Supplementary Materials.

Table S1. ^{14}C data for bison assemblages used in this study. *Indicates new AMS ^{14}C age estimates on bison bone collagen.

Table S2. $^{87}Sr/^{86}Sr$ results of all sediment and vegetation samples.

Table S3. All stable isotope results from bison tooth enamel.

Site Descriptions.

Simonsen (13CK61). The Simonsen site is located on an abandoned meander of the Little Sioux River, 3.2 km west of Quimby, Iowa (Agogino and Frankforter, 1960; Frankforter and Agogino, 1959a, 1959b, 1960). Archaeological materials are present in two stratified zones, levels 3 and 7. All materials from the Simonsen site are currently curated at the Sanford Museum in Cherokee, IA. Four bone samples were submitted to the University of Arizona AMS lab for ^{14}C dating (Table S1). Three of these are bison petrous occipitals from level 7 and are statistically indistinguishable (calibrated mean of 7800-7610 cal yr BP). The fourth is a bison long bone shaft fragment from level 3, near a hearth and the mandible of a large domesticated dog. This yielded a slightly younger age estimate between 7430 and 7270 cal yr BP.

All of the teeth analyzed in this study are from Level 7. Within this level the densest concentration of bones were in eight contiguous 1.5 x 1.5 m units. Multiple articulated segments (>10), including at least one partial carcass, were removed from these units. This level represents a multi-animal bison kill event. The presence of numerous axial and cranial elements, as well as a number of articulated carcass segments suggests that this locality is the location of the actual kill, rather than a secondary processing area (Widga, 2006). Two hearths, multiple burned areas,

and a large anvil stone indicate further on-site processing of bison carcasses. Unfortunately, the bison assemblage is dominated by prime-aged male animals, and includes few juvenile or young animals with erupting dentitions, so no season-of-death assessment is possible at this time.

Cherokee Sewer (13CK405). Perhaps the best-documented example of Early Plains Archaic lifeways in the eastern Great Plains is the Cherokee Sewer site (Anderson and Shutler, 1978; Anderson and Semken, 1980; Shutler and Anderson, 1974). Interdisciplinary investigations at this locality by personnel from the University of Iowa and the Sanford Museum in the 1970s examined materials from the two middle Holocene components of the site: Horizon Ib (7430-7020 cal yr BP) and Horizon IIb (8170-7930 cal yr BP). Most researchers who examined the Cherokee Sewer materials have suggested that these main occupations are representative of bison processing activities possibly occurring during the late fall or winter (Anderson and Semken, 1980; Pyle, 1980; Whittaker, 1998).

Logan Creek, Zone B (25BT3). The type-site of the Logan Creek Complex is the multi-component Logan Creek site, near Oakland in northeastern Nebraska. Nebraska State Historical Society investigations delineated at least 9 occupation levels within an alluvial fan on Logan Creek, a tributary of the Elkhorn River. A ^{14}C age estimate on charcoal from a hearth feature in Zone B indicates an occupation between 7480-6980 cal yr BP (Mandel, 1995). Bison dominate the faunal assemblage. Analyses of bison dentitions from this zone indicate a late spring seasonality estimate. Butchering patterns suggest the Zone B assemblage is a bison processing site associated with a nearby multi-animal kill (Widga, 2003, 2004).

Hill Site (13ML62). Discovered during road construction along Pony Creek in southwestern Iowa, materials from the Hill site were salvaged by W. D. Frankforter in 1958 (Frankforter, 1959). Initial test excavations revealed a deeply buried component with materials

47 suggesting an Archaic occupation. However, prior to undertaking large-scale systematic
48 excavations, floodwaters washed out most of the deposits. Frankforter returned to salvage
49 remaining portions of the site late in the year. A new series of ^{14}C dates suggest the Hill
50 occupation dates between 7570-7420 cal yr BP (Table S1). While fragmentary, a variety of
51 vertebrate faunal remains were recorded including bison, deer, mole, bird and turtle (Widga
52 2006). Frankforter (1959) suggested that the Hill site was a campsite or habitation area rather
53 than a processing/kill site due to the presence of a large hearth complex, disarticulated animal
54 remains and the distribution of lithic manufacturing debris.

