Back on the horse: Recent developments in archaeological and palaeontological research in Alberta

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More than meat: Residue analysis results of mauls in Alberta

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ABSTRACT

Mauls are a grooved ground stone tool found at archaeological sites in central and southern Alberta. Rarely studied as a valid tool category, the most commonly assumed function of mauls is the processing of bone and meat. They are often assumed to be of Late Prehistoric date. We summarize a systematic study of mauls in Alberta and focus on those associated with datable artifacts or radiocarbon dates. We submitted these mauls for starch grain or lipid residue analysis, the results of which show mauls were used for more than pounding meat and bone. This evidence is supported by ethnographic literature.

KEYWORDS

maul, residue, starch, lipid, plants, seeds

1. Introduction

A grooved maul is a stone cobble with a groove pecked out around the mid portion that was used to attach a wooden handle. The maul in Figure 1 is a reproduction demonstrating what a maul looks like with a handle attached. Writing of the Blackfoot, Grinnell (1913:200) provided a good description of hafting, uses, and types of mauls: "The handles of mauls and war clubs were usually made of green sticks fitted as closely as possible into a groove made in the stone, the whole being bound together by a covering of hide put on green, tightly fitted and strongly sewed. This, as it shrank in drying, bound the different parts of the implement together in the strongest possible manner". In an earlier account of the Blackfoot, Grinnell (1892:200) wrote: "The hammers were of two sorts: one quite heavy, almost like a sledge-hammer or maul, and with a short handle: the other much lighter, and with a longer, more limber handle. This last was used by men in war as a mace or war club, while the heavier hammer was used by women as an axe to break up fallen trees for firewood; as a hammer to drive tent-pins into the ground, to kill disabled animals, or to break up heavy bones for the marrow they contained." Wissler (1986:22) wrote, on the basis of his ethnographic work with the Blackfoot in the early 1900s, that mauls were used to pound chokecherries, break bones to obtain marrow and pound dried meat to make pemmican.

Mauls were necessary for a variety of daily tasks. However, there is evidence that they were also used in ceremony. In a story about the Old Man, Grinnell described Old Man's attempts to doctor a child back to life. Old Man instructs two women to sit near the doorway facing each other. "Each one held a puk-sah-tchis, [a maul] with which she was to beat in time to the singing" (Grinnell 1892:163).

Grooved mauls without their handles are commonly found on archaeological site surfaces. Roughly 159 sites in Alberta contain mauls, based on a review of site forms in 2016. Mauls are frequently found by landowners, but few have been identified in archaeological excavations. When found, they are rarely studied in detail, and, in the past, have been largely ignored in archaeological reports.

Figure 1. Maul hafted into handle, Royal Alberta Museum.

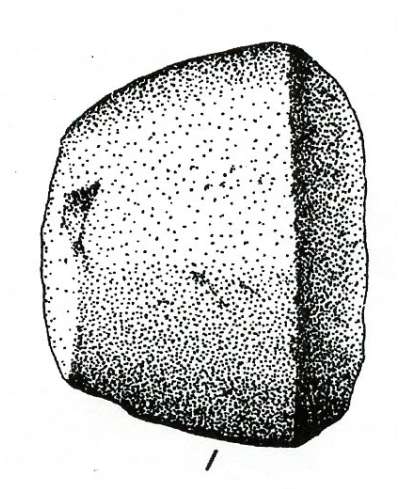

Figure 2. Maul from the Fletcher site (Forbis 1968).

