A Late Precontact Bison Kill during the Avonlea to Old Women's Transition on the Great Plains

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A thesis submitted in partial fulfillment of the requirements for the degree of

Master of Arts

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ABSTRACT

This thesis encompasses a primary report and interpretation of the excavations at EfOx-70 and 71, a late Precontact bison kill and processing area near Duchess, Alberta. The reporting portion includes activities from the 2019 field excavations and provides further in-depth analysis and interpretation of AMS radiocarbon dates and of faunal and lithic remains at the sites. A summary of the excavations and results is followed by an analysis of the lithic materials, their distribution across the sites, the tool typology, and the raw materials. The faunal remains, including a detailed analysis of seasonality and animal age based on tooth eruption, are discussed in relation to their distribution across the sites showing EfOx-70 as a bone bed and primary processing area and EfOx-71 as a secondary processing site. Further to a discussion of the artifacts that characterize the sites, I explore temporality and discuss the Avonlea-Old Women's archaeological transition on the great plains. The geography and topographic features of the landscape are also discussed with hypotheses of how the bison were procured and dispatched.

ACKNOWLEDGEMENTS

There are several people I would thank for making this thesis possible. First, my supervisor, Dr. John (Jack) W. Ives for his extensive knowledge on archaeological methods and theory, for helping me understand my strengths and limitations, and for being a great support in my studies as well as outside of them. I would like to thank Dr. Kisha Supernant for providing valuable guidance throughout my undergrad and into my Masters. Dr. Robert Losey, thank you for providing guidance and expertise throughout the work of my undergraduate degree, for being a part of my defence committee and providing recommendations for revisions to the thesis.

I would like to thank many people at the Archaeological Survey of Alberta for providing guidance and resources for this work. Thank you, Todd Kristensen for your continued support and discussion in matters of Alberta's archaeology. Thank you, Darryl Bereziuk and Martina Purdon for allowing me to obtain a permit for this project and for assistance in following permitting guidelines. I would like to thank Trevor Peck for his guidance and substantial knowledge on projectile point typologies and general archaeological knowledge.

Other archaeologists and good friends provided valuable insights and support. William Wadsworth, you have provided immense support including expertise on geographic information systems and mapping. Furthermore, thank you for being a supportive friend and for our Age of Empires study breaks. Katherine Gadd, thank you for your assistance with maps, figures, and site forms. Thank you, Eric Tebby, Erika Sutherland, Katherine Bishop, Jen Nelson, and Philbert Katto for providing ears, edits, and understanding as fellow graduate students. Cody Sharphead, thanks for the continued idea sharing and the KRF quarry trip followed by 100 km/hr winds and late-night drives across the border. I would like to thank my volunteers, especially Brynne Martin and Madison Bremault for cataloguing countless artifacts and providing great syntheses of the faunal remains at the sites. Brynne and Madison, you provided phenomenal supports in cataloguing, cleaning, and analyzing artifacts and established the “vertebral column” of the cataloguing and artifact processing. Thanks to the many archaeologists who have provided valuable resources and guidance throughout this project. These individuals include John W. Brink for his knowledge on bison behaviour and precontact bison hunting; Robin Woywitka for discussions on the geomorphology of the Matzhiwin Creek area; Allison Landals for valuable insight on bone preservation at bison kills; Patrick Rennie for insight on Montana toolstones, for providing hospitality and guided tours of Montana archaeological sites, and for an endless supply of research resources. I’d like to thank an inspiration, namely Eugene Gryba for sharing a passion for rocks and how to chip them.

A special thanks to the students of the 2019 University of Alberta’s Anthropology 396 Field School, for being an excellent team and working to excavate EfOx-70 and 71. Thank you landowner Mr. Kelsey Campbell for allowing us to conduct excavations on your property on the south bank of Matzhiwin Creek and for continually and generously providing access to the land for research purposes. Many thanks to Edwin and Ruth Mattheis for their donation of the Mattheis Research Ranch to the University of Alberta and thanks to the Rangelands Research Institute for the maintenance and organization of the Ranch facilities used as basecamp since initial archaeological work in 2012.

I’d like to thank friends and family members who supported me through this time. Thanks to my parents: Jon and Elaine Fisher; my daughters: Olivia and Dakota Fisher; and other friends and family that have supported me throughout. Jeremy Bryant, thank you for the “dub club” writing sessions, and Nathan Brown for your support in most areas of my life. Makenzie

Leeb, thank you for being a phenomenal friend and inspiration. I acknowledge and appreciate all your support.

This project was funded by the following agencies: the University of Alberta, Department of Anthropology's Graduate Program in the form of Master's program acceptance funding; the Government of Alberta through the Alberta Historical Resources Foundation in the form of the Roger Soderstrom Scholarship; the Social Sciences and Humanities Research Council of Canada through the Joseph-Armand Bombardier Canada Graduate Scholarship; the University of Alberta's Faculty of Graduate Studies and Research through the Walter H. Johns Graduate Fellowship; and the University of Alberta, Department of Anthropology's Bryan/Gruhn and Travel Grant. Additionally, my supervisor, John W. Ives' Landrex Distinguished Professorship has funded research connected to this project.

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Chapter 1: Introduction

Each year for the last four, I have spent some days camping at the edge of the Red Deer river just east of Emerson Bridge at its Highway 36 crossing, along the north edge of the Mattheis Ranch (Figure 1.1). In August, when the river is low, I often walk through the shallows encountering numerous bison bones in the water and on the embankment, many showing marks of human butchering (Figure 1.2 A and B). Walking here provides a connection to the past. Not only do I see the remains of bison that were so rich on the plains, but I also see evidence of the people who made this their home for centuries. It is not uncommon to stumble upon a series of artifacts protruding from the embankments of the river, or within the gravels on the shore (Figure 1.2 C). Archaeology provides tangible evidence that can be coupled with history, both oral and written, enhancing our collective understanding of how Indigenous bison hunting groups were actively connected to the landscape and the bison.

The bones at bison kills and ancient campsites are a reminder of the richness of the prairie lands. The work of the bison herds by grazing, wallowing, and migrating sustained life for other species including microbes, dung beetles, birds, rodents, frogs, plants, and people (Olsen 2016; Taschereau-Mamers 2019). Travelling through these landscapes today, bison are rare, found only in parks and farms, making it easy to forget their dominant presence in the recent past. To emphasize this difference, I would note that Peter Fidler in 1793 observed a herd along the edge of the Red Deer River so large that “no ground could be seen for them in that complete semicircle and extending at least 10 miles” (MacGregor 1966:82).

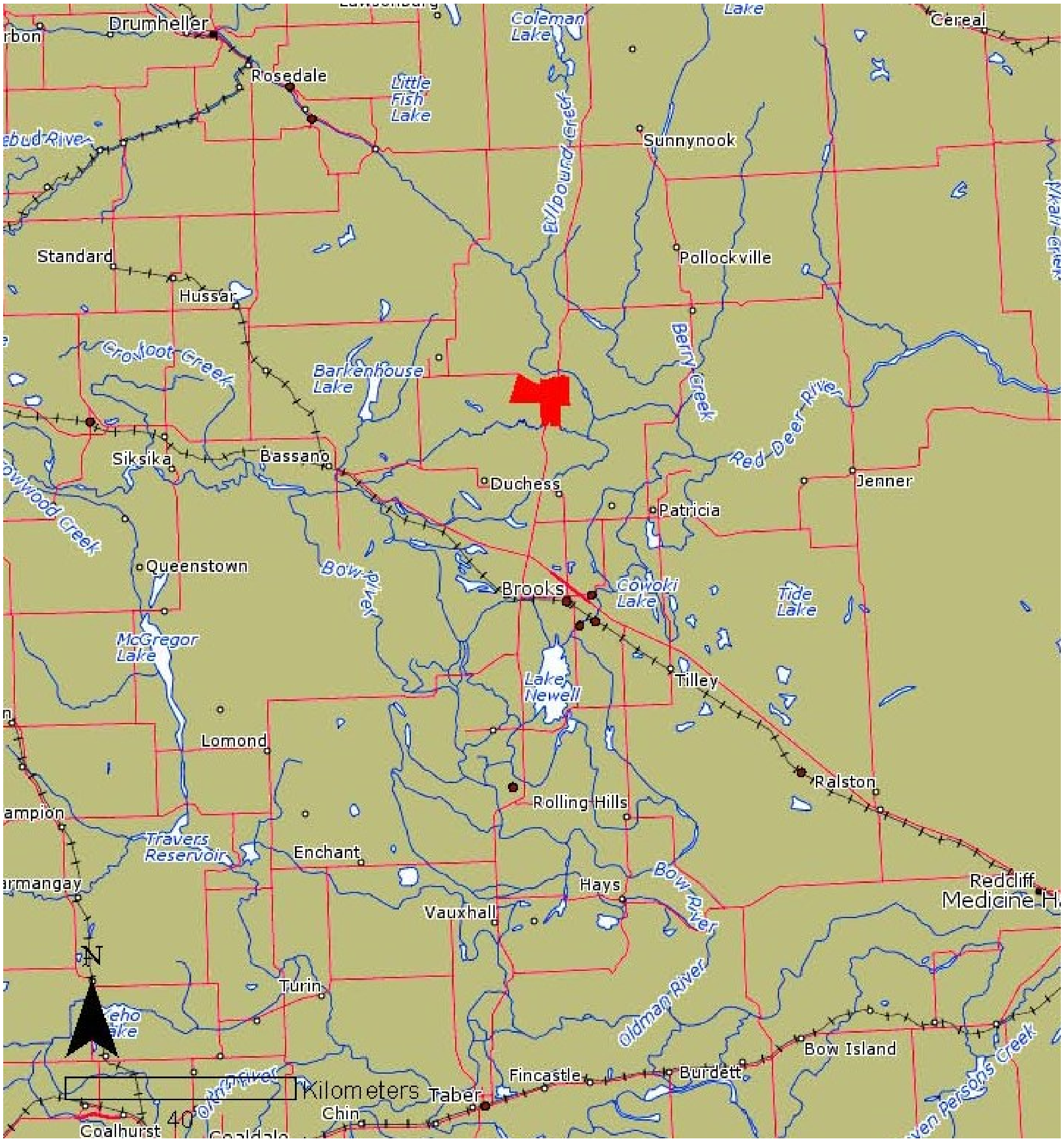


Figure 1.1 *Location of the Mattheis Ranch. The sites discussed throughout this thesis are located at the southeastern portion of the Ranch.*

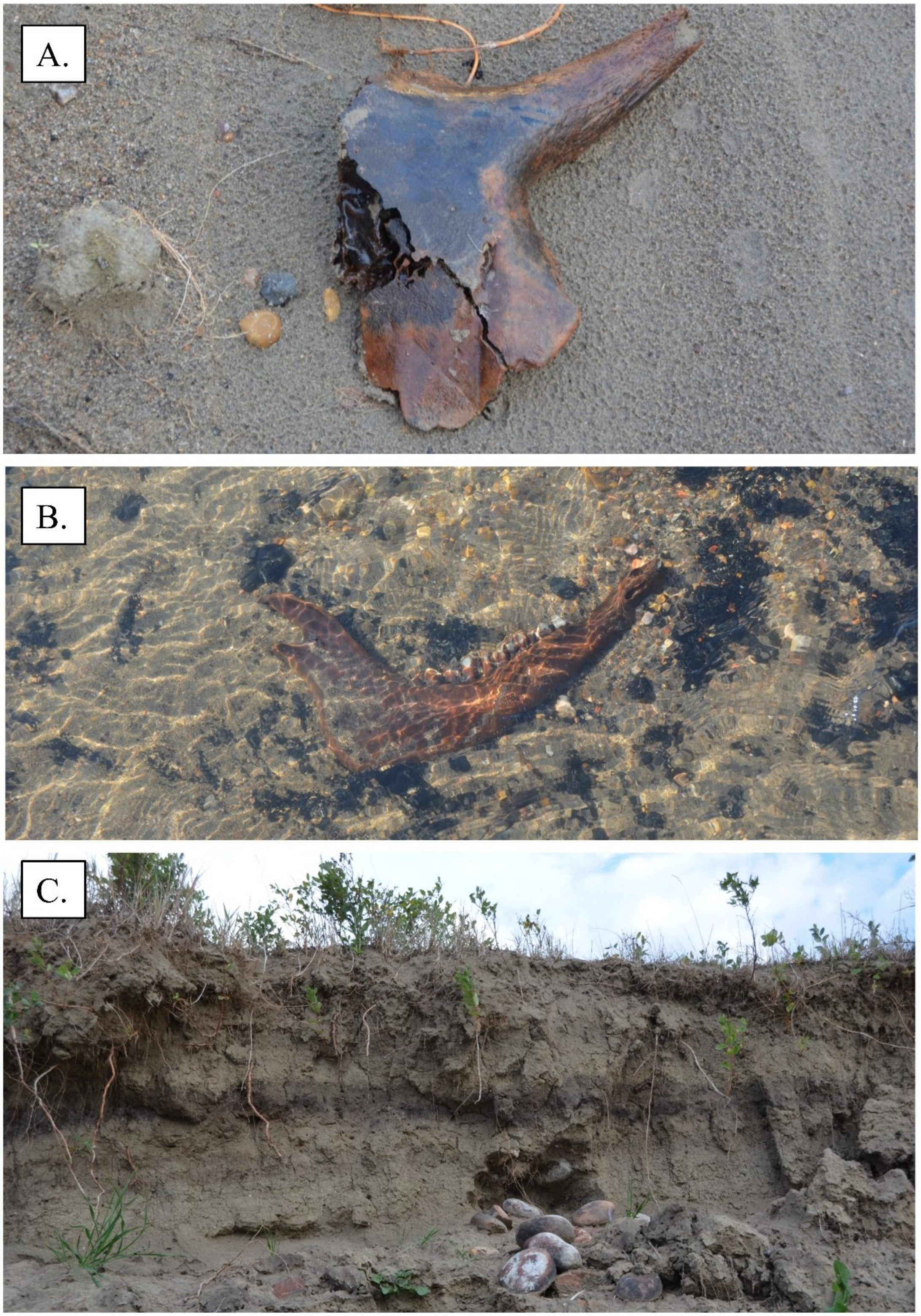


Figure 1.2 *Artifacts in the Red Deer River* ***(A)*** *Bison skull fragment on the embankment,* ***(B)*** *Bison mandible in the shallows,* ***(C)*** *Remnants of a boiling pit or sweat lodge on the embankment of the river.*

Matzhiwin Creek, a tributary of the Red Deer River, was the chosen locale for a community of bison hunters to gather and trap a herd of bison once or a few closely spaced times in the A.D. tenth century, at a time when a change in material culture was happening on the northern Great Plains. The remains of these hunts are present in a few sites in the Matzhiwin Creek valley just west of the Highway 36 crossing near Duchess, Alberta. This thesis provides an account of the 2019 archaeological investigations supplemented by previous field seasons that occurred in 2012 and 2017. This project, coupled with archaeological field training for students, was designed to understand as much as possible about the sites before they are completely removed by creek erosion and other taphonomic processes.

The Buffalo Treaty, first signed in 2014, reflects the careful work of more than 20 Indigenous communities to restore their relationship with bison whom they consider their family (CBC 2014, 2016). Archaeology of bison hunting sites demonstrates a close connection between bison and people, confirming the familial bonds understood within the Buffalo Treaty. The Truth and Reconciliation commissioners stated that "reconciliation will never occur unless we are also reconciled with the earth" (2015:18). As archaeologists, our job involves working directly with the earth that yields many as yet untold stories. At Matzhiwin Creek, the earth reveals a story of an adept community whose relationship with the bison and intimate knowledge of the land allowed them to survive and thrive on the Plains. Throughout this thesis, the symbiotic relationship between two communities, people and bison, is seen through the distribution of bison remains across the sites and a connection with the land is seen through the stone tools and the topography. When the bison were mostly eradicated from the Plains by colonists, the way of life for many Indigenous communities was dramatically altered. I believe that the information we have gained from this project can contribute to efforts of Truth and Reconciliation as the stories presented here are of a truly phenomenal people.

1.1 Introduction to the 19-055 Research Permit at EfOx-70 and 71

Permit 19-055 was obtained for two related purposes: 1) As part of a graduate research program (this thesis) designed to conduct further research into a bison kill and associated complex of archaeological sites present on and just south of the University of Alberta's Mattheis Ranch, Rangelands Research Institute, and 2) as the primary setting for ANTHR 396 (*Archaeological Field Methods*), the University of Alberta archaeological field school in 2019, conducted under the auspices of the *Institute of Prairie Archaeology*.

Keeping in mind that these sites are within traditional areas of cultural and spiritual activity of Indigenous peoples, excavations were carried out with the intention to better respect, understand, and increase knowledge of Indigenous history within southern Alberta and the wider Plains region of Western Canada and the United States. Three University of Alberta, archaeological field schools conducted under the auspices of the *Institute of Prairie Archaeology* of the University of Alberta have now taken place within the site complex. Each time Niitsitapi (Blackfoot) and Tsuut'ina (Sarcee) ceremonialists attended to bless our excavations. This work took place on Treaty 7 Territory, traditionally occupied by the Siksika (Blackfoot), Kainai (Blood), Piikani (Peigan), Stoney-Nakoda, Tsuut'ina (Sarcee), Plains Cree, and Métis nations. The sites covered under this thesis consist of EfOx-70 and 71. The previous ANTHR 396 field season in 2017 was primarily conducted at EfOx-77; however, some observation and collection took place at EfOx-70 and 71. This conditioned the plans for the 2019 field school. EfOx-70 and 71 are on the property of Mr. Kelsey Campbell on the south bank of Matzhiwin Creek, west of the Highway 36 bridge and on the southern border of the Mattheis Ranch. Mr. Campbell has kindly allowed University of Alberta field crews to conduct survey and excavation on his property. The Mattheis Ranch, donated by Edwin and Ruth Mattheis to the University of Alberta and managed by the Rangeland Research Institute, Faculty of Agriculture, Life and Environmental Sciences, is comprised of ~13,000 acres of largely uncultivated native prairie. It also contains sites EfOx-72, 73, 75, and 77, which make up part of the site complex reported upon here (Figure 1.1).

The Sites

Sometime in the A. D. 10th century, a group of Plains bison hunters occupied the landscape around Matzhiwin Creek and its confluence with the Red Deer river. In the area around the Highway 36 bridge over Matzhiwin Creek within the Borden designation EfOx, the bison hunters took advantage of the natural topography and employed their hunting skills, driving a number of bison into a trap, dispatching them with arrows and processing them with stone tools for their meat and hides. Their weaponry and stone tools consisted of both fine-grained siliceous rocks from areas as far as Montana and central North Dakota and materials found more locally including Swan River chert, quartzite, siliceous pebbles, and silicified wood.

This group carried out one or a few successful bison kills and animals were processed not only for their meat, but for the marrow in their long bones and the pulp cavities in the bottom the mandibles. Evidence in the archaeological remains shows that the occupants were highly competent bison hunters. As evidenced by canid remains, dogs or wolves were present during the occupation and some of those remains show evidence of being butchered. A cooking area to the east of the kill (EfOx-71) was characterized by hearths and boiling pits as people procured the meat from the carcasses and marrow from the bones. Some bone was utilized as structural supports which could relate to cooking activities such as drying or smoking meat. Pottery was used to cook and occasionally a vessel was broken and left.

1.2 Research Questions

This thesis is largely a report for Permit 19-055, but it also contains a set of research questions based on the data that was obtained from the survey and excavations of EfOx-70, 71, the surrounding landscape, and other archaeological sites. These questions are presented in the sections that describe or synthesize the data pertinent to the questions. The first question is found in Chapter 6 and asks whether some of the faunal remains recovered at the sites can give some indication of the season(s) in which the kill(s) occurred. The remaining questions are articulated in Chapter 7 and are related primarily to the different activities conducted by the occupants of each site.

EfOx-70 is a bonebed containing disarticulated bone elements, projectile points, and chopping and butchering tools. EfOx-71 contains secondarily processed bones and other tool types such as scrapers and ceramic sherds that are associated with hearth activities. I found a distinct distribution of tool types and their raw materials between EfOx-70 and 71 that directly correlated with butchered bone elements between the two sites. The spatial relationship between bone elements at EfOx-70 and 71 is reminiscent of many other bison kill and processing sites and suggests primary butchering at EfOx-70 with secondary butchering and processing at EfOx-71. Using the raw materials of the stone tools and their by-products at EfOx-70 and 71, I drew a direct correlation between raw material and tool type. Furthermore, I wondered whether the analysis of raw material types among the projectile points could provide clues to trade and mobility. As Avonlea and Old Women's phase projectile points were discovered throughout EfOx-70 and 71, I wondered if the projectile points and their stratigraphic relationships could aid in determining the number of occupations that occurred at the sites. Finally, I conducted preliminary analysis in attempts to understand the nature of the kill event based on the topography of the landscape.

1.3 Summary of Chapters

This thesis is broken down into seven chapters. Following this introduction, Chapter 2 outlines the known cultural and temporal context of the sites, acting as a framework from which interpretations of the material culture and landscape can be further understood. Chapter 3 describes the 2019 excavation process, outlining the units and levels established and the artifacts encountered in each area. Chapter 4 presents the data from the excavations. Chapter 5 contains information on 30 radiocarbon dates obtained from the 2019 and previous field seasons and is intended to provide a temporal framework for the EfOx sites. Chapter 6 constitutes an analysis of 31 bison mandibles uncovered at EfOx-70 and 71 that act as clues to the seasonality and herd composition of the bison kill(s). Finally, Chapter 7 is a synthesis of the excavations, artifacts, and other information uncovered about EfOx-70 and 71 and provides discussion and interpretation of the results including hypotheses regarding the procurement and trapping of the bison at the sites.

Chapter 2: Site Background and Regional Archaeological Context

2.1 Background and Previous Field Studies

EfOx-70 through 75 and EfOx-77 are the Borden designations for a cluster of sites along Matzhiwin Creek, just west of the Highway 36 crossing (Figure 2.1). EfOx-70 through 75 were discovered as the result of an impact assessment by TERA Environmental Consultants for ATCO and AltaLink transmission lines. EfOx-70 and 71 are situated on the south side (right bank) of Matzhiwin Creek and were deemed the locations of both a bison bonebed and camp and processing area (Girard 2012a and b). EfOx-77 was discovered as the result of archaeological survey connected with the University of Alberta's 2012 field school. Research by both TERA and the University of Alberta's *Institute of Prairie Archaeology* from 2011 through 2017 revealed these areas to contain artifacts. AMS radiocarbon dates occupation of the sites during a transitional period between the Avonlea and Old Women's Phases around A.D. 800-1000 (Ives et al. 2020). EfOx-72, 73, 74, 75 and 77 are situated on the north side (left bank) of Matzhiwin Creek and also produced artifacts that are consistent with camp and processing use.

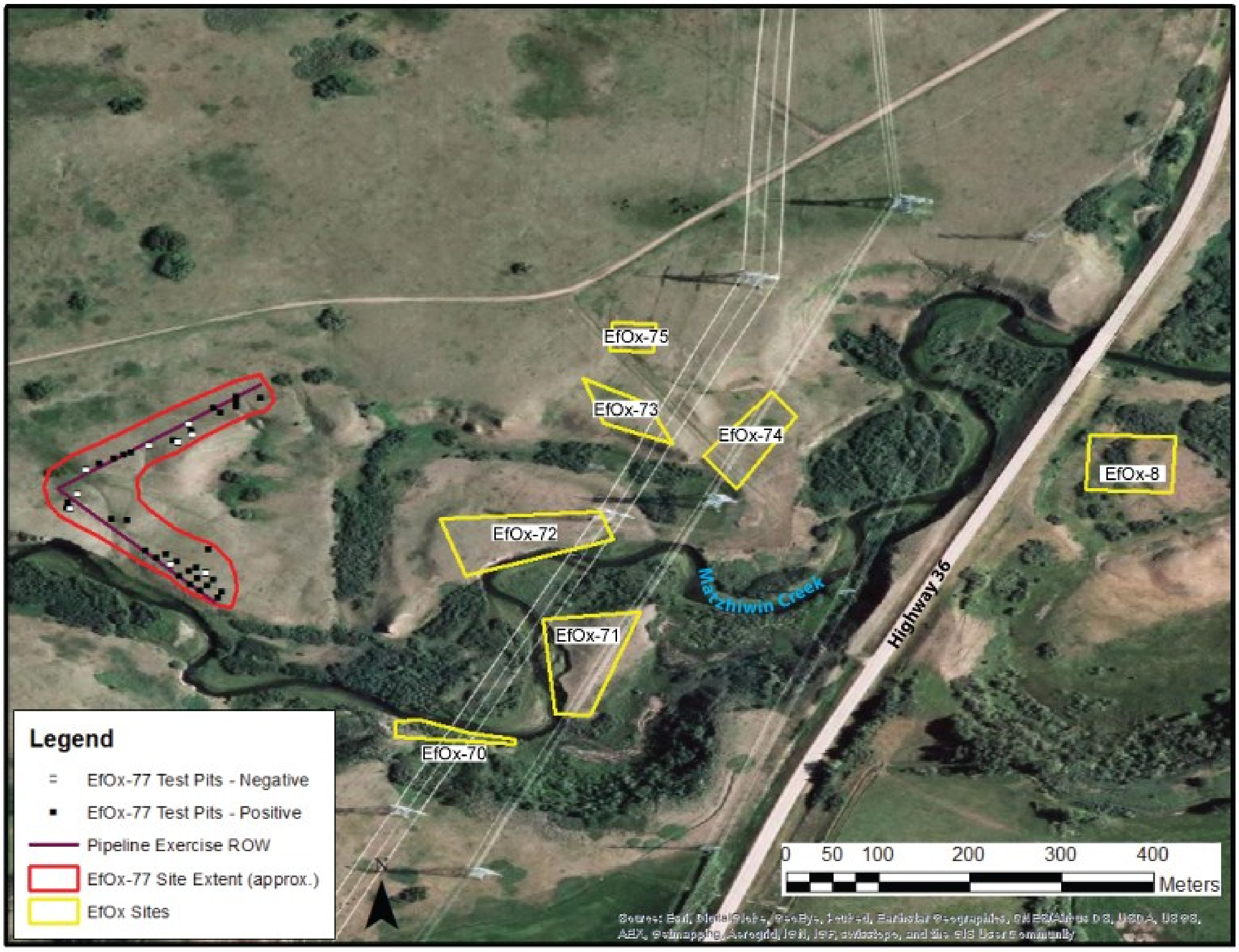


Figure 2.1 *Location of the EfOx sites*

TERA 2011

Under permits 11-049 and 11-225 TERA Environmental Consultants (TERA) was commissioned by AltaLink Management Ltd. (AltaLink) to conduct a Historical Resources Impact Assessment (HRIA) for the proposed project known as the Cassils to Ware Junction, Hanna Region Transmission Development. The project was located entirely within the County of Newell No. 4, approximately 9 km west of Brooks, Alberta. TERA obtained an Archaeological Mitigative Permit (Permit 11-225) to conduct an HRIA for the project and used a combination of truck and pedestrian reconnaissance covering the entire project area. Pedestrian reconnaissance involved an intensive visual inspection of the ground surface and, where warranted, a shovel testing program. Visual inspection of the project area located one surface feature at EfOx-71 and exposed cutbank artifacts at EfOx-70 and EfOx-71. Significant cultural deposits were encountered at EfOx-70, 71, and 74. Thus, TERA recommended that the area be avoided by the impact of the project if possible, or that stage 1 archaeological mitigation be undertaken. In March 2012, AltaLink repositioned the proposed transmission line right-of-way (where it crosses Matzhiwin Creek) 15 m east to prevent the project from traversing EfOx-70. In addition, AltaLink repositioned two towers so that no tower pads would be placed within known site boundaries in the valley. EfOx-71 and 74 remain within the right-of-way; however, the towers and their construction did not impact the site locations (Girard 2012a and b).

EfOx-70 and 71 were both discovered in 2011 during the initial survey by TERA (11-049). EfOx-71 was considered a multi-component subsurface campsite located on the first terrace on the south side of Matzhiwin Creek. Much of the terrace is flat but grades into a hilltop that ascends to the northeast (likely connected with EfOx-72 in the past, but now bisected by Matzhiwin Creek). The western side of the terrace was slumping, revealing cultural materials which continue to erode due to creek activity. At EfOx-70, TERA noted a thick layer of bison bone and manuport rocks (bone breakers) eroding from the cutbank that serves as the north side of the site boundary descending towards Matzhiwin creek. The bone bed spanned the entire length of the terrace at a depth of about 150 to 170 cmbs. This remains the case although the eastern portion of the site ascends quickly from 90-150 cmbs up to 40 cmbs, meeting a slope that descends east into a permanent wetland acting as the southern boundary of EfOx-71. As noted by TERA, most of the site has slumped and likely been lost in the creek due to floodwaters, rain and other erosional processes since 2012 (Figure 2.2).

Institute of Prairie Archaeology, 2012-Present

The University of Alberta's original 2012 interest in this portion of the Ranch was stimulated by the presence of artifacts in an erosional cut exposed to the west of EfOx-72 to 75 (now known as EfOx-77). The 2012 testing was designed to explore promising areas outside the development impact zone TERA had surveyed and tested. Students, for their field school exercise, tested a hypothetical pipeline right-of-way running along the upper bench, and then descending at a sharp angle to the lower bench above the creek (See Figure 2.1). Test pits were situated along the centre line of the hypothetical right-of-way, and then expanded on either side depending on whether the pit was positive or negative for artifacts. This site was subsequently designated as EfOx-77 because of its apparent separation from the sites immediately to the east by an oxbow scar from a previous course for Matzhiwin Creek. In reality, the EfOx-70 to 75 and EfOx-77 site complex is likely a locality with camp and processing components associated with the bison kill on the south side of the creek.

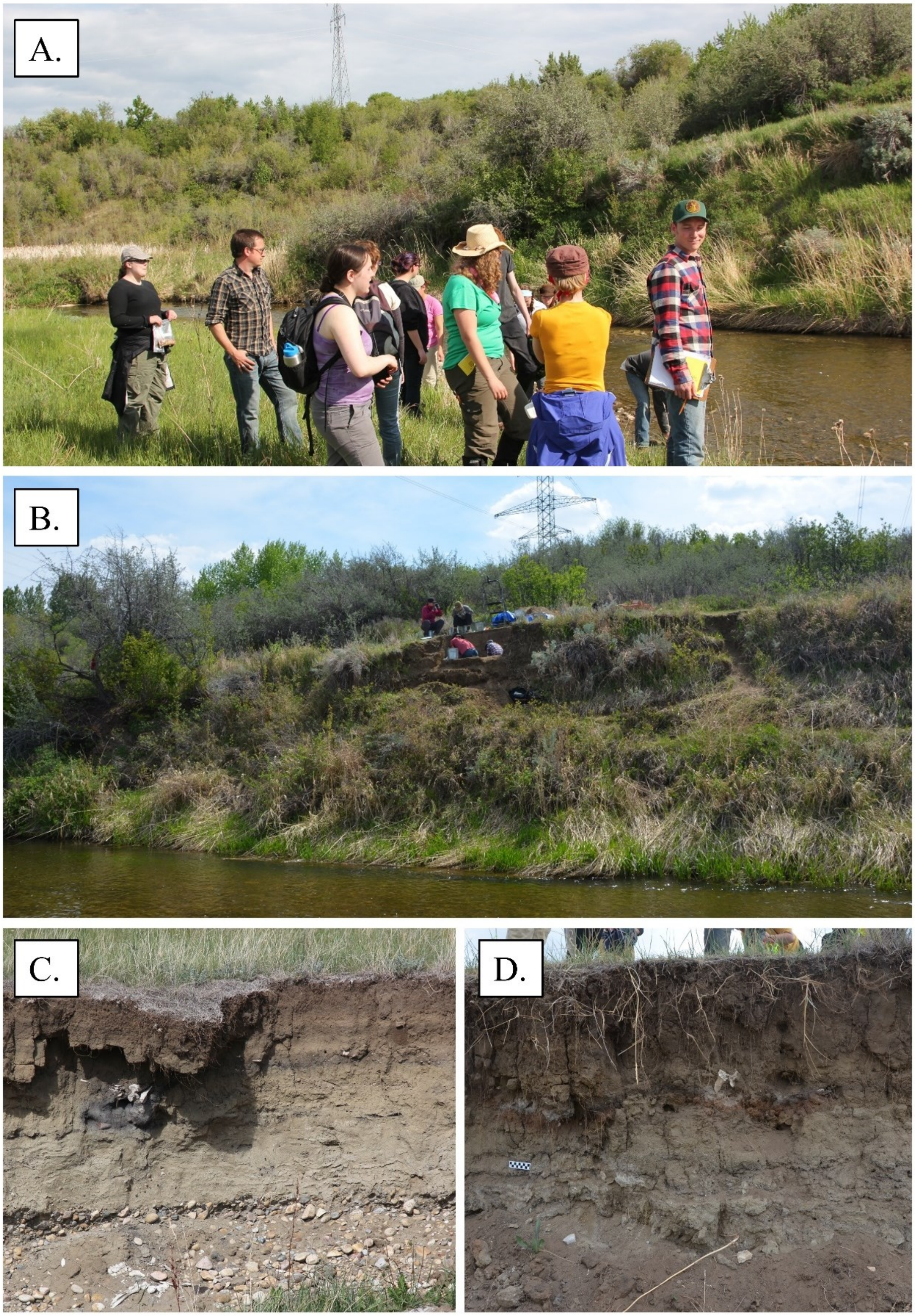


***Figure 2.2** EfOx-70 and 71 Embankment **(A)** EfOx-70 embankment 2012, **(B)** EfOx-70 embankment 2019, (C) Hearth at EfOx-71 2012, **(D)** Hearth in similar area after erosion 2019.*

EfOx-77 was discovered in 2012, and the 2017 field school was designed to provide more understanding through excavations at the site. Field activities took place during the 2017 field methods course and students conducted excavations primarily at EfOx-77 and opened fifteen 1x1 meter units. Additionally, one component of the 2017 work involved the south edge of the Mattheis Ranch, along Matzhiwin Creek, west of Highway 36 (Figure 2.1). With Mr. Kelsey Campbell's permission, the students tested both the bison kill (EfOx-70) and the processing area to the east (EfOx-71). Students conducted some surface collection and cleaning of sections related to hearth and boiling pit features exposed in the cutbank at both of these sites. Such features have been eroding out of the embankment since 2012, hastened by 2013 flooding (See Figure 2.2). Apart from the rich deposits evident in these profiles, we were concerned about monitoring site loss from erosional processes along Matzhiwin Creek. Thus, the 2019 field season was planned to take place at EfOx-70 and 71 for both mitigative and research purposes. As the flow of Matzhiwin Creek will continually disturb the archaeology on its banks, the 2019 field school became an excellent opportunity not only to recover analytical samples at the site but also to teach undergraduate students field methods.

Between the 2017 and 2019 field seasons, our research was conducted primarily in the lab revealing three occupations at EfOx-70, 71, and 77. Ultra-filtered bone collagen AMS radiocarbon dates from Areas A and B at EfOx-77 indicated occupations between A.D. 900-1000 whereas Area C, the lowest EfOx-77 terrace had thin late period activities likely from A.D. 1600-1700 as well as sparse materials from the A.D. 200-300 interval. During 2017 fieldwork, profiles were cleaned at embankments along the terraces of the EfOx-70 bison kill and the associated EfOx-71 camp and processing area to obtain samples for radiocarbon dating. This work, conducted under research permit 17-056, indicated the same A.D. 800-1000 time range, discussed further in Chapter 5. One or a very few closely spaced, intensive bison kill events took place at EfOx-70 between ~A.D. 900-975. Further dating from the 2019 field season affirmed this chronology, providing dates that fall within the Late Pre-Contact period that involves the transition from the Avonlea to Old Women's phases.

2.2 Regional Archaeological Context

The landscape around Matzhiwin Creek, as throughout much of Alberta, has a rich history of human occupation beginning at the end of the Last Glacial Maximum, 13,000 years ago (Ives et al. 2019; Ives et al. 2013). The cultural history of First Nations prior to the arrival of Europeans is generally divided into three periods known as the Early, Middle, and Late Precontact. These subdivisions are based on changes in economic organization reflected by stylistic and technological changes in projectile point types from spears to atlatls and finally to arrows (Peck 2011; Bubel et al. 2012). Although the EfOx-70-77 site complex is primarily Late Precontact, projectile points from the Early Precontact Period (Paleoindian) to the present are not uncommon in the area. The fluted point traditions are represented but almost exclusively, as throughout much of Alberta, in surficial finds from cultivated fields (Ives et al. 2019:2). The Western Canadian Fluted Point Database (Ives et al. 2013) has been assembled to call attention to and outline the instances of Paleo traditions in Northwestern North America. Within the southeastern portion of the province of Alberta, fluted points have been noted in private collections in places such as Red Deer, Penhold, Bowden, and Medicine Hat (Peck 2011:31, 44). Along with the early fluted point traditions, a Hell Gap point has been collected from a fire guard just to the west of the Mattheis Ranch and several sites with Cody Complex materials have been discovered, particularly in the Oyen area (Bubel et al. 2012:41; Peck 2011:87). Many Cody points were produced with Knife River Flint (KRF) from northwestern North Dakota (Kristensen et al. 2018). Personal observation (2018) of a private collection near Youngstown, Alberta revealed a large Alberta point of KRF in a private collection. A Cody Knife of KRF found ~10 kilometers to the northwest of Matzhiwin Creek is also part of a private collection from the area (Bubel et al. 2012:49). Following the Paleo time period, continuous and abundant occurrences of later traditions are evident in the area (see Peck 2011 for Middle and Late Prehistoric occurrences).

Not far north of Matzhiwin Creek's confluence with the Red Deer River, stone features characterize the river's edge including the Thunder Medicine Wheel (EfOx-28), the Suitor 1 (EgOx-2), 2 and 3 (EgOx-1) Medicine Wheels, and the Hutton Medicine Wheel (EgOx-46). Extensive survey along the edges of the Red Deer River from ~30 kilometers north to its confluence with Matzihiwn Creek has revealed multiple instances of stone cobble features, including cairns, circles, and medicine wheels (Beaulieu 2018). Spatial analysis of these features revealed a mass of archaeological sites often encompassing a high number of cobble rings, generally in clusters and in association with distinct topographic features. An especially large cluster of cobble rings was located on the left bank of the Red Deer River just north of the Matzhiwin Creek confluence, not far from the EfOx kill site upstream (Beaulieu 2018).

The stone features so prominent in the area are among many on the northwestern Plains, some holding much significance to Indigenous groups descendant of those who constructed them. For instance, the Majorville medicine wheel, with its prominent cairn structure, is ~50 km to the southwest of the Matzhiwin Creek sites and is visited frequently as a sacred site (Brumley 1988). Medicine wheels, along with networks of trails, river crossings, hunting grounds and tipi rings present a tangible impression of the day-to-day activities of the people that frequented the area in the past (Oetelaar and Oetelaar 2006; Beaulieu 2018). The number of stone structures and other sites, as exemplified in Beaulieu's study, situates the Matzhiwin Creek bison kill within the high density of sites reflecting the greater archaeological context of the area.

The name "Matzhiwin" for the creek is alluded to in some historic documents. A map issued by the Department of the Interior in 1881 called "Grazing Country", identified local topographic features such as the Hand Hills, the Wintering Hills, Hunting Hill, and the Red Deer River, as well as labelling what may be Matzhiwin Creek as the Beaver Head River (Johnston 1881; Beaulieu 2018). Jean L'Heureux, in an 1877 map (reproduced in Kennedy 2014), mentioned Kes-tok-ke-oto-kan, which he translated literally as Beaver Head, and which may be the source of the 1881 Department of the Interior "Grazing Country" map (see Beaulieu 2018:82). Further, as noted by one of our 2019 field school students, the word "Matzhiwin" strikingly resembles the Plains Cree word "mâcîwin" (mah-chee-win) or 'hunting' (Mills pers comm. 2019). Mills noted the addition of the letter "z" as an odd orthographic addition stating that the recorder of the word could have scribed it as a 'c' or 'ts' (Matchiwin or Matshiwin) because Cree dialects do not utilize voiced post alveolar fricatives within their dialects. However, Anishinaabe utilize voicing within their languages such as the distinction between 'z' and 's'. So far, the only Anishinaabe speaking people to have lived on the Plains are the Saulteaux, a language closely related to Cree. Thus, this 'z' could potentially be of a Saulteaux origin (mah-zhee-win). A name like "Hunting Creek" would make sense given the EfOx sites, the presence of topography conducive to hunting, as well as the lush riparian habitats that would have characterized the valley floor during some seasons.

The cultural context of the area includes the historic presence of the Blackfoot, Gros Ventre, Sarsi, Assiniboine, Plains Cree, Kutenai, Shoshone, Hidatsa, and Crow, all known to have been highly mobile across the Northwestern Plains during the onset of European contact

(Vickers and Peck 2009). Wissler (1910) discussed ethnographic observations of groups obtaining a winter meat supply from bison drives, noting that pounds were used by the Plains Cree, Assiniboine, Siksika, Atsina. He observed that driving bison over a cliff with or without a corral below was largely practised by the Piegan (Blackfoot), Blood (Blackfoot), Arapaho, Gros Ventre (Astina), Kutenai, and probably practised by the Hidatsa and Crow. Grinnell (1892:230) noted a pre-horse era on the plains where the groups secured most of their buffalo by means of traps and surrounds. Groups such as the Cheyenne, Arapaho, Mandan, Snake (Paiute, Bannock, and Shoshone), Cree, Hidatsa, Blackfoot, Sarsi, and Atsina used the surround (pound or corral) and the *piskun* (Blackfoot) or jump.

