THE GREATER PLAINS

Rethinking a Region's Environmental Histories

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Introduction

Since the end of the last glaciation, fire has been essential to the return and expansion of grasslands on the northwestern plains. Overwhelmingly, however, scientific explanations of grassland fires have revolved around natural phenomena, discounting the fact that Native Americans changed greatly the surrounding environment for their use and survival with fire.[1] Scars on old trees, charcoal particles in lake sediments, or postfire erosion in arid lands are generally attributed to natural fires given certain conditions such as episodes of global warming and dry climate: as G. W. Williams notes, "since the trees and sediments cannot document how the fires *started*, lightning becomes the easiest 'natural' explanation."[2] Yet, historical and ecological references to intentional use of fire under numerous circumstances and for a wide variety of purposes are growing fast. H. T. Lewis, long-term scholar of Native fires, recorded at least seventy different fire applications to manipulate vegetation. His and over three hundred other studies detail how fire was used to improve hunting grounds, manage crops, improve growth and yields of grasslands and pastures, fireproof key econiches from destructive wildland fires, collect insects, deter pests, signal strategically and combat enemies, manipulate the trade market, clear pathways, fell trees, and clean riparian areas.[3]

Fire in the North American grassland was a common occurrence throughout the Holocene.[4] Historical accounts of early travelers

across the plains support the role of fire as important in creating and maintaining the prairie. Plains historians have debated the origin of fire for a very long time; Carl Sauer and Omer Stewart most effectively articulated the role of anthropogenic fires in the maintenance of a healthy grassland.[5] The climatic regime of the northwest plains, with its cold snowy winters and hot dry summers, favored the growth of fescue grass that would provide ample fuel for natural and anthropogenic fires. The most important uses of fire on the upland prairie near the Rocky Mountains involved the manipulation of bison herd movements and the renewal of nutritious grasses (especially around fall and winter hunting areas) so that the pregnant cows would remain in areas of fresh spring growth until they had calved.[6] Given the extent of fire use by historic bison hunters, one would expect that this practice originated far into the past.

There are a number of regions in North America (e.g., the Southwest) where anthropogenic fires have been recorded and dated through dendrochronology; unfortunately, the archaeology of ancient anthropogenic fires is still in its infancy.[7] When scholars indeed acknowledge prehistoric fires as intentional, explanations most often lean toward signaling, agriculture, settlement abandonment, and acts of war. Far less common are discussions of anthropogenic fires in the context of premeditated landscape and resource management in the past with the intention of obtaining specific future results; this gap is likely the result of methodological challenges in identifying ancient fires in certain contexts.

Modern pyro-archaeological studies have focused on various ecosystems (e.g., the Pacific Northwest, California, Southwest, and Southeast).[8] Prehistoric fires in grassland ecosystems, however, have received the least attention, even though fire is an essential component in grassland renewal. Through the analysis of grass phytoliths preserved in a sequence of buried soil horizons in the Lauder Sandhills in southwestern Manitoba, Canada, Matthew Boyd demonstrated that, as early as 2,400 radiocarbon years ago, hunter-gatherers deliberately burned the prairie.[9] In this pioneering

study, he concluded that fire may have been used to make bison-herd movements more predictable and may have enabled higher human carrying capacities.

Boyd's study has huge implications for reconstructing how bison hunters in the past developed an understanding of the delayed effects of their immediate actions, which in turn allowed them to plan for the future. Beginning two thousand years ago, bison hunters developed architectural features for mass-harvesting bison and, a few centuries later, they adopted the bow-and-arrow technology. The combination of fire, permanent architecture, efficient hunting weapons, and millenary ecological knowledge created a snowball effect as indicated by exponential population growth and aggregation near large-scale communal hunting facilities during the last millennium.[10]

In this chapter we present the results of a pyro-archaeological study aimed at identifying evidence of intentional fire use by Late Prehistoric bison hunters (Old Women's Phase) who were the immediate ancestors of the historic Blackfoot. The ultimate objective of this study is to demonstrate how bison hunters incorporated fire into their annual calendar to promote grassland growth in bison milling areas in order to attract herds near their encampments at critical times of the year. First, we summarize historical evidence of fire uses by the Blackfoot. Then, we introduce the archaeology of Old Women's Phase bison hunting along the Two Medicine River, Montana. Third, we present and discuss the results of the pyro-archaeology component in the Kutoyis Archaeological Project. We conclude that the natural and cultural impacts of certain historical-ecological trends in the Great Plains, such as anthropogenic fires, are best understood and explained by applying a long-term perspective.

