deep, covers several acres of ground, and has rushes growing in it. There are also numerous trails made by mustangs leading to it, showing that it is much frequented by them... This lake I have called “Mustang Pond.” I conceive it to be very important for travelers (Marcy 1850:207).

Whether the trails to the locality were made by “mustangs,” as Marcy surmised—as opposed to bison—is not known. Marcy’s journal does not recount actual observations of either here, but it could have been one or both that carved those trails. Bison had been present on the Southern High Plains since the Pleistocene, and their remains occur at this locality embedded in Stratum 2 diatomite dating to 8800 B.P. (Trench 11 and Unit F; see Figure 2). As of the late eighteenth century, unbranded criollo cattle (progenitors of what would become “Longhorns”) were wild in Texas, and early colonists often referred to these as “mustang cattle” (Dobie 1980:12). It is possible that Marcy was referring to these cattle when naming the springs, but historic accounts do not refer to wild or domestic cattle in the area until the late nineteenth century. Likewise, as these cattle were later variously known as “Spanish cattle” and also simply “wild cattle,” it is unknown whether the term “mustang cattle” persisted until that time (Dobie 1980).

Following their Late Pleistocene extinction, horses were reintroduced onto the Southern High Plains upon Spanish contact. Coronado lost horses on the plains in 1541 (Webb 1931:117), as did Juan de Oñate some 60 years later (Swagerty 2001:260). However, it was probably not until the mid-17th century that horses occurred in significant numbers on the Southern High Plains, having by then reached Native American tribes either in trade or through raiding (Bamforth 1988:94; Ewers 1955:3; Swagerty 1988:355; Webb 1931:57, 117). Over the centuries that followed, horses thrived in this setting, individuals escaped, and wild herds increased in number. The Spanish term for wild horses is *mesteños*, which Americans later corrupted as mustangs (Jackson 1986:10), and these presum-

ably watered at Mustang Springs.

They clearly did so alongside bison, for Army Lt. Colonel W.R. Shafter describes Mustang Springs as containing water "...in great abundance, hundreds of buffalo watering at them daily, not exhausting them. Plenty of mesquite roots for fuel, and good grass and shelter in ravines" (Shafter 1933:91 [1876]; Liles 1953:103). The buffalo hide hunter John R. Cook describes seeing the last large herd of bison ten miles south of Mustang Springs in February of 1878, and another hunter, Joe S. McComb reportedly killed nearly 800 head from September to March 1878–1879 near the springs (Liles 1953). As noted, this kill is reported to be the last of the large bison kills in the region (Dary 1974; Gard 1959).

During an expedition through the area in the spring of 1853 to scout potential trans-continental railroad routes along the 32nd parallel, Captain John Pope reported having 32 sheep stampeded and lost to wolves near the springs (Liles 1953:92; Pope 1855). Wolves, though rare today in Texas, often congregated around bison aggregations, which served as their primary food source (Davis 1966:111). Though no wolves were identified in the Mustang Springs fauna, coyotes, which are present, are today ubiquitous across the region.

Although historic records are unclear, probably owing to confusion over what specific spring "Mustang Springs" refers to (see Meltzer and Collins 1987 for discussion), C.C. Slaughter apparently headquartered his "Long S" cattle ranch near Mustang Springs in the late 1870s, perhaps concurrent with the arrival of the railroad and the establishment of Martin County (Liles 1953:173). During this time, Slaughter bred open-pasture Longhorns mixed with short-horn Durhams (Murray 1981). Following large cattle die-offs stemming from the 1890s drought and the introduction of barbed wire to the Southern High Plains, Slaughter later switched to breeding Herefords in closed pastures at his "Lazy S" ranch, occupying large parts of Hockley and Cochran Counties (Murray 1981). Identified Mustang Springs cattle could represent any of these breeds. Domestic sheep were also brought in during the 1870s, numbering in the tens of thousands in Martin County by the 1890s (Liles 1953). Goats are also noted to have been raised by early settlers to Martin County

(Smithson and Hull 1970:31), although identified ovicaprid remains appear to all be sheep.

Historic accounts of the local fauna are clearly sparse, but the recorded fauna from Mustang Springs correlates well with archaeological observations of bison, cattle, horse, and sheep and attests to the diversity of species utilizing this spring-fed pond. However, that record does little to convey a sense of the depositional history of this assemblage, and for that it is necessary to consider the faunal record.