2.3 Culture History

The time period most relevant to the Matzhiwin Creek kill is that of the Late Precontact Period. During the time of the site's most intensive occupation (A.D. 800-1,000/1,200-1,000 B.P.), a transition in material culture was happening on the Northern Plains. The Avonlea Phase (ca. 1,350-1,100 B.P.) gave way to the Old Women's Phase (ca. 1,000-250 B.P.). This shift in material culture is present at the Matzhiwin Creek kill and is found in a few related sites.

Avonlea Phase

The Avonlea Phase, derived from its type site near Avonlea, Saskatchewan (Davis and Fisher 1988), is a well defined Precontact phase or horizon marking the beginning of the Late Precontact period around 1,700-1,400 B.P. and continuing until about 1,100-900 B.P. Avonlea sites extend from the edge of the Rocky Mountains of Alberta and Montana in the west, to the southern fringe of the boreal forest in northern Alberta and Saskatchewan, and into southwestern Manitoba, and North Dakota (Meyer and Walde 2009:50; Peck 2011:335-336). Avonlea points are often exquisitely made, being tiny, extremely thin, having a triangular shape with shallow side notches and slightly concave bases. All of the predominantly smaller Avonlea points are considered to be arrow heads. Ceramics are also associated with the Avonlea phase and can show regional variation (Peck 2011; Vickers 1986). At least three main ceramic wares are associated with the Avonlea phase: Rock Lake Net/Fabric Impressed ware (Alberta and Saskatchewan Plains), Truman parallel grooved ware (Northeastern Montana and the adjacent areas of Alberta and Saskatchewan), and Etheridge cord-roughened ware (Northern Montana and southern Alberta). A fourth ware that contains a smooth outer surface has also been found sporadically throughout the Avonlea geographic area (Meyer and Walde 2009:52) as is the case for the sherds found at EfOx-70 and 71.

Old Women's Phase

The Old Women's Phase is the last well-defined Precontact phase in the southern Alberta plains and foothills and dates to ca. 1,100 - 200 B.P. The Old Women's Phase received its name in the 1960's as Richard Forbis developed a classification for projectile points found at the Women's (*A Ki Piskun*) Buffalo Jump near Cayley, Alberta. The phase is characterized by small triangular, side notched arrow points, Late Variant Saskatchewan Basin ceramics, an emphasis on local Plains or Montana lithics, extensive use of split pebble techniques to produce blanks for endscrapers and points, and an increased use of [heat treated] silicified wood (Peck 2011; Vickers 1986). Cayley series projectile points characterize the Old Women's phase encompassing both Plains and Prairie side notched points as well as other side notched morphologies (Peck and Ives 2001). The Old Women's Phase is well represented in kill sites, campsites, and stone circle sites throughout southern Alberta (Peck 2011).

The Old Women's Phase, using the Inferential Historical Approach, can be reasonably connected to the Niitsitapi (Blackfoot) (Byrne 1973; Reeves and Kennedy 1980; Vickers and

Peck 2009). Ethnographic, historic, and oral histories recognize the traditional lands of the Niitsitapi as roughly demarcated by landmarks such as *omaka-Ty* (the North Saskatchewan River) in the north to *ponokasis- 'ughty* (the Yellowstone River) in the south and from *mis-takis* (the Rocky Mountains) in the west to the *omaxi-spatchikway* (the Great Sand Hills) in the east (Oetelaar and Oetelaar 2006:376). Within this geographic area (as defined by explorers, traders, and oral traditions alike) the material culture that signals the presence of the Niitsitapi provides a robust affinity with the landscape including a prairie tradition of rock art (Klassen 2003), *iniskim* (buffalo charming stones), type three and four death lodges (Vickers and Peck 2009), *Napi* effigies and Cayley series projectile points (Peck and Ives 2001).

Avonlea-Old Women's Phase Transition

The EfOx-70-77 sites contain Avonlea as well as Old Women's material culture. Forbis (1960) was the first to allude to a transition between Avonlea and Old Women's during his work at the Upper Kill site and designated the point typologies as the "Upper Kill type." Reeves (1983:377) originally proposed some connection between Besant (a middle prehistoric archaeological phase) and Old Women's because of similarity between Samantha (Besant arrow) points and Prairie Side notched, but the discovery that sites with mixed Avonlea and Old Women's materials that were contemporaneous (or very closely sequent occupations) affirmed that there was a transition between these two phases instead. Brumley and Dau (1988) suggested that the Old Women's phase was one that developed out of a variant of the Avonlea phase in Southern Alberta.

While there is a significant change in projectile point form, pottery styles continued to be made as the shift between the two phases took place (Byrne 1973; Meyer and Walde 2009). Of the pottery wares associated with the Avonlea Phase, none of the four are exclusive to it and some variants such as Etheridge ware follow through into the Old Women's phase (Meyer and Walde 2009:52, 62). Ceramics at EfOx-70 and 71 have a smooth outer surface potentially related to the smooth pottery found throughout the Avonlea geographic area mentioned by Meyer and Walde (2009:52).

Avonlea to Old Woman's phase transitional sites are few and rarely appear outside of Alberta (Peck 2011), thus emphasizing the importance of the EfOx-70-77 sites to a greater understanding of Plains cultural history. EfOx-70 and 71 share transitional characteristics with the Estuary Site (EfOk-16) in Saskatchewan, containing both Avonlea and Cayley Series points in close stratigraphic relation. At the Estuary site, one Old Women's Phase level produced a date of 1070 ± 70 B.P. and a lower level, showing transitional characteristics with both Avonlea and Old Women's materials, to 1190 ± 170 B.P. (Adams 1977). The Upper Kill site (DiPd-1), the uppermost of two ambush or corral kill sites in southeastern Alberta, contained 90% Avonlea and 10% Old Women's projectile points and some Etheridge ware ceramic sherds. It produced a date of 935 ± 90 B.P. (Forbis 1960; Byrne 1973:630). The Empress Site (EfOo-130) is a tipi ring camp containing both ceramics and contemporaneous Avonlea and Cayley series points dating to around 1190 B.P. (Hudececk 1989; Clarke 2000).

The projectile points at the previously mentioned sites share close similarities with the points at EfOx-70, 71, and 77, all showing Avonlea phase points with symmetric bodies, small, shallow notches, and parallel flaking followed by a range of points that exhibit loosening of such controls in Old Women's projectile point forms. This "loosening of controls" constitutes the presence of points with variable blade length, irregular flaking, and varied notch depth and positioning (Figure 2.3). Other transitional sites include some components of Head-Smashed-In

Buffalo Jump (Brink and Daw 1989); the Ramillies Site (Vickers 1986); and the Hartley site (Clarke 1995).

These sites provide a rare glimpse into the time frame in which the Old Women's Phase takes shape from Avonlea antecedents. Three field seasons of research at EfOx-70, 71, and 77 have now provided a refined series of AMS radiocarbon dates to enhance our understanding of this material culture change on the Plains. A robust assemblage of projectile points showing transitional characteristics, 24 tightly clustered AMS radiocarbon dates, hearth features, faunal remains, and some pottery now make the EfOx sites among the most thoroughly explored transitional sites in this unique time period. With only small fractions of each EfOx site excavated and tested, the potential for further understanding remains strong for future research along Matzhiwin Creek.

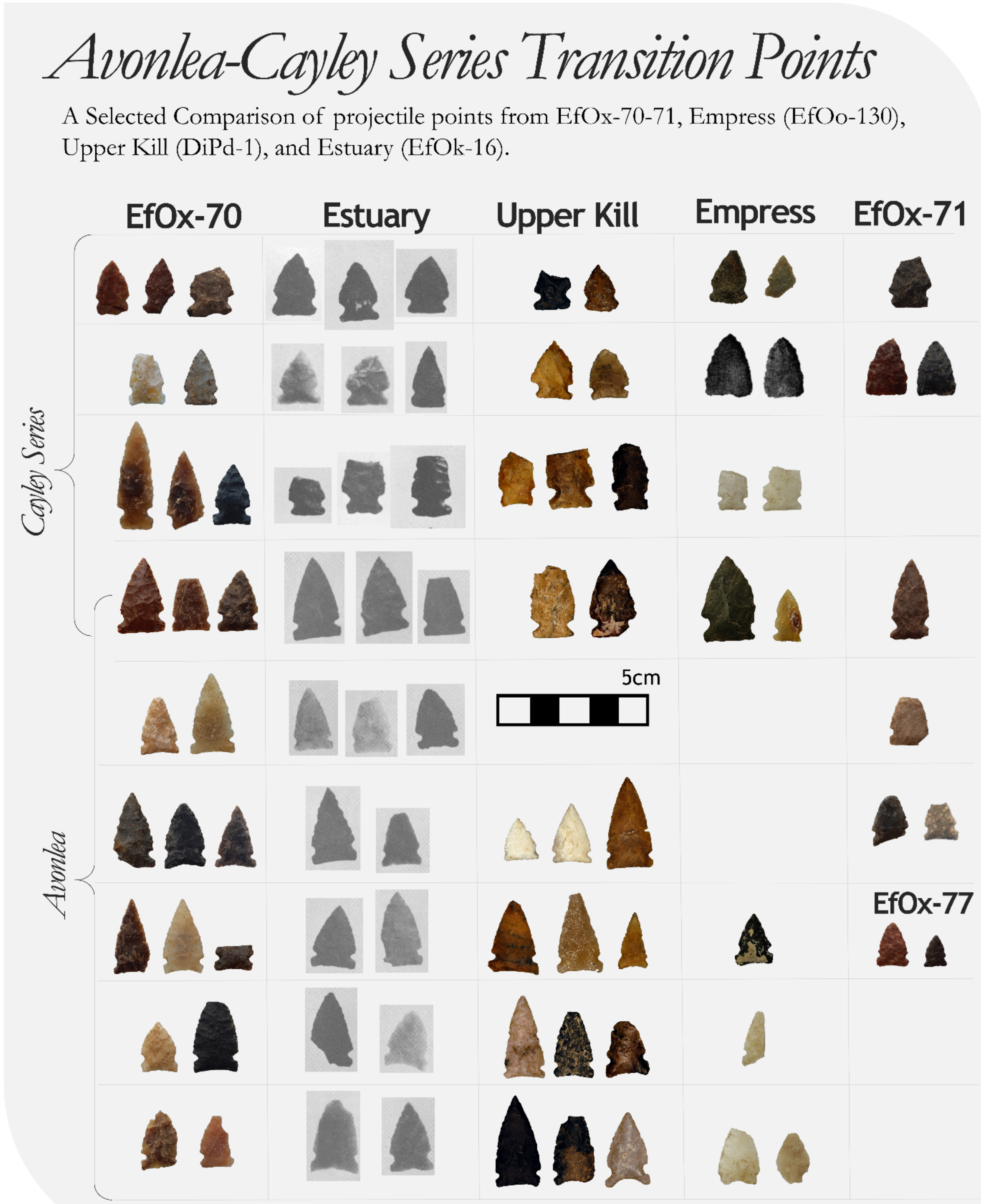


Figure 2.3 *Projectile Point Comparison between selected Avonlea to Cayley Series Transitional sites. Photos from Estuary found in Adams 1977. Photos from Upper Kill and Empress courtesy of Trevor R. Peck 2020.*

Chapter 3: Research Methods

3.1 EfOx-70 Excavation Summary

EfOx-70 is marked by a bone bed that, in some areas, is as thick as 70 centimeters. In the bone bed, excavated from Units 1-3 and the associated embankment exposure, we discovered multiple artifacts including projectile points (n=31), lithic choppers and flakes, disarticulated *B. bison* elements, and a few Canidae remains. The bone specimens that we uncovered in Units 1 through 3 were weighted toward mandibles, ribs, vertebrae, and lower limb bones such as metapodials and phalanges. Few articulated elements were present in the units. Aside from some loosely articulated metapodials and phalanges and occasional sets of two to three vertebrae, all skeletal elements were separated before being deposited in the area of units 1-3.

In the thickest portion of the bone bed (east side), we discovered two distinct layers of bone. The first (Levels 1-2, ~90-110 cmbs) was characterized by well preserved bone and few lithics. Beneath the initial bone layer, a thin lens of charred bone and charcoal separated it from the lower bone layer. The lower bone layer (Level 3 ~110-180 cmbs) contained highly degraded bone and more lithic artifacts than in Levels 1 and 2. The base of Unit 2, Level 3 contained a burn feature which included some calcined bone as well as reddened and charred sediment in a circular pattern.

EfOx-70: Unit 1 was the westernmost and Unit 2, the eastern unit of the original two units we placed into the bone bed (Figure 3.1). Unit 3 consisted of the embankment shelf acting as the northern wall of Units 1 and 2 which we excavated after Units 1 and 2 were completed. We used the southwest corner of each unit as a datum point for taking measurements, mapped artifacts and faunal remains by their position north, east, and the depth below surface, and measured with a string, line level, and total station. Individual levels were determined by changes in sediment color and consistency or in the quality of bone preservation. We removed the overburden layer of all units by shovel shaving and subsequent layers by careful troweling, brushing, and working around bone with wooden picks. Upon reaching the first level within Units 1-3, we screened the sediment through 1/8th inch mesh. Occasionally, we placed a 1x1meter grid over the units (as seen in Figure 3.4) and we photographed as well drew the excavation profile into unit maps. Originally, we used the total station to record every bone, but as the density of faunal remains increased, we resorted to taking four points over the grid every 10 centimeters and then photographing the grid. In Level 3 of all units, the bone was both mineralized and substantially decomposed often making it difficult to record and impossible to collect, as it completely disintegrated upon exposure and handling.

Figure 3.1 *Location of Excavation units at EfOx-70*

Overburden

The overburden layer extended from 0-103 centimeters below surface (cmbs) in Unit 1, 0-110 cmbs in Unit 2, and 0-103 cmbs in the westernmost portion to 110 cmbs in the easternmost of Unit 3. We collected 15 artifacts in the overburden layer: 12 ungulate bone fragments, two bison innominate fragments, and one quartzite flake. The bone fragments we recovered from this layer by screening, and the fragments of a left and right bison innominate we recovered in situ. The singular lithic found in this layer, a quartzite flake, was found in the screen. The sediment in this layer was silty, compact, and poorly sorted with pebbles throughout. Deposition of the overburden could have occurred due to slope wash from the declivity immediately to the south or by other forms of aggradation discussed further in Chapter 7. The overburden layer was characterized by three buried soils (the first at approximately 18 cm below surface, the second at ~85 cm below surface, and the third at ~100 cm below surface), as well as some calcareous deposits beginning in the lower portion of the unit, around 70 cm below surface. We noted many roots disturbing this level, as well as activity from ant burrowing.

3.2 Units 1-3, Level 1

We designated Level 1 (Figure 3.2) at 103-117 cmbs in Unit 1, 110 cmbs to 120 cmbs in Unit 2, and 103-117 cmbs at the western portion and 110-120 cmbs at the eastern portion of Unit 3. A slope of about 10 centimeters on the surface meant that the depth of each excavated level would show a difference of up to 10 cm in some places between Units 1 to 2 (Figure 3.3) and between the east and west portions of Unit 3. Level 1 of each unit was separated from the overburden by a final buried soil. The sediment that characterized Level 1 was sandy silt, medium brown in color, with some darker lenses and charcoal deposits. In Unit 1, Level 1, we collected 17 faunal specimens and chose to discard numerous bone fragments smaller than 1 x 1 cm due to the impracticality of their collection. No lithics or other cultural material were collected in situ or from the screen in Unit 1, Level 1.

In Unit 2, Level 1, we collected 61 bone specimens found in situ and one bag of fragmented bones retrieved from screening. In this level, the remains were relatively well-preserved, exhibiting some surficial root damage and surface discoloration from the sediment in the form of orange tints and black spots. All faunal remains were identified by the author, using the University of Alberta's zooarchaeology collection. These remains were identified as bison (*B. bison*) and were scattered predominantly in the northeastern quadrants of Units 1 and 2. In Unit 3, Level 1, we collected four bone specimens but noted a number of small fragments spread throughout the unit. A total of seven lithics: five flakes, one core, and one anvil were recovered from Unit 3, Level 1. This was the only unit to contain lithics at Level 1.

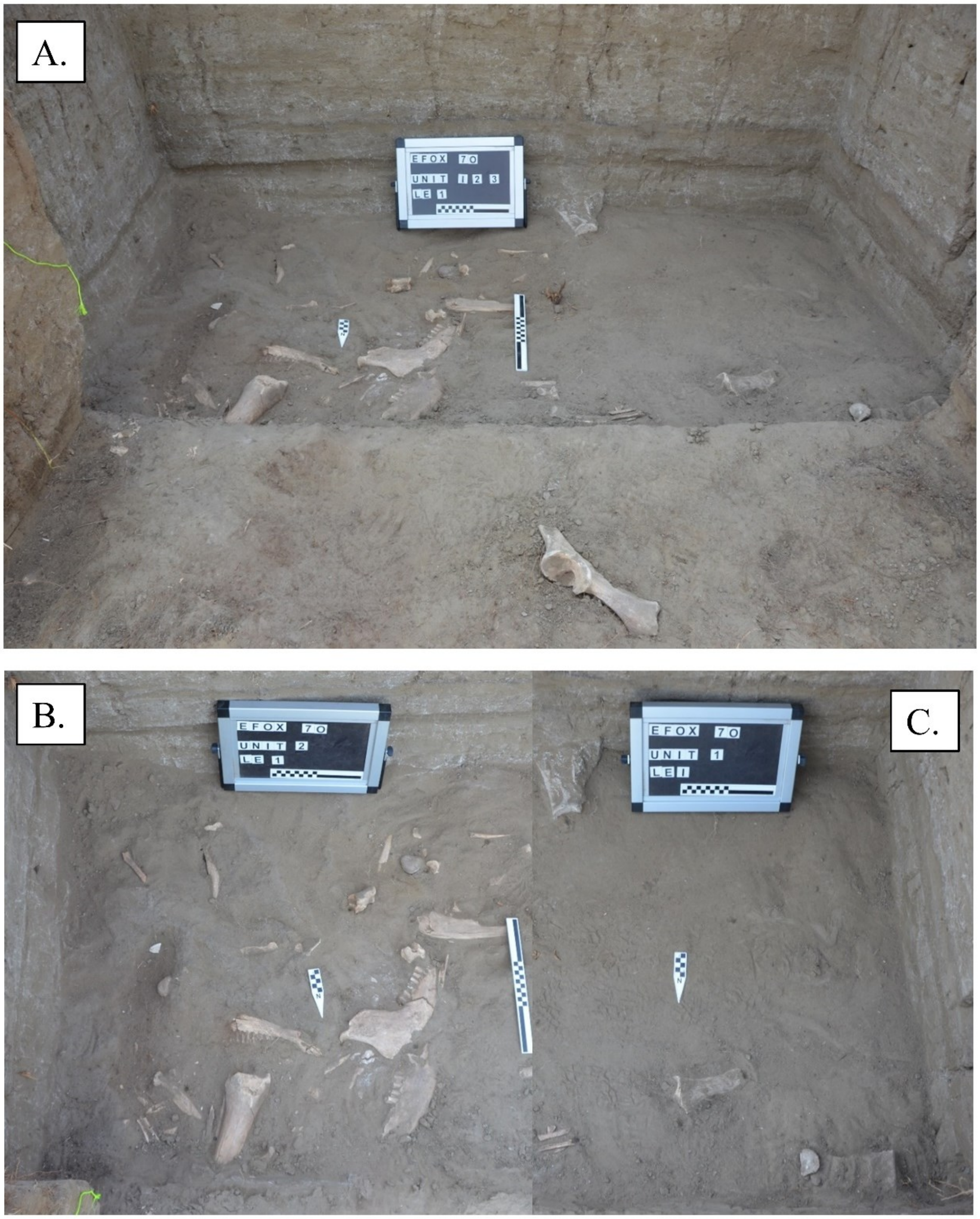


Figure 3.2 *EfOx-70: Units 1-3, Level 1.* ***(A)*** *Units 1-2, Level one (end), and Unit 3 Level 1 (beginning),* ***(B)*** *Unit 2, Level 1 with concentration of mandibles,* ***(C)*** *Unit 1, Level 1.*

Figure 3.3 *Southern wall of Units 1-2. Note the gradual slope to the east in the overburden that is not reflected in the cultural layer. Yellow lines represent 10 cm intervals.*

3.3 Units 1-3, Level 2

We discovered and collected faunal specimens throughout Level 2 in Units 1, 2, and 3. Unit 1, Level 2 was 117-131 centimeters below surface (Figure 3.4). Unit 2, Level 2 was from 120 cmbs to 130 cmbs, and Unit 3, Level 2 extended from 117-131 cmbs in the western portion and 102 to 130 cmbs in the eastern portion. We collected and recorded a total of 708 faunal specimens in Units 1-3, Level 2. Level 2 also contained one ceramic sherd each in Unit 1 and 2, and three in Unit 3. There were several reddish-brown spots in the sediment of this level likely caused by staining from root activity as they were most prominent around extant roots. Overall, the bone fragments in Level 2 were reasonably well preserved, but more fragmentary than those in Level 1.

***Figure 3.4** EfOx-70: Units 1-3, Level 2. **(A)** Unit 2, Level 2, **(B)** Unit 1, Level 2, **(C)** Unit 3, Level 2.*

3.4 Units 1-3, Level 3

The final level we excavated in Units 1-3 extended from 131-188 cmbs in Unit 1, 130-180 cmbs in Unit 2, and 130-185 cmbs in Unit 3. This level was characterized by fine brown silt with some black sediment lenses and grey ash deposits, containing highly fragmented and degraded bone (Figure 3.5). Although bone was more numerous in this layer, there was a dramatic shift in the quality of preservation. While the bone specimens from Levels 1 and 2 were better preserved, with fewer degraded specimens, the bones of Level 3 were extremely degraded and, in most cases, almost completely mineralized, making their collection and recording nearly impossible. We chose to collect only a few degraded samples from this layer for testing along with any bones that were relatively well preserved. The degraded bones were still mapped and captured in photographs. X-Ray diffraction was used to analyze the bones and demonstrated that the poorly preserved bones contained a significant amount of gypsum and other intrusive minerals as opposed to the well-preserved bones (Figure 3.6). Bone specimens and lithics, save for small flakes and points, were glittery in appearance and often crumbled to dust when held. Repeated seasonal flooding and related capillary action may explain both the mineral deposits and the heavy degradation of the bone (Kendall et al. 2018:31). Often, the only faunal specimens that were able to be retrieved were teeth, but even they were subject to degradation and would often fragment when handled. In the first few centimeters of Level 3, a high concentration of charcoal was found throughout the units as well as many instances of burned bone fragments.

Figure 3.5 *EfOx-70: Units 1-3, Level 3.* ***(A)*** *Unit 2, Level 3,* ***(B)*** *Unit 1, Level 3,* ***(C)*** *Unit 3, Level 3.*

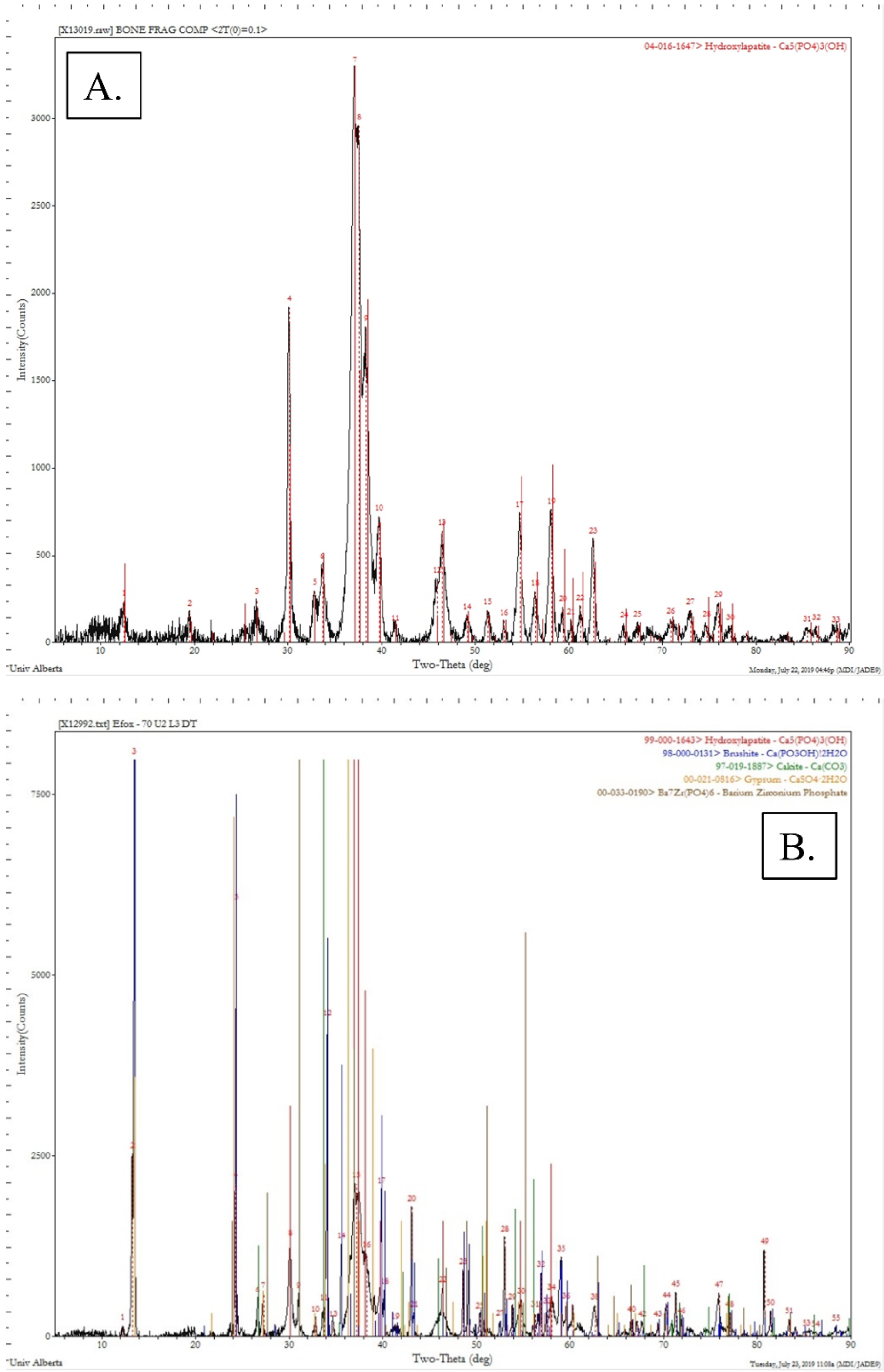


***Figure 3.6** Elemental composition of bone EfOx-70 **(A)** Sample from Level 2 showing peak of hydroxyapatite, **(B)** Sample from Level 3 showing peak in gypsum, brushite, and calcite.*

3.5 Burn Feature, Unit 2, Level 3

We discovered a burn feature at the base of Unit 2, Level 3. Little bone was found directly associated with this feature (Figure 3.7). The feature became evident as the faunal remains were beginning to dissipate in the level. Black staining covered the majority of the unit floor in a circular pattern, with white ash at the center. Below this feature a layer of orange-red sediment dissimilar to the colouration of the previous levels was also noted.

Figure 3.7 *EfOx-70, Unit 2, Base of Level 3. A burn feature characterized the culmination of cultural material in Unit 2. Signs of the burn feature were not found in Units 1 and 3.*

3.6 EfOx-71 Excavation Summary

We observed and excavated one distinct cultural layer in EfOx-71 Units 1-4 between 20 and 40 centimeters below surface. The materials we discovered at EfOx-71 exhibit food processing and secondary butchering activities, evidenced by the presence of hearths, pottery, point preforms, scrapers, lithic debitage related to the maintenance and production of tools, and fragmented long bones. We uncovered multiple bison long bone fragments and fewer axial elements as well as a few Canidae remains. We encountered a bone upright, consisting of two vertical proximal tibia and a distal radius within the hearth features as well as a scatter of broken ceramics. Eight out of ten shovel tests at this site were positive containing lithic debitage, stone choppers, hammerstones, scrapers and processed bone elements.

3.7 Excavation Results

At EfOx-71, we excavated a three-metre trench running west to east from the eroding east bank of Matzhiwin Creek. The trench was separated into three 1x1 meter units and ten shovel tests along with a fourth unit directly next to Shovel Test 7 were entered at the site (Figure 3.8). The presence of cultural material eroding from the bank and a visible hearth feature guided the decision to place units in this area. We chose the southwest corner of each unit as the datum point from which the northing, easting, and below surface provenience of any in situ cultural material or feature found was measured. Levels were determined based on changes in sediment colour and consistency and increases or decreases in cultural material. We screened all matrix through 1/8 inch wire mesh screens, with bone fragments larger than ~4 cm being bagged and recorded along with any lithics or cultural material. Due to the sheer number of bone fragments, we discarded small fragments when deemed insignificant to the understanding of the site; however, we still recorded the presence of these fragments in field notes and level records.

We used shovel shaving to remove the first layer of overburden and, upon reaching the cultural level, we used troweling and more detailed excavation methods such as brushing and using wooden picks to carefully excavate the faunal remains and stone artifacts.

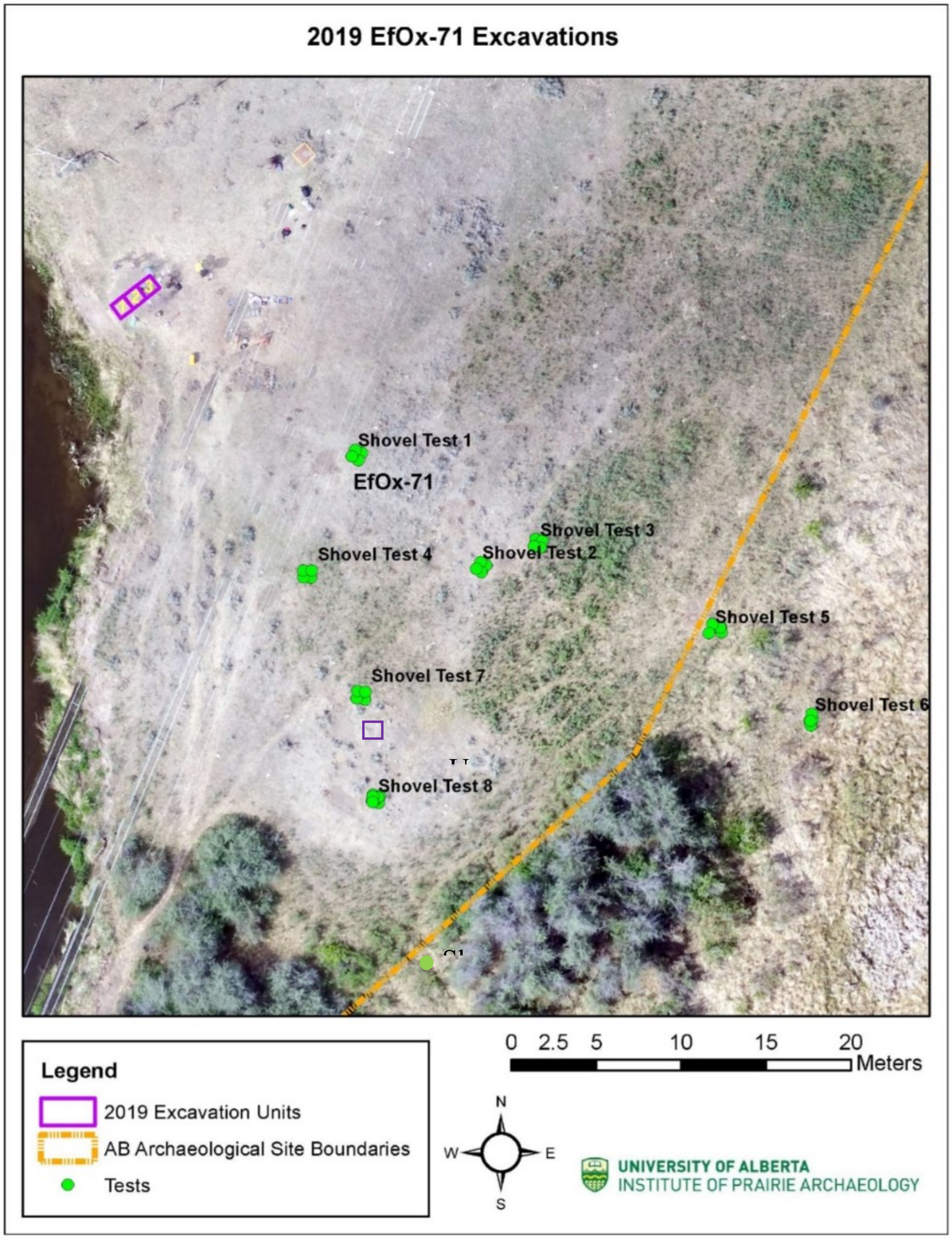


Figure 3.8 *Location of Excavation units at EfOx-71*

3.8 Results: Unit 1

We recovered a total of 404 artifacts (121 faunal, 282 lithic, 1 piece of pottery) throughout Unit 1 (Figure 3.9) and within the hearth feature(s) that covered the west half of the unit. Most of the artifacts were lithics found both in situ and in screening. The debitage around the hearth feature(s) in Unit 1 was largely composed of small retouch flakes. The faunal remains found in Unit 1 were primarily highly fragmented bison bones. We uncovered a number of fire cracked rocks (FCR) in the unit, photographed and drew them into unit maps but did not assign catalogue numbers as they are not accepted for collection at the Royal Alberta Museum.

Overburden

The overburden was composed mainly of topsoil in the form of hardened silty sediment, prairie grass root, and small pebbles. Extensive root action was present throughout this level, with sediment being softer and containing some charcoal deposits with an increase in depth. Level 1 began with the end of the overburden level at 22.6 cmbs, indicated by change in natural stratigraphy and the presence of larger bone specimens.

Level 1

We marked Level 1 by an increase in cultural material. Less root action was present within this level and sediment became softer and darker with depth. However, insect traces along with some charcoal deposits were scattered throughout. Bone fragments were heavily concentrated in the western portion of the unit; other cultural material was unsystematically dispersed. Some larger pieces of fire cracked rock were uncovered within the first few centimeters of the level along with one flake of a fine-grained silicified material. A well-preserved bison cervical vertebra was found in situ along with a subadult bison mandible.

Another cervical vertebra was found close by in a poor state of preservation, having been degraded to multiple fragments when we removed it from its position. Areas surrounding these bones had many small bone fragments likely fragmented from the larger bones. We marked the end of Level 1 at 39.7 cmbs as it was followed by a significant increase in cultural material, marking the beginning of Level 2.

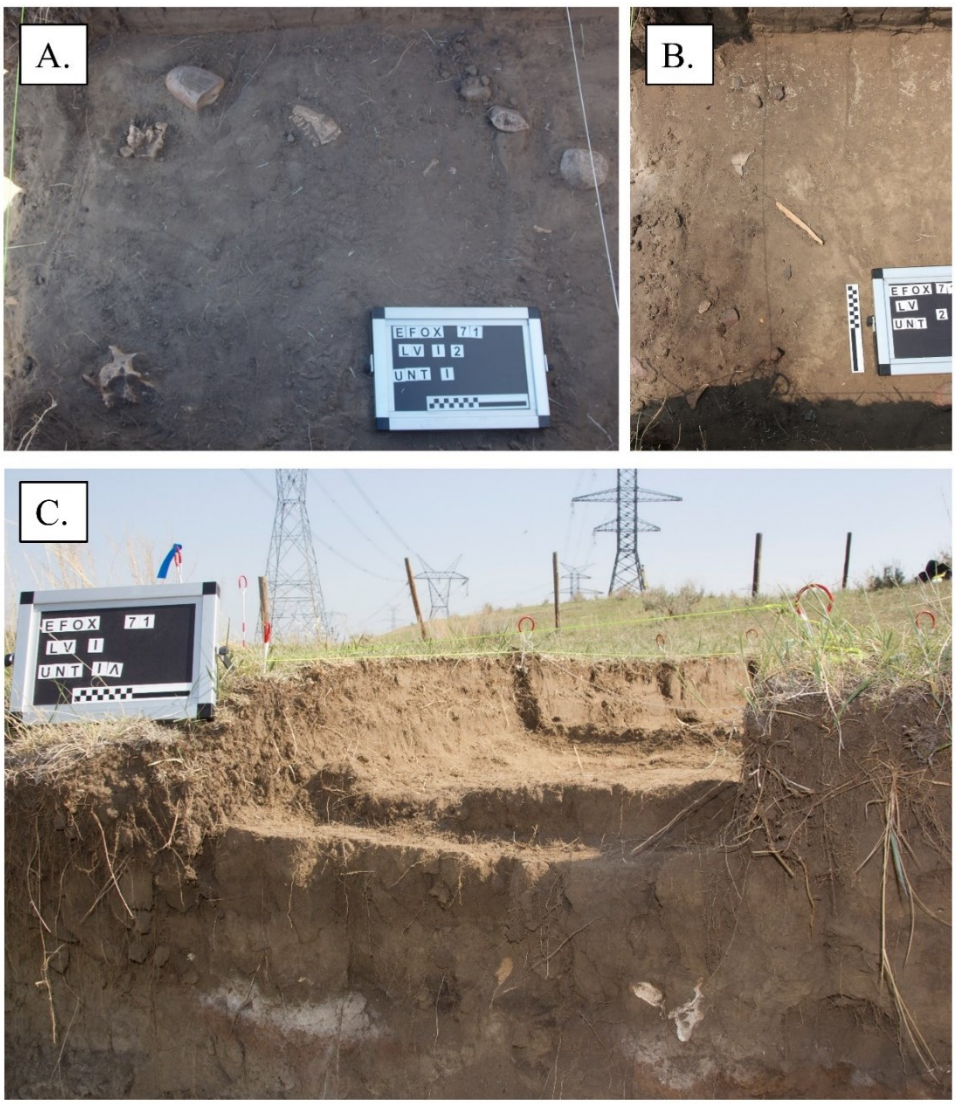


Figure 3.9 *Unit 1.* ***(A)*** *Unit 1, Level 2,* ***(B)*** *Modified rib fragment,* ***(C)*** *Unit 1, Level 1 showing visible hearth feature(s) in the embankment.*

Level 2

We noted a considerable increase in cultural material and artifacts in Level 2 (Figure 3.9 A) and collected a total of 65 lithic artifacts including flakes comprised of heat-treated silicified wood, chert, mudstone, pebble chert, and Swan River chert. Faunal material we recovered at this level included fragmented bison ribs, tibia fragments, a scapula, mandible and one Canidae tooth. The faunal remains were scattered throughout the unit while stone artifacts were concentrated in small groups both in the center of the unit and in the northeast quadrant. The outline of a hearth feature (Figure 3.9 C) was identified by sediment changes along the west side of the unit with the beginning of its boundary marking the end of Level 2 at 41.8 cm below surface.

Level 3

Level 3 contained a considerable amount of lithics, bone, and fire cracked rock with a concentration of artifacts around the hearth area on the west side of the unit (Figure 3.9 A and B). Sediment at this level was sandier and softer in comparison to the previous two levels and was impacted in areas by root, insect, and rodent activity. We noted black as well as oxidized sediments surrounding the hearth area(s). This level contained the highest concentration of lithics, comprising 73 percent of those in Unit 1.

3.9 Hearth Features

We designated two hearth features while excavating, but it is more likely that both were lobes of one hearth. The first we excavated was located in the southwestern quadrant of the unit (Figure 3.10 D). Measuring 63 cm x 31 cm and with a depth of 49 – 58 cm, this feature showed clear signs of a burn including ash and black deposits as well as red staining caused by heat induced iron oxidization. We uncovered artifacts from the hearth including flakes as well as fire cracked rock. Three different sediment samples were taken from this feature. A krotovina and some erosion onto the embankment prevented the definitive marking of the extent of the hearth. The burn feature extended south further into the embankment.

The second hearth feature (Figure 3.10 C), located in the northwestern quadrant of the unit, measured 53 cm x 39 cm and with a depth of 47 – 63 cmbs. This hearth was less affected by erosion than Hearth 1 and extended deeper vertically into Unit 1. This feature was also impacted by a krotovina, displacing some of the artifacts from their original positions. This hearth contained a concentration of fire cracked rock and debitage. The burn that occurred was well defined by its basin shape, sediment changes around the edge, and ash.

