Drivelines, hunting blinds, effigies and intercept hunting strategies in the Greater Yellowstone Ecosystem, USA

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Abstract: This paper shares a description of cairn lines and hunting blinds in association with an ice patch in the Greater Yellowstone Ecosystem. Until now no definitive stone features, including drivelines and hunting blinds, have been reported in association with Greater Yellowstone Ecosystem ice patches; however, such features are known from ice patches in northern North America, eg Yukon Territory. In the system reported here, the ice patch is presumed to be an animal attractant with the drivelines and blinds positioned to serve as intercepts. The paper also shares a brief report of a stone effigy of a probable bighorn sheep that appears to be associated with an ice patch. Such features are emblematic of spiritual provisioning in the alpine.

Keywords: drivelines, effigies, Yellowstone

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Drivelines and animal ecology

Drivelines are arguably one of the most recognisable aspects of indigenously engineered landscapes on the High Plains and Rocky Mountain Front (Scheiber & Zedeño 2015). Frequently associated with bison 'kills', or 'jumps', these features are a subject of persistent interest to archaeologists (eg Brown 1932; Carlson & Bement 2018; Davis & Wilson 1978; Kehoe 1973; Roos et al 2018). While the existence of driveline systems is firmly encoded in the traditional ecological knowledge (TEK) of many indigenous groups – and the features have been studied by generations of archaeologists – a disconnect still exists in the application of this historically grounded knowledge in modern animal management including historic ranges and migratory routes.

Cannon et al (2020) posit that historically, ecological assessments of Greater Yellowstone Ecosystem (GYE) fauna and flora fail to appropriately account for archaeological observations – let alone indigenous oral traditions – regarding the interaction of humans with bison (*Bison bison*) and other species (see also Cannon 2001). Strengthening indigenous interaction with GYE animal populations is significant and necessary in that it reaffirms and sustains traditional relationships between living tribal cultures and keystone species such as bison (eg Baldes 2016; see also ibmp.info/library). Archaeological observations can support these efforts by linking ancient and modern stewardship practices by empirically demonstrating the prolonged interaction of humans and GYE fauna. Acknowledging this immutable connection is integral to not only reifying human–animal dynamics on the High Plains and in the GYE, but is also a practical use for archaeological data in support of TEK. For perspective, the illumination of the driveline complexes of the Rocky Mountain Front near Glacier National Park in northwestern Montana by Oetelaar (2014), Zedeño et al (2014) and Pikuni (Blackfeet Nation) partners is an exemplar of collaborative inquiry.

One of the largest driveline complexes in North America lies in the northern portion of the GYE in the Paradise Valley of the upper Yellowstone River drainage to the north of Yellowstone National Park (Figure 1). This area is approximately 10 miles downriver from the modern 'tolerance area' stipulated for bison in the north management zone of the GYE (IBMP 2014). Today, the movement of bison outside of the confines of Yellowstone National Park is restricted due to concerns over the transmission of brucellosis, a disease that can cause abortion in domestic cattle (IBMP 2014). Historically, bison moved freely across large landscapes and, other than hunting via drivelines, bison movement was not constrained. The seasonal migration of GYE ungulates toward warmer and

Figure 1 Many of the drivelines documented in this area of the Paradise Valley north of Yellowstone National Park were mapped by Tom Jerde. Jerde's hand-drawn maps were subsequently digitised by Patrick Rennie, Montana Department of Natural Resources Conservation Service, and they are reproduced here with permission. The topographic background was removed to prevent disclosure of specific site location information. The thick black bands on the left and right of the image are stylised boundaries of the Yellowstone River flood plain. The current course of the river meanders through the middle of the image flowing from the bottom (south) to the top (north). Based on geographic extent, approximately 90% of the drivelines are on privately owned land

drier environs at lower elevation is well documented (eg Kauffman et al 2018; White et al 2021). The Paradise Valley drivelines, including the Emigrant Creek Kill Complex (24PA711) (Huppe 1988; Jerde 1985), undoubtedly reflect one of the routes by which bison (historically), as well as other migratory game species, such as elk (*Cervus elaphus*) and bighorn sheep (*Ovis canadensis*), seasonally moved from summer grazing at higher elevations to more temperate habitats well down the Yellowstone River and beyond.