55 Itasca Bison Site (21CE1). The Itasca Bison site is located in Clearwater County,
56 Minnesota, approximately 300 m south of the western arm of Lake Itasca. This site, excavated by
57 Wilford in 1937 and again by Shay in the 1960s, has been interpreted as a bison kill and an
58 associated campsite (Jenks, 1937; Shay, 1971). The bonebed itself is in the modern floodplain of
59 Nicollet creek. A series of ^{14}C dates on preserved wood specimens from below and above the
60 bonebed suggested use of the locality sometime between 7800 and 8900 cal yr BP (Shay, 1971).
61 Through the course of this investigation it became clear that a variety of post-depositional
62 processes had affected the Itasca bonebed and the strength of the association between the ^{14}C
63 dated wood and the event(s) that created the bonebed came into question. Three additional AMS
64 ^{14}C dates (collagen) were acquired from bones in the main excavation block (Table S1). Two of
65 these samples are statistically indistinguishable and have a combined age estimate of 7970-7790
66 cal yr BP. The third sample is statistically distinct and ~600 years older (8520-8180 cal yr BP)
67 and is more consistent with Shay's (1971) dated wood specimens. These dates indicate the
68 possibility that multiple death events are represented in the Itasca site.
69

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Supplemental Material, table S1

Table S1. ^{14}C data for bison assemblages used in this study. *Indicates new AMS ^{14}C age estimates on bison bone collagen.

State	Site Name (context)	Lab Numbe	Material	^{14}C BP	$\delta^{13}C$ (PDB)	Reference
Minnesota	Itasca (main trench)	AA68343*	Collagen	7552±86	-15.8‰	This Study
	Itasca (main trench)	AA68344*	Collagen	7112±69	-18.2‰	This Study
	Itasca (main trench)	AA68345*	Collagen	7027±59	-18.4‰	This Study
Iowa	Hill (non-contig. Feature 3)	AA68347*	Collagen	6592±70	-14.6‰	This Study
	Hill (main excavation)	AA68348*	Collagen	6696±78	-13‰	This Study
	Hill (main excavation)	AA68349*	Collagen	6484±58	-15.3‰	This Study
	Hill (main excavation)	M 984	Charcoal	7250±400		Frankforter 1959
	Simonsen (lvl. 7)	AA68350*	Collagen	7006±72	-14‰	This Study
	Simonsen (lvl. 7)	AA68351*	Collagen	6717±68	-13.2‰	This Study
	Simonsen (lvl. 7)	AA68352*	Collagen	6905±72	-12.9‰	This Study
	Simonsen (lvl. 3)	AA68353*	Collagen	6433±69	-12.4‰	This Study
	Simonsen	I 79	Wood?	8430±520		Agogino and Frankforter, 1960
	Cherokee IIb	UCR 491	Charcoal	6800±190		Hoyer, 1980
	Cherokee IIb	WIS 891	Charcoal	7145±75		Hoyer, 1980
	Cherokee IIb	UCLA 1877	Charcoal	7370±100		Hoyer, 1980
Nebraska	Logan Creek B	Tx-7660	Charcoal	6340±120		Mandel, 1995

