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An archaeologist's view: Knowing the data. A commentary on Keigley (2019) and Beschta and Ripple (2019)

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In a recent article Keigley[1] discusses a perennial issue in Yellowstone National Park (YNP) and the surrounding area known collectively as the Greater Yellowstone Area (GYA): the management of bison (*Bison bison*).[2] A later commentary by Beschta and Ripple[3] also addressed this issue. We are writing this commentary because there remains a misunderstanding in the application of the archaeological record to contemporary wildlife and range management,[i] specifically how the record comes to be visible to archaeologists and a myriad of factors that influence our understanding of the record not only from a natural context but also from a research context. Heavily influenced by the writings of Binford we take his insistence seriously that archaeologists "should not seek explanations for observed differences and similarities in 'material culture' within a single interpretive frame of reference" (p. 218).[4] Researchers who rely on the archaeological record should understand the complexities of that record. In other words, move from a descriptive science to an explanatory one.

By quoting the Cambridge Dictionary of Philosophy, Keigley[1] suggests archaeologists are involved in a *rationalization* of the archaeological record in order to explain, "why existing conditions do not comport with expected conditions" (p. 7). This is a misunderstanding of archaeological method and theory. The transformation of archaeology from the merely descriptive to a theoretical science (Binford[4] termed it "New Archaeology" and later "Processual Archaeology") began with the publication of *A Study of Archaeology* by Taylor[5] followed by a series of papers by Binford[6] in the 1960s. Binford's[7] "idea that the accuracy of knowledge about the past could be *tested* was the most radical departure from traditional archaeology" (p. 10).[8] Archaeologists in the 1970s onward began to apply middlerange theory,[9] linking present archaeological statics to past behavioral dynamics (p. 12),[8] and taphonomic (i.e., process of fossilization) studies in order to understand how the archaeological record was formed and why it looked as it did upon excavation and subsequent analysis.

In Binford's mind processual archaeology is "an objective science in which hypotheses could be tested against data" (p. 17).[8] But first archaeologists, like other critical researchers, must understand what the record represents. For example, what are the biases in our data that are inherently influencing our view of the record and can those biases be explained? Specifically, what are the formation processes, both natural and cultural, that have influenced the archaeological record?[9] Binford deliberately sought that discussion within the archaeological community in *Debating Archaeology*.[10]

With that background, we explored the archaeological record of YNP and the GYA. Through the Wyoming Cultural Resource Information System, we obtained site data for the Wyoming portion of the GYA.[ii] This dataset documents 6,336 Native American precontact (prehistoric in Keigley's writing) sites. Of these, <4% (n = 228) have been formally tested, ranging from small-scale test excavations (~1 m^2) to interdisciplinary data recovery investigations that involved large-scale excavations. Of the few archaeological sites that have had subsurface testing, 126 have preserved bone or organic materials, of which 49 have bison bone identified (Fig. 1).[iii] Admittedly limited, the extant record indicates bison

[i] Our focus of criticism is limited to how the archaeological record is interpreted. We are not necessarily arguing that bison density in what is now YNP and the plains was similar. There is little dispute that bison numbers and density was higher at lower elevation plains and basin that surround the GYA. This is apparent by the large number of bison drive sites in Paradise Valley to the north of YNP.

[ii] Data was obtained in March 2019 from the Wyoming State Historic Preservation Office. The Wyoming records were accessed because they are more easily queried for the information we were seeking. The Idaho and Montana records are not as easily queried but are being compiled by the authors as part of our ongoing research into bison in the GYA.

[iii] It should be noted that the referenced database is incomplete, and numbers should be considered minimal. Ongoing review of site forms and unpublished reports will surely add to this record.