Mauls are often assumed to be a tool of the Late Prehistoric, used primarily in the processing of meat and bone and the production of pemmican. In 1965, Wormington and Forbis wrote that "Most of the grooved mauls are thought to occur late in the prehistoric sequence. Large numbers of such specimens are found throughout the southern portions of the Province" (1965:107). While mauls are very numerous in the Late Prehistoric period, they are also found at sites with Middle Prehistoric representations, including Mummy Cave (EgPn-480), Pelican Lake (DiPn-20, EhPo-78) and Besant (EgPn-11, DjPl-13). In his report on the Fletcher site (DjOw-1), Forbis (1968:2) stated that a grooved maul fragment (Figure 2) was recovered from the bone bed of the Fletcher site (DjOw-1), which he suggestd is 10,000-11,000 years old and definitely dating from before the Altithermal period (7000 yr BP). Forbis acknowledged that mauls were generally considered post-Altithermal in age (1968:6-7). B.O.K. Reeves was present during these excavations and confirmed that the maul came from the Paleoindian bone bed (Reeves, personal communication, 2014). Perhaps mauls found on the surface that have been assumed to be Late Prehistoric are in fact from an earlier period. Wissler documented an "informant [who] indicated she found the stone for her maul already grooved and had never heard of anyone shaping or grooving the stone. Instead, they found them at old campsites" (Wissler 1986:22).

The durability of mauls would allow them to be used over and over, possibly for hundreds or even thousands of years. Such re-use may prevent us from discovering the period in which they were created. The lack of style change over the millennia also contributes to our inability to definitively date them. The few mauls that have been recovered in context offer the opportunity to test assumptions about this necessary and valuable ground stone tool. Testing mauls for residues allows us to detect materials processed for which there is no other evidence, such as plants and other organic materials that degrade quickly in Alberta soils.

2. Study summary

Using criteria adapted from Adams (2002), we evaluated 59 mauls recovered through historical resource management projects and housed at the Royal Alberta Museum. Fifty three observations/measurements were taken on each maul, consisting of general morphological characteristics such as weight, length, thickness, shape, manufacturing, groove metrics, primary use wear, and secondary uses.

2.1. Terms defined

Figure 3 depicts the common features of a maul. The groove divides the maul into two polls, the distal and proximal. The top and bottom of the maul may be identifiable, if there is a gap in the groove that indicates the bottom. If the bottom can be identified, then the left and right sides are obvious.

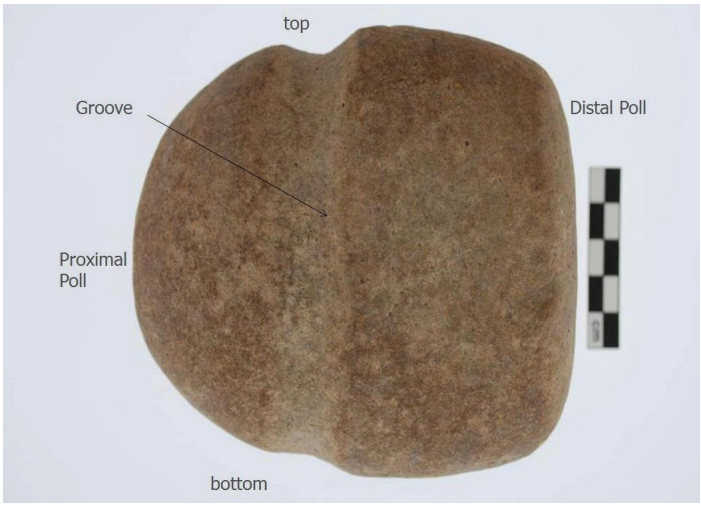

Figure 3. Physical Characteristics of a maul, Royal Alberta Museum.

Use wear is generally visible on the end of the distal and sometimes the proximal poll, indicated by areas flattened or battered from impact. The sides of the distal and proximal polls can exhibit secondary use wear, such as could result from anvil use in bi-polar lithic reduction.

Within our sample, we were able to identify five basic shape groups of mauls. Ovate mauls have an oval outline or ovoid shape (i.e., egg-like). Small ovate mauls are less than 100 millimetres long and 800 grams in weight. Shaped mauls have a groove and both polls have been pecked and ground into a specific shape, some of which are conical or ovate. Flat and wide mauls are similar to an axe but a groove is pecked and ground and they lack the sharp flaked end of an axe. There is also a group of irregular shaped mauls that lack symmetry and are typically large chunky rocks with a groove but no additional modification.