Supplemental Material TableS2

Table S2. Sr isotope results of all sediment and vegetation samples

Lab ID #	Sediment Source	State	Latitude	Longitude	$^{87}Sr/^{86}Sr$	Material	Taxon
GS7	Arkansas River Loess	KS	38.03	-101.18	0.71095	Grass	*Schizachyrium scopari*
GS149	Des Moines Lobe	IA	43.07	-93.36	0.70943	Grass	*Hordeum jubatum*
GS83	Des Moines Lobe	MN	45.25	-93.71	0.71096	Grass	*Andropogon sp.*
GS145	Des Moines Lobe	MN	43.57	-93.36	0.71041	Grass	*Panicum sp.*
GS146	Des Moines Lobe	MN	43.18	-93.36	0.71012	Grass	*Andropogon virginicus*
GS200	Des Moines Lobe	MN	43.66	-94.72	0.70984	Grass	*Bromus sp.*
GS201	Des Moines Lobe	MN	43.66	-94.11	0.70923	Grass	*Andropogon sp.*
GS202	Des Moines Lobe	MN	44.16	-94.04	0.70983	Grass	*Panicum sp.*
GS203	Des Moines Lobe	MN	44.26	-94.02	0.71030	Grass	*Andropogon gerardi*
GS223	Des Moines Lobe	SD	45.91	-96.86	0.71059	Grass	*Andropogon virginicus*
GS129	Missouri Valley	NE	41.61	-96.47	0.70896	Grass	*Andropogon sp.*
L1b	Missouri Valley	NE	41.80	-96.48	0.70876	Sediment	
GS220	James Lobe	ND	46.89	-98.68	0.70917	Grass	*Bromus sp.*
GS221	James Lobe	ND	46.91	-98.01	0.70907	Grass	*Andropogon virginicus*
GS21	James Lobe	SD	44.53	-96.89	0.70941	Grass	*Andropogon sp.*
GS218	James Lobe (alluvium)	ND	46.84	-100.52	0.70818	Grass	*Bromus sp.*
GS222	Lake Agassiz Basin	ND	46.85	-96.86	0.71100	Grass	*Andropogon virginicus*
GS80	Missouri Valley Alluvium	ND	43.79	-99.40	0.70844	Grass	*Andropogon gerardi*
L19	Missouri Valley Loess	IA	41.11	-95.77	0.70879	Sediment	
GS19	Missouri Valley Loess	IA	40.68	-95.69	0.70890	Grass	*Bromus sp.*
GS183	Missouri Valley Loess	IA	42.18	-95.84	0.70915	Grass	*Bromus sp.*
L15a	Sand Hills Loess	NE	40.98	-98.13	0.70935	Sediment	
GS191	Pre-Wisconsinan Till Plains	IA	42.66	-95.60	0.71040	Grass	*Bromus sp.*
GS192	Pre-Wisconsinan Till Plains	IA	42.86	-95.49	0.70939	Grass	*Andropogon virginicus*
GS197	Pre-Wisconsinan Till Plains	IA	43.34	-95.23	0.71019	Grass	*Andropogon gerardi*
GS199.2	Pre-Wisconsinan Till Plains	MN	43.52	-95.21	0.70923	Grass	cf. *Andropogon*
GS188	Pre-Wisconsinan Till Plains	IA	42.61	-95.68	0.70940	Grass	*Andropogon sp.*
GS189	Pre-Wisconsinan Till Plains	IA	42.63	-95.67	0.70978	Grass	*Andropogon gerardi*
GS190	Pre-Wisconsinan Till Plains	IA	42.63	-95.66	0.70984	Grass	*Bromus sp.*
L24b	Sand Hills Loess	NE	40.08	-99.37	0.70978	Sediment	
L20b	Sand Hills Loess	NE	40.65	-100.07	0.70963	Sediment	
L7b	Sand Hills Loess	NE	40.36	-100.68	0.71037	Sediment	
GS2	Smoky Hill Loess	KS	38.87	-99.07	0.70913	Grass	*Bromus sp.*
GS5	Smoky Hill Loess	KS	39.34	-102.02	0.71043	Grass	*Artemisia sp.*
GS5	Smoky Hill Loess	KS	39.34	-102.02	0.71090	Grass	*Bromus sp.*
GS209	Superior Lobe	MN	45.74	-93.69	0.71163	Grass	*Bromus sp.*
GS212	Superior Lobe	MN	46.13	-93.72	0.71207	Grass	*Andropogon gerardi*
GS85	Wadena Lobe	MN	46.01	-94.90	0.71068	Grass	*Andropogon sp.*
GS86	Wadena Lobe	MN	47.19	-95.23	0.71075	Grass	*Andropogon sp.*

Table S3. All stable isotope results from bison tooth enamel.