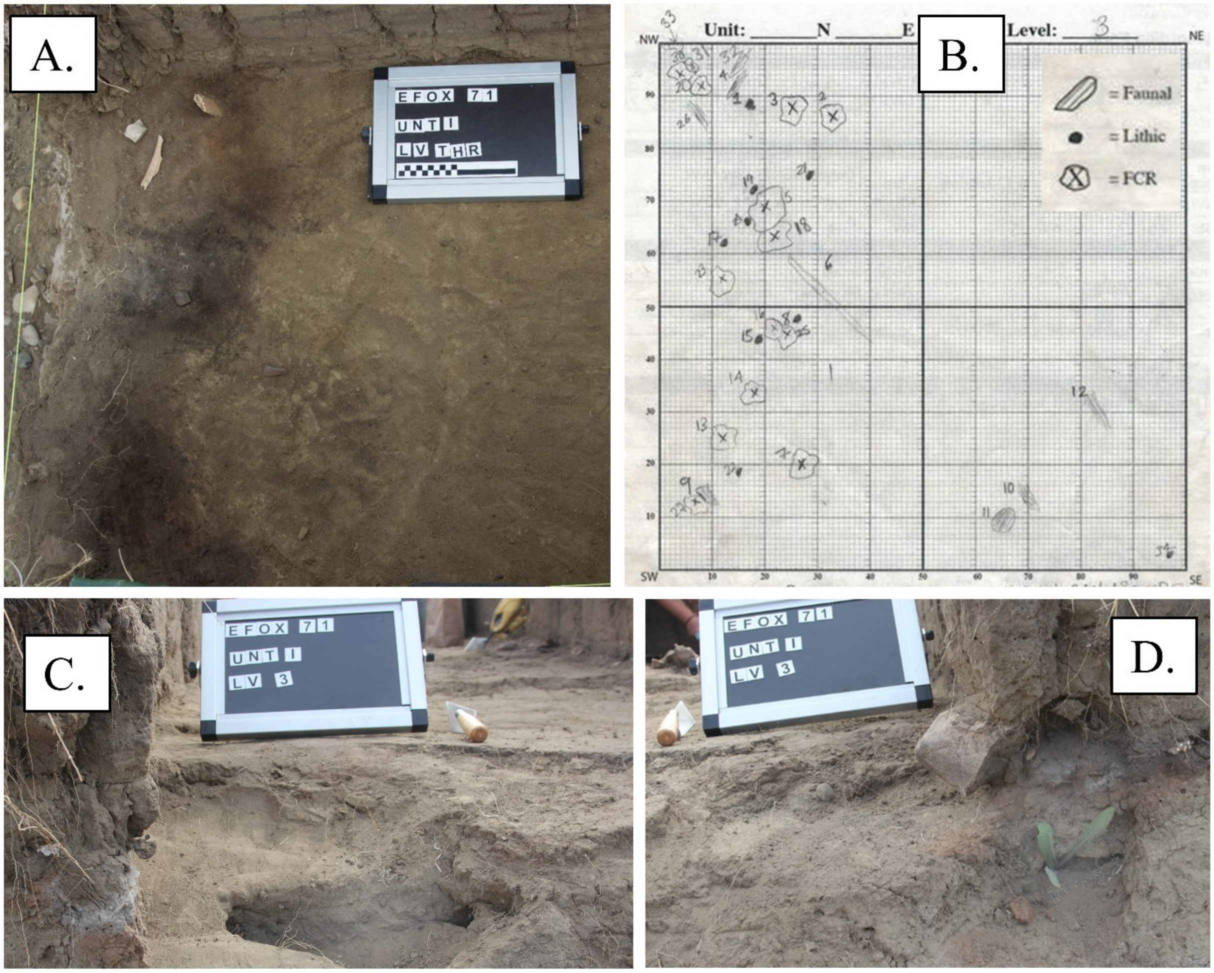


Figure 3.10 *Unit 1, Level 3 Hearth Features.* ***(A)*** *Soil staining from hearth features 1 and 2,* ***(B)*** *Concentration of fire cracked rock in west side of unit within hearth features,* ***(C)*** *Profile of Hearth Feature 1,* ***(D)*** *Profile of Hearth Feature 2. Hearth Features 1 and 2 may be two lobes of the same feature.*

3.10 Results: Unit 2

We collected a total of 705 artifacts in Unit 2 at EfOx-71 including 270 faunal specimens, 360 lithic artifacts, 69 ceramic sherds, 1 shell, and 4 seeds. Twenty-one fire cracked rocks (FCR) were also encountered but not catalogued. We designated an area with a concentrated number of ceramic sherds as Feature 3 and an area with a high concentration of ash, artifacts, and four upright bones as Feature 4. Lithic artifacts that we recovered in this unit included four scrapers, an Avonlea projectile point, and two Plains triangular preforms.

Overburden

The overburden of Unit 2 extended from 0-19 cm below surface. The sediment we encountered in this layer was silty and a grey-brown colour, well sorted with small pebbles and roots met by a buried soil at approximately 18-19 cm below surface. The northwest quadrant of the overburden was cut diagonally from the western to the northern wall by a krotovina at 24 cm below surface. Termination of the overburden layer and the beginning of Level 1 was marked by a buried soil with presence of faunal remains.

Level 1

Level 1 was established after we encountered a buried soil marked by artifacts beginning at 19 cmbs. The sediment of Level 1 was light tan in colour, well sorted, and comprised mostly of silt with charcoal and calcined bone inclusions. We encountered a krotovina in the northeast and southeast quadrants of Level 1. Materials we recovered were one fire cracked rock (FCR), 38 lithics, and three faunal specimens. The lithics found in Level 1 were primarily flakes of pebble chert, quartzite, and heat-treated silicified wood. Two lithic tools in this level were endscrapers. We saw no obvious pattern in the distribution of artifacts in Level 1 aside from EfOx-71:861, 868, and 869 which were located within a 20 cm range and were all composed of silicified wood, possibly indicating shared origin.

Level 2

We established Level 2 (Figure 3.11 A) by further changes in sediment and increased artifact density, most notably the appearance of ceramics, beginning at 38 cm below surface. The sediment we encountered in Level 2 was a mix of sand and silt (favouring sand) coloured light yellow-brown. Disturbances to Level 2 were a continuation of the krotovina we encountered in the northeast and southeast quadrants of Level 1, with a path extending to the northwest quadrant. Materials excavated from Level 2 totalled 257 faunal remains, one shell, four seeds, 69 pieces of pottery, and 283 lithics. Lithics included flakes, tools, and projectile points from materials including pebble chert, quartzite, silicified wood, Swan River chert, Knife River flint, and Montana chert. Faunal remains in Level 2 were *B. bison*, with the exception of two specimens that possibly represent a *Canidae* species. The seeds found are similar to *Elaeagnus commutate* (silverberry or wolfwillow), a common plant species in the area. Of all excavations from the 2011-2019 field seasons, EfOx-71, Unit 2, Level 2 revealed the highest concentration of ceramics. There were 69 pieces found at this level, tightly clustered. We gave the ceramic concentration the designation of Feature 3; it was closely associated with Feature 4 (Figure 3.11 B).

Level 3

We established Level 3 at a change in sediment and a decrease in cultural material. Beginning at 47.5 cm below surface, the sediment was sandy with a light tan colour, well sorted, without inclusions or disturbances. Excavation was initially performed via trowelling, then to shovel-shaving in 1 cm intervals to the border of Feature 4, which was still being excavated at the time. We determined the termination of Level 3 when the depth reached the same level as

Unit 1 and we observed no further cultural material. Artifacts in Level 3 were sparse and found via screening, including small bone fragments and lithics.

Figure 3.11 *Unit 2.* ***(A)*** *Concentration of artifacts beginning of Level 2,* ***(B)*** *Feature 4.*

3.11 Feature 3, Pottery Spread

Feature 3 (Figure 3.12) was concentrated in the southern quadrants of Level 2. The ceramics were shattered, with a total of 37 pieces. Thirty-two of the pieces were stable enough to be removed from the level and bagged, while a few (EfOx-71:989, 1230, 1227, 1158) were too fragmented to recover whole. Many of the ceramic sherds have delaminated. All display charring on the interior and some on the exterior. The thickness of the sherds varies between 0.4-1.2 cm and the colour varies from gray to brown and tan. Decoration on the vessels is sparse with two sherds with punctate marks and some with faint grooves on the surface. Out of all of the excavations at the EfOx sites, this feature contained the most ceramics found. We found enough sherds in this feature to merit some work on refitting the pieces in order to discover the shape of the vessel(s).

Figure 3.12 *Feature 3: Pottery Spread.* ***(A)*** *Excavating Feature 3,* ***(B)*** *A close up of Feature 3 (Arrows pointing to ceramics and Feature 4).*

3.12 Feature 4, Bone Upright

We uncovered a bone upright feature (Figure 3.13) in the northeast quadrant that crossed the border between Units 2 and 3. Feature 4 comprised a 55 x 47 cm area of ash, dark and oxidized sediment extending from 37 - 44 cm below surface. Within the feature, we recovered four upright bones, several flakes, a bison scapula, long bone, rib, and cranial fragments as well as a canid innominate (Figure 3.13 C and E). The structure of the bone upright was that of two proximal portions of a left and right tibia and the distal portion of a fused right radius and ulna, all belonging to *B. bison*. Of the 801 artifacts we recovered in Level 2, 117 were recovered from Feature 4. Upon discovering the feature, we mapped its extent, outlined it and then excavated the rest of the unit.

3.13 Results: Unit 3

We measured the Overburden level of Unit 3 from 0- 20.5 cm at its deepest point. The sediment was well sorted, silty and medium brown in colour. The overburden level was unremarkable, similar in composition to Units 1-2, containing insect activity, rootlets, and small bone fragments.

Level 1

Level 1 (Figure 3.14) began at 20.5 cm below surface after a sediment colour and consistency change. This level extended to 39 cm below surface and we recovered 153 artifacts therein. These finds consisted of 122 bison and unidentifiable mammal bone and tooth fragments, some of which were calcined, the shaft of a left bison femur, a bison mandible and radius-ulna in fragments, five quartzite fire broken rocks (not collected), twenty four flakes of materials including quartz, quartzite, silicified wood, mudstone, and Knife River flint and two point preform fragments made from silicified wood (EfOx-71:848 and 849). We noted the sediment of Level 1 to be silty and medium brown in colour with the occasional presence of rootlets. The pebbles in this level were poorly sorted ranging from 1 cm to 6 cm in size.

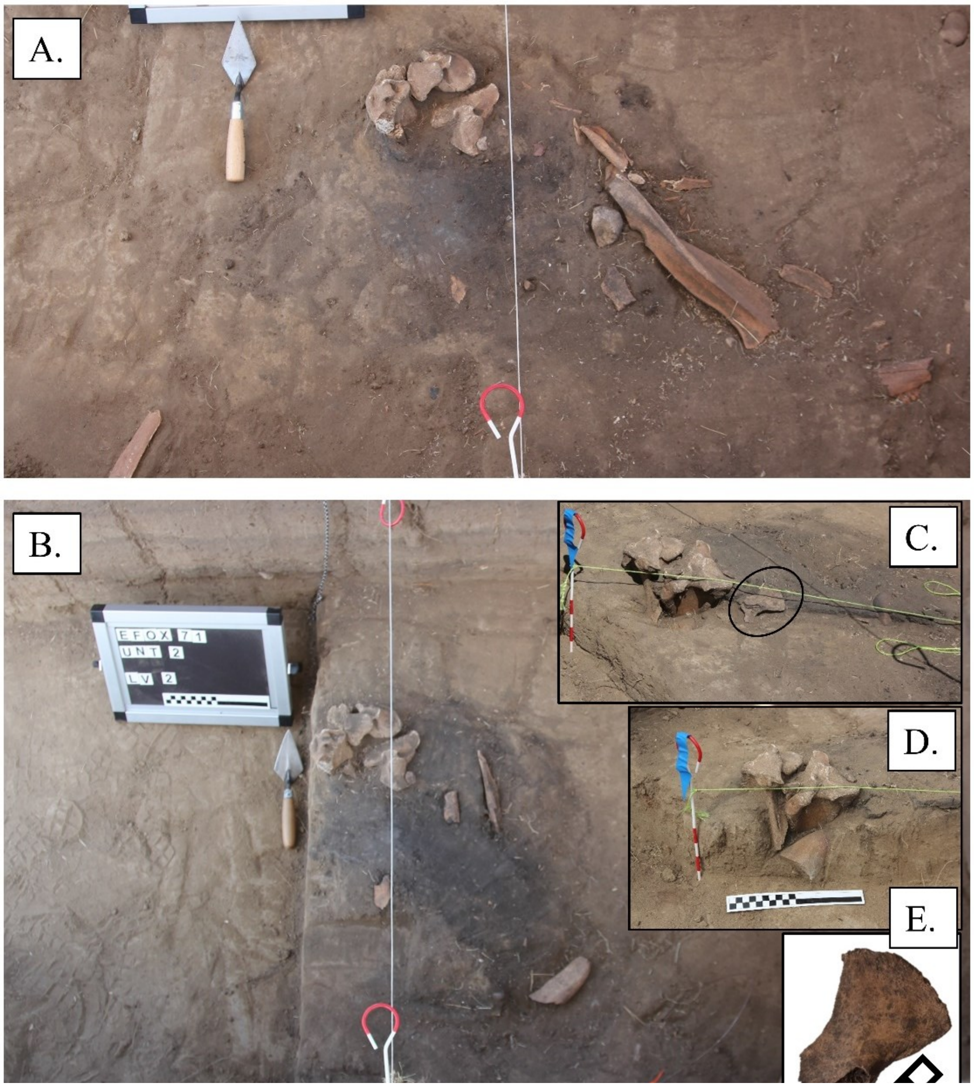


Figure 3.13 *Feature 4: Bone Upright.* ***(A)*** *The extent of Feature 4,* ***(B)*** *Soil stain emanating from the feature,* ***(C)*** *A close up of Feature 4 showing the upright bison long bones and the canid innominate (circled),* ***(D)*** *Proximal tibias and fire broken rock, (E) Canid innominate.*

Level 2

In Level 2 (39- 53 cm below surface Figure 3.14 B) we recovered 801 artifacts including 323 faunal remains, 476 lithics, and two seeds. Gradually, as we trowelled through this level, we noted darker sediment including flecks of black charcoal and lenses of dark grey. There were concentrations of stone flakes in the northwest corner and a projectile point tip (EfOx-71:1224) of a fine-grained silicified sedimentary material was recovered from this area of the unit. Other tools that we recovered throughout the unit included a projectile point preform or knife (EfOx-71:1223) and a point preform of a heat-treated microquartzite (EfOx-71:1246). We uncovered multiple pieces of FCR in this level but not within any specific feature or pattern. Two notable artifacts included the distal portion of an endscraper (EfOx-71:1220) made of Knife River flint and a scraper made from a cortical flake of Montana chert.

Level 3

Level 3 extended from 47- 60 cm below surface. We noted the sediment as compact, well-sorted, lightly coloured silt. We uncovered 76 artifacts including 52 faunal remains and 24 lithics. The level was characterized by the outlines of a hearth or potentially a continuation of Feature 4 as it lay directly south of the feature. We determined the level end at 60 cm below surface. One projectile point preform (EfOx-71:1255) made of a silicified sedimentary material was found in the screen on the cusp between Level 2 and 3. Twenty-two flakes were found in the screen including Swan River chert, quartzite, and silicified wood.

Figure 3.14 *Unit 3* ***(A)*** *Level 1,* ***(B)*** *Level 2,* ***(C)*** *Concentration of artifacts in Level 2.*

3.14 Results: Unit 4

Unit 4 (Figure 3.15) was excavated directly south of Shovel Test 7. We decided to place a unit here because of the high concentration of lithic material uncovered in shovel tests 7 and 8. We collected 74 faunal remains and 135 lithic artifacts. Ten fire cracked rocks (FCR) were also encountered but not collected. The overburden layer of Unit 4 extended from 0-20 cm below surface. The sediment we encountered here was silty of a light-medium brown colour, well sorted with small pebbles and rootlets. The eastern half of the unit was cut through the center by a krotovina as the overburden came to an end.

Level 1

Level 1 (Figure 3.15 C) was established after we encountered a buried soil marked by cultural artifacts beginning at 20 cm below surface. The sediments of Level 1 were comprised mostly of silt and were a light brown colour, well sorted with charcoal and bone fragment inclusions. The krotovina that we encountered at the end of the overburden level remained throughout level one and contained bone and stone flakes. We recovered seven fire cracked rocks (FCR), 17 lithics, and 52 faunal bone fragments from this level. The lithics found in Level 1 were comprised of flakes made from materials including pebble chert, quartzite, heat-treated silicified wood, and Swan River chert. Two of these lithics were scrapers, an endscraper made of a silicified sedimentary material and a broken bifacially worked knife blade made of silicified wood. Faunal remains we uncovered in Level 1 were unremarkable and highly fragmented save for a *B. bison* distal tibia portion that exhibits a spiral fracture along the diaphysis.

Level 2

We established a separation to Level 2 (Figure 3.15 D) as a level change was needed to organize the density of artifacts. The sediment colour and composition remained relatively the same although we noted flakes of charcoal continually becoming more present. Disturbances to Level 2 were a continuation of the rodent trackway encountered in the northeastern and southeastern quadrants of Level 1. Items collected from Level 2 totalled nine FCR, 22 faunal remains and 118 lithic artifacts. Lithics included flakes of quartzite and small retouch debitage of fine-grained materials. Tools included a core fragment and an endscraper made of a pebble chert. The end of Level 2 we designated by the absence of cultural material and an abrupt change in sediment to sand characterized by flakes of charcoal. The charcoal was flakey and resembled the charcoal lens which can be seen along the banks of Matzhiwin Creek.

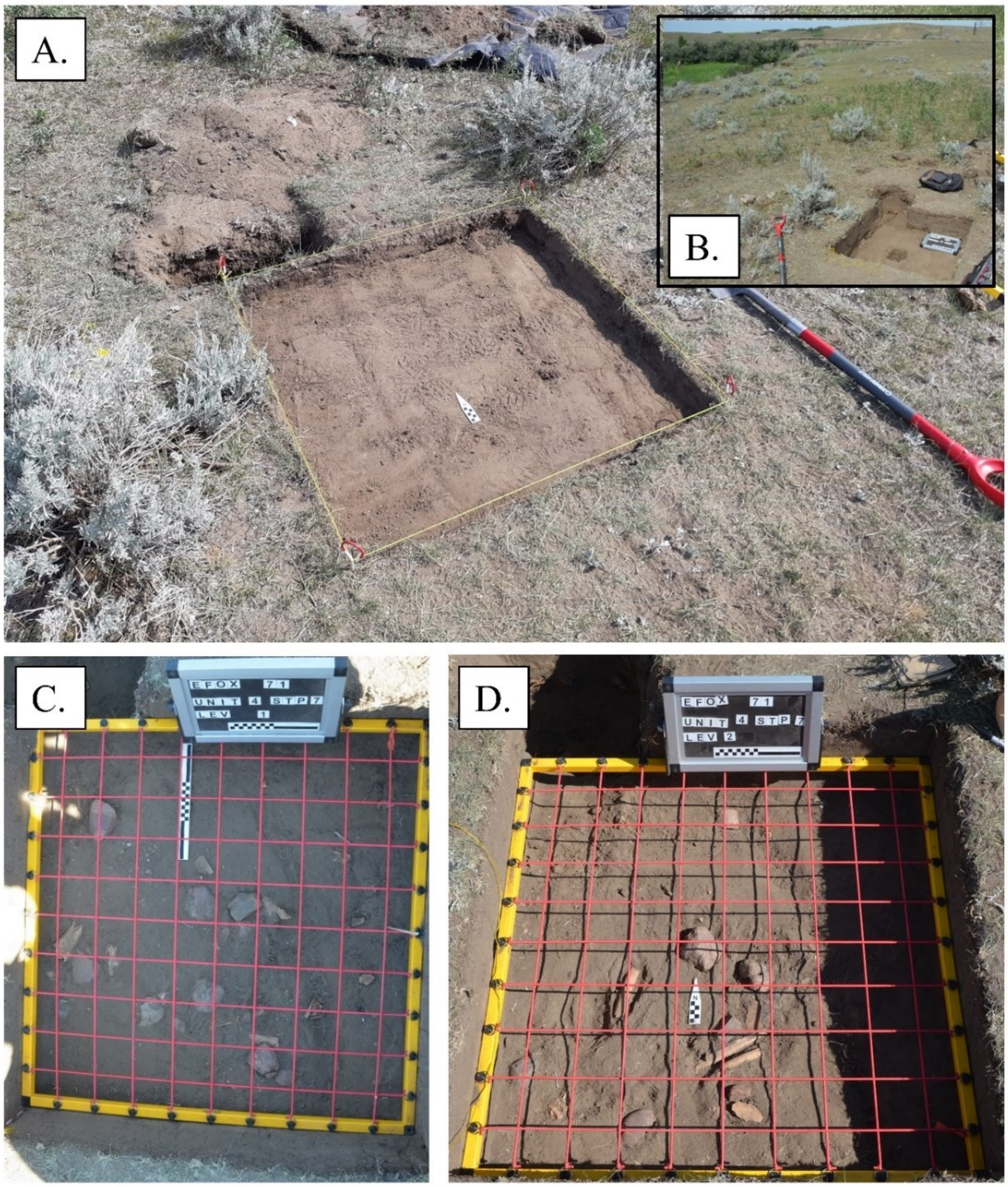


Figure 3.15 *Unit 4* ***(A)*** *Beginning of Level 1,* ***(B)*** *Position of Unit 4 at EfOx-71,* ***(C)*** *Level 1 artifact concentration,* ***(D)*** *Level 2 artifact concentration.*

3.15 Shovel Testing Summary

Along with the four units excavated at EfOx-71, we made a total of ten shovel tests within the site limits. These were set up in order to determine site extent. We began the shovel tests approximately 20 meters southeast of Unit 3 and followed a southeasterly direction (Figure 3.16). All shovel tests, save six and nine, were positive and demonstrated continued cultural activity to the southern and eastern borders of EfOx-71. All cultural materials found within the shovel tests were found at depths from 19-48 cmbs. As the shovel tests drew closer to the southern and eastern portion of the site and towards the marsh, we noted that the quantity of cultural material diminished or was absent as shovel test six was the easternmost and shovel test nine was the southernmost.

The shovel testing program began with shovel test 1, approximately 20 meters southeast of EfOx-71: Unit 3 (Figure 3.16). We then entered tests in a linear fashion to the east and south of Shovel Test 1. In Shovel Test 1, at 31 cm below surface we began encountering cultural material which extended to 36.5 cmbs. Artifacts included two quartzite flakes and a hammerstone, and three articulated *B. bison* thoracic vertebrae along with somewhat articulated ribs and a fragmented tibia were also recovered (Figure 3.16 B).

Shovel test 2 was also positive for cultural material though not as rich as Shovel Test 1. In shovel test 2, we encountered two quartzite flakes and a total of 26 bison bone fragments. In shovel test 3, we collected six flakes, one of Swan River chert and the others of quartzite, three freshwater clam shell fragments, and 122 bison bone fragments. Shovel test 4 contained 38 bison bones and fragments and one flake of quartzite. In shovel test 5, we collected 40 bones and fragments including a relatively complete bison scapula and 4 flakes of quartzite. Shovel test 6 was sterile for cultural material. Shovel tests 7 and 8 were placed within 5 meters from each other and contained numerous flakes and other cultural material. In shovel test 7 (Figure 3.17), we recovered 53 bison bones and fragments and three flakes of quartzite, ten flakes of silicified sedimentary stone, seven flakes of silicified wood, and a silicified wood scraper. Shovel test 8 contained 128 bison bone fragments, three quartzite flakes, six quartz flakes, one quartzite chopper tool, 40 flakes of assorted fine-grained siliceous materials, all between 21 and 26 cmbs. As we removed the topsoil from Shovel Test 8, we discovered a historic nail at a depth of 2 cmbs. Shovel test 9 was the southernmost test that we entered. It was sterile and quickly became inundated with water as we were at the edge of the marsh that acts as the southern border of EfOx-71. Shovel test 10 (Figure 3.18) was deliberately placed on the bank of Matzhiwin Creek about 20 meters west of Shovel Test 7. We chose to test here because of a number of *Canidae* remains that were eroding onto the embankment. This shovel test was carefully excavated by trowel rather than shovel in order to preserve the provenience of any further *Canidae* elements that could be discovered. We uncovered an atlas in situ and a broken mandible and axis were found eroded on the embankment.

Figure 3.16 *Shovel Tests* ***(A)*** *Orientation of Shovel Test 1 at EfOx-71* ***(B)*** *Tibia and thoracic vertebrae in Shovel Test 1.*

Figure 3.17 *Shovel Tests* ***(A)*** *Shovel test 7,* ***(B)*** *Metacarpal and molars in shovel test 7.*

Figure 3.18 *Shovel Test 10 was entered into the embankment of Matzhiwin Creek, about 20 meters south of EfOX-71: Unit 1. This pit was carefully excavated because canid elements were eroding from the embankment.*

Chapter 4: Data Presentation

EfOx-70 and 71 represent distinctly different activity areas. EfOx-70 is a bonebed containing disarticulated bone elements, projectile points, and chopping and butchering tools. EfOx-71 contains secondarily processed bones, other tool types such as scrapers, and ceramic sherds that are associated with hearth activities. I found a distinct distribution of tool types and their raw materials between EfOx-70 and 71 that directly correlated with butchered bone elements between the two sites. In this chapter I synthesize the data on the lithics and associated raw materials, ceramics, and faunal remains found at the sites (Table 4.1 and 4.2)

Table 4.1 EfOx-70

EfOx-70 Materials Recovered	**Total**		**Total**
Faunal Remains	935	**Fish Scales**	2
Ceramic Sherds	20	**Stone Cores**	8
Seeds	15	**Flakes**	199
Projectile points	31	**Lithic tools**	14
Hammerstone	2	**Ground Stone**	1
Pecked Stone	1	**FCR**	10

Table 4.2 EfOx-71

EfOx-71 Materials Recovered	**Total**		**Total**
Faunal Remains	1,579	Shell	4
Pottery Fragments	70	Stone Cores	6
Seeds	4	Flakes	1,357
Projectile points and Preforms	15	Lithic tools	19
Hammerstone	9	Ground Stone	1
Fire Cracked Rock	50		

4.1 Lithic Tools: EfOx-70

We collected 248 lithic artifacts in Units 1-3 and along the embankment surface of EfOx-70. Flakes were the most dominant, comprising 80 percent of the lithic assemblage. Of the tools at EfOx-70, projectile points were the most common, accounting for 12.5 percent of the lithic assemblage. Other tools consisted of choppers (Figure 4.1), hammerstones, cutting tools, and a ground and pecked stone (Figure 4.2). While the chopping and cutting tools suggest primary butchering activities, the ground and pecked stones are ambiguous in function. The ground stone (Figure 4.2 A) is relatively unremarkable aside from one edge that has been ground flat. The pecked stone (Figure 4.2 D) has been intentionally pecked in the center and has grooved striations drawing away from the center. The tools that we recovered at EfOx-70 were associated with multiple retouch flakes of higher quality raw materials throughout the units suggesting that the occupants had other butchering tools onsite and were sharpening them as they worked.

Table 4.3 EfOx-70 Lithics

EfOx-70	Quartzite	Silicified Wood	Knife River Flint	Swan River Chert	Montana Chert	Silicified Sedimentary	Chert / Chalcedony	Total	%
Core	8							8	3.2
Hammerstone	2							2	0.8
Projectile Point	4	5	4	3	2		13	31	12.5
Abrader	1							1	0.4
Flake	87	2	7	15	10		78	199	80.2
Ground Stone	1							1	0.4
Split Pebble							1	1	0.4
Anvil	2							2	0.8
Knife		1						1	0.4
Pecked Stone	1							1	0.4
Preform						1		1	0.4

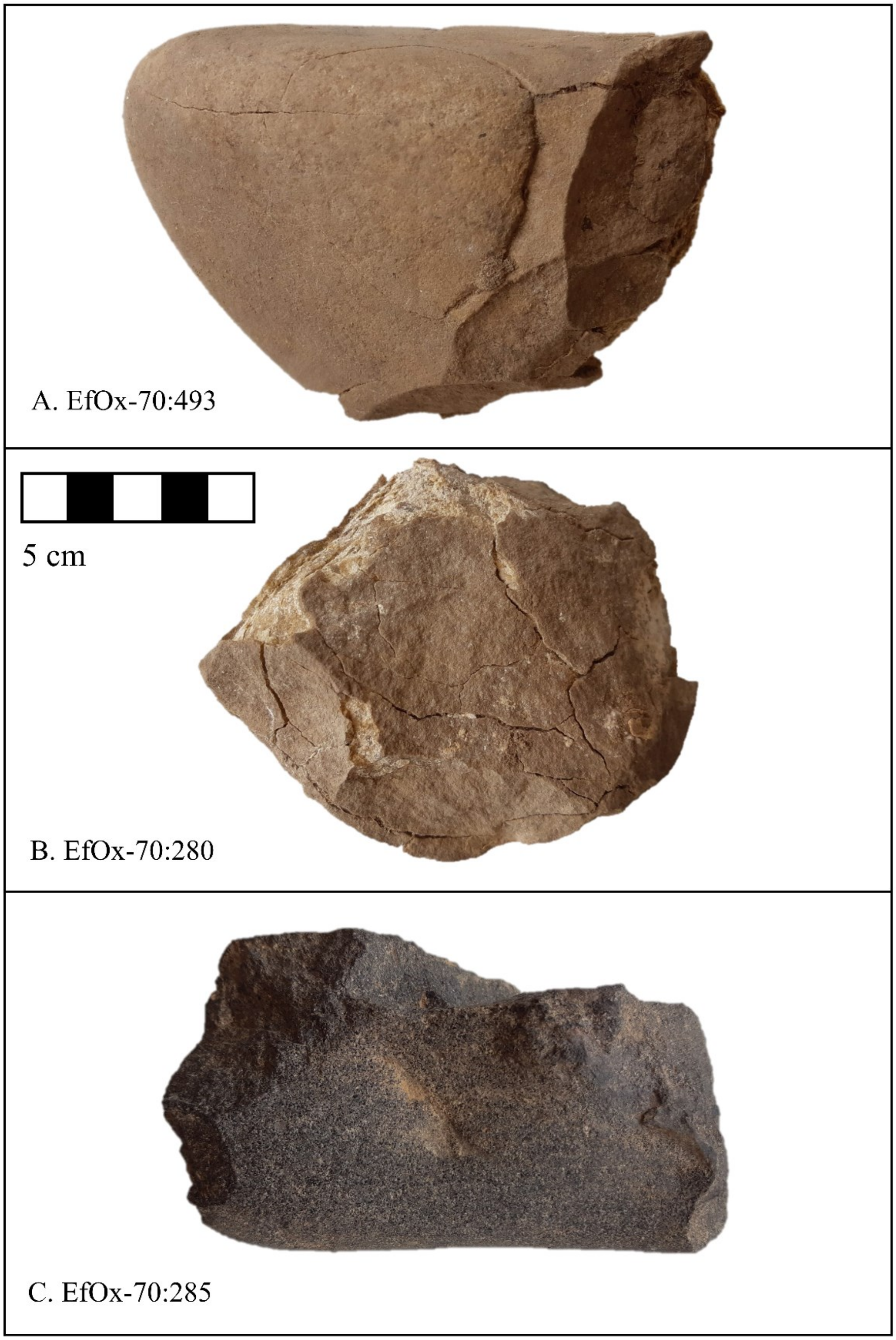


Figure 4.1 *Choppers.* ***(A)*** *quartzite chopper,* ***(B)*** *taphonomic degradation on quartzite chopper,* ***(C)*** *metamorphic stone chopper.*

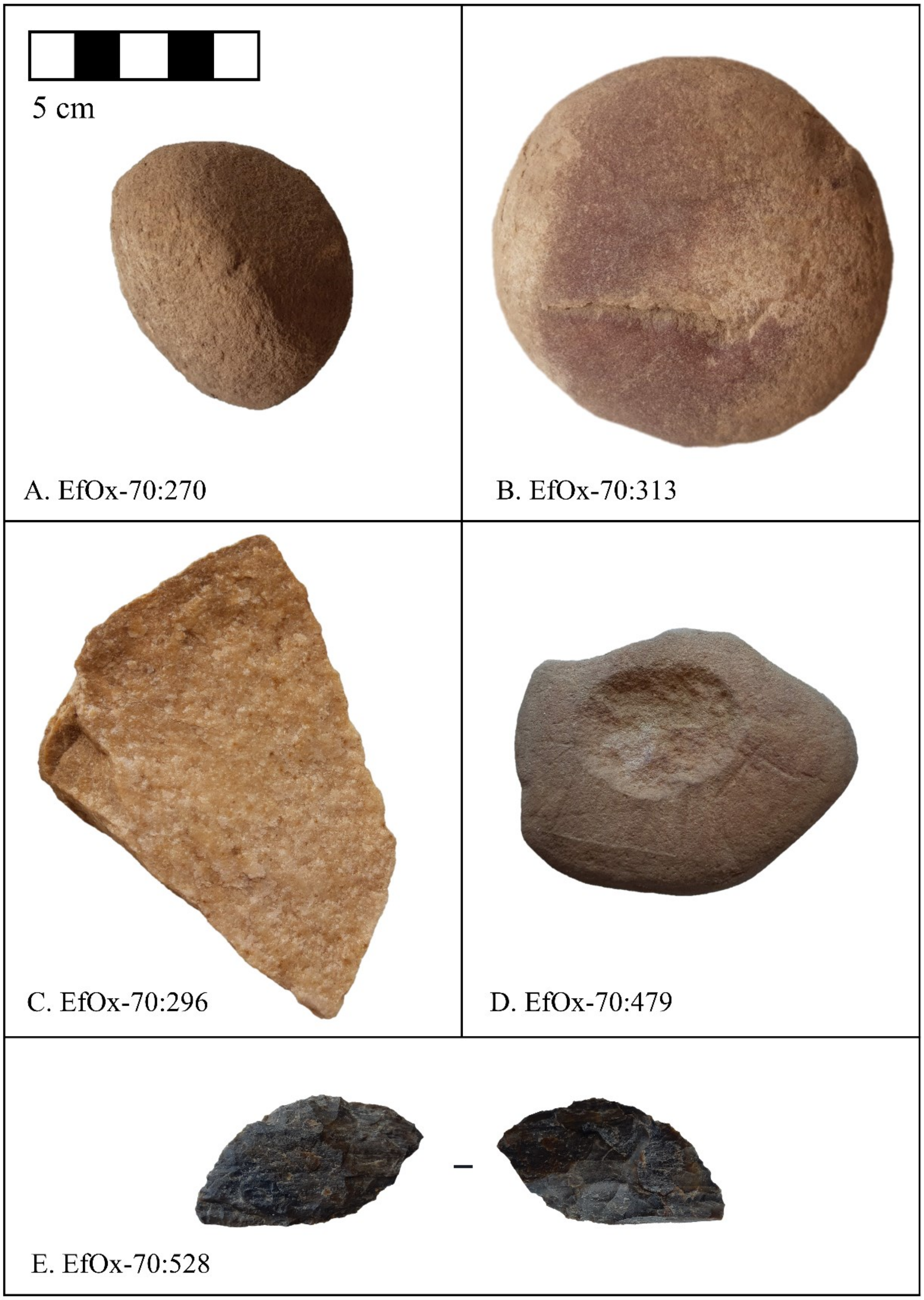


Figure 4.2 *Other tools.* ***(A)*** *quartzite ground stone,* ***(B)*** *hammerstone,* ***(C)*** *retouched quartzite flake,* ***(D)*** *pecked and grooved stone,* ***(E)*** *bifacial knife.*

4.2 Projectile Points and Preforms: EfOx-70 and 71

As in Figures 4.3 and 4.4, all of the projectile points at EfOx-70 (31) were formed whereas 11 of the 15 at EfOx-71 were preforms, marking a distinct difference between the two sites.

In relation to morphology, all projectile points at EfOx-70 were finished forms, some complete, and some broken from impact during the kill event. Morphologies of all of the points fall within Avonlea or Old Women's typologies with some in-between showing transitional characteristics (Figure 4.3 and 4.4). The stratigraphic relationship of the points at EfOx-70 reveals a trend in the morphology of the projectile points and is discussed further in Chapter 7. The projectile points at EfOx-70 share similarities with other Avonlea to Old Women's transitional sites all showing tightly morphologically controlled Avonlea phase points with symmetric bodies, delicate notching, and parallel flaking followed by a range of transitional points with variable blade length, irregular flaking, and varied notch positioning.

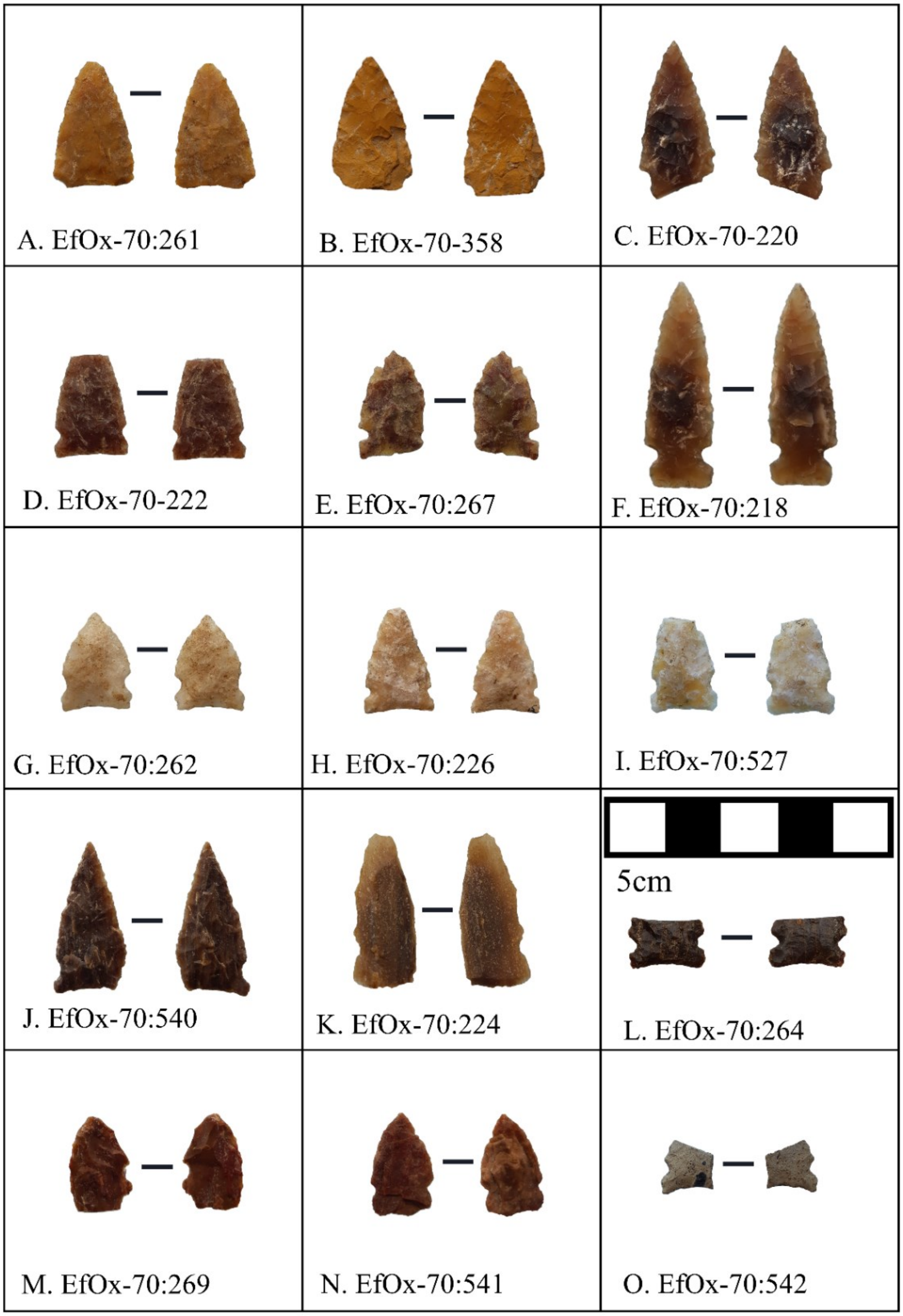


Figure 4.3 *Projectile points from EfOx-70.* ***(A-B)*** *Montana chert,* ***(C-F)*** *Knife River flint,* ***(G-I)*** *Swan River chert,* ***(J-N)*** *Silicified wood,* ***(O)*** *Possible pyro-metamorphic.*

Figure 4.4 *Projectile points from EfOx-70.* ***(A-C)*** *Quartzite,* ***(D-P)*** *Varied fine-grained siliceous materials.*

4.3 Lithic Tools: EfOx-71

We uncovered 1,407 lithic artifacts in units 1-4, along the surface of the embankment, as well as shovel tests 1-10 at EfOx-71. Here, the lithic assemblage contained a variable assortment of tools and by-products but with a heavy focus on butchering and cutting tools over weaponry and manufacture. The breakdown of artifact type according to raw material and tool type is outlined in Table 4.4. Raw materials at EfOx-71 were weighted towards locally procured materials. Multiple tool types, including scraping and cutting tools, were represented at EfOx-71 and were more variable than those at EfOx-70. They were representative of secondary butchering activities with some lithic production around hearth activities.