2.2. Raw materials

The majority of the mauls of identifiable raw material (59 percent) are of quartzite (Figure 4). Quartzite is an ideal material for grooved mauls because it is hard yet workable and very common in Alberta where it occurs as cobbles of ovoid shape ideally suited for mauls. The only modification needed is the creation of a groove, although that is no small task. Odell (2003:76) documented an example of a man working continuously 3-5 days to complete a ground stone axe by pecking off fine granules and grinding edges with sandstone, water, and clay. Pecking/grinding a deep groove on a large cobble would likely take a similar amount of time. Once the tool is made, it can last for several generations.

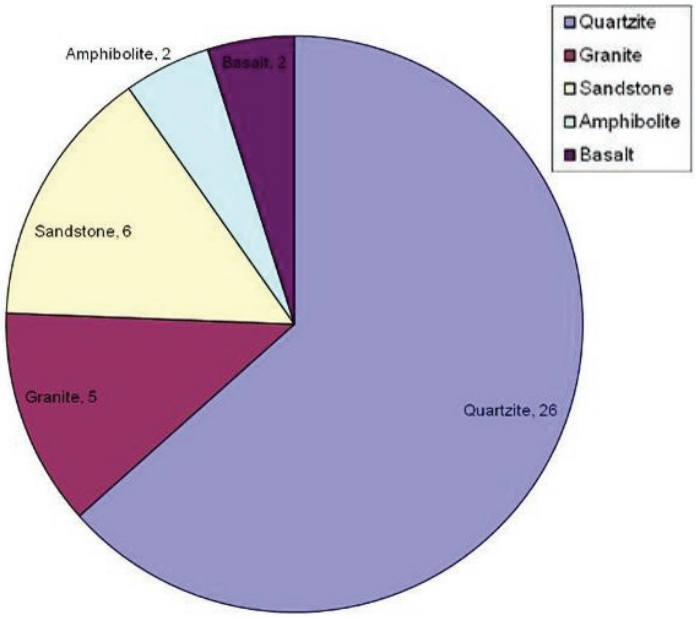

Figure 4. Raw material types of recorded mauls in Alberta.

While quartzite was clearly preferred and available, other raw materials were also used (Figure 4). Mauls in the sample are also made of granite, amphibolite, basalt, and sandstone. All the materials are found in Alberta. No mauls made of exotic raw materials have been found to date.

2.3 Residue analysis

Of the 59 mauls in our study, 12 had sufficient archaeological context and association with datable artifacts or radiocarbon dates to be good candidates for residue testing; nine were selected for analysis (Figures 5 and 6 and Table 1). We chose specimens from excavated contexts because the residues on these artifacts have experienced less weathering and transport than those found in surface contexts. The distal ends of the mauls tend to exhibit more use, making them better targets locations for residue analysis. In cases where the distal poll is missing, the proximal poll was tested (Figure 6). Starch grain analysis was purchased from Sonia Zarillo at the University of Calgary and PaleoResearch Institue in Golden, Colorado. Lipid analysis for other mauls was purchased from Mary Malainey and Timothy Figol at Brandon University in Brandon, Manitoba. Some of the mauls were also tested for phytoliths and protein residues by PaleoResearch Institute but the results for these were negative. Table 1 summarizes the results of the residue analysis.