Fire among the Blackfoot

At the time of first indirect European contact (ca. 1730), the Blackfoot were specialized bison hunters whose territory extended from the North Saskatchewan River in Alberta to the northern shore of Yellowstone Lake in Montana, and from the Rocky Mountain

Front to the Great Sandhills in western Saskatchewan.[11] Late Prehistoric bison kill sites associated with the Blackfoot's immediate ancestors encompassed large areas of upland prairie where they built rock-lined funnels that connected bison milling areas to a steep bluff overlooking a river valley or to a wooden corral or "pound." Major drainages trended northeast from their source; these drainages had areas of broad valley floors lined with cottonwood and aspen forests as well as diverse understory vegetation. Bison "jumps" or kill sites associated with steep landforms were common along the upper and middle river valleys, whereas bison pounds were situated in gentler terrain toward the eastern part of their territory.

Defensible boundaries in the Blackfoot territory were first recorded by Henry Kelsey in 1691. He traversed central Saskatchewan and noted that the tribes inhabiting this region (Crees, Assiniboines, and Gros Ventres) recognized a boundary with the Blackfoot and knew that it was not to be crossed without consequence.[12] This is technically a prehistoric boundary as the horse did not arrive into the northern plains until 1730. As George Colpitts notes, by the early 1800s both the Blackfoot and their neighbors had resorted to keep burning the prairie along this boundary to deter intrusions and create a no-man's-land.[13]

One of the earliest fires recorded in Blackfoot country was deemed accidental by Hudson's Bay trader Peter Fidler, who saw a grass fire near the present town of Calgary in January 1792.[14] It was later noted that the Indians "deliberately started fires for ceremonial, superstitious, and other reasons, for example, as an offering for fair weather or the return of a war party. Fire was also used for war, signalling, hunting, and controlling the movement of wildlife."[15] Most eyewitness accounts of the Blackfoot use of fire are associated with territorial defense and warfare. The Blackfoot were noted for using fire to surround a hiding enemy party, as observed by Osbourne Russell in 1835: "They commenced setting fire to the dry grass and rubbish with which we were surrounded . . . in a few moments the fire was converted into one circle of flame and smoke which united over our heads."[16] Warren

Ferris also noted, in his trip to Big Hole Valley, Montana, in 1831 that the Blackfoot set fire signals at first sight of an approaching party. "We were now on the borders of the Blackfoot country and had frequently seen traces of small parties, who it was reasonably inferred might be collected by smoke, which is their accustomed rallying signal. . . . Clouds of smoke were observed on the following day curling up from the summit of a mountain."[17] In his trek across Montana in 1859, John Mullan further observed trails that had been cleared by fire in the Big Hole Valley.[18]

Only vague notes were made in the historical period about the Blackfoot burning the prairie for reasons beyond signaling, trade competition, and war. Yet contemporary Blackfoot people uphold traditions of prairie fires (see figure 4). Kainai (Blood) elder Andy Blackwater, for instance, noted that fire was held in great respect because of its power.[19] People used fire to clear undesirable brush and forest stands, to make room for useful plants, and to promote new grass growth in bison wintering areas. As well, fire was an essential tool in bison drives. Bison runners or scouts, often camouflaged in bison or wolf skins, would carefully observe the position of a herd relative to the intended jump or pound site. A small fire was lit behind the herd so that when the herd became aware of the fire they would naturally enter the stone-lined funnel and run toward the fall. Hunters would line along the funnel to push the bison forward and discourage escape. This aspect of the bison drive was imbued with spiritualism and ceremony, as were all other aspects of the relationship between bison and the Blackfoot.

It is important to note that, for the Blackfoot and many other Plains groups, bison hunting was not only a subsistence and trade economy; bison, in fact were (and continue to be) at the center of their spiritual and practical worlds. Fire, from this perspective, would have allowed the renewal of the prairie and, in turn, the renewal of the bison herds—a form of reciprocity for all the gifts bison gave to the Blackfoot people.

At a Kainai (Blood) encampment that Prince Maximilian de Wied visited in 1832, he observed that the act of setting fire for the bison drive was ritually reenacted during the Okan (Medicine

FIG. 4. Blackfoot chiefs demonstrate to photographer Harry Pollard how to set a prairie fire (1903). Provincial Archives of Alberta, P467.

