Evidence of Bison in Adams County, Idaho
USDA Payette National Forest
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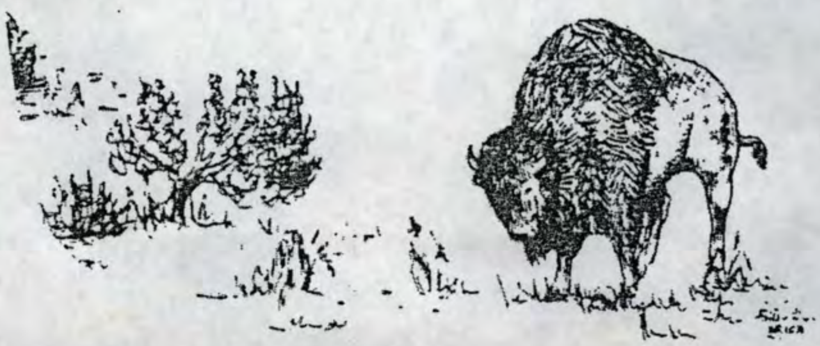
August 2, 2003

In March 2001, a sample of stone tools from an American Indian occupation (10-AM-399) located east of Indian Valley on the Payette National Forest (PNF) was sent to Archaeological Investigations Northwest, Inc. for testing ancient blood residue proteins. The action was part of mitigation results from an Archaeological Resource Protection Act (ARPA) violation. Five obsidian tools yielded positive results for having bovine anti-serum. This was the first scientific evidence suggesting the presence of bison on the PNF.

At another ARPA investigated American Indian occupation (10-AM-266) located adjacent to Crooked River, a tributary of the Snake River Canyon, Eastern Washington University (EWU) in October 2001 uncovered what they thought were domestic cow bones. The bones were found in buried archaeological context directly associated with several late period arrowpoints and other stone tools. EWU archaeologist Stan Gough suspected that the bones were bison, and had one bone radiocarbon dated in March 2003. The bone dated to 335 +/- 35 before present (BP) or 300 to 370 calibrated years BP or 1580 to 1650 A.D. The Indians at this time did not have horses, and hunted bison on foot. The horse did not appear among the Nez Perce Indians until circa 1740. This is the first time bison bones have ever been found in a dated archaeological context on the PNF.

Analysis of ancient blood proteins and radiometric dating are indispensable archaeological techniques in demonstrating that bison were once present on the PNF. Civil penalties under ARPA provided or encouraged the funding for mitigating damage to these archaeological sites.



3

Zooarchaeology and Wildlife Management in the Greater Yellowstone Ecosystem

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When Yellowstone National Park was created by an act of Congress in 1872 its boundaries were arbitrarily drawn in the hopes of protecting all of the region's geothermal basins. From its infancy Yellowstone has been the focus of an ongoing debate regarding how its wildlife should be managed (Pritchard 1999). Initially the park was intended to provide various animal taxa with protection from poachers (Jacoby 2001). The debate has now evolved to include: (1) the reestablishment of locally extirpated species; (2) the region's carrying capacity; and (3) future climatic change. In this chapter we explore how the zooarchaeological record has been applied to some of these issues, and more importantly, how the zooarchaeological record can become an integral part of management discourse.

DESCRIPTION OF THE ECOSYSTEM

The Greater Yellowstone Ecosystem (GYE) is an 18,000 square mile (4.6 million hectares) region in northwestern Wyoming, southwestern Montana, and northeastern Idaho. It includes two national parks and seven national forests (Figure 3.1). Ecosystem boundaries were first proposed in the 1970s and 1980s based on the range of local grizzly bears (*Ursus arctos*) (Schullery 1997). More recent definitions have expanded the size of the GYE and changed the focus from individual species to broader ecological principles (Keiter and Boyce 1991; Schullery 1997).