THE FAUNAL RECORD

Documentation

A multi-component coding system similar to that utilized by Hill (2001), Rapson (1990), and Todd (1987) to analyze Great Plains archaeofauna was used to record Mustang Springs faunal data. In addition to basic descriptive information on species/body size, skeletal element, skeletal portion, skeletal segment, and side, documentation includes observations detailing specimen condition (breakage, burning, cortical surface modification, weathering) and animal age and sex.

Summary data (Table 2) for all recovered fauna from sampled trenches are tabulated according to number of identified specimens (NISP), total number of specimens (NOST), and minimum number of individuals (MNI). For this analysis a specimen was considered identifiable if it was describable to both species/body size and element. Unidentified specimens include all unspecified tooth fragments, cranial fragments, long bone flakes, flat bone fragments, cancellous bone fragments, and turtle shell fragments. These specimens were considered unidentifiable to deter inflation of NISP values. Those specimens that could not be classified by species, family, or order were classified to approximate body size (Table 2).

Identification of *Bos taurus* and *Bison bison* was aided by comparative skeletons and distinguishing post-cranial skeletal features summarized in Balkwill and Cumbaa (1992). In those cases where large bovid bones were too fragmented to identify elements to species, or distinguishing skeletal features were ambiguous³, specimens were categorized as bos/bison. Identification of sheep remains was aided by dental and post-cranial char-

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Table 2. Summary data of all recovered fauna from Trenches 7–9, and Unit F. The number of total specimens (NOST) refers to the combined number of identified and unidentified specimens (as described in the methods section).^a Acronyms are those used in subsequent tables.

Scientific name (CLAS) ^a	Common name	NISP	NOST	%NISP	MNI
Bos/Bison (BB)	Domestic cattle or bison				
	mature	77	78	19.1	2
	immature	99	106	24.5	2
Aves (BD)	Unspecified bird	48	64	11.9	2
<i>Bison bison</i> (BI)	Bison	65	87	16.1	4
<i>Bos taurus</i> (BO)	Domestic cattle	18	18	4.5	1
<i>Canidae</i> (CN)	Unspecified canid	7	7	1.7	1
<i>Canis latrans</i> (CT)	Coyote	2	2	0.5	1
<i>Carnivora</i> (CV)	Unspecified carnivore	1	1	0.2	1
<i>Equus caballus</i> (EQ)	Horse				
	mature	51	52	12.6	2
	immature	4	4	1.0	1
Lagomorph (LG)	Unspecified rabbit	1	1	0.2	1
<i>Ovis aries</i> (OA)	Domestic sheep	10	11	2.5	1
<i>Cervidae</i> (OD)	Unspecified cervid	5	5	1.2	1
<i>Rodentia</i> (RO)	Unspecified rodent	2	2	0.5	1
<i>Kinosternon flavescens</i> (TO)	Yellow Mud Turtle	14	15	3.5	2
	Total	404	452	100.0	-
Body size class (CLAS)	Fauna included	NISP	NOST	%NISP	MNI
Unidentified small (UA)	Rodent, rabbit, turtle, bird		14	0.0	-
Unidentified medium (UD)	Sheep, goat, coyote	33	36	17.3	-
Unidentified large (UL)	Bison, cattle, horse	158	310	82.7	-
Totally unidentified (UN)	Totally unidentified	-	1548	0.0	-
	Total	191	1908	100.0	-
	Total (All)	595	2360	-	

Table 3. Specimen counts of large and medium sized mammals.

Unit	Bos/Bison		Bison		Bos		Equus		Ovis	
	NISP	%NISP	NISP	%NISP	NISP	%NISP	NISP	%NISP	NISP	%NISP
F	4	5.2	0	0.0	2	11.1	2	3.6	1	10.0
Trench 7	8	10.4	7	10.8	0	0.0	33	60.0	3	30.0
Trench 7/8	2	2.6	0	0.0	0	0.0	1	1.8	0	0.0
Trench 8	11	14.3	4	6.2	2	11.1	8	14.6	0	0.0
Trench 9	52	67.5	54	83.1	14	77.8	11	20.0	6	60.0
Total	77	100.0	65	100.0	18	100.0	55	100.0	10	100.0

acteristics summarized in Balasse and Ambrose (2005), Boessneck (1970), Grine (1986), and Halstead et al. (2002). *Kinosternon flavescens* remains were identified by Dr. Eileen Johnson, and the remaining fauna were all identified using private comparative specimens or those held at the Schuler Museum, Southern Methodist University.

