University of Alberta

Archaeological Investigations of FaOm-1: The Bodo Bison Skulls Site

by

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ABSTRACT

The Bodo sand hills, in southeastern Alberta, are the site of a major archaeological site complex. A $25m^2$ excavation block in the southeastern quadrant of the complex contained several features, and large amounts of chipped-stone debitage, thermally altered stone, ceramic material, and animal bone.

The majority of the artifactual material is associated with an occupation containing projectile points and pottery associated with the Old Women's Phase of the Late Pre-Contact Period. Radiocarbon dating places the occupation from ca. 1650 to present. The assemblage includes evidence of bison secondary butchery and processing, including the production of bone grease, and associated camp activities. Faunal evidence strongly indicates occupation from late winter to early summer; however, bone grease production is more typically associated with late fall to winter occupations. The presence of multiple occupation episodes, during different seasons, with different resource priorities, explains apparent discrepancies in activity and seasonality indicators.

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Part 1: Introduction and Background Material

1. Introduction

The Bodo site complex may prove to be one of the major archaeological sites in Alberta and the Northern Plains. Dense, intact, and well-preserved deposits of cultural material are spread over an area of approximately ten square kilometers. By the end of the 2004 field season, diagnostic projectile points from the Old Women's, Pelican Lake, and Oxbow phases had been recovered, providing evidence for occupation in both the Late and Middle Pre-Contact periods, ca. 200 - 1200 BP, and ca. 2000 - 4600 BP (Humphreys 1999:15). Despite this long history of occupation, stratified deposits are exceedingly rare within the site complex. This is primarily due to the unstable nature of the sand hill environment in which the site complex is located. The absence of complex stratigraphic profiles means that researchers will have to more fully analyze occupations in order to determine temporal and spatial relationships between them.

Archaeological investigations within the site complex from 1995 through 2004 have occurred in the contexts of Heritage Resource Impact Assessments and Mitigation, and three seasons of excavation by the University of Alberta Department of Anthropology Archaeological Field School. These investigations have therefore focused primarily on determining the quality and extent of the cultural deposits in the site complex, and have only touched upon questions of site character, cultural affiliations, and the duration, period and season of occupation.

Research Questions

This study is an attempt to answer some of these basic archaeological research questions, for one small area in the Bodo site complex. Areas of inquiry include:

1. Cultural affiliation of the site occupants, both in terms of archaeologically constructed phases, and, if possible, historic ethnic groups.

2. Site character, in terms of the types of human activities contributing to the formation of the archaeological deposits.

3. Site chronology, including the historic period of occupation, defined as precisely as possible, the duration and frequency of occupation, and the seasonality of occupation.

4. Spatial issues, including the identification of activity areas within the study area, and the relationship of the study area to other excavation areas in the immediate vicinity and in the Bodo site complex.

5. Results from detailed analysis of the study area will be used to shed some light on the character, history and role of the entire Bodo site complex, and to provide insight into the reasons for this exceptional archaeological resource's existence.

Methods

The study is based upon archaeological material excavated and catalogued in the context of cultural resource management and mitigative excavation. This study will therefore attempt to identify and use analytical methods and models that are appropriate to the limitations of the data set produced in such a context. This includes such methods as artifact class spatial distributions, lithic debitage and tool aggregate analysis, basic tool typology, faunal taxa and element representation and diagnostic artifact typology, which focus on the attributes and relationships of the entire artifact assemblage, or samples thereof, rather than detailed, and labour intensive, analysis of individual artifacts. Data generated through the use of these analytical methods is evaluated and interpreted, where possible, on the basis of published experimental data. Where modern actualistic data is lacking, inconclusive, or inappropriate, the archaeological data set is evaluated and interpreted with reference to extant relevant historic and ethnographic data. While historic and ethnographic data is often limited it is the best data set available from which to derive interpretations regarding the recent past. Given the close geographical and temporal proximity of the archaeological occupation to the ethnographic records, many of the more controversial aspects of ethnographic analogy are not a concern.

Theoretical position

In the attempt to answer basic archaeological questions, it is easy to overlook the fundamental assumptions upon which interpretations are based. This study essentially follows the classic archaeological tradition of attempting to determine past human activity on the basis of an examination of the material remains produced in association with that activity.

Basic interpretations of artifactual materials are based upon the assumption that the contemporary state of materials is the result of the actions of a variety of processes, including human, animal and environmental modification, transformation and transportation (Schiffer 1987). Following the geological law of uniformitarianism - that the physical and chemical laws in operation in the present were operational in the past, and that modern observations are therefore applicable to past events - it is assumed that the past processes that produced artifactual materials can be reproduced in the present. On this basis, experimental, ethnographic, and historical evidence can be used to interpret past processes. It is further assumed that these specific anthropogenic processes are integrated into systems by which people interact with their environment, and that an integrated set of these systems are what anthropologists and archaeologists refer to as 'culture'. This is fundamentally in keeping with the processual tradition of archaeology, which developed in the mid-twentieth century, and was popularized by Lewis Binford (Trigger 1989: 295), although the position taken in this study is somewhat less positivist, and can probably be criticized as more subjective, than that proposed by Binford.

2. Background:

2.1. Region:

Location

The Bodo Bison Skulls site is located approximately five kilometers southwest of the town of Bodo in southeastern Alberta (Fig. 1). At the end of the 2000 field season, during which the material dealt with in this thesis was excavated, the site was estimated to extend approximately 1.84 km E-W by 0.90 km N-S, giving the site a total area of 132.62 hectares (Gibson, 2001: 32). Subsequent survey and excavation have continued to expand the boundaries of this extensive site complex. It is currently believed to extend over 5 km E-W, and 2 km N-S (Gibson, personal communication 2005). The site complex is located in an area of stabilized sand dunes (Gibson, 2001: 3).

These sand hills are dominated by a "mixed vegetation community of grasses, prickly rose, willows, aspen and black poplars" (Gibson, 2001: 3).

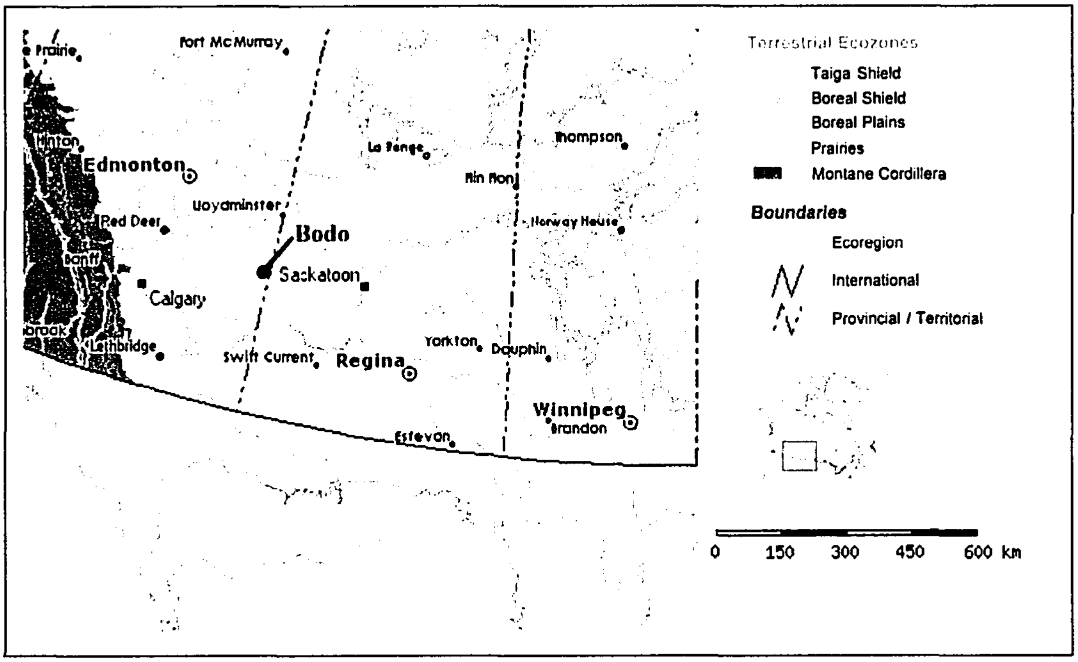


Fig. 1: Location of the Bodo site complex. (Natural Resources Canada, 2005)

Approximately 2 km north of the site is Eyehill Creek, which runs through a pleistocene river valley from Sounding Lake in the west, to Manitou Lake in the northeast (Fig. 2). Beyond this valley and surrounding the hills the landscape opens up to short grass prairie (Gibson, 2001: 3).

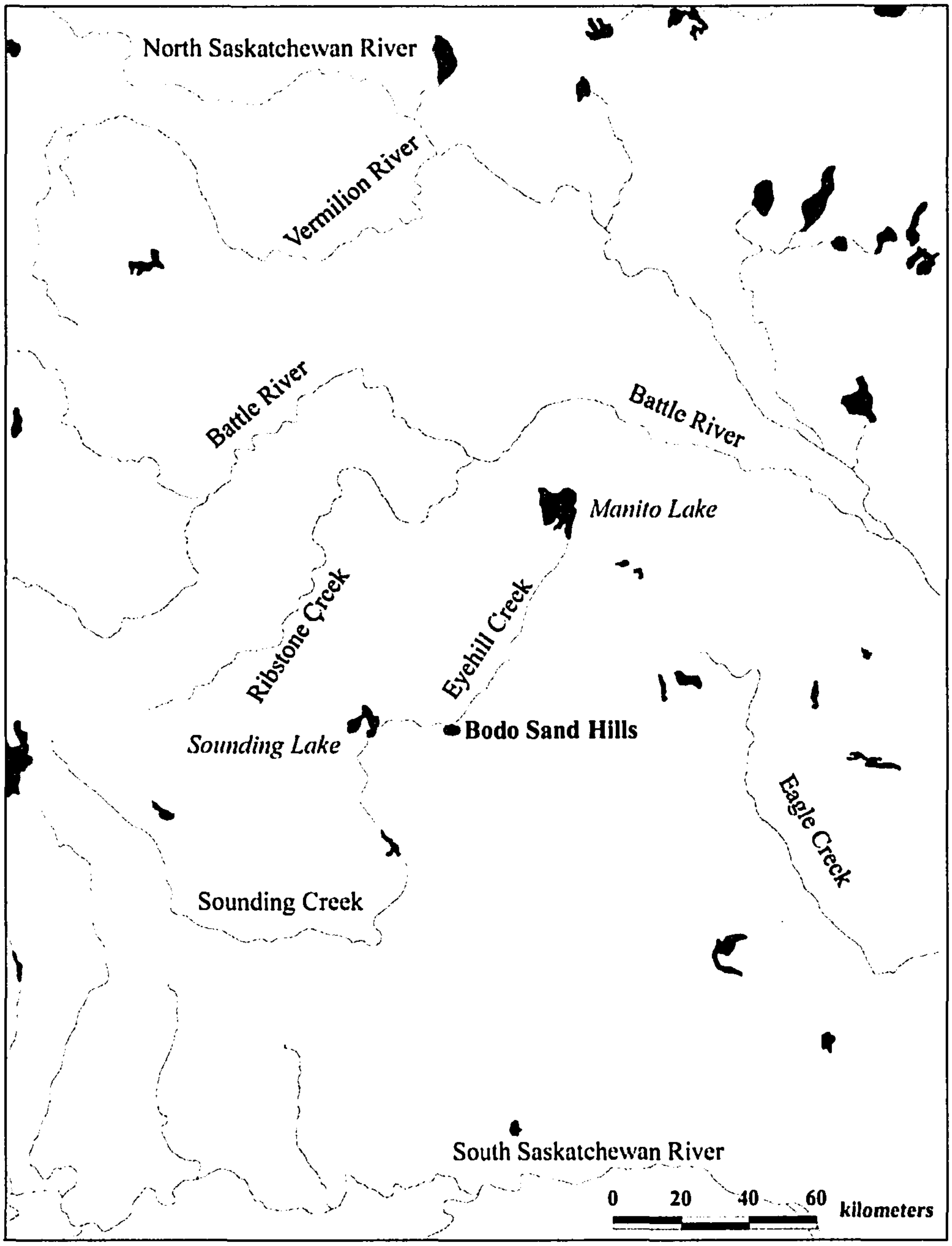


Fig. 2: Bodo Sand Hills and surrounding region.

Climate

The Bodo sand hills are located within the Mixed Grass ecoregion of southeast Alberta. This ecoregion is transitional between the Dry Mixed Grass ecoregion to the south and the Aspen Parkland to the north, with relatively xeric sites exhibiting vegetation consistent with the Dry Mixed Grass ecoregion and moister sites exhibiting deciduous shrubs and trees akin to that of the Aspen Parkland (Strong and Leggat, 1992: 11). The ecoregion is typified by dark brown chernozemic soil. Strong and Leggat have used this characteristic to define the boundaries of this transitional ecoregion. The boundary with the Aspen Parkland is defined by the transition to black chernozemic soil, while the boundary with the Dry Mixed Grass ecoregion is defined by the transition to brown chernozemic soil (Strong and Leggat, 1992: 11). The region experiences a relatively continental climatic regime, with cold winters, short summers and low precipitation (Strong and Leggat, 1992: 4). Mean annual precipitation is 326 mm (Strong and Leggat, 1992: 7). Mean annual temperature is 5.3 °C, with the mean summer (May-August) daily temperature ranging from 14.0 to 16.0 °C (25th and 75th percentile values), and the mean daily winter (November-February) temperature ranging from –9.2 to –1.7 °C (Strong and Leggat, 1992: 6-7).

Ecology

The reference ecosystem for the Mixed Grass Ecoregion is "Needle-Wheat Grass, Moderately well drained Dark Brown Chernozems" (Strong and Leggat, 1992: 12), but localized microclimates may produce ecosystems ranging from the grama grass of the

Dry Mixed Grass ecoregion to poplars, willows and birches typical of the Aspen Parkland. (Strong and Leggat, 1992: 12) This intraregional variation leads to a diverse and productive local ecosystem, especially in atypical areas such as the Bodo sand hills.

Modern vegetation communities in the area are dominated by willows (*salix spp.*), trembling aspen (*Populus tremuloides*), and to a lesser extent poplar (*P. balsamifera*). Various shrubs are present in the area, many bearing edible berries, including creeping juniper (*Juniperus horizontalis*), gooseberry (*Ribes oxyacanthoides*), choke cherry (*Prunus virginiana*), raspberry (*Rubus idaeus*), wild rose (*Rosa spp.*), buffalo-berry (*Shepherdia canadensis*), cranberry (*Viburnum edule*), serviceberry (*Amelanchier alnifolia*), blueberry (*Vaccinium caespitosum*), honeysuckle (*Symphoricarpos spp.*), silverberry (*Eleagnus commutata*), and dogwood (*Cornus stolonifera*). A number of smaller plants and wildflowers are also present, notably the prickly pear cactus (*Opuntia polyacantha*), and various grasses.

This area currently supports a variety of fauna, including several species of ungulates: mule deer (*Odocoilus hemionus*), white-tailed deer (*O. virginianus*), pronghorn antelope (*Antilocapra americana*), moose (*Alces alces*), and formerly elk (*Cervus canadensis*) and of course, bison (*Bison bison*). Several species of small mammals and carnivores are present in the area, including the ubiquitous Richardson's and thirteen-lined ground squirrels (*Spermophilus richardsonii, S. tridecemlineatus*), the snowshoe hare (*Lepus americanus*), white-tailed jackrabbit (*Lepus townsendii*), skunk (*Mephitis mephitis*), porcupine (*Erethizon dorsatum*), red fox (*Vulpes vulpes*), coyote (*Canis latrans*), occasional black bear (*Ursus americanus*) and cougar (*Felis concolor*). The wolf (*Canis lupus*), and grizzly (*Ursus horribilis*) were present historically. Various upland game bird species are also present, such as sage grouse (*Centrocercus urophasianus*), ruffed grouse (*Bonasa umbellus*) and sharp-tailed grouse (*Pedioecetes phasianellus*).

The presence of permanent and seasonal bodies of water in the vicinity opens up another area of resources, including aquatic mammals such as the beaver (*Castor canadensis*) and muskrat (*Ondatra zibethicus*), and a number of species of migratory waterfowl, notably Canada geese (*Branta canadensis*), snow geese (*Chen hyperborean*), mallards (*Anas platyrhynchos*) and other ducks (*Anas* spp. *Aythya* spp. *Bucephala* spp.), as well as the great blue heron (*Ardea herodias*) and other shorebirds. Local lakes and streams, including Sounding lake, Dillberry lake, Fleeinghorse lake, and Eyehill Creek, also provide habitats for a number of fish species, including burbot (*Lota lota*), suckers (*Catostomus* sp.), goldeye (*Hiodon alosoides*), walleye (*Stizostedion vitreum*), sauger (*S. canadense*), yellow perch (*Perca flavescens*), pike (*Esox lucius*), and smaller species including the trout-perch (*Percopsis omiscomaycus*), lake herring (*Coregonus artedii*), stickleback (*Culaea inconstans*), and minnows (*Notropus hudsonius, Couesius plumbeus, Pimephales promelas*). (Gibson, 2001: 3; Kavanagh, 1991)

2.2. Paleoclimate:

Introduction

Though the overall climate and regional patterning in the Northern Plains and Aspen Parkland has been relatively stable over the past 2000 years, the highly variable microenvironment of the Bodo sand hills renders it highly susceptible to climatic fluctuations. Minor changes in temperature and precipitation would result in dramatic changes in the distribution of critical resources, such as water and aspen stands, as well as the overall stability of these sand hills.

The general trend over the past 2000 years on the Northern Plains, as indicated by most lake records, has been towards cooler temperatures and increased precipitation (Beaudoin 2003: 27). This general trend has, however, been interrupted by numerous short-term droughts, and some longer-term drying and warming periods. The most extreme, and long-term, deviation from the overall cooling trend was seen from ca. AD 900 to 1300, and is often, though not universally, associated with the approximately contemporary Medieval Warm Period of northern Europe (Grove and Switsur 1994: 161). Following this period of relatively warm and arid conditions, the climatic regime is believed to have grown moister and cooler from approximately 1400 to 1800. It is during this period that Europe experienced the "Little Ice Age" (Grove and Switsur 1994: 143).

Late Holocene paleoclimatic evidence for the immediate vicinity of Bodo, Alberta is not yet available. Paleoclimatic records do exist for many surrounding regions, including the Rocky Mountains to the west (Grove and Switsur 1994; Luckman 1988, 1994; Hu *et al.* 2001 [Alaska]), the Great Plains of North Dakota to the south (Laird *et al.*

1996; Valero-Garcez *et al.* 1997; Laird *et al.* 1998; Fritz *et al.* 2000), the Canadian Prairies (Vance *et al.* 1992; Vance *et al.* 1997; Campbell *et al.* 1994; Campbell 1998), and the Aspen Parkland to the northwest (Campbell and Campbell, 2000). These records generally agree, and can be used to infer the existence of a warm, dry period in Bodo approximately 700 to 1100 years ago, followed by relatively cool and moist conditions.

Rocky Mountains

There are two primary sources for paleoclimatic data from the Rocky Mountains, geological records of glacial advance, and preserved remnants of high treeline stands. Grove and Switsur cite Osborn and Luckman's (1988) identification of a period of maximum glacial advance shortly after AD 900, identified as the Cavell (Grove and Switsur 1994:160). Dating for this advance comes from terminal and lateral moraines, such as that of the Bugaboo glacier, radiocarbon dated to AD 1020-1220, and trees felled by glacial advance, such as a spruce forest overrun by the Robson glacier radiocarbon dated to AD 795-990 (Grove and Switsur 1994: 160).

Glacial recession after the Cavell advance is associated with high treeline stands. Luckman (1994) has surveyed the evidence for these high stands, focusing on the radiocarbon or dendrochronological dating of snags and stumps "at and above the present treeline or where these snags are considerably larger than trees presently growing at the site" (Luckman, 1994: 172). Luckman has identified snags growing upslope of the current treeline, indicating improved growing conditions, at the Athabasca, Robson, Kiwa, Bennington and Peyto glaciers, radiocarbon dated to the 11^{th} to 13^{th} centuries (Luckman 1994: 173). Luckman has also identified a large number of snags killed by an advance of the Athabasca glacier in the second half of the 17th century (Luckman 1994: 175), roughly contemporary with the Little Ice Age.