The high elevation mountains and plateaus that characterize the GYE are the result of uplift associated with the Yellowstone hot spot. The southwestward migration of the North American plate over the hotspot has caused a northeastward migration of geothermal and tectonic activity

[1] Lyman, R. Lee, and Kenneth P. Cannon (editors)
2004 *Archaeology and Conservation Biology*. University of Utah Press, Salt Lake City. In press.

for which the region is world famous (Pierce and Morgan 1992). During the mid-Quaternary (150,000 to 12,000 B.P.) the GYE experienced several episodes of glaciation. The 900-meter-thick Pinedale glaciation was centered along a north–south axis through Yellowstone Lake with ice flowing radially to the northeast, west, and southwest (Pierce 1976; Good and Pierce 1996). Annual temperature during full glaciation was probably 12°C colder than present. Regional biotic communities underwent significant changes with species responding to environmental change based on their individual tolerances (FAUNMAP Working Group 1996; Thompson et al. 1993; Whitlock 1993). Today eighty percent of the GYE is forested, although a number of vegetational communities are present (Despain 1990), and range from sagebrush–grasslands at 1370 m to alpine tundra at elevations over 3900 m. Topographic relief provided by the uplift creates a mosaic of biotic communities within relatively small areas (Clark 1999).

Because species respond to environmental change based on their individual tolerances (Graham 1985; Whitlock et al. 1995), community composition is not stable over time. Shifts in climatic patterns have significant influences on local vegetation communities, depending on elevation, edaphic conditions, slope, aspect, and other factors. The community structure in the GYE today is geologically recent, though it is a product of its history. To understand how these communities develop we need to consult a record that spans thousands of years. The zooarchaeological record provides this time depth, and it also provides evidence of past variability that can inform contemporary management decisions. To use the evidence in this way we must develop a management context that integrates modern ecological studies and prehistoric data (Committee on Ungulate Management in Yellowstone National Park [CUMYNP] 2002).

ZOOARCHAEOLOGY AND WILDLIFE MANAGEMENT

The Organic Act that created Yellowstone National Park (Haines 1977) calls for "the preservation, from injury or spoliation, of all timber, mineral deposits, natural curiosities, or wonders . . . and their retention in their natural condition." Congress also charged the Secretary of the Interior with preventing the "wanton destruction of the fish and game," as well as preventing the capture or killing of animals "for the purposes of merchandise or profit." The concept of a "natural condition" was implicit in the inception of Yellowstone (Pritchard 1999:5). Almost immediately it became apparent that greater protection of the region's large mammals from "market-hunting slaughter" was needed (Schullery et al. 1998). Lobbying by sportsmen and conservationists, led by *Forest and Stream* editor George Bird Grinnell, resulted in a secretarial order in 1883 that prohibited hunting in the park. The perception was that the park would serve not only as a game reserve, but also as a game reservoir from which surrounding public hunting lands could perpetually be restocked by emigrating animals (Schullery et al. 1998). The public grassroots action resulted in passage of the Lacey Act in 1894 which provided legislative protection for large game animals within Yellowstone (Pritchard 1999).

Throughout much of the early to mid-twentieth century management of large mammals was based upon the emerging science of range management. Inherent in the Lacey Act was the perception that elk (*Cervus elaphus*) were overpopulating the northern range of Yellowstone and thus causing range deterioration and other problems (Schullery 1997). The act included provisions for the introduction of Plains bison (*Bison bison*) from private herds (Meagher 1973), periodic culling of elk and bison (Houston 1982), and the extirpation of predators (Schullery and Whittlesey 1999), particularly the wolf (*Canis lupus*). The Leopold Report of 1963 (Leopold et al. 1963) provided the seeds for a new management paradigm that became known as "natural regulation." In 1967 this policy was enacted, but culling of elk and bison was still a common practice. The "balance of nature" was being disturbed by such human actions, and the Leopold report advocated active management to restore this balance (Pritchard 1999:208).

The public conception of the GYE was presented in the 1980s based largely on the migration patterns of local grizzly bears. The vision for management of the GYE incorporated such modern concepts of ecology as landscape-level change and the role of chance events within the context of island biogeography. It was during this period that wildlife biologists, both inside and outside the National Park Service, began consulting the archaeological record. Initially it was to argue for the role of First Americans in ecosystem management, but the zooarchaeological record was also searched for evidence of the presence (or absence) of particular species.