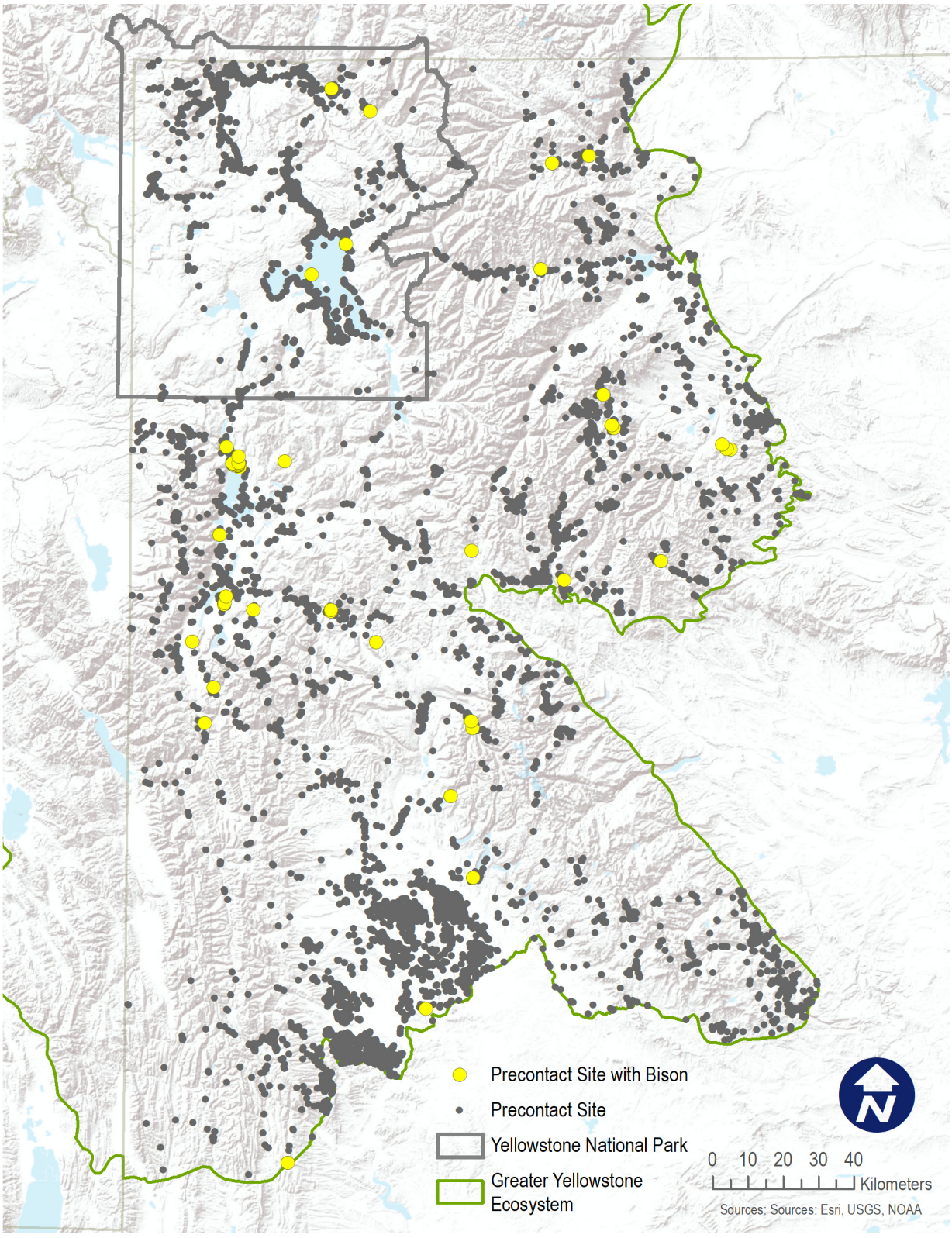

Figure 1. Map of Wyoming portion of the Greater Yellowstone Area depicting location of precontact archaeological sites and sites with identified bison bone. Data provided by Wyoming State Historic Preservation Office in March 2019.

were in the GYA for over 10,000 years. The record from the historic period (1796–1881), for which Keigley is most focused, is equally compelling according to research by Whittlesey et al.,[11] which Keigley does not reference.

Some important take away points are strikingly apparent (see Fig. 1). First, the known archaeological record of Native American sites is biased and not a true reflection of human behavior let alone bison behavior.[iv] For example, in YNP most of the sites have been recorded along modern roadways and in developed areas since these projects have fallen under Section 106 of the National Historic Preservation Act of 1966, as amended through 1992 (Public Law 89–665; 80 STAT.915; 16 U.S.C. 470),[12] that stipulates archaeological surveys be conducted before construction projects. Second, large areas of YNP have not been surveyed, and most pertinent to this discussion within the Northern Range, few precontact archaeological sites have preserved bone, specifically sites with identified bison bones. Third, the distribution of sites with recorded bone is not random and is the result of where archaeologists have chosen to investigate. Lastly, the current archaeological record and the dataset are only a sample of the precontact archaeological record and not a representation of the entirety of human bison behavior.