Summary Data

A total of 2,928 bone specimens (NOST) were recovered in the 1986 and 1987 field seasons from all trenches and test excavations at Mustang Springs. This analysis focuses on only the historic-era fauna from the western portion of the site, comprising 2,360 specimens (Table 2). A total of 404 of these specimens are identifiable to both class and element (NISP). Bos/bison dominate identified bones, followed by bison, horse, cattle, yellow mud turtles, and sheep. For those specimens classified by body-size only, unidentified large are most numerous.

Trench 9 yielded the highest proportion of bos and bison (Table 3). All large bovid cranial material (save that from juvenile individuals) is bison; domestic cattle are represented by post-cranial elements only. Identifiable cattle and sheep elements are sparse and localized in Trench 9, while horse is most abundant in Trench 7. At least two bos or bison calves, one of them nearly complete, are present in Trench 9. Age estimates, based on mandibular dental eruption, identify TR9-57 as a newborn, and place TR9-102 within a Group 1 cohort. Crania of an old age bull bison (TR9-66), a mature bull bison (TR9-SK2), and a mature cow bison (TR9-12) were also recovered from Trench 9, and another bull bison of indeterminate age was found in Trench 7 (TR7-SK1).

Cortical surface weathering data are recorded for all identifiable large to medium body-sized specimens according to Rapson (1990). Most bones (%NISP=82.4) fall within stages 1-2 and

only a small number (%NISP=2.7) exceeds this degree of weathering. Surface modifications were not observed on identifiable and unidentifiable small fauna, thus these taxa are excluded from modification tallies. In all instances modifications were distinguished using strong direct light and low (10x) magnification.

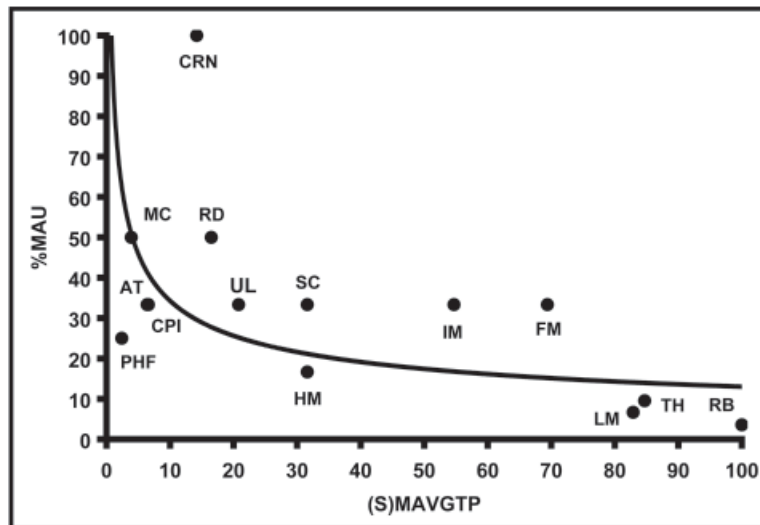
Despite excellent cortical surface preservation, modifications are rare on the majority of bone specimens. Some (%NOST=4.6), however, have multiple, overlapping parallel, shallow abrasions and polishing that is often consistent with trampling and fluvial activity (Brain 1967; Fiorillo 1987, 1991). Evidence of human modification is also rare, with only a single bison specimen displaying evidence of cut marks. Light carnivore damage, visible as tooth punctures, is present on only 0.3% of recorded specimens.

Taphonomic History

As is apparent from the geological context in which these faunal remains were uncovered, and such surface modification as was detected, multiple taphonomic processes potentially shaped this assemblage over time. These processes are explored in more detail, to gain a better understanding of that taphonomic history and the agencies that account for its appearance and character.

Human Agency. The historic record documents that most animals present in the Mustang

Figure 4. %MAU vs. (S)MAVGTP for mature bos, bison, and bos/bison from Trench 9.