Lodge Ceremony) or Blackfoot Sun Dance. At the culmination of the four-day dance the Motoki or Buffalo Women Society came out of their lodge dancing as buffalo cows while the attending crowd stood in driving funnel formation in front of their lodge.[20] The Motoki lodge is a ceremonial representation of the bison piskun or corral.[21]

Given the prevalence and religious significance of the interaction between bison hunting and fire, it is reasonable to expect that prairie-burning activities left recoverable remains in the archaeological record. The Kutoyis Archaeological Project (KAP), which focuses on landscape-scale Late Prehistoric bison hunting organi-

zation in the Blackfeet Indian Reservation, Montana, has proven to be the ideal locale to ascertain this ancient interaction.

Bison Hunting on the Two Medicine River, Montana

Until Native Americans adopted the horse and amassed large enough herds to make mounted hunting a profitable enterprise, all communal hunting was done on foot. Europeans who first entered the northwestern plains toward the end of the eighteenth century were struck by the scale of pedestrian bison-hunting ventures among the Blackfoot. Working mainly as traders for the Hudson's Bay Company or the North West Company, these Europeans described in some detail the layout and construction of bison "parks" and the tactics of hunters who drove the bison by pushing herds into the parks and killing them with bows and arrows, axes, clubs, spears, and any other powerful weapon they could muster.

Eyewitness accounts of bison hunting during the Early Contact Period referred, for the most part, to facilities and events taking place in the periphery of the Blackfoot aboriginal territory. With very few exceptions (e.g., Peter Fidler's 1792–93 winter expedition to the foothills of southern Alberta), the fierce Blackfoot did not wish to have traders and fur trappers in their heartland and, therefore, the specific construction and topographic layout of Blackfoot hunting complexes located near the Rocky Mountains were largely unknown to Europeans.[22] Traders never failed to note fires burning, even through winter. However, the use of fire to manage bison and grassland was rarely, if at all, noted by these outsiders.

The glacial till–covered Rocky Mountain foothills provided hunters with unlimited amounts of stone to build permanent bison drives, lodge foundations, effigies, monuments, and so on.[23] As well, the foothills furnished ideal topographic features to build the jumps. Peter Fidler (1792, December 27–29) witnessed the pedestrian bison drives along the Alberta foothills; he noted that the Peigan hunters had built one or more connected pounds or corrals (known in Blackfoot as piskuns or "deep blood kettles") under a bluff or cliff.[24] They killed large numbers of bison by stampeding them until they fell stumbling into the pound.

European observers also took important note of the knowledge and skill possessed by the hunters. Wind, weather, season, ecology, topography, and astronomy all came into place when attempting to sight and attract a bison herd into the jump. This knowledge was passed down through generations, along with the rituals and "medicines" necessary to hunt successfully.[25] Prescribed fire was a critical component of their ecological knowledge. To take advantage of the foothills topography, the Blackfoot ancestors painstakingly built rock-lined funnels connecting bison milling areas and a potential kill site. Sometimes these funnels connected milling areas to water bodies, so that the hunters would be able to move a herd from one drainage to the next. The result was an intricate network of drivelines that crisscrossed the upland prairie strategically, to bring bison to their death. Yet another important piece of knowledge was the fat content of bison males and females at different times of the year. Hunters aimed at obtaining the greatest amount of fat and therefore targeted different sectors of the herd depending on the season.[26] Intricate drivelines helped hunters split the herd for this specific purpose.

The ideal jumps were located above broad valleys where the floodplain was wide enough to provide enough room for a processing camp. Proximity to water and fuel were also critical for processing large amounts of meat; communal hunts could yield thousands of pounds of meat. Hunters used jumps in the cold months of the year, which helped preserve fresh meat until it was dried and turned into pemmican. Pemmican was nutritious, lightweight, and could be stored for long periods of time.[27] Bison tongues, a sacred food, were dried for use in ceremonies and particularly in the summer Okan.[28] Jumps were rarely used in the late spring or summer, when only pounds or parks were built from wood to hunt for immediate consumption.

The central Two Medicine River Valley, with its lofty bluffs and broad valley floor, offered the ideal conditions for building multiple bison drives. As early as the 1890s Walter McClintock visited the Two Medicine River jumps in the company of Blackfoot bison runners.[29] They explained to McClintock that the construc-

tion of multiple jumps was strategic; it allowed hunters to drive herds in a certain direction depending on weather conditions and to change plans if these conditions changed. They also told him that the driving and jumping enterprise, along with processing, was a band-wide affair that necessitated all able hands. Wintering encampments of each band were also interspersed along the central valley in close proximity to the jumps.