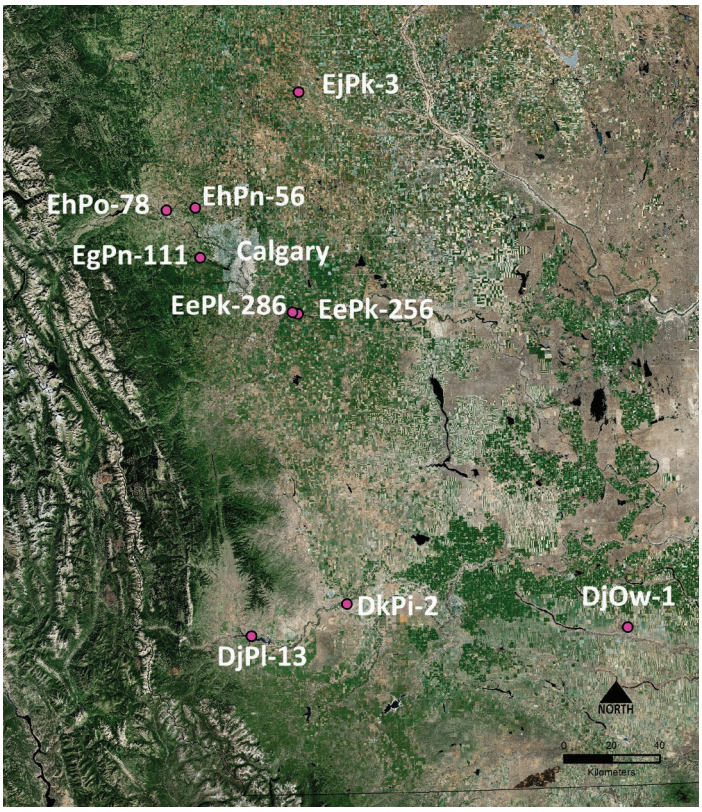

Figure 5. Map of sites discussed.

Figure 6. Mauls tested for residue , Royal Alberta Museum and Todd Kristensen.

Table 1. Summary of residue analysis results. U of C = University of Calgary, BU = Brandon University.

Borden Number	Date	Residue Results	Lab/Researcher
EgPn-111:15, 67	Besant 1480+/-70 BP (Beta-127231, δ13 19.3o/oo)	#15 Zarillo: 8 starch grains, 3 diagnostic maize, 4 possible maize, 1 Hordeae tribe starch. #67 Yost: three very small starch grains whose shape and size are consistent with those found in grass seeds, esp. smaller cool season grass taxa that are dominate in this area such as Festuca (fescue) and Koleria (Junegrass).	Sonia Zarillo (UC) Chad Yost, PaleoResearch Institute, Golden Colorado
DkPi-2:214192	Late Prehistoric 910+/-70 BP (AECV-1635C δ13 24.5o/oo)	778 starch grains. 65% were maize, 30% possible maize, 3% n=23 Hordeae grass tribe, 1% n=9 Polygonum (knotweed) root starches, 2.8 % n=22 starch grains that could not be identified.	Sonia Zarillo (UC)
EhPn-56:121	Late Prehistoric 310+/-70 BP (Beta-176505, δ13 21.0o/oo)	159 starch granules present. 47% n=75 identified as Zea mays, 42% n=67 possible maize, Hordeae (wild barley) tribe 3%, 7.5% could not be identified.	Sonia Zarillo (UC)
EjPk-3:910	Late Prehistoric, associated with side-notched projectile point	Starch - a single angular grain consistent with those found in some Stipoideae (Stipa, Achnatherum, Oryzopsis (Indian Rice Grass) and Pooideae (Elymus (Giant wild Rye), Horeum, Agropyron, etc.)	Chad Yost, PaleoResearch Institute, Golden Colorado
DkPi-2:215520	Late Prehistoric 430+/-70BP (AECV-1838C, δ13 -19.5o/oo) to 840+/-70BP (AECV-1641C, δ13 -19.2o/oo)	Identification: large Herbivore and Plant OR Bone marrow, with low fat content plants; Animal and Plant origin confirmed.	Mary Malainey and Timothy Figol (BU)
EhPo-78:3127	Pelican Lake, associated with Pelican Lake projectile points	Identification: moderate-high fat content food combined with Low Fat content plants; Animal and Plant origin confirmed, conifer products present.	Mary Malainey and Timothy Figol (BU)
EePk-286:46	Undetermined	Identification: low fat content plants with animal products; Plant and Animal origin confirmed, conifer products present.	Mary Malainey and Timothy Figol (BU)

Table 1. *(continued)*

Borden Number	Date	Residue Results	Lab/Researcher
EePk-256:3	Undetermined	Identification: such high levels of medium chain fatty acids are consistent with the presence of low fat content plants, such as plant roots, greens and certain berries. Traces of animal products and plant seeds are present.	Mary Malainey and Timothy Figol (BU)
DjPl-13:7143	Besant 1610+/-90 BP, (AECV-758C),C13/C12 ratio 19.0o/oo - 1590+/-80 BP (AECV-1361C), C13/C12 ratio 18.3o/oo	Identification: low fat content plants, medium fat content animals, and medium fat content plant seeds.The presence of animal products is more strongly indicated. Freshwater fish, terrapin, Rabdotus snail and late winter fat-depleted elk are examples of medium fat content animal foods.	Mary Malainey and Timothy Figol (BU)

3. Starch grain snalysis

Our hypothesis was that mauls used to process starchy plants might have traces of these plants left behind on their working surfaces. We used analysis of starch grain residues to test whether plant remnants were preserved on the mauls.