Trees from the Athabasca and Pennington glacier areas, crossdated with local snags, and a floating chronology from Robson glacier snags, have produced a regional tree-ring record dating back to AD 865 (Luckman 1994: 177-180). This record indicates a period of optimal climatic conditions, beginning ca. AD 950 (Luckman 1994: 180), which continues to the mid 13th century, excepting a decade of lower ring-width from 1110-1120. After the 13th century the tree ring-width records indicate fluctuations of optimal and sub-optimal climatic conditions on the sub-centennial scale until a modern optimal period beginning in the mid-20th century (Luckman 1994: 179).

The general picture provided from the palaeoclimatic record of the southern Canadian Rockies appears to indicate a period of glacial advance ending in the early 10th century (Grove and Switsur, 1994: 160). This was followed by a probable treeline high-stand until the 11th to 13th centuries (Luckman, 1994: 173), and favourable climatic conditions for tree growth from the second half of the 10th century, slowly declining into the 15th century (Luckman, 1994: 180). The rest of the present millennium has been typified by fluctuating climatic conditions, with probable cold periods in the late 15th and late 17th centuries, indicated by low tree ring-widths and forest diebacks (Luckman, 1994: 179, 175).

Northern Great Plains

Fritz *et al.* and Laird *et al.* have analyzed lake sediment cores from a number of lakes in North Dakota (Laird *et al.*, 1996; Valero-Garcez *et al.*, 1997; Laird *et al.*, 1998;

Fritz *et al.*, 2000). These researchers have examined the past salinity profiles of Moon, Coldwater and Rice lakes in North Dakota, based on Diatom analysis (Moon and Coldwater) and Mg/Ca analysis from Ostracode shells preserved in the sediment column (Coldwater and Rice). All three records extend more than two millennia BP. Despite discrepancies resulting from differences in lake morphology, and probable variations in precipitation between the three lakes (Fritz, *et al.* 2000: 181), the lacustrine sediment records of these three lakes indicate the dominance of generally arid conditions in the region from ca. AD 900 to 1350. This general trend is supported by data for low lake levels at a number of other lakes in the northern Great Plains (Valero-Garcez *et al.* 1997: 367). Fritz *et al.* (2000: 182) point out that early second millennium aridity does not particularly deviate from the overall salinity regime of the previous millennium, but is significantly different from the record of fluctuating, though generally lower, salinity since.

Vance *et al.* (1992) provide a climatic record that is geographically closer to the Bodo area, but of less fine resolution. In their analysis of palaeobotanical and mineralogical data from sediment cores of Chappice Lake, in southeastern Alberta, they identify a period of high water and low salinity from ca. 2600 to 1000 years BP, followed by a period of "alternating massive and laminated sediments with generally high *Ruppia* pollen and seed representation … from 1000 to 600 yr BP … The laminated sediments record low-water stands related to significant droughts" (Vance *et al.* 1992: 881). Following this period of extreme drought frequency the lake appears to have returned to high water, low salinity conditions until the last century.

Van Stempvoort *et al.* (1993; cited in Beaudoin, 2003) had similar findings from stable isotope and pigment analyses at Redberry Lake, Saskatchewan, near the transition from the Northern Plains to the Aspen Parkland. There, the period from 2500 to 1500 years B.P. was characterized by greater evaporation than present, with more humid conditions persisting from 1500 B.P. on (Beaudoin, 2003: 27). The mineralogical record from North Ingebrigt Lake, Saskatchewan, records an abrupt increase in relative humidity, and freshening of the hypersaline lake, ca. 1000 yr B.P. (Shang and Last, 1999; cited in Beaudoin, 2003: 28). Kenosee Lake, in southeastern Saskatchewan, began increasing in depth, and decreasing in salinity, from ca. 2000 yr B.P., with a dramatic increase after 600 yr B.P. (Vance *et al.* 1997; cited in Beaudoin, 2003: 28)

Aspen Parkland

Campbell's (1998) study of Pine Lake, Alberta, near the transition from the Northern Plains to the Aspen Parkland of the Rocky Mountain foothills, analyzes variations in median grain size as a proxy indicator of past precipitation regimes with an annual to decadal resolution. The sediment column exhibited intervals of low median grain size corresponding to historically recorded droughts of the 1980s, 1960s, 1920s - 1930s, and 1890s (Campbell 1998: 98). Further down the sediment column, an interval of high grain size prevailed for approximately 130cm (to ca. 750 years BP), followed by an extended interval of small median grain size from approximately 130 to 200 cm depth, corresponding to the period ca. 750 – 1200 BP, and a return to a larger grain size (Campbell, 1998: 100).

Campbell and Campbell's (2000) study of the sediment profile of Pen 5 Pond in Elk Island National Park, Alberta, near the northern margin of the Aspen Parkland region, focused on charcoal content and charcoal to pollen ratio. Two periods of significantly low charcoal content were identified, at 0 to 20 cm (to ca. 100 BP) and at 65 to 85 cm, ca. 800 to 1200 BP (Campbell and Campbell, 2000: 272). These periods of low charcoal content corresponded to slight increases in *Populus* and *Chenopodiacaea* pollen influx, and decreases in *Betula* influx (Campbell and Campbell, 2000: 273). Campbell and Campbell hypothesize that the apparent relationship between low fire frequency and high *Populus* relative to *Betula* pollen influx, is due to the draining of flatlands bordering on modern ponds during the modern era and the period from ca. 800 – 1200 BP. During these low-water periods fire-resistant *Populus* would replace the fire-adapted and fire-prone shrub *Betula* on the low-lying flat land, thereby reducing the fire frequency (Campbell and Campbell, 2000: 277).

Summary

While varying somewhat in precise timing, paleoclimatic records from the regions surrounding the Bodo Bison Skulls site all appear to exhibit a period of relatively high temperatures, and/or aridity in the early centuries of the last millennium, followed by a return to cooler, moister conditions. Paleolimnological and palynological evidence from the northern margin of the Albertan Aspen Parkland appears to argue for relative aridity ca. AD 800 – 1200 (Campbell and Campbell 2000). Lacustrine sediment records from the southern margin of the Aspen Parkland similarly indicate generally lower precipitation from ca. AD 750 to 1200 (Campbell 1998). Paleolimnological evidence from the Alberta Great Plains indicates dry conditions from ca. AD 1000 – 1400 (Vance *et al.* 1992). Similar evidence from North Dakota argues for predominantly arid conditions throughout the region from ca. AD 900 – 1350 (Laird *et al.* 1994; Laird *et al.* 1996; Valero-Garcez *et al.* 1997; Laird *et al.* 1998; Fritz *et al.* 2000). Treeline, annual growth-ring, and glacial evidence from the southern Rocky Mountains to the west similarly argue for warmer conditions from ca. AD 950 – 1350 (Grove and Switsur 1994; Luckman 1988, 1994). In all cases, evidence for a period of relative aridity is followed by evidence for a return to the overall cooling and moistening trend, peaking at some point in the nineteenth century, prior to twentieth century aridity.

A period of extended drought conditions across the Northern Plains may have significantly affected human settlement patterns, and the seasonal round of the bison herds. Though resistant to fire, aspen is vulnerable to prolonged drought (Hogg 1994: 1842). Long-term (multi-decadal to centennial) drought may have resulted in a significant northward shift of the southern margin of the Aspen Parkland, and reduction of river valley and other isolated aspen stands. The effects of such long-term reductions in the regional moisture regime upon the microenvironments of the Bodo sand hills are uncertain. The existence of numerous standing aspen and willow deadfall in the area as a result of recent near-drought conditions may suggest that these microenvironments are highly sensitive to such changes. The moisture regime of the early centuries of the last millennium may have resulted in a major reduction in overall vegetative cover in the area. Devegetation may even have triggered localized or extensive reactivation of the dune field. The reduction or elimination of the aspen stands, and overall desiccation, of the Bodo sand hills would decrease the availability of shelter and firewood, important winter resources, and water, an essential summer resource. Conversely, the relatively cool and moist period of the late second millennium A.D. probably resulted in an expansion of brush cover, increased stability and soil development, and an increase in the size, number and duration of seasonal ponds and sloughs. Even at the peak of the Little Ice Age, however, aspen, poplar and willow stands were unlikely to have reached the height and density of modern wooded areas in the Bodo sand hills, due to the effects of wildfire.

2.3. Regional Culture History

Introduction

Preliminary analysis of material excavated from FaOm-1, including Area 7 of Lease 10-32, has identified material that is consistent with a Late Pre-Contact period (ca. A.D. 500 to 1750) occupation on the Northern Plains. The Late Pre-Contact period on the Northern Plains has been classified and described in various ways and by various names. The most commonly cited defining characteristic of the late period is the appearance of smaller projectile points (e.g. Mulloy 1958; Reeves 1969; Frison 1978). Reeves (1970, cited in Foor 1985: 128; Reeves 1973) was the first to explicitly infer that these small points represent the adoption of bow and arrow technology, and define his "Late Prehistoric Period" on the basis of this technology. Other analysts see the integration of ceramics into the technological repertoire of plains peoples as being of equal or greater significance. At the time of Reeves' classification of Northern Plains culture history, the Besant Phase, particularly in Alberta, was believed to be aceramic, with the introduction of ceramic technology to the Northern Plains coinciding with the adoption of bow and arrow technology in the Avonlea Phase (Walde and Meyer 2003: 134). Archaeological work in the past three decades has recovered pottery from a number of Besant sites on the Canadian plains, complicating the classification of the Besant Phase. It now appears appropriate to consider the Besant Phase as transitional between the Middle and Late Pre-Contact Periods, with the inclusion of ceramics, but the retention of the atlatl (Walde and Meyer 2003: 134). Following the Besant Phase, the remainder of the Late Pre-Contact period on the western half of the Northern Plains is divided into two phases, Avonlea and Old Women's.

Cultural adaptation to life on the Northern Plains, as indicated by archaeological remains, shows remarkable continuity through millennia of pre-contact occupation in the region. From the earliest signs of human activity, until the arrival of Europeans and extensive agriculture, human adaptation to the plains of North America has centered on big game hunting, with a special focus on bison (Michlovic, 1986). Relatively recent research (e.g. Davis et al. 2000, Smith 1988) has begun to draw attention to the important role of other ungulates, fowl, and fish in the diets of Northern Plains peoples, particularly during periods of bison scarcity and the lean times of late winter and spring. Bison still appears, however, to have been by far the preferred staple food for the majority of Northern Plains peoples. While dramatic changes appear in the archaeological record of the region over this vast span of time - the introduction of the atlatl and the bow, the adoption of pottery, and the development and improvement of communal hunting methods such as the pound and jump - these changes to material culture and social organization appear primarily to have improved the efficiency of bison hunting and the storage of bison products, increasing, rather than decreasing the central role of bison in the lives of the pre-contact occupants of the Northern Plains.

Bison

Evidence of a wide variety of faunal and floral resources are regularly encountered at pre-contact plains sites, including the Bodo Bison Skulls site; however, these resources typically appear to be supplemental to the primary food source, bison. The seasonal round of Late Pre-Contact bison hunting peoples appears to have been closely tied to that of their primary food source. Due to their early historic eradication, the behavior of the massive pre-contact bison herds must be extrapolated from the limited records of the earliest European travelers on the Northern Plains. This extrapolation has produced major debates regarding the nature and existence of bison seasonal migration. Through the first half of the twentieth century, the general impression of bison seasonal mobility, both among scholars and the general public, was of vast herds of bison traveling the length of the North American plains (Binnema 2004: 38), from north to south and back again, akin to the voyages of migratory birds. Roe's study of the North American bison shattered this assumption among scholars, arguing that bison "wanderings were utterly erratic and unpredictable" (Roe 1970: 674). As with most scholarly debates, the consensus regarding bison seasonal mobility is settling between these two extreme points. Most modern scholars agree that prior to the historic period, free-roaming herds of bison followed some migratory pattern (e.g., Arthur 1975; Moodie and Ray 1976; Morgan 1980; Bamforth 1987). There remains significant debate regarding the motivation, nature, predictability, and pattern of bison migration, especially regarding the precise location of bison wintering territory (e.g., Malainey and Sherriff 1996).

Trevor Peck's (2001) summary of the historic and archaeological evidence regarding Bison seasonal mobility argues for a 'Buffalo Year' which runs as follows: in Mid-summer (late June to mid-July) the bison were feeding in small groups, relatively evenly distributed across the plains. The rut began in late July, and the mating season continued to September. During the rut, bison congregated in massive herds at the edges of the plains. At the end of the rut the bison continued to move away from their summer grounds and into more sheltered territory in the parklands and wooded river valleys. By mid-November the bison had reached their wintering grounds in the Aspen Parkland and other sheltered, wooded areas and were resident in large herds in limited sheltered territory. Bison usually overwintered in the Aspen Parkland and wooded river valleys, though historic records of particularly mild winters suggest that they may have returned to the plains for forage in good weather. In March and April the herds began to tentatively move out of their wintering grounds. Some calves were also born during this period, though as any Albertan knows the unpredictable weather of the Northern Plains frequently brings cool temperatures and snow as late as May, resulting in high mortality for these early calves. From mid-April to June calving season peaked while the bison moved through the plains – parkland interface, where the rut had occurred some months earlier, eventually returning to the open plains (Peck 2001: 245-247). This regular, though variable, seasonal round provided plains people with a relatively predictable and plentiful primary food source, year-round.

Seasonal Round

The Late Pre-Contact seasonal round appears to have been strongly influenced by the annual round of the Bison. In late spring small groups of people were dispersed over the plains. This low-density distribution of hunting groups matched the bison's distribution and enabled these groups to subsist from spring through to late summer with relative security, relying on frequent encounters with small groups of animals. During this period these groups would have been harvesting various other seasonally available resources, including, in late summer, highly productive berry patches (Peck, 2001: 248). Late summer and autumn saw the congregation of vast herds of bison for the rut. Late

Pre-Contact bison hunters followed the herds off the plains towards their wintering grounds in the Aspen Parkland. It is at this time that the historically recorded Sun-Dance occurred (Peck, 2001: 244), with many groups coming together to share information regarding predicted bison wintering grounds and planned winter camp locations. In late autumn the bison broke up into large herds and moved into the parkland, river valleys, and other sheltered areas. Large fall kills would have occurred when cooperating groups of hunters manipulated these large herds over jumps and into pounds. These large communal kills would generally occur on the margins of the parkland, where there was a ready supply of timber and brush for the construction of pounds, and a relatively large labour source moving to, or already at, their winter camps (Peck, 2001: 248). Once reaching their wintering grounds, both bison herds and human groups typically settled in to wait out the long, often bitterly cold, plains winter. Typically smaller communal drives and pounds would occur regularly throughout the winter, providing the people with the majority of their winter fare, supplemented by individual stalking of other game, and occasionally isolated bison (Peck, 2001: 248). In spring groups would move out onto the plains and disperse, though generally somewhat later than their prey, in order to avoid the possibility of being caught on the open plains during a late spring snowstorm (Peck, 2001: 248). Though bison were definitely the primary source of food for these people, their diet would have been supplemented with a variety of other game, including other ungulates, birds, and fish, as well as a variety of plant resources. This is particularly apparent in the latest pre-contact period (Walde, et al., 1995: 34).

Late Middle Pre-Contact to Late Pre-Contact: Besant Phase

The classification and structuring of the archaeological record of the Late Pre-Contact Period on the Northern Plains is somewhat disputed, particularly regarding local or regional variations. The broad classifications, however, are relatively well defined. The Besant Phase is generally agreed to be transitional from the late Middle Pre-Contact to the Late Pre-Contact, though there is some dispute regarding dating and sequence with the following Avonlea phase. In the Canadian Plains the Besant Phase is extant from ca. 2200 BP to 1500 BP. Like many archaeological classifications on the plains, the Besant Phase is associated with an eponymous projectile point type. The Besant point is broadly lanceolate to triangular in shape, generally from 30-78 mm in length, with wide side-notches very near the base (Vickers, 1994: 9). The large size of these points is generally considered indicative of their association with atlatl technology, making them the last dart points on the Northern Plains. The Besant Phase is also associated with pottery, of the Plains Woodland type. This pottery is typified by sand or grit temper, generally conical form and cord-roughened external surface. Decoration is rare, usually limited to a single line of punctates and / or bosses around the lip or rim of the vessel. Pottery is most commonly found in Besant sites in the southeast, near the Middle Missouri region, becoming increasingly rare as one moves west and north (Walde, et al., 1995: 18). The Besant phase is replaced by the Avonlea Phase on the Canadian Plains by ca. 1500 BP, and continues somewhat later (1200 BP) in the northern American Plains (Walde, et al., 1995: 19).

Late Pre-Contact: Avonlea Phase

The Avonlea Phase is the first Late Pre-Contact phase in the Northern Plains. The Avonlea point type is "very small, thin, carefully pressure flaked … with straight or slightly concave bases and small, low side-notches", and is generally considered the first arrowhead on the Northern Plains (Walde, et al., 1995: 20). The lithic technology of the Avonlea phase emphasized the use of local lithic materials (Vickers, 1994: 15) and the 'split-pebble' or bipolar core technique (Walde, et al., 1995: 26). Avonlea pottery differs from that of Besant. Typical Avonlea Phase vessels are conoidal or 'coconut' shaped, with net-impressed, parallel-grooved, or smoothed finish, with occasional punctate decoration circling the rim of the vessel (Vickers, 1994: 15). Walde (2003) has identified four regionally, and possibly temporally, distinct pottery wares associated with the Avonlea Phase, each of which deviates from this general description in some details. The Avonlea Phase is replaced by the Old Women's Phase beginning around 1200 BP.

Late Pre-Contact: Old Women's Phase

The Old Women's Phase is the last recognized pre-contact archaeological manifestation on most of the western half of the Northern Plains, including the study area. Projectile points of the Old Women's phase are small, triangular and side-notched, but exhibit significantly greater variation and coarser flaking than those of the Avonlea phase. Walde, et al. (1995: 28, citing Duke, 1981) argue that Old Women's phase projectile point flaking characteristics do, however, indicate continuity with the Avonlea phase. The significance of this increased variation in Late Pre-Contact period side-notched projectile points is unclear. Thomas Kehoe (1966) divided these points into two classifications, Prairie Side-Notched and Plains Side-Notched, with the latter replacing the former ca. 650 BP. This division has predominated Late Pre-Contact projectile point classification since; however, a recent analysis of Late Pre-Contact side-notched points from Alberta and Saskatchewan did not find statistically significant variation to support this division (Peck and Ives 2001). Peck and Ives' analysis found a statistically significant shift in a number of key basal features post ca. 650 BP in projectile points from assemblages only in southeastern Saskatchewan. They argue that the distribution of these points is consistent with that of sites attributed to the Mortlach Phase of Late Pre-Contact southeastern Saskatchewan, and thus refer to these points as the Mortlach Group (Peck and Ives 2001: 181). The remainder of Late Pre-Contact side-notched points, which appear ca. 1250 BP across the Northern Plains and continue until the adoption of metal points in the west, they designate the Cayley series. Attributes that differentiate Mortlach from Cayley are a preference for narrower side-notches, and straighter, more rectangular bases in the former (Peck and Ives 2001: 180).

In other aspects of lithic technology, the Old Women's Phase shows considerable continuity with the preceding Avonlea Phase. A preference for local lithic material and bipolar reduction techniques continued. Petrified wood is a commonly used lithic material in this phase (Walde et al. 1995: 26, 28). Old Women's ceramic vessels are commonly globular in form, with pronounced shoulders and short necks (Vickers 1994: 21; Walde et al. 1995: 28). The exterior surface commonly exhibits cord-wrapped or fabric/net-impressed finish, though this texture is often fully or partially smoothed

(Vickers 1994: 21). Decoration is generally limited to punctates or incisions around the lip, neck or shoulder, but "is not only sparse but highly variable, even idiosyncratic" (Walde et al. 1995: 29). There is significant continuity between Avonlea and Old Women's pottery. William Byrne (1973) grouped Old Women's phase ceramics with those of the Avonlea phase as the "Saskatchewan Basin Complex", to indicate their continuity and to differentiate them from the ceramics of the Middle Missouri region, to which he believed they were unrelated (Vickers 1994: 21). Walde and Meyer (2003: 143) identified the dominant pottery type of the Old Women's Phase as Ethridge Ware, which they argue originated during the Avonlea Phase (Walde and Meyer 2002:142). In the study area, the Old Women's phase continued to the historic era, and is generally, though not universally, believed to represent pre-contact Blackfoot occupation (Vickers 1994: 28; Walde et al., 1995: 51).