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Springs assemblage are local, but direct evidence of human action, in terms of butchering (cutmarks, impacts, etc.), is sparse, as, for that matter, is direct evidence of carnivore action. The presence of domesticated animals indicates that humans at some point played a role in animal accumulation in the area, but it is unknown to what extent they were responsible for processing and depositing animal carcasses at the site. Given that the last recorded bison kill on the Southern High Plains of Texas occurred near here, perhaps at least a portion of the fauna may represent hunting episodes. Of all the fauna present in abundance (bison, horse, sheep, and cattle), bison are the likeliest to have been actively hunted in historic times, although Dobie (1980:13–15) also makes reference to “wild cattle” hunting in nineteenth century Texas.

To elucidate the potential role of human activity in bos and bison carcass accumulation at the site, derived %MAU values for combined bos, bison, and bos/bison specimens from Trench 9 are compared to total nutritive product indices for bison ((S)MAVGTP; Emerson 1990). Correlation of these values should reflect the frequency with which elements are represented based on their total potential nutritive yield. In a kill site setting, for example, where high utility elements are expected to be transported away to another locality (i.e., a camp) for secondary processing, element frequency should be inversely correlated with total product yield. It has been observed, however, that total products and bone density are indirectly correlated⁴; those elements with the lowest total product yield are often those of highest density and, thus, processes of natural attrition may mask or mimic expected identifiers of human agency (Lyman 1994).

Combined mature large bovid element frequencies are compared to bone density values from Kreutzer (1992, 1996; Table 4) to assess the degree to which large bovid element frequency at Mustang Springs is dependent on volume density. As shown in Figure 4, a significant ($r_s = -0.604$, $p = 0.022$) inverse correlation exists between bison element frequencies and total products indices and, although not significant ($r_s = 0.454$, $p = 0.051$), a weak positive relationship between element frequency and bone density is evident. As a whole, these data suggest that nutrient-rich material may

have been transported away from the site, but also that density-mediated attrition may have played a minor role in element survival.

However, comparing combined element frequencies of multiple species may be an inappropriate approach to measure the possible degree of human agency in large bovid carcass deposition at the site. Although these remains are from the same statistical radiocarbon population, Mustang Springs is clearly a palimpsest of depositional events. Since human agency in these events could be of either Euro-American (hide hunters or ranchers) or Native American origin, and represent processing activities of either of two large bovid species, it cannot be assumed that carcass utilization strategies would be constant for each depositional event. Just comparing identified bison element frequencies against element utility, however, still shows a clear dominance of low utility crania, but also a relatively constant frequency of post-cranial bones representing a spectrum of food utility values (Figure 5). Such a pattern is not consistent with a reverse utility model.

As such, these data argue against the correlation between element frequency and food utility being a valid indicator of significant human agency in large bovid carcass accumulation at the site in this instance. Furthermore, given that most of the remains of a newborn bos/bison (all low-density elements) are well-preserved in Trench 9, density-mediated attrition is probably not, despite the positive relationship, a significant agent of large bovid element survival at Mustang Springs.

Fluvial Dispersion and Trampling. Once deposited, multiple processes can act on exposed skeletal remains. Sediment abrasion, for example, was recorded on a number of the Mustang Springs bones, which is typically attributed to two processes: (1) trampling by animals, and/or (2) fluvial or aeolian sediment action (Lyman 1994). Most experimental research on sediment abrasion focuses on the affects of trampling by large herbivores and humans, which is characterized as producing multiple sets of randomly oriented fine, shallow, sub-parallel scratches on large portions bone cortical surface and forming collapsed compression fractures on break edges (Andrews and Cook 1985; Behrensmeyer et al. 1986; Gifford-Gonzalez et al. 1985; Fiorillo 1987, 1989, 1991;

Table 4. Element counts (NISP, MNE, %MAU), bone volume density (VD), standardized modified average total nutritive products ((S)MAVGTP), skeletal weight index (SWI), and standardized settling velocity (STD V) values for bos and bison, Trench 9 only. ^a Average density values of dominate element portions used to estimate MNE (Hill 2001; from Kreuzer 1992, 1996).