3.1. Starch grain analysis methods

The starch grain analysis process involves removing starch grains of plants from a tool through a series of washes using an ultrasonic toothbrush or sonic bath to help dislodge particles. The resulting liquid containing the starch particles goes through several stages of washing and drying. Preserved particles are placed under a microscope for identification (Zarillo 2009:2-3; Yost 2010:2; Perry and Quigg 2011). Four mauls were tested for starch grains, and one broken maul was tested by two different labs.

3.2. Starch grain residue results

The maul from EgPn-111 is an ovate maul made of dark gray basalt. The distal poll is missing and the proximal poll is broken into five fragments. The maul shows secondary use as an anvil, possibly for bi-polar reduction. The maul is associated with a bone collagen radiocarbon date of 1480±70 ^{14}C yr BP (Beta-127231, δ^{13} 19.3o/oo), placing it in the Besant period. This maul was located northwest of the main bone bed of this single event bison kill site. The majority of the fauna at the site was bison (*Bison bison*) but *Cervid* (elk), *Canis* sp. (dog/wolf/coyote) and *Odecoileus* sp. (deer) were also present. No plant or seed material was recovered (Head et al. 2002).

One fragment of the proximal poll (#67) was sent to PaleoResearch Institute and one (#15) to Sonia Zarillo at the University of Calgary for starch grain residue testing. The starch grain analysis performed by Zarillo yielded *Zea mays* (corn) and *Hordeae* (wild barley). Zarillo is not confident of the origin of the maize grains detected on this maul because there were only eight starch grains recovered but is confident that the source was not lab contamination. The maize results are somewhat surprising since the maul is dated to the Besant period, which is very early evidence for the use of maize in Alberta. Zarillo recommends ruling out all sources of contamination since the maul's recovery before accepting the results (Zarillo 2009:14-15). It is clear that the results from this maul do not represent conclusive evidence of maize use during the Besant.

The starch grain analysis performed by PaleoResearch Institute on a different fragment of the maul (EgPn-111:67) found a single aggregate of at least three very small starch grains adhering to a small mass of organic matter possibly containing some charred material. The shape and size of the grains are consistent with grass seeds such as *Festuca* (fescue) and *Koeleria* (Junegrass) (Yost 2010). This suggests the maul was used at some point to pound grass seeds. The low number of starch grains may be attributed to the age of the tool, the lack of preservation of the distal primary working end of the maul and depositional circumstances. Both tests recovered a low number of starch grains from this maul, possibly because only the proximal non-working end was preserved. However, both fragments of the poll showed plant use.

DkPi-2:214192 is an ovate, small, complete maul made of very light tan quartzite from the Junction bison kill and campsite. It is associated with a radiocarbon date of 910±70 ^{14}C yr BP (AECV-1635C δ^{13} 24.5o/oo) obtained from a bison humerus.The maul was found in a locality of oxidized sediment and ash concentrations which also included some fragmented bone and fire broken rock. A large variety of fauna was recovered from the site including *Bison bison* (bison), *Alces* (moose), *Antilocapra americana* (pronghorn), a large variety of other medium and small mammals, birds, and fish. No plant or seed material was recovered from this site (Unfreed 1993).

DkPi-2:214192 was sent to Zarillo for starch analysis which yielded 778 starch grains. She determined that *Zea mays* (corn) made up 65% of the sample, and an additional 30% were possible maize. *Hordeae* (wild barley) and *Polygonum* (knotweed) root starches were also present on the maul. Knotweed root was known to have been boiled

and then dried or roasted and pounded into flour. Some grains show damage consistent with dry milling indicated by fissures radiating from the centre of the granule (Zarillo 2009:12).