Blackfoot Pyro-Technology

The KAP aimed at reconstructing the spatial organization of communal bison hunting dating to the Late Prehistoric through Protohistoric periods (1,000–250 cal BP) from a perspective that highlights architectural investment on bison-driving facilities along the Two Medicine River.[30] (See figure 5.) Zedeño and colleagues gathered information discussed here during a multiyear archaeological project, which focused on the geography of extractive localities illustrative of the bison-hunting complex of the ancestral Blackfoot (Old Women's Phase). A survey conducted by Thomas Kehoe in the 1950s revealed the existence of five driveline/jump clusters located on both banks of the river.[31] These clusters extended along the central and lower valleys. Since then, the fourth cluster has been destroyed by agriculture and the fifth cluster is only partially preserved. Nevertheless, we relocated ten jumps and mapped the corresponding drivelines and encampments. In total, we recorded twenty-six thousand stone features of which twenty-four thousand are part of the hunting complexes.

To assess the role of fire on Blackfoot land use and its relationship to the ecology of shortgrass prairies of the Rocky Mountain foothills, we used a spatially explicit geoarchaeological approach. Specifically, we used stratified records of fire and postfire erosion from terrestrial sediments near archaeologically documented driveline and bison jump complexes. We cleared, described, and continuously sampled alluvial sediments from two small fan terraces in the Spring Coulee tributary of the Two Medicine River (KAP 2 and KAP 3). Spring Coulee drains an area that includes the catchment basin for the driveline complex associated with the Two Med-

FIG. 5. Stranglewolf bison jump viewed from Magee bison jump, Two Medicine River, Montana. Photo by M. N. Zedeño.

icine/Schultz bison jump.[32] These stratigraphic sequences included interbedded overbank flooding deposits and colluvial deposits, with young soils overprinted on some deposits, especially at KAP 3.

We also partially cleared, described, and discontinuously sampled a thick sequence of colluvial deposits adjacent to the Stranglewolf bison jump and driveline complex (KAP 4). This fan collects sediments from a small drainage that overlaps the driveline basin. Both KAP 2 and KAP 4 contain discrete, fine-grained beds that are rich in charcoal and interbedded with colluvial (KAP 4) and fine-grained alluvial (KAP 2) deposits. To determine the age of these fire-derived deposits, we radiocarbon-dated aggregated fine charcoal from charcoal rich deposits at KAP 2 and 4, and non-fire-related deposits and soils at KAP 2, 3, and 4. Both the Two Medicine/Schultz and Stranglewolf bison jump sites have been radiocarbon-dated to the fifteenth and sixteenth centuries cal BP, although older deposits at both jump sites may not have been exposed in limited test excavations.[33] Radiocarbon dates from the Kutoyis jump site

FIG. 6. Spring Coulee bank profile, showing several burning episodes. Two Medicine River, Montana. Photo by Christopher Roos.

indicate that peak use may have occurred during the fourteenth, fifteenth, and early sixteenth centuries, but that earlier uses date to the twelfth and thirteenth centuries.

Interpretation

Radiocarbon dating was complicated by the fact that the source material for alluvial and colluvial deposits included glacial till that also contained charcoal; in this case the charcoal was from prior to the Last Glacial Maxima (ca. 26,000–18,000 years ago). This meant that many dates on aggregated charcoal were artificially too old because they included some of this ancient charcoal inherited from the glacial till. Therefore, we excluded dates in the sequence that are older than dates from deposits stratigraphically below them in our analysis.

For our oldest locality (KAP 3), all three radiocarbon dates are in stratigraphic order spanning the last 10,000 years. All three of these are from soils and not clearly from postfire deposits. At

KAP 2 eight of the twelve dates are in stratigraphic order. A basal date is Terminal Pleistocene in age and may date the basal colluvium; this could also be impacted by inherited ancient charcoal, as a second date from this unit was beyond the measurement limit for radiocarbon (>49,000 years ago). Five of the eight dates are on discrete charcoal beds. The remaining samples bookend the fire dates but are from non-fire-related deposits. At KAP 4 inherited charcoal was a more significant problem. Nonetheless, eight of twenty-eight dates are in stratigraphic order over the last 1,000 years, with two dates on basal alluvial deposits that are Terminal Pleistocene in age. Two charcoal beds from the stratigraphic sequence were undated, whereas five were directly dated. Three non-fire-related deposits were dated to bookend the sequence of charcoal-rich deposits.