Skeletal Element	NISP	MNE	%MAU	Bone Density (VD) ^a	Total Products [(S)MAVGTP]	Skeletal Wt. Index (SWI)	Standardized Settling Velocity (STD V)
CRN	41	3	100.0	-	14.2	100.0	-
MR	7	2	33.3	0.79	-	23.4	78.7
HY	2	2	33.3	0.36	-	-	-
CE	2	1	33.3	0.91	6.4	11.1	57.1
TH	10	4	9.5	0.42	84.7	5.1	44.6
LM	2	1	6.7	0.42	82.9	11.9	52.3
RB	3	3	3.6	0.27	100.0	5.6	38.3
SC	3	2	33.3	0.50	31.6	22.6	46.8
HM	1	1	16.7	0.48	31.6	54.7	72.3
RD	3	3	50.0	0.42	16.5	43.5	64.6
UL	2	2	33.3	0.69	20.8	-	-
CPA	1	1	16.7	-	6.6	-	-
CPF	1	1	16.7	-	6.6	-	-
CPI	2	2	33.3	0.35	6.6	-	-
CPS	2	2	33.3	0.50	6.6	-	-
CPU	1	1	16.7	0.43	6.6	-	-
MC	3	3	50.0	0.53	3.9	36.4	80.9
IM	4	2	33.3	0.52	54.7	43.9	-
FM	2	2	33.3	0.31	69.4	92.4	65.9
PHF	2	2	33.3	-	-	3.5	-
PHS	6	6	25.0	0.48	2.4	3.7	-
PHT	4	4	16.7	0.46	2.4	4.2	-
SE	2	2	8.3	0.32	2.4	-	-

Haynes 1991; Haynes and Stanford 1984; Olsen and Shipman 1988).

The potential for trampling damage depends on site location, substrate composition, and skeletal element (Fiorillo 1991; Haynes 1991). Where animals and their skeletal remains are both abundant, the probability of exposed skeletal material being trampled is high (Haynes 1991). Likewise, experimental observations suggest that the sandier a particular substrate, the greater the frequency of trampled bones expected (Fiorillo 1991). Actualistic studies have further found that high surface area long bones show signs of trampling more so than do irregular bones like carpals and tarsals (Olsen and Shipman 1988); the more surface area to be incised, the higher the probability

of sediment abrasion.

Water holes and other landscape features that attract large concentrations of animals, like Mustang Springs, tend to also collect their skeletal material in abundance (Haynes 1985:57). Bison and other large herbivores do not obtain sufficient water from forage and thus must aggregate and commute between drinking and feeding sources to satisfy their large daily dietary quotas (Bamforth 1988). In historically documented drought episodes, large herbivores constrain their movements even more (Haynes 1985:59) and thus are more likely to encounter predation or suffer natural death due to starvation or dehydration around oases if water sources are depleted. Water hole skeletal assemblages are likely to suffer dispersal, fragmen-

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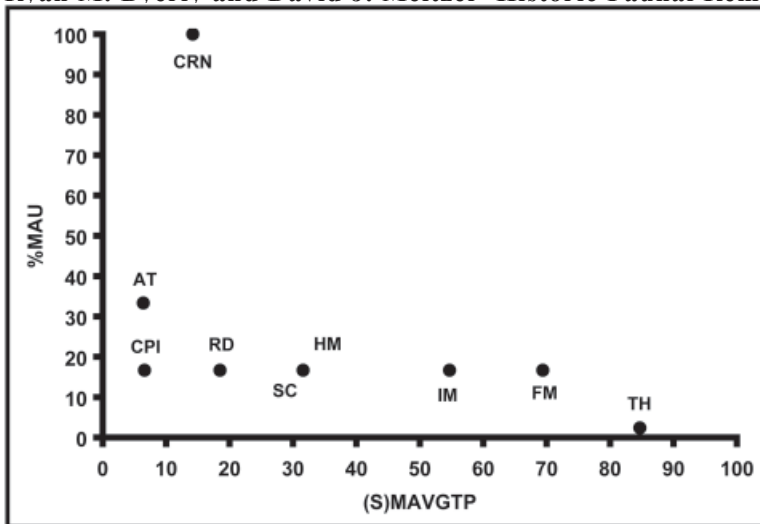


Figure 5. %MAU vs. (S)MAVGTP for mature bison only, Trench 9.

tation, and modification because of the watering or feeding (hunting and scavenging) activities of the diverse fauna utilizing the site (Haynes 1985). But because of their proximity to water, they may also incur fluvial modification.