The Paradise Valley drivelines are an example of an intercept hunting strategy emplaced along a regular foraging and migratory route. In this instance, the drivelines would have engaged migrating ungulates on the move toward winter range. The directionality of the 'V-shaped' structures suggests they were primarily used to engage animals moving down valley from south to north (Figure 1). Based on our understanding of bison physiology, behaviour and seasonality, the fall would be the optimal time to hunt bison as they have spent the summer building up fat reserves for the subsequent winter and the cow/calf groups have separated themselves from the more solitary bulls. Indigenous knowledge of seasonal patterns of bison movement could result in successful hunts with the opportunity to dry and preserve meat as well as fat, in the form of pemmican, as a long-term foodstuff.

The drivelines in this complex exhibit a range of physical characteristics (morphologies), including closely spaced continuous rock lines/fences; rock groupings (cairns) that are regularly spaced; lines that parallel one another; lines that extend perpendicular to cliff faces and/or steep slopes; and lines that parallel cliff faces and/or steep slopes (Huppe 1988; Jerde 1985; Lee 2015). Dalyn Grindle (personal communication 2021) suggests the later variant – cairn lines running parallel to the cliff edge – may preserve lead cows and only result in the capture/death of bison flanking these important knowledge holders thereby maintaining herd leadership and integrity. Save for early work by Brown (1932), and more detailed descriptions in Arthur (1962; 1966) and cultural site records (eg Jerde 1985), this staggeringly expansive complex remains relatively unstudied by archaeologists. Informants in Huppe (1988:A-3), eg Bill Sherwood, Scotty Robson and Tom Jerde, note that the density of pre-contact occupation along the Yellowstone River is so extensive as to defy a cohesive understanding of the full landscape or compartmentalisation into discrete, bounded entities (see also Fisher et al 2007 regarding a discussion of hunting pits further up river).

The historical presence of prey animals in this valley is recognised by traditional knowledge holders (eg Doyle 2022; see also Kauffman et al 2018:38). The lead author and other colleagues began studying these features in 2015 (Lee 2015). This paper documents a unique high-alpine driveline adjacent to an ice patch feature associated with animal use. The primary aim is to describe the driveline and discuss its possible uses in the context of larger drivelines found at lower elevations. In addition to serving as a GYE-specific example of intercept drivelines, this paper serves as a starting point to spur broader awareness, investigation and understanding of these engineered landscapes.

Humans in the high country

Human involvement in alpine environments is a subject of longstanding archaeological interest, (eg Benedict 1992; 1996; Pitblado & Rademaker 2017) including the interplay of drivelines and animal behaviour (eg LaBelle & Pelton 2013). Based on artifacts being exposed by melting snow and ice (eg Lee 2012), it is easy to assume that hunting was a primary alpine activity for indigenous populations; however, there are clearly additional resources and activities occurring in these locations. Indigenous peoples have a long and complex connection with high-elevation areas that is embodied in their traditional knowledge of spirits, places, land use and ecology. As conveyed in Tyro's (2014) film, *Alpine Archeology in the Land of the Blackfeet, Pend d'Oreille, Kootenai and Salish,*

> Languages, songs, dances, prayers, ceremonies, hunting, hide-tanning, beading, fishing, plant gathering, food and medicine preparations, feasts and storytelling [all relate to the alpine]. (Mike Durglo Sr, Salish)

> Songs, origin stories, sacred teepees; plants, birds and animals in our bundles all come from the Rocky Mountains. (Carol Murray, Blackfeet)

Mountainous environments are emotionally impactful, and many are managed today as wilderness areas in national forests and national parks. Evidence of long-term and repeated use of alpine environments, including ice patches (Lee & Puseman 2017), vividly illustrates that these locations were used by indigenous peoples – sometimes intensively – for hunting, ceremony and other activities.

Alpine drivelines

In the GYE, alpine drivelines made of wood are primarily associated with the hunting of bighorn sheep, with nearly a dozen such traps described along the eastern flank of the Rocky Mountains (Eakin 2011; Frison et al 1990; Kornfeld et al 2010). Although fewer in number, at least one set of stone drivelines has been suggested to have been used to hunt bison (Guenther et al 2021; Robins 2021).