Table 4.4: EfOx-71 Lithics

EfOx-71	Quartzite	Silicified Wood	Knife River Flint	Swan River Chert	Montana Chert	Silicified Sedimentary	Chert / Chalcedony	Quartz	Total	%
Cores	6								6	0.4
Hammerstones	9								9	0.64
Projectile Points/preforms	1	3		1		6	4		15	1
Endscrapers						3	1		4	0.28
Flakes	235	218	9	148	23	140	474	110	1357	96.4
Bifaces	1								1	0.07
Split Pebbles						2	1		3	0.2
Retouched Flakes					1	2			3	0.2
Scrapers		2	1			3	3		9	0.64
Totals	251	223	9	149	24	156	483	110	1407	100

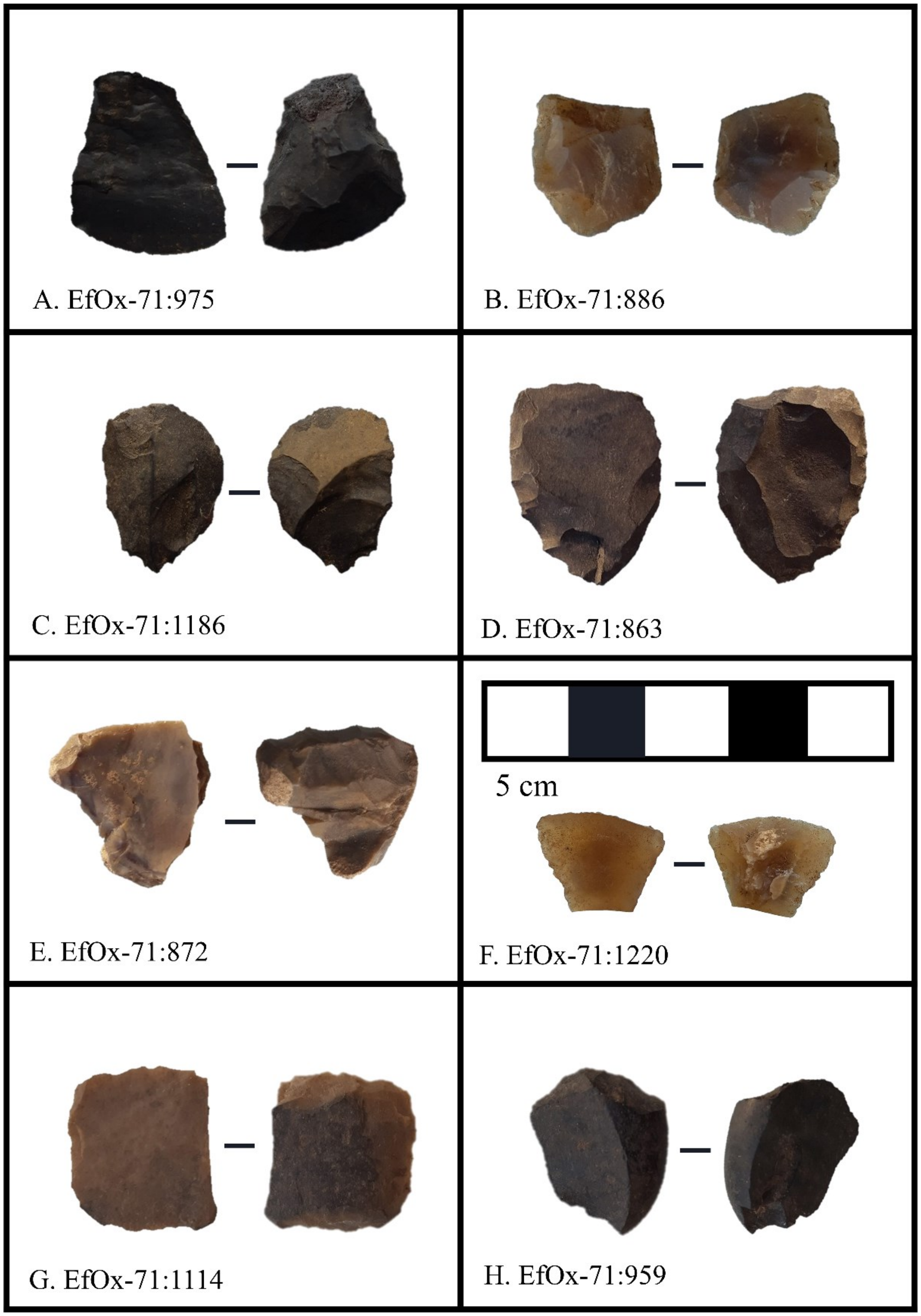


Figure 4.5 *Endscrapers.* ***(A-B)*** *Unit 1,* ***(C-E)*** *Unit 2,* ***(F)*** *Unit 3,* ***(G-H)*** *Unit 4*

Scraping tools at EfOx-71 consisted primarily of small, teardrop-shaped endscrapers and reworked cortical flakes. Endscrapers are generally made on a stone flake with a working edge along the wider convex end (Crabtree 1972:60). Tools generally considered endscrapers are manufactured by retouching the dorsal surface at the distal end of a flake. Endscrapers can also be found manufactured on bipolarly split pebbles (4.5 G-H). These tools have also been called “tear-drop” or “thumbnail” scrapers based on their shapes. Ethnographic accounts indicate that their primary function was related but not limited to hide processing (Siegel 1984:36; Wilmsen 1968; Boszhardt and McCarthy 1999). We recovered endscrapers in each excavated unit at EfOx-71 suggesting that hide working was a part of the activities around the hearths. Endscrapers at EfOx-71 were primarily made with locally procured raw materials such as silicified sedimentary stones (Figure 4.5 A, C, D, H) and microcrystalline siliceous (chert or chalcedony) pebbles (Figure 4.5 B, E, G). One endscraper (Figure 4.5 F) was created from Knife River flint. The absence of endscrapers at EfOx-70 further distinguishes the site activities from each other. We excavated and collected cutting tools, some bifacially and some unifacially worked (Figure 4.6). Bifacially worked tools (Figure 4.6 A, B, D) were expediently made on local toolstones including siltstone (B) and silicified wood (A, D). Unifacially worked cutting tools (Figure 4.6 C, E, F) were all produced on cortical flakes. Tools C and E were produced on local silicified siltstone materials and F appears to have been made from Montana chert. One unmodified bipolarly split pebble (Figure 4.6 G) was recovered from EfOx-71, Unit 4. This artifact is one half of a silicified sedimentary pebble and exhibits impact scars on both the proximal and distal ends. Bipolar split pebbles are characterized by a major impact scar on the proximal end and a minor impact scar on the distal end whereas the other half will have a major and minor bulb of percussion in the same areas (Low 1997:4). This technique allowed for use of the maximum productive surface on an otherwise relatively small pebble. Endscrapers, projectile points and other tools could be manufactured using this technique, requiring the splitting of the pebble between a hammerstone and an anvil (Low 1997:4). This pebble, along with endscrapers and point preforms, showing evidence of the same manufacture, indicates the adeptness of the occupants at performing this skill.

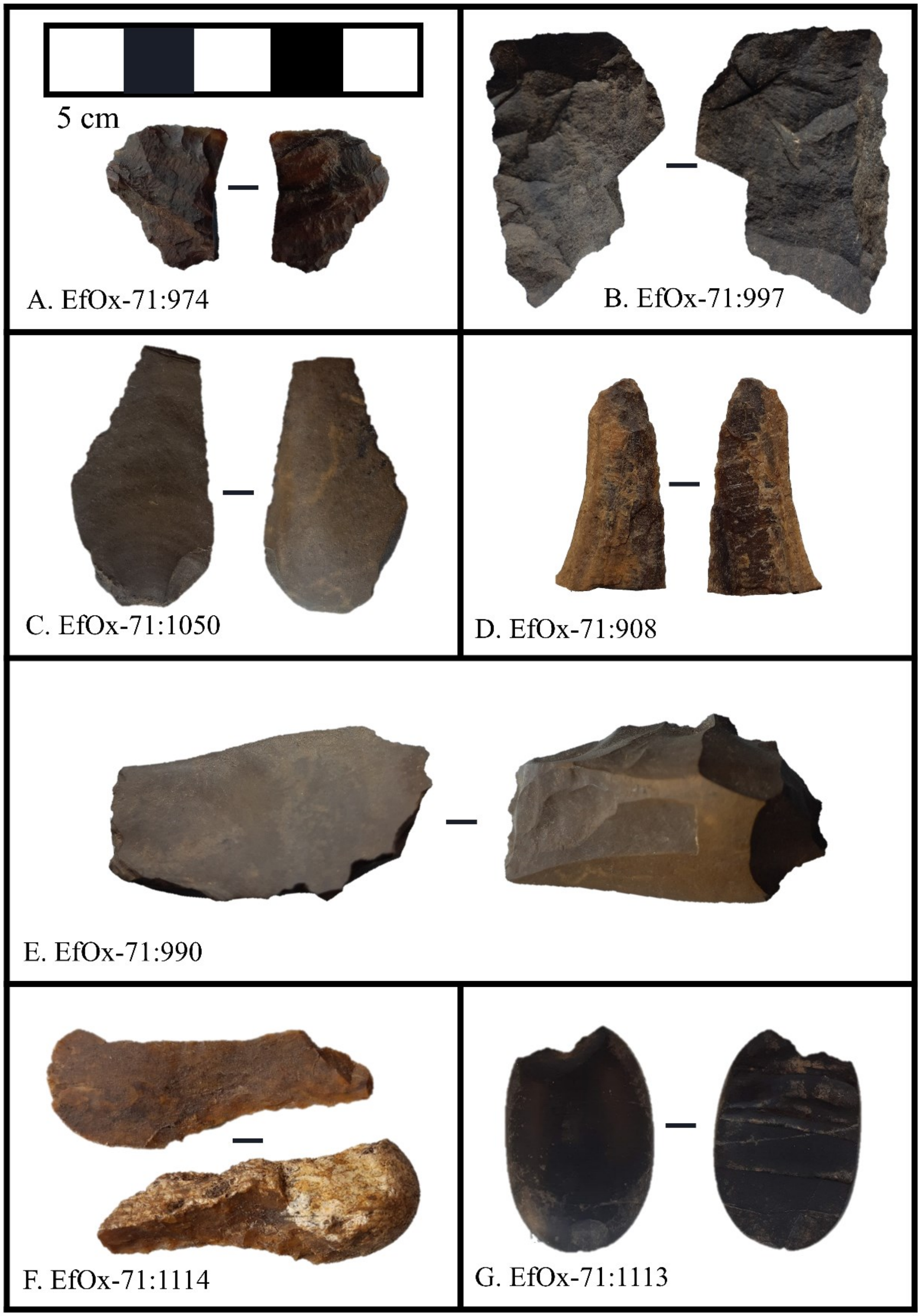


Figure 4.6 *Scraping/cutting tools.* ***(A-B)*** *Unit 1,* ***(C-E)*** *Unit 2,* ***(F)*** *Unit 3,* ***(G-H)*** *Unit 4.*

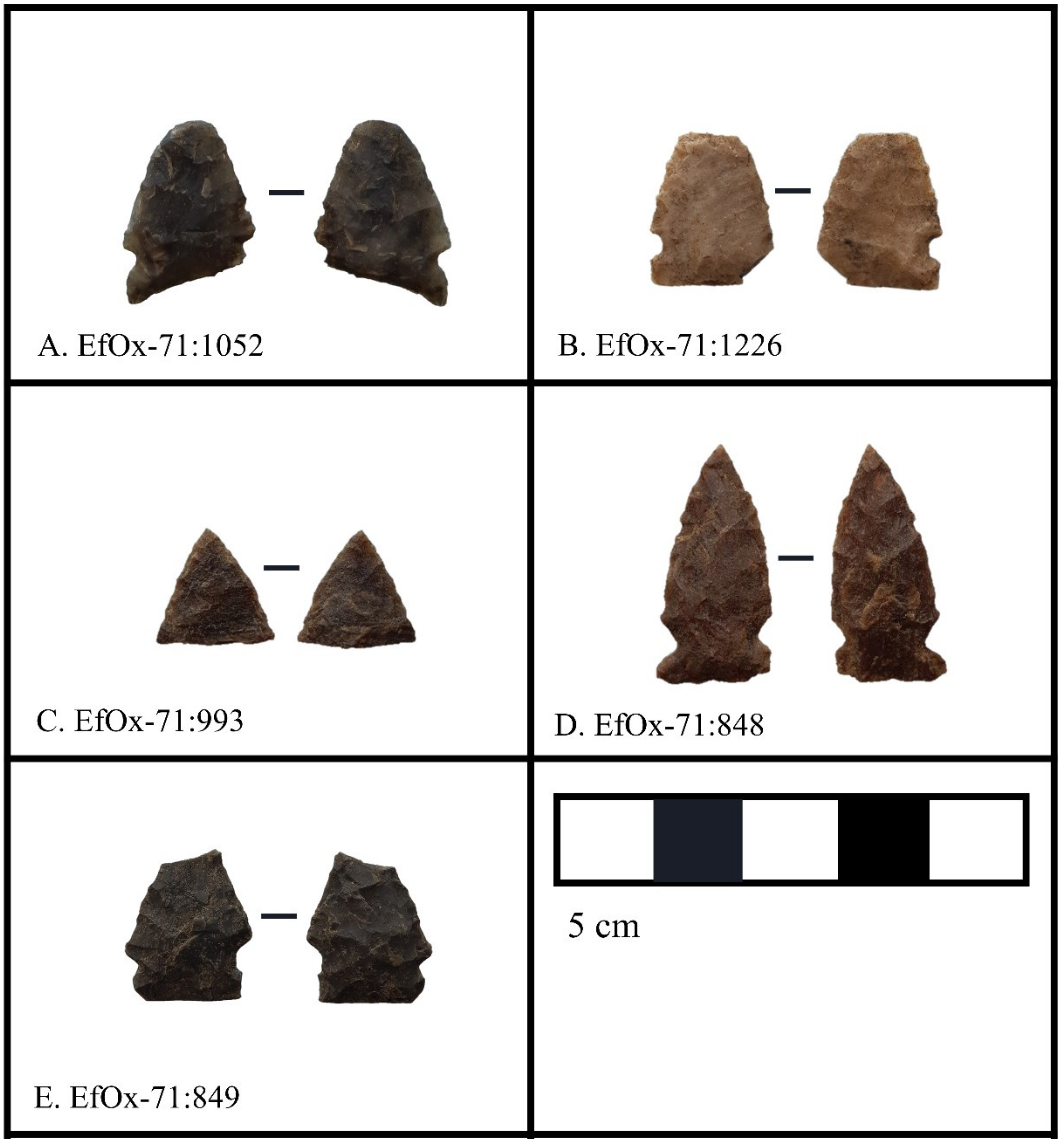


***Figure 4.7** Projectile points from EfOx-71*

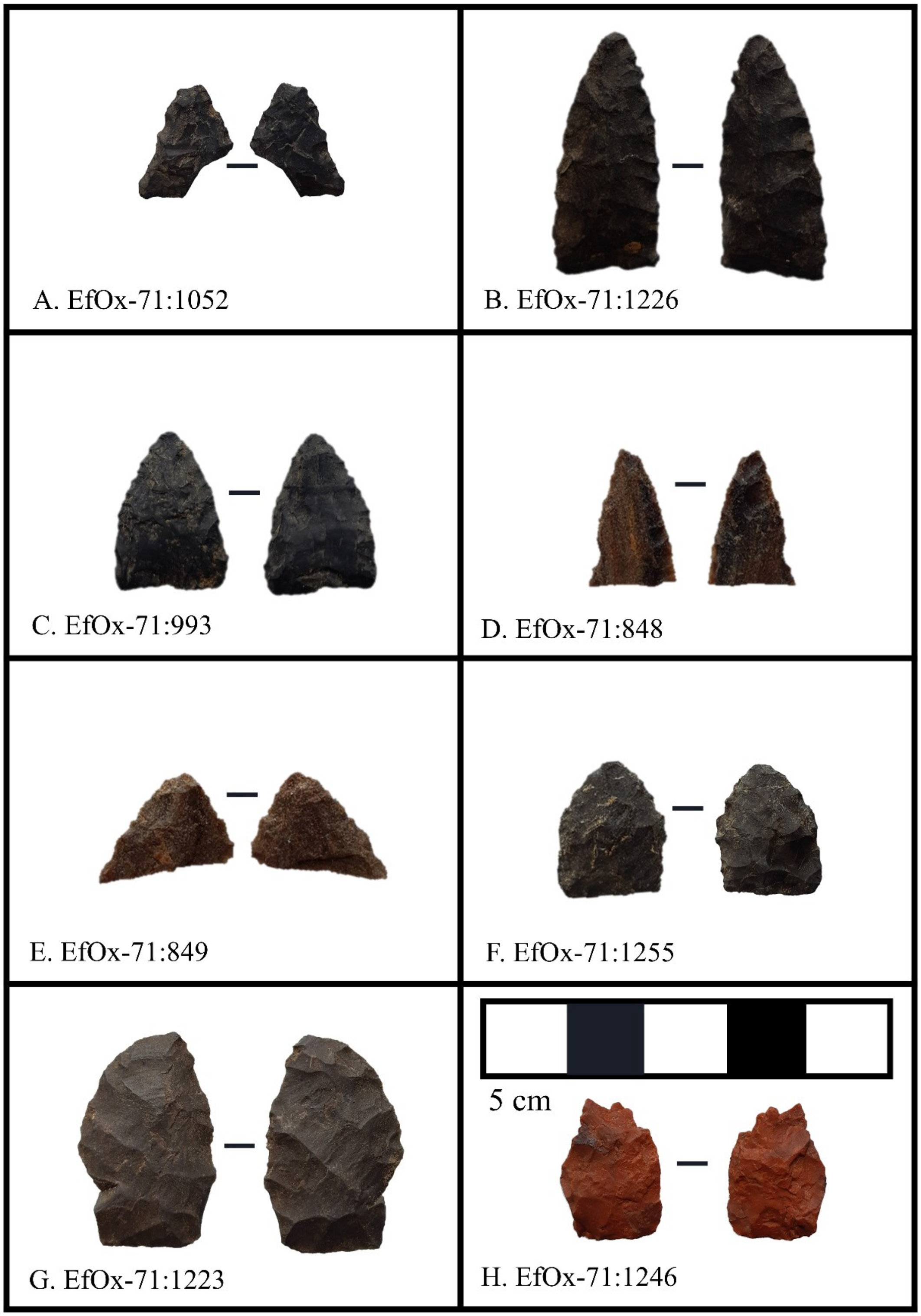


***Figure 4.8** Preforms from EfOx-71*

4.4 Raw Stone Materials

At EfOx-70 and 71, I noted a direct correlation between raw material and tool type. The tool types at EfOx-70 were almost exclusively large quartzite choppers, projectile points, and retouch flakes suggesting the presence of other butchering tools. EfOx-71 contained more diversity in lithic technology. Raw material distributions, both by weight and by count (Figure 4.9), reflect the nature of tool type distribution at both sites. For raw stone material distribution at EfOx-70, quartzite artifacts accounted for 98 percent of the total weight of lithics in the units and 87 percent at EfOx-71 (Figure 4.9 B and D). By number, however, quartzite accounted for 43 percent at EfOx-70 and 24 percent at EfOx-71, showing a greater numerical diversity in raw material types than is the case with larger tools (Figure 4.9 A and C). The high variability in raw materials that we found in the projectile points was reflected in the retouch flakes suggesting that tools of higher-grade materials (likely other bifaces such as the one we recovered from EfOx-70, Figure 4.2 E) were being resharpened during butchering activities. It is plausible that tools of higher quality, non-local source materials were being conserved; thus, their presence in the archaeological record is only reflected by the sharpening flakes.

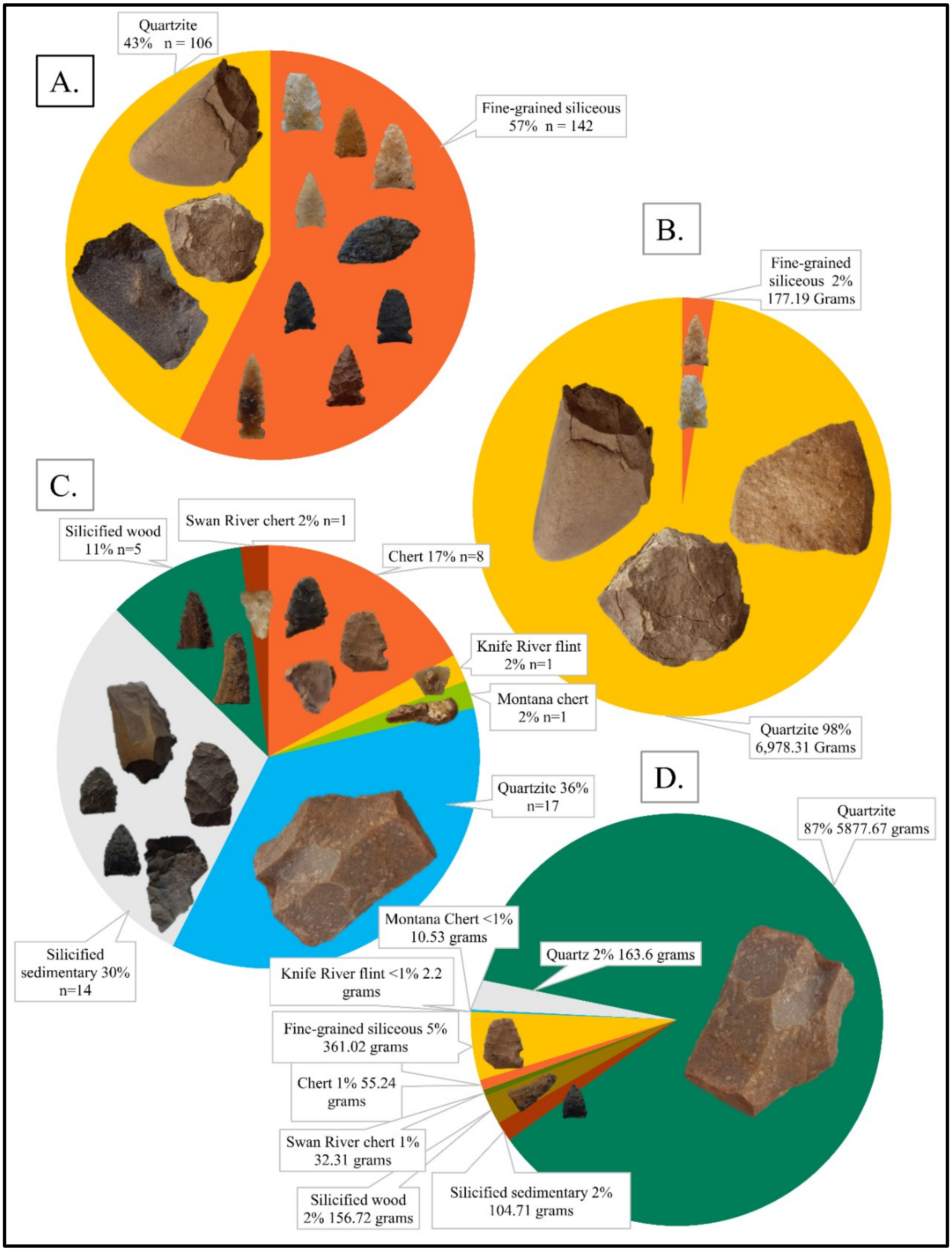


Figure 4.9 *Raw material distribution across tools and debitage* ***(A)*** *By number at EfOx-70,* ***(B)*** *By weight at EfOx-70,* ***(C)*** *By number at EfOx-71,* ***(D)*** *By weight at EfOx-71.*

4.5 Source Localities of Stone Artifacts from EfOx-70 and 71

While local stone materials accounted for more than half of the assemblages overall, the relationship among the tool types, tool-making by-products and their raw materials is noteworthy. The most obvious distinction would be made with respect to projectile points. Twenty-two points (71 percent) at EfOx-70 were made from non-local raw materials (61 percent if the Swan River chert was collected locally). At EfOx-71, all but two projectile points were manufactured from local materials. This pattern not only provides evidence for the occupant's adeptness for collecting, treating, and forming tools from local materials, it also presents a picture of activity areas that would be less evident had we not been developing an understanding of raw material types used in precontact Alberta.

During the University of Alberta's 2012 and 2017 field seasons, students recovered lithic materials from several test pits, small, controlled excavation areas, and surface finds primarily at EfOx-77 (Ives et al. 2020). Much additional material was recovered in the 2019 field season revealing greater variability in raw materials, particularly with respect to weaponry and resharpening flakes. The raw materials in the lithic assemblage demonstrate a preparedness for hunting and living in a landscape that is rather poor in high-quality toolstones. High quality toolstones are those that exhibit even conchoidal fracturing relatively uninhibited by fissures, cracks, and inclusions (Andrefsky 2014:24). Certain toolstones are often found distributed further from their sources due to their desirable knapping qualities. Some more common non-local toolstones found at the sites include Montana chert and Knife River flint. Swan River chert does occur locally in glacially dispersed nodules but is found more commonly closer to its source locations in western Manitoba.

Montana Chert

Three formed tools of Montana chert were uncovered at EfOx-70 and 71; however, numerous retouch flakes were encountered suggesting there were more tools of Montana chert present during the site's occupation (Figure 4.10). Montana Chert has been used as a catch-all term for siliceous materials that come primarily from the Madison Formation of southwestern Montana, Wyoming and Idaho (Roll et al. 2005). Montana Chert is commonly associated with the Avonlea and Old Women's Phases (Hudececk 1989) but is not exclusive to that period in Alberta, showing up in artifacts since the Early Precontact Period.

The characterization of Montana cherts represents a problem: namely they elude definitive geochemical identification and their macroscopic characteristics (colour, inclusions and mottling) are expressed across a vast geological area comprising most of southwestern Montana. The testing of eight different Montana chert sources demonstrated five of these sources (three Smith River Quarries; one in the Gallatin Valley; and one in the Flint Creek Valley) show indistinguishable elemental composition (Roll et al. 2005). The range of variability within each quarry significantly overlapped with other quarries. Although visible differences are apparent in some Montana Cherts, the overlap in variability between sources is too great to be reliant on this technique as well. With the aid of Patrick Rennie (Montana Department of Natural Resources and Conservation), I surveyed three different quarries in 2019 that had abundant raw materials but with limited larger, homogenous pieces. Rennie confirmed that familiar quarry sites in Montana showed similar patterns (Rennie pers. Comm. 2019). As of 2005, a search of Montana state files revealed that 655 recorded archaeological sites were those related to the procurement of lithic materials as the principal activity, 163 of these being "bedrock quarries" and 492 being "surface stone quarries" (Roll et al. 2005:60). The sheer number of quarry areas in Montana and the macroscopic similarities of many materials, coupled with the indistinguishable elemental composition, make it difficult to say much with certainty regarding Montana chert sources and their use in Alberta. Nonetheless, the macroscopic qualities in the stone of some Montana sources do allow informed suggestions about the origins of some archaeological assemblages. Principally, the variation at some Montana chert quarries may be matched to variation within archaeological assemblages, but this would require greater numbers of Montana chert artifacts in assemblages. At EfOx-70 and 71, Montana chert is present, but in too small of quantity to provide further interpretations at this time.

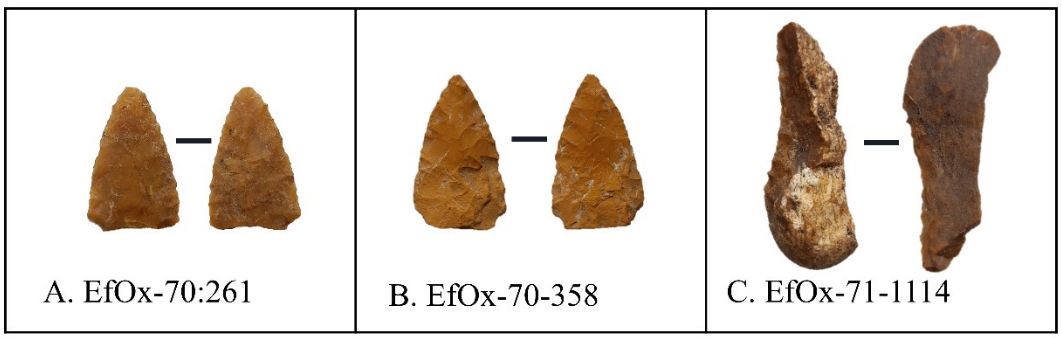


Figure 4.10 *Montana Chert*

Knife River Flint

Due to its striking appearance, exquisite knapping properties, and its frequent presence in assemblages (often in well-formed tools), Knife River Flint (KRF) is perhaps the most discussed imported raw material found in Alberta's archaeological assemblages. Archaeologists, by the 1980s, estimated that approximately 12.5 million kilograms of Knife River Flint were quarried in the precontact period from its primary sources in the Dunn and Mercer Counties of North Dakota (Ahler 1986:105; Clayton et al. 1970). This material is thought to have been used for the production of over 600 million tools and cores, spread throughout a spatial extent of 3.7 million square kilometres in North America (Ahler 1986:105).

Knife River Flint is a relatively uniform, cryptocrystalline, silica-rich sedimentary rock, identified as a silicified lignite, with some bedding planes and plant fossils. The planes and fragmentary fossils rarely inhibit high quality conchoidal fracturing (Ahler 1986; Kristensen et al. 2018). All of the known natural occurrences of KRF are from secondary contexts because the original bedrock outcrops have since eroded. KRF is thought to have formed within the Eocene aged Golden Valley Formation, now largely removed by Late Cenozoic erosion and subsequent glaciation.

We recovered artifacts and retouch flakes of Knife River flint at EfOx-70, 71, and in 2012 and 2017 at EfOx-77. Six formed tools of KRF are mentioned in this discussion (Figure 4.11). These are four projectile points from EfOx-70, one distal portion of an endscraper from EfOx-71, and one endscraper from EfOx-77. EfOx-70:218 is the largest projectile point that we recovered from EfOx-70. While all the other projectile points uncovered at the site were either characteristically Avonlea or rather “stubby” Old Women’s points, EfOx-70:218 is the most elongate of the points uncovered. The other three KRF points uncovered at EfOx-70 (EfOx-70:220, 222, and 267) exhibit Avonlea morphological characteristics. Most of the KRF retouch flakes that we uncovered were found at EfOx-70 suggesting that butchering tools of KRF were present and being sharpened there.

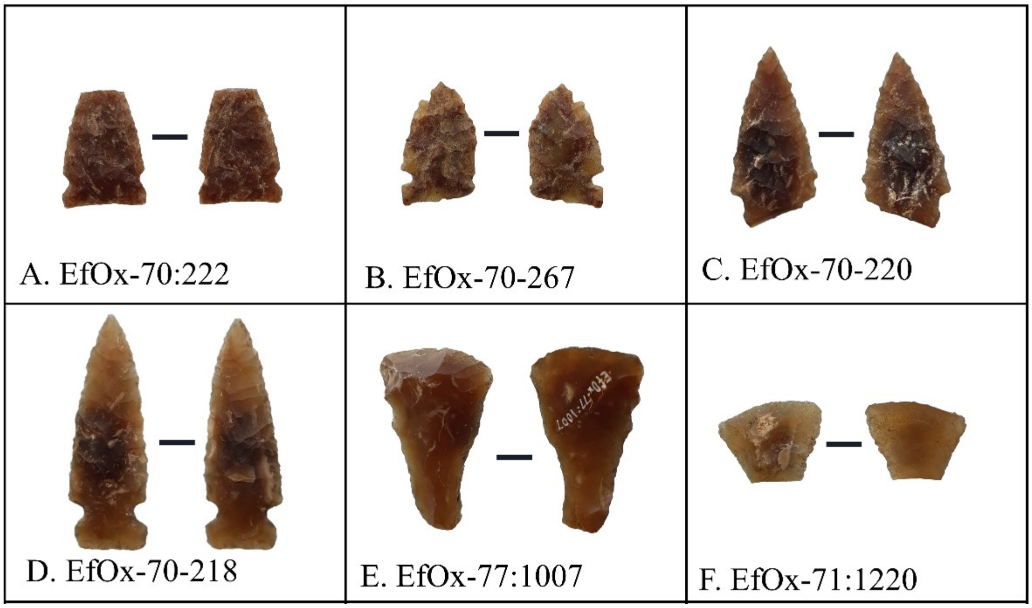


Figure 4.11 *Knife River Flint*

Swan River Chert

Swan River Chert (SRC) is a quartz, bonded by chalcedony, ranging in colour from white through gray to brown and is normally very tough to work. The bright colors (red, orange, pink, purple, black, gray, blue, white, and even transparent) and luster commonly seen on archaeological specimens are the result of the chert having been heat-treated by precontact tool makers to improve the flaking quality of the stone (Low 1996; Grasby et al. 2002; this author's personal experimentation). SRC displays high variability in texture and is typically characterized by quartz lined vugs, with abundant irregular shaped small cavities. A primary bedrock source of Swan River chert was identified by Grasby et al. (2002) at the Mafeking quarry in west central Manitoba; however, the natural distribution of Swan River chert extends from west-central Manitoba (where it is most frequent in archaeological sites) to southern Saskatchewan and southeastern Alberta, with some being found in Minnesota, North Dakota, and Montana (Low 1996; Grasby et al. 2002).

In 2011-2012, TERA noted the presence of Swan River Chert in both debitage and tool form at EfOx-70 and 71 (Girard et al. 2012). They regarded it as being an exotic material assuming it to have been transported from areas closer to its primary source. Evidence now demonstrates that the material is found in the site area in secondary glacial till and lag deposits as cobbles of poor grade Swan River chert have been discovered around Matzhiwin Creek (pers. comm. Eugene Gryba; personal discovery 2019). The poor quality (coarse grained and quite "vuggy") of the secondary SRC cobbles is consistent with some artifacts found at the EfOx-70, 71, and 77, suggesting that some SRC was recovered locally.

The SRC at EfOx-70, 71, and 77 comes primarily as well-formed tools and microdebitage, however. We uncovered three SRC projectile points in the excavations of EfOx-70 in 2019 as well as a bifacial preform on the embankment of EfOx-71 (Figure 4.12). One projectile point of SRC was uncovered at EfOx-77 area C in 2017. Three large flakes of poor quality SRC were uncovered at EfOx-70 along with numerous retouch flakes of finer quality SRC. Excavations at EfOx-71 revealed numerous SRC flakes ranging from 0.1 – 2.0 grams in weight providing evidence of the manufacture or modification of SRC tools that likely originated from more distant, higher quality sources.

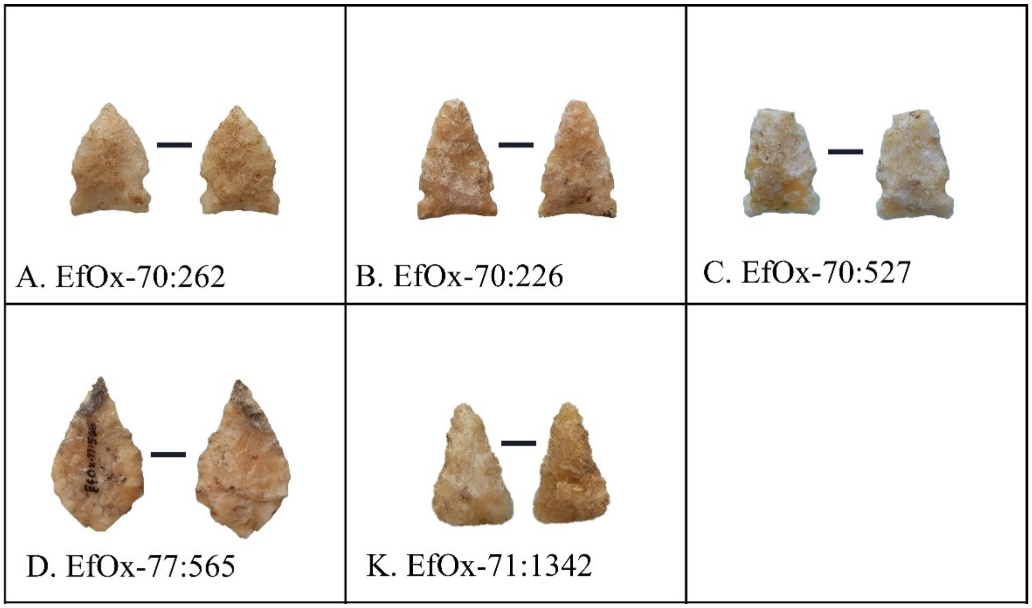


Figure 4.12 *Swan River Chert*

Silicified Wood

Silicified wood is often found throughout precontact sites in Alberta as a toolstone (Figure 4.13), but it is more prevalent in the Late Precontact period. In Alberta, the Avonlea Phase is dominated by local fine-grained materials with small amounts of petrified (silicified) wood, obsidian, Knife River Flint, and exotic cherts (Peck 2011). With the onset of the Old Women's phase, similar materials are present with an increase in silicified wood use as well as an increase in bipolar techniques used for wedges, endscrapers, and projectile points fashioned from small pebbles (Hudecek 1989, Peck 2011). There are a number of reasons that could account for the increase of silicified wood at this time period, ranging from a higher awareness of its presence throughout Alberta to an awareness of the improvement of the material upon heat treatment (discussion about its improved properties upon heat treatment can be found in Krahulic 2016; personal experiments and observations have also confirmed this). One possible reason for its increased use could be the decrease in the size of projectile points during this time period. Often, the tree rings in pieces of silicified wood de-laminate easily, limiting the size of the blank from which a projectile point or scraper can be made. EfOx-70:224 (Figure 4.13) is an example of a de-laminated tree ring layer that has been used to create a projectile point. EfOx-70:224 (Figure 4.13) is an example of a point made on a de-laminated tree piece of silicified wood. EfOx-70:541 and 269 are projectile points made from heat-treated silicified wood that show the inhibiting tree ring lamination, limiting the shape and size of the produced projectile point. Although the tree rings are evident on EfOx-70:540 and 264, they are organized vertically rather than horizontally, demonstrating a higher quality raw material and a higher degree of silicification allowing for conchoidal fracture to pass through rather than around the tree rings. Flaking against vertical tree rings indicates a higher quality silicified wood as the rings did not in these cases inhibit the flaking quality of the raw material.

Silicified woods are known in the Edmonton Formation of the uppermost part of the Cretaceous (Maastrichtian) and are distributed widely across the province of Alberta (Ramanujam and Stewart 1969). Silicified woods are also found in the Upper Cretaceous (Campanian) deposits of the Oldman Formation found in exposures of the Red Deer River valley near Medicine Hat and Denhart (Ramanujam 1972). I have personally discovered this material along the North Saskatchewan, Oldman, and Red Deer Rivers. It is quite abundant in areas that contain gravel bars. Some of the material is silicified to the extent that it is quite amenable to flintknapping whereas other pieces have much less silica content causing it to laminate and break more easily.

Figure 4.13 *Silicified Wood*

Quartzite and Other Locally Available Raw Materials

Quartzite can be found both locally and almost anywhere throughout Alberta in lag deposits and along creeks and rivers. In the Matzhiwin Creek valley, the Empress formation of Saskatchewan sands and gravels is exposed and would have made raw quartzite materials easily available to the area's occupants (Barling 1995:82). There is variety in the quartzite tools at EfOx-70 and 71, some being high-quality and fine-grained while some are quite coarse. The projectile points of quartzite are all made from a higher quality quartzite (Figure 4.14).

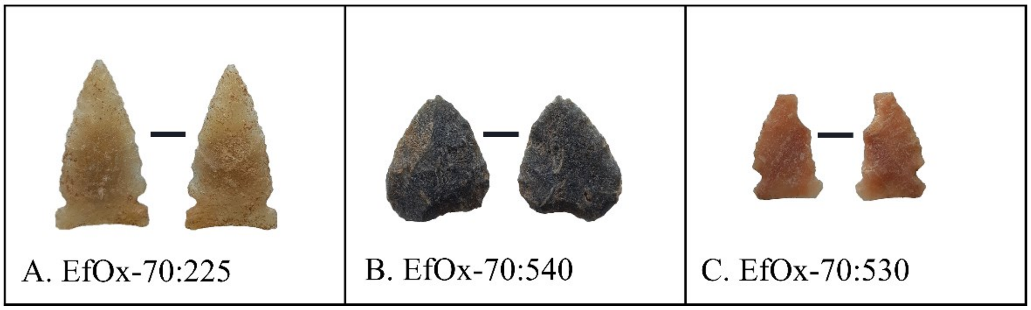


Figure 4.14 *Quartzite Projectile Points*

Many tools and their by-products at EfOx-70-71 were of a range of materials that elude confident classification (Figure 4.15). These materials include miscellaneous cherts, siltstones, mudstones. Many of the silicified sedimentary materials could be local in origin as some display cortex evidencing their origin as pebbles. Similar materials of this kind were collected by the author in and around Matzhiwin Creek and along the Red Deer River, heat-treated, and chipped. They were amenable to flint knapping and in some cases had remarkable similarity to raw materials in artifact form.

The wide variety of raw materials exhibited in curated tools at the EfOx sites suggests the occupants were collecting raw materials from a range of sources throughout their movement on the landscape. These included distant sources like Knife River Flint in North Dakota (Kristensen et al. 2018) and the Madison Formation in Montana, along with lag deposits of higher quality Swan River Chert in southern Manitoba and Saskatchewan (Low 1996; Grasby et al. 2002). It is possible that the occupants collected materials throughout their travels or perhaps the collection of raw materials provided some reason for their travels (see Seeman 1994 and Beck 2008). Some of the silicified wood could have been collected locally but there is a range in its quality which could indicate collection from varied sources (Ramanujam 1972). Along with the identifiable raw materials, there were a number of unidentified fine-grained materials such as cherts, chalcedony and silicified sedimentary materials which could be from more local lag deposits or elsewhere (Figure 4.15). Another scenario is that the wide range of raw material could be a result of down-the-line trade. If this was the case, it seems that the sites are within the outer reaches of distribution from source areas resulting in lower frequencies of the raw materials. The exotic material is represented in projectile points and retouch flakes. The retouch flakes indicate that there were more tools made of exotic materials but that they were not necessarily left behind. The evidence for them is in the by-products from their sharpening.

Whether materials were collected during travel or procured through trade, the evidence does not indicate that the occupants had a preference for one material over another. If the raw material performed the function for the purpose, it seems to have been considered good enough. At the EfOx sites, and more generally in the Old Women's Phase (Peck 2011) it seems that a wider range of raw material is used corresponding with a loosening of controls on projectile point morphology (Brumley and Dau 1988:47-48; Peck and Ives 2001:188). At EfOx-70, 71, and 77 there is no dominant material in the curated tool assemblages. Although silicified wood is more common in chipped stone debitage, it is found locally (Ramanujam 1972) and the range of tool types and variability is greater indicating multiple silicified wood sources.

Figure 4.15 *Projectile Points of Unknown Raw Materials*

4.6 Lithic Heat Treatment

Controlled heat treatment was used to enhance the flaking quality of a toolstone and to change colour, appearance, and composition (Domanski and Webb 2007). Heat treating lithic materials greatly reduces the frequency of step and hinge terminations and allows for more predictability and ease in percussion and pressure flaking (Gryba 2017; Domanski and Web 2007; Bleed and Meier 1980). Elasticity, compressive strength, tensile strength, and fracture toughness are all known to be affected by heat treatment, but fracture toughness remains the most consistent and quantifiable indicator (Domanski et al. 1994). To increase the flaking efficacy of siliceous raw stone materials, they generally require gradual heating and cooling at temperatures between 200°C and 600°C, but the exact temperature range is dependent on the raw material (Domanski and Webb 2007; Schmidt et al. 2016). For instance, the quality of Knife River Flint, Montana Chert, and silicified wood can be improved at 275°C- 300°C, Swan River Chert between 300°C and 425°C, and some courser materials upwards of 600°C (Ahler 1983; Gryba 2017; Domanski and Webb 1992; Stuart 2013; author's experiments). At temperatures higher than 600°C, suitable stone tool materials begin to craze, crack, discolour and become unsuitable for knapping, often crushing rather than flaking (Ahler 1983; Domanski and Webb 1992).