The Mustang Springs fauna has a relatively low incidence of sediment abrasion compared to the total specimens recovered; but where present, surface damage is heavy and most often characteristic of trampling and fluvial modification, not human action (Figure 6). Those modifications identified as sediment abrasion, for example, are shallow and show multiples sets of irregular parallel to sub-parallel overlapping striations. Observed cutmarks, on the other hand, tend to be deeper and show a more characteristic v-shaped cross-section, most often with marked shoulder effects.

Much of the substrate on which recovered bone was lying is composed of a layer of gravel intermixed with small to medium caliche cobbles and broken chert nodules. Furthermore, the sediment composition at the

levels of bone recovery in Trench 9 are 52–72% sand. Such a coarse matrix, mixed with high percentages of sand, would provide an environment amenable to bone cortical surface abrasion by trampling. Indeed, 68.6% of modified specimens (n=72) are large planar surface area elements (long bones, ribs, or innominate fragments), 19.0% (n=20) are skull elements (cranial fragments, mandibles, and hyoids) and the remaining 9.5% (n=10) are irregular vertebrae and small surface area bones

(toes, carpals, and tarsals). These data indicate that the relative frequency of damaged bones roughly correlates to those that are expected to be most susceptible to trampling modification (see Olsen and Shipman 1988). However, considering the location of the site, modification by fluvial activity is also likely.

In their experimental studies, Shipman and Rose (1988) concluded that neither fluvial nor aeolian action produce the macroscopic or micro-

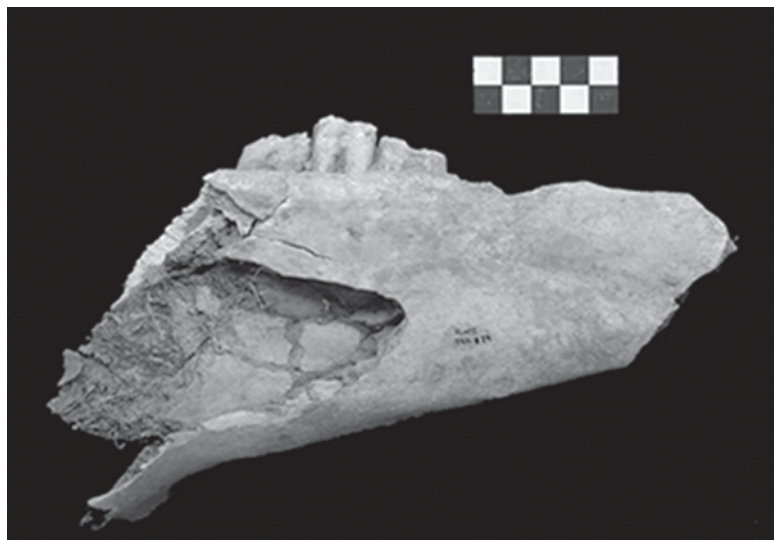


Figure 6. Crushed horse mandible from Trench 7/8.

scopic linear grooves or fine scratches characteristic of trampling damage. Nonetheless, it can be assumed that the same basic criteria governing the potential of trampling are applicable to assess potential fluvial action. Obviously, skeletal material deposited in or adjacent to fluvial environments, even if those environments are ephemeral, are more likely to be dispersed and modified by moving water than those removed from fluvial environments. Cortical surface abrasion and polishing will also depend on the substrate

either in solution with water or in the channel bed. Although untested experimentally, the linear grooves characteristic of trampling may, for example, appear with the consistent movement of fine particles over a bone surface in sub-aerial fluvial environments, such as sandy spring deposits exemplified by Stratum 1.

Skeletal remains behave like normal bed load material in response to channel activities. That is, an object within fluid will respond to the directed force applied to it depending on the submerged weight and density of the object and the object shape (Brown 1997:93). Low-density bones have high transport potentials (Boaz and Behrensmeyer 1976), as do bones that are spherical in shape because they maximize cross-sectional area (e.g. crania and vertebrae). Rod- and blade-shaped bones (e.g. scapulae and ribs) are less likely to be transported under similar fluvial energies because they maximize the resistance force between the channel bed and the bone. The directed force of water movement tends to also preferentially orient bones with the direction of flow (Lyman 1994); Coard (1999) notes that this is highly dependent on whether or not elements were articulated during transport.