YNP is a challenging place for the preservation of bone for determining not just abundance but sexing of elements and reconstruction of herd structure (p. 88).[13] When we look at sites with preserved bone, they tend to be in soils with moderately acidic to neutral pH,[v] which are substantially limited on the Yellowstone Plateau.[14] Another important taphonomic issue in forested areas, which today (and during much of the Holocene[15]) predominate the Yellowstone Plateau, is tree-throw or floralturbation disturbance of the archaeological matrix and its contents by trees or other vegetation.[16] Repeated tree tip-outs or tree-throw (i.e., as trees fall over surficial sediments and soils adhere to the roots leaving behind a depression which is later filled in with younger sediments) keep the archaeological record and organic materials up in the biomantle where they continue to be degraded, as opposed to allowing them to be incrementally buried where they might be preserved.

Late 18th and early 19th century Native American sites become vulnerable to information loss through the destruction of near surface archaeological remains by forest fires and subsequent erosion, through looting and trampling by grazing livestock, and because of poor contexts, such as the grass-roots zone, forest floor duff (O horizon soil layer), or the churned floor of caves and rockshelters.[17] When a site is burned, and the duff consumed, typically there is an extensive faunal assemblage present for the first year after the fire. The freshly burned bone is highly weathered, and after the duff is removed, the bone is unprotected and quickly disintegrates. This has been well documented within the GYA,[18] and in YNP 771 sites have been burned in fires over the past four decades.[vi] More frequent forest fires, and the lack of post-fire cultural resource investigations and treatment have resulted in a loss of information related to the use of high elevation environments by Native Americans.

A final factor to consider is glaciation. Extensive glaciation of the Yellowstone Plateau and surrounding high country scoured the landscape.[19] The combination of till, with its tight, compact nature, along with tree cover has yielded little sediment from slopes and thus little sediment flux in the fluvial and slope systems. Areas of glaciation scoured bedrock and add to this low sediment flux issue. In the northern Yellowstone region, there are essentially no footslope deposits and limited Holocene aged fans, which typically preserve long archaeological records (Fig. 2). This contrasts with the southern portion of the GYA (southern Jackson Hole), where loess accumulated on slopes after the Pinedale retreat.[20] In this southern area, reworked loess deposits have provided deeply buried soils with good faunal preservation. Sites on these types of landscapes include stratified sites such as the Crescent H Ranch site,[21] the Game Creek site,[22] the Goetz site,[23] and the Stinking Springs Rockshelter.[13]

Keigley (p. 7)[1] further discusses our research[23,24] on archaeological sites we have examined that suggest a pattern of hunting isolated bulls, which is a pattern seen in other areas of the Northern Rockies.[25] We are not disputing our own research, but the fact that two sites show a record of probable encounter hunting (i.e., when hunter-gatherers come across game while in the pursuit of obtaining other resources) of bulls does not exclude the presence of breeding herds within the boundaries of YNP.[vii] Encounter hunting of dispersed bison was a successful strategy for small groups of hunters, as opposed to the logistically difficult and dangerous hunting of mixed herds.[26] After the rut, bison herds are made up of females, calves, and young males.[27] Females are typically protective of calves and hunting these mixed herds would put the hunters at great risk when it was unnecessary to meet the nutritional needs of small groups occupying YNP during the warmer months[28] or in sheltered winter range.[29] Mass hunting of mixed herds occurred in the fall when larger groups formed for communal bison hunting and other social functions.[28] During fall bison have greater fat reserves and their hides are better for making into clothing.[30] Mass kills typically took place in unique topographic features that

[iv] This paper has only discussed the archaeological record of bison in YNP and has not included the paleontological record of bison. For example, Hadly, E.A. 1996. Influence of late Holocene climate on northern rocky mountain mammals. *Quaternary Research* 46:298–310.

[v] Acidic soils are poor environments for the preservation of bone and basic soils are better environments. We argue the lack of bone preservation in YNP is likely due to the limited alkaline soils, as well as other chemical and physical factors.

[vi] Derived from Wyoming State Historic Preservation records obtained in March 2019.

[vii] The extant archaeological record leads to the hunting strategy discussed, however the low degree of preservation that characterizes the northern GYA makes identification of sex difficult even when hundreds of bison bone fragments are present. Sexing of elements requires the presence of key landmarks on the bone and nearly complete specimens. Evidence for the presence of breeding herds within the Northern Range comes from an immature bison innominate displaying butchering marks that was recovered from Late Prehistoric deposits at site 48YE168.