EhPn-56:121 has a conical shaped proximal end and an ovate distal end. It is made of very dark gray quartzite and is half preserved lengthwise. It was found close to a hearth, 20-40 centimetres below the surface at this multi-component campsite. A bone collagen sample dated to 310±70 ^{14}C yr BP (Beta-176505, δ^{13} 21.0o/oo) places this maul in the Late Prehistoric period. Fauna recovered from the site included bison, unidentified large ungulate limb and mammalian scrap. No plant or seed material was recovered from this site (Murphy 2003).

This maul was sent to Zarillo for analysis which yielded 159 starch grains. Zarillo identified possible *Zea mays* (corn) and *Hordeae* (wild barley). Some starch grains could not be identified but were consistent with the Poaceae (grass) family. Some maize granules showed evidence of dry milling (Zarillo 2009:7).

EjPk-3:910 is an ovate maul with only the proximal poll represented. It is made of light orange and brown sandstone. It likely dates to the Late Prehistoric period due to the presence of an associated side-notched projectile point. The maul was found between the remains of two boiling pits, suggesting it was likely used as a boiling stone, which may be why it is broken. Fauna found include *Bison bison* (bison), *Canidae* (dog/wolf/coyote), *Rodentia* (rodents), ungulate and unidentified *Mammalia*. No plant or seed material was recovered at this site (Moravetz 2005).

This maul was submitted to PaleoResearch Institute for analysis. Yost found starch grains consistent with grass seed such as Stipa (spear grass), *Achnatherum* (needle grass), *Oryzopsis* (rice grass), *Elymus* (wild rye), *Hordeum* (wild barley) and *Agropyron* (wheatgrass) (Yost 2010:5).

4. Lipid residue analysis

Lipid analysis is a method of extracting and identifying fatty acid residues on artifacts recovered from archaeological sites. Fatty acids are the major constituents of fats and oils and are insoluble in water. The ratios of different fatty acids are compared to those of known groups of food plants and animals

4.1. Lipid analysis methods

Lipid residue is extracted by washing the surface of the artifact with chloroform and methanol. The liquid is evaporated and the resulting residue is analysed using gas chromatography and mass spectrometry.

Lipid analysis can detect "clear differences in the fatty acid composition of large mammal fat, large herbivore meat, fish, plant roots, greens and berries/seeds/nuts …" (Malainey and Figol 2010:4). The reader is referred to Malainey (1997, 2007) and Malainey et al. 1999a, 1999b) for detailed procedural descriptions of lipid residue analysis.

4.2. Lipid analysis results

DkPi-2:215520 is an ovate maul made of quartzite. The sides of the polls and the ends of this maul show evidence of secondary use as an anvil stone. This maul, excavated from a depth of 82-94 centimetres below surface, was found at the Junction site in southern Alberta. The level is dated from 430±70 ^{14}C yr BP (AECV-1838C, δ^{13} -19.5o/oo) to 840±70 ^{14}C yr BP (AECV-1641C, δ^{13} -19.2o/oo). A large variety of fauna was excavated from the site including *Bison bison* (bison), *Alces* (moose), *Antilocapridae* (antelope), a large variety of medium and small mammals, birds, and fish. In the area where the maul was located, 58 percent of the faunal material had been modified in some way. This material consists of bone bead waste, cut bone, polished bone, cut and perforated shell, polished teeth, antler tines, perforators, bone wedges, bone awls, a flesher, and cut rib shafts (Unfreed 1993).

Malainey (Malainey and Figol 2010) found residue on DkPi-2:215520 that could represent two assemblages of fatty acids . It could be from large herbivore bone marrow or fatty meat and low fat plants such as root greens and certain berries. Alternatively, the residue signal could be produced by lean herbivore meat combined with medium or higher fat content plant materials such as seeds. Both animal and plant lipids were confirmed.