Drivelines for killing sheep are made from standing wood and deadfall, and can incorporate rocks, boulders and/or other topographic features. Following Eakin (2011:16), in the eastern Absaroka mountains of the GYE, the wood/timber fences tend to be arranged in one of two general morphologies. These

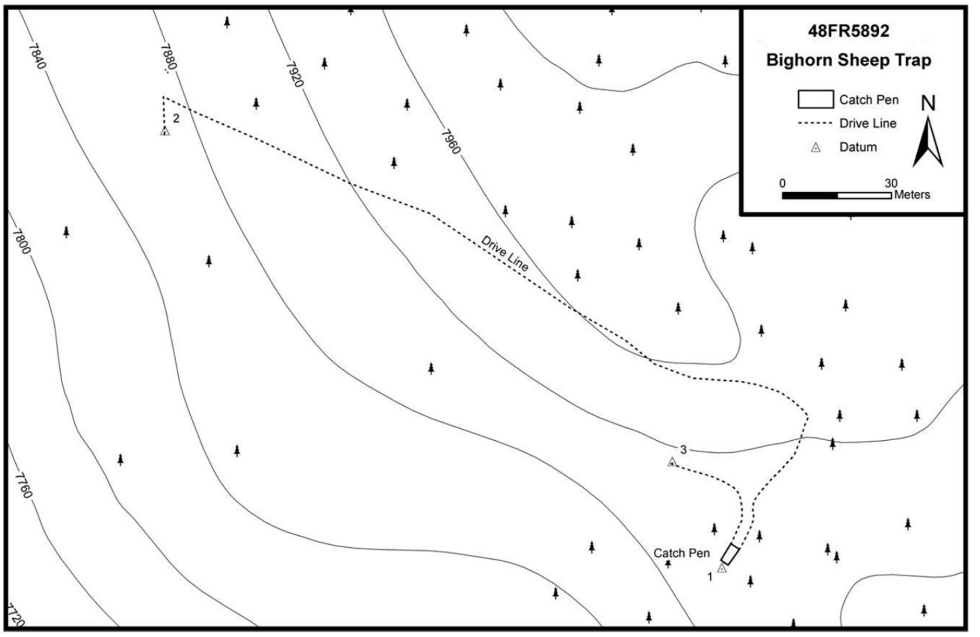

Figure 2 Plan view of representative J-shaped, or hook-shaped, sheep trap (from Eakin 2011)

Figure 3 The catch-pen of a bighorn sheep trap (left) and an associated driveline (right) in the GYE. Tree ring dates and other archaeological data indicate these types of sites tend to date no earlier than the late Precontact period, c 500 BP in the GYE

consist of an earlier 'V-shape' design and a later 'J-shape' or 'hook-shape' design incorporating a terminal curve, both terminating in a cribbed log catch-pen (Figure 2). Tree ring dates derived from intact portions of driveline remnants (Figure 3), as well as on archaeological data from other mass sheep kills, date these features to the late Precontact period, c 500 BP (Kornfeld et al 2010). Given the effort involved in their construction, these driveline features were likely maintained and re-used for years (Kornfeld et al 2010:304).

In accord with observations at other known bighorn sheep hunting locales in the GYE, bighorn sheep skulls left at kill sites bespeak a clear ceremonial aspect (Doyle 2020); just one of many spokes that integrated humans into the GYE since time immemorial (eg Grant 2021; Hotakainen 2022). The placement of bighorn sheep skulls in trees by indigenous populations occurred in parts of the GYE, with these sacred sites being increasingly at risk due to the age of the trees, natural decay and increasing frequency and intensity of forest fires (Eakin 2005:77; Meeteetse Museums 2021; see also Hamlin 2021).

Concentrations of sheep skulls are also known to be associated with areas where drivelines and animal processing areas may have burned. For example, Eakin (2005:78) describes a cluster of eight burned skulls at a campsite/bighorn sheep processing area within about 300 m of a sheep trap, and Frison (2004:160) describes a concentration of c. 25 sheep skulls associated with the remains of a badly deteriorated log fence in the GYE. The latter location is noted in Kornfeld et al (2010:312) with the additional observation that very few postcranial elements were present relative to the number of crania.

Observations of archaeological sites associated with ice patches in the GYE suggest the intentional placement of bighorn sheep skulls was occurring well before c 500 BP. For example, at 48PA3147, an ice patch site with a c 10,000 year record of human activity, more than 20 bighorn sheep skulls dating over the last 6000 years are being exposed by atypical melting (Lee & Puseman 2017). The near absence of post cranial elements suggests the retention of the predominantly ram skulls in this location reflects intentionality. Genetic material from these skulls is helping to elucidate the relationship between ancient and contemporary bighorn sheep populations in the GYE (Flesch et al 2021).