So that multiple tests of potential fluvial action on the Mustang Springs fauna could be conducted, only Trench 9 large bovid specimens were

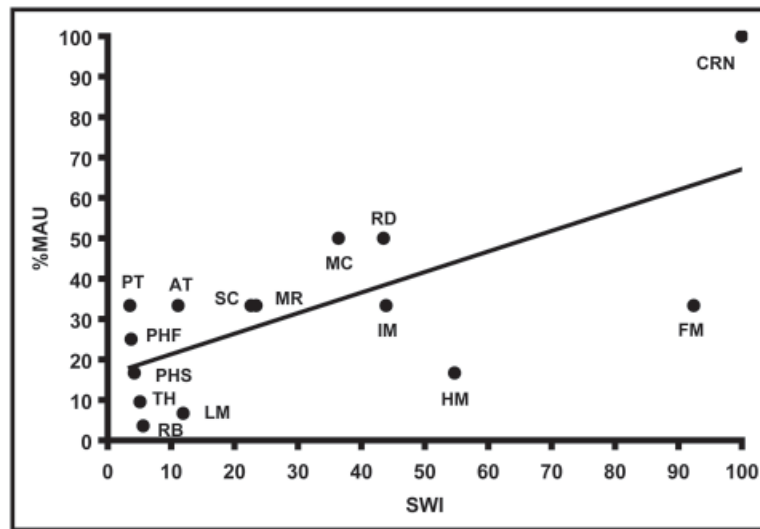


Figure 7. %MAU vs. SWI for mature bos, bison, and bos/bison from Trench 9.

used, as fluvial transport indices are most abundant for these fauna and Trench 9 is the only unit for which all the necessary information is available. Here element frequencies are compared to both skeletal weight and settling velocity indices derived from fluvial transport experiments of large mammals (Frison and Todd 1986; Lyman 1994; Todd 2003).

The skeletal weight index (SWI) developed by Frison and Todd (1986) for African elephant bones assumes that for a transported assemblage, element frequency will be inversely correlated to potential transport (Lyman 1994). SWI data for bison are not available, so Lyman's (1994:175) derived reedbuck SWI data were used, as reedbuck most closely matches bison and cattle in terms of body size. Comparison of combined large bovid element frequencies against the derived SWI shows no significant correlation ($r_s = -0.512$, $p = 0.051$; Figure 7), but does indicate a weak positive relationship. A similar comparison between bone element frequency and standardized settling velocity (STD V; Todd 2003) shows a significant ($r_s = 0.659$, $p = 0.038$) positive correlation (Figure 8). According to the STD V model, those elements with higher transport potential, and hence low settling velocity values, are preferentially winnowed out of an assemblage given high fluvial input (Todd 2003). A significant correlation between element fre-

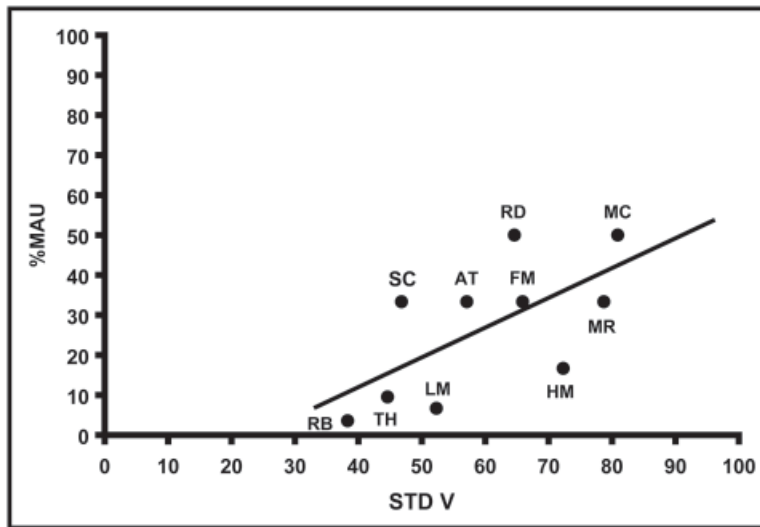


Figure 8. %MAU vs. STD V for mature bos, bison, and bos/bison from Trench 9.

quency and settling velocity suggests that Trench 9 is a lag deposit. This finding supports the supposition that Trench 9 sediments and bone were winnowed by water.