2.4. Excavation History:

FaOm-1: 1995-1996

FaOm-1 was first identified by Terry Gibson and Peggy McKeand of Western Heritage Inc., a Cultural Resource Management firm that specializes in the identification, protection and excavation of archaeological sites for the energy and forestry industries. A number of Bison skulls were exposed in a trench during pipeline construction by Fletcher Challenge Petroleum in 1995. Further archaeological assessment and mitigative excavation was carried out during the 1996 field season, and indicated that FaOm-1 was both extensive and rich in archaeological material, representing a Late Pre-Contact occupation, dating between ca. A.D. 800 and 1780 (Gibson, 2001: 1). At this time it was expected that the site had been extensively disturbed by Oilfield activity since the 1970s, and that intact cultural remains were unlikely to be found (Gibson, 2001: 3).

FaOm-1: 2000

Further exploration and assessment of the site occurred in 2000, when Murphy Oil Company Ltd. proposed the development of three new oil wells in the immediate vicinity of the original site. These are referred to as Leases 13A-32-36-1 W4M (13A-32), 2-5-37-1 W4M (2-5), and 11-32-36-1 W4M (11-32), in accordance with the legal descriptions of their locations. The location of these developments within the Bodo site complex is displayed in Plate 1, all plates are presented in Appendix I. Initial assessment involved shovel testing and pedestrian surface survey of all three oil leases under Alberta Community Development: Heritage Resource Management Branch archaeological permit 2000-081. Preliminary pedestrian survey identified bone and lithic material scattered on all three leases. Shovel tests similarly encountered scattered lithic and faunal material throughout lease 13A-32 and the south edge of lease 2-5, although the context was often extensively disturbed as a result of previous industrial activity, and tests were difficult, or impossible, in many areas, due to the presence of thick layers of clay and gravel overburden, installed during previous development of the oilfield (Gibson 2001: 8).

FaOm-1: Lease 11-32

Previous oilfield activity on Lease 11-32 was limited to the presence of pipelines along the west and south borders of the lease (Gibson 2001: 17). Initial pedestrian survey identified faunal material and thermally altered stone wherever the ground surface was exposed, particularly along a vehicle track on the west side of the lease and cattle trails crossing the lease (Gibson 2001: 14). Initial assessment also involved the excavation of three stratigraphic shovel tests, which indicated "that the archaeological deposit on the proposed wellpad area was extensive, intact and quite prolific" (Gibson 2001: 15). Further detailed assessment followed in June of 2000, as a result of Murphy Oil's continued preference to develop the lease (Gibson 2001: 16). A set of 50 cm by 50 cm shovel tests, spaced at approximately 20 m intervals over the lease produced significant volumes of faunal and lithic material, generally coming from fairly intact cultural deposits at depths from 20 to 30 cm below surface (Gibson 2001: 16). A single fragment of an iron trade point was recovered from one test pit, indicating a record of activity on the site during the Proto-Contact period (Gibson 2001: 16). The presence of extensive, intact, cultural deposits in the lease area led to the recommendation by Gibson of mitigative excavation. Taking these recommendations into account Alberta Community

Development decided that there was insufficient time for mitigative action, and instead instructed Murphy Oil to select another location for this development, preferably one that had been affected by previous industrial development (Gibson 2001: 17). On the basis of this recommendation Murphy Oil decided to reactivate wellpad 10-32-36-1 W4M, originally developed during the 1970s, as an area from which to target the reserves beneath 11-32.

FaOm-1: Lease 10-32

Lease 10-32 is located in the southeastern quadrant of the Bodo site complex, south and east of several low, semi-stabilized sand dunes (Gibson 2001:18). It is an irregular quadrangle, approximately 100 m by 75 m. The central area of the lease, around the deactivated wellhead, was built up with clay and gravel during previous development. The remainder of the lease was relatively level, and apparently largely undisturbed, local native prairie (Gibson 2001: 18). Plate 2 is a map of lease 10-32 depicting shovel tests and excavation areas.

The first stage of Heritage Resource Impact Assessment involved pedestrian survey and shovel testing on 2-3 July, 2000. The survey identified bone and debitage scatters in most of the disturbed areas of the lease, and indicated a "fairly uniform and relatively rich archaeological deposit" over the entire area "in keeping with the character of other areas of FaOm-1" (Gibson 2001: 19). Four shovel tests were placed along the margins of the disturbed central area, and one test within the disturbed area. All five of these pits produced some archaeological material. Four produced undisturbed cultural remains and the fifth produced some scattered bone fragments

(Gibson 2001: 18). Based on these findings, Alberta Community Development authorized more detailed assessment of lease 10-32, including up to 50 m^2 of excavation, and the installation of a clay and gravel cap over the lease prior to redevelopment (Gibson 2001:19).

Detailed assessment was undertaken from July to October of 2000 in three phases (Gibson 2001:19). The first phase of excavation involved a number of sample excavations and stratigraphic shovel tests to determine the extent, condition and quality of archaeological deposits beneath the pad. Ten separate areas were excavated, "concentrating in locations where intact subsurface archaeological deposits were known or suspected" (Gibson 2001: 20). Three additional shovel tests were also made. Six of the ten excavated areas contained intact cultural remains, with "profuse quantities of materials in excellent stratigraphic context" encountered in areas 3, 5 and 7 (Gibson 2001:20). In Area 3, in the north-central area of the lease, 5m^2 were excavated, exposing what appeared to be the remains of a single bison butchering episode (Gibson 2001:20). In Area 5, in the northwest corner of the pad, a 2 m by 2 m excavation block exposed a dense bed of faunal material. A single 1m^2 unit was excavated deeper, and the bed of bison bone, decomposed viscera and hair proved to be 20-30 cm thick. A large number of intact and fragmentary projectile points were recovered in association with this faunal material (Gibson 2001:21). Initially, 2 m by 2 m of Area 7, in the southwest corner of the pad, was excavated. This was expanded to 4m by 4m after the initial excavation exposed what appeared to be the remains of a well-preserved living floor and hearth, surrounded by a dense distribution of faunal material, lithic debitage and ceramic fragments (Gibson

2001: 22). After this first phase of excavations, the entire lease was capped with a protective layer of clay so that drilling could proceed (Gibson 2001:19).

After drilling, mitigative excavation of Areas 5 and 7 continued. The remaining three units of Area 5 were fully excavated, and Area 7 was extended to 5m by 5m, and fully excavated. After excavation of Area 7 was completed, the area was lined with plastic, covered with clay, and fenced off from the active well area. (Gibson 2001: 23)

The third phase of assessment of Lease 10-32 involved the excavation of three backhoe trenches, approximately 5 m by 1.5 m, along the proposed route of a flowline trench. Only limited disturbed and deflated archaeological deposits were encountered in these trenches (Gibson 2001: 23). Trenching for the flowline exposed an intact cultural deposit approximately 5 m from the wellhead in the north trench wall. The occupational lens extended for approximately 4m but was truncated at the west and east ends by prior development disturbance. The lens consisted of bone and fire-broken rock, embedded in a paleosol, typical of other areas of FaOm-1 (Gibson 2001: 24)

2.5. Local Topography

Excavation Area 7 is located in an area of relatively level, undisturbed native prairie (Gibson 2001:18). Low stabilized dunes lie approximately 100 m to the north and northwest. Beyond these is relatively dense brush. Open prairie continues to the east, rising slightly. The ground falls off somewhat to the south, with a wooded area 100-150 m to the southeast, a low brushy hollow about 50 m to the south, and broad, low-lying prairie continuing for hundreds of meters to the southwest. The excavation area itself has a slight grade, with a total rise of approximately 50 cm from west to east, and 10 cm from south to north. Plates 3 and 4 are photos of the terrain surrounding excavation Area 7.

2.6. Stratigraphy

The Bodo sand hills are an area of semi-stable sand dunes, located on a shelf of clay overlooking a pleistocene river valley, through which Eyehill Creek now flows. This semi-stable dune field is similar to large sand hill complexes throughout southern Alberta and Saskatchewan. One such area lies between the North and South Saskatchewan Rivers, west of Saskatoon. The geology and ecology of this area, and their relationship to the archaeology of the area, were described in detail by Ian G. Dyck (1970). Dyck cites five physiographic types present in these semi-stable dune areas, as defined by Hulett, et al. (1966). These physiographic types also describe the variability of the Bodo sand hills:

> (1) active complexes, which have erosion or deposition taking place;
>
> (2) stabilized blowouts, which are distinct saucer-shaped depressions aligned in the direction of the prevailing effective wind, showing evidence of recent erosion, but no erosion at present;
>
> (3) stabilized dunes, which show a characteristic dune form (windward and lee slopes) and show no evidence of recent erosion;
>
> (4) dune depressions, which are usually located on stabilized dunes and show no evidence of recent erosion, being distinguished from blowouts principally in respect to the latter characteristics;
>
> (5) sand flats, which are level stabilized areas between dunes. (Hulett, et al. 1966:1309)

The combination of a sandy soil and a semi-arid climate result in marginal, and highly vulnerable vegetative cover. Disturbance of the vegetative cover by agents such as fire or industrial activity, as well as minimal disturbance such as animal trails and wallows, can result in devegetation and destabilization of large areas. This vulnerabilty leads to an environment in which localized areas are constantly destabilizing and shifting from one of the above physiographic types, into active complexes, only to eventually restabilize into one of the other types. This depositional environment leads to a complex stratigraphic patchwork, in which a developing soil, on physiographic type 2 through 5, may be buried by windblown sand, producing a paleosol, only to have localized disturbance result in a blowout, deflating the buried soil, but often leaving artifactual material behind, in secondary context. Paleosols may therefore be encountered in one location, but be absent a few meters away. This process also suggests that the older an occupation, the greater the probability of destabilization at some point since its deposition.

The excavation blocks on Lease 10-32 exemplify this pattern of patchwork stratigraphy. All test excavations and blocks in the central area of the lease exhibit extensive disturbance as a result of the initial development of the lease in the 1970s. The periphery of the lease, however, appears to have escaped this recent disturbance, and many test excavations and blocks contain one or more paleosols with intact cultural deposits. The generalized stratigraphic profile of excavation Area 7 begins with an overburden of light brown sand, 20 to 40 cm thick. Occasional faunal artifacts were recovered from this layer. Below this sand was a "thin veneer" (Gibson, personal communication 2005) of artifactual material, including a number of large bone fragments and nearly complete elements, lithic debitage and tools, and ceramic fragments. This layer was not associated with a paleosol, and is henceforward referred to as the upper occupation. Below this veneer of material was a layer of sand, approximately 10 cm deep, which contained occasional faunal artifacts. At the base of this sand layer began a

5 to 10 cm thick layer of dark, organic rich sediment, interpreted as a paleosol, within which was a well-defined living floor and a dense layer of lithic, ceramic and faunal artifactual material, and a number of features. This layer is henceforward referred to as the lower occupation. Immediately below this occupation level was light brown sand, with some, primarily faunal, artifactual material. The sandy matrix continued, sterile, to the maximum depth of the excavation, approximately 30 cm below the lower occupation.

Part 2: Inventory and Analysis

3. Upper Occupation

3.1. Features

The artifactual material in the upper excavation levels was not associated with a preserved paleosol, and no visible features were present.

3.2. Chipped Stone

Debitage

Only 24 lithic fragments were recovered from the upper occupation, with a total mass of 11.8 grams. The greatest constituent, both by number and by mass, is Swan River Chert. Silicified wood and jasper are the second most common materials, by mass and by number, respectively; silicified peat is of lesser significance in this sample. Siltstone and chert pebbles, and other cryptocrystalline silicates are minor constituents. Of note is the absence of the white chalcedony present in the lower occupation assemblage. For more thorough descriptions of the lithic raw materials present in the assemblage, see the discussion under the lower occupation. Chipped-stone debitage recovered from the upper occupation level is concentrated in the northeast corner of the excavation area, with 20 of the 24 fragments being recovered from 202.5 m N to 204.5 m N, 104.0 m E to 105.0 m E.

Material	Number	% Total Number	Mass (g)	% Total Mass (g)
Swan River Chert	7	29.17	3.4	28.81
Silicified Peat	3	12.50	1.2	10.17
Silicified Wood	4	16.67	3.1	26.27
Jasper	5	20.83	2.0	16.95
Siltstone & Pebble Ch.	2	8.33	1.1	9.32
Other Micro- & Crypto-crystalline Silicates	3	12.50	1.0	8.47
Total	**24**	**100.00**	**11.8**	**100.00**

Table 1: Upper occupation lithic debitage summary.

Tools

The assemblage from the upper occupation level includes six tools or tool fragments. These tools were recovered from across the entire excavation area. More detailed definitions of the tool types are included in the discussion of the lithic material from the lower occupation. The upper occupation tool assemblage includes three retouched pieces, two of silicified peat (68065, 7726) and one of siltstone or 'pebble chert' (67903). The lone uniface recovered from the upper excavation level (67808; Plate 15e) is a very small (13.8 mm long) siltstone tool. It has been thoroughly retouched, and exhibits wear both on its distal extremity and the proximal portions of its lateral edges. This wear, and the relatively low angle of retouch on the distal edge suggest that this tool may be a small hafted plane. There is a single Swan River Chert tool (62194; Plate 16a), a wedge or pièce esquillée. Finally, the upper occupation includes a strongly asymmetrical, basally notched, silicified peat biface (61166; Plate 13d). It may be a hafted knife, or a manufacturing discard, intended to be a point, but abandoned due to the presence of a large mass on the dorsal surface. Metric and non-metric attributes of all tools are presented in Appendix II.

3.3. Thermally Altered Stone

The upper occupation includes 23 small fragments of thermally altered stone, with a total mass of 26.1 grams. The sample is composed of granite and sandstone fragments, with granite dominating. The mean size of fire-broken granite is significantly smaller than that of sandstone. The majority of the stone is concentrated in the northern east side of the excavation area, from 202.5 to 204.5 m N, 104.0 to 105.0 m E.

	Number	% N	Mass	% Mass	Mean Mass
Granite	14	60.87	12.6	48.28	0.90
Sandstone	7	30.43	11.0	42.15	1.57
Other	2	8.70	2.5	9.58	1.25
Total	23	100.00	26.1	100.00	1.13

Table 2: Upper occupation thermally altered stone summary.

3.4. Ceramics

The artifact assemblage from the upper occupation level includes six ceramic fragments. This includes two fragments which exhibit preserved exterior surface treatment, one smoothed, the other cord roughened. Four additional sherds are present, but none retain evidence of surface modification. None of the sherds retain any evidence of decoration, except the surface modification. Nor do any of the sherds exhibit any evidence of vessel morphology.

3.5. Faunal Material

Excavation level 3 contained a thin veneer of faunal material. This faunal material forms the basis of the upper occupation. Faunal material recovered from the upper occupation is predominantly fragmentary and significantly weathered, though some major axial element portions are present. The faunal sample includes 845 bone fragments, with a total mass of 6689.7 g. The distribution of the upper occupation faunal material is presented in Figures 3 and 4.

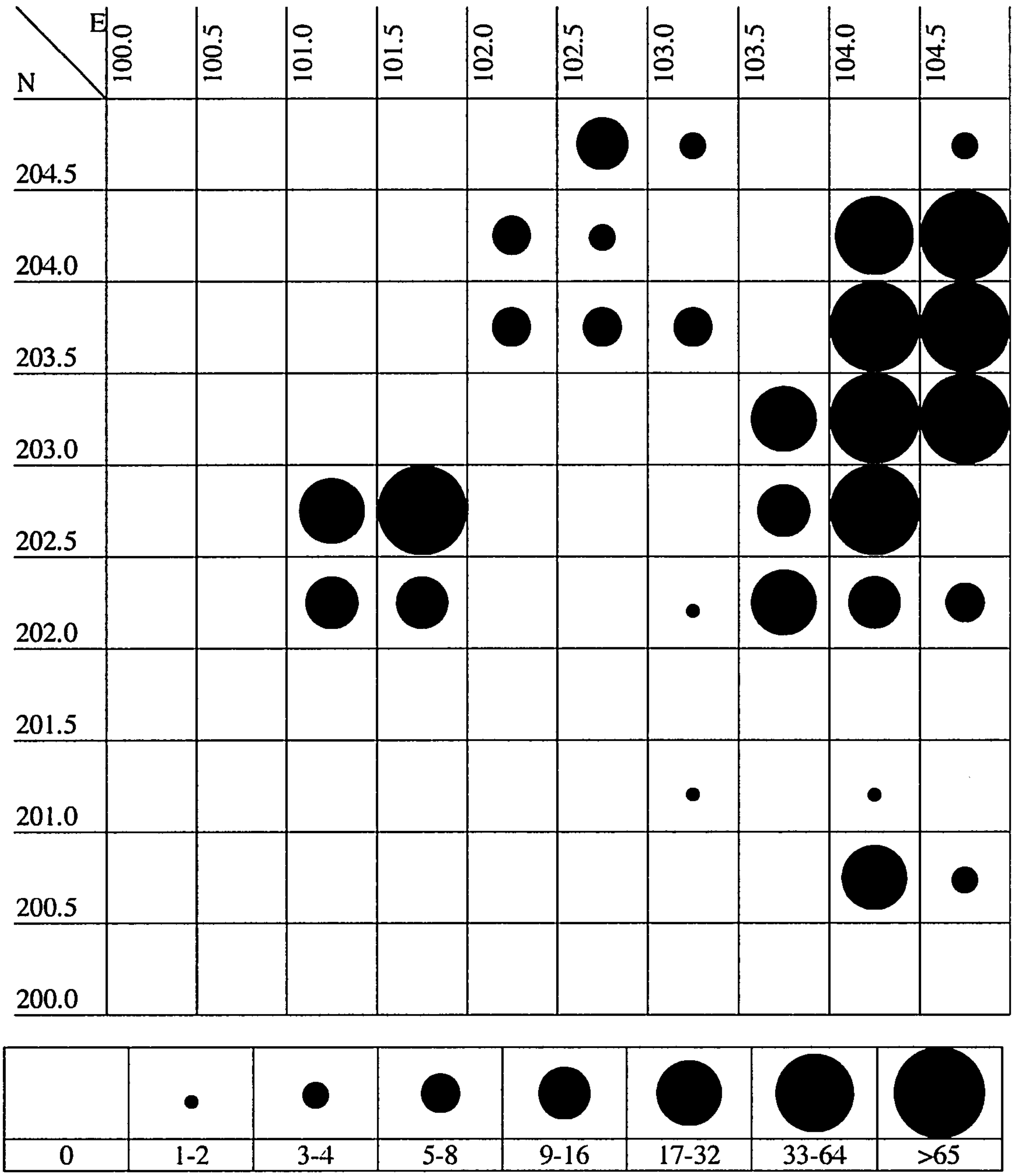


Fig. 3: Upper occupation distribution of bone; number of fragments per subunit.