Evidence for testing local materials through heat-treatment is present at the EfOx sites. Micro-crystalline silicate materials found in raw form were heated by the author and resulted in very similar material to what was found in some artifacts (Figure 4.16). In particular, EfOx-71:1246 is a Plains Triangular preform with almost identical colouring and crystalline structure to a cobble of heated microquartzite or chert that was procured from the edge of the creek and heated to 290°C. Silicified wood raw materials found in the area are generally a brown to light tan colour becoming darker and reddened upon heat treatment. Almost all instances of the silicified wood found at the EfOx sites are darker brown or red suggesting they were heated by the occupants. Some materials, such as Knife River Flint and Montana chert, are more difficult to determine; however, Swan River chert is nearly impossible to work in its raw form and heat treatment was practiced on the material throughout the Pre-Contact Period suggesting that the Swan River chert at the EfOx sites was heat-treated as well (Grasby et al. 2002; Stuart 2013).

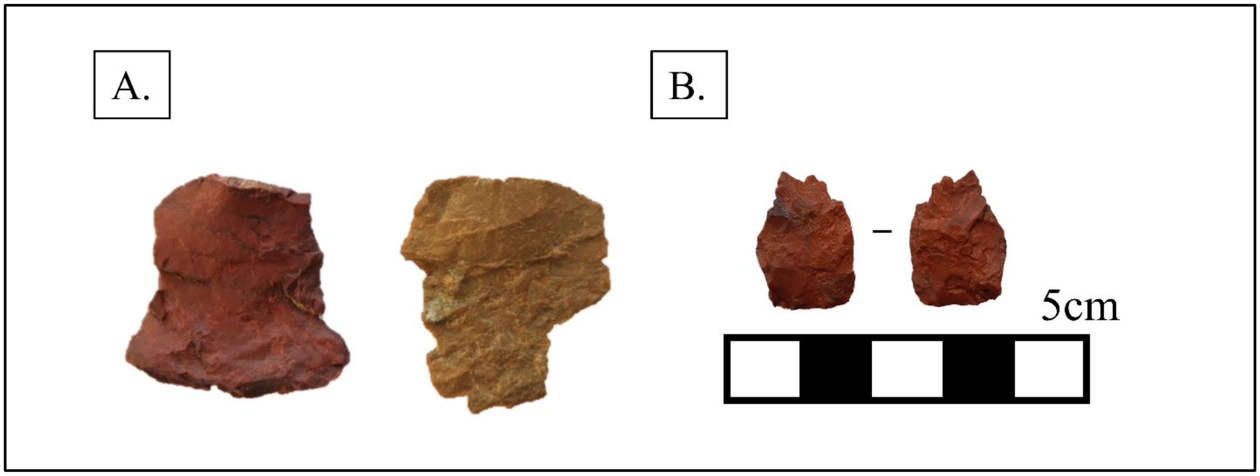


Figure 4.16 *Heat Treatment* ***(A)*** *Two flakes from the same quartzite core retrieved on the banks of Matzhiwin Creek just south of EfOx-77, Block C. Heated (left) and unheated (right). The unheated flake (right) was struck from the parent core and then the core was heated to 290°C. After heating, the heated flake (left) was struck from the parent core. Note both the colour change and vitreous lustre of the heated flake (left).* ***(B)*** *EfOx-71:1246 is a preform of what appears to be the same material as the flakes. We uncovered this preform at EfOx-71 in 2019.*

4.7 Features Ceramics and Faunal Remains

Here, the data on features, ceramics, and faunal remains collected from the Excavations of EfOx-70 and 71 is presented.

Features

We chose to excavate Units 1-3 at EfOx-71 because of a burn feature visible in the embankment. We discovered that the burn feature was part of one or two closely spaced hearths in Unit 1. We discovered another hearth at the border of Units 2 and 3. The second hearth was associated with a bone upright feature (Feature 4) and a scatter of ceramic, lithic, and bone artifacts. The three units contained lithic debitage mostly in the form of tertiary reduction flakes, endscrapers and other small cutting tools, projectile point preforms, ceramic sherds, and heavily processed bone. The bone upright feature included three vertical long bones and an upright rib with some bone fragments, including a canid innominate.

Based on the artifacts we collected around the features at EfOx-71, my conclusions are that EfOx-71 and associated areas represent drop-zone artifacts associated with hearth activities including cooking, secondary processing of carcasses, lithic retooling, and hide working activities. In 2017 our discoveries at EfOx-77, an associated site to the northwest, included a hearth with a similar assemblage of artifacts as those distributed at EfOx-71, suggesting multiple activity centers in the vicinity of the bison kill.

Ceramics

At EfOx-71, ceramic sherds were found throughout Units 1-3 (none in 4 or in the shovel tests), but most were found in association with what we designated Feature 3: Pottery Scatter in Unit 2, Level 2 (Figure 4.17 A). There were 69 tightly clustered sherds in this feature, and it was only minimally separated from Feature 4, the bone upright and burn feature. Many ceramic sherds refit (Figure 4.17 B-C) and some contained a reflective temper comprised of mica (Figure 4.17 D). The thickness of the sherds varied between 0.4-1.2 cm. While the varied thickness may indicate the sherds of more than one ceramic vessel in Feature 3, sherd EfOx-71:987 gradually thins from 1 cm to 0.8 in the same piece and several measurements were skewed by delamination. Overspill is present on many of the sherds and any analysis thereof may indicate what was being cooked in the vessel(s).

We recovered a total of sixteen ceramic sherds at EfOx-70. Compared to the material recovered at EfOx-71, this is a relatively small number of pieces, but does indicate the possibility of some cooking occurring around the bonebed itself. Twelve of the sixteen sherds were recovered in Unit 1; three in Unit 3, and one in Unit 2. Of the twelve pieces in Unit 1, six were found in the western half of the unit from 128-133 cmbs suggesting they came from the same vessel. The colour of the sherds across both sites varies from a light to dark brown with some gray and black. The differences in colour may be attributed to different vessels, uneven firing during manufacture, or overspill during use. Decoration on the sherds is sparse but some sherds have faint grooves running along the outer surface and at least two sherds (Figure 4.17 B) have punctate marks.

Figure 4.17 *Ceramics EfOx-71* ***(A)*** *Feature 3: Pottery scatter* ***(B)*** *Refit EfOx 71:982, 936, 875* ***(C)*** *Refit EfOx-71:987, 985* ***(D)*** *Mica temper EfOx-71:876.*

Faunal Remains

Over 3,500 collected faunal specimens from EfOx-70 and 71 were reviewed and compared with the University of Alberta, Department of Anthropology skeletal faunal collection. They were almost exclusively identified as *B. bison*. Identifiable non-bison bones, though few, were identified in the genus *Canis*. Using bison mandibles alone, an MNI of 18 animals is represented from the bones identified in just three units in the EfOx-70 excavation area. The spatial relationship between bone elements at EfOx-70 and 71 is reminiscent of many other bison kill and processing sites such as Fincastle (Bubel 2014) and Muhlbach (Gruhn 1969; Graham 2014) and presents a picture of primary butchering at EfOx-70 with secondary butchering and processing at EfOx-71. As defined at the Fincastle site (Watts 2008:12; Bubel 2014:216-218), primary butchering areas demonstrate faunal remains with sections of the animal in higher quantities relative to the more transportable appendicular portions, whereas secondary butchering demonstrates transportable appendicular portions often highly processed.

At EfOx-70, of the collected 935 faunal specimens across Units 1-3 and from the surface of the embankment, 660 of the bone specimens were identifiable to bone element and species. For calculating the MNI (minimum number of individuals) at EfOx-70, right *B. bison* mandibles were used to determine an MNI of 18 individuals. Although numerous other remains were present, using other identified elements did not increase the MNI. At EfOx-71 an MNI of three was determined based on three left mandibles. The bone distribution at EfOx-71 was more sparse and fragmentary than that of EfOx-70.

Using an MNI of 18 individuals represented in the 3 units at EfOx-70, the number of animals present at the kill site can be extrapolated. For instance, if 18 animals are represented in three units (~3meters squared), an even division presents six animals per unit. The embankment exposure of the bonebed is roughly 30 - 40 meters in length with an unknown extent to the south. Assuming the bonebed runs at least one meter south, 35 squared meters of bonebed (6 x 35 = 210) results in an estimated 210 animals. Only right mandibles were used to determine MNI. The number of mandibles in units 1-3 is disproportionate to the other elements present and there is evidence of mandibles being stacked or organized during the butchering process. Rather than assuming six animals per unit, a conservative estimate of two animals per unit would result in 70 animals. Another consideration here is that likely 50% or more of the site has been eroded away by creek activity. If we assume that a 35-meter embankment continued just one meter north before creek erosion containing the same concentration of bone, this would double the conservative number of 70 to 140 animals. Just three excavation units revealing 18 animals projected across what remains of EfOx-70 would result in an incredible number of bison. This projection does not even consider that the bonebed likely extends more than one meter south into the embankment and, at one time, more than one meter north. Additionally, EfOx-71 and other related sites also contained right mandibles that, if they are determined to be a part of the same kill event, would further increase the number of animals. Although it is not possible to say exactly how many bison were present at the kill, there is little question that a great number of animals were killed and butchered.

A Note on Bone Preservation at EfOx-70

There were three notable differences between the area that we excavated and the rest of the exposed bonebed in the embankment profile at EfOx-70. First, the entirety of the bonebed does not appear to contain a Level 3. In fact, only the excavated area and roughly five meters on either side showed a visible profile of this layer. Profile examination of the entirety of the ~30 meter exposed embankment revealed that the bonebed elsewhere averaged 20 centimetres in thickness and contained relatively well-preserved bone. Not visible, aside from the area directly associated with Units 1-3, was the layer of comminuted bone below an ash layer.

A second difference regarding the Level 2-3 separation is that bone below this separation gradually degraded in quality further below the separation (Figure 4.18). This was accompanied by an increase in the preservation of softer tissues such as keratin horn sheaths and maggot casings, not present in Levels 1-2. The third difference is related to the presence of a reflective mineral throughout the bone in Level 3 demonstrating some elemental or mineral restructuring of the bone. X-Ray diffraction analysis of bone samples from Level 3 showed a distinctly different

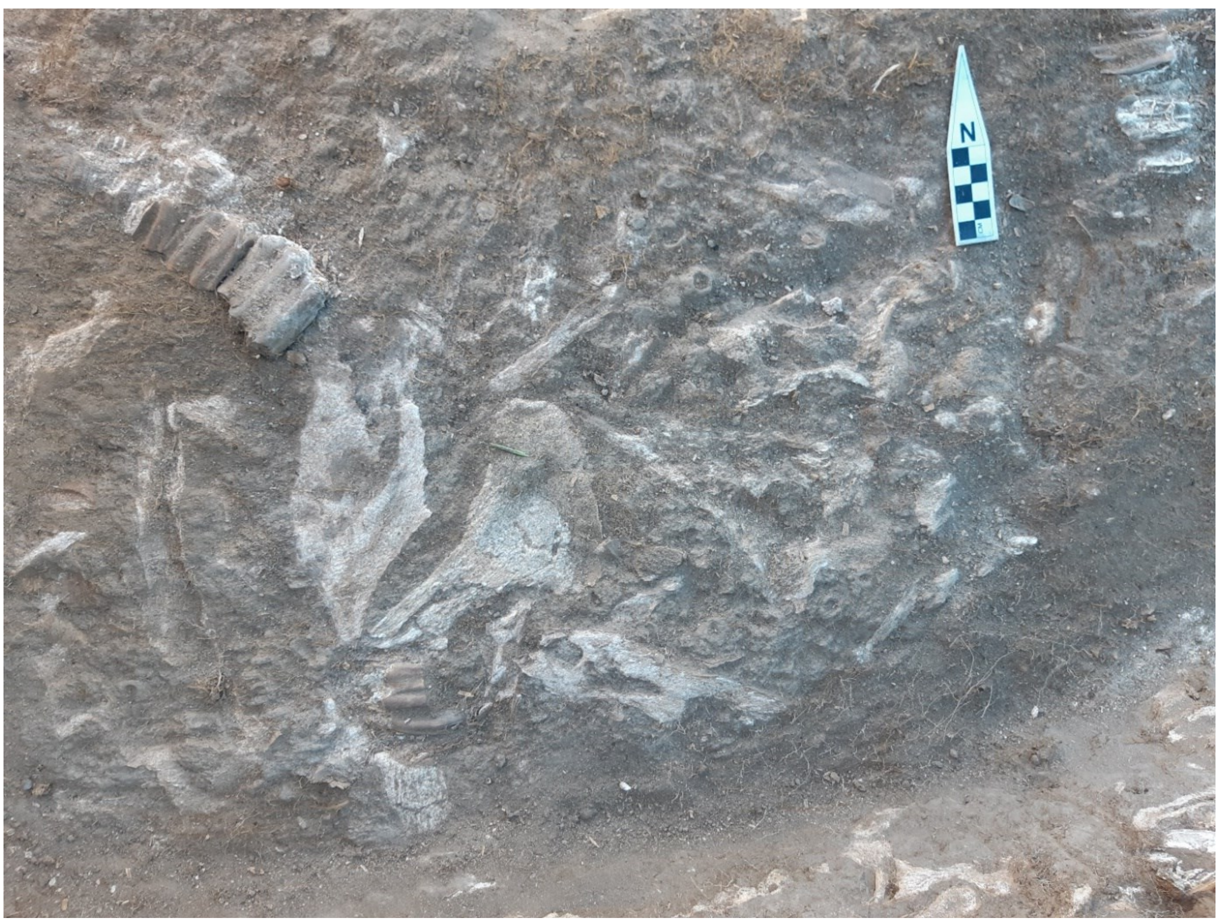


Figure 4.18 *Bone degradation in Level 3 at EfOx-70*

mineral composition, favoring gypsum, over that of Levels 1-2. The preserved keratin and maggot

casings along with the presence of gypsum and other minerals suggest that a fluctuating water table, periodically inundating the deeper Level 3 of the bonebed, may explain the conditions.

4.8 Conclusion

EfOx-70 and 71 present a series of artifacts that provide clues to the activities carried out at the sites. The lithic tool and faunal remain distribution are markedly different between the sites and I found a distinct distribution of tool types and their raw materials between EfOx-70 and 71 that directly correlated with butchered bone elements between the two sites. Once established, an understanding of the distribution of artifacts between the sites, allowed further interpretations related to the lifeways of the occupants.

The stone material types at EfOx-70, 71 and associated sites are diverse, exhibiting a range of types both available locally and acquired from distant sources. The lithic typologies further delineate activity centers at EfOx-70 and 71. Raw stone materials present at the EfOx sites that are from distant sources have high-quality attributes including cryptocrystalline, silica rich structures and conchoidal fracturing rarely inhibited by bedding planes. Such attributes would allow the artisan to easily draw flakes and shape the material into the desired outcome. Heat-treatment to these materials further increases the desirable qualities of the stones. The materials from distant localities include Knife River Flint, Montana Chert, some Swan River Chert, and several other higher quality unknown materials represented in the projectile points. These higher quality materials are represented at the sites but in fewer occurrences than more local materials, emphasizing their place at the far end of a distance-decay curve. This pattern suggests that the occupants were connected to a framework where high-quality raw materials were circulated, but at a distance where they were limited in availability. Furthermore, the occupants took advantage of locally available raw materials, enhancing their attributes with heat treatment.

Chapter 5: AMS Radiocarbon Dating at Matzhiwin Creek

Outlined here is a summary of the radiocarbon results from EfOx-70, 71 and 77 from permits 12-077, 17-056, and 19-055. Funding from the Rangeland Research Institute, University of Alberta has made the AMS radiocarbon dating for the sites possible. A total of 30 dates obtained from bone collected over three episodes of research provides a window into the chronology of sites at EfOx-70, 71, and 77.

5.1 2012 Research (Permit 12-077)

The 2012 field school research formed a baseline for chronological understanding of the Matzwhin Creek sites. Faunal remains were obtained both from the high, prairie level terrace (Area A, as described by Ives et al. 2020) and the left bank of Matzhiwin Creek (Area C). Figure 5.1 provides the results of this initial radiocarbon dating. The four dates obtained on the upper terrace of EfOx-77 clustered between 1110-1145 ^{14}C yr BP and the five lower terrace dates (Area C) revealed three temporal periods, one of Besant age in unit ST C8 (1785 ± 20 ^{14}C yr BP), one of similar age to the upper terrace (Area A) dates (1085 ± 20 ^{14}C yr BP) and three other lower terrace dates from ST C12 and C17 reflecting a protohistoric occupation (145-220 ^{14}C yr BP). Following the 2012 field season we obtained three samples, acquired by TERA at the EfOx-70 bonebed, with ages ranging from 1120-1210 ^{14}C yr BP, indicating that the bone bed was contemporaneous with the middle range of occupation at EfOx-77 (Girard 2012a, 2012b; Ives et al. 2020).

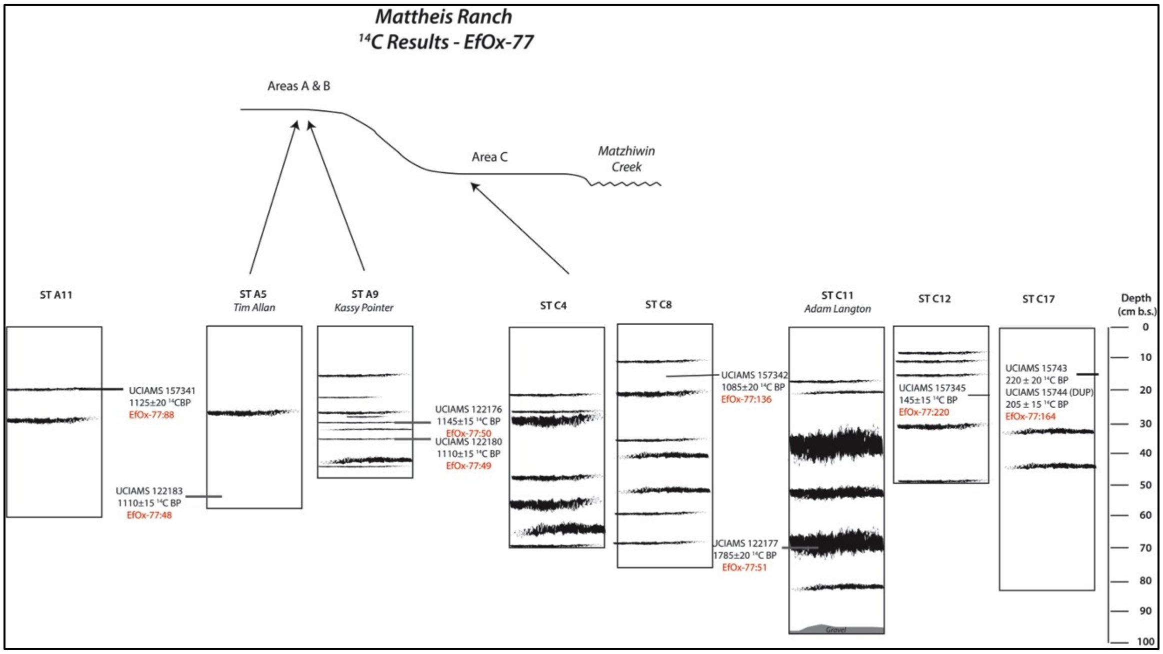


Figure 5.1 *Distribution of AMS dates across test units on the upper and lower terraces of EfOx-77. (Figure from Ives et al. 2020)*

Table 5.1 AMS Radiocarbon Dates for EfOx-70, 71 and 77, Matzhiwin Creek

Lab Number	Specimen	Unit	AMS Date	δ ^{13}C	Calibrated Date (2 σ)
2012 Activities					
UCIAMS-122176	EfOx-77:50	AST-9	1145 ± 15	-17.8	A.D. 777-971*
UCIAMS-122177	EfOx-77:51	CST-11	1785 ± 20	-18.3	A.D. 140-328
UCIAMS-122180	EfOx-77:49	AST-9	1110 ± 15	-19.6	A.D. 893-981
UCIAMS-122183	EfOx-77:48	AST-5	1110 ± 15	-19.2	A.D. 893-981
UCIAMS-157341	EfOx-77:88	AST-11	1125 ± 15	-19.2	A.D. 889-971
UCIAMS-157342	EfOx-77:136	CST-8	1085 ± 20	-19.4	A.D. 895-1014
UCIAMS-157343	EfOx-77:164	CST-17	220 ± 20	-19.2	A.D. 1646-‡
UCIAMS-157344†	EfOx-77:164	CST-17	205 ± 15	N/A	A.D. 1653-‡

UCIAMS-157345	EfOx-77:220	CST-12	145 ± 15	-19.2	A.D. 1673-1943‡
UCIAMS-197761	EfOx-77:1706	Area A Hearth	1100 ± 20	-18.9	A.D. 893-990
UCIAMS-197762	EfOx-77:917	Level 11, NW Quad, C Trench	1755 ± 20	-19.2	A.D. 234-343
2017 Activities					
UCIAMS-197758	EfOx-71:746	Ftr 1, North	1105 ± 20	-19.4	A.D. 893-987
UCIAMS-197759	EfOx-71:737	Ftr 1, South	1100 ± 20	-19.3	A.D. 892-990
UCIAMS-197760	EfOx-71:739	Ftr 2, South	1105 ± 20	-19.3	A.D. 893-987
UCIAMS-131374	EfOx-70:1	Bone Bed	1180 ± 20	-19.9	A.D. 772-893
UCIAMS-131375	EfOx-70:2	Bone Bed	1210 ± 20	-18.6	A.D. 726-885
UCIAMS-131376	EfOx-70:3	Bone Bed	1120 ± 20	-18.8	A.D. 887-981
UCIAMS-197755	EfOx-70:99	Bone Bed	1120 ± 20	-18.8	A.D. 887-981
UCIAMS-197756	EfOx-70:88	Bone Bed	1085 ± 20	-19.0	A.D. 895-1014
UCIAMS-197757	EfOx-70:85	Bone Bed	1120 ± 20	-19.1	A.D. 887-981
2019 Activities					
UOC-11446	EfOx-70:535	Bone Bed	1159 ± 25	-19.4	A.D. 775-965
UOC-11447	EfOx-70:536	Bone Bed	Insufficient Collagen	---	---
UOC-11448	EfOx-70:532	Bone Bed	1134 ± 24	-18.2	A.D. 777-984
UOC-11449	EfOx-70:538	Bone Bed	1142 ± 23	-19.2	A.D. 777-975
UOC-11450	EfOx-70:539	Bone Bed	1062 ± 24	-18.8	A.D. 900-1022
UOC-11451	EfOx70:537	Bone Bed	1148 ± 24	-18.8	A.D. 777-971
UOC-11452	EfOx70:534	Bone Bed	1154 ± 25	-19.9	A.D. 776-969

UOC-11453	EfOx-70:533	Bone Bed	1102 ± 23	-18.8	A.D. 791-991
UOC-11454	EfOx-71:1133	Bone	1135 ± 25	-19.0	A.D. 777-984
UOC-11455	EfOx-71:1134	Bone	1129 ± 24	-20.2	A.D. 778-988

**Calibrations in OxCal v4.2, IntCal13 (Reimer et al. 2013).*
†Duplicate date, routine laboratory procedure for a split sample.
‡Calibrates out of range. Radiocarbon dating in this nearer time range is less reliable and precise, arising from atomic bomb and other effects. (Table courtesy of John W. Ives)

5.2 2017 Research (Permit 17-056)

Field school research in 2017 began with focus on Areas A and C at EfOx-77 as they were the most fruitful test areas from the previous field season. Excavation units in Area A yielded a concentration of fragmentary bone surrounding a hearth feature. Bone directly associated with the feature revealed at date of 1100 ± 20 ^{14}C yr BP. At Area C a bone fragment at the base of a 4 x1 meter excavation trench revealed a date of 1755 ± 20 ^{14}C yr B.P. further establishing a weak presence in the Besant time frame.

During the 2017 field school, students also cleaned profiles of visible features eroding from the embankment of Matzhiwin Creek at EfOx-70 and 71. Burn features exposed on the embankment of EfOx-71 provided three dates ranging from 1100-1105 ± 20 ^{14}C yr BP. The bonebed at EfOx-70 revealed two bone layers, the upper portion comprising well preserved bone and the lower in an advanced state of decomposition. A sample from the upper, better preserved portion of the bone bed yielded an age of 1100 ± 20 ^{14}C yr BP. Two samples from the deteriorating, underlying bone yielded ages of 1100 ± 20 ^{14}C yr BP in one case, and 1085 ± 20 ^{14}C yr BP in another.

5.3 2019 Research (Permit 19-055)

The most recent phase of field school research in 2019 focused on placing excavation units at EfOx-70 and 71. Bone samples from the bed at EfOx-70, both well preserved and deteriorating elements, yielded seven ages ranging from 1062-1159 ^{14}C yr BP, with one other sample (UOC-11447) providing insufficient collagen for dating. Two more samples from EfOx-71 taken from activity areas associated with the hearth features, yielded ages of 1129 ± 24 ^{14}C yr BP and 1135 ± 25 ^{14}C yr BP.

The radiocarbon dates for the 2019 field season were submitted to the A. E. Lalonde facility (UOC- sample prefixes) connected with the University of Ottawa, whereas all previous samples had been submitted to the Keck AMS facility at the University of California-Irvine (UCIAMS- sample prefixes). The UOC results are consistent with previous UCIAMS ages, but with standard errors of ± 23-25 years for the UOC ages when compared with the UCIAMS results (± 15-20 years).

5.4 Interpretation of AMS Radiocarbon Results

All calibrated dates from the Matzhiwin Creek locality are presented in Figure 5.2. With the exception of two older (Besant time period) and three younger (protohistoric) dates at EfOx-77 (Area C), the most intensive occupation of the sites was in the AD 800-1000 range with 24 dates falling in this time interval. All calibrated dates for this interval are outlined in Figure 5.3. The EfOx-70 bone bed has some dates with probabilities in the AD ninth century but overall the majority fall within the 10th century.

There is ambiguity in the calibration curve itself reflecting the possibility that all of the dates represent a single use of the site or, perhaps, a series of closely spaced kill events resulting in the bonebed at EfOx-70. Regardless, there was a distinct beginning and end to the use of the site all within a relatively short time span. This ambiguity is reflected in Figure 5.4 showing the calibrations for UCIAMS-197768 and -197759 along with the UOC-11454 and -11455 samples at EfOx-71. These reflect a plateau across a trough and peak in the calibration curve rather than intercepting at an oblique segment of the curve. This results in two probabilities, suggesting that the actual age of the samples could be either near the turn of the ninth to tenth centuries, or the latter part of the tenth century, or conceivably, two temporal pulses of activity.

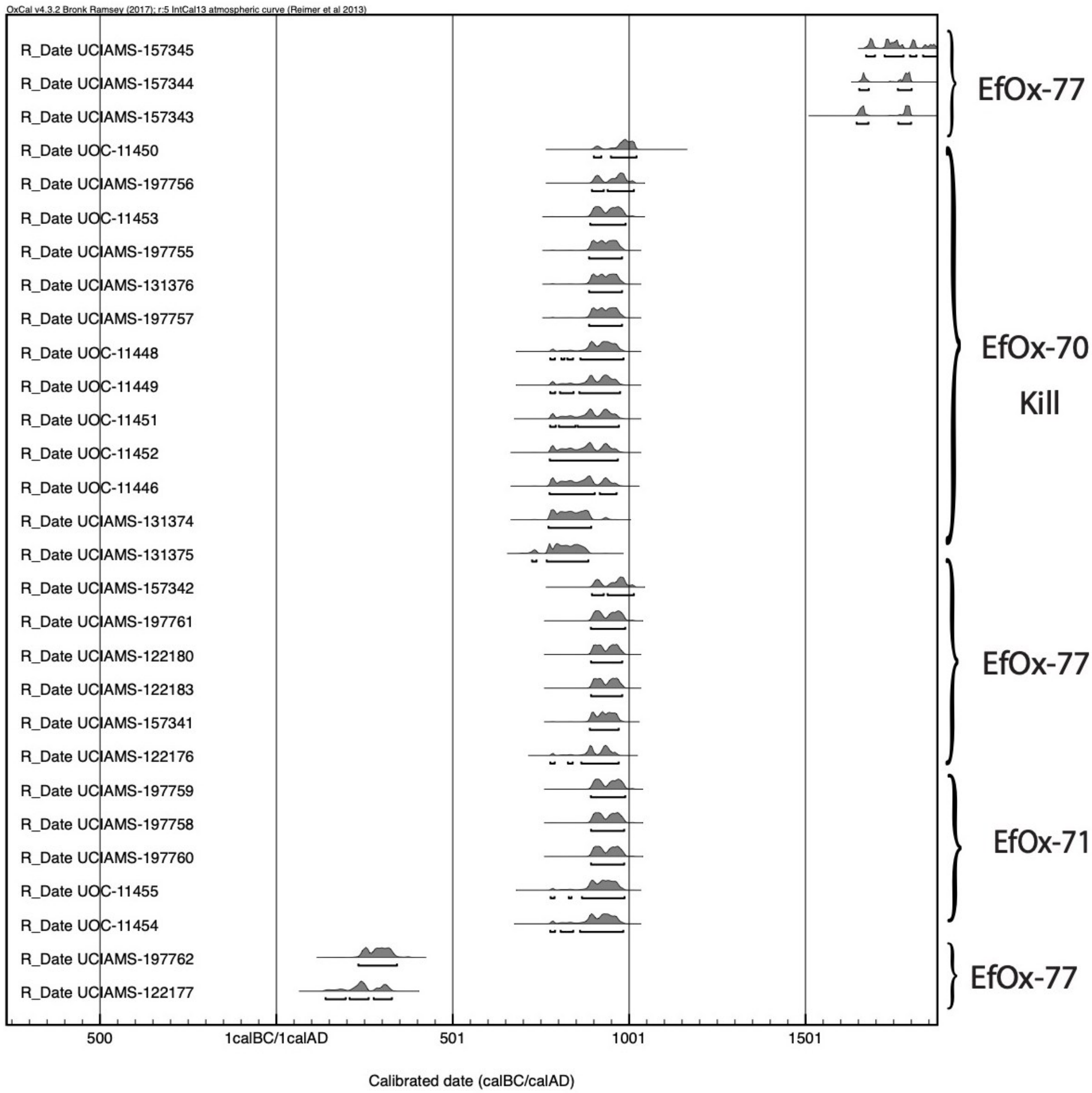


Figure 5.2 *All calibrated AMS radiocarbon dates from EfOx-70, 71 and 77 showing three periods of occupation. (Figure and calibration courtesy of John W. Ives)*

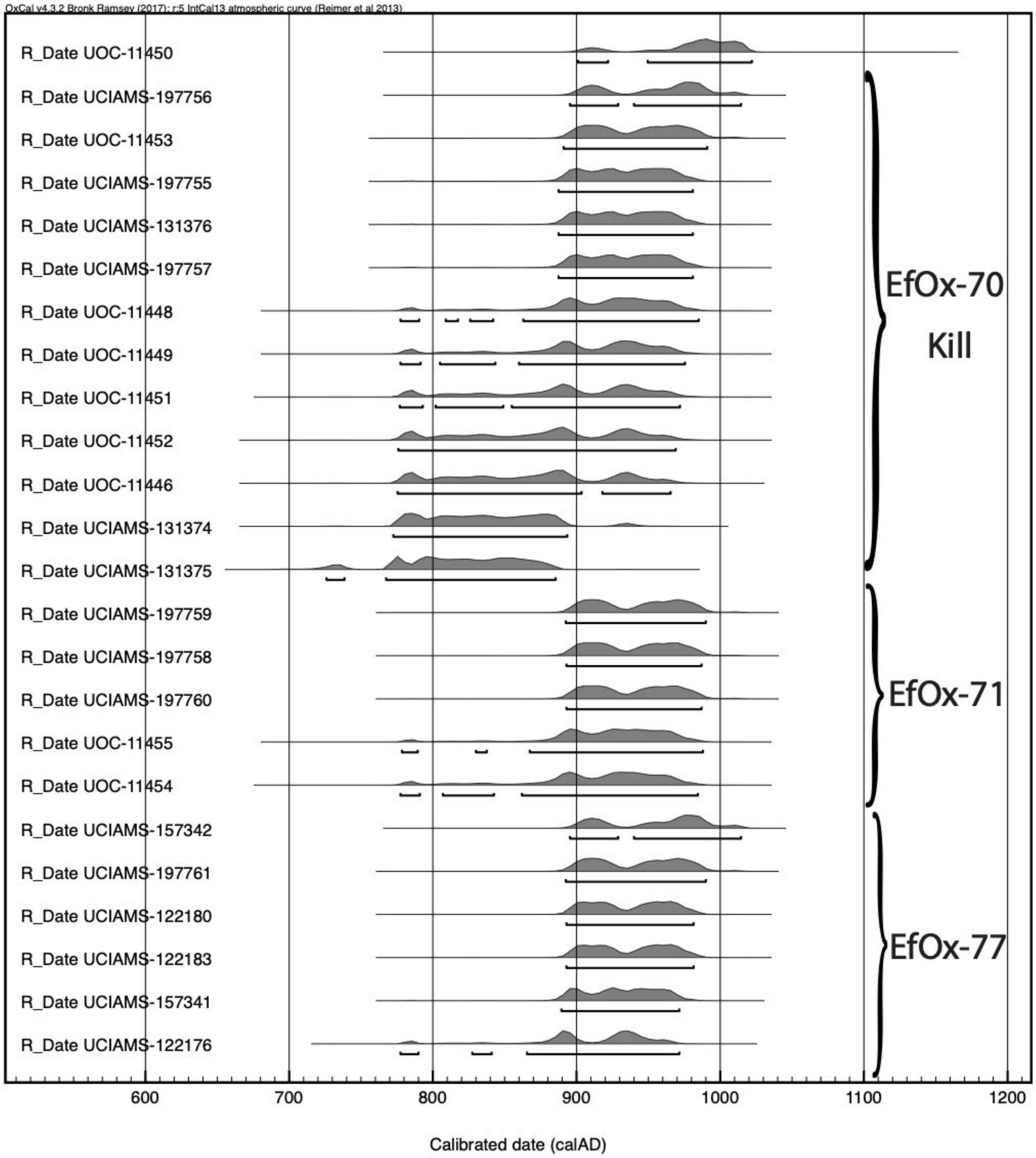


Figure 5.3 *All calibrated AMS radiocarbon dates from EfOx-70, 71 and 77 in the interval from AD 800-1000. (Figure and calibration courtesy of John W. Ives)*

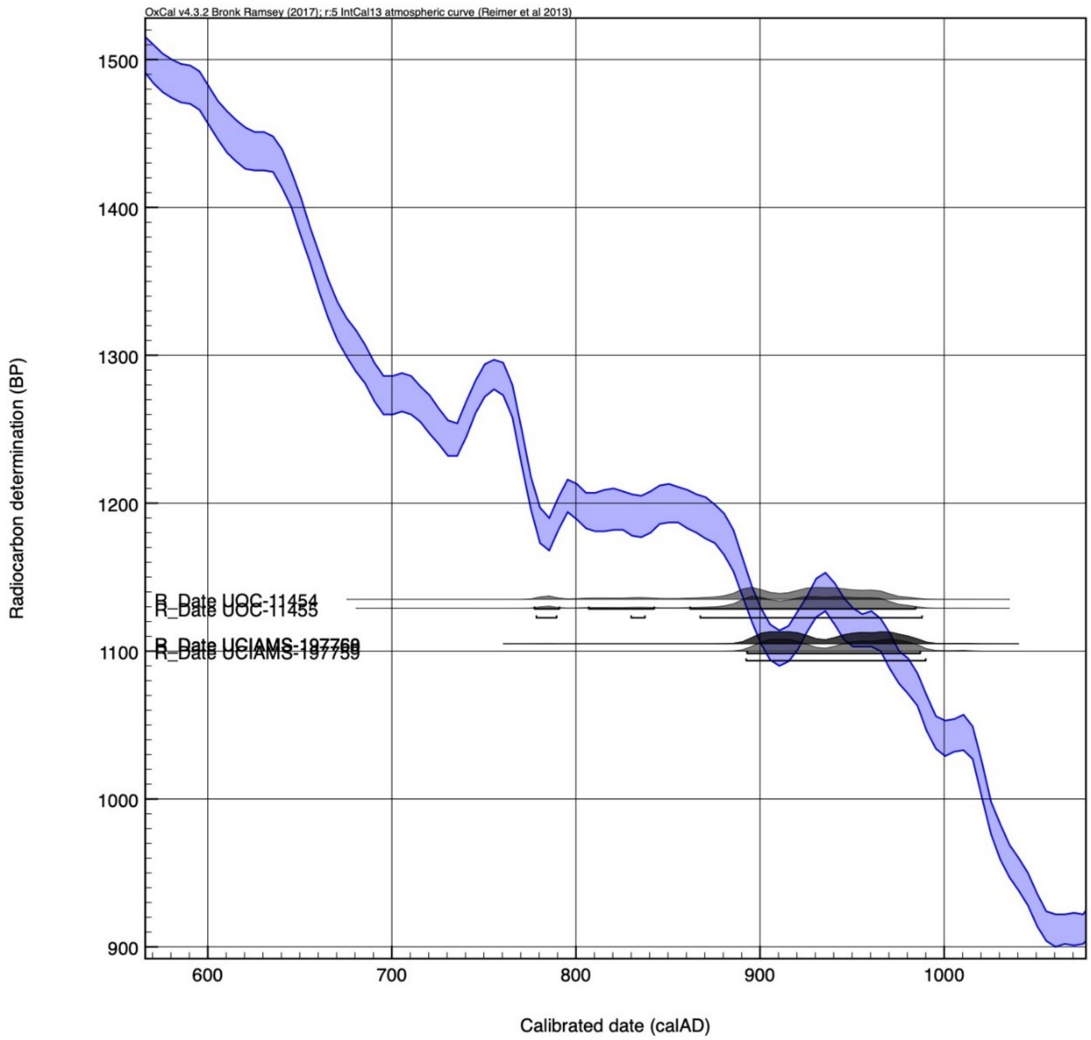


Figure 5.4 *EfOx-71 radiocarbon intercepts with the calibration curve showing a plateau in the calibration curve with a peak and trough, making calendric age estimates more imprecise than would be the case for a simpler intercept, as would be the case for the seventh or eleventh centuries, for example, in this diagram. (Figure and Calibration courtesy of John W. Ives)*

5.5 AMS Radiocarbon Dates and the Avonlea to Old Women's Phase Transition

The Matzhiwin Creek locality currently reflects one of the best dated northern Plains assemblages documenting the transitional interval between the Avonlea and Old Women's Phases in the AD 900s. If the EfOx-70, 71, and 77 kill, camp and processing areas resulted from a single event, it seems to have taken place during a material culture transition to the Old Women's Phase. Even if the sites reflect more than one event in this narrow time interval, such events would have taken place roughly within 75 years, suggesting a transition over two or three generations. Either case suggests a rapid transition.

As described in the next section, the projectile point morphologies recovered from EfOx-70, 71 and 77 closely match the transitional time frame revealed by the sample of radiocarbon dates provided here. In the EfOx-70 kill deposits, there is a slight stratigraphic tendency for more classic Avonlea forms to precede a mixture of Avonlea and more irregular forms. Like other transitional sites, the Matzhiwin Creek sites suggest a material culture change within a continuing population rather than a dramatic culture or population shift. The shift to the Old Women's phase, marked by projectile points and ceramics, comes at a time when critical Nistitapii (Blackfoot) material culture becomes especially evident on the northern Plains. This is reflected in the association of Cayley Series projectile points and Saskatchewan Basin: Late Variant ceramics of the Old Women's Phase with *iniskim* (Buffalo charming stones), Napi Effigy figures, and Type 3 and 4 Medicine Wheel subtypes, in some cases known to be the death lodges of prominent leaders (Vickers and Peck 2009).

Chapter 6: Data Analysis: Ageing *B. bison*

Although archaeologists originally considered faunal remains as merely a part of the archaeological matrix where other cultural evidence could be located (Wheat 1978), analysis of faunal remains from archaeological sites can and has provided considerable information on past human lifeways. During the 1960s, archaeologists began considering faunal remains as valuable cultural indicators in their own right (Frison 1998). Today, investigators have developed numerous ways to glean information about human behaviour from the animal bones at archaeological sites. In particular, the age of an animal at death and the season in which it died became a growing focus in paleontology, wildlife biology, and archaeology (Niven 1997). High crowned teeth in ungulates have been particularly helpful in ageing and seasonality because they often follow predictable schedules of eruption and wear.

It is tempting to immediately draw some conclusions about the assemblage of bison remains at EfOx-70 and 71 based on the excavation results of the units entered at the sites. There is much to consider, however, about the way the bison were gathered, corralled, dispatched, and butchered. Questions remain regarding the herd composition and what it may tell us about human and animal relationships at the EfOx sites. Throughout this section, I will outline some of the research on bison hunting in the archaeological record and will discuss preliminary analysis of 31 mandibles that I have analyzed based on some of the methods discussed.

Although the sites EfOx-70 and 71 are of moderate size, with evidence of numerous bison being procured in the events that took place, we excavated a small area. The data presented here are based on the results of seven square meters along with ten shovel tests from the two sites in 2019. That information is supplemented by profile clearing, recording, radiocarbon dating and embankment observations for both sites from the 2017 and 2019 investigations. Inferences about the herd composition and seasonality of the bison that were hunted are based on dental eruption. Of all faunal remains uncovered at EfOx-70 and 71, the most consistent and relatively well-preserved elements were mandibles. I chose a total of 31 *B. bison* mandibles for this analysis based on their superior level of preservation. The majority of the mandibles were recovered from EfOx-70 (n=25) and the remaining six were excavated from EfOx-71.