Locality	ID	Catalog Number/Description	DAG	Individual	Tooth	DCEJ[a] (mm)	DML[b] (mm)	ROWLENGTH	HERDLENGTH	$\delta^{13}C$ (‰)	$\delta^{18}O$ (‰)	$^{87}Sr/^{86}Sr$
Cherokee IIb	13CK401A	BB9/4/#218	7	Cher-1	M_3	1.75	66.00	98.82	-111.18	-6.13	-8.91	0.70983
Cherokee IIb	13CK401A	BB9/4/#218	7	Cher-1	M_3	9.75	58.00	93.44	-116.56	-6.38	-8.13	0.70985
Cherokee IIb	13CK401A	BB9/4/#218	7	Cher-1	M_3	16.75	51.00	88.73	-121.27	-5.59	-5.12	0.70948
Cherokee IIb	13CK401A	BB9/4/#218	7	Cher-1	M_3	23.75	44.00	84.02	-125.98	-4.22	-6.91	0.70935
Cherokee IIb	13CK401A	BB9/4/#218	7	Cher-1	M_3	32.50	35.25	78.14	-131.86	-2.09	-8.34	0.70939
Cherokee IIb	13CK401A	BB9/4/#218	7	Cher-1	M_3	40.75	27.00	72.59	-137.41	-0.40	-9.06	0.70939
Cherokee IIb	13CK401A	BB9/4/#218	7	Cher-1	M_3	47.75	20.00	67.88	-142.12	0.29	-6.53	0.70938
Cherokee IIb	13CK401B	177-502/IIbT1-10/#219	8	Cher-2	M_3	1.00	66.75	99.33	-140.67	-3.59	-5.48	0.70952
Cherokee IIb	13CK401B	177-502/IIbT1-10/#219	8	Cher-2	M_3	9.75	58.00	93.44	-146.56	-2.38	-5.40	0.70963
Cherokee IIb	13CK401B	177-502/IIbT1-10/#219	8	Cher-2	M_3	17.50	50.25	88.23	-151.77	-3.71	-7.72	0.71000
Cherokee IIb	13CK401B	177-502/IIbT1-10/#219	8	Cher-2	M_3	26.50	41.25	82.17	-157.83	-4.81	-11.64	0.71007
Cherokee IIb	13CK401B	177-502/IIbT1-10/#219	8	Cher-2	M_3	34.75	33.00	76.62	-163.38	-5.13	-11.28	0.70992
Cherokee IIb	13CK401B	177-502/IIbT1-10/#219	8	Cher-2	M_3	43.75	24.00	70.57	-169.43	-5.06	-6.90	0.70983
Cherokee IIb	13CK401C	177-1329/IIbT1-133/#215	3	Cher-3	M_2	1.00	62.40	68.89	-21.11	-1.70	-8.74	0.70931
Cherokee IIb	13CK401C	177-1329/IIbT1-133/#215	3	Cher-3	M_2	9.25	54.15	63.34	-26.66	-1.38	-8.59	0.70938
Cherokee IIb	13CK401C	177-1329/IIbT1-133/#215	3	Cher-3	M_2	16.25	47.15	58.63	-31.37	-1.38	-5.20	0.70941
Cherokee IIb	13CK401C	177-1329/IIbT1-133/#215	3	Cher-3	M_2	23.50	39.90	53.75	-36.25	-1.79	-3.62	0.70940
Cherokee IIb	13CK401C	177-1329/IIbT1-133/#215	3	Cher-3	M_2	32.25	31.15	47.86	-42.14	-2.24	-5.89	0.70942
Cherokee IIb	13CK401C	177-1329/IIbT1-133/#215	3	Cher-3	M_2	41.75	21.65	41.47	-48.53	-2.52	-8.27	0.70940
Cherokee IIb	13CK401C	177-1329/IIbT1-133/#215	3	Cher-3	M_2	51.75	11.65	34.75	-55.25	-2.46	-8.96	0.70940
Cherokee IIb	13CK401C	177-1329/IIbT1-133/#215	3	Cher-3	M_2	61.50	1.90	28.19	-61.81	-3.24	-5.88	0.70940
Cherokee IIb	13CK401D	177-1329/IIbT1-133/#215	3	Cher-3	M_3	1.75	66.00	98.82	8.82	-1.75	-5.91	0.70923