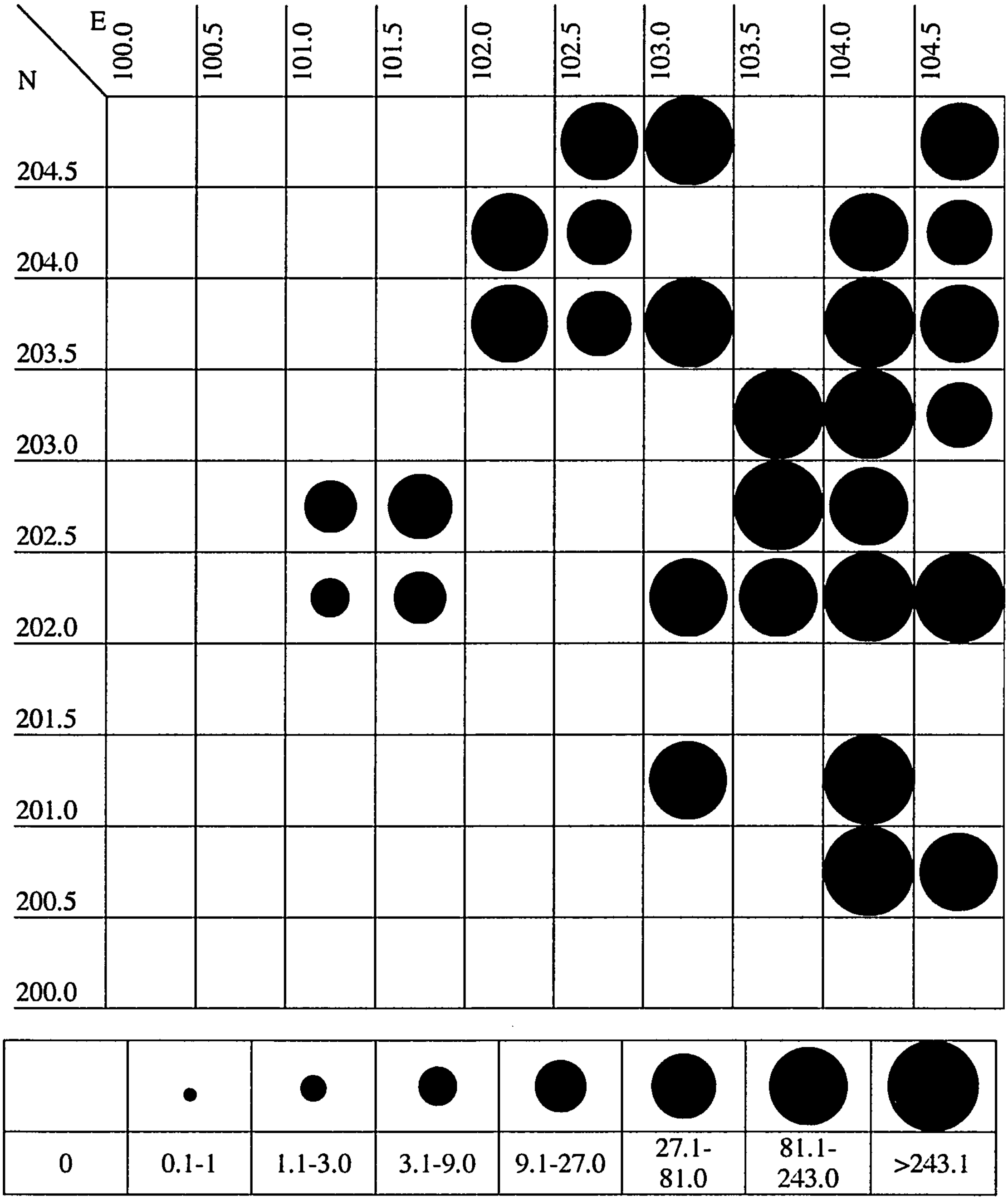


Fig. 4: Upper occupation distribution of bone; total mass (g) of fragments per subunit.

The distribution by number indicates a concentration in the northeast corner. The distribution by mass indicates the presence of a few larger fragments surrounding the main concentration. The cluster of faunal material in unit 202 N 101 E may be an artifact of excavation and collection methods.

Only 121 bone fragments were included in the analyzed faunal sample, with a total mass of only 76.5 grams. The only identifiable element is a complete bison third incisor. There are also three other fragments of dental material. The remaining artifacts in the identified faunal sample are all unidentifiable bone fragments, probably bison.

In the complete faunal assemblage from the upper occupation, a number of artifacts exhibit various cultural and natural modifications, including burning, cutmarks, and evidence of carnivore and rodent activity, in addition to extensive weathering. No bone tools were recovered from the upper occupation. Cultural and natural modification of bone from the upper occupation is summarized in Table 3.

	Number of fragments	% of total number	Total Mass (g) of fragments	% of total mass (g)
Cutmarks	7	0.83	702.3	10.50
Carnivore Chewed	8	0.95	154.2	2.31
Rodent Gnawed	2	0.24	19.2	0.29
Burnt	28	3.31	15.2	0.23
Calcine	10	1.18	3.2	0.05
Total fragments	845	100.00	6689.7	100.00

Table 3: Upper occupation bone modification.

4. Lower Occupation

4.1. Features

Excavation notes and photographs record the presence of a number of features in the excavation area. In the majority of the excavation area, excavation notes consistently report the presence of a well-defined living floor near the base of the thick and extensive paleosol. The majority of artifactual material recovered from these units was directly associated with this living floor. Three features were recorded in this area, directly associated with the well-defined living floor.

Feature 1 (Plate 5) is a "distinct basin hearth dug into the sand ... 46 by 57 cm (SE/NW by SW/NE) and 12 cm deep" (Gibson: excavation notes Oct. 10 2000) in the very northwest corner of the excavation area, in subunit 204.5 m N, 100.0 m E. This feature was filled with ash, charcoal, burnt and calcined bone, and other artifactual material.

Feature 2 (Plate 6) is a pit feature, approximately 50 cm across and 15 to 20 cm deep, centered in subunit 203.5 m N, 101.0 m E. This is approximately 1 m southeast of the basin hearth, above, and associated with the same 'well-defined living floor'. This pit is associated with concentrations of fragmentary bone, lithic debitage, and potsherds, as well as some larger faunal elements.

Another hearth, designated here as Feature 3 (Plate 7), approximately 60 cm across, but somewhat irregular in outline, was centered at 201.5 m N, 101.5 m E. This feature was also associated with a lens of ash and scattered charcoal, burnt bone, and other artifactual material. Faunal material from both above and below this feature, and from the associated occupation level in a neighbouring excavation unit, were selected for radiocarbon dating, and will be discussed below.

In the northeast periphery of the excavation area the living floor is less well-defined. Artifactual material, including large bone fragments and nearly complete elements, are dispersed somewhat above, and below, the occupational level. A roughly circular concentration of ash, charcoal, burnt bone, and other artifactual material, approximately 50 to 70 cm across was present, centered about 203.0 m N 104.5 m E. It is also interpreted as a simple, unexcavated hearth, and designated as Feature 4 (Plate 8). This feature is under- and overlain by large bone fragments and nearly complete elements. Faunal material associated with this feature, and from both above and below the occupation level, were also selected for radiocarbon dating.

4.2. Chipped-Stone

4.2.1. Introduction

The chipped stone assemblage is typified by a preponderance of small, angular shatter, with fragments exhibiting typical flake characteristics rather rare. Chipped stone tools in the assemblage tend to be small, fragmentary, and minimally formed. The dominant lithic raw materials present are silicified peat, silicified wood, and Swan River Chert. Minority components of the lithic assemblage include a variety of other micro- and crypto-crystalline silicates, siltstone, quartzite, quartz, and obsidian.

Lithic Raw Materials

The most common raw material, numerically, is silicified peat or lignite, which exhibits a broad range of characteristics. Two types predominate: the first is dark reddish brown, semi-translucent, and exhibits relatively regular fracture characteristics. It is similar to Knife River Flint in colour and lustre (Clayton et al. 1970); however, most fragments of this material exhibit inclusions and imperfections that are inconsistent with Knife River Flint, including small red and black flecks and a greater tendency to fracture along internal bedding planes. Silicified peat in the assemblage also tends to be slightly coarser, and less vitreous, than Knife River Flint, and woody inclusions present tend to be larger and retain more of their original organic structure. The second common type is medium brown in color (similar to milk chocolate), opaque, and exhibits occasional bedding planes and snail macrofossils. This material is somewhat coarser than the aforementioned dark reddish-brown silicified peat.

Other, less common, types of silicified peat include a medium brown, semi-translucent variety that exhibits a much coarser texture, and a dark reddish brown, translucent variety, that exhibits a much greater tendency to fracture along bedding planes and other imperfections in the material. The debitage sample also contains small numbers of flakes and shatter that range between these types, in terms of color and opacity. It is possible that some of the aforementioned silicified peat may be low-quality Knife River Flint, or flint from associated or similar geological deposits in South Dakota (Ferguson 1996) or Manitoba (Hlady 1965); however, due to the implications regarding trade and travel associated with the presence of actual Knife River Flint in the assemblage, I hesitate to make this identification without a full, microscopic, petrological analysis of samples.

The silicified wood varies dramatically in color, from deep reds to dull greys and semi-translucent whites, and is highly variable in its flaking characteristics. The majority of the wood is relatively poorly silicified, and tends to fracture along the grain and between the rings of the fossilized organic material. It tends to break into tabular fragments rather than conchoidal flakes. These tabular fragments exhibit a broad range in size, tending to be somewhat larger than flakes of other materials. The silicified wood debitage regularly exhibits evidence of bipolar percussion, such as crushed areas at one or both ends of the long axis and negative flake scars originating at opposing ends.

Swan River Chert is the most distinctive raw material present in the assemblage. Swan River Chert exhibits a very broad range of colours, "from white through beige to dark grey or blue grey; pale pink to deep red; from pale yellow to deep orange... reddish brown to reddish black ... [commonly] with red, orange, yellow, beige, white and various grey bands visible" (Campling 1980: 294). Low (1996) attributes "the range from whites/grays to reds" to thermal alteration (Low 1996: 165). In its natural state, Swan River Chert "ranges from white through gray to brown and even black" (Grasby et al. 2002: 275). Swan River Chert is best identified by its heterogeneous texture under magnification, exhibiting "a tri-modal crystallinity of granoblastic quartz, chalcedonic spherulites and anhedral crypto-crystalline quartz" (Campling 1980: 299). Macroscopically, Swan River Chert is often identified by its densely vuggy texture, producing an appearance similar to curdled milk. The texture of the Swan River Chert in the assemblage varies substantially, ranging from very fine nearly homogeneous cryptocrystalline specimens to coarse microcrystalline specimens resembling quartzite. Swan River Chert is a common material in archaeological assemblages across much of the Northern Plains. This is primarily due to its distribution as cobbles in glacial deposits across "southern Manitoba ... east-central and southern Saskatchewan, southeastern Alberta, northern Montana and north/northeastern North Dakota" (Low 1996: 168). The Laurentide ice sheet is believed to have distributed these nodules and cobbles from a bedrock source(s) in southwest Manitoba, where nodules of material consistent with Swan River Chert have been identified in vertical solution chimneys in Devonian carbonates (Grasby et al. 2002).

A broad variety of other micro- to crypto-crystalline silicate rocks are also present in the lithic assemblage, including a range of 'generic' cherts and chalcedonys. A translucent, homogeneous white material makes up a substantial portion of this 'miscellaneous' sample, including a single core; however, this material may be over-represented, particularly in the smallest size classes (2-6mm) due to the difficulty in correctly identifying micro debitage of light-colored Swan River Chert and some silicified wood. Another significant minor constituent of the lithic assemblage is a jasper-like material. This material exhibits a range of colours from orange to red, and regular conchoidal fracture. Much of the other generic chert may be a product of the bipolar reduction of small chert pebbles, but cannot be conclusively identified as such due to the absence of cortex or diagnostic bipolar flake characteristics.

Small siltstone and chert pebbles, reduced through bipolar percussion, comprise a minor, though significant, portion of the lithic assemblage. From personal experience surveying and excavating the Bodo Bison Skulls site complex, 'pebble chert' seems less common in Area 7 than in other areas in the site complex.

A number of flakes, and a single large fragment, of massive quartz and rose quartz are also present. This material is very difficult to knap, due to the irregularity of its crystalline structure. Despite this, it has been present, in small amounts, at many of the areas excavated and surveyed in the Bodo Bison Skulls site complex.

Quartzite is minimally represented in the lithic assemblage, numerically, contrary to expectations in Alberta. Its contribution to the total mass of the lithic assemblage is bolstered by the presence of a large bifacial chopper. The quartzite core and debitage that is present is of relatively good flaking quality.

A small amount of obsidian, including a single tool fragment, is present in this area. Obsidian is also present in other areas of the site complex. The presence of this exotic material is indicative of very long range travel and /or trade, ranging over a large region in western North America, to the rocky mountains.

4.2.2. Chipped Stone Artifact Inventory and Description

4.2.2.1. Chipped Stone Debitage

The chipped-stone debitage assemblage includes all flakes, flake fragments and shatter, but excludes cores, formed tools, and flakes exhibiting retouch or evidence of utilization. The vast majority of lithic debitage recovered from Area 7 came from the lower occupation. There were 1457 pieces of lithic debitage recovered from the lower excavation levels. The total mass of lithic material is 517.5 grams. The primary materials represented in the debitage sample are Swan River Chert, silicified peat, and silicifed wood, each comprising approximately one-fifth the chipped-stone debitage sample. White chalcedony is another common material, though its presence may be over-represented due to the misidentification of Swan River Chert and light-colored silicified wood microdebitage. Siltstone and chert pebbles, quartzite, jasper and various other cryptocrystalline silicates are minor components. Quartzite is over-represented by mass, due to the large average size of its fragments. Massive quartz and obsidian are present in very small amounts.

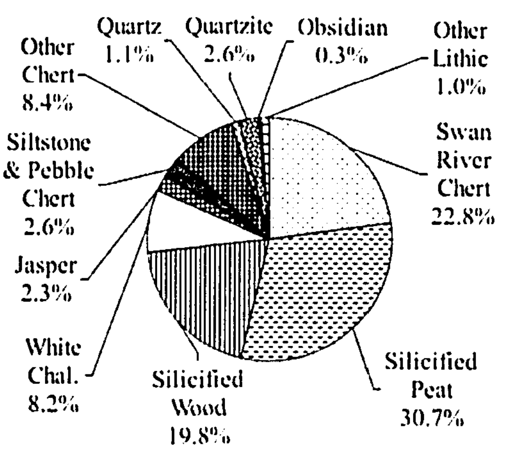


Fig. 5: Debitage material types; relative frequency by number.

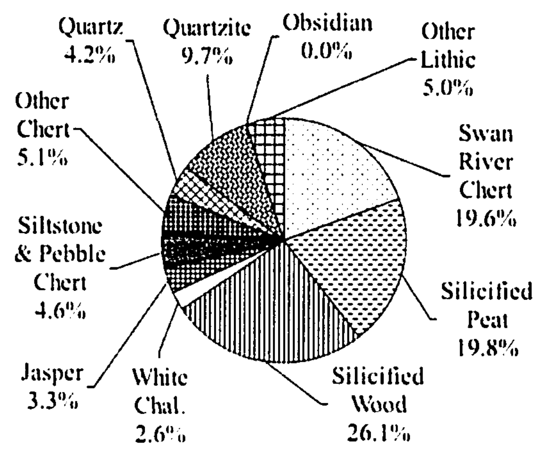


Fig. 6: Debitage material types; relative frequency by total mass.

The general character of the chipped-stone debitage is of relatively small fragments, with angular shatter dominating the assemblage. Very few fragments exhibit the characteristic features of direct percussion or pressure flakes. This is particularly true of the silicified wood sample, which tends to be present as relatively large, blocky fragments, broken along the grain of the wood. Only very small silicified wood pressure flakes exhibit typical conchoidal fracture. The silicified peat debitage sample is quite variable. Some fragments exhibit a tendency towards blocky fracture similar to that of silicified wood, breaking along bedding planes and woody inclusions. Other fragments are very thoroughly and homogeneously silicified and fracture with regular conchoidal fracture. These high-grade silicified peats are the most fine grained material in the sample, with the exception of the small amount of obsidian. The Swan River Chert present also varies substantially in terms of homogeneity and fineness. Overall, it tends to be medium to fine in its flaking characteristics.

Debitage Distribution

For the purposes of its distribution, chipped stone debitage includes all flakes, shatter, and other fragments, but excludes fragments indicating utilization or modification, and cores. Debitage was recovered from every excavation unit in Area 7; however, there are substantial differences in the amounts of material, both numerically and by mass. Substantial numerical concentrations of lithic material can be seen in some portions of the excavation area; however, it should be noted that collection procedures, including the collection and fine-screening of matrix in some sub-units, may skew the distribution somewhat.