Greater Yellowstone Area ice patch TM-1, drivelines and hunting blinds

The TM-1 ice patch lies at an elevation of c 10,320 feet above sea level (Figure 4) and is part of a cluster of nine permanent ice patches on the border of Montana and Wyoming (Lee 2014). The ice patch itself is presumed to be an

Figure 4 The drivelines at TM-1 lie in the low pass visible on the horizon above and slightly to the right of the large ice patch in the foreground. Photo date: 2010

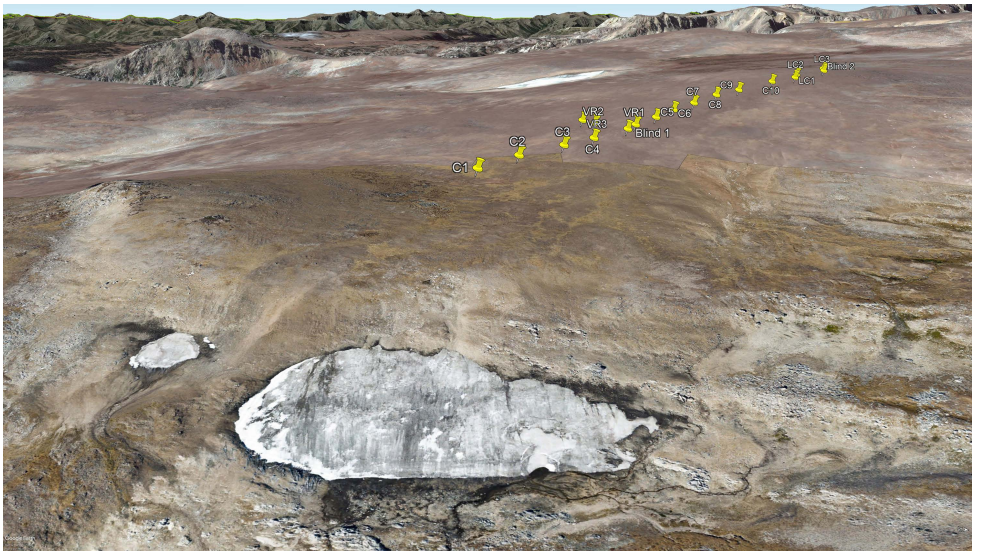

Figure 5 Oblique view of the TM1 ice patch with driveline complex on ridgeline at right. The image is a composite taken from Google Earth with a high-resolution overlay image of the ice patch and vicinity created by Chris Boyer, Kestrel Aerial Services (www.kestrelaerial.com). C = Cairn; VR = Vertical Rock; LC = Large Cairn

animal attractant, with the driveline(s) and blind(s) positioned to serve as an intercept to animals making their way to the ice patch from the plateau to the southwest (Figure 5). Fresh elk and bighorn sheep faeces are regularly observed on the surface of this ice patch during the summer months, and horn sheathes from bighorn and bison as well as bison bone have been identified around the perimeter. Based on currently available data, the exact species that may have been targeted by hunters using the TM-1 system is an open question. Had it been bison, the number of animals involved at this high alpine site would have presumably been fewer than the larger herds expected to interact with the Paradise Valley drivelines. Indigenous populations undoubtedly recognised that bison behaviour exhibits a certain amount of spatial and temporal variability depending on season and consequently the smaller alpine system described here may reflect variable patterns in bison movement.

A low rock wall, 'Blind 1' (Figure 6 at left), was first observed in 2009 while researchers were en route to survey the prominent ice patch in Figure 4. At that time, we postulated the feature may have been built as a windbreak by sheepherders based on the presence of a historic era, hole-in-top can wedged into the rocks. In 2015, the Greater Yellowstone Coordinating Committee (GYCC) sponsored a field training opportunity for agency archaeologists and volunteers, and during one of the field surveys, a group visited the TM-1 ice patch and identified the line of deeply sodded, lichen covered low cairns in Figure 6 (at right). As an observation of the changing nature of this particular archaeological site, during that visit, we also discovered the historic era tin can was no longer present in the rock feature. Further, when TM-1 was revisited in 2020, wooden sticks – possibly parts of the marker poles used to mark the route of Beartooth Highway in deep snow – had been placed in many of the cairns along the ridgeline. Collectively, these observations demonstrate the features in this location are being transformed by modern human activity. As of 2022, most of the poles have fallen out of the cairns with only one collapsed/bent pole remaining.