Wolf Reintroduction

One of the major goals of the natural regulation policy in the GYE is the establishment of the full suite of species that were present at the time of Yellowstone's creation. One of the first steps in this process was the reestablishment of wolves (Fischer 1995; Milstein 1995; U.S. Fish and Wildlife Service 1987). A review of the prehistoric record of wolves (Cannon 1992) prepared as part of the report for Congress bolstered the historical record (Schullery and Whittlesey 1992) and countered arguments by opposition groups. The latter claimed wolves were only recent migrants to the area having been forced into this "marginal" environment by Euroamerican settlement (Laundré 1992). Gray wolf remains were found in 10 prehistoric deposits within the GYE and northern Rocky Mountains spanning the last 12,000 years. The prehistoric evidence thus provides a long and continuous documentation of the presence of wolves and important prey in several ecological zones since the Late Pleistocene. And, it legitimates the reintroduction of wolves because the zooarchaeological data indicate that wolves are what the National Park Service (1978) defines as a "native species."

In 1995, 14 wolves were introduced to YNP and within the first year two litters were born and four separate packs emerged (U.S. Fish and Wildlife Service 1996; Schullery 1997). In 2002, there were 14 packs inside YNP with approximately 160 individuals plus several other functioning packs within the GYE (Smith et al. 2003).

Elk

The public and scientific interest in elk in the GYE is not new. During the 1890s Yellowstone's acting superintendent showed concern over the growing elk population and the impact this large ungulate was having on the region (Schullery 1997). Human settlement of Jackson Hole south of Grand Teton National Park displaced elk from their prime winter range, and hard winters in the early years of the twentieth century had a devastating impact on the elk population. Members of the local community, along with government representatives, raised money for the purchase of feed; despite their efforts, hundreds died (Boyce 1989). With funding from public and private sources the National Elk Refuge (Figure 3.1) was established in 1912. Today concern has shifted again to whether elk numbers are inflated and the effect elk may be having on vegetation, soils, or other animals species (Boyce 1989; Kay 1990). As Schullery (1997:149) has stated "no single issue has so engaged Yellowstone's managers and constituencies as the 'elk problem,' and no other issue is more likely to shape future attempts to manage the park with concern for ecological processes."

To understand the nature of precontact elk populations researchers began in the 1980s to consider the zooarchaeological record. Archaeologist Gary Wright (1984) presented two hypotheses for the paucity of elk in northwestern Wyoming archaeological sites. The first, based on contemporary accounts from the nineteenth century, suggested elk were insufficiently abundant to provide a consistent and predictable resource for prehistoric humans. While this may be true, we suggest that some elk would have been exploited, even if only opportunistically. Wright's second hypothesis was that the migration patterns of human groups and those of elk rarely overlapped, and then only for short periods during the middle of the spring and late autumn. When humans were occupying the valley floor, elk were on their summer ranges in the higher elevations, and during the winter when elk were occupying the valley, human groups had abandoned the area. We do not yet have the data to test this second hypothesis.

The authors of two important publications at the time—*Playing God in Yellowstone* (Chase 1987), and *Wildlife in Transition* (Despain et al. 1986)—were not archaeologists, but they consulted the zooarchaeological record during the course of their research. Chase (1987) basically followed Wright's (1984) earlier suggestions and concluded that elk had never been abundant in the GYE. Despain et al. (1986) hypothesized that elk used Yellowstone for winter range prior to the arrival of Euroamericans. Data collected from the literature suggested that elk were present in the area in precontact times. The evidence was, however, limited to one archaeological site and a paleontological context in the north-central portion of Yellowstone National Park. The depositional context of the latter is not clear, but Despain et al. (1986:118, note 6) feel that the remains are at least 250 years old. The elk bones from archaeological deposits are also of uncertain age. Houston (1982) had earlier argued for a long record of elk in the region based on the 9000-year record at the Myers-Hindman site (Table 3.1; Figure 3.1).