6.1 Tooth Eruption and Wear in Specimens at Archaeological Sites

High crowned ungulate mammals are common in North American archaeological sites as animals such as bison, horse, deer, caribou, elk, and moose have been utilized since there was human presence in North America (Klein et al. 1983:47). In western Canada there has been an emphasis on studying the dentition and age of Pleistocene horse (Levine 1983: 23), red deer (elk or wapiti) (Klein et al. 1983:47), pronghorn antelope (Nimmo 1971), and bison (e.g. Frison 1971, 1974, 1978, 1982, 1988; Frison et al. 1976; Todd and Hofman 1987). The age and season of an animal's death can play an important role in understanding the greater context of a site and presents information about the humans who relied on the animals, providing insight into hunting strategies, subsistence, and preferential selection.

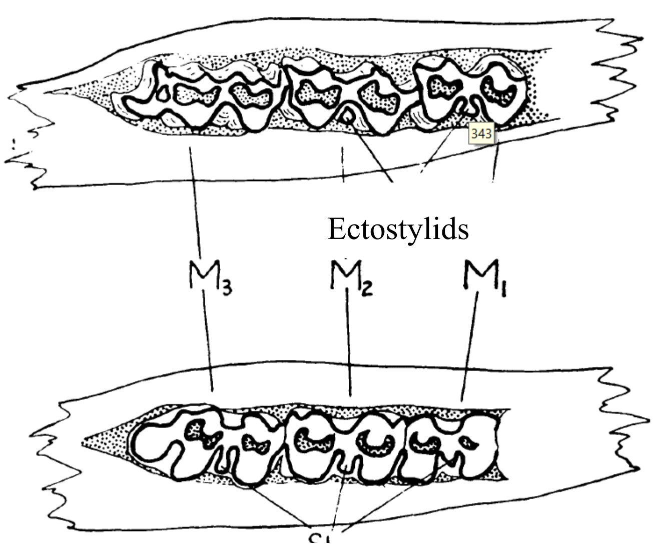
Precontact archaeological assemblages on the North American Plains are often dominated by bison remains because of the significance this animal had in the lifeways of Plains hunter-gatherers. As such, there has been much focus on what the faunal assemblages at these sites can tell archaeologists about the people who hunted them. Preliminary research on this topic came from Skinner and Kaisen (1947) and because of the continued efforts of numerous plains archaeologists in the 1970's and 1980's, including work by George C. Frison, Charles A. Reher, Dennis J. Stanford, Lawrence C. Todd, and Michael Wilson, highly developed systems for analysing bison dentitions were developed (Niven 1997). The methodologies established by these researchers have been continuously refined in recent decades and have contributed towards a standardized documentation of bison dentition (Niven 1997:22-23).

The eruption and wear patterns on *B. bison* teeth have played an important role in interpreting Plains bison bone beds (Todd 1987:28). Maxillary and mandibular dentition are both useful for measuring age according to eruption and wear patterns, but there is a prevalence of data on the lower dentition (Clark and Wilson 1981; Dyck and Morlan 1995; Morlan 1994; Rapson et al. 1996; Todd 1987:129). The lack of research on maxillary bison molars is largely due to the subjective variability of eruption and wear patterns (Klein and Cruz-Uribe 1984:53), and poor preservation in cranial bones compared to mandibles (Niven 1997:20-21). This pattern is evident at EfOx-70 as numerous maxillary molars were uncovered but most were disarticulated.

6.2 Methods

Three commonly used methods for determining the age of animals from their teeth will be outlined briefly in the following paragraphs: 1) dental eruption and wear matching of archaeological specimens with data from the same species where animal ages are known; 2) measuring crown height and other dimensions in the teeth; and 3) counting of the growth rings "annuli" in the dentine or cementum.

Age identification of bison populations is understood through the eruption schedules (see Fuller 1959: Figure 6.1) of modern specimens with known ages (Frison 1998; Haynes 1987; Klein and Cruz-Uribe 1984:48; Reher 1974; Stiner 1990). The first method discussed here is helpful for understanding the age of juvenile bison and is based on the state of eruption in molar teeth. Ageing juvenile dentition is more accurate than ageing dentally mature adults because once the teeth have fully erupted, they become subject to variable wear patterns (Rapson et al. 1996). Baseline information for eruption schedules can be found in discussions by Frison et al. (1978); Haynes (1984); Hill (2008); Reher (1974); and Todd et al. (1990, 1996) An example of the precise schedule of eruption for bison molar teeth can be found in Reher's (1974:114) discussion of bison mandibles at the Casper Site, Wyoming. The bison first molar erupts to the level of other teeth (the occlusal level) at six months of age and will wear starting at the medial (anterior) cusp. Tooth eruption observed in bison at the Casper Site shows juveniles with wear on the first cusp and slight wear on the second cusp led to the interpretation that they were at least six months of age, and more likely seven to eight months in age (Reher 1974:114). The eruption schedules in juvenile animals are often easier to attribute to an age compared to adult counterparts. Adult ageing relies on wear, sex, body mass, and other variables related to the environment and foods that are being eaten (Gifford-Gonzalez 2018:127; Silver 1963:256).



Ectostylids

Figure 6.1 *Image obtained from Fuller (1959) showing a four-year-old bison (top) and a bison in the later stages of its life (bottom). Fuller, in his extensive study made with mandibles from recently deceased bison of known ages at Wood Buffalo National Park, used the wear on the ectostylid to demonstrate age. In the four-year-old, M1 exhibits a looped ectostylid, M2 exhibits a circular wear pattern and M3 shows no wear on the ectostylid. The more mature bison showed U-shaped wear patterns on the ectostylids of all mandibular molars.*

Another method for estimating age is based on the crown heights, measured from the cemento-enamel junction (CEJ) to the top of the crown. This method is only viable in animals that have reached dental maturity, wherein all teeth have fully erupted. Measuring crown heights was used by wildlife biologists (e.g., Severinghaus 1949), and later adapted by archaeologists to define age profiles of animals at archaeological sites (e.g. Klein and Cruz-Uribe 1984; Klein et al. 1981,1983; Morlan 1994). The method has since been refined by various researchers with specific goals (e.g., Todd et al. 1990; 1996). Foundational bison dentition studies, such as those by Frison and Reher in the 1970s and 1980s (e.g. Frison 1971, 1974, 1978), used this measurement-based method with the first molar (M1) because the CEJ was exposed above the alveolus. Further observations on M2 and M3 often require the removal of bone and destruction of the specimen. Later analysis involved exposing all molars at the CEJ to properly measure crown heights (Niven and Hill 1998; Todd et al. 1996). In these studies, bone was sawn, analysed, and then re-glued to the mandible after measurements. Niven (1997) noted that, in smaller assemblages, crown heights on all three molars are critical to discerning age groups. It is also possible that crown height and wear are different between populations of the same species based on forage quality (Klein and Cruz-Uribe 1984:52). As an example, Plains bison populations have a wide range of tooth attrition among documented assemblages (Frison 1982; Reher 1974; Todd et al. 1996).

A third method for measuring age involves observing occlusal wear on teeth (Gifford-Gonzalez 2018:131; Klein and Cruz-Uribe 1984:44). Ungulate tooth crowns will wear at varying rates over an ungulate's lifespan depending on the types of abrasive tissues in plants. Ungulates that predominantly eat rougher diets (e.g., horses and cattle) are exposed to increased dental wear and their teeth contain higher enamel on their molar and premolar crowns compared to ungulates that generally eat softer diets. As a tooth wears, patterns take shape on the tooth that are quantifiable, recognizable, and attributed to a range of possible ages (Gifford-Gonzalez 2018). This method also has its problems in relation to inter-observer interpretation and the assumption that each animal's tooth wears at the same rate. Some animals of the same species may graze in different pastures of more rough plants, causing this to vary (Gifford-Gonzalez 2018).

Perhaps one of the most precise estimations of death age in mammals is the count of "annular growth rings in the dentine of tooth roots or in the "pads" of non-cellular bony cementum at the base of molars" (Gifford-Gonzalez 2018:127). This is done in a way similar to counting tree rings. The features on teeth grow annually in sets of two rings (one a slower and one a faster growth) (Gifford-Gonzalez 2018:127; Klein and Cruz-Uribe 1984:44). Each of these rings can be counted and analysed to understand the age of the animal. This practice is known as cementum annuli analysis and the paired annuli are counted to understand the number of years an animal lived. The problem with this method, however, is that it is destructive, and a tooth must be sectioned to be examined (Gifford-Gonzalez 2018). Although this is the most accurate method, other practices such as measuring crown heights, dental eruption, and wear remain viable methods and are often more feasible in terms of time expenditure (see Peck 2001).

6.3 Objectives, Seasonality, and Mortality Structures in a Bison Kill

When procuring meat, human behaviour depends on the organization of the humans, the nature of the prey, the technology, and the variables in the environment that are external to both humans and prey (Driver 1990:13). When analyzing hunting sites and examining subsistence strategies, researchers need to critically consider each of these factors as they continually fluctuate. Factors that include season, condition of the animals, landscape, and the size of the human group can all impact how humans obtained their subsistence in the past (Driver 1990).

There are also various reasons why people decide to procure certain animals that extend well beyond subsistence. As an example, how hunters obtained hides, tools, and aspects related to social ranking and other social rewards can influence subsistence strategies (e.g., Lupo and Schmitt 2016).

Faunal remains, including bones and teeth of bison, are useful tools in better understanding different factors related to subsistence strategy at any given kill site. As previously mentioned, bison have seasonally restricted mating and birthing periods, so the schedule of tooth eruption can provide ample data for archaeologists to interpret seasonality and age. Although some animal species give birth at various points throughout the year, North American bison generally calve in a restricted time period (March-April) (Rutberg 1984; Gifford-Gonzalez 2018). Such a restricted time period means that the scheduled tooth eruption should align with the birth season and can be correlated to the season in which the bison died. If the tooth rows in a bison are completely erupted, such schedules no longer afford the estimation of specific seasonality.

Table 6.1 Examples of bison kill sites and their associated season of kill

Location	Site	Season	Study
Alberta	Cactus Flower	Autumn	Brumley 1978
	Little Bow	Spring	Vickers 1991
	Ross	Spring	Vickers 1991
	Maple Leaf	Spring	Landals 1990
Colorado	Jones-Miller	Autumn	Stanford 1978
	Lamb Springs	Autumn	Knell & Becker 2018
Wyoming	Ruby Pound	Autumn	Frison 1971
	Hawken	Autumn	Firson et al. 1976
	Hell Gap	Autumn	Larson et al. 2009
Nebraska	Scottsbluff	Spring	Todd et al. 1990
	Clary Ranch	Summer	Hill 2008
Texas	Lipscomb	Summer	Todd et al. 1990

6.4 Seasonal Hunting

Based on dental eruption, Reher and Frison (1974:114) estimated that many recorded Precontact Plains communal bison kills took place during autumn months (Table 6.1). Because winters on the Great Plains can be particularly harsh, people may have chosen to time communal hunting activities shortly before winter to provide them with enough meat and hides to carry them through. In terms of bison physiology, cows would be the preferred target as they are at their peak physical condition in terms of fat stores and thick hides during this season. Additionally, the bulls are at the end of rut during late autumn so they would not be attempting to isolate cows from the herd and causing other sorts of disruption (Brink 2008:66-67). This model has been referred to as Frison's "overwintering model" (Speth 2012:177).

A similar number of recorded kill sites occurred in spring to those that occurred in the fall. Additionally, many bison hunts occurred when the animals were in poor physiological condition related to diverse grazing and environmental conditions (Fawcett 1987). Although autumn may have been the most economically efficient time to procure bison due to hide condition and high fat yield, there are other factors to consider that would also have affected bison procurement. Spring kills (Table 6.1) are present at many archaeological sites and could have occurred at the time cows were calving (April-May). According to Frison (1974) and Brink (2008) spring would be an undesirable time to procure bison because cows would be more aggressive and would be difficult to run as they would wait for their young. Thinking in terms of hide procurement for robes, this would be an excellent time for a hunt as calve hides were used for robes and bags, among other things (Vickers 1991). Summer has often been considered the stereotypical season of the bison kill as popular representations often show communal hunts taking place in that season (Brink 2008:61). During early summer, many of the cows would be nursing and would have depleted fat stores while somewhat later in summer bulls would be unpredictable and hard to manage during rut (Brink 2008). Despite these limitations, there are kill sites that appear to have occurred in the summer (Table 6.1) emphasizing that there were numerous factors at play in terms of seasonal hunting. Cooper (2008:137-143), in her analysis of Frison's autumn procurement model, found that there was a preponderance of small winter kills when animals were in poor physical condition. Thus, communal bison kills are present archaeologically throughout all seasons as numerous factors played into these events.

Cow dominated assemblages can be assumed to be the result of autumn hunts because of the prevalence of cow-calf groups in the herd at this time of year. Speth (2012) describes the importance of understanding sex ratios as bison and other ungulates are disturbed or travel away from danger. When a bison herd is disturbed, the cows generally take up the front followed by calves with the bulls taking up the rear. Already this presents a pattern in herd composition because, despite bison being corralled or plummeting over a precipice, hunters were not always successful at pushing entire herds into a trap (see Ewers 1949 for George Bird Grinnell's ethnographic accounts of this nature). This would mean that adult females would often be the most dominant animals in trap assemblages. Many ungulates, including bison, arrange themselves in a non-random pattern, and thus, the assemblage at a bison kill may also reflect such patterning.

An abundance or lack of certain age groups may also reflect selective procurement by human hunters based on nutritional condition of the bison and the fat and grease content in meat, internal organs, and bones in efforts to avoid caloric deficiencies (Speth and Spielman 1983; Driver 1990). Many mass bison kills contain an underrepresentation of juvenile remains (Driver and Maxwell 2013; Speth 2012). Frison's overwintering model assumes cow and calf dominated assemblages as they would be travelling together during autumn. Discussions regarding a paucity of juvenile remains often favor taphonomic processes and scavenger models known as *differential survival* that would lead to a lower frequency of juvenile remains found in archaeological assemblages (Stiner 1991; 2002). Poor preservation of calves and yearlings does not always explain their absence or low frequency in the assemblages of mass kills (Driver and Maxwell 2013:102). Other reasons for their underrepresentation could range from selective transport of entire young animals away from the kill site (Reher and Frison 1980:75) to environmental conditions that reduced the number of calves in a herd (Driver 1983), predation of younger animals by wolves and grizzly bears (Hill 2008), and specific targeting of prime animals by human hunters (Stiner 1994). Driver and Maxwell (2013) mentioned that the demographic make-up of a kill could often reflect the actual makeup of the living population. For instance, the population that made up the archaeological assemblage could have undergone a period of low fertility or high juvenile mortality due to disease, environmental conditions or predation prior to the kill event. Speth (2012) presented yet another possibility that could result from the hunters trapping methods leading to a bias in adult animals. Perhaps many juvenile animals could lag behind the herd that is being stampeded. Thus, the underrepresentation of calves in many mass bison kills could be a result of numerous factors that go beyond seasonality and taphonomic processes (Speth 2012:178).

Using Stiner's (1994) model, Driver and Maxwell (2013) analyzed assemblages at twenty-three mass bison kills from the northern plains. Their results demonstrated that prime aged animals constituted a high proportion of the kill assemblages. The results show that most of these kills do not conform to a classic catastrophic mortality profile but rather, paralleled Stiner's assumptions that human hunters typically create prime-dominated mortality profiles. Regardless of whether differential preservation affects younger animals at these sites, juvenile teeth should still preserve in these circumstances. Driver and Maxwell (2013) used the work of Stiner and others to present a picture of the prime dominated assemblages at mass bison kill sites, demonstrating that humans likely took advantage of a niche that was not occupied by the bison's other natural predators such as wolves and grizzly bears.

At the EfOx sites by Matzhiwin Creek, many unfused bones are present at the site and are, in some cases, larger than those that are fused. As Speth (2012) mentioned, juvenile males have a much quicker growing rate and may sometimes exceed the size of the adult females, thus being represented in kill sites but less obvious unless unfused elements are easily identified. The representation of bison at different stages of development is important to understand as they could indicate whether a site has multiple phases of use as well as the age and season of a particular bison kill. A bison kill that consists of one event should reflect animals at the same stage in their development from year to year. For instance, if there are bison that are 1.5 years of age, other bison in the assemblage should reflect development at the 0.5 year stage. Thus, bison could be 1.5 years, 2.5 years, 3.5 years and so on (Frison et al. 1976:37; Reher 1974:114). For example, modern *B. bison* populations that calve between April 15 and May 15 would yield yearlings butchered on December 1 with range from 6.5 to 7.5 months and second-year old animals will be 18.5 to 19.5 months old.

The constrained calving season of *B. bison* can aid in determining whether an event was natural or anthropogenic. This can be understood by the presence of human tools and cut marks on bone but can be reinforced by the mortality structure of the animals at archaeological sites. There are two mortality structures that are often discussed in reference to bison kills: attritional and catastrophic mortality. In an instance of attritional mortality, a wide variety of animal ages should be represented, but mainly young and old (Klein 1982; Lyman 1987; Reher 1974:117; Stiner 1990). Alternatively, catastrophic mortality should demonstrate deceased animals that show signs of death at the same moment in time and should contain more viable adult members (Reher 1974:117; Stiner 1990). Dentition samples that contain a number of animals with seasonally restricted births and who died in a single catastrophic event will show tooth wear and eruption stages that cluster into discrete age groups (Niven 1997:22-23). It is also important to consider any fluctuations in birthing rates that may have stemmed from nutritional and environmental stress. Such factors may, in rare cases, have an affect on the structure of an assemblage in a bison kill (Reher and Frison 1980).

6.5 Beyond Optimal Foraging Theory

The above discussions have been highly focused by ecologically or environmentally determinant approaches and are particularly attractive because they are founded on a sound body of theory, are amenable to quantification, and generate testable expectations that in many cases we can evaluate directly with the faunal data from archaeological sites (Speth 2013). However, the way that people go about hunting and preparing food entails far more than "calories, search and pursuit costs, return rates and foraging efficiency" (Speth 2013:180). People's dynamic behaviour follows a host of cultural phenomena determining their actions. Thus, protein and calories are but partial elements in communal hunting. Other factors, such as those that are sociopolitical, are not quantifiable and as a result are less amenable for analysis. As a result, culture can sometimes be left in the wake of more quantifiable science, assuming humans to operate as optimal foragers and hunters becoming more or less like robots than human beings.

There is a case to be made that the number of recorded kill sites are too low to represent annual events in the Precontact archaeological record, and thus, that factors beyond environmental and subsistence were certainly involved. For example, both Fawcett (1987) and Ives (1990:326-328) noted that the initially irregular and subsequently regular pattern of kill events at the Vore Site in Wyoming did not match the decadal bison forage pattern that Frison and Reher (1983) proposed as the mechanism driving communal kill events. Fawcett (1987) argued that communal hunts may have been initiated to mediate social and political tensions by providing food and other exchangeable items for human aggregations including feasting and ceremony. Such hunts would require leaders that were not only involved in organizing the drives, but in the mediation of social and political tensions. The products of these hunts could be distributed among the participants and varied goods could be exchanged (Fawcett 1987:37). Any number of social actions could be carried out during these events and they would certainly provide the framework for large social gatherings.

Social models regarding communal bison hunting beg numerous questions, many that are harder to answer via the archaeological record. How many groups aggregated to perform the hunt, whether they had kinship ties, and what social or political elements factored into the hunts are just some questions behind such events. As a baseline, Frison's "overwintering model" and other economic discussions are helpful for looking at communal bison hunting on the Great Plains. There are nevertheless a number of other factors, including indigenous knowledge and human animal relationships, that should be considered to allow a wider breadth of understanding of bison assemblages at mass kill sites. Without being exhaustive about incorporating realistic social scenarios, the truth is that if we do not open up the discussion to these types of questions, we limit ourselves to assuming that mass bison kills were based exclusively on subsistence. We then neglect the framework of human decision-making relationships, and interactions that anthropology attempts to understand.

6.6 Results

This analysis of age and seasonality of the bison at EfOx-70 and 71 is based on 31 well preserved mandibles. Reher and Frison (1980:59) recommend analyzing at least 200 mandibles to explore concepts related to seasonality and population dynamics. Although that may be an ideal sample size, it is not always feasible to achieve when working with kill sites that have small assemblages. As with all archaeology, bison kill site data can never be more than an interpretive tool (Reher and Frison 1980:76). I intend to use these samples as a baseline study rather than a definitive evaluation of age and seasonality at Matzhiwin Creek. Figure 6.2 categorizes the mandibles by age group showing a prime dominated mortality profile.

Figure 6.2 (A) *Bison according to assigned age groups. Groups 4 and 5 are most dominant,* ***(B)*** *Graph showing a prime dominated sample.*

EfOx-70 and 71 Bison Mandible Groups

I have created seven groups based on a difference in age range via dental eruption and have chosen the best-preserved mandible from each group to act as an illustration of features for that group.

Table 6.2 Bison Mandibles from EfOx-70 and 71 arranged into age groups.

Mandible	Age Group	Molar 1	Molar 2	Molar 3
Group 1				
70:81	0.2-0.6 Years	Erupted	Below Alveolus	Below Alveolus
71:956	0.2-0.6 Years	Erupted	Erupting	Below Alveolus
70:331	0.2-0.6 Years	Molars are absent but Deciduous Premolars are in conjunction with age range		
Group 2				
71:879	1.2-1.6 Years	Erupted	Erupted: Showing Little wear	Absent
70:206	1.2-1.6 Years	Erupted	Erupted: Showing Little Wear	Absent
Group 3				
71:796	2.2-2.6 Years	Erupted	Erupted	Erupting: No Wear
70:174	2.2-2.6 Years	Erupted	Erupted:	Absent
70:80	2.2-2.6	Erupted	Erupted:	Erupting Unworn 1-2 Cusp
70:209	2.2-2.6	Erupted	Erupted:	Erupting Unworn 1-2 Cusp
Group 4				
71:751	3.2-3.6	Erupted Ectostylid: U	Erupted	Erupted Cusps 1-3
70:333	3.2-3.6	Erupted Ectostylid: U	Erupted	Erupted Cusps 1-3
70:332	3.2-3.6	Erupted Ectostylid: U	Erupted	Erupted Cusps 1-3
70:336	3.2-3.6	Erupted Ectostylid: U	Erupted	Erupted Cusps 1-3
70:334	3.2-3.6	Erupted Ectostylid: U	Erupted	Erupted Cusps 1-3

70:328	3.2-3.6	Erupted Ectostylid: U	Erupted	Erupted Cusps 1-3
70:327	3.2-3.6	Erupted Ectostylid: U	Erupted	Erupted Cusps 1-3
70:330	3.2-3.6	Erupted Ectostylid: O	Erupted Ectostylid: O	Absent
Group 5				
70:329	4.2-4.6	Erupted Ectostylid: U	Erupted Ectostylid: O	Erupted Cusps 1-3 In Wear
71:797	4.2-4.6	Erupted Ectostylid: U	Erupted Ectostylid: O	Erupted Cusps 1-3 In Wear
70:107	4.2-4.6	Absent	Erupted Ectostylid: O	Erupted Cusps 1-3 In Wear
70:84	4.2-4.6	Erupted Ectostylid: U	Erupted Ectostylid: O	Erupted Cusps 1-3 In Wear
70:153	4.2-4.6	Erupted Ectostylid: U	Erupted Ectostylid: O	Erupted Cusps 1-3 In Wear
70:153	4.2-4.6	Erupted Ectostylid: U	Erupted Ectostylid: O	Erupted Cusps 1-3 In Wear
70:175	4.2-4.6	Erupted Ectostylid: U	Erupted Ectostylid: O	Erupted Cusps 1-3 In Wear
70:335	4.2-4.6	Erupted Ectostylid: U	Erupted Ectostylid: O	Erupted Cusps 1-3 In Wear
Group 6				
70:83	5.4-14.4	Ectostylid: U	Ectostylid: U	Ectostylid: U
70:324	5.4-14.4	Ectostylid: U	Ectostylid: U	Ectostylid: O
70:208	5.4-14.4	Ectostylid: U	Ectostylid: O	Ectostylid: Close to Surface
71:1018	5.4-14.4	Ectostylid: U	Ectostylid: U	Ectostylid: O
70:79	5.4-14.4	Ectostylid: U	Ectostylid: U	Ectostylid: O
Group 7				
70:78	Aged	Completely worn	Completely worn	Ectostylid: U

Bison Mandibles from EfOx-70 and 71 arranged into age groups. Those highlighted in red are used as an example to represent each group. When slightly worn, ectostylids present 'O' shaped wear and 'U' shaped for heavily worn.

Group 1. For Group 1, I have chosen mandible 71:956 (Figure 6.3) as an example. This sample contains all molars and pre-molars save M3, although its space within the mandible has been preserved. This mandible represents a yearling aged approximately 0.2-0.6 years in age. All premolars are deciduous and showing their roots as they are being pushed out by permanent premolars. Molar 1 has erupted to the level of the premolars and is being worn. Only the first cusp of Molar 2 is present above the alveolus and is not yet in wear. Molar 3, were it present, would still be within the mandible, below the jaw-line.

Figure 6.3 *Group 1 mandible (0.2-0.6 years) EfOx-71:956*

Group 2. The representative of group 2 is mandible 70:206. This mandible contains only premolar 4 and molars 1 and 2 but the preservation of the occlusal surface is useful in demonstrating the animal's age. This mandible represents an animal in its second year of life. Molar 1 is in its full stage of wear with the ectostylid still below the occlusal surface. Molar 2 is in use as well, however with only a little wear on the second cusp of the tooth.

Figure 6.4 *Group 2 mandible (1.2-1.6 years) EfOx-70:206*

Group 3. Group 3 is characterized by animals in their third year of life (approximately 2.2-2.6 years of age). EfOx-71:796 (Figure 6.5) represents this group. All molars in this mandible are present. M1 shows wear on both cusps with the ectostylid approaching the occlusal surface. Molar 2 shows more wear than the mandibles from group 2, with increased wear on cusps 1 and 2. Molar 3 has erupted about halfway to the height of Molar 2 and does not yet exhibit any wear.

Figure 6.5 *Group 3 mandible (2.2-2.6 years) EfOx-71:796*

Group 4. This group is characterized by animals in their 4th year (~3.2-3.6 years of age). EfOx-71:751 (Figure 6.6) is an excellent representation of this group by its preservation of all molars. In this sample, all mandibular molars have erupted and contain wear on the occlusal surface of cusps 1 and 2. The third cusp of Molar 3, however, does not yet show wear. The ectostylid of Molar 1 has reached the occlusal surface and is worn in a "U" shape. The ectostylids of Molars 2 and 3 can be seen above the alveolus but are not yet in wear.

Figure 6.6 *Group 4 mandible (3.2-3.6 years) EfOx-71:751*

Group 5 (animals aged 4.2-4.6 years). This group is characterized by animals with all cusps of all mandibular molars in wear. The ectostylids of molar 2 have reached the occlusal surface and show an "O" shaped wear. EfOx-71:797 (Figure 6.7) contains all molars and premolars preserved within the jaw line.

Figure 6.*7 Group 5 mandible (4.2-4.6 years) EfOx-71:797*

Group 6 (animals aged 5 years and older). This group is characterized by animals with all cusps and ectostylids of all mandibular molars in wear. EfOx-70:324 (Figure 6.8) has all premolars and molars preserved. Molars 1 and 2 show "U" shaped wear on their ectostylids. Molar 3 shows an "O" shaped wear pattern.

Figure 6.8 *Group 6 mandible (5 + years) EfOx-70:324*

Group 7 (old age). One mandible (EfOx-70:78, Figure 6.9) shows wear far beyond that of any other mandibles in group 6, therefore I have chosen to give it its own group. This mandible has preserved molars 1-3. Molar 1 is worn almost completely through, Molar 2 retains enamel only on the outer surface of the tooth, and Molar 3 is heavily worn with a “U” shaped ectostylid.

Figure 6.9 *Group 7 mandible (old age) EfOx-70:78*

Mandible EfOx-70:78 is of an older aged bison and has worn teeth similar to the end-of-life individuals outlined by *attritional* mortality (Lyman 1987). The life span of large grazing herbivores, such as bison, is dependent on how long their teeth can withstand continual wear caused by chewing grasses and plant foods. The constant chewing of plant foods causes a speedy rate of wear and any flaw in the tooth row will increase the rate of attrition (Frison 1982). Problems of old age usually occur in relation to the first molar. As this is the first molar to come into wear, it is also the first to wear out (Frison 1982: 240). EfOx-70:78 shows significant wear on the first molar to the point of the first cusp almost being eliminated. The second molar of EfOx-70:78 is worn to the dentine surrounded by a ring of enamel. This tooth wear demonstrates a much older bison being susceptible to nutritional deficiencies and could have more easily fallen victim to predators.

6.7 Discussion

These mandibles have demonstrated that there are a wide range of ages present from half a year to over seven years old. The majority of the tested mandibles fall within prime age ranges from years three to six. Additionally, the molar eruption patterns in the mandibles follow unified stages of eruption suggesting the animals died within the same season. Bison are sexually mature by the age of two, thus 25 of the 31 animals are within the prime age range. Groups 4 and 5 are represented by the most mandibles (8 in each), followed by Group 6 with five mandibles. Five animals fall under two years of age and one shows signs of old age. Using the parabola of catastrophic vs attritional mortality (Stiner 1994), animals that characterize attritional mortality profiles are underrepresented in this sample. Rather, calves are only represented by three mandibles, yearlings by two mandibles, and old age by one. The sample of 31 mandibles is not substantial enough to determine whether this would be statistically significant; however, it does not deviate from a prime dominated catastrophic mortality profile, our expectation for a mass kill of this type. Using 23 mass bison kills as a sample, Driver (2013) found a preponderance of prime dominated kills. So, although the sample is too small to act as a representation of the entire number of animals involved, it certainly does correspond to a prime-dominated assemblage, as expected for a communal bison kill.

The molar eruption in the 31 mandibles does seem to be consistent with what is expected for the autumn season. Previously, I used discussions of bison kills and descriptions of tooth wear and eruption based on summer (Scottsbluff site: Todd et al. 1996), autumn (Hawken site: Frison et al. 1976), and winter kill sites (Harder site: Morlan 1994). The tooth eruption in the Scottsbluff mandibles is at an earlier stage (less erupted) compared to those in the Hawken site which are behind in eruption to the Harder mandibles. The mandibles at EfOx-70 and 71 fall between the examples from the Hawken site (autumn) (Frison et al. 1976) and the Harder site (winter) (Morlan 1994). Therefore, this preliminary analysis would suggest that the bison kill at the Mattheis Ranch took place sometime between late autumn to early winter.

Chapter 7: Synthesis and Discussion

EfOx-70 and 71 represent distinctly different activity areas. EfOx-70 is a bonebed containing disarticulated bone elements, projectile points, and chopping and butchering tools. EfOx-71 contains secondarily processed bones and other tool types such as scrapers and ceramic sherds that are associated with hearth activities. I found a distinct distribution of tool types and their raw materials between EfOx-70 and 71 that directly correlated with butchered bone elements between the two sites. The spatial relationship between bone elements at EfOx-70 and 71 is reminiscent of many other bison kill and processing sites and suggests primary butchering at EfOx-70 with secondary butchering and processing at EfOx-71. Using the raw materials of the stone tools and their by-products at EfOx-70 and 71, I drew a direct correlation between raw material and tool type. Furthermore, I wondered whether the analysis of raw material types among the projectile points could provide clues to trade and mobility and, as Avonlea and Old Women's phase projectile points were discovered throughout EfOx-70 and 71, I wondered if the projectile points and their stratigraphic relationships could aid in determining the number of occupations that occurred at the sites.

7.1 Interpretations based on Lithic Distribution and Raw Materials

I have derived two interpretations from the lithic artifacts that delineate activity centers at EfOx-70 and 71. The first interpretation is related to the large chopping tools found at EfOx-70 and the lack thereof at EfOx-71 (Figure 7.1). Only one larger chopping tool was found at EfOx-71 in Shovel Test 8. The large chopping tools at EfOx-70 indicate primary disarticulation of bone elements requiring heavy tools. The scarcity of these tools at EfOx-71 could indicate the intentional removal of large items from hearth areas. The second interpretation concerns the exclusive presence of endscrapers and related tools at EfOx-71. As mentioned above, these tools could be used for a variety of activities from hide processing to wood working that were evidently not practiced in the areas around our excavation units at EfOx-70, and in fact would be unlikely in the bone bed locality. The preponderance of finished and expended projectile points at EfOx-70 suggests that the bonebed is not far from where the kill took place and that points were left or lost within butchered carcass segments (Figure 7.1). The lack of completed and expended points at EfOx-71, along with the presence of preforms, suggests that some retooling of weaponry took place at this location whereas primary butchering took place at EfOx-70 before carcass segments were brought to the hearth areas.

The exclusive presence of endscrapers and the absence of large chopping tools at EfOx-71 merits discussion on the spatial formation of artifact assemblages. In Binford's (1983) ethnoarchaeological studies, noted concentric zones around hearths where varied refuse was deposited. Stevenson (1985) posited that it should be possible to monitor the spatial and temporal formation of artifact assemblages using Binford's "toss" and "drop" zones, providing an example of what it might look like at the Peace Point site in northern Alberta. These concepts are based upon the clearing of larger pieces of refuse that would get in the way of activities normally conducted around hearths leaving smaller items to remain in and around hearth activity. We made similar observations at EfOx-71 as the "living floor" around the hearths contained worn out and expedient scrapers, projectile point preforms, broken ceramics, small pieces of fragmented bone, lithic debitage and smaller stone tools that would characterize a "drop zone." The absence of larger tools could be explained by this phenomenon but also could be related to the differing activities between the sites. A further breakdown of the tool types at EfOx-70 and 71 is provided in the charts of Figure 7.2.

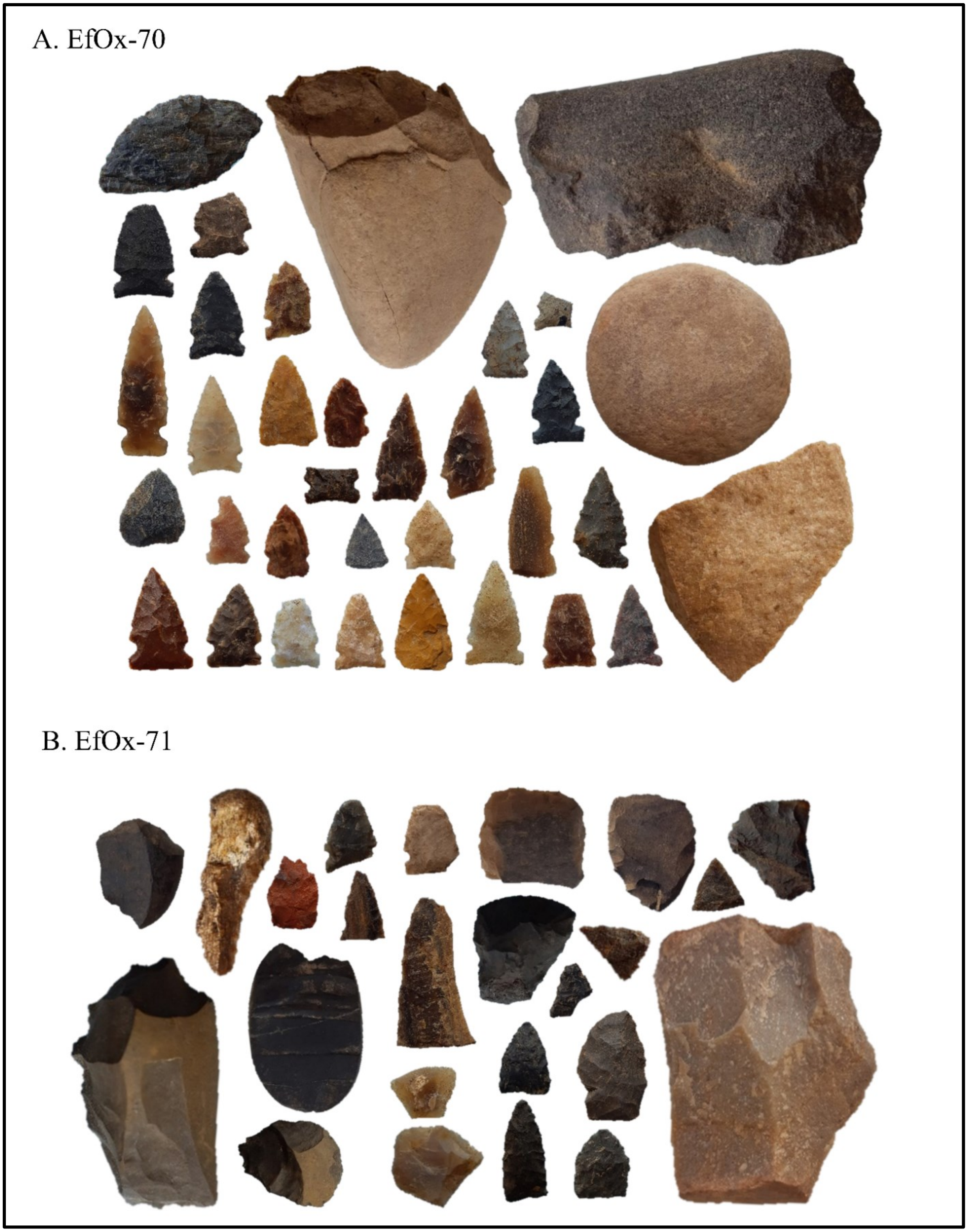


Figure 7.1 *Tool Types as distributed between sites. Notice EfOx-70* ***(A)*** *is represented primarily by choppers and projectile points and EfOx-71* ***(B)*** *by scrapers and preforms.*

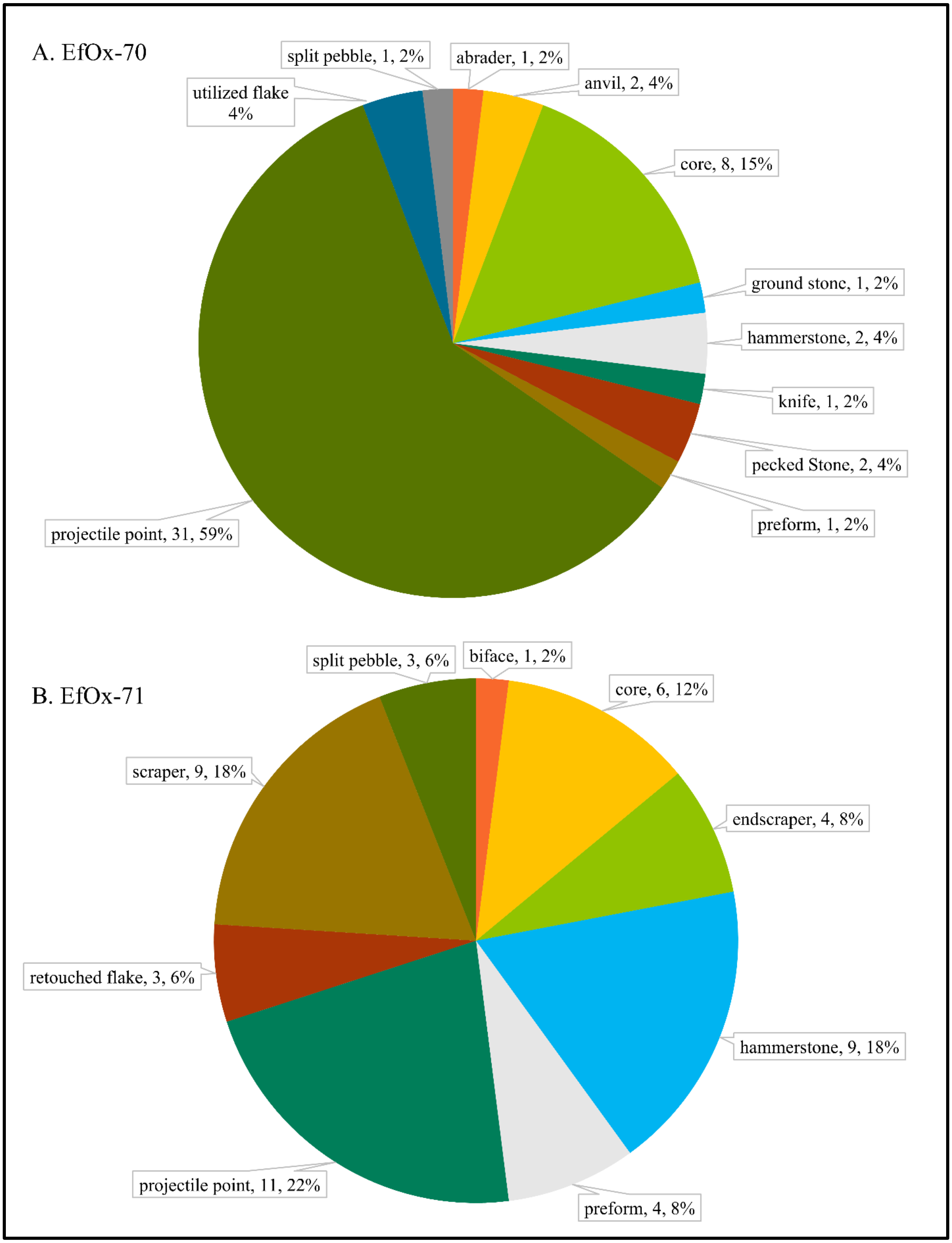


Figure 7.2 *Tool Distributions at EfOx-70* ***(A)*** *and EfOx-71* ***(B)****. The percentages in this figure exclude flakes.*

7.2 Raw Stone Materials

Using the raw materials of the stone tools and their by-products at EfOx-70 and 71, I drew a direct correlation between raw material and tool type. The tool types at EfOx-70 were almost exclusively large quartzite choppers, projectile points, and retouch flakes suggesting the presence of other butchering tools. EfOx-71 contained more diversity in lithic technology. Raw material distributions, both by weight and by count (Figure 7.3), reflect the nature of tool type distribution at both sites. For raw stone material distribution at EfOx-70, quartzite artifacts accounted for 98 percent of the total weight of lithics in the units and 87 percent at EfOx-71 (7.3 B and D). By number, however, quartzite accounted for 43 percent at EfOx-70 and 24 percent at EfOx-71, showing a greater numerical diversity in raw material types than is the case with larger tools (7.3 A and C). The high variability in raw materials that we found in the projectile points was reflected in the retouch flakes suggesting that tools of higher-grade materials were being resharpened during butchering activities. It is plausible that tools of higher quality, non-local source materials were being conserved; thus, their presence in the archaeological record is only reflected by the sharpening flakes.