Cherokee IIb	13CK401D	177-1329/IIbT1-133/#215	3	Cher-3	M_3	14.25	53.50	90.41	0.41	-1.62	-5.32	0.70929
Cherokee IIb	13CK401D	177-1329/IIbT1-133/#215	3	Cher-3	M_3	23.25	44.50	84.36	-5.64	-1.37	-7.26	0.70924
Cherokee IIb	13CK401D	177-1329/IIbT1-133/#215	3	Cher-3	M_3	31.25	36.50	78.98	-11.02	-1.57	-9.72	0.70926
Cherokee IIb	13CK401D	177-1329/IIbT1-133/#215	3	Cher-3	M_3	39.75	28.00	73.26	-16.74	-1.46	-9.46	0.70926
Cherokee IIb	13CK401D	177-1329/IIbT1-133/#215	3	Cher-3	M_3	50.25	17.50	66.20	-23.80	-1.90	-7.67	0.70938
Cherokee IIb	13CK401D	177-1329/IIbT1-133/#215	3	Cher-3	M_3	59.75	8.00	59.80	-30.20	-1.92	-5.59	0.70945
Cherokee IIb	13CK401D	177-1329/IIbT1-133/#215	3	Cher-3	M_3	67.75	0.00	54.42	-35.58	-2.60	-5.36	0.70945
Simonsen Lvl. 7	13CK61A	192.55.Z	D (10)	Sim-1	M_2	1.25	62.15	68.72	-231.28	-5.81	-5.56	
Simonsen Lvl. 7	13CK61A	192.55.Z	D (10)	Sim-1	M_2	8.75	54.65	63.67	-236.33	-7.14	-5.36	
Simonsen Lvl. 7	13CK61A	192.55.Z	D (10)	Sim-1	M_2	18.25	45.15	57.28	-242.72	-5.65	-4.35	
Simonsen Lvl. 7	13CK61A	192.55.Z	D (10)	Sim-1	M_2	27.75	35.65	50.89	-249.11	-5.21	-5.45	
Simonsen Lvl. 7	13CK61C	NE37 W/SKULL #1	C (9)	Sim-2	M_2	9.75	53.65	63.00	-207.00	-1.67	-7.51	
Simonsen Lvl. 7	13CK61C	NE37 W/SKULL #1	C (9)	Sim-2	M_2	21.50	41.90	55.10	-214.90	-1.65	-3.90	
Simonsen Lvl. 7	13CK61C	NE37 W/SKULL #1	C (9)	Sim-2	M_2	29.25	34.15	49.88	-220.12	-2.60	-3.15	
Simonsen Lvl. 7	13CK61D	SQ36 D:28"; MR UNDER ROCK	C (9)	Sim-3	M_1	1.50	51.00	34.31	-235.69	-2.00	-8.19	
Simonsen Lvl. 7	13CK61D	SQ36 D:28"; MR UNDER ROCK	C (9)	Sim-3	M_1	8.75	43.75	29.43	-240.57	-1.62	-8.89	
Simonsen Lvl. 7	13CK61D	SQ36 D:28"; MR UNDER ROCK	C (9)	Sim-3	M_1	15.25	37.25	25.06	-244.94	-1.31	-8.65	
Simonsen Lvl. 7	13CK61D	SQ36 D:28"; MR UNDER ROCK	C (9)	Sim-3	M_1	21.75	30.75	20.69	-249.31	-1.22	-8.46	
Simonsen Lvl. 7	13CK61E	SQ36 D:28"; MR UNDER ROCK	C (9)	Sim-3	M_2	9.50	53.90	63.17	-206.83	-2.14	-8.91	
Simonsen Lvl. 7	13CK61E	SQ36 D:28"; MR UNDER ROCK	C (9)	Sim-3	M_2	22.50	40.90	54.42	-215.58	-1.28	-6.96	
Simonsen Lvl. 7	13CK61E	SQ36 D:28"; MR UNDER ROCK	C (9)	Sim-3	M_2	26.00	37.40	52.07	-217.93	-0.99	-4.48	
Simonsen Lvl. 7	13CK61E	SQ36 D:28"; MR UNDER ROCK	C (9)	Sim-3	M_2	35.25	28.15	45.85	-224.15	-1.15	-4.78	
Simonsen Lvl. 7	13CK61F	166-55	A (7)	Sim-4	M_3	1.25	66.50	99.16	-110.84	-3.58	-5.51	0.70928