Use of the zooarchaeological record has virtually become commonplace in literature of the 1990s. One of the more prolific researchers to utilize the prehistoric record of elk in discussions of contemporary wildlife management issues is Charles Kay. A critical assumption in his studies is that First Americans were hunting elk in proportion to elk abundance on the landscape and the zooarchaeological record should reflect this (Kay 1990, 1994, 2002). According to this assumption, if elk populations today are as large as they were in the past, then elk should dominate the zooarchaeological record. Kay (1990, 1994) has probably compiled more zooarchaeological data for the western states than anyone else to date. He indicates that he reviewed more than 500 archaeological reports on excavated sites in Idaho, Montana, Nevada, Oregon, Washington, and Wyoming (Kay 1990:57). In trying to understand those data he identified a number of biases that may influence the available evidence: (1) inconsistent recovery and reporting of faunal remains; (2) limited excavation; (3) poor preservation of organic materials; and (4) archaeological research driven largely by cultural resource management projects and minimal problem-oriented research. By increasing the sample size and lumping all data, Kay (1990) believed that he could minimize such biases. He concluded (Kay 1990:487; see also Kay 1994) that:

> Archaeological evidence indicates that pre-Columbian ungulate populations were not resource limited. . . . Of nearly 60,000 ungulate bones unearthered at >400 archaeological sites in the United States and Canadian Rockies, <3% were elk, and only about 10% were bison. . . . Even in the Greater Yellowstone Ecosystem, where elk presently constitute around 80% of the total ungulate fauna, elk are rare to nonexistent in archaeological sites.

It may be, however, that Kay's data do "not get us back to the original population density, for too many unknowns are involved, the least of which may be due to sampling error. [Further,] elk remains, while never a dominant member of the faunal assemblage, are consistently present throughout the prehistoric record" (Cannon 1992:1-252). For example, in a study independent of Kay's, Barnosky (1996) noted that more than one third of the 200 archaeological and paleontological sites she examined contained elk remains. Further, she found that of "the late Holocene records of Wyoming, Montana, and Idaho, only four of 19 did not contain elk. Paleontological sites in this region are slightly more likely to contain elk remains than are archaeological sites, suggesting that either there may be a cultural bias reducing the representation of elk, or a bias in the reporting or identification of faunal remains from archaeological sites" (Barnosky 1996:161).

Kay's use of the zooarchaeological record as an analog for modern conditions is flawed for several reasons. His lumping of data from a seven-state area and more than 10,000 years of time into a single value may minimize various taphonomic and sampling biases just as he hopes, but this is unknown (CUMYNP 2002). More importantly, it masks what may be significant spatio-temporal variation in elk abundances. Temporal variation is masked when, for example, the number of identified specimens (NISP) from seven temporally distinct settlement units (SU) defined by Lahren (1976) at the Myers-Hindman site are summed. The sum indicates that elk remains comprise about 12 percent of all ungulate remains. If calculated for each individual settlement unit, elk abundance ranges from 3.31 percent of all ungulate remains to 34.78 percent (Table 3.1). Kay also masks spatial variation by data lumping. The 400-year-old Bugas-Holding site, (Rapson 1990) a single winter occupation, becomes comparable to the Myers-Hindman site that was occupied intermittently between 9000 B.P. and 800 B.P. (Lahren 1976); the nearly 100 km that separates the two sites (Figure 3.1) and attendant environmental differences are also masked. Elk and other animals are not managed by one set of rules over the entire geographic area comprising Kay's sampling universe, nor were they subjected to identical environmental and predation histories, but his lumping of all spatio-temporally distinct data presumes both. Similar problems attend other data Kay (1990, 1994) uses (Yochim 2001).

Bison

The management policies concerning the GYE have intimately involved bison. Expressions of this range from the public outcry over their slaughter in the late nineteenth century that produced the Lacey Act to the current outpouring of support on behalf of the Yellowstone bison slaughtered during the winter of 1996–97 in the name of protecting the local cattle industry (Peacock 1997). Federal agencies in the GYE are currently developing management plans for the region's bison herds (Grand Teton National Park and National Elk Refuge 1996; National Park Service 2000).