Another dimension to the distribution of tools, by-products and their relationship to raw materials, is reflected in the presence of local over exotic toolstones. At EfOx-70, 46 percent of the lithics were locally available, a figure that would rise to 54 percent if the Swan River chert was local in origin. At EfOx-71, 59 percent were locally available materials, 69 percent if Swan River chert was collected locally. In the pie charts, the tool distribution by raw materials shows that at EfOx-71, many of the scrapers and preforms were made on locally available silicified sedimentary and silicified wood stones (7.3 C). At EfOx-70, the raw materials are less variable but so are the tool types. As seen in the pie charts, large choppers were made of locally available quartzite and projectile points were made of fine-grained siliceous materials.

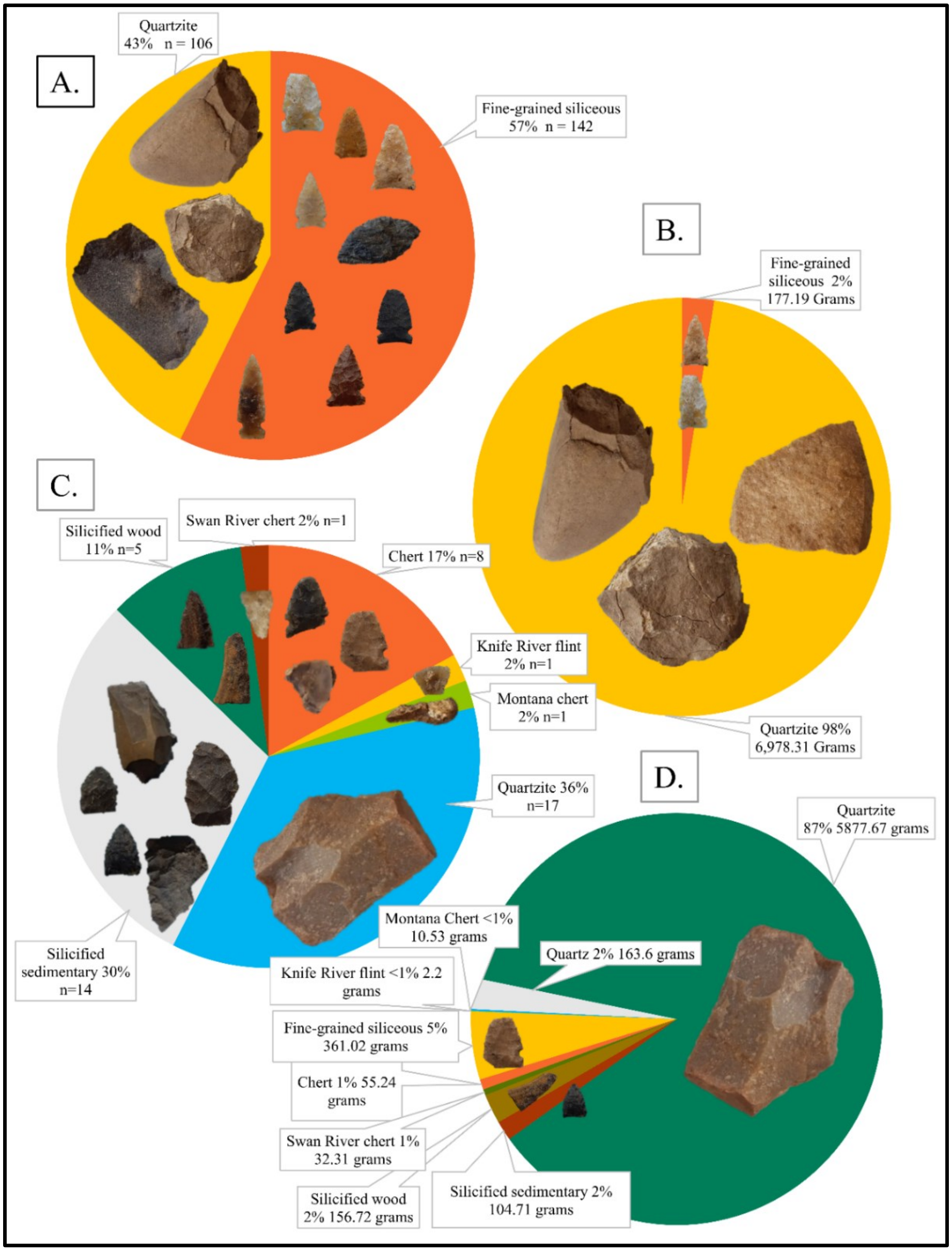


Figure 7.3 *Raw material distribution across tools and debitage* ***(A)*** *By number at EfOx-70,* ***(B)*** *By weight at EfOx-70,* ***(C)*** *By number at EfOx-71,* ***(D)*** *By weight at EfOx-71.*

Following interpretations about site activity based on the stone tools and their by-products, I wondered whether the analysis of raw material types among the projectile points could provide clues to trade and mobility. The great variety in raw material types in the projectile points warrants a discussion around the occupant's preparedness and planning before and after the kill. The phrase *gearing up* has been used throughout the literature on lithic technologies, referring to the process of establishing a toolkit for a planned kill. I imagine gearing up to be a phenomenon falling under the umbrella of embedded or disembedded procurement (Seeman 1994), where lithic procurement strategies could be embedded within seasonal rounds. Disembedded strategies would meet specific lithic technological needs outside of other seasonal round activities. Gearing up in either sense implies a specific intent for a planned activity. In the case of the EfOx sites, the activity requiring the greatest needs would be associated with the undertaking of a communal bison kill and the processing of the meat and hides. Here, I will provide an example using the Vore site: a well stratified series of late period bison kills within a circular sinkhole, in the Black Hills of northeastern Wyoming. It is dominated by curated tools (primarily projectile points) of non-local origin. Reher and Frison (1980) hypothesized that the three main raw materials pointed towards source quarry incorporation into the seasonal rounds of the Late-Precontact occupants. The Vore site showed a preponderance (75 percent) of lithic raw materials coming from three widely separated quarry areas: Spanish Diggings quartzites (southeast Wyoming), Powder River Basin porcellanites or metamorphosed shales (north-central Wyoming or central Montana), and Knife River Flint (west-central North Dakota).

In a similar fashion to the Vore site, the weaponry within the bonebed at EfOx-70 is largely composed of higher quality toolstones, unavailable locally, that were collected whether by seasonal round or by trade. The projectile points we recovered at EfOx-70 demonstrated variability in raw materials that included Knife River flint (4), Montana chert (2), Swan River chert (3), heat-treated silicified wood (5), fine-grained quartzite (4) and thirteen varied high-quality raw materials from unknown locations. I considered this noteworthy because there did not seem to be one material that dominated the formed tool assemblage at EfOx-70. Rather, a number of raw materials from a range of localities characterized the refined tools. Aside from the Swan River chert and silicified wood, the other fine-grained materials were not evidently local. EfOx-70 may demonstrate gearing up for weaponry but with more variability in the collection strategy than compared with the occupants at the Vore site. The Vore site is closer to the source localities of the three most common raw materials in that projectile point assemblage, whereas "exotics" like Knife River Flint in the EfOx assemblages would have come from much farther away, and outside of a typical seasonal round (Reher and Frison 1980:125-128).

The variability in the raw materials of the projectile points at the EfOx sites suggests that the occupants used a combination of trade and collection throughout their travels on the landscape, similar to that of Dawe's (1987) interpretations at Head-Smashed-In. This would involve gearing up throughout seasonal movements, similar to but more diverse than that of the occupants at the Vore site. Evidence found in the preforms at EfOx-71 and 77 shows that the occupants did not overlook the opportunity to retool with local materials despite the poorer quality of the toolstones. As I have mentioned the "quality" of toolstones throughout this discussion, it should be clarified that "quality" is related to the ease of manufacture, ability of a material to retain an edge, and size of the parent rock (i.e. pebble or tabular nodule). Ultimately, the occupants were cognisant of the needs associated with their hunting activities and took advantage of any one or all of these scenarios, showing an adeptness to operating as highly mobile bison hunters on the Plains, even in places containing a paucity of high-quality lithic materials.

7.3 Interpretations Related to Projectile Points

EfOx-70

As mentioned previously, both Avonlea and Old Women's phase projectile points were discovered throughout EfOx-70 and 71. Although the AMS radiocarbon dates show some ambiguity as to the number and time of occupations, I wondered if the projectile points and their stratigraphic relationships could aid in determining how many occupations occurred at EfOx-70. Beginning with morphology, all projectile points at EfOx-70 were finished forms, some complete, and some broken from impact, likely during the kill event. Morphologies of all of the points fall within Avonlea or Old Women's typologies with some in-between showing transitional characteristics. The stratigraphic relationship of the points at EfOx-70 reveals a trend in the morphology of the projectile points. While EfOx-71 has roughly 20 centimeters of overburden above the cultural layer, EfOx-70 has approximately 90 centimeters of overburden. This difference is explained by the escarpment directly south of the bonebed and the likelihood that years of accumulated slope wash accounts for most of the overburden. Although the initial bone layer (Levels 1-2, ~90 cm below surface), provided well preserved bone, Level 3 contained poorly preserved bone, gradually decreasing in quality with depth. The clearest stratigraphic change at EfOx-70 was beneath Levels 1-2. Some charcoal and calcined bone was present here but not in dense enough quantities to suggest an intense burn feature. The separation between Levels 2 and 3 is also distinguished by the greatest difference in projectile point morphology (Figure 7.4). Projectile points below the Level 2-3 separation conform very closely to Avonlea forms whereas the top two rows deviate from classic Avonlea morphology and resemble points that occur in assemblages from Avonlea to Old Women's transitional time periods such as the Estuary Site (EfOk-16), the Upper Kill site (DiPd-1), and the Empress Site (EfOo-130) (Adams 1977; Forbis 1960; Byrne 1973:630; Hudececk 1989; Clarke 2000). As discussed in Chapter 2, the projectile points at EfOx-70 share similarities with other transitional sites all showing tightly morphologically controlled Avonlea phase points with symmetric bodies, delicate notching, and parallel flaking followed by a range of transitional points with variable blade length, irregular flaking, and varied notch positioning. The temporal and morphological connection between these EfOx sites emphasizes their importance as the most robustly dated of the Avonlea to Old Women's transitional sites.

The apparent morphological differences between the projectile points in Levels 2 and 3 accompanied by the increased bone degradation and preservation of softer tissues suggests different taphonomic phenomena affecting the two levels. Level 3, being the thickest (~60 cm) and most distinct of the three levels, lacked any clear stratigraphic distinctions, but it is possible that slope wash and decomposition in the bonebed may have caused the shifting of artifacts within this Level. The bonebed at EfOx-70, therefore, raises some questions regarding chronology, preservation, and frequency or duration of occupations. Perhaps excavations at the western portion of the bonebed where there is one clear cultural layer represented in the profile would provide some insight into the occupation(s) at EfOx-70. Should the projectile points found within this area conform more to the Cayley series typology as Levels 1-2 in Units 1-3 did, it may indicate that deeper levels containing heavily degraded bone constitute a previous kill event some decades before.

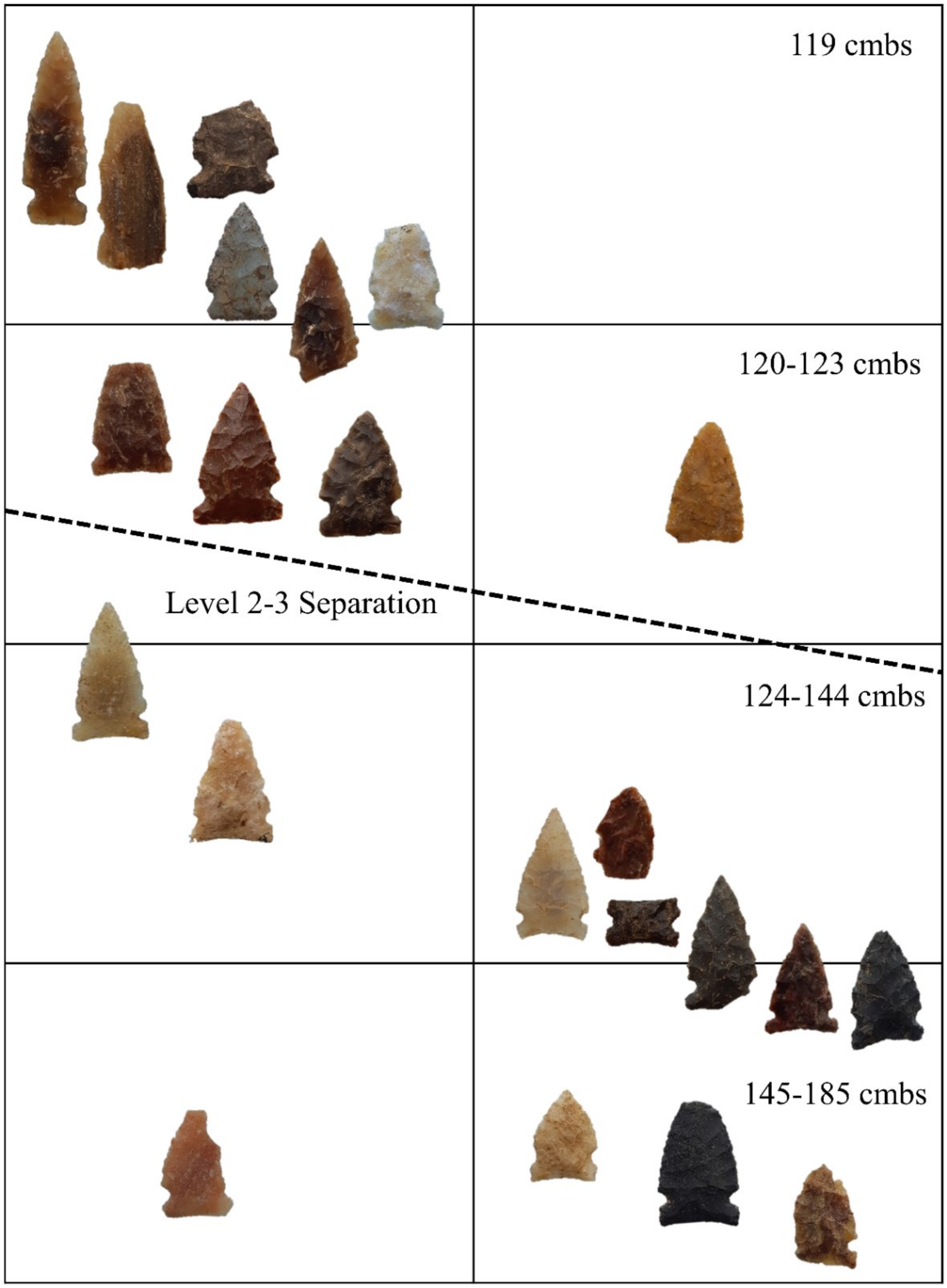


Figure 7.4 *The stratigraphic relationship of projectile points at EfOx-70: The overburden of Unit 1 was roughly 15 cm thicker at the SW corner gradually descending into Unit 2, thus the stratigraphic relationship between the levels should be looked at in relation to level separation rather than depth below surface. Note the most characteristic Avonlea points are found in the lowest portion of the excavation units with more transitional and Cayley series points near the top.*

As the AMS radiocarbon dates in the bonebed did not provide us with a clear distinction, perhaps the projectile points can. The wiggle match in the radiocarbon calibration curve, primarily the plateau intercept, makes it difficult to determine if there were one, two, or a few closely spaced occupations. If we imagine that the site was occupied more than once in ~75-100 years, the projectile point morphology and the limited stratigraphy at EfOx-70 could be capturing the Avonlea-Old Women's transition from Avonlea to Cayley Series projectile points in closely sequent kill events. This seems somewhat more probable than the alternative, which would be that there is a mixed assemblage resulting from a single occupation at a critical time in the northern Plains archaeological record. As mentioned in Chapter 2, sites like Estuary, Upper Kill and Empress also reflect this transitional period. EfOx-70, 71, and 77 are now among the most robustly dated transitional sites. However we interpret the dates and stratigraphy, they reflect an unusually narrow range of occupancy accompanied by an evident transformation of material culture, in what could amount to two or three human generations, or less.

7.4 Projectile Points EfOx-71

The projectile point assemblage of EfOx-71 was markedly different than that of EfOx-70. While it was expected that fewer projectile points would be discovered further from the kill locality, there are still some interpretations than can be made with respect to the morphology of the projectile points and preforms at EfOx-71. Completed points such as those found at EfOx-70 were rare. Two "finished" points found in the EfOx-71 units have evidence of being "expended," meaning they were used, broken, and likely discarded from arrow shafts. Two finished projectile points were also found along the embankment of EfOx-71, though out of their original context. At EfOx-71, the presence of broken projectile points and preforms may suggest the retooling of weaponry.

Two expended points are made of unfamiliar raw materials of a higher quality than those locally available. Both points have a broken basal tang. The missing tangs from the base of each point would impair their use in a haft. It is likely that the points were removed from the hafts of arrows as the occupants were replenishing their weaponry. The preponderance of preforms within the hearth activity area suggests new points were being manufactured to replace broken or lost arrowheads.

Common at EfOx-71 and absent at EfOx-70 were triangular preforms. Plains Triangular preforms are common in sites of this time period. At Head-Smashed-In (HSI), a bison kill with multiple occupations in a related time period to that of EfOx, as of 1987, the 758 points uncovered in the processing area included 85 triangular preforms, the majority crafted from exotic raw materials. So far, in contrast to HSI, all of the preforms found at EfOx-71 and EfOx-77 (a site with similar activity areas as to that of EfOx-71) were made from locally available raw materials. Dawe (1987) hypothesized that the points at Head-Smashed-In were being prepared and traded in to refit arrow shafts. He suggested the trade of higher quality preforms but also noted the production of more expedient preforms and arrowheads from local materials. HSI, like the EfOx sites, has poor-quality local lithic materials, but unlike many of the preforms at HSI, the preforms at EfOx-71 and 77 were expediently made with local raw materials, providing evidence that the occupants needed to refit their weaponry and were constrained to do so with local raw materials. The preponderance of high quality (exotic) toolstone in the projectile points at EfOx-70 together with the use of local materials to prepare new projectile points at EfOx-71 and 77 suggests that the occupants had access to high quality raw materials, whether traded (likely as triangular preforms) or gathered in seasonal rounds, prior to successful hunting. After the hunt, occupants needed to retool using local materials, a factor suggesting that they remained in the area for some time.

7.5 The Features and Ceramics at EfOx-70 and 71

Hearths and Bone Upright

The local for the excavation of units 1-3 at EfOx-71 was chosen because of a burn feature visible in the embankment. Upon excavation, we discovered another hearth at the border of units 2 and 3. The second hearth was associated with a bone upright feature (Feature 4) and a scatter of ceramics, lithics, and faunal remains. The three units contained lithic debitage mostly in the form of tertiary reduction flakes, endscrapers and other small cutting tools, projectile point preforms, ceramic sherds, and heavily processed bone. The bone upright feature included three vertical long bones and an upright rib with some bone fragments, including a canid innominate. The function of the bone upright is unknown but could have assisted in some cooking activity or to prop up hide preparation structures. Bone uprights are not uncommon in Middle and Late Precontact bison hunting sites such as Fincastle (Bubel 2014), Stelzer and Mulbach (Graham and Ives 2019), Head-Smashed-In (Brink and Dawe 1989), and Junction (Vivian and Blakey 2018). The function of bone uprights is not well understood, and their form is variable. They may have served multiple functions depending on the needs of the occupants. The soil colour emanating southeast of Feature 4 at EfOx-71 resembles that of features that have been dug into the ground by the occupants. For instance, Pit Feature B from the Hardisty bison pound, an Avonlea component site near Hardisty, Alberta, contains bone elements that were dug and buried by the occupants (Moors 2010:82, 92). Hardisty Pit Feature B and Feature 4 from EfOx-71 are similar both in colour, shape, and orientation and were dug by the occupants in an ovate pattern with a northwest to southeast orientation (Figure 7.5). Though the composition of bone elements is different and more sparse at EfOx-71, the similarities between the two are of note.

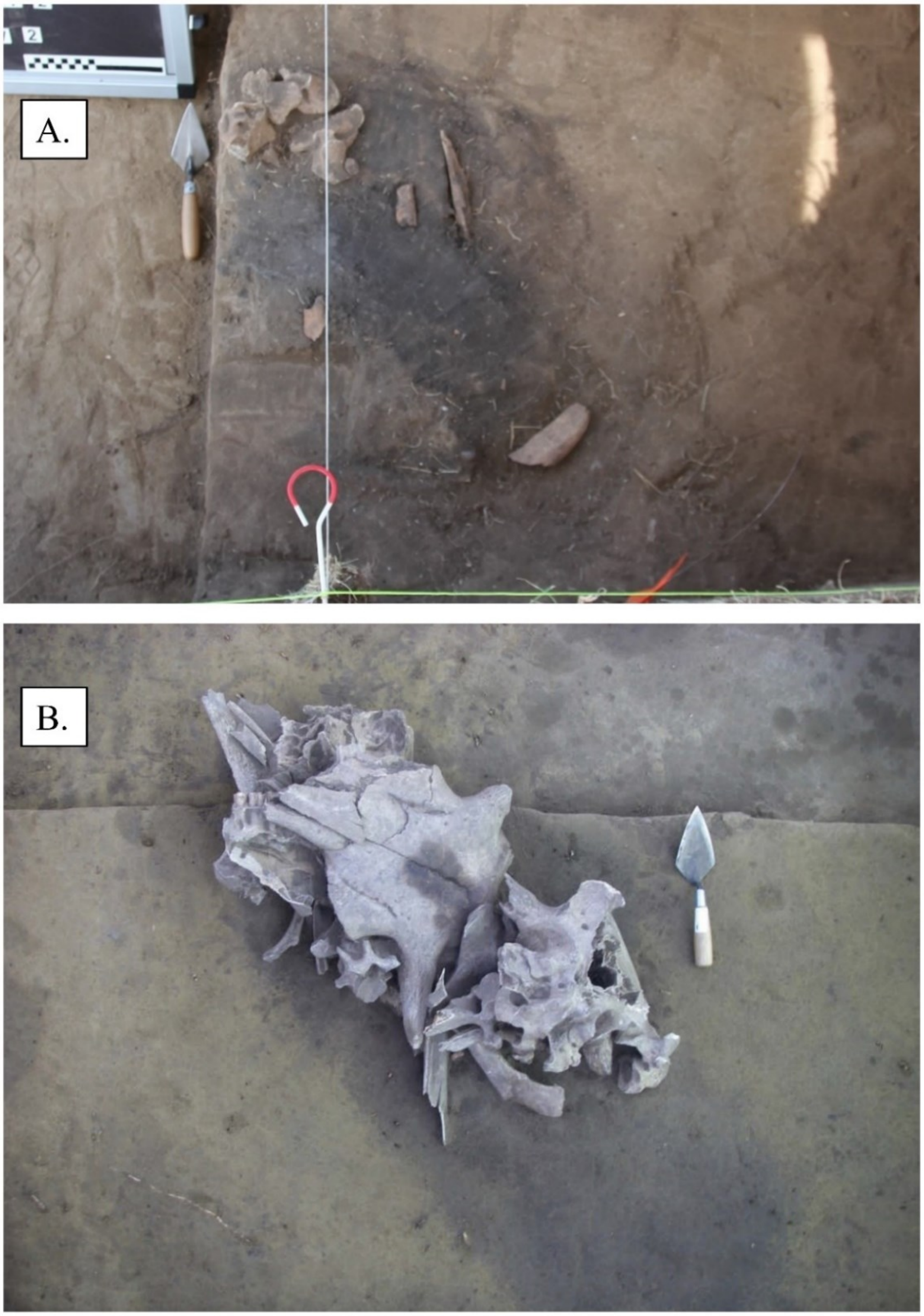


Figure 7.5 *Bone Features* ***(A)*** *Feature 4 at EfOx-71,* ***(B)*** *Pit Feature B at the Hardisty bison pound. Note the similar soil color, shape and orientation of the features. Photograph B retrieved from Moors 2010:82.*

Ceramics

Although small in comparison to the lithic artifacts and faunal remains, the ceramic assemblages of EfOx-70 and 71 merit some discussion. Typological classification of the ceramics at EfOx-70 and 71 is less clear. Although a significant change in projectile point form occurs between the Avonlea and Old Women's phases, the ceramic wares remain similar (Byrne 1973; Meyer and Walde 2009). Ceramics associated with the Avonlea phase can show regional variation (Peck 2011; Vickers 1986) but generally fall under three main wares known as Rock Lake Net/Fabric Impressed ware (Alberta and Saskatchewan Plains), Truman Parallel Grooved ware (Northeastern Montana and the adjacent areas of Alberta and Saskatchewan), and Etheridge Cord-Roughened ware (Northern Montana and southern Alberta). They are followed by a fourth ware that contains a smooth outer surface that has also been found sporadically throughout the Avonlea geographic area (Meyer and Walde 2009:52). Of the ceramic wares associated with Avonlea, none of the four are exclusive to it and some variants such as Etheridge ware follow through into the Old Women's phase (Meyer and Walde 2009:52, 62). The ceramics we uncovered at EfOx-70 and 71 as well as the few sherds uncovered at EfOx-77 in previous field seasons, contain a smooth outer surface potentially related to the smooth wares found throughout the Avonlea geographic area mentioned by Meyer and Walde (2009:52). There is not enough decoration or other characteristics to definitively classify the ceramics into one particular category or another, but its presence is consistent with the time frame and other diagnostics within the sites.

Interpretations Based on Bone Distribution

The spatial relationship between bone elements at EfOx-70 and 71 is reminiscent of many other bison kill and processing sites such as Fincastle (Bubel 2014) and Muhlbach (Gruhn 1969; Graham 2014) and presents a picture of primary butchering at EfOx-70 with secondary butchering and processing at EfOx-71. As defined at the Fincastle site (Watts 2008:12; Bubel 2014:216-218), primary butchering areas demonstrate faunal remains with sections of the animal in higher quantities relative to the more transportable appendicular portions, whereas secondary butchering demonstrates transportable appendicular portions often highly processed.

As seen in Figure 7.6 and 7.7, fewer appendicular elements (aside from the lower metapodials and foot bones) were recovered from EfOx-70 whereas EfOx-71 contained a higher percentage of appendicular elements. The EfOx-71 appendicular elements were highly fragmented from processing or marrow extraction; however, both the Fincastle and Mulhlbach sites contain evidence of primary butchering of a similar nature to that of EfOx-70 (Bubel 2014; (Gruhn 1969:135-138). Lower limb portions, loosely articulated, were found at EfOx-70 with metapodials severed in the center of the diaphysis suggesting the removal of low ultility foot bones from high rank appendicular elements (Figure 7.8). The presence of heavy stone choppers within the bone bed suggests their utility for this process.

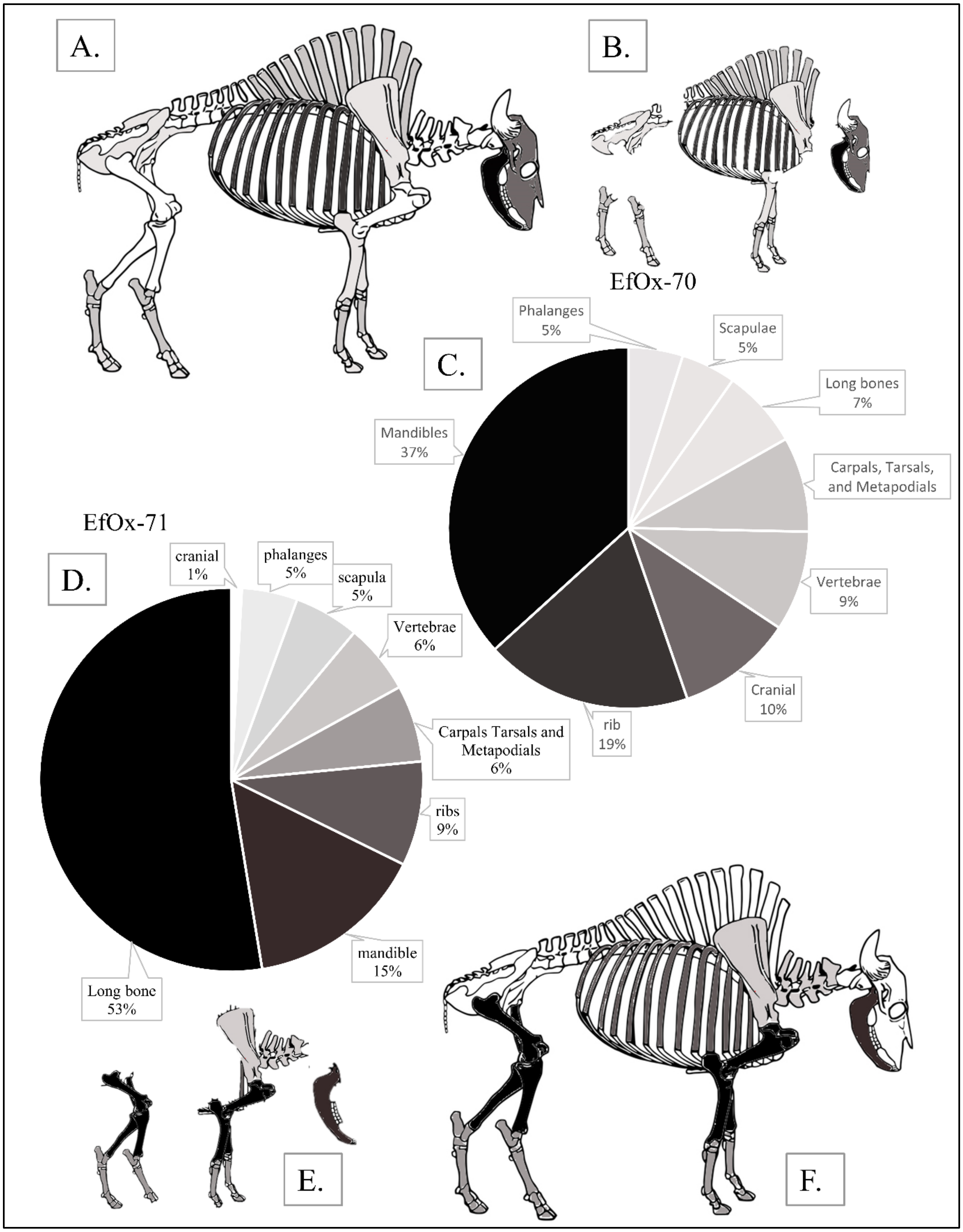


Figure 7.6 *Carcass distribution by bone element at EfOx-70 and 71.* ***(A-B)*** *Presence of bone elements by shade at EfOx-70,* ***(C)*** *Representation of bone elements by weight at EfOx-70 and* ***(D)*** *EfOx-71,* ***(E-F)*** *Carcass distribution by bone element at EfOx-71. *Darker shades indicate higher representation. Data catalogued and synthesized by Madison Bremault, Brynne Martin, and Dale Fisher*

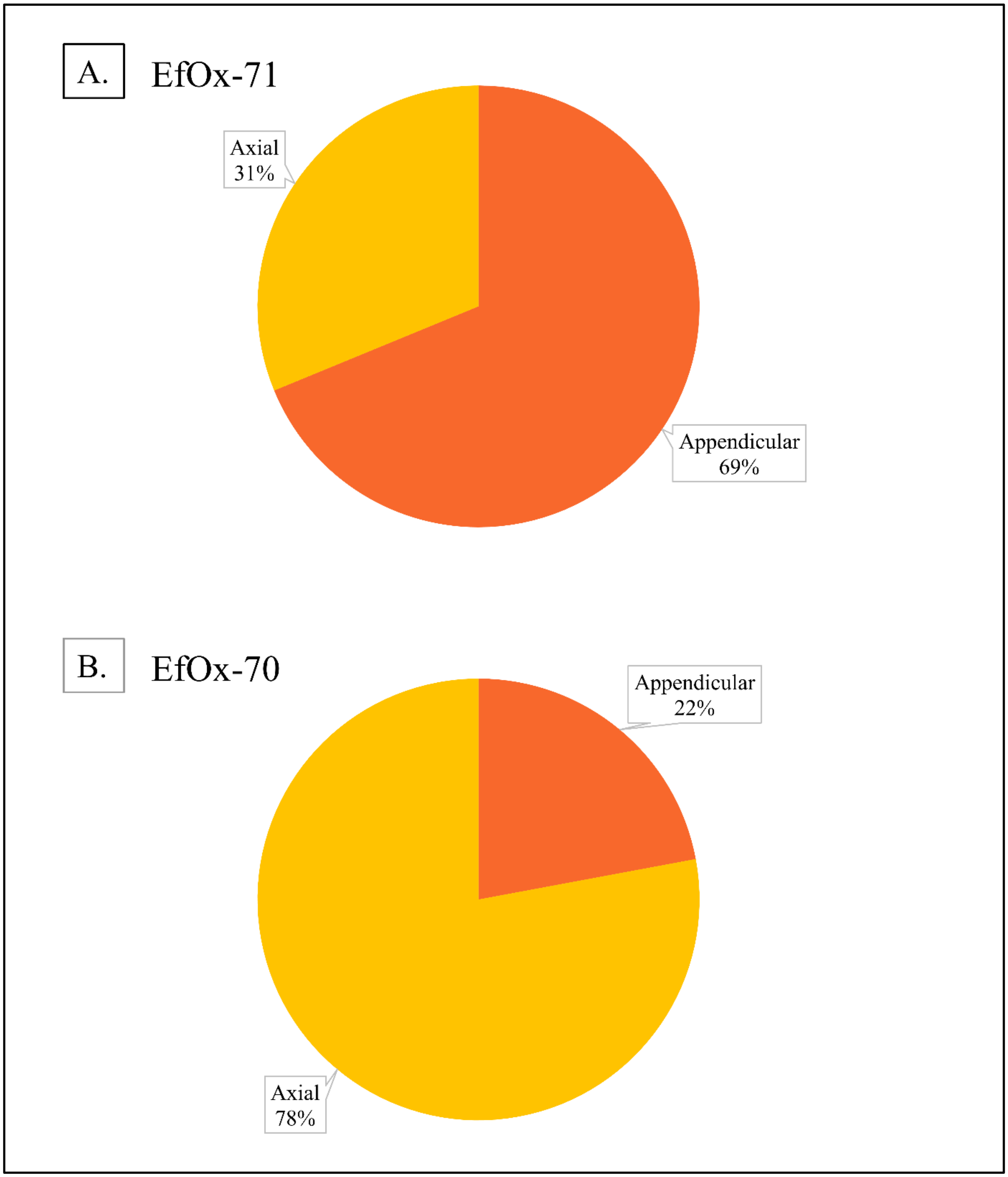


Figure 7.7 *Faunal remains represented according to identifiable* B.bison *elements. Here, only identifiable bones were used to calculate NISP and were used to delineate axial and appendicular portions.* ***(A)*** *EfOx-71,* ***(B)****, EfOx-70. At both EfOx-70 and 71 unidentifiable comminuted or degraded bone fragments are most numerous. Of the number of identifiable specimens present (NISP), appendicular elements are more representative at EfOx-71 as expected for a secondary butchering area. Data catalogued and synthesized by Madison Bremault, Brynne Martin, and Dale Fisher.*

Figure 7.8 *Metapodials from EfOx-70 broken at the diaphysis*

The Fincastle and Muhlbach sites showed similar patterning with some articulation of metapodials and phalanges (Bubel 2014:216; Gruhn 1969:136). EfOx-71, Unit 3 also contained loosely articulated lower limb bones suggesting limb disarticulation at this site, although these lower limb bones were those of a juvenile animal. At Fincastle, Muhlbach, and EfOx-70 vertebrae were present and articulated or loosely articulated in small sequences. As at Fincastle, evidence of long bones was almost absent in primary butchering areas (EfOx-70) but fragmentary long bones were present where secondary butchering activities took place (EfOx-71). Few humeri were found at EfOx-70 although scapulae were present. This resembles the pattern Frison (1973:39) discussed in which forelimbs were dismembered at the scapula-humerus joint at the Wardell bison kill. At EfOx-71, the number of disarticulated and heavily fragmented long bones suggests secondary butchering activities. Many of these bones show evidence of fresh breaks demonstrating spiral fractures and conchoidal scars.

Patterns in the faunal assemblage from EfOx-70 closely resemble patterns in the butchering processes at Fincastle (Bubel 2014:217) and Muhlbach (Gruhn 1969:137). No complete femora, humeri, or tibiae were recovered at Fincastle, and there were few instances of complete tibiae at Muhlbach. At EfOx-71 there was a single whole tibia found in a test pit. The absence of complete long bones but the presence of numerous fragments (as well as a few epiphyseal sections) suggests heavy secondary butchering and marrow and grease extraction at EfOx-71.

Few mandibles from EfOx-70 and 71 contained intact rami suggesting that they were broken in removal from the cranium as at Fincastle and Muhlbach (Bubel 2014:218; Gruhn 1969:137). Many mandibles at EfOx-70 showed fresh fractures at the base of the mandible body perhaps to access the pulp cavity. Tongue removal may have taken place at EfOx-70: the three units we opened there had a significant number of mandibles found in a discrete cluster. Ten hyoid fragments, representing at least five hyoids, were found at EfOx-70 Units 1-2. Evidence for similar butchering processes is present at Fincastle and Muhlbach as clusters of mandibles were present at Muhlbach in the main trench and in the east Area of Fincastle suggesting specific locales for tongue removal (Graham 2014:131; Gruhn 1969:149; Bubel 2014:218).

Graham (2014) provided GIS based reconstruction of the bone bed at Muhlbach, using Gruhn's (1969) original drawings and concluded that the distribution of faunal remains represented significant primary butchering at the site, high rank element transportation, and some areas of secondary butchering on the peripheries. Graham identified this pattern, based on Brink et al. (1985) for Head-Smashed-In Buffalo Jump, by quantifying axial versus appendicular elements (Graham 2014:127-135). The abundance of axial over appendicular elements should represent a primary butchering area and vice versa for a secondary butchering area (Brink et al. 1985:175). Using the number of identifiable skeletal elements present at EfOx-70 and 71, axial elements are, indeed, better represented at the primary butchering area (EfOx-70) and appendicular elements are better represented at the secondary butchering area (EfOx-71) (Figures 7.6 and 7.7). Although most individual specimens present at each site were highly fragmented and unidentifiable, the ratio of highly fragmented bone is higher at EfOx-71 than at EfOx-70, also suggesting the presence of more secondary butchering at EfOx-71.

Similar selection and separation of high rank elements, such as the tongue and long bones with associated meat, is outlined in Gilbert Wilson's (1924) account of Buffalo Bird Woman during a Hidatsa bison hunt in 1870, synthesised by Brink (2004). Brink broke down the descriptions of meat processing by Buffalo Bird Woman into carcass sections and bone elements, outlining meat utility and providing insight into archaeological assemblages. In the account, Buffalo Bird Woman described carcass segmentation focusing on high utility items but also demonstrated that many high ranking items, such as the liver and heart, were removed in a way that would show little evidence in the archaeological record (Brink 2004).

In summary, EfOx-70 and 71 long bones were rarely found in more than fragments; foot bones were abundant and loosely articulated, cranial bones were scarce, and fractured ribs and semi-articulated vertebra were found throughout. Mandible clustering was present at EfOx-71. Using Muhlbach and Fincastle as examples, EfOx-70 follows the trajectory of a primary butchering local while EfOx-71 provides evidence of secondary butchering around hearth activities.

7.6 Ancient Landform Hypotheses and Hunting Strategies at Matzhiwin Creek

The Matzhwin Creek bison kill is part of a greater site complex consisting of archaeological sites EfOx-70-75 and 77. EfOx-70-72 fall within the Matzhiwin Creek valley and sites 73-75 and 77 are on the prairie along the north edge of the creek valley. While one or a few closely spaced episodes of communal bison hunting were successful at this locale, it is not currently possible to determine with certainty how those hunting activities were executed. For the benefit of any future research, however, it is worth exploring plausible scenarios that could be the subject of more extensive investigation. Three possible scenarios for the entrapment of bison at EfOx-70 are discussed here. The first follows the idea of procurement from a declivity directly to the south, the second assumes a northwestern gathering basin into the trap at the bone bed, and the third assumes a drive of bison, already in the creek valley, from the west into a trap following a knickpoint in the creek valley.

Barling (1995) examined the postglacial alluvial chronologies of Matzhiwin Creek detailing the timing and causes of the creek's adjustments on the landscape. This geomorphological analysis provides context for the kill event at the EfOx sites some 1,100 years ago. The Matzhiwin Creek drainage culminates at an over 70-meter incision into its valley as it descends into the Red Deer River. The creek's historical trajectory was a key contributing factor to the kill at EfOx. The resulting landforms have led us to three hypothesized scenarios for the entrapment of bison at the sites. Owing to Matzhiwin Creek's smaller drainage basin and lower volume of water, it only begins a deep incision in its downstream reach commencing just west of the EfOx sites at what Barling has defined as a knickpoint. The principal deep incision of the creek took place until the mid-Holocene after which alluvial fans formed on the valley floor as a result of an arid period. Minor episodes of aggradation and degradation have occurred since (Barling 1995:74). It is probable that the major incising of the creek bed had already taken place by the time of the EfOx occupation circa 1,100 years ago. Air photos taken in the early 1950s, compared to recent photos, provide evidence of degradation to the creek banks. Although minor in terms of geomorphology, this degradation has had a major impact to EfOx-70, 71, and 72, as more than 40 meters of embankment north of EfOx-70 and west of EfOx-71 have been lost since the air photos were taken (Figure 7.9). My current interpretation is that EfOx-70 and 71 may be situated on Barling's T2-T3 aggradational terrace remnant resulting from overbank flood episodes or slope wash from the prairie level (1995: Figure 3.5). Such accumulated sediments are most dramatic at EfOx-70 resulting in a higher elevations and almost a meter of accumulated sediments over the bonebed.