The cairns in the v-shaped driveline system are of two different morphologies. The shorter wing, which is roughly perpendicular to the ridgeline, is comprised of three cairns with a prominent vertical rock in each (Figure 7). The longer wing, comprised of 13 cairns of piled rock (Figure 8), extends along the ridgeline above and to the northwest of the pass. From left to right in Figure 8, the first and second cairns depicted are representative of those in the main line, which follows the crest of a gentle ridge to the northwest of the low pass above the TM-1 ice patch. Of note, the cairn in the image at left appears to be recently bolstered by the addition of a new rock on top of the more sodded-in base. We observed the vegetation free spot from whence the new rock had been procured in 2020.

Figure 6 At left, a low stone wall 'Blind 1' and at right a cairn line flanked by a group of archaeologists

Figure 7 The three vertical rock (VR) cairns. Of note, you can see two of the VR cairns on the horizon in the background of the image with Blind 1 in Figure 6. These cairns are different in morphology than the longer line of cairns in Figure 8

Figure 8 The first and second cairns (C) in the images above are in the longer cairn line. The stick in the cairn in the second image was not present in 2015. It, along with 'new' sticks in two other cairns were first observed in 2020. The image on the right is representative of the three large cairns (LC) that occur highest up on the hillside to the west

Blind 1 is positioned at the intersection of the line of vertical cairns that are roughly oriented north-south and the longer line of stacked rock cairns that follow the ridgeline. Blind 1 could have concealed one, or at most, two hunters in a prone position to animals arriving from the southwest. A second blind (Blind 2) is located higher up the slope near the cluster of large cairns represented by the image at right in Figure 8. As with other drivelines, the topographic positioning of this driveline and blind was likely tailored to the behavioural patterns of the animals they were designed to harvest (see Frison et al 1990; Frison 2004). As to what that game was, bighorn sheep and elk frequent the area, but it is worth noting that mule deer (*Odocoileus hemionus*) have been observed on the plateaus and, undoubtedly, bison were present up until the nineteenth-century extirpation based on the bison bones found in association with the TM-1 and other ice patches in the GYE.

The temporal utility of the blind(s) described here was likely different from that of the ice patch below the pass and ridgeline. It is generally presumed that the approach to an ice patch for hunting would occur from above (upslope) or from the lateral margins given the added energy required to propel a hunting weapon uphill and the increased exposure/visibility of the hunter when approaching from below. Approaching game from above an ice patch can also benefit from advantageous and predictable wind direction. For example, on warm days in the mid-to late afternoon, upslope/up-valley winds can occur which would preclude animals from smelling approaching hunters. This would be a detriment to hunters using the blind, which suggests the blinds may have been used earlier in the day before the afternoon upslope wind occurred, or on days when the wind was otherwise favourable, eg cloudy/cool days.

Alpine driveline use may increase when ephemeral (transient) alpine ice is at a minimum, and large permanent patches like TM1 are more attractive to animals. The authors and other colleagues have been working to replicate the ice patch coring effort detailed in Chellman et al (2021; see also Lee et al 2018) by extracting ice cores from TM1. We suspect the radiocarbon ages of the lags that form when ice patches undergo prolonged melt may correspond to warm/dry intervals, and by extension, may represent periods favouring use of the driveline. The presence of herbivore digested material within some of these organic layers suggests that animals may have sought refuge from hot and dry conditions and the insects and other pests associated with pronounced drought events during this time period. As with patterns observed at other ice patches worldwide, the presence of high concentrations of animal bones in the vicinity of TM1 offers some evidence that these features provided important resource for herbivores, and possibly more so during hot and dry intervals.

Spiritual provisioning (bighorn sheep effigy)

The presence of other provisioning locations in the alpine, including prayer structures (eg fasting beds) and effigies, such as the grouping illustrated in Figure 9, further illustrate the deeply engrained legacies of many tribal groups in the GYE. Thus far, the close association between the probable bighorn sheep effigy in Figure 9 and a permanent ice patch (TR7) is a unique occurrence; however, similar parings of effigies and fasting beds have been identified elsewhere in the GYE. For example, Lee and Lee (2017) describe an effigy and enclosure recorded during a post-fire inventory on a ridgeline overlooking Sheep Mountain and the North Fork of the Shoshone River. The ice patch and effigy paring described here are about 100 km (60 miles) to the south of the ice patch driveline described above.