The Yellowstone bison herd is one of the few remaining free-ranging herds in North America, rescued from near extinction in the late nineteenth century by a combination of aggressive protection of the native herd and the introduction of bison from private herds (Keiter 1997). During the early part of the twentieth century the two herds were managed separately, but eventually they were allowed to interbreed. Over the next 50 years Yellowstone's bison were intensively managed, with culling a common practice (Schullery 1986; see also Meagher 1973; Schullery et al. 1998). Shortly after the Leopold Report (Leopold et al. 1963) was issued, the National Park Service took a non-interventionist approach to natural resource management, relying instead on natural processes to effect change and to control wildlife population numbers (Keiter 1997). Bison responded positively from 397 in 1967 to a high of 3956 individuals in 1995 (National Park Service 1997:113–114; Figure 3.2).

The Jackson Hole Bison Management Plan (Grand Teton National Park and National Elk Refuge [GRTE–NER] 1996:5) notes that bison were absent from Jackson Hole between "at least 1840 and 1948." The modern Jackson Hole bison herd was created in 1948 with the introduction of 20 individuals (3 bulls, 12 cows, and 5 calves) from Yellowstone National Park to the 1,500-acre (600 hectare) Jackson Hole Wildlife Park near the eastern border of Grand Teton National

Park (Figure 3.2). This private, non-profit endeavor was sponsored by the New York Zoological Society, the Jackson Hole Preserve, Inc., and the Wyoming Game and Fish Commission. This population was maintained at between 15 and 30 individuals until 1963, when brucellosis (*Brucella abortus*) was detected in the herd, and the bison, with the exception of four vaccinated yearlings and five new calves, were destroyed (Cain et al. 1998; GRTE–NER 1996).

The herd was revitalized in 1964 with the introduction of 12 bison from Theodore Roosevelt National Park, bringing the herd size up to 21. In 1968, the herd size was down to 11 adults and 4 or 5 calves, who later in the year escaped the confines of the wildlife park. The herd was eventually allowed to range freely in 1969, partially because of the Leopold Report, which called for the incorporation of ecological principles into the management of natural resources.

The free-ranging herd soon established fairly well defined movement patterns in GRTE, with summers in the Potholes/Signal Mountain/Snake River bottoms area and winters in the Snake River bottoms and further south. Since the winter of 1975–76, with the exception of the 1976–77 winter, the herd has wintered on the National Elk Refuge (GRTE–NER 1996:6). Herd size has grown substantially since becoming free-ranging. Growth in the 1970s was relatively slow, but in 1980 bison began feeding on supplemental winter feed intended for elk. Herd growth has been dramatic since 1980, probably in large part due to the supplemental feed and the subsequent decrease in winter mortality (GRTE–NER 1996:6; Figure 3.1).

Currently managers in GYE are faced with the task of "maintain[ing] a wild, free-ranging population of bison" (National Park Service 2000:i), yet it is only recently that they have begun to study more than the last one-hundred years of bison history. For example, recently the following recommendation was made: "Yellowstone is a dynamic landscape, and we cannot determine whether management actions have forced components of the system beyond their historical range of variability unless we place recent dynamics in a longer time frame. Knowledge of prehistoric and historical environments is essential for creating a context for this evaluation" (CUMYNP 2002:32).

Schullery et al. (1998:327) are correct "that paleontological, archaeological, and historical research completed so far does not allow for reliable comparisons of the abundance of bison . . . at times past with abundance now." We believe, however, that a cross-disciplinary approach to the management of bison can go far beyond merely tallying numbers of specimens. The application of new and emerging techniques such as stable isotope analysis, pollen and phytolith analysis, and DNA extraction are important tools for reconstructing the biology and ecology of prehistoric bison. Application of these new techniques will provide empirical data relevant to contemporary management issues such as: "(1) how long bison have resided in the Greater Yellowstone Ecosystem, (2) the characteristics of the pre-park population, (3) the influence of prehistoric humans on bison, (4) how populations reacted to past climatic change, and (5) what management decisions can be made to ensure viable populations, in light of our current understanding of future climatic change" (Cannon 2001:147).