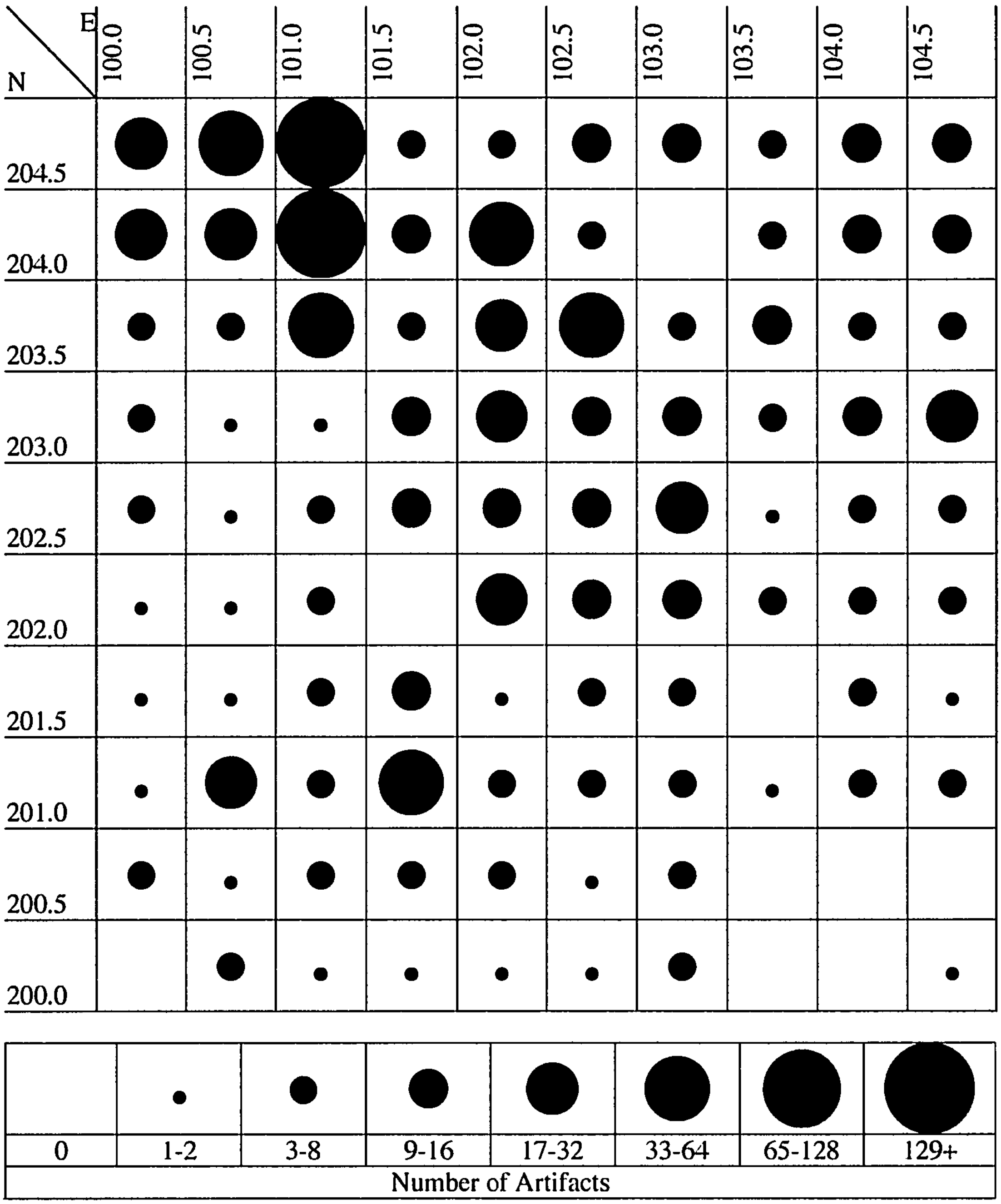


Fig. 7: Distribution of chipped-stone debitage; number per sub-unit

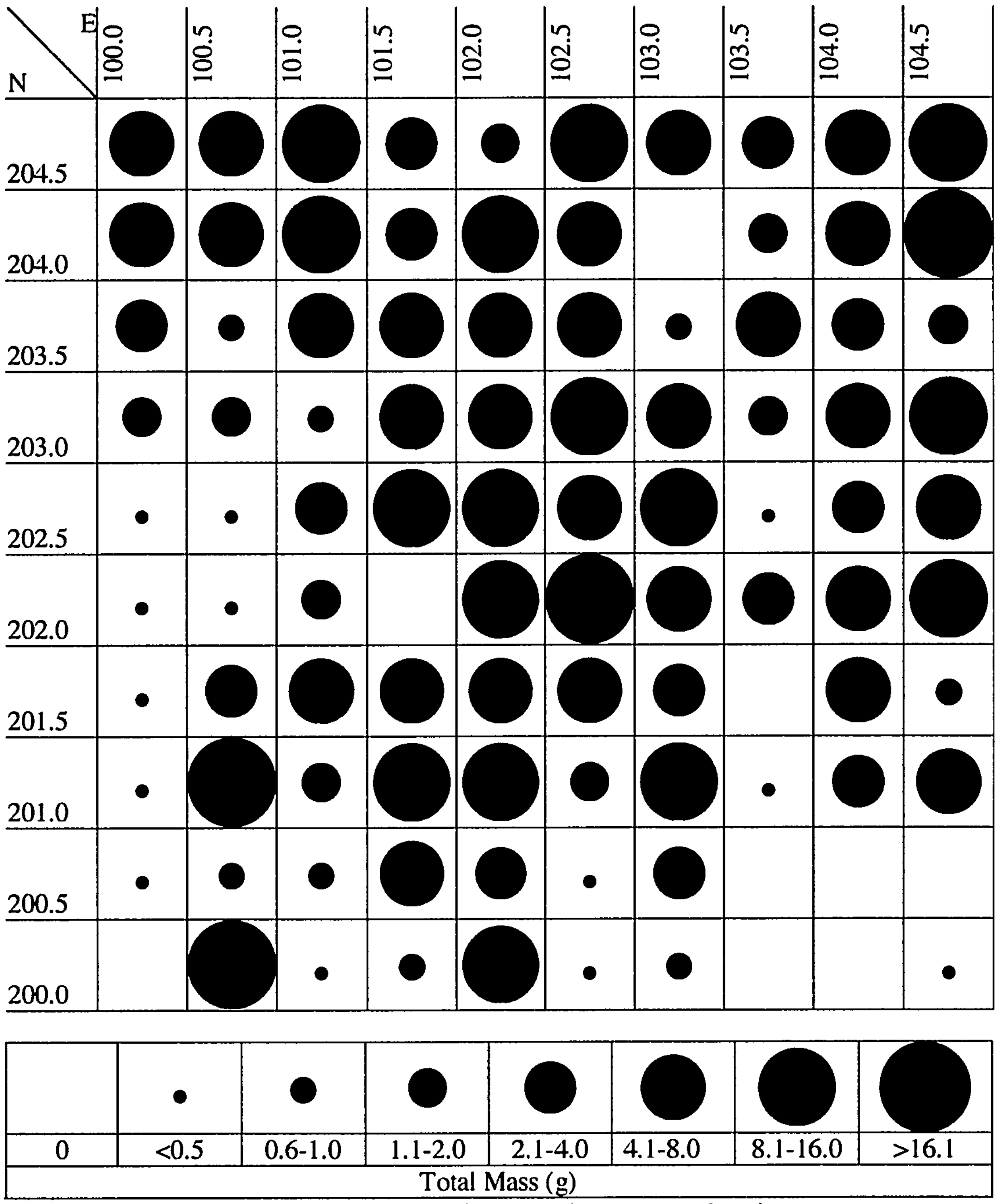


Fig. 8: Distribution of chipped-stone debitage; total mass per sub-unit.

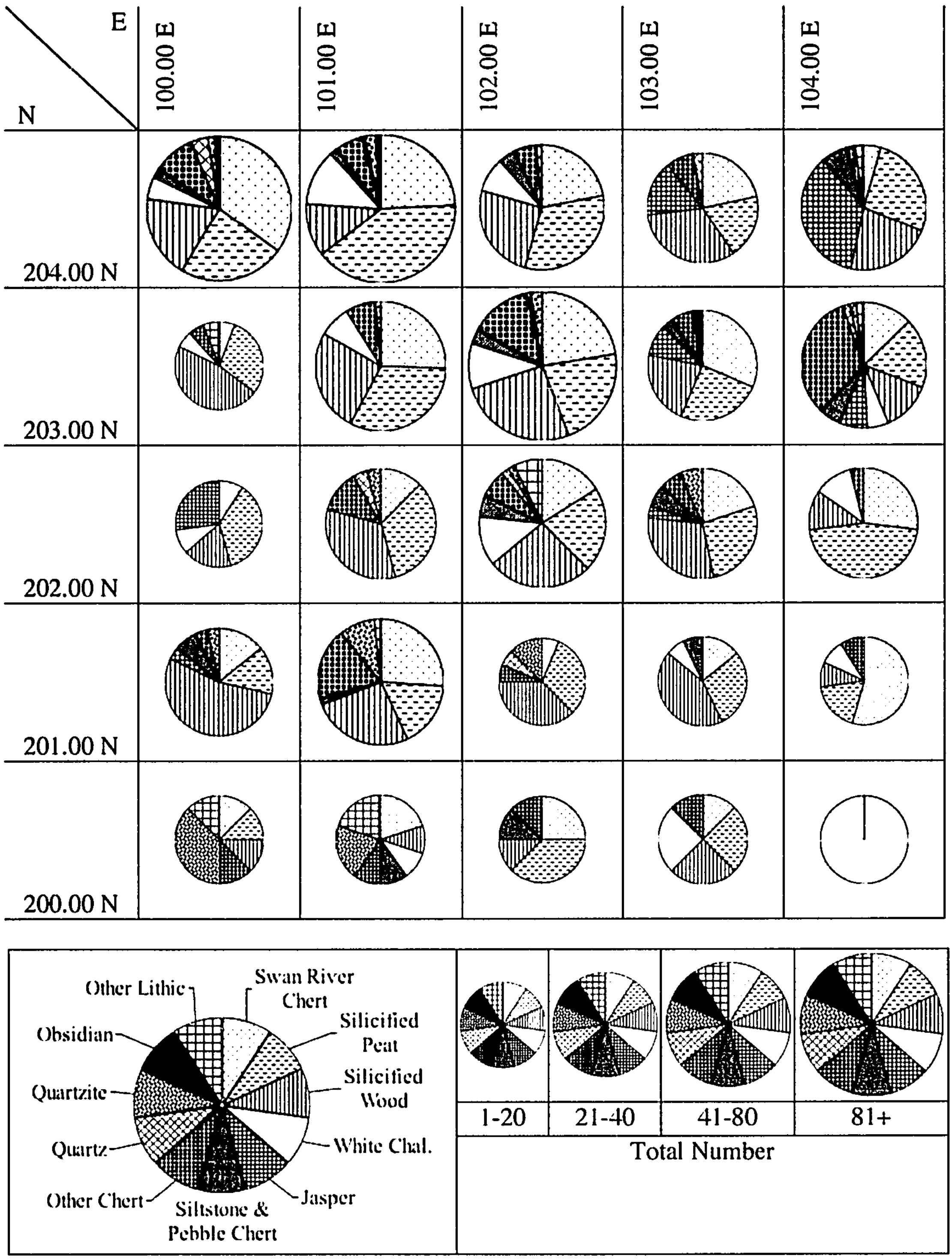


Fig. 9: Distribution of debitage; number of fragments, by material type, per unit.

Looking at the distributions of debitage both by frequency and by total mass, four concentrations of debitage are apparent. The first concentration, and greatest by frequency, is in the northwest corner of the excavation area, centered about 204.5 m N and 101.0 m E. This concentration appears to be associated with features 1 and 2. The second concentration, somewhat apparent in the frequency distribution, and readily apparent in the distribution by mass, is located in the center of the excavation area, centered around 202.5 m N and 102.5 m E. There is a minor concentration, both by frequency and total mass, in the southwest quadrant of the excavation area, about 201.5 m N, and 101.5 m E, near feature 3. A fourth concentration appears to be present in the northeast corner of the excavation area, around 203.5 m N, 104.5 m E. This concentration appears to surround feature 4.

Breaking down the distribution of lithic debitage by material type, by unit, indicates some additional patterns. Again, large concentrations of material are present in the northwest and north-central areas, with lesser concentrations in the northeast and southwest corners. Concentrations 1 and 2, which produced very large numbers of small flakes, are dominated by two of the primary materials at the site, Swan River Chert, and silicified peat, with lesser proportions of other materials. Fine white chalcedony is a fourth major material in concentration 1, in the northwest corner of the excavation area, but is present in only trace amounts in other areas.

In contrast to the pattern in concentration 1, concentration 4 in the northeast corner exhibits a reduced proportion of the three primary materials, especially Swan River Chert. Making up the difference is a large amount of a jasper-like material, which is nearly absent from the rest of the excavation area. Concentration 3 in the southwest corner similarly indicates a reduced importance of the fine-grained, high quality Swan River Chert and silicified peat, with a greater proportion of silicified wood and other cryptocrystalline silicates.

4.2.2.2. Chipped Stone Cores

Only nine cores or core remnants are present in the assemblage. These cores tend to be relatively small, with a mean mass of only 9.1 grams. None of them is greater than 56 mm in any dimension. Cores are pictured in Plate 9. Metric and non-metric attributes of the cores are presented in Table 15 in Appendix II.

The bipolar percussion reduction technique is overwhelmingly apparent. Evidence of this technique, including battered and crushed areas at opposing poles and negative flake scars emanating from both ends, is exhibited on all of the complete cores, absent only from the very small chert core fragment (11169 – Plate 9e), which retains only a single platform area. The single white chalcedony core (14716 – Plate 9i) also retains evidence of multidirectional direct percussion reduction, apparently to the point of exhaustion. It then appears to have been subjected to bipolar reduction in an attempt to obtain additional usable flakes.

Silicified peat and silicified wood each comprise about 20% of the sample of cores numerically, and 30% by weight. A notable deviation from the overall norms is the scarcity of Swan River Chert in the sample of cores. The single, diminutive, Swan River Chert core (59727 - Plate 9f) accounts for only 11% of the sample numerically and 1.1% of the sample by weight. Quartzite and 'pebble chert' are each somewhat over-represented.

4.2.2.3. Chipped Stone Tools

Introduction

The lower occupation assemblage includes 108 chipped-stone tools and tool fragments. Some fragments refit, leaving 101 complete or partial tools. The tools were inspected using 2x and 10x hand lenses, and a 10-50x stereoscopic microscope. Any pieces exhibiting evidence of retouch or utilization were considered tools. They have been separated into seven discrete classes on the basis of gross morphological characteristics. Images of lithic tools are presented in Appendix I. Metric and non-metric attributes are presented in Appendix II.

Edge Modified Pieces

Only eight fragments were identified as exhibiting edge modification consistent with use-wear, such as micro-flaking, rounding or polish, but lacking invasive retouch. These artifacts are pictured in Plate 10. The low number is likely limited by the relatively low magnification used for analysis, and the time devoted to each lithic artifact. The identified edge modified pieces exhibit a raw material profile similar to that of the entire chipped-stone assemblage.

Retouched Pieces

The tool sample from the lower occupation includes 35 retouched pieces. Examples of this tool class are presented in Plate 11. The term piece is used rather than flake because the majority of the tools are either manufactured on pieces of irregular shatter, or are too fragmentary to determine the type of blank. Retouched pieces are here distinguished from edge modified pieces on the presence of somewhat invasive (2-8 mm), semi-continuous, uni- or bifacial flaking along one or more margins. The distinction between retouched pieces and bifaces is largely a difference in degree rather than kind.

This tool class is dominated by tabular or irregular fragments of silicified wood and peat with one or more marginally retouched edges, with little modification to the piece's overall form. Silicified wood is the most common material in this tool class, comprising nearly 40% of the tools and tool fragments. Silicified peat comprises a further 24%, Swan River Chert is a distant third at 16%.

Most of the retouched pieces are highly fragmentary, and many exhibit retouch or use-wear along broken edges. Two retouched pieces (43764, Plate 11t; 56753, Plate 11s) exhibit use-wear along broken edges similar to burin facets. One of these (43764), a triangular fragment of yellowish brown high-grade chalcedony, also exhibits heavy wear on all three of its corners, consistent with graving.

The fragmentary nature, poor quality and small size of much of the raw material exploited in this assemblage make classification difficult. For example, three tools (64119, Plate 11a; 65781, Plate 11q; 67903, in the upper occupation) have been classified as retouched pieces, but possibly also are consistent with a classification as side-scrapers. All three have been produced in part via bipolar percussion, the smaller two (67903 and 65781) from chert and black siltstone pebbles, respectively, while the largest (64119) has been fashioned from piece of well-silicified wood.

Choppers

This class of tool could be considered a specialized form of retouched piece, but due to their large size, they will be treated separately. Three large bifacially worked tools were recovered from the lower occupation of Area 7. One each of these tools is manufactured from basalt, quartzite and schist; all exhibit heavy wear along their working surfaces. The quartzite chopper (49120, Plate 12a) is the most typical of the three, featuring circumferential bifacial retouch, forming a thickened discoidal tool. The basalt tool (36676, Plate 12b) is less completely knapped, with a short working edge and a more triangular form. The final chopper (56762, Plate 12c) is fashioned from a thin, rectangular piece of schist. It has been retouched on opposing ends, both of which exhibit use-wear. The tool is thin enough to have been easily hafted, though evidence of hafting is not readily apparent.

Bifaces

The distinction between an extensively retouched piece and a biface is somewhat arbitrary. Generally, if the tool exhibits extensive, invasive bifacial retouch extending beyond the midpoint of the tool it has been classified as a biface. Thirteen tools classified as bifaces were recovered from the lower excavation levels. Examples of this tool class are presented in Plate 13. The biface sample is more than 50% Swan River Chert, with silicified peat and silicified wood each comprising only 15% of the sample. None of the tools is complete. Most of the biface fragments are too small to identify any further; however, four (10180, Plate 13b; 24846; 48782, Plate 13e; 59252, Plate 13a) are probably point or preform fragments; one (63403, Plate 13c) may be a small, asymmetrical knife; and another (58057, Plate 13g) is a small, symmetrical, rectangular, bifacially worked piece of silicified wood, which may have been hafted.

Projectile Points

Twenty-six projectile points or point fragments were recovered from the lower occupation; 2 of these fragments refit. The 25 tools are all consistent with late pre-contact side-notched points. The projectile points are pictured in Plate 14. As with the biface sample, Swan River Chert is strongly overrepresented, comprising 50% of the projectile point sample. Silicified wood and silicified peat account for 24% and 12%, respectively.

Projectile Point Typology

The projectile point sample includes seven tip fragments, with no preserved hafting elements, five blade fragments, and five basal fragments, typically fractured at or near the neck. One each of the aforementioned blade and base fragments (48499 and 52406, respectively) refit to form a nearly complete point. Two fragments are from points that have fractured longitudinally, preserving portions of a single lateral margin. Finally, there are seven complete or nearly complete points.

Peck (1996) attempted to identify statistically significant types amongst Late Pre-Contact Northern Plains projectile point assemblages. The analysis of projectile points from the Area 7 assemblage is based on a suite of metric and non-metric attributes defined by Peck, and follows standard orientation rules. The haft element of the tool is considered proximal, while the tip is distal. The ventral and dorsal surfaces of the tool correspond to the ventral and dorsal surfaces of the flake from which the tool has been manufactured, when apparent. When this is not evident, the more intact lateral margin has been arbitrarily designated as the left side (Peck 1996:29-30). Non-metric attributes include material, colour, flaking pattern, outline form, cross-section, base form, basal edge shape, notch type, and notch form. Metric attributes include mass, maximum length, width and thickness, blade length, width and thickness, shoulder height, notch height, base height, shoulder width, notch depth, neck width, maximum, proximal and distal base width, maximum base thickness, shoulder angle, and proximal and distal base angles. For paired attributes, where preserved, the left and right sides of each point have been measured and recorded separately. In the statistical analysis, each measurement has been treated as separate and distinct. This is consistent with Peck's (1996: 53) analysis. Peck did not find a statistically significant difference between right and left attributes in his samples, and therefore combined the data-sets for the left and right sided attributes in order to significantly increase the sample size for each feature (Peck 1996: 53).

The projectile points exhibit some variation, but within a fairly limited range. All of the points exhibit irregular or marginal flaking patterns, are slightly to moderately asymmetrical in outline, and are typically asymmetrically convex (50%, n=12) or plano-convex (33%, n=8) in cross-section. They are fashioned from a variety of cryptocrystalline silicates. The most common are variably coloured, heat-treated Swan River Chert (52%, n=13), silicified wood (24%, n=6), and silicified peat. The points vary significantly in size, averaging 21.43 mm long (sd. 3.88 mm, r. 17.55 - 29.10 mm, n=7); 12.77 mm wide (sd. 1.24 mm, r. 10.05 - 14.00 mm, n=9); and 3.46 mm thick (sd. 0.55 mm, r. 2.65 - 4.50 mm, n=10).

The blade element is typically asymmetrically triangular, with slightly convex blade margins, coming to a variably acute to somewhat obtuse point. Average blade length is 15.15 mm (sd. 3.58, r. 10.60 - 20.90, n=8), while width averages 13.15 mm (sd. 1.29 mm, r. 10.05 - 14.85 mm, n=12).

The observable haft elements in the assemblage have an average length (shoulder height) of 7.18 mm (sd 1.16 mm, r. 4.95 - 9.30 mm, n=15). The haft elements of the assemblage show significant uniformity in some attributes. All of the specimens present exhibit bilateral side notching. On one specimen (3147 / 3394, refit), the basal margins are so divergent as to make the point appear nearly corner notched; however, the notches are in fact oriented towards the median line of the point, and the base form appears in part a result of flaws in the lithic raw material. Notches are typically V-shaped (42%, n=8), or rounded (32%, n=6), with some angular (16%, n=3) or U-shaped (11%, n=2). Most notches, where observable, are broader than they are deep (65%, n=11). The average notch breadth or height is 2.96 mm (sd. 1.08 mm, r. 1.75 - 6.00 mm, n=14), while the average depth is 2.47 mm (sd. 0.66, r. 1.20 - 4.10 mm, n=25). The proximal and distal angles forming the notch are typically obtuse. The shoulder angle averages 103.8° (sd. 17.31°, r. 80 - 139°, n=24). The distal base angle, or proximal angle of the notch, averages 117.83° (sd. 19.06°, r. 96 - 163°, n=18). The most common base shape is "fish-tailed" (form 2, after Peck, 1996: 262) in 40% (n=4) of the observable specimens, exhibiting a contracting base and concave basal edge. Other recognizable base forms include "barn-shaped" (form 4), "rectangular" (form 6), biconvex lenticular forms (forms 8 and 11) and one concavo-convex form (form 15). Sixty-four percent (n=7) of the observable basal edges were concave, while convex and straight basal edges were each present in 18% (n=2) of the sample. The average base is 4.32 mm high (sd. 0.89 mm, r.

3.15 - 5.70 mm, n=18), and 13.29 mm wide (sd. 2.29 mm, r. 9.80 - 16.05 mm, n=8). The proximal base angle is typically obtuse, averaging 105.41° (sd. 15.40°, r. 80 - 137°, n=17).

Peck and Ives (2001) have identified two broad classifications of Late Pre-Contact side-notched projectile points. These classifications are the Cayley Series, present across the Northern Plains from ca. 1250-650 BP, and in a restricted western distribution from ca. 650 BP to the historic era, and the Mortlach Group, present in the eastern half of the Northern Plains from ca. 650 BP to the historic era. They have identified ten key attributes that exhibit statistically significant spatial and temporal variation and enable the affiliation of a projectile point assemblage with either the Cayley Series or the Mortlach Group. These ten attributes are shoulder height, shoulder angle, notch form, notch depth, notch height, base form, basal edge shape, base height, proximal base angle, and distal base angle.

Comparisons of three non-metric traits, notch form, basal edge shape, and base form, of the point assemblage from Area 7 to means for Cayley and Mortlach assemblages taken from Peck and Ives (2001) are shown in Figs. 10-13. Comparison of the frequencies of various notch forms (Fig. 10) indicates a strong similarity between the point sample from Area 7 and both the early and late Cayley Series samples. Figure 11 groups these various notch forms as to whether they are broader or narrower than they are deep. The sample from Area 7 is dominated by broad forms, consistent with the Cayley Series.