EhPo-78:3127 is the third oldest maul found in Alberta. The site is a Middle Prehistoric Pelican Lake campsite. The maul is ovate in shape and made of light reddish brown quartzite. It exhibits pitting characteristic of secondary use as an anvil. The maul was recovered from a depth of 70 centimetres below the ground surface, in association with some highly fragmented and calcined bison bones. These bones have been attributed to intense butchering and breakage for marrow and grease extraction (de Guzman 2008). This excavation unit and level also contained three Pelican Lake projectile points. The generally accepted date ranges for Pelican Lake occupations is 3600-2100 yr BP (Bubel et al. 2012: 62).

Lipid analysis (Malainey and Figol 2010) of this maul found residues of fatty meat of medium–sized mammals (such as beaver), certain seeds, and birds such as grouse in

addition to low fat plant material such as roots greens and certain berries as well as conifer.

EePk-286:46 is a quartzite maul, ovate in shape. It was recovered by a backhoe 50 centimetres below the ground surface at a buried campsite. Scatters of bone, fire broken rock and a few stone tools were excavated. There are no radiocarbon dates or associated datable point styles. The depth at which the maul was found may indicate some antiquity (Vivian 2016) and made the maul a candidate for testing.

Lipid analysis (Malainey and Figol 2010) of this maul recovered low fat plant lipids such as roots, greens, certain berries and medium fat content plant food such as maize or medium fat content animal foods such as freshwater fish and fat depleted elk. Conifer residue was also identified, likely from pine or spruce resin (Malainey and Figol 2010).

EePk-256:3 is an ovate maul made of fine grained quartzite. It exhibits secondary use as an anvil. The maul was collected from an erosional exposure. The remains at the site consisted of two components with dense scatters of faunal remains and fire broken rock, with immature bison in each component. A buried stone circle occurred in the upper component. No age or cultural affiliation could be determined for the site (Vivian 2015).

High levels of medium chain fatty acids were discovered during residue analysis (Malainey and Figol 2016). These high levels are consistent with the presence of low fat content plant parts, such as plant roots, greens and certain berries. This strongly suggests that the maul was primarily used to process plant material. Only traces of animal products and plant seeds were present (Malainey and Figol 2016).

DjPl-13:7143 is a complete ovate maul made of fine-grained quartzite. There is some secondary pitting suggesting use as an anvil. It was recovered from a Besant living floor with a date range of 1610±90 years BP, (AECV-758C,$^{13}C/^{12}C$ ratio 19.0o/oo) to 1590±80 years BP (AECV-1361C, $^{13}C/^{12}C$ ratio 18.3o/oo). Both dates are from bison bone collagen (Van Dyke et al. 1992:2). This floor is associated with several features and high artifact densities including net sinkers, fire broken rock, lithic tools including drills, hammerstones, projectile points and debitage. Eighty three percent of the faunal material recovered during the 1990 excavation was bison. No fish remains were recovered during initial excavations (Van Dyke et al. 1992). During an earlier excavation, similar cultural material was excavated from the site, and two fish bones were found (Van Dyke et al. 1990).

Residue analysis detected low fat content plants, medium fat content animals, and medium fat content plant seeds. Freshwater fish, terrapin, Rabdotus snail and late winter fat-depleted elk are possible examples. The presence of animal products is more strongly indicated than on previous specimens (Malainey and Figol 2016).

5. Discussion

The residue analysis produced some unexpected results. Two Late Period mauls, one from the Junction site (DkPi-2) and one from EhPn-56 had high amounts of *Zea mays*(corn) starch grains. Zarillo determined that these results were not surprising given the maize starch recovered from other artifacts in Alberta, Saskatchewan, and Manitoba. It appears that there was some trade of maize onto the Northwestern Plains during pre-contact times, likely originating from the Middle Missouri (Zarillo 2009:14).

Although maize starch grains have been identified in recent years on both stone tools and pottery fragments found in Alberta, it is not clear where the maize may have originated or in what form it is coming into Alberta. If there was robust trade in maize, kernels or cobs of corn should show up in the archaeological record. To our knowledge, there have been no corn cobs or corn kernels recovered from any excavation in Alberta. Was the corn already ground when it was traded or was it coming in only in small quantities? The mauls with maize starch also had evidence of other starches, suggesting that maize was combined with other foods.