The prehistoric record of bison in the GYE extends back at least 10,000 years (Cannon 1992). Nineteenth-century observations suggest bison ranged throughout the lower-elevation meadows, with probable summer migrations into the high alpine meadows (Meagher 1973). Today, bison are restricted to public lands in Yellowstone National Park and Jackson Hole. Migrations beyond these political boundaries result in either hazing or death (Peacock 1997). On the one hand, a general paucity of bison in the archaeological record, as well as low and fluctuating numbers of modern bison in Yellowstone and Jackson Hole, led Wright (1984: 28) to conclude that "bison were always relatively rare in northwestern Wyoming, and that they would have been too unpredictable in numbers to provide a stable food source" for humans; he continued, "since populations were small, one successful kill of adults would have reduced the reproductive potential of the herd to a level where it would no longer have been a significant part of the ecosystem." Meagher (1973:14), on the other hand, suggests that "substantial numbers of bison inhabited the Yellowstone Plateau at all seasons, and long before the killing of the northern herd of Great Plains bison in the early 1880s." These two perspectives illustrate opposing views and make it clear that there are many details regarding the population history of bison left to learn.

Since the time when Wright and Meagher presented their views, new information has become available concerning both modern and prehistoric populations. Part of Wright's argument for low numbers of bison in the prehistoric record came from the extrapolation of population dynamics of modern bison in both Yellowstone and Jackson Hole. While bison in both these areas received protection by the Department of Interior, Wright failed to mention that bison were often removed from the herds based on various management decisions. Winter counts of bison in Jackson Hole indicate that since the mid-1960s bison numbers have increased to 438 in 1999 (Figure 3.2).

While it is problematic to interpret similarities between prehistoric bison populations and modern managed herds, it is apparent that the region can support a sizable population. Given new zooarchaeological data, it is time to reevaluate the role of bison in the GYE. The known prehistoric record of the GYE provides a minimum of 66 strata in 30 archaeological and 3 paleontological sites that have produced bison remains (Cannon 2001). These represent 29 open archaeological sites, one archaeological cave site, and three paleontological sites, but do not include the various drive sites in Paradise Valley north of Yellowstone National Park (Cannon 2001). George Arthur (1966) estimated that at least 10 bison kill sites are present in Paradise Valley, including a large complex of drive lines and rock cairns known as the Emigrant Buffalo Jump.

Thirteen sites in Jackson Hole have produced bison remains. The earliest evidence of bison in the region is reported from south of Jackson Hole on the Snake River near Hoback (Figure 3.2). During excavation for development, "a layer of mixed bison bone and shell was exposed.... Several bison skulls were retrieved from this layer [and] were not of any bison larger than modern populations" (Love 1972:50; underlining in original). Mollusk shell collected from a "trench intersecting 2-ft shell bed at depth of 3 ft" by J. D. Love in 1959 and submitted to the U.S. Geological Survey produced an age of 11,940 ± 500 B.P. (W-1070; Ives et al. 1964:60), though this date should be viewed with some caution (Cannon 2001).

A more reliably dated and substantial archaeological assemblage of bison was found at the Horner site, the type site of the Cody Cultural Complex (Frison and Todd 1987). This site along the Shoshone River north of Cody, Wyoming was excavated initially by Princeton University and the Smithsonian Institution in the late 1940s and early 1950s, and then more recently in the 1980s by the University of Wyoming. Excavations have produced a substantial population of bison (ca. 300 individuals) that date to approximately 9000 years ago.