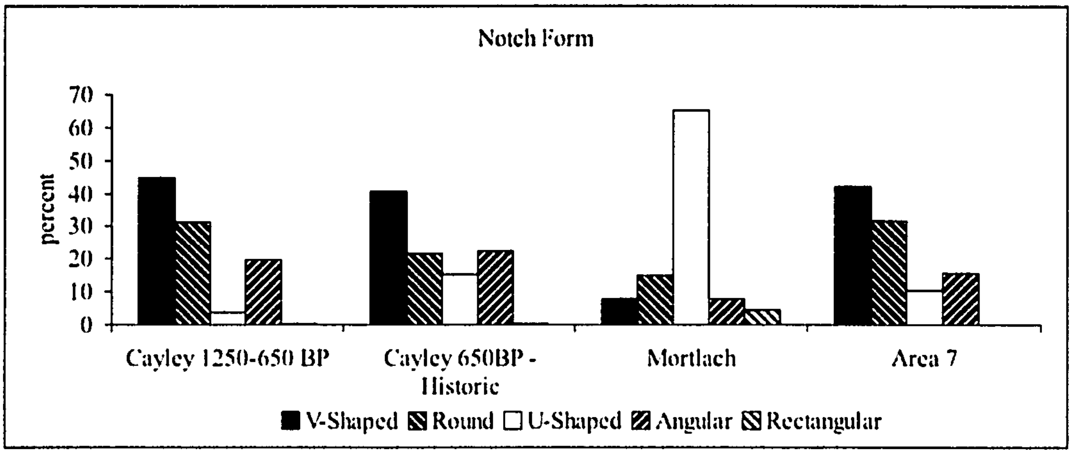


Fig. 10: Notch form relative frequencies. Data from Peck and Ives, 2001.

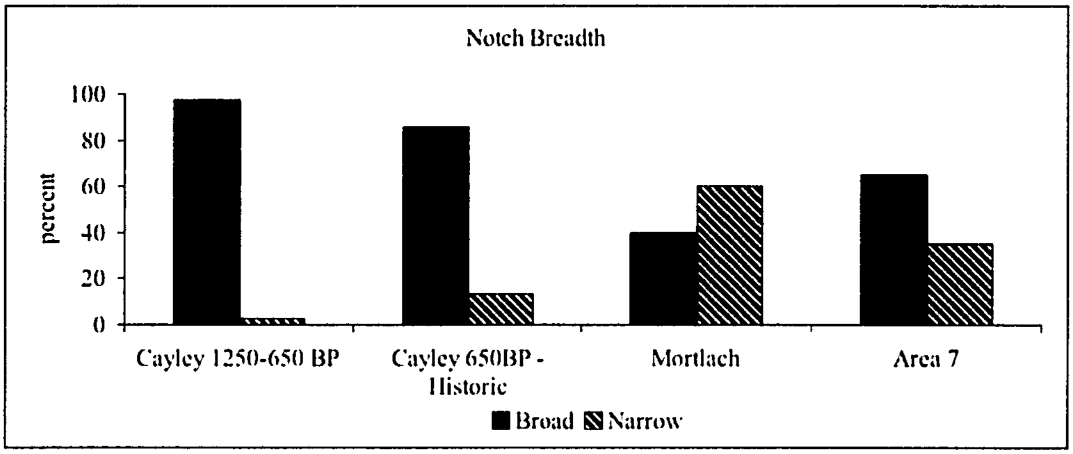


Fig. 11: Notch breadth relative frequencies. Data from Peck and Ives, 2001.

Base form and basal edge shape are less conclusive. The basal edge shape frequencies of Area 7 are consistent with neither the Cayley Series, nor Mortlach Group. This discrepancy could be due to any combination of interobserver error and the small size of the Area 7 sample. Base form frequencies for the Area 7 sample are also somewhat ambiguous; however, the high frequency of fishtail bases, and the near absence of rectangular bases in the Area 7 sample strongly suggest an affiliation with the Cayley Series, rather than the Mortlach Group.

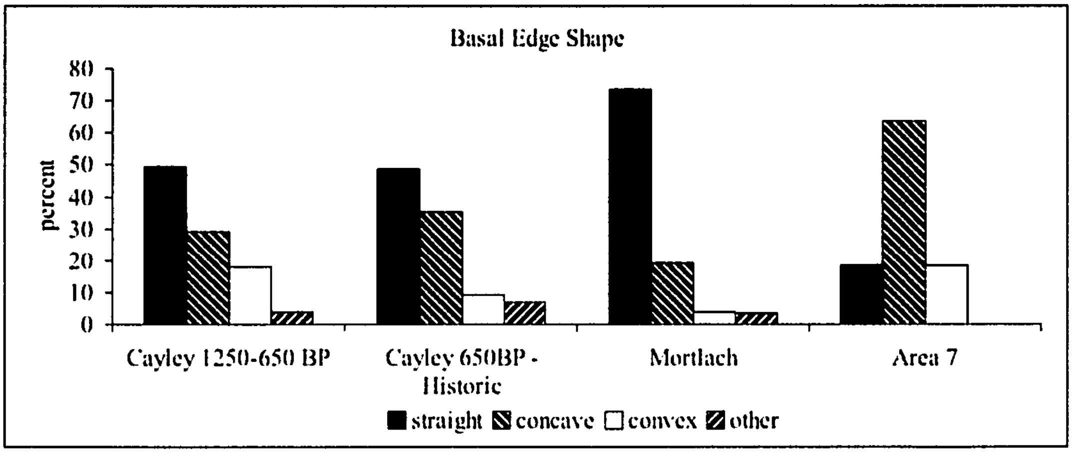


Fig. 12: Basal edge shape relative frequencies. Data from Peck and Ives, 2001.

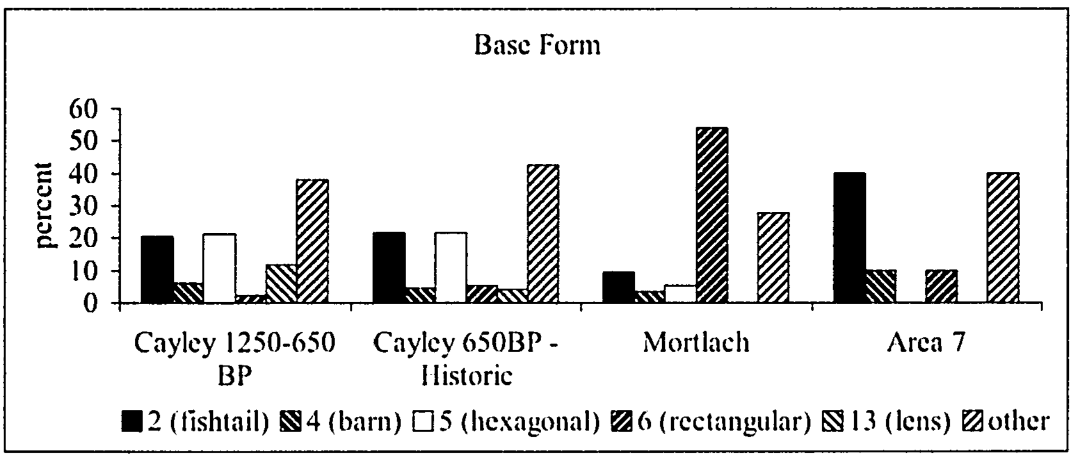


Fig. 13: Base form relative frequencies. Data from Peck and Ives, 2001.

The seven continuous attributes shown to exhibit significant spatio-temporal variation by Peck and Ives are shoulder and base height, notch depth and height, and shoulder, distal base, and proximal base angles. Means of these attributes for the Cayley Series, Mortlach Group, and Area 7 samples are presented in Table 4.

Attribute	Cayley series 1250-650 BP	Cayley series 650 BP - historic	Mortlach group	FaOm-1 Area 7
Base height (mean)	1.98	3.97	4.11	4.32
Notch Depth (mean)	1.80		2.29	2.47
Notch Height (mean)	3.21		2.52	2.96
Shoulder Height (mean)	6.45		6.82	7.18
Distal Base Angle (mean)	112.44		99.06	117.83
Proximal Base Angle (mean)	105.20		95.07	105.41
Shoulder Angle (mean)	106.70		91.77	103.83

Table 4: Projectile point continuous attributes. After Peck and Ives, 2001.

Means of the three haft element angles for each sample are displayed in Figure 14. The means of these three angles for the Area 7 projectile point sample are all relatively obtuse, and are very similar to the mean angles of the Cayley series. The linear metric attributes of the Area 7 projectile point sample tend to be quite large, with means greater than either the Cayley Series or the Mortlach Group.

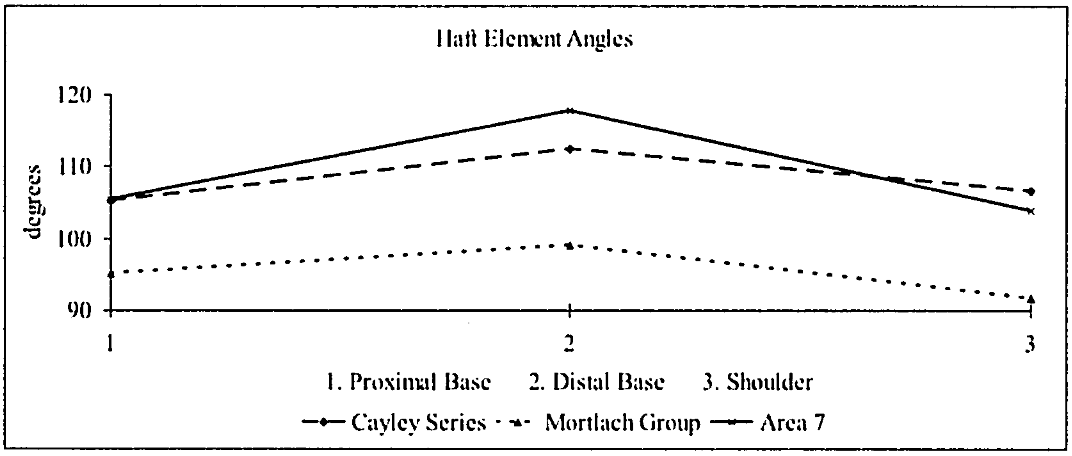


Fig. 14: Haft element angle comparison. Data from Peck and Ives, 2001.

The Cayley Series is notable in its range of variation, with a preference for straight or concave basal edges; a tendency towards V-shaped or rounded notches that are broader than they are deep; and relatively obtuse haft element angles, that give many of the point bases a fishtail or hexagonal appearance (Peck and Ives 2001: 176-177). The

Mortlach Group of projectile points tends to show less variation, with a strong preference for straight basal edges and narrow, rectangular notches, with haft element angles that approach 90°, giving Mortlach group points rectangular bases (Peck and Ives 2001: 180-181). Disregarding the linear measurements, which are likely skewed due to the presence of a number of relatively large points, and the notable absence of any extremely small points in the sample from Area 7, the discrete attributes, haft element angles and overall haft element morphologies are consistent with the Cayley Series.

Unifaces

This tool class includes those tools that are invasively unifacially, or primarily unifacially, worked, typically with a relatively steep angle of retouch (60° or greater). Unifacial tools are presented in Plate 15. Of the eight unifacial tools recovered from the lower excavation levels, one (64088 – Plate 15f) is similar in morphology and size to a small uniface described in the upper occupation (67808 – Plate 15e), and classified as a possible small hafted plane, though less complete. The remaining unifaces are all consistent with the small end scrapers common on the northern plains, sometimes referred to as thumbnail scrapers. Fully 50% of these tools are manufactured from siliceous siltstone, consistent with the common use of split "black pebble-chert" (siltstone) blanks. The remaining scrapers represent a variety of materials, including the jasper-like material and white chalcedony present in significant numbers in the debitage sample.

Wedges

Wedges or pièces esquillées have been the subject of some debate in North American and plains archaeology (e.g., Ranere 1975; Hayden 1980; Shott 1989, 1999; Le Blanc 1992; Goodyear 1993). This debate is largely derived from confusion between bipolar cores and pièces esquillées, and a tendency to use the terms "as though they were synonymous, and toss everything treated in a bipolar fashion into the same box" (Hayden 1980: 2). The term 'wedge', though functionally laden, has therefore been used here. Hayden provides a number of features which aid in the distinction of pièces esquillées from bipolar cores. Descriptions of pièces esquillées include:

> -although crushing at the ends can be severe, pièces esquillées generally do *not* have primary flakes removed, or at least no bipolar flake removals that would normally be usable even as micro-tools;
> -flakes removed from either end often extend down only a fraction of the dorsal or ventral face of the original flake or blade segment; ...
> -such pieces are generally not very thick - contrary to MacDonald's statement that pièces esquillées are often made from thick flakes or blocky core fragments - and they may even occur as very diminutive pieces. (Hayden 1980: 3)

Another feature exhibited on a number of the wedges in this sample is the presence of "columnar fractures", similar in appearance to burin facets, extending the length of the piece (Le Blanc, personal communcation 2005). None of these facets exhibited obvious evidence of use.

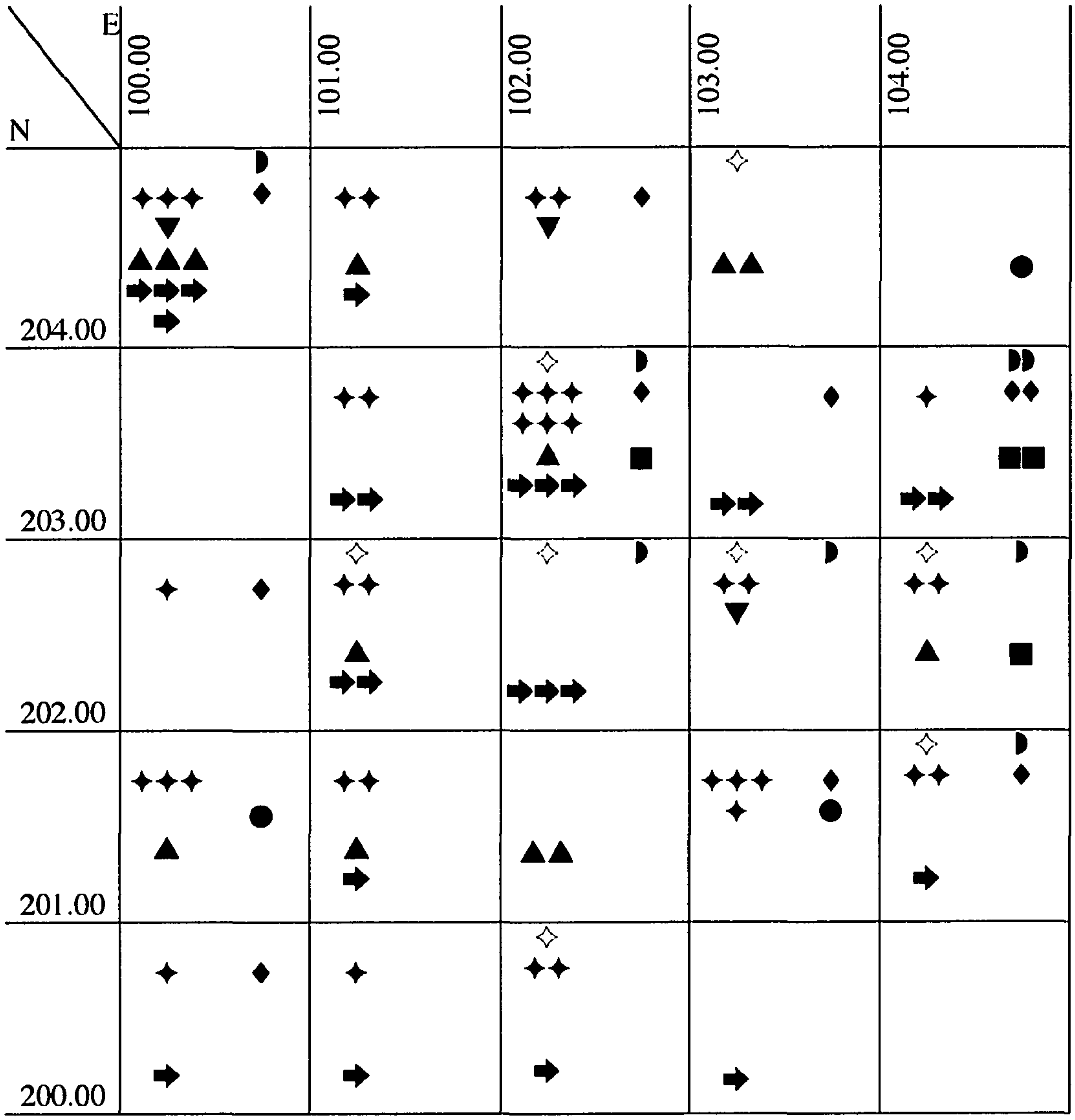
Nine wedges have been identified in the chipped-stone assemblage from the lower occupation, and are presented in Plate 16. The tools exhibit a similar raw material makeup to the overall chipped-stone assemblage. The tools average just under 2 cm in length and width, and an average mass just over 2 grams. These measurements are slightly smaller than means for wedges from level 5 of Rat Indian Creek (Le Blanc 1992: 7), though the small sample size from this study area makes any comparisons difficult. Two of the wedges (39349, Plate 16h; 42619/43762/56752 refitted, Plate 16d) exhibit evidence of previous lives as end scrapers. Both of these tools are manufactured from high-grade silicified peat. Both are highly fragmentary, and appear to have been utilized to exhaustion.

Distribution

Tools and tool fragments were recovered from most units in the lower occupation. The distribution of tools and tool fragments is displayed in Figure 15. This distribution includes all lithic tools, whether manufactured by chipped or ground stone technology (discussed below). Some tools were recovered in multiple fragments, sometimes from different units. In these cases, tools have been enumerated in all units in which fragments were recovered. Where multiple fragments of a single tool were recovered from the same unit, that tool has been counted only once.

Overall tool distribution closely mirrors the frequency distribution of lithic debitage. Substantial concentrations of tool fragments are present in the northwest corner, north-central area, and the central east edge of the excavation area, coinciding with debitage concentrations 1, 2 and 4. A concentration of tool fragments may also be present in the southwestern quadrant, coinciding with debitage concentration 3.

Most tool types, including edge-modified and retouched pieces, bifaces, and points, display a fairly uniform distribution. There appears to be a slight concentration of unifaces or scrapers in the east-central area and eastern edge of the excavation area, surrounding hearth feature 4. Only one artifact of this type appears in the otherwise artifact- and tool-rich northwest corner. Anvils are similarly clustered at the east edge of the excavation area, near feature 4. Three of the four anvils and anvil fragments were recovered from units 202 N / 104 E and 203 N / 104 E.



✧	Utilized Piece	◗	Uniface / Scraper
✦	Retouched Piece	◆	Wedge
▼	Chopper	●	Hammer
▲	Biface	■	Anvil
➡	Projectile Point		

Fig. 15: Distribution of lithic tools, lower occupation, by unit.

4.2.3. Chipped Stone Artifact Analysis

4.2.3.1. Debitage Aggregate Analysis

Due to limitations in the data set, and in the interests of efficiency, chipped-stone debitage has been subjected to aggregate analysis, following, primarily, the work of Stanley Ahler, at the University of North Dakota. Aggregate analysis shifts attention "from the individual object to observations on a batch or some subset of the complete batch of debris from a single context" (Ahler, 1989a: 87). Over two decades, Ahler led hundreds of lithic replication experiments in which a comprehensive set of input (e.g. reduction type, raw material, knapper, skill level, various core / objective piece attributes) and output (number and mass of flakes by size class, cortex presence, etc., various output tool attributes) variables were recorded (Ahler 1989a, Ahler 1989b).

In the course of these experiments, a number of output variables were shown to be excellent post-dictors of the lithic reduction method and stage by which the samples were produced. Chief among these variables is debitage size. Based upon the theoretical premise of "Progressive Size Reduction" Ahler hypothesized that,

> For a given beginning size of raw material, flakes produced early in reduction should have relatively greater numbers in the large size classes and relatively fewer numbers in the smaller size classes, while flakes produced from the same core/tool late in the production trajectory should have fewer or no numbers in the large size classes and relatively greater numbers in the smaller size classes;

and that,

> the overall flake size distribution should reflect the size of the initial piece of raw material, even in a one-step reduction process. The general size distribution of a flake sample can be documented by *relative counts of flakes across all size grades.* (Ahler 1989b: 90, emphasis in original)

Of course, reality is much less straightforward. Ahler's experiments found that in virtually all replicative experiments, with a broad range of material types and reduction methods, small flakes and fragments were produced in far greater numbers than large flakes (Ahler 1989: 90). Ahler found that, due to the relatively low mass of small fragments, "a size distribution expressed as a proportion of total weight according to size grades [exhibited] a much more distinct graphic depiction of the size differences than may be apparent in flake count data" (Ahler 1989b:90).