There was a wide variety of prairie grass seed starches present on all the mauls tested for starch residue. They were identified as *Festuca* (fescue), *Koeleria* (junegrass), *Hordeae* (wild barley), *Polygonum* (knotweed), *Stipoideae* (spear grass, needle grass, rice grass), and *Pooideae* (wild rye and wheatgrass). Since they were recovered from cracks and crevices of working surfaces of the mauls, it is clear that grass seed was being pounded and ground using these tools. The identification of these different types of starchy plants expands our view of the types and variety of foods utilized by First Nations people in Alberta during the prehistoric period. Mauls were clearly being used to process more than just bone and meat.

A passage from Wissler supports this evidence. He noted that the Blackfoot consumed a considerable amount of vegetable food, often compounded with the flesh of buffalo or deer (Wissler 1986:20). Unfortunately, Wissler does not describe the types of plants eaten.

There is evidence as well that some plants were used in food processing. Kuhnlein and Turner indicate many grasses were not eaten but used in food preparation (Kuhnlein and Turner 1991:98-99). For example, food storage involved

placement of dried grasses between layers of dried berries and other foods. It is reasonable then that grass seeds might have been included when chokecherries or Saskatoon berries were pounded in the production of pemmican. Of the Blackfoot, Grinnell documented the use of grass stalks to line roasting pits (Grinnell 1892:718-719). Our review of ethnographic literature, while not exhaustive, does show evidence of grass being utilized in food production by the Blackfoot. All of the mauls tested for starch grains had evidence of grass processing. This suggests that whether being deliberately harvested for consumption or used in the processing and storage of food, grasses were used by Aboriginal people.

Lipid analysis results show more residues than just large herbivores and bone marrow, although those are present, for example on DkPi-2:215520. The results also show low fat plants and seeds as possible sources of the lipids as well as smaller mammals and fish.

Medium fat content foods were found on DjPl-13:7143. Examples of this type of fat are freshwater fish, terrapin, Rabdotus snail and late winter, fat-depleted elk. Since two fish bones, and stone netsinkers were also recovered from DjPl-13, it is possible that freshwater fish were processed with this maul. There is ethnographic evidence that fish were sometimes made into pemmican. While travelling towards Lake Winnipeg, Hind reported that he obtained dried fish that was pounded and mixed with sturgeon oil (Hind 1971:487). Site DjPl-13 is located just north of the forks of the Oldman and Castle Rivers, on the first terrace above the flood plain. Therefore, fish were available to the people camping on this terrace.

Conifer residue on two mauls, EhPo-78:3127 and EePk-286:46, may be explained by the recorded Blackfoot practice of mixing animal marrow and back-fat with pulverized fragments of sub-alpine fir cones, which was then served as a confection and digestive aid (Hellson and Gadd 1974).

Three of the five mauls tested for lipids had both plant and animal lipids confirmed (DkPi-2:215520, EePk-286:46, EhPo-78:3127), while a fourth maul (EePk-256:3) showed primarily plant lipids, and the fifth maul (DjPl-13:7143) had a much stronger presence of animal fats.

6. Conclusion

Our review of archaeological occurrences of mauls in Alberta indicates that they were present as early as 9000 yr BP at the Fletcher site, as well as in the Mummy Cave, Pelican Lake and Besant periods. Mauls found on the surface should not be assumed to be of late prehistoric date. Even mauls from sites with secure late prehistoric dates may have been made in earlier periods, but continued to be used due to their durability and curation over time. Their lack of style change over time constrains our ability to date the period in which they were made.

A large range of plant and animal foods was found on the mauls analyzed in this study. Because plant foods degrade so quickly, residue analysis is one of the few ways to detect them in early sites. It is evident from the residue analysis that different types of plant and animal foods were often combined during preparation and cooking. This idea is supported by comments from Wissler (Wissler 1986:20) and Grinnell (Grinnell 1892:718-719). These results challenge the assumption that mauls were used primarily for making pemmican and breaking bones, although this was clearly done as well. Mauls were an all-purpose tool used to process various types of animal and plant material. They provide a rich source of data about organic materials used by First Nations that cannot be detected in any other way.

7. Acknowledgments

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