Three sites in Yellowstone and several sites in Jackson Hole are either adjacent to modern migration routes or within modern seasonal ranges (Cannon 2001). Archaeological investigations in areas currently used by bison could inform development of a model of bison habitat use and selection under various climatic regimes. This information may be useful when managing herds in anticipation of future climatic change, as well as for managing modern winter range (National Park Service 2000). Understanding the relationship between past and future climatic change, and its implication for ecosystem management, is a high priority research need for federal agencies (CUMYNP 2002; U.S. Fish and Wildlife Service 1999).

The zooarchaeological record by its nature provides empirical data on how humans and bison interacted. As others have argued, humans were probably the main predator of bison (Fisher and Roll 1998) and significantly influenced their behavior, distribution, evolution, and abundance. During the past 100 years culling of herds was a common practice. However, the practice rarely took into consideration the impact this had on herd structure and genetic diversity (Shull and Tipton 1987). A unique aspect of the zooarchaeological record is that it provides snapshots of different times that allow us to explore such issues as herd structure and genetic diversity.

With recent advances in the extraction of DNA from fossils, the archaeological record provides a unique opportunity not only for addressing issues of taxonomy but also the genetic variability of bison populations prior to the nineteenth century bottleneck. The zooarchaeological record can also be used to study migration and gene flow among populations (Chambers 1998). Management of the genetic diversity and integrity of threatened populations is an important issue in conservation biology (Meffe and Carroll 1997). In addition to long-term conservation goals of protecting the germplasm, other conservation issues can be addressed using genetic analyses, such as understanding the effect of hybridization of the native Yellowstone National Park bison with bison introduced in the early twentieth century and determination of minimal viable population size (e.g., Schnabel et al. 2000; Ward et al. 2001). DNA analysis of archaeological bison remains should provide guidance on these issues (Derr 1999; Ward et al. 1999). As mentioned above, archaeological kill sites of bison represent moments in time. Such samples provide moment-in-time information on herd demography (age and sex ratios) as well as genetic diversity. These attributes can be compared to those of modern herds to assess how genetic diversity and demography have changed over time. Such comparisons could alert biologists and managers to populations that may be at risk to the various consequences of low genetic diversity or unusual demography.

DISCUSSION

Understanding the relationship between past and future climatic change, and its implication for ecosystem management, is recognized as a high priority research need (CUMYNP 2002). Recent simulation models indicate that doubling the carbon dioxide concentration in the atmosphere will produce a combination of elevational and directional range adjustments by individual plant taxa (Bartlein et al. 1997). The range of high-elevation species will be reduced and some species will become regionally extirpated. Resulting new vegetation communities have no modern analogues because they mix low-elevation montane species currently in the region with extralocal species from the northern and central Rockies and Pacific Northwest. These results are similar to those that the FAUNMAP Working Group (1996) found when analyzing the zooarchaeological record—mammalian species respond as individuals based on their particular tolerances and not as communities. Such responses call into question the adequacy of current management to anticipate the nature of future climatic change. As prehistorians we have the tools to provide insight into how populations in the past responded to change and to model how populations in the future may respond.

The zooarchaeological record has much to offer the management of wildlife in the Greater Yellowstone Ecosystem. In preparing the justification for the reintroduction of the wolf, the prehistoric record provided a much longer record of the presence of wolf and its prey species than was evident in the historic record alone. But we also know that there are a number of critical taphonomic and sampling issues to contend with when one uses the zooarchaeological record to address wildlife issues (Cannon 1992; Lyman 1994, 1996; CUMYNP 2002).

The zooarchaeological record provides information on the presence or absence of individual species as well as insights to ecology and the evolution of community structures. This is exemplified by the records of elk and bison. Current simulation models indicate future climatic change will produce communities that have no modern analogues due to species level responses. By understanding how mammalian species responded to previous shifts in climatic regimes, we may be better prepared to make empirically based management decisions concerning populations in the face of modern and future changes (Cannon 2001; CUMYNP 2002).