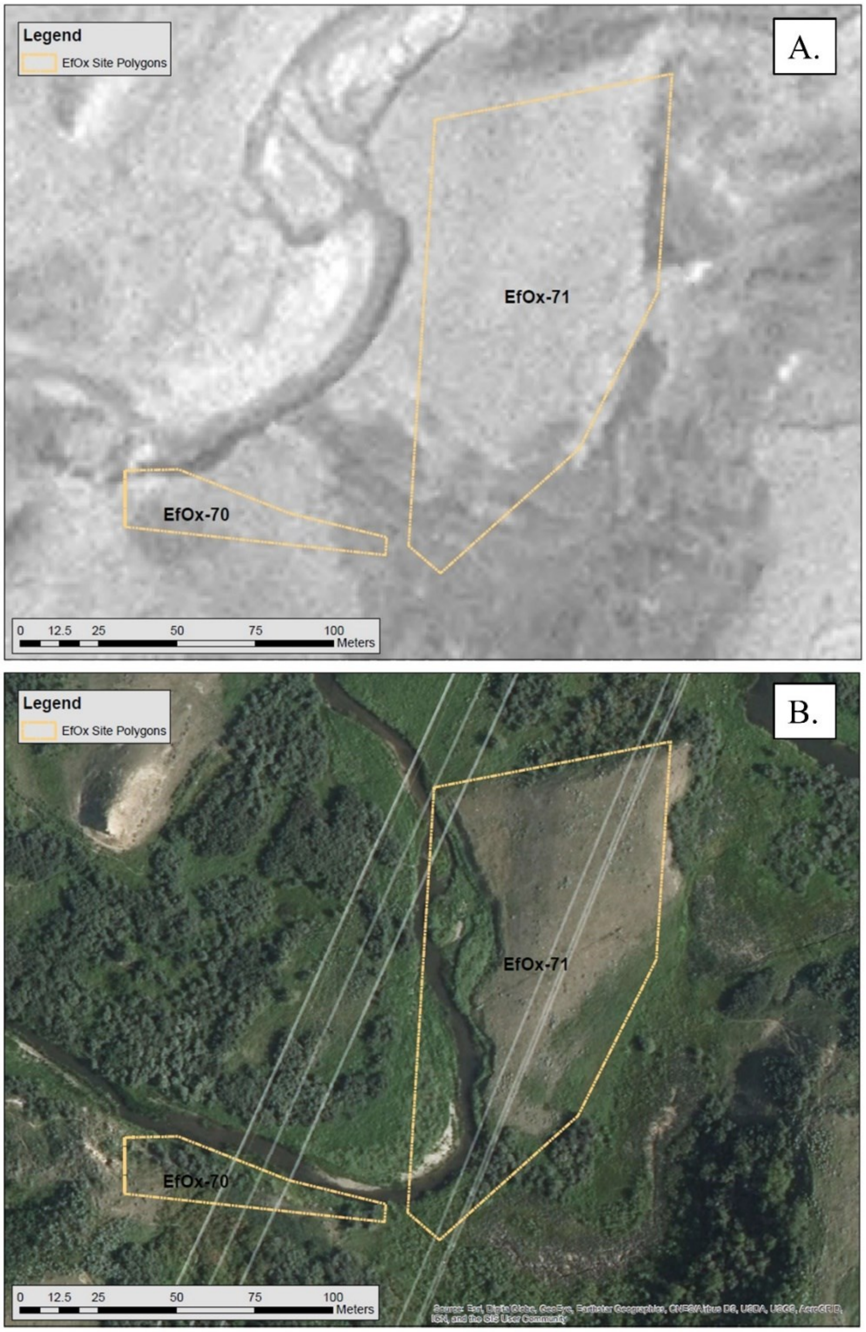


Figure 7.9 *Aerial photos of EfOx-70 and 71.* ***(A)*** *Photo taken between 1950 and 1952,* ***(B)*** *Photo taken in 2019. Note the creek trajectory and erosional process since the 1950s. Maps created in ArcGIS courtesy of Katherine Gadd.*

Since the kill, minor degradation has continued with the flow of Matzhiwin Creek. A comparison of an aerial photo from 1950-52 and satellite imagery from 2020 is perhaps the best representation of minor degradation and lateral stream migration (Figure 7.9). There is some question as to the landscape at the time of the bison kill. As identified by the oxbow scars, Matzhiwin Creek has followed numerous courses around the EfOx sites throughout its history. What is apparent is that the landforms that comprise EfOx-70, 71, and 72 have been cut through by the creek at some point in the past. Currently the creek erodes all three sites. Using the elevation data available through LiDAR, and with the invaluable aid of William Wadsworth, I have reconstructed some landforms exhibiting less erosion by Matzhiwin Creek (Figure 7.10). Using Surfer 18, we have filled in areas that have been incised by creek activity providing a general idea of the landscape prior to erosion. Since the 1950s the creek has continued to erode removing over 40 meters of embankment. Projected into the past, it is likely that the creek has eroded significant portions of the archaeological sites.

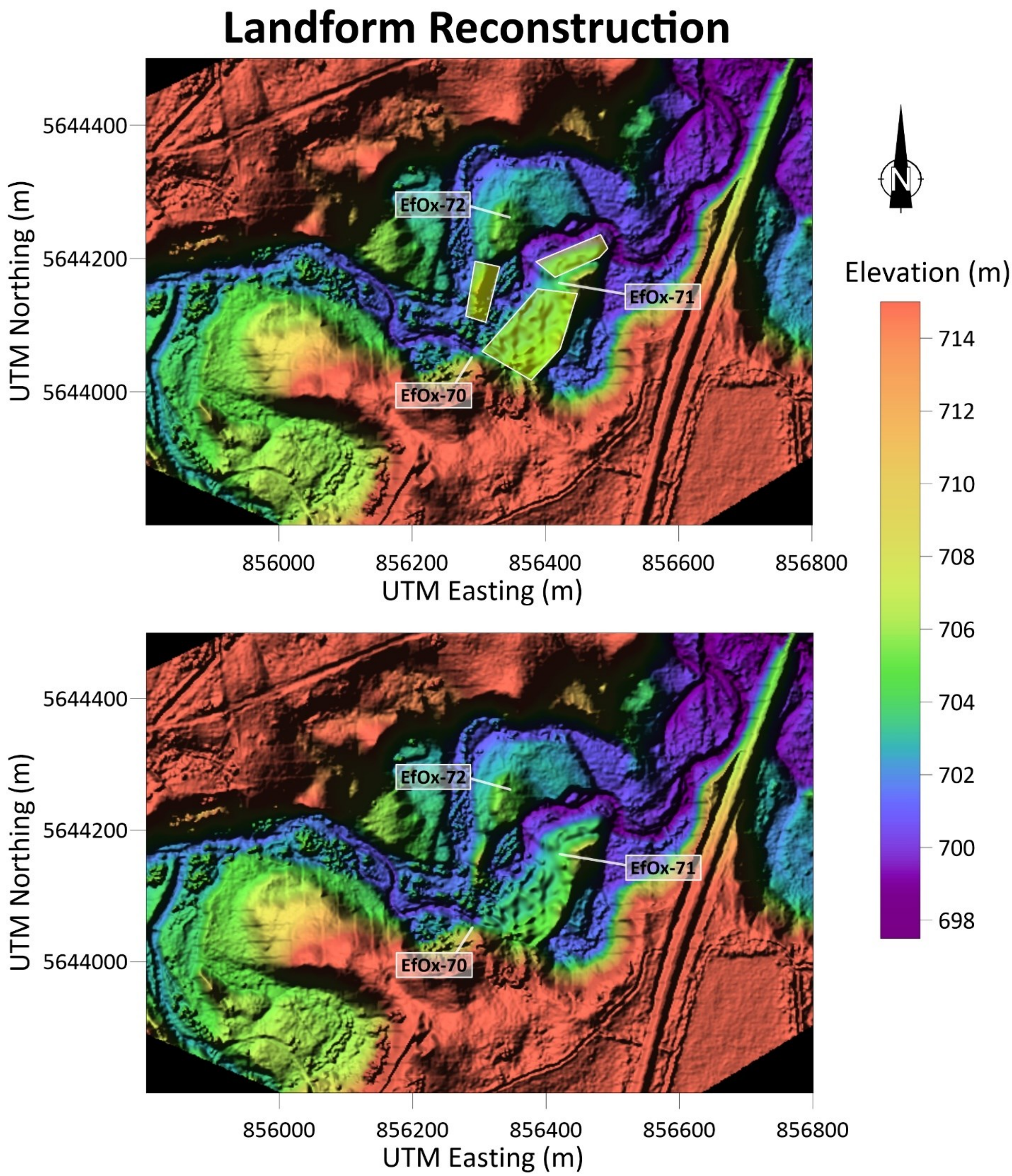


Figure 7.10 *Landscape Reconstruction at EfOx-70. The top image has reconstructed landforms outlined with polygons; the bottom shows the reconstructed landforms without polygons for greater clarity. This reconstruction assumes the creek was flowing in its current course but with less erosion along its embankments. Images courtesy of William Wadsworth (2020) created in Surfer 18 using LiDAR data from Valtus Imagery Services.*

Scenario 1

The first and most parsimonious scenario we envisioned was that the bison were driven over the embankment directly south or southeast of EfOx-70 (Figure 7.11 B). Following this we assumed other possibilities due to what we noted as a paucity of topographical features on the prairie above that were conducive to the gathering and entrapment of bison. It is, however, possible that such topographic features could have been removed or altered due to farming, roadway construction, and other development. Whether or not bison were driven over the embankment would be testable only with the aid of equipment that would allow deep testing of the sediments along the embankment south of EfOx-70. This embankment is thick in sediments subject to mass movement processes and slope wash over the years. It is also steep, well treed terrain with limited prospects for heavier equipment access. Even 1.5-meter auger tests just 3-5 meters south of the excavation units at EfOx-70 were not deep enough to reach the bone bed, demonstrating the thickness of the overburden. If the bison descended from the south, such that the bone bed exposed at Matzhiwin Creek itself is north of the principal kill locus against the escarpment, much deeper mechanical testing on the southern embankment will be necessary to determine this.

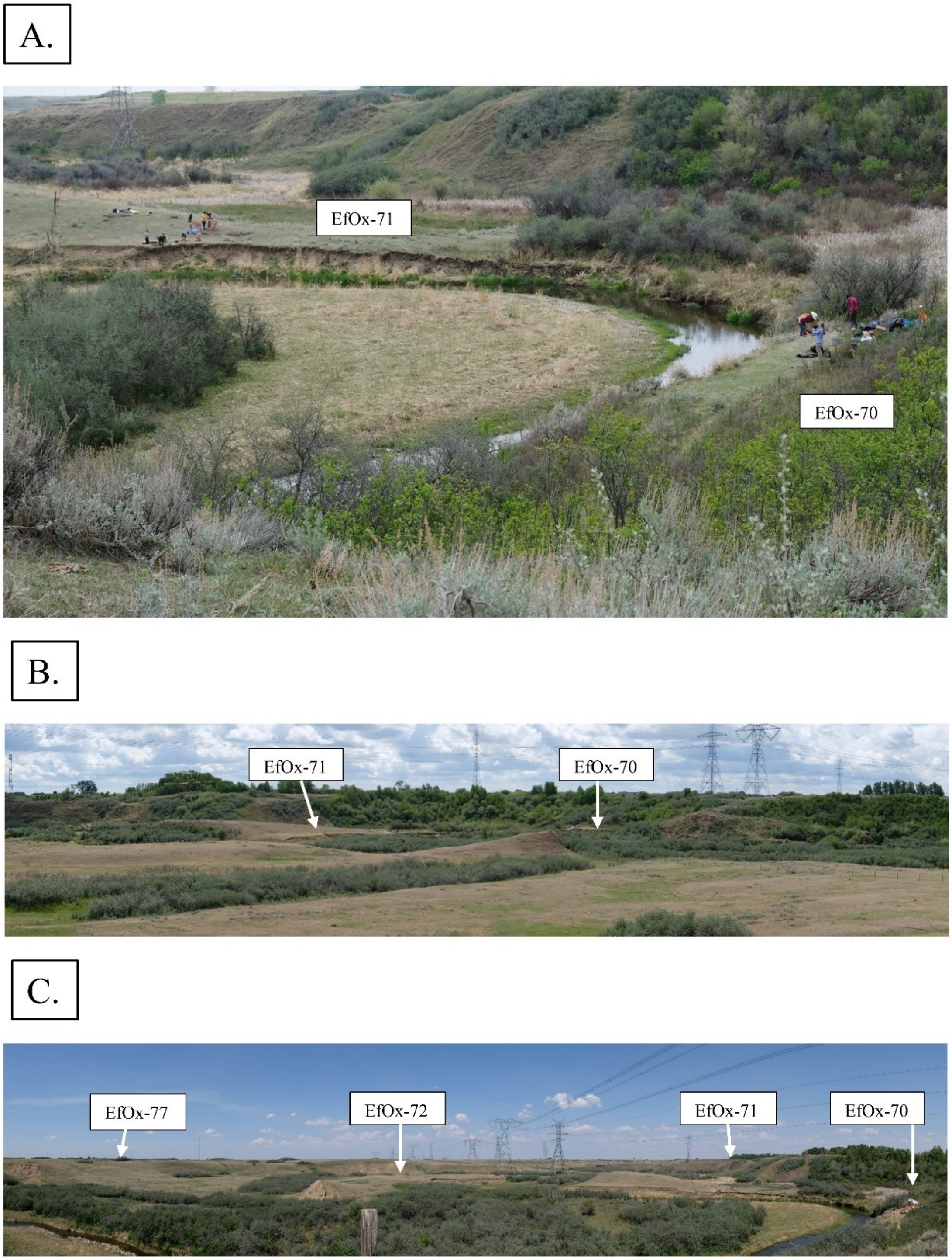


Figure 7.11 *Oblique views of EfOx-70, 71, and associated sites.* ***(A)*** *View of EfOx-70 and 71 from the west,* ***(B)*** *View of EfOx-70 and 71 from the north,* ***(C)*** *View of EfOx-70, 71, 72, and 77 from the south.*

Scenario 2

A second scenario involves the assumption that bison were gathered from the northwest, driven into the creek valley via a gentle slope or "tongue" leading down from the high terrace across EfOx-77 (Figure 7.11 C). Bison might then have been pushed toward the kill site and trapped or ambushed in the area directly north of EfOx-70 and west of EfOx-71 where the creek currently runs. The western portion of EfOx-77 to the northwest of the kill (Figure 7.11 C) descends as a gradual slope into the Matzhiwin Creek valley and has two visible cairns, one at the base of the slope and the other near the top (Figure 7.12 B). It is possible that these could have been markers for drive lanes. This "tongue" creates a broad pathway, constrained by heights of land to southwest and northeast, and allows animals to gradually descend into the valley near the kill site. It is deeply rutted from regular use by grazing cattle today. Northwest of the tongue that descends into the valley, there is funnel-shaped, lower-lying land between extensive Duchess Dune Field sand ridges (Figure 7.12 A Wolfe et al. 2002). This area may have served as a gathering basin in which there were more favorable seasonal grazing conditions. Since the 1950s, Ducks Unlimited has used the low-lying land to create wetlands now present in this area, and it is likely that in its natural state this lower-lying land would have retained spring moisture later in the year, creating superior forage. If bison were procured from the northwest, hunters could have pushed bison that were foraging in the low land, by constricting the animals with movement to rear and lateral sides as at large scale bison traps such as Head-Smashed-In.

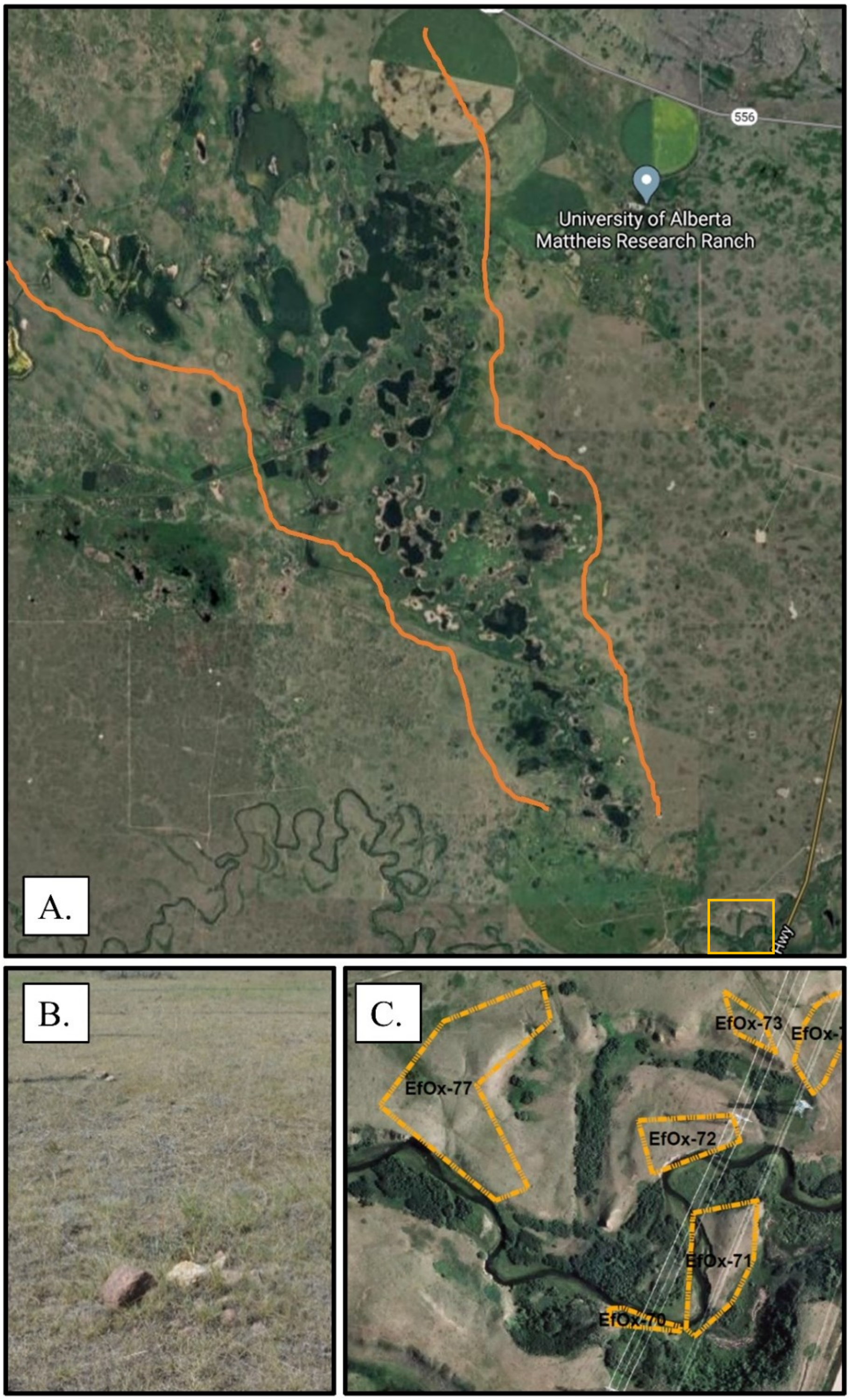


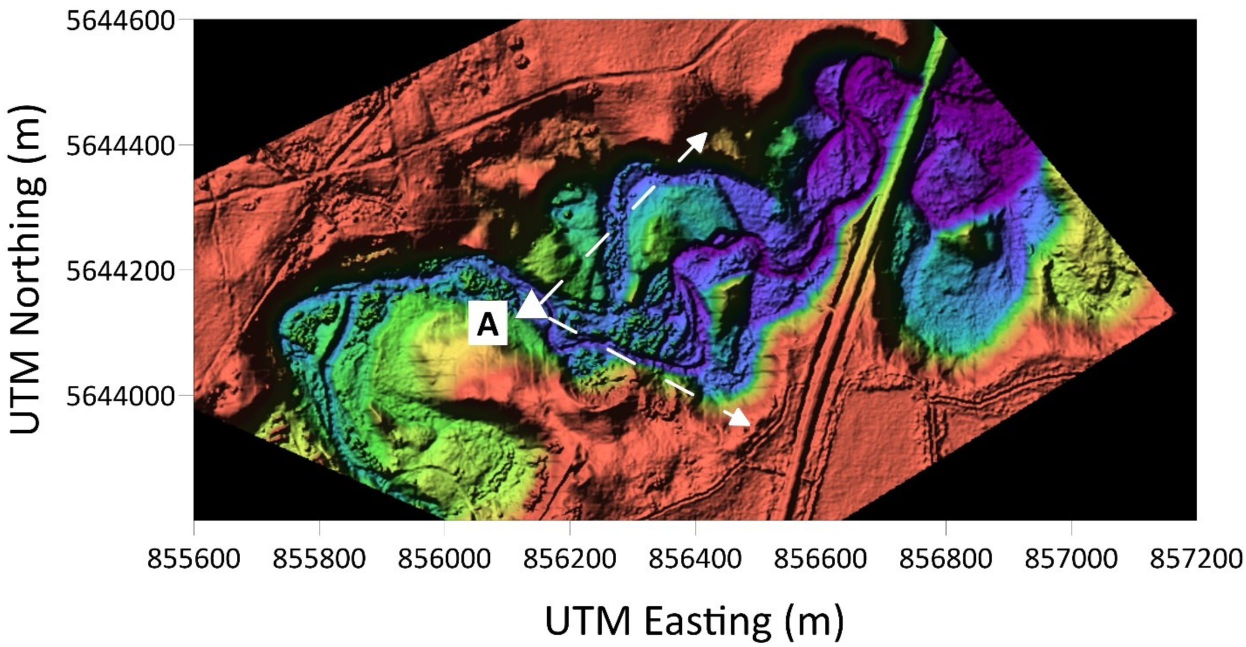
Figure 7.12 *Potential Gathering Basin.* ***(A)*** *Low lying land funnelled toward the sites,* ***(B)*** *Cairn at the descend into creek valley,* ***(C)*** *The sites.*

Scenario 3

A third scenario involves the assumption that bison, already in the creek valley, were pushed from the west toward the kill site being subsequently dispatched by hunters with arrows along the embankment whether by ambush or into a trap or pound. The Bassano Dam, constructed from 1910-1914, has affected the Matzhiwin Creek subwatershed (Red Deer Watershed Alliance 2009). In recent years, the creek varies in water level, but maintains a consistent shallow flow over most of the year. In years before the dam, the creek would have had the potential to be seasonally dry at times or heavily inundated with water in the spring or after heavy rains. At the time of the kill, the Matzhiwin Creek valley could have contained favorable grazing conditions for bison herds allowing hunters to drive bison through the valley and into the kill site. The portion of the creek valley to the west of the sites shown in the LiDAR imagery (Figure 7.13 and 7.14), which would have contained relatively open, riparian habitat, likely provided favorable grazing conditions and water sources for bison during a longer period of the year. It might therefore have functioned as a gathering basin allowing the hunters to take advantage of the constriction in the creek valley pushing them east towards the kill site.

The area just southwest of EfOx-77 has been identified as a "knickpoint" in the long creek profile. It featured better consolidated preglacial sands and gravels slowing further incising of the creek; downstream of this point, Matzhiwin Creek begins its deepest incision as it approaches the Red Deer River (Barling 1995). The EfOx-70-77 sites involve advantageous topography beyond the knickpoint where the site inhabitants could trap and dispatch the bison. Barling's knickpoint is immediately north of Landowner Kelsey Campbell's ranch and any animals moving here from the west would be constrained by the valley walls (westernmost portion of Figure 7.13). The knickpoint is accentuated in the LiDAR imagery and is followed by lateral stream migration (the deep blue in Figure 7.13 and 7.14).

East of the knickpoint, the tongue mentioned in Scenario 2 would have been the only escape route out of the valley before the kill site. This provides a second possible explanation for the cairns. The cairns could have acted as staging points to restrict the exit of the bison from the creek valley. Constructing a pound or trap within the creek bed would not be unimaginable especially with the increase in lateral stream migration following the knickpoint. If animals were pushed to the south side of the creek valley, they would enter a bowl-like topographic feature around EfOx-70 and 71 (Figure 7.13 and 7.14). Taking advantage of the natural topography, the hunters could have constructed further constraining features, such as wooden surrounds.



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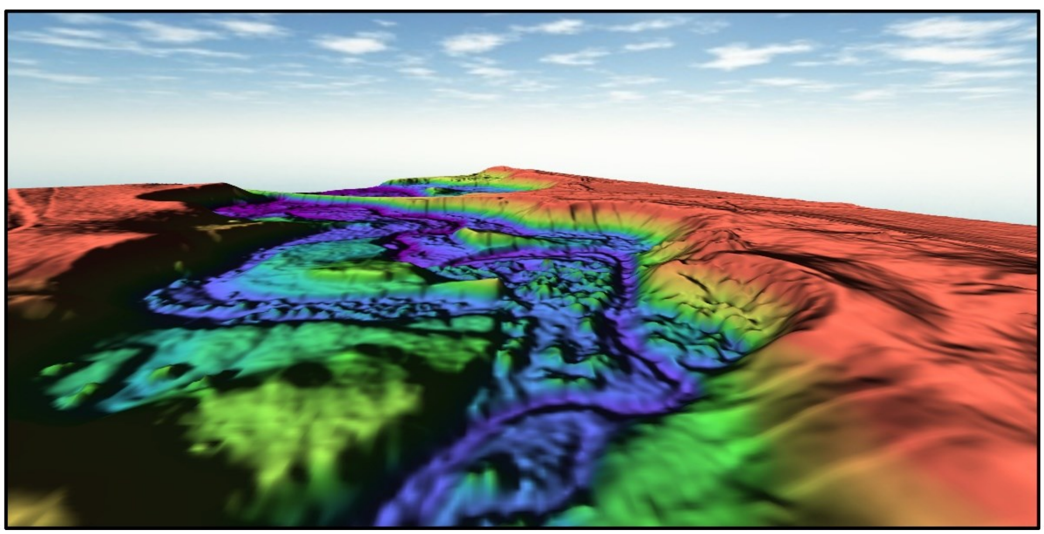

Figure 7.13 *Elevation imagery (aerial and oblique view). The white triangle is a vantage point looking east from Matzhiwin creek to EfOx-70 and 71. The aerial view (top) shows the knickpoint directly west of (A), the viewpoint, followed by an increase in lateral stream migration, as described by Barling (1995). The topographic bowl-feature is best seen between EfOx-70 and 71 in the oblique view. Images courtesy of William Wadsworth (2020) created in Surfer 18 using LiDAR data from Valtus Imagery Services. Actual topography based on DEM hillshade.*

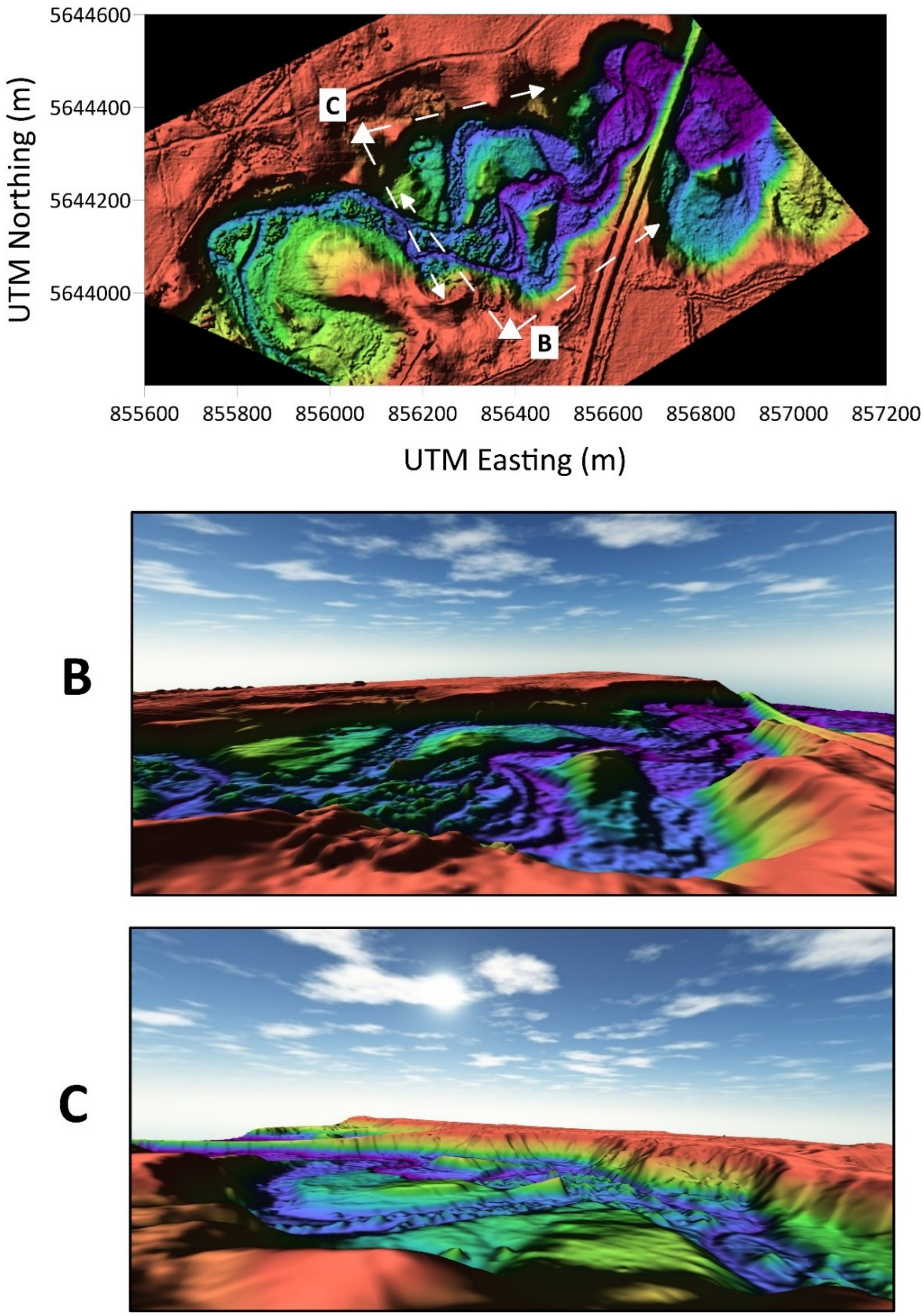

Figure 7.14 *Elevation imagery (oblique view). The white triangle (B) is a vantage point looking north from EfOx-70 while (C) is a vantage point looking southeast from EfOx-77. Images courtesy of William Wadsworth 2020 created in Surfer 18 using LiDAR data from Valtus Imagery Services.*

The difference in the preservation of bone between EfOx-70 and 71 is curious. As mentioned, the bone in EfOx-70 Level 3 is heavily degraded. This occurs primarily in the easternmost portion of the bonebed, and the single bone bed proceeding to the west did not suffer this degradation. A wetland continues due east of EfOx-70 (Figure 7.12 C); it appears to have formed either within an oxbow scar of Matzhiwin Creek's earlier trajectory or perhaps as a consequence of arcuate slumping from the steep embankment above on the south side of Matzhiwin Creek. Barling (1995:52-61) noted that his T2 and T3 landforms were difficult to distinguish from each other. Based on Barling's figures, the EfOx-70 landform appears to be a remnant of what he called a T3 aggradation surface (Barling 1995:69-71, Figures 3.5, 3.7, 3.8). Barling's T3 surface is characterized by a period of aggradation with radiocarbon dates from bone samples on this surface ranging between 1,860 ± 70 (TO 4577) and 1,320 ± 90 (TO 4576) calendar years before present. Should the T3 surface be the one that the EfOx-70 occupation took place upon, it is notable that the aggradation period was followed by a two to four-meter incision of the creek bed after 1,300 years ago (Barling 1995:71). Assuming EfOx-70 is located on an eroded remnant of this surface, it is entirely possible that the oxbow scar/marsh to the east of EfOx-70 was an active river channel at the time of the occupation, separating EfOx-70 and 71, or at least creating a situation in which that depression featured regular inundation. Should this have been the case, fluctuating water table conditions that followed the T2/T3 aggradation could have created impacts that would explain the poorer bone preservation in the lower levels on the eastern portion of the bone bed. Because of the multiple intercepts with the radiocarbon calibration curve, it is not yet possible to determine whether just one or a few closely spaced kills took place at the EfOx sites. The stratigraphy at EfOx-70 suggests the possibility of two or three closely spaced events. If, in fact, there was more than one event, it is possible that any one or all three of the scenarios discussed above could have been employed by the hunters.

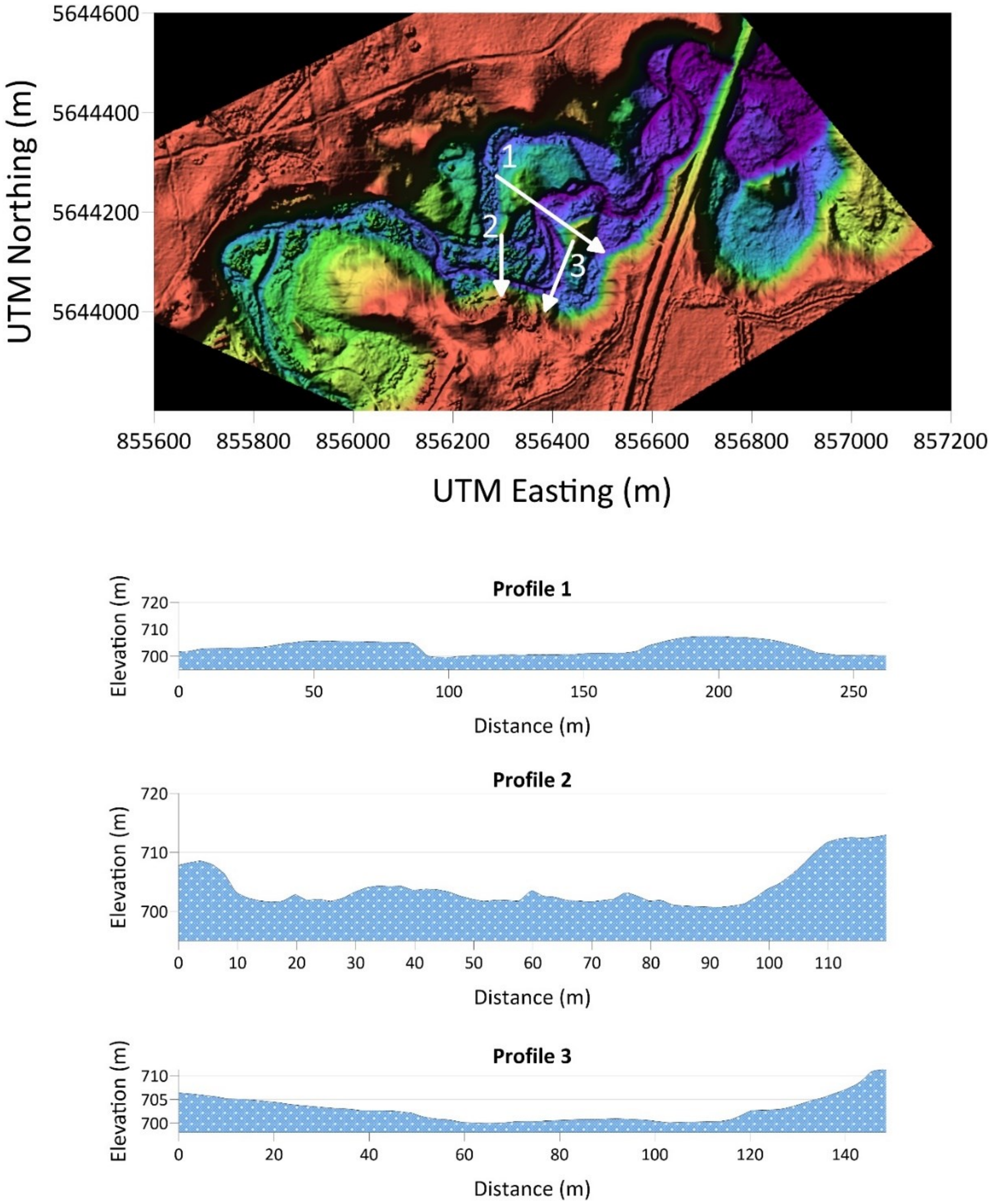

Figure 7.15 *Elevation data demonstrating the relationship between extant landforms and the likelihood of their connection in the past.* ***(Profile 1)*** *shows how EfOx-71 could connect with EfOx-72.* ***(Profile 2)*** *shows the relationship of the north and south portion of a ridge at the western border of EfOx-70, and* ***(Profile 3)*** *connects EfOx-71 to EfOx-70. Images courtesy of William Wadsworth 2020 created in Surfer 18 using LiDAR data from Valtus Imagery Services.*

Throughout this section, I have provided three potential scenarios for the entrapment of bison at the EfOx site complex. These scenarios are based on the interpretation of both extant and extinct landforms through observation of Matzhiwin Creek's meanders, surficial geology, and our knowledge about bison hunting on the Great Plains. If there were in fact two or three kill events, it is possible that more than one of these strategies was employed—or even all them. Whatever the entrapment scenario, it *was* successful once or a few closely spaced times. The EfOx sites provide a window into an adept community able to read the landscape and carry out a hunt. To envision the activities at EfOx-70 and 71 is to envision a community working together to carry out an enormous task with intricate and nuanced elements that we can glimpse in the archaeological record. Communal bison kills required extensive intellectual and physical resources including the placement of drive cairns (Brink and Rollans 1990), the procurement of raw materials, such as heating cobbles (Brink and Dawe 2003), and collaborative human action.

Although much later in time, European accounts of bison hunts provide a glimpse into the feat. Peter Fidler (1792) provided an account of hunters bringing 3-4 herds of bison via "dead men" (stone cairn lines) to a steep rock face at a dry creek. Fidler's accounts involved horses, but they still provide some insight into the strategies employed by adept First Nations bison hunters. In one particular account, Fidler recalled two bison cows that fell over the precipice, but the rest of the animals broke away with many being shot on horseback with arrows. The day after, hunters brought about thirty animals over the precipice, seven being killed immediately, but several having broken legs before being subsequently dispatched. In another account Fidler (1792) described a pound entrapment with varied success, noting that the men brought herds from over 40 miles distant and spent nights around the pound working to bring the animals in. The old men and boys attended to the dead men (cairns) while the others pushed the bison close to the pound. He noted that the chief killed the first animal after which other members were allowed to kill the remaining bison as they ran continually around the pound. Once all bison were dispatched, the women climbed into the pound and began butchering the best parts. Unfortunately, we can never fully reconstruct or understand the nuanced elements that contributed to a successful hunt at the EfOx sites, but we can appreciate the collaboration, intelligence, and skill that needed to be in place for such an activity to be carried out. Fidler's accounts involved horses and the accessibility of guns, metal arrow tips, and other trade goods—further accentuating the ingenuity carried out by precontact bison hunts, whose tools and mobility required more time and attention.

George Bird Grinnell was another European who witnessed the bison hunting of the Blackfoot people and their use of disguises and bison curiosity to bring them quickly to a cliffs edge or within the confines of a pound (Grinnell 1893). Remarkable ingenuity and planning with a deep understanding of the bison allowed the continued success of bison hunters on the Plains. The EfOx sites are but one example of the great phenomenon of communal bison hunts, giving us modern perspectives on the ingenuity, community, and power of Indigenous hunters of the recent past.

Conclusion

This thesis describes, in detail, the excavation of two important sites within a complex of sites connected to one or a few closely spaced bison kills. Our work at associated camp and processing areas has provided evidence of food preparation and lithic manufacture, highlighting the ingenuity and adeptness of a successful First Nations hunting community. The sites fall into a time period that emphasizes the transition between the Avonlea and Old Women's time periods characterized by a change in material culture, principally the morphological characteristics of the projectile points. Through research since the discovery of the sites in 2011, they are now, arguably, the best dated Avonlea to Old Women's transitional sites on the Plains. Both the morphological characteristics of the projectile points and their place in the A.D. 800-1,000 time interval provide their position in this transitional period. Coupled with other sites such as Estuary, Empress, and Upper Kill, new perspectives on this material culture transition can be explored, enhancing our understanding of bison kills, and the successful communities that did so.

Relatively small excavations have provided plenty of material culture to understand the sites chronology, seasonality, and function. Should further excavation take place at EfOx-70 and 71, we will be better prepared in our techniques allowing enhanced understanding of sites. First, careful documentation and observation of stratigraphical changes could provide some clarity on the ambiguity as to the single or multiple occupations at the sites. As discussed in Chapter 7, the method by which the occupants gathered and trapped the bison could be explored in further detail. If more work was to occur at the EfOx sites, perhaps the best direction would be to discover the nature of the kill event(s), following clues in the landforms around the sites and deep testing into the embankment south of EfOx-70 to asses the prospect of a declivity kill event over the south bank of EfOx-70.

Additionally, special care in the excavations at EfOx-70 could reveal more information regarding the number and chronology of occupations at the site. Due to the advanced bone degradation in the lower levels, alternative excavation techniques should be employed to record the frequencies of bone elements and possible stratigraphic changes. One method that I suggest for this is detailed drawings and photographs that outline each bone before it is excavated. Although the bones cannot often be collected from this local due to their degradation, their outlines are visible while being excavated and detailed photographs and drawings will aid in their identification and preservation of information.

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