Radiocarbon dates that are in stratigraphic order were calibrated using Bayesian algorithms in BCal.[34] In this way, we could use the stratigraphic order of the dated deposits to generate informed posterior probability distribution functions. This approach allowed us to estimate with 95 percent of statistical confidence the age of charcoal-rich deposits that were not directly dated.

Results

Charcoal-rich deposits at both KAP 2 and 4 indicate that peak fire activity occurred between roughly 750 and 350 cal BP, with evidence for postfire erosion extending to ca. 950 cal BP. These dates overlap with local radiocarbon-dated use of the Two Medicine/Schultz and Stranglewolf jump sites as well as dates from other jumps and campsites.[35] Furthermore, the non-fire-related dates on either side of the charcoal sequence and the lack of charcoal-rich beds at KAP 3 suggest that this period of fire and postfire erosion may have been unique in the entire Holocene.[36] It is important to note that there is no climatic reason to think that this pattern of burning should have changed in the seventeenth century; in fact, higher fuel production correlated to grassland expansion in moist conditions likely spanned the Medieval Warm Period (ca. 950–650 BP) as well as the Little Ice Age (ca. 750–140 BP). Fes-

cue grasslands of the northwestern plains are fuel limited and require greater levels of moisture to produce abundant and continuous fuels in order to carry fires. Episodic decadal wet periods are equally abundant during 750–350 BP and thereafter. This observation further corroborates the inference that the period of enhanced fire activity between 750 and 350 cal BP was associated with the active use and maintenance of the driveline complex for intensive bison hunting.

Old Women's Phase bison kill sites on the Two Medicine River and vicinity generally exhibit two fire signals: one associated with the burning of the fresh bone bed, which results in patchy hot fires that turn the soil into brick, and another associated with heat features in the associated processing camp. Anthropogenic fires analyzed by the authors present yet a third, nonrandom, and very distinctive fire signal—it appears stratigraphically as episodic charcoal-rich deposits interbedded with noncharcoal deposits. This signal differs from natural wildfires in that it is directly associated with bison kill and processing sites. Likewise, radiocarbon age ranges for both sites and nonrandom fires match the beginning and end of human use of kill sites as well as the beginning and end of grassland burning practices. The analysis of burning sequences further indicates that hunters were burning the grassland near bison jumps in alternate patterns, so that some jumps were available for grazing and mass-harvesting while others were recovering from a recent patch-burning episode.[37]

There are two primary ways by which anthropogenic burning may have been used by ancestral Blackfoot hunters. One mechanism would have been to use fire to drive bison herds toward the jump. Alternatively, fire could have been used as a mechanism to manipulate the location of herds to attract them toward particular driveline complexes or to render other areas less attractive. Gerald Oetelaar favors the latter, which is in keeping with a growing literature on pyric herbivory.[38] Bison prefer recently burned patches of forage, so selective patch burning attracts bison to particular areas where they may more easily be manipulated into a particular drive lane. Alternatively, freshly burned areas that have

not yet regenerated are unsuitable for forage and may repel bison from particular areas where they are not wanted. Based on the radiocarbon-dated charcoal stratigraphy alone, we cannot adjudicate between the fire-drive or pyric herbivory explanations. Nor are they entirely mutually exclusive. However, our sampling localities most closely correspond to fire-improved grazing areas than to driving initiation areas that are much farther away from the jump, often more than four thousand meters. Therefore, we tend to agree with Oetelaar that a pyric herbivory model for fire lighting during peak driveline use is most likely. In this sense, we can clearly think about Blackfoot hunters as ecosystem engineers in the fescue prairie province who possessed the particular technology associated with construction, use, and fire-optimization of driveline complexes.