Orientations derived from 32 elements of all represented fauna in the plan map of Trench 9 (Figure 2) are consistent with the direction of channel flow, indicating that fluvial action was, at least in part, a contributor to skeletal element reorientation. Combined with the significant positive correlation between element frequency and STD V, however, and the weak positive relationship between element frequency and SWI, these data suggest that fluvial reworking was probably a contributor to at least large bovid skeletal dispersion, and probably transport from the site. The fact that a near complete newborn was recovered within the sampled area might argue against significant transport, unless it was transported to the site and buried as a complete carcass. Boaz (1982; also Lyman 1994:174) notes, for example, that when animals are migrating across large rivers some individuals drown and are transported as whole carcasses downstream, although in an ephemeral drainage system the probability of such an event being preserved seems low.

Surface exposure and burial. The paucity of extensive surface weathering recorded on the Mustang Springs fauna, and lack of significant carni-

vore modification, indicates rapid burial of the bone (Behrensmeier 1978). However, the bones must have remained on the surface long enough to incur the trampling and fluvial damage recorded on a portion of the exposed material. Even with ephemeral flow, drainages like Mustang Draw can carry large amounts of sediment during periods of intense precipitation and flooding, with the force of moving water strong enough to scour the drainage upstream and redeposit suspended and bed load material downstream (Patton and

Schumm 1981). As earlier noted, nearly 1.5 m of sediment covers the Trench 9 fauna, possibly accumulated in as little as a century.

SUMMARY

Excavations on the western side of the Mustang Springs site produced a relatively rich fauna dominated by bison and cattle—which are known to be in the area historically—within the confines of several backhoe trenches and a test excavation unit. Radiocarbon-dated elements of that recovered fauna fell into three age groups: modern, 100 B.P., and 280 B.P.—all within the Historic period. Bone elements of the latter two groups were resting on the same stratigraphic lag surface, herein denoted Z1/5.

Considering the geomorphic and taphonomic evidence, the sampled Mustang Springs faunal assemblage represents an autochthonous fauna that accumulated gradually around the edge of a water hole, probably by means of natural attrition. The sampled fauna, however, represents a palimpsest of different depositional events affected by multiple taphonomic processes. That cutmarks are present on some remains, however low in frequency, hints to direct human action in some capacity. Likewise, human agency is assuredly evidenced in the form of domestic management of cattle and sheep, and perhaps in the form of bison hunting. These bison could be a remnant of the

last of the Southern High Plains bison herd killed by commercial hide hunters near the site. Their age is consistent with such an inference, but no direct empirical evidence supports this.

Based on observed cortical surface modifications, bone preservation, and tests for anthropogenic or fluvial agents of dispersal, the exposed carcasses and skeletal remains were subsequently dispersed and modified through trampling, likely by large herbivores utilizing the springs as a water source, and fluvial action. Although the bones were exposed on the surface long enough to incur trampling damage, burial occurred soon thereafter, was relatively rapid, of fluvial origin, and of enough force to transport some bones away and orient the remaining bones in the direction of flow. These hypotheses may be tested for cattle, bison, and other faunal components through future excavation, including detailed recording of bone inclination and orientation. A more complete understanding of the role of human agency in depositing large bovid remains may also be had by increasing sample size, requiring further excavation, and conducting a more thorough evaluation of observed cortical surface modification, ideally through SEM analysis.

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ENDNOTES

¹ The actual trenches were longer; these are the lengths of the trench floors.

² CAMS-105772 (200±50 B.P.) can be placed in either group. It is included with the older of the two because that chronological

fit is statistically closer. Were it included with the younger group, it would increase the average age of that group to 114±18 B.P.

³ For certain bovid elements confident species identification was not possible. Some comparative bison phalanges used in this analysis, for example, could be identified as cattle using Balkwill and Cumbaa's (1992) descriptive criteria.

⁴ This analysis, for example, identifies a significant inverse correlation between total products and volume density values ($r_s = -0.644$, $p = 0.018$).

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