Ahler's second hypothesis was based upon the premise of "Progressive Cortex Removal", which posited that "the frequency of cortical flakes will be highest in early and single-step manufacturing procedures and will be lowest in late stage and complex manufacturing procedures" and therefore, "Because flake size can be expected to vary with technology and stage of manufacture, it should be important to record the *presence or absence of cortex on flakes according to size grade"* (Ahler 1989b: 90, emphasis in original).

Ahler's experimental procedure involved the size-grading of all debitage produced in the experiment. Five size-grades were identified, though the smallest of these was not typically used in analysis (Ahler 1989b:91). Ahler's size-grades, and the size-classes used in this study to approximate them, are presented in Table 5. In the course of Ahler's experiments, size-grade 4 was determined to be a critical size because "flake byproducts from pressure flaking are almost all small enough to pass through a quarter-inch mesh hardware cloth screen" making the relative proportions of debitage at this size-class an excellent distinguisher of pressure flaking, as opposed to percussion flaking (Ahler

1989b:91).

Size Grade	Nominal Designation	Actual Diagonal Opening Size (mm)	Area 7 Catalog Equivalent (mm)
G1	1 inch	35.9	25-50
G2	¾ inch	18.0	12-25
G3	U.S. No. 3 ¾	8.01	6-12
G4	U.S. No. 7	3.59	2-6
G5	U.S. No. 16	1.67	0-2

Table 5: Experimental and Archaeological Size Grades (after Ahler, 1989a: 204)

In Ahler's size-grading procedure "flakes ... are hand manipulated though the G1 and G2 screens in order to minimize specimen damage. Materials passing through these screens are then mechanically shaken over smaller grades (G3 and smaller) for a standard 30 second period" (Ahler 1989b: 100). This procedure approximately grades flakes by their smallest dimension. The cataloging procedure for the assemblage from Area 7 involved the individual classification of debitage into size-classes by the fragment's maximum dimension. The size classes utilized for this study are accordingly slightly larger than Ahler's size-grades. This difference in size-classification methods renders the two data sets, to a certain degree, incomparable; however, the premise that the proportion of small-sized debitage is representative of the overall reduction stage is still valid. Another problem with the Area 7 debitage sample involves collection methods. Standard collection procedure for Western Heritage Management Inc., and most other archaeological consulting firms, involves the screening of all matrix through quarter-inch mesh hardware cloth. This certainly results in the loss of some of the material in Ahler's critical size-grade 4. Collection procedures at Area 7, however, were slightly modified by the collection of matrix "whenever it became obvious that small materials would be lost through the screen" (Gibson, personal communication 2005). Size-class distributions therefore also have been calculated for the sample consisting of quadrants in which matrix was collected and fine-screened, preserving the micro-debitage.

The difference in size-class distributions between the total debitage sample, and the fine-screened debitage sample are displayed in Fig. 16. Neither distribution can be considered correct. The total debitage sample is certainly skewed towards the larger size-classes due to the loss of micro-debitage through the quarter-inch screen. The fine-screened debitage sample is probably skewed towards the smaller size classes due to the preferential collection of matrix samples only when micro-debitage was observed. The real size-class distribution of the population from which these samples have been selected is most likely somewhere between the two, probably closer to that of the restricted debitage sample, taken from the areas of densest chipped-stone debitage concentration.

Debitage aggregate analysis for Area 7 focuses on size-grade distribution by count, rather than by mass. The decision to use count ratios is due to data-set limitations resulting from laboratory methods and equipment. Debitage mass was measured only to the tenth of a gram, which resulted in the rounding down of the mass of much of the micro-debitage to 0.0g. This problem is much less significant for the larger debitage, but nonetheless renders the data unusable for this analysis.

Size class distributions for the units in which matrix was collected and screened are believed to be more accurate representations of the actual character of the debitage population; however, size class distribution data from the entire excavation area makes differences between the various raw materials much clearer.

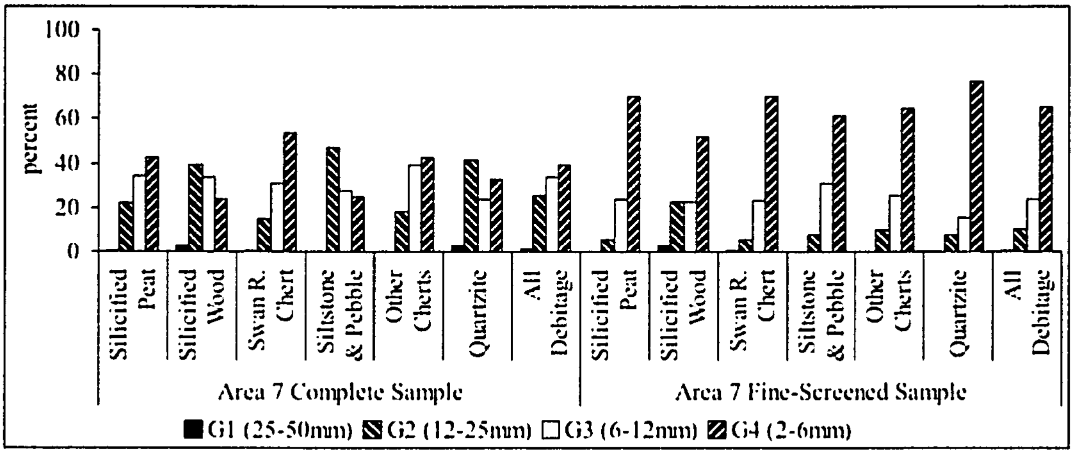


Fig. 16: FaOm-1 Area 7 debitage samples size-class relative frequency distributions, by lithic material.

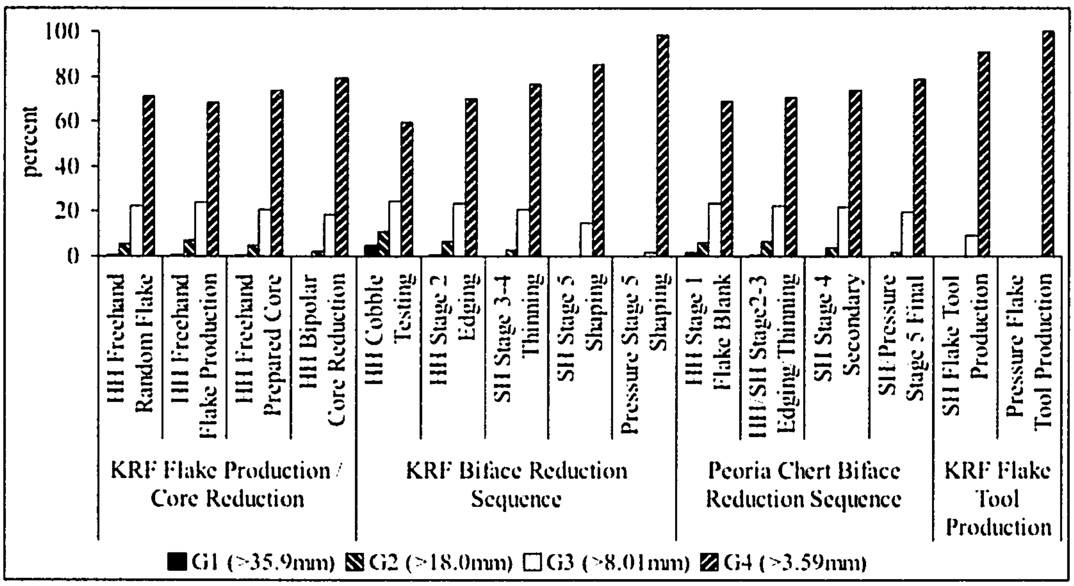


Fig. 17: Ahler's experimental debitage samples size-class relative frequency distributions, by lithic raw material, reduction sequence and reduction stage (data from Ahler 1989b). KRF = Knife River Flint. HH = Hard Hammer. SH = Soft Hammer.

Ahler (1989b) provides size grade distribution data for a number of experimental lithic reduction sequence debitage samples. This data is presented in Fig. 16. Comparison of the fine-screened archaeological samples from Area 7 to Ahler's experimental samples indicates that size-grade distributions from Area 7, particularly of the more fine-grained materials such as silicified peat and Swan River Chert, are similar to Ahler's Knife River Flint freehand flake production, prepared core reduction and bipolar core reduction, and both Knife River Flint and Peoria Chert biface edging, thinning and shaping. These experimental examples approximately represent the middle of the reduction trajectory. This indicates that lithic reduction activities in Area 7 emphasized the production of tools from prepared cores or bifaces, rather than early stage core preparation or late stage tool maintenance, though these activities certainly occurred to some degree.

Comparison of the various lithic materials exploited at Area 7 indicates significant differences in size-grade relative distribution. The predominance of size grade 4 debitage in the finest-grained materials, silicified peat and Swan River Chert, indicate the predominance of relatively late-stage reduction methods. This contrasts with the size-grade distributions for other materials, notably silicified wood, quartzite and siltstone and chert pebbles, which exhibit a greater proportion of larger sized debitage, indicating the presence of relatively early-stage reduction. For the siltstone and chert pebbles, this finding is supported by their relatively high cortical flake ratio, indicated in Fig. 18. Plotting the cortical fragment frequency against the ratio of G4 to G1-3 fragments presents six clusters of materials. The first includes the aforementioned siltstone and chert pebbles, which exhibit a relatively high cortical fragment rate and a relatively low G4:G1-3 ratio, indicating the presence of significant early stage debitage. The second includes only 'other lithic material' and indicates a moderate rate of cortex presence, and a very early reduction stage. These materials were present in the tool sample primarily as two large choppers. Silicified wood appears in its own distribution, with relatively low cortex frequencies and a low G4:G1-3 ratio. This would indicate that the silicified wood debitage sample includes significant amounts of early-stage material. The unique fracture pattern of silicified wood may have affected the size grade distribution, as it has a tendency to fracture into relatively large blocky fragments, and cortex can be difficult to identify. Silicified peat and other micro- and crypto-crystalline materials, including 'white chalcedony' and 'jasper' are clustered near 10% cortical fragments and a G4:G1-3 ratio of 0.7, indicating limited early-stage reduction. Swan River Chert exhibits a very low frequency of cortical flakes and a relatively high late-stage debitage ratio, suggesting the near absence of early reduction stage activity at Area 7. Finally, the very small obsidian sample exhibited no cortex, and only very small sized debitage, indicating only very late-stage reduction.

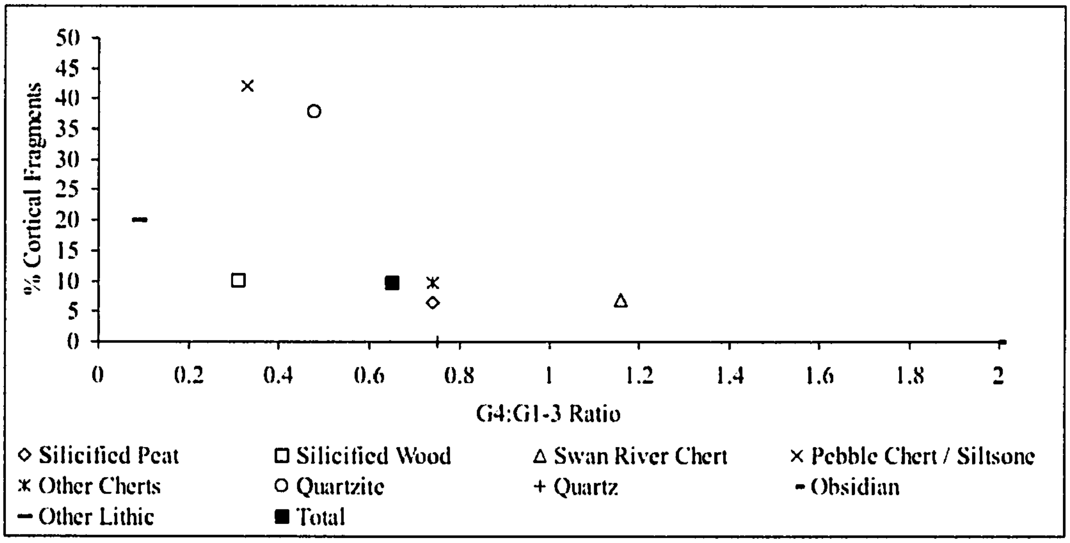


Fig. 18: Debitage cortex presence relative frequency vs. size-class ratio, by material type.

4.2.3.2. Tool Aggregate Analysis

The tool sample from Area 7, fragmentary as it is, may provide some indication of the general character of the occupation. James Ebert (1979) presented two assumptions regarding the form of tools in generalized hunter-gatherer societies:

> 1. Tools manufactured with the object of being carried about are expected to be smaller than tools intended to be used in one place.
> 2. Tools intended for multiple episodes of use are expected to be the result of a greater input of energy during manufacture and maintenance than tools used once and then discarded. (Ebert 1979: 68)

Ebert posited that "an approximate index of energy expenditure can be compiled by counting the number of flake scars resulting from the removal of flakes during manufacture and maintenance of a tool" (1979: 68). This model, which posits that a tool's curation will be inversely proportional to its size and directly proportional to its complexity certainly oversimplifies the complex reality of tool production, use, maintenance and discard. Pokotylo and Hanks (1989) document the curation of *tthete* large, simple, "hafted cortex spall flakes with marginal bifacial retouch" (Pokotylo and Hanks 1989: 56) used for the softening of hides, over periods in excess of 4 years among the Mackenzie Basin Dene, and cite the multigenerational curation of similar tools among the Tahltan of British Columbia as long as 100 years (Albright 1984). Despite these occasional exceptions, Ebert's assumptions, and measures derived from them, may be useful as a gauge for the overall character of an assemblage.

Martin P.R. Magne integrated Ebert's hypotheses regarding tool size and complexity with Binford's hypotheses regarding group mobility and site formation processes. In particular, Magne connected Ebert's notion of small, complex, multi-use tools to Binford's idea of personal gear (Magne 1985: 35). In his 1985 survey of lithic technology at a number of southern interior British Columbian sites Magne also refined Ebert's methods regarding tool size and complexity. Magne substituted tool mass for Ebert's rough calculation of tool volume, "since volume can be expected to be nearly perfectly correlated with weight, varying only with specific gravity of the raw materials under consideration" (Magne 1985:221).

Magne found that sites exhibited significant variation in terms of the ratio of flake scars to mass. Magne's site assemblages showed a cluster of "typical" sites, which were not easily interpretable, around the ratio of one flake scar per gram (1985: 221). Contrasting with these typical sites were a number of sites which fell significantly above the 1:1 ratio, which were interpreted as "the result of highly mobile tasks, or as the depositional loci of no longer useful personal gear" (Magne 1985: 224); and sites with a flake scar to mass ratio below 1:1, "interpreted as the results of expedient tasks or residential generalized tasks, employing furniture along with expedient tools" (Magne 1985: 224).

This study generally attempts to follow Magne's methods comparing total tool mass to total tool flake scar count; however, due to the fragmentary nature of the tools in the sample, and the frequent difficulty in identifying the dorsal side of the tool, both dorsal and ventral flake scars have been counted. For comparability to Magne's samples, and others using his method, the total flake scar count has then been halved. Total tool mass is plotted against half the total flake scar count for each material, and the complete tool assemblage, in Fig. 19. The overall flake scar count to mass ratio for Area 7 falls just below the 1:1 ratio of Magne's typical sites; however, significant differences are apparent between the various materials included in the assemblage. The three large bifacial choppers, one of quartzite and two of "other" material, can be seen to have substantially influenced the results, similar to the effect of "the presence of granular basalt and/or spall tools in the assemblages" on some of Magne's sites (1985: 221). It is of note that the total mass of the tool sample from Area 7 is nearly 50% larger than the largest of Magne's samples, EeRk-7 (Magne 1985: 223).

Magne critiques Ebert's model, in that it "does not consider debitage, which reveal immediate deposition patterns at sites" (1985: 224). Magne suggests that the number of tools be plotted against the percentage of late stage debitage, in order to distinguish between sites produced by high rates of discard, and sites produced by high rates of tool maintenance and discard. Magne posits that:

> assemblages resulting from relatively short-term tool maintenance activities should exhibit few tools, and relatively large amounts of late stage debitage, whereas assemblages that are simply short-term manufacturing loci should exhibit few tools, since the manufacturing products should have been then transported to use-locations ... Sites with many tools and large amounts of late stage debitage should have resulted from re-occupied tool maintenance locations, and assemblages with many tools and little late stage debitage should be the products of long term use locations where tool maintenance was not undertaken. (Magne, 1985: 224)

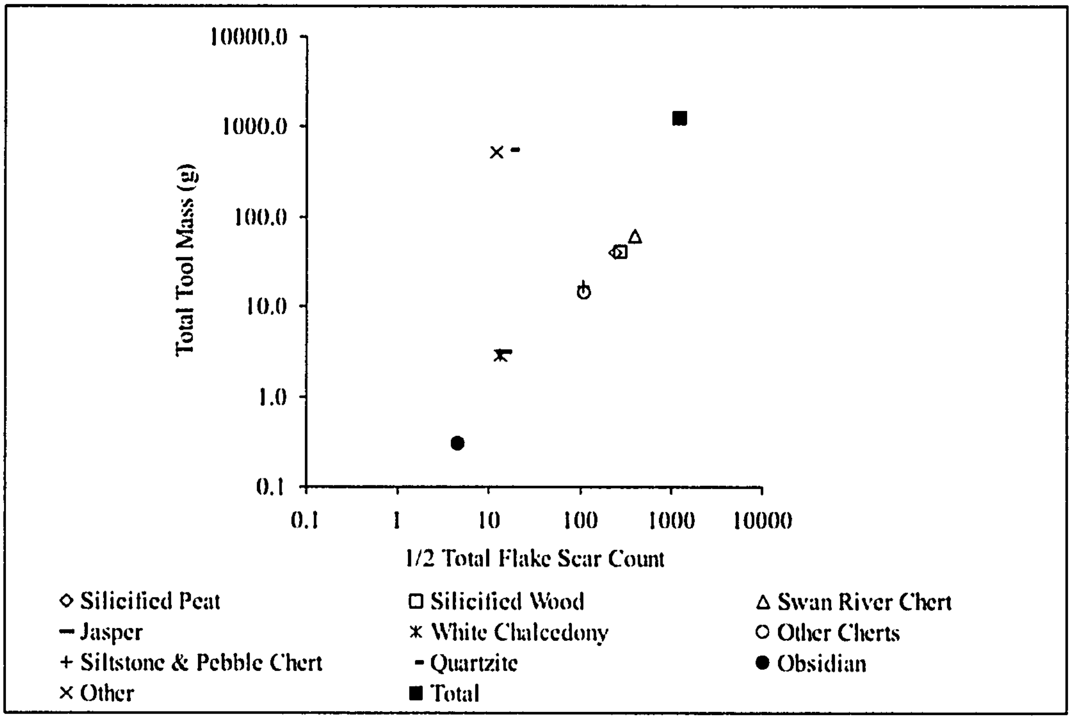


Fig. 19: Tool mass vs. flake scar count, by material.