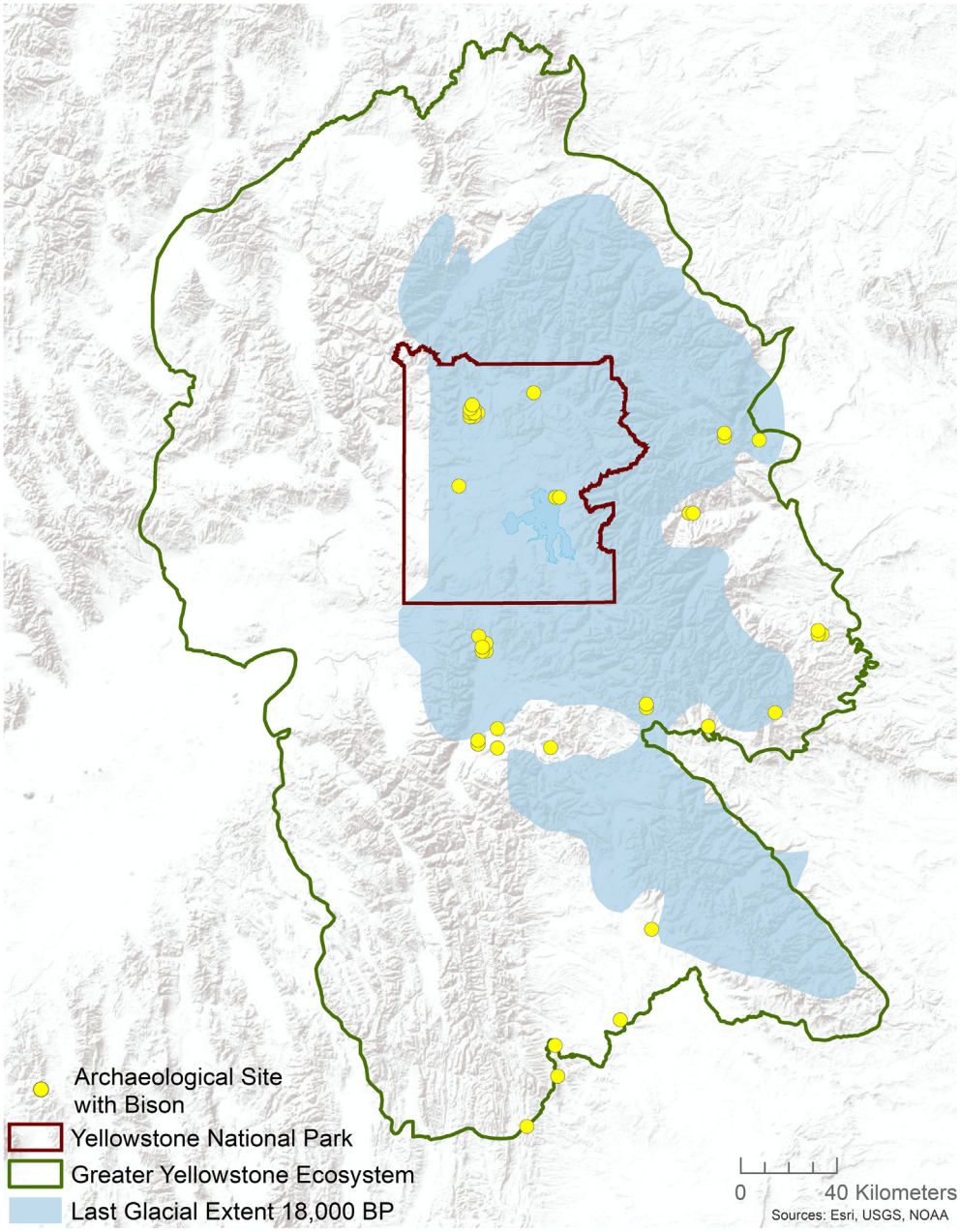

Figure 2. Glacial extent during Pinedale glaciation within the Greater Yellowstone Area.

hunters use to their advantage.[30] Many unique topographic features are present north of YNP in Paradise Valley.[31,viii]

The comments of Beschta and Ripple[3] regarding Keigley,[1] particularly their discussion of precontact human occupation is not accurate. This is, in part due to their dependence on a secondhand reference of the archaeological record, that uses data from before 1997.[32] They overlooked recent published work that refutes their claim that "the abundance of archaeological material diminished coincidentally with the Little Ice Age" (p. 149).[3]