Simonsen Lvl. 7	13CK61F	166-55	A (7)	Sim-4	M_3	7.50	60.25	94.95	-115.05	-2.08	-5.97	0.70934
Simonsen Lvl. 7	13CK61F	166-55	A (7)	Sim-4	M_3	15.50	52.25	89.57	-120.43	-2.02	-8.31	0.70925
Simonsen Lvl. 7	13CK61F	166-55	A (7)	Sim-4	M_3	24.25	43.50	83.69	-126.31	-1.59	-8.94	0.70927
Simonsen Lvl. 7	13CK61F	166-55	A (7)	Sim-4	M_3	32.25	35.50	78.30	-131.70	-0.60	-8.96	0.70935
Simonsen Lvl. 7	13CK61F	166-55	A (7)	Sim-4	M_3	39.75	28.00	73.26	-136.74	-0.65	-7.50	0.70936
Simonsen Lvl. 7	13CK61F	166-55	A (7)	Sim-4	M_3	47.00	20.75	68.38	-141.62	-1.02	-6.25	0.70950
Simonsen Lvl. 7	13CK61G	167-55	A (7)	Sim-5	M_2	1.75	61.65	68.38	-141.62	-0.37	-5.91	
Simonsen Lvl. 7	13CK61G	167-55	A (7)	Sim-5	M_2	13.50	49.90	60.48	-149.52	-1.31	-5.41	
Simonsen Lvl. 7	13CK61G	167-55	A (7)	Sim-5	M_2	22.50	40.90	54.42	-155.58	-2.72	-6.24	
Simonsen Lvl. 7	13CK61G	167-55	A (7)	Sim-5	M_2	31.50	31.90	48.37	-161.63	-4.41	-8.85	
Simonsen Lvl. 7	13CK61G	167-55	A (7)	Sim-5	M_2	39.25	24.15	43.16	-166.84	-5.30	-10.02	
Simonsen Lvl. 7	13CK61H	167-55	A (7)	Sim-5	M_3	1.75	66.00	98.82	-111.18	-2.85	-6.08	
Simonsen Lvl. 7	13CK61H	167-55	A (7)	Sim-5	M_3	9.75	58.00	93.44	-116.56	-2.12	-6.98	
Simonsen Lvl. 7	13CK61H	167-55	A (7)	Sim-5	M_3	16.75	51.00	88.73	-121.27	-2.21	-7.95	
Simonsen Lvl. 7	13CK61H	167-55	A (7)	Sim-5	M_3	23.75	44.00	84.02	-125.98	-1.47	-9.24	
Simonsen Lvl. 7	13CK61H	167-55	A (7)	Sim-5	M_3	31.75	36.00	78.64	-131.36	-0.30	-9.60	
Simonsen Lvl. 7	13CK61H	167-55	A (7)	Sim-5	M_3	40.25	27.50	72.92	-137.08	-0.28	-7.27	
Simonsen Lvl. 7	13CK61H	167-55	A (7)	Sim-5	M_3	48.00	19.75	67.71	-142.29	-1.63	-5.95	
Simonsen Lvl. 7	13CK61I	113.56.Z	B (8)	Sim-6	M_2	1.25	62.15	68.72	-171.28	-2.56	-8.15	
Simonsen Lvl. 7	13CK61I	113.56.Z	B (8)	Sim-6	M_2	9.75	53.65	63.00	-177.00	-1.69	-7.79	
Simonsen Lvl. 7	13CK61I	113.56.Z	B (8)	Sim-6	M_2	18.75	44.65	56.95	-183.05	-0.75	-6.59	
Simonsen Lvl. 7	13CK61I	113.56.Z	B (8)	Sim-6	M_2	25.50	37.90	52.40	-187.60	-0.60	-4.74	
Simonsen Lvl. 7	13CK61I	113.56.Z	B (8)	Sim-6	M_2	33.50	29.90	47.02	-192.98	-1.20	-4.53	
Simonsen Lvl. 7	13CK61I	113.56.Z	B (8)	Sim-6	M_2	40.25	23.15	42.48	-197.52	-1.57	-4.71	
Simonsen Lvl. 7	13CK61I	113.56.Z	B (8)	Sim-6	M_2	49.00	14.40	36.60	-203.40	-2.30	-5.88	
Simonsen Lvl. 7	13CK61J	591-58	B (8)	Sim-7	M_2	1.00	62.40	68.89	-171.11	-4.69	-9.01	