Another task at hand is deciding how we transform what appears to be an arcane argument among academics into a viable role in the wildlife management discussion. At a recent meeting of the Department of Interior's Bison Management Group (2000) we were presented with the rebuff that the archaeological evidence of bison, though interesting, was like counting angels on the head of a pin. Boyce (1991:196) had earlier expressed this sentiment much more simply: "Even if we could find 'proof' of substantial Indian predation on elk and other ungulates, we have no way of estimating the number of animals that should be culled to duplicate this source of mortality." We argue differently. Berger and Cunningham (1994) provide a comprehensive ecological and behavioral study of the bison herd at Badlands National Park in South Dakota. Data gathered from this study coupled with precontact data from paleontological and archaeological sites will provide just a comprehensive behavioral and ecological study of precontact populations of bison in North America, including knowledge about natural and cultural causes of ungulate mortality (paleontological and archaeological studies of ungulate mortality are discussed in Stiner 1991 and references therein).

Zooarchaeological studies can contribute to conservation issues highlighted by Berger and Cunningham (1994:269) in the following methods: 1) precontact herd structures, 2) identification of the presence or absence of precontact populations, and 3) provide a record at an evolutionary scale for the genetic conservation in contemporary populations. Zooarchaeology provides information about herd structure using archaeological sites such as bison kill sites. These sites provide the information needed at a scale that can be isolated to a particular herd at a particular time. This is important in the discussion of implications of environmental and climatological pressures and herd responses. Zooarchaeological studies can also contribute to the debate of multiple populations, either genetic or geographically different, within the North American bison. Considering the penultimate distribution of bison in many different ecozones, multiple subspecies of bison is conceivable (cf. van Zyll de Jong 1986). Zooarchaeolgical data can also inform on past populations of bison using mitochondrial DNA (mtDNA). Biological anthropology studies have used mtDNA to sort out the genetic relatedness between ancient human populations as well as inform on the possibility of sub-species within the hominid line (Cooper et al. 1997; Richards et al. 1993). A study of mtDNA from precontact specimens is predicated by recent mtDNA studies of contemporary populations (e.g., Derr 1999; Strobeck 1992) because archaeological and paleontological specimens provide the data needed in the understanding of past populations' evolutionary histories. An understanding of past populations' behavior and biology is required for informed decisions of genetic conservation and management of contemporary populations. Zooarchaeological studies and data gathered from paleontological and archaeological sites provide such information.

We believe it better to attempt to count angels than to ignore potentially significant (paleo)ecological information. The cost of making the wrong management decision will more often than not outweigh the cost of a failed tallying effort. We have shown here some of the ways that prehistoric data can be used in the service of conservation biology as practiced in one of the best-known ecosystems in the world.

TABLE 3.1

NISP and Relative Abundance of Ungulates per Settlement Unit at the Myers-Hindman Site

Settlement unit (SU)	Age (yr B.P.)	Bison	Deer	Elk	Bighorn Sheep	Pronghorn	Totals
1	9000	14 (37.84)	10 (27.03)	2 (5.40)	9 (24.32)	2 (5.40)	37
3	5500	30 (24.79)	8 (6.61)	7 (3.31)	62 (1.24)	17 (14.05)	121
4	3300	48 (28.57)	48 (28.57)	20 (11.90)	46 (27.38)	6 (3.57)	168
5	2300	33 (31.43)	28 (26.67)	13 (12.38)	24 (22.86)	7 (6.67)	105
6	1900	38 (56.72)	6 (8.95)	8 (11.94)	7 (10.45)	8 (11.94)	67
7	1450	23 (62.16)	3 (8.11)	7 (18.92)	3 (8.11)	1 (2.70)	37
8	800	22 (47.83)	2 (3.35)	16 (34.78)	8 (11.87)	1 (2.7)	46
	totals:	208	105	70	156	42	581

Note: after Lahren (1976)

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figure captions

Figure 3.1. The Greater Yellowstone Ecosystem (bold dashed line) and location of zooarchaeological sites and places mentioned in the text. 1, Myers-Hindman site; 2, Bugas-Holding site; 3, National Elk Refuge; 4, Hoback; 5, Horner site.

Figure 3.2. Winter bison counts for Yellowstone National Park (National Park Service 1997) and Jackson Hole (data provided by Steve Cain, Grand Teton National Park).