Research done by Adams,[33] Eakin,[34] and more extensively by Todd[18] and his students[35] in higher elevations of the eastern GYA as part of the Greybull River Sustainable Landscape Ecology project (GRSLE), indicate an extensive occupation of high elevation areas (>2,440 m [>8,005 feet]) during the Protohistoric Historic Period (500 to 150 years ago), which coincides with the Little Ice Age (16th through 19th centuries). For example, sites in the Boulder Ridge area indicated warm season use (e.g., evidence of late spring

[viii] The Slough Creek Compound (48YE420) was recorded in the late 1950s by Dee Taylor and his students. The site consists of several topographic features along with cairns and a low rock wall, post holes, plus stone tools and fragmented large mammal bone. The site has been interpreted as a large game trap or compound.

occupation at site 48PA2667 is provided by late term or newborn bighorn sheep [*Ovis canadensis*] lamb long bones) for hunting bighorn sheep, elk (*Cervus elaphus*), and bison.[34] Although these sites represent relatively short-term occupations (i.e., days to weeks), the labor invested in the construction of bighorn sheep traps, and their association within a site complex, suggests these areas were regularly visited during the late 18th through mid-19th century. They may represent a multi-generational familiarity with the area that could extend back into the precontact period[34] (i.e., 500 to 200 years ago). Todd's[18] review of the GRSLE project indicated an intensification of high altitude use during the Late Prehistoric (last 1,500 years) based upon projectile point styles (mean elevation 2,680 m [8,793 feet]), which implies a diverse (broad spectrum or intensive) land use pattern.[36]

Winter occupation has been identified at the Bugas-Holding site within overbank alluvial deposits of Sunlight Creek in the Sunlight Basin at an elevation of 2,178 m (7146 feet).[29] The area is well sheltered winter range for bison and sheep as indicated by the faunal remains from eight hearth and dump area locales that were radiocarbon dated to median cal AD 1540 (cal AD 1391–1681).[ix] At least 15 bison are represented in the assemblage along with 14 bighorn sheep, 2 elk, and 1 pronghorn (*Antilocapra americana*). Bison fetal bones at this site indicate the presence of a breeding herd occupying the areas from November through May.[29]

Other evidence for occupation during the Protohistoric Period (late 18th and early 19th century) comes from ice patch research by Lee and Puseman[37] in the GYA. A birch (*Betula* sp.) shaft fragment was found north of YNP and dates to cal AD 1781 (215 years BP). Potential prey species were recorded and dated from these ice patches that include bighorn sheep remains and a bison thoracic spine with soft tissue that returned a radiocarbon modern age (AD 1950). Although this and older 13th century (cal AD 1220 and AD 1267) bison remains could not be attributed to human hunting, they do provide additional evidence of bison in the region.

While we commend Keigley[1] and Beschta and Ripple[3] for looking further afield for data to support a complex management issue in YNP and the GYA, a better understanding of the complexities involved in the preservation of archaeological sites and the interpretation of the data is necessary. As Lauwerier and Plug[38] and others have articulated,[39] the archaeological record is an important resource for understanding how systems have developed over the course of hundreds and thousands of years that is directly applicable to thoughtfully managing public lands in what appears to be a very dynamic future climate regime.[40]

Returning once again to Binford,[4] archaeology, and the interpretation of the archaeological record, cannot be made from a single frame of reference, but must proceed in a larger interdisciplinary context. Looking at the record as a presence or absence proposition is not a viable interpretation of the archaeological record. Per the traditional aphorism "absence of evidence is not evidence of an absence,"[41] arguing that only males were present based on the limited sample of male bison bones (and lack of female bison identified) in an archaeological context where most of the bones cannot be attributed to either sex due to preservation shortcomings is an uninformed and simplistic view of the processes that create the archaeological record.

Keigley[1] brings forth an important topic regarding the abundance of bison during the last 500 years and into the historic period, as well as how their abundance influences decisions about their current management. We present an argument that the archaeological record is an important source of data for addressing the long-term development of ecosystems,[21] but must be understood in the context of the complexity of the archaeological record. That is how the archaeological record is formed and interpreted by archaeologists. We hope our rebuttal can be seen as way forward in developing interdisciplinary research teams of wildlife biologists, rangeland managers, and archaeologists in the investigation of the long-term record of bison, as well as other species, for a more complete understanding of our past and how it can be applied to create a more thoughtful and informed management policy.

[ix] Radiocarbon ages were calibrated using the online program Calib ver. 7.1 (www.calib.org). Preface of cal indicates presented age has been calibrated.

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