Figure 9 This ice patch (TR7), effigy, and enclosure are in a cluster of 21 ice patches roughly 100 km (60 miles) away from the ice patch driveline complex where TM1 is located

As noted previously, bighorn sheep were an important food source and cultural symbol for indigenous populations, and the antiquity of this relationship is substantiated by archaeological investigations at a nearby rock shelter on the North Fork of the Shoshone River (Husted & Edgar 2002) as well as the 5000+ year record of bighorn sheep hunting at ice patches described in Lee and Puseman (2017). Collectively, these and other bighorn related features, such as an historic account of a 'spoked ring' containing an enormous bighorn skull

emblazoned with red ochre lines adjacent to a fasting bed (Tom Wolfe, cited as personal communication in Lahren 2006:135; see also Lahren et al 2002) underscore a ceremonial aspect of alpine landscapes.

Discussion

Aside from the game drive reported here, no other stone drivelines have been recorded in association with an ice patch in the alpine of the GYE. Guenther et al (2021), Gans and Guenther (2021) and Robins (2021) have reported a high-altitude stone driveline that appears to be associated with bison hunting in the south-central portion of the GYE, and stone drivelines are well documented in alpine areas further south. In particular, indigenous peoples built numerous stone game drive structures on the tundra uplands of the Colorado Front Range (CFR) (eg Benedict 1996; Cassells 2000; Meyer 2019; Whittenburg 2017) and further south, eg Monarch Pass in the Sawatch Range (Hutchinson 1990). The CFR systems vary in complexity from features that evolved over time incorporating hundreds of cairns to small drive systems similar in size to the one reported here. For example, the southern system on Buchannan Pass, which consists of 12 cairns and a single blind (Lee et al 2006) is reminiscent of the TM-1 driveline. Hunting blinds associated with ice patches have been described in the Yukon Territory (eg Pennanen et al 2021). The absence of a clear ice patch adaptation in the CFR may relate to the use of these extensive game drive systems (Lee & Benedict 2012), whereas the use of ice patches in the GYE may be reflected by the relative absence of stone hunting features in comparison.

In order to better understand the use of high alpine drivelines, more longitudinal studies/observations of the effect of low cairns on game animals are needed. This could be accomplished using unobtrusive game cameras placed at or near the TM-1 blind(s) to observe the modern routes of animals transiting the area. Toward this end, Jason LaBelle and students at Colorado State University (personal communication 2019) deployed cameras for this purpose at alpine drivelines in the CFR and have captured animals appearing to be influenced in the direction of their movements by these structures. The authors suspect that even low cairns, placed in a thoughtful way, may exhibit a subtle influence as 'drift fences' with their action being bolstered by the addition of flagging (eg Brink & Rollans 1990) or 'sewels' (Hutchinson 1990).

Conclusion

We believe the TM-1 ice patch, where we have regularly observed animal tracks and fresh faeces, is inexorably woven into the landscape knowledge of many alpine creatures, including elk, humans, sheep and bison (historically). Given the sheer scale of the alpine environment in the GYE and the relatively diminutive size of the driveline and blind(s) at TM-1, we hypothesise this TM-1 system was designed to be used by smaller hunting parties – just a few individuals at most – to intercept animals making their way to the ice patch. This is in marked contrast to the large driveline complexes in lower elevation terrain and the major log pen sheep traps (eg Figure 1 and Figure 3) which required numerous people to coordinate (Medicine Crow 1978; see also Arthur 1978 for further discussion regarding the use of drivelines in the GYE). Collectively, the examples shared are illustrative of some of the variation subsumed under driveline technology (see also Figures 2 and 3).

In concert with the efforts of many others, the observations of provisioning in the alpine (via drivelines associated with an ice patch) shared here support the conceptualisation of sustained human interactions and involvements in this liveable and familiar landscape. These relationships have been historically glossed over in many of the dominate narratives including the construct of 'wilderness' (Wilderness Act, 16 US C. 1131–1136, 78 Stat. 890). The presence of other provisioning locations in the alpine environments of the GYE, including, effigies, fasting beds and enclosures, such as the one below the peak of the Grand Teton, are 'a testament to the power of place […] and enduring legacy to the [indigenous peoples] who lived in the region for millennia' (Castaneda 2022; see also Loendorf & Brien 2022). These engineered landscapes underscore and illustrate the deeply engrained histories of many tribal groups in the GYE. With this effort, and the continued effort of others, we continue to build on the charge of Nabokov and Loendorf (2004:299) to integrate humans into the biome and to see the GYE 'as a multicultural habitat that has been visited, inhabited, shaped and instilled with meaning by American Indians for millennia'.

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