The patch burning that would have been necessary to manipulate forage in this approach would have had impacts beyond the suitability and desirability of forage for bison. Patch heterogeneity created by this strategy would have had impacts on habitat suitability for small mammals, birds, as well as for botanical diversity in the grasslands. The decline in this patch-burning strategy, as seen in the cessation of the charcoal-rich deposits at KAP 2 and KAP 4 by 350 cal BP, is consistent with the temporary retreat of the Blackfoot to the north and, later on, their transition from pedestrian to equestrian bison hunting. We know from historical and ethnographic records that fire use, including pyric herbivory patch burning, persisted into the equestrian period.[39] However, the stratigraphic and ethnohistoric records suggest that it did not continue in the same kill localities as in the preceding centuries, although it certainly was ubiquitous around late-fall kill sites to the north, specifically on the Upper Oldman River in Alberta, Canada, as observed by Peter Fidler in 1792. Historic anthropogenic fire signals and their purpose may prove far more difficult to sort out than prehistoric ones, given the extent of fire use as a weapon in areas traditionally used for bison hunting by the Siksika and Kainai divisions of the Blackfoot Confederacy. Finally, the extensive growth of Blackfoot horse herds, combined with new bison-

hide trade opportunities beginning in 1830, conspired to terminate the ecosystem engineering practices of the ancestors.[40]

Our records also suggest that the archaeological landscapes characterized by driveline complexes and bison jumps in the northwestern plains may have also been characterized by pyrogenic heterogeneity and biodiversity, even as economic inferences have emphasized the importance of bison. In fact, many of the ecological consequences of patch burning beyond hunting may not have had clear economic impacts for Blackfoot hunters. Nevertheless, in these landscapes the Blackfoot were key ecosystem engineers through their manipulation of fescue grasslands through patch burning to enhance their hunting productivity.

Conclusion

The antiquity of fire practices in the northwestern plains (2,400 years) is a testament to the unique relationship that bison hunters had with their prey and their environment. Early in the development of specialized bison hunting, fire was implemented as a tool for gaining control over the movement of bison and, as a consequence, increase the human carrying capacity of northern grasslands. The findings from our pyro-archaeology study reveal a direct correlation between human intensive communal hunting during the last millennium and prairie fires. Furthermore, geoarchaeology indicates that postfire erosion began and stopped in tandem with the construction and decommissioning of vast hunting complexes located along the Two Medicine River Valley, respectively. When combined with extensive evidence of meat processing for storage at the Kutoyis processing site, the record of anthropogenic fires in the valley's hunting complexes is further evidence of the ancestral Blackfoot's ability to transform their landscape in order to bond with their keystone species and plan for the future. As noted by Zedeño and colleagues, planning, which involves not only the development of a calendar but also the adoption of institutions of social control, in turn indicates that the ancestral Blackfoot society operated within a higher degree of organizational complexity than previously thought.

In sum, precontact fire use among northwest plains bison hunters constitutes an example of the combined effect of human agency and technological acumen on the manipulation of prairie ecology that led to great prosperity among these mobile people—prosperity that ended only with the demise of bison.

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38. Gerald A. Oetelaar, "Better Homes and Pastures: Human Agency and the Construction of Place in Communal Bison Hunting on the Northern Plains," *Plains Anthropologist* 59, no. 229 (2014): 9–37, https://doi.org/10.1179/2052546X13Y.0000000004; B. W. Allred, S. D. Fuhlendorf, D. M. Engle, and R. D. Elmore, "Ungulate Preference for Burned Patches Reveals Strength of Fire: Grazing Interaction," *Ecology and Evolution* 1, no. 2 (October 2011): 132–44, https://onlinelibrary.wiley.com/doi/pdf/10.1002/ece3.12; David M. J. S. Bowman, George L. W. Perry, Steve I. Higgins, Chris N. Johnson, Samuel D. Fuhlendorf, and Brett P. Murphy, "Pyrodiversity and Biodiversity Are Coupled Because Fire Is Embedded in Food-Webs," *Philosophical Transactions of the Royal Society B: Biological Sciences* 371, no. 1696 (2016), https://doi.org/10.1098/rstb.2015.0169; Samuel D. Fuhlendorf, David M. Engle, Jay A. Y. Kerby, and Robert Hamilton, "Pyric Herbivory: Rewilding Landscapes through the Recoupling of Fire and Grazing," *Conservation Biology* 23, no. 3 (June 2009): 588–98, https://doi.org/10.1111/j.1523-1739.2008.01139.x.

39. Oetelaar, "Better Homes."

40. C. I. Roos, M. N. Zedeño, K. L. Hollenback, and B. Bethke, "Pox, Pistols, and Ponies: Indigenous Fire Regime and Bison Hunting Change after 'Contact'" (paper presented at the 76th Annual Plains Anthropological Conference, San Antonio TX, October 27, 2018).