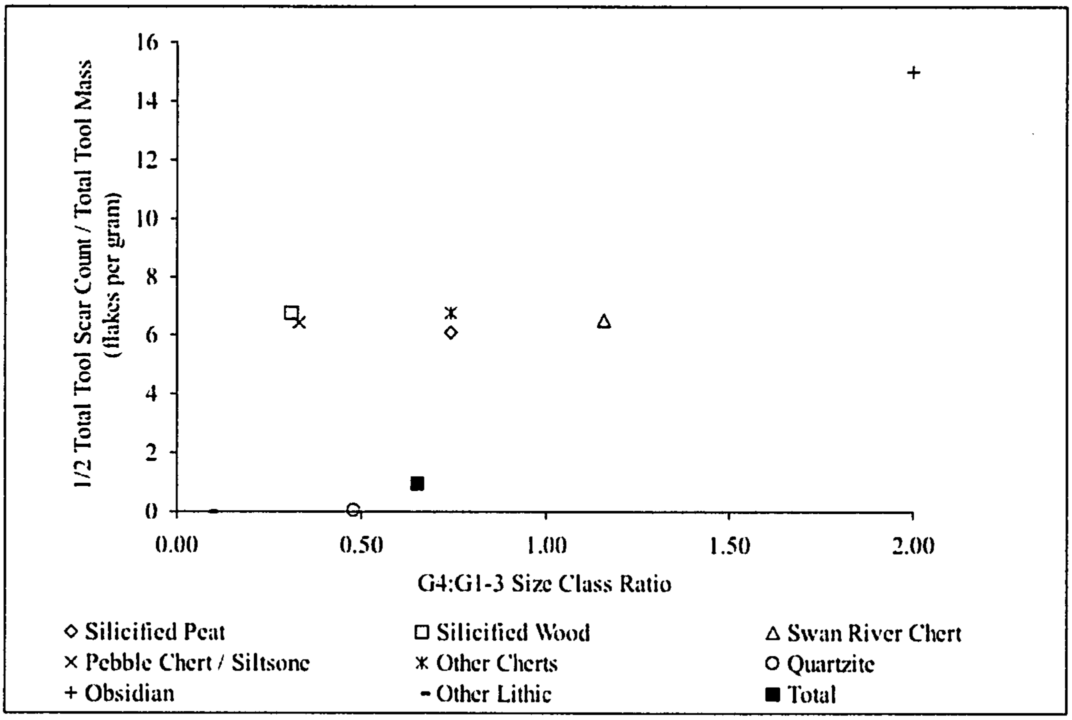


Fig. 20: Tool complexity vs. reduction stage, by material.

Fig. 20 plots tool complexity, based on Magne's scar count to tool mass ratio, against reduction stage, based on Ahler's small to large debitage ratio. The chart can thus be read with the Y-axis representing a continuum from simple to complex tools, bottom to top, and the X-axis representing the stages of reduction carried out on site, from predominantly early stage on the left, to predominantly late stage on the right. There are three distinct groups of materials. Group 1 consists of quartzite and "other" lithic materials, and represents large, simple tools, probably manufactured on site. Group 3 consists of the lone obsidian tool fragment, probably the remnant of a tool that experienced long-term maintenance, with only late-stage maintenance (resharpening or reworking) on site. Group 2 includes the dominant materials present at Area 7, silicified wood, silicified peat, Swan River Chert, pebble chert and other micro- and crypto-crystalline silicates. This group appears to be divided into three clusters, differentiated along the reduction trajectory axis. The first cluster includes silicified wood and siltstone and chert pebbles. These materials have been worked into moderately complex tools, with all reduction stages occurring on site. The second cluster consists of silicified peat and other cherts, including jasper and white chalcedony. These materials have been worked into tools of similar complexity, but appear to be represented at a later reduction stage in the debitage sample. Finally, Swan River Chert appears even further up the reduction trajectory axis, indicating the near absence of early-stage reduction of this material at Area 7.

Summary

These various analyses present a situation of very discriminate use of various lithic raw materials. Relatively coarse materials, such as silicified wood and siltstone, present in local gravel deposits, appear to have been introduced to the site as raw pebbles. These materials were manufactured primarily into relatively expedient tools, such as retouched pieces, tabular knives and split-pebble endscrapers, and discarded relatively early in their use-lives. Moderately fine-grained, but heterogeneous, materials, including a number of varieties of silicified peat and some other cryptocrystalline silicates, appear to have been imported to the site as prepared cores. These may have been transported some distance, although complete microscopic and chemical petrographic analysis will be necessary to determine their actual source. These prepared cores were also used to manufacture relatively expedient retouched pieces and tabular knives. Again, these tools appear to have been discarded early in their use-lives, often after fracturing along flaws in the raw material. Finally, fine-grained, relatively homogeneous materials, including some white chalcedony, some of the finest silicified peat, Swan River Chert, and the very small sample of obsidian, appear to have entered the site primarily as finished tools, including projectile points, endscrapers and bifaces, and occasionally small prepared cores. Reduction of these materials on-site was highly conservative, and primarily restricted to tool maintenance. The extreme conservation of these materials can be seen in the reworking of some of the broken tools, and the utilization of fractured edges and very small pieces.

4.3. Ground and Pecked Stone Artifacts

Introduction

Only seven artifacts in the lithic assemblage indicate evidence of grinding or pecking. All of these artifacts appear to have been modified through utilization rather than formal manufacture. They are easily divisible into two classes: hammers and anvils. Hammerstones and anvils are pictured in Plates 17 and 18.

Hammerstones

Three lithic artifacts exhibit battering and pecking consistent with utilization as hammerstones. All three are fragments of larger cobbles, exhibiting pecking and battering on projecting portions. One (59455, Plate 17a) also exhibits evidence of thermal alteration.

Anvils

Four artifacts have been identified as anvils. All exhibit areas of substantial pecking. The smallest two (40936, Plate 18b; 63903, Plate 18d) are fragments of flat, tabular stones, exhibiting areas of pecking and battering on their superior surfaces adjacent to fractured edges. A third (62413, Plate 18a) is a large tabular piece exhibiting limited evidence of pecking near the center of its superior surface. All three of these artifacts also exhibit evidence of thermal alteration. The final anvil (61640, Plate 18c) is a large (2253 g), heavily worn granite cobble that exhibits substantial pecking and wear in a linear area on its superior surface. Within this area of pecking is a fine white powdery residue, possibly consistent with bone dust. The inferior surface of this cobble exhibits charring consistent with thermal alteration.

The pecking and wear present on these tools is consistent with that produced by direct percussion and especially bipolar percussion of lithic materials. It also may be consistent with the cracking of bone in order to access marrow and for the production of small bone fragments to be boiled for bone grease.

4.4. Thermally Altered Stone

Inventory

The assemblage from the lower occupation in Area 7 includes 1127 fragments of thermally altered stone of various sizes, with a total mass in excess of 36.7 kilograms. The material ranges in size from single grains or crystals of disintegrated sandstone and granite, to granite boulders greater than 1.5 kg. The dominant materials in the thermally altered stone assemblage are granite and sandstone, with minor constituents of other materials, including gneiss, schist, quartzite, limestone and dolomite. A summary of the composition of the thermally altered stone assemblage is presented in Table 6. While all of these materials are available in bedrock and till outcrops in the Eyehill Creek valley and adjacent uplands, the stabilized dunes that make up the Bodo hills are nearly devoid of any particles larger than sand grains. It is therefore suspected that any lithic material present in excavation areas has been introduced as a result of patterned human activity.

	Number	% Total Number	Mass (g)	% Total Mass (g)	Mean Fragment Mass (g)
Gneiss	35	3.1	2228.4	6.1	63.67
Granite	506	44.9	20266.6	55.1	40.05
Quartzite	13	1.2	3575.1	9.7	275.01
Sandstone	464	41.2	4239.6	11.5	9.14
Schist	58	5.1	3025.2	8.2	52.16
Other	51	4.5	3444.4	9.4	67.54
Total	1127	100.0	36779.3	100.0	32.63

Table 6: Lower occupation thermally altered stone.

Brink and Dawe (2003: 91-93) have summarized information regarding the efficiency of various lithic materials for stone boiling, from ethnographic, archaeological and experimental sources. The sources they cite, and their own experiments, generally agree that massive, fine-grained stones, such as quartzite, granite, gneiss, mudstone and limestone were preferable to coarse-grained, porous stones like sandstone for stone boiling. Porous sandstone, while efficiently absorbing heat, was found to have a number of characteristics that make it unsuitable for repeated reheating. Sandstone absorbs water, increasing the amount of energy required to reheat the stone, and resulting in a tendency "to fracture and explode in the hot fires" (Brink and Dawe 2003: 93). Sandstone also tends to "shed a considerable amount of sand into the cooking pits" which "would have become incorporated into any soups, stews and bone grease renderings" (Brink and Dawe 2003: 93). While massive stones like quartzite and granite "have little internal space to absorb the shock of temperature change, and were less forgiving of thermal stress during transfer from hearth to water" (Brink and Dawe 2003: 93), these fragments are more resilient to subsequent reheating than sandstone. Brink and Dawe do, however, believe that "sandstone was the preferred rock for use in food roasting pits" (2003: 93), where the problems of fracture and grit associated with reheating saturated stones would not be a problem.

The size distribution of the thermally altered stone assemblage (Fig. 21) may also reveal some aspects of human activity. The assemblage is dominated, numerically, by material in the 6-12 mm and 12-25 mm size classes. Only 8.6 % of the thermally altered stone is in the 50+ mm size class. This largest size class is dominated by the less common materials in the assemblage, only 7.9 % and 4.1 % of the dominant materials, granite and sandstone, are in the largest size class. On the basis of their experiments, Brink and Dawe state that "rocks below about 10 cm in any dimension have reached the point where reheating is not worth the labour nor the use of fuel relative to the amount of heat these rocks could absorb and transfer back to a water-filled pit" (2003:96). They support their estimation with ethnographic references to stone boiling with "fist-sized rocks and larger" (2003:96). This suggests that the majority of the thermally altered stone fragments recovered from excavation Area 7 represent the remains of stones imported to the site and repeatedly reheated to exhaustion.

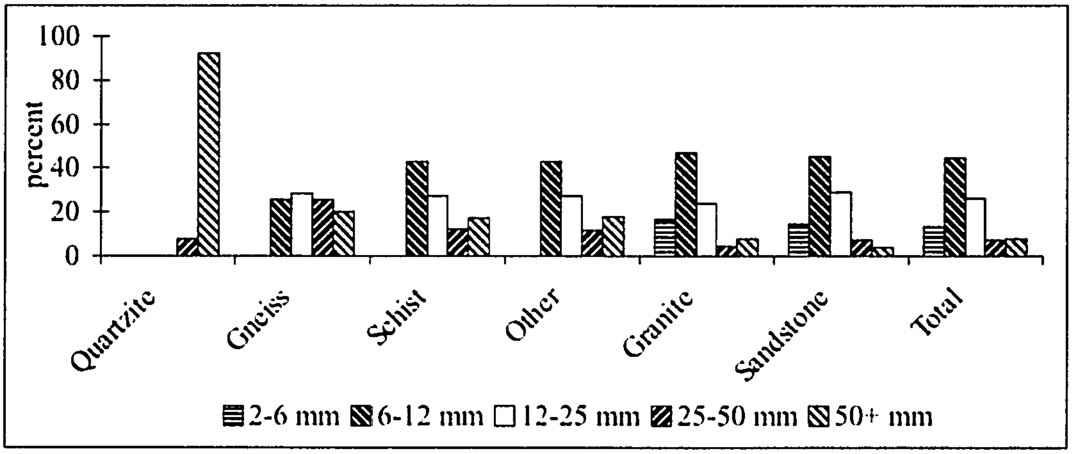


Fig. 21: Thermally altered stone size-class relative distribution.

The presence of the remains of at least two ceramic vessels in the assemblage may suggest an alternative explanation for the predominance of very small granite fragments. Both of the vessels in the assemblage bear disintegrated granite temper. This suggests that the small granite clasts may in fact be the desired product of temper production, rather than a byproduct of cooking or processing activities. It is of note that clay, possibly suitable for the production of ceramic vessels, has been identified in the vicinity of the Bodo Bison Skulls site. Also of note is the presence of two small pieces of unknown lithic material in the Excavation Area 7 assemblage that may be fragments of unformed, but possibly fired, sandy clay. Evidence for the possible production of ceramic vessels is suggestive, but inconclusive.

Distribution

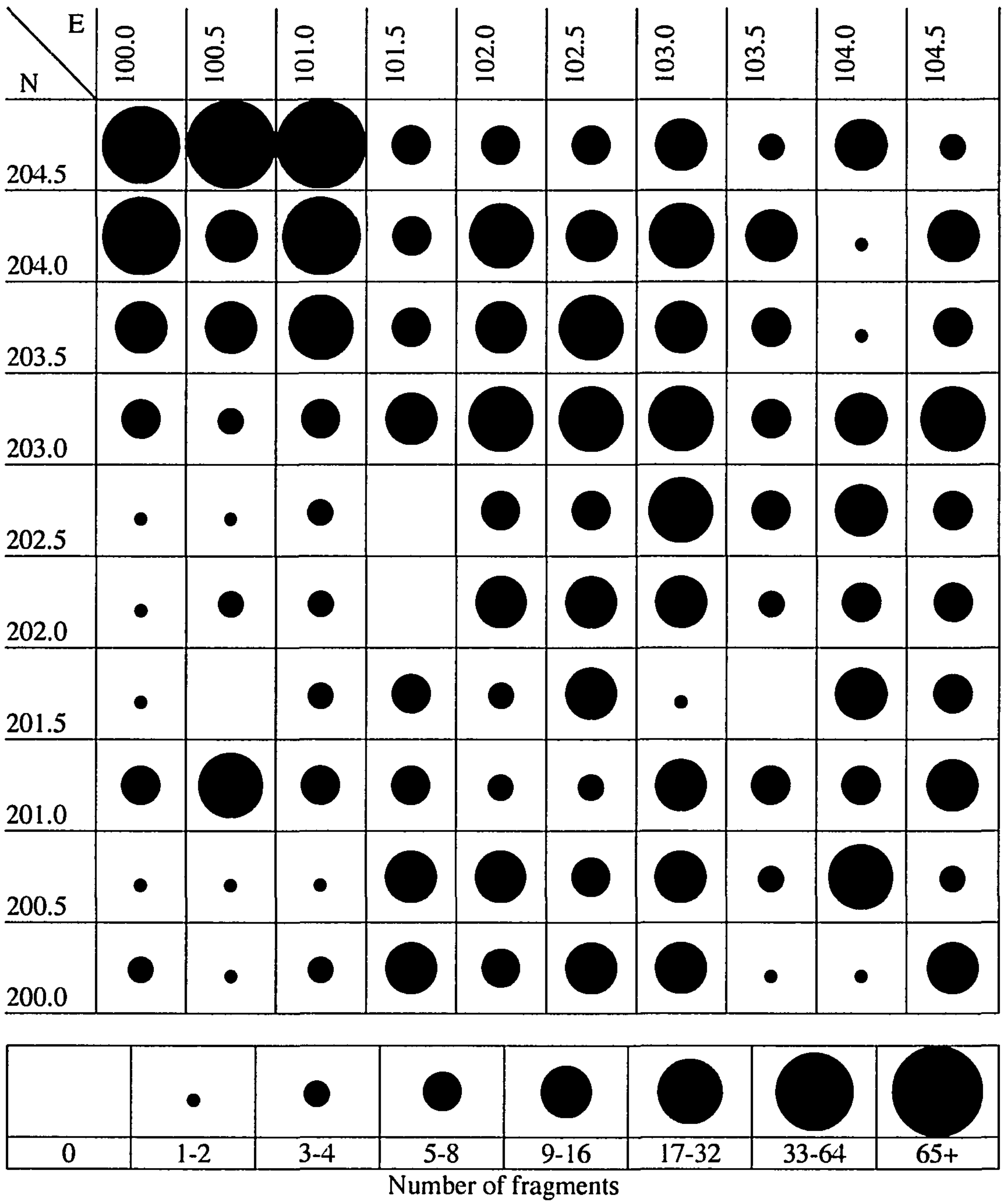


Fig. 22: Distribution of thermally altered stone; number of fragments per subunit.

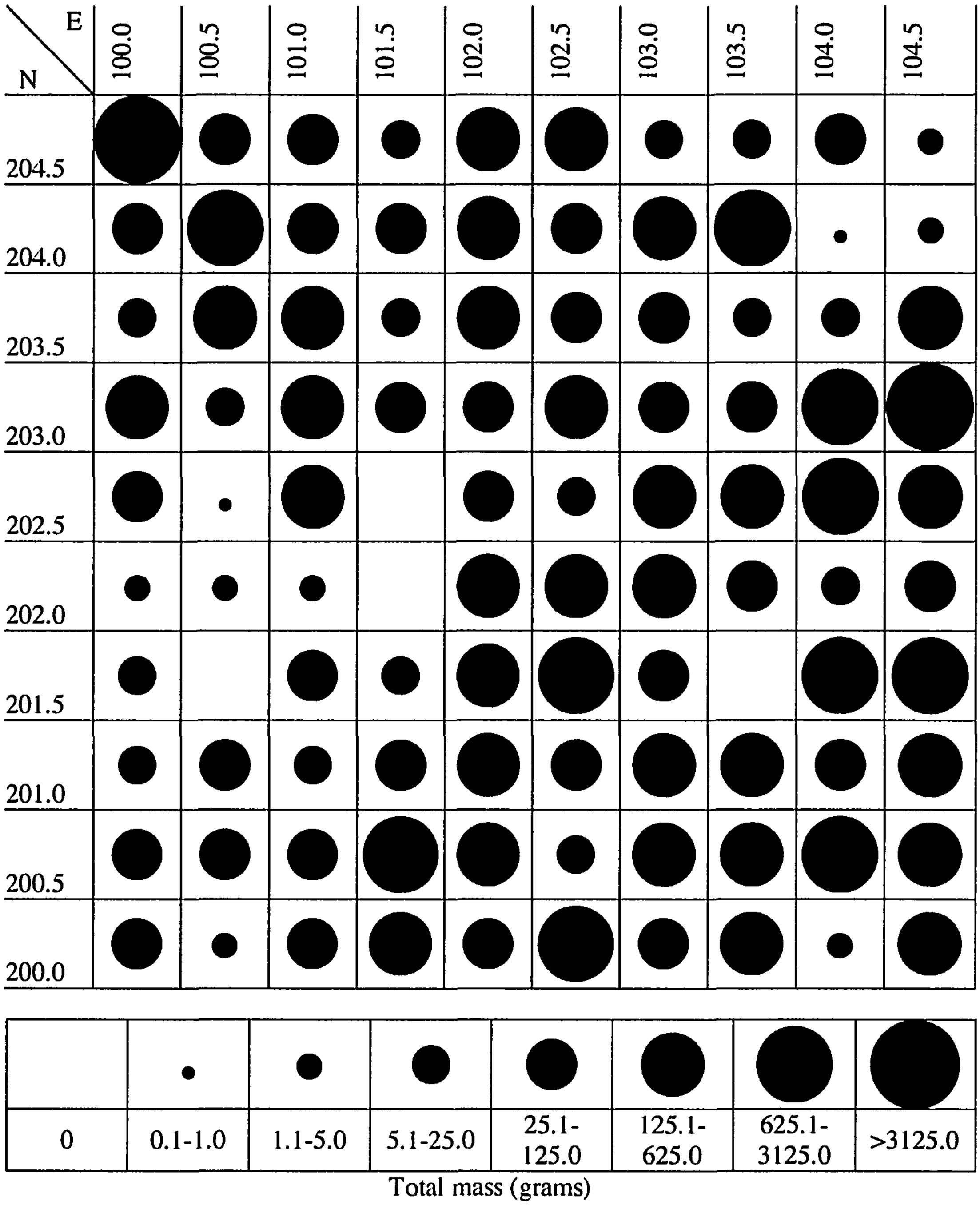


Fig. 23: Distribution of thermally altered stone; total mass per subunit.

Thermally altered stone, including all fragments of fire-cracked and broken stone, as well as large fragments exhibiting charring, was distributed throughout the excavation area. Figure 22 displays the frequency distribution of thermally altered stone.

Concentrations of stone are present in the northwest corner and the north-central area, with smaller concentrations along the southern and eastern edges. The distribution of thermally altered stone by mass, seen in Figure 23, confirms the presence of large amounts of stone in the northwest and north-central areas, but indicates that these concentrations are of relatively small fragments. The areas along the southern, and especially eastern, edges of the excavation area, in contrast contain a relatively small number of large pieces of thermally altered stone. Both figures indicate that the southwest and northeast corners of the excavation area are relatively devoid of thermally altered stone.

4.5. Other Lithic Material:

Inventory

In addition to the previously mentioned lithic material, the assemblage from Area 7 includes a number of lithic materials that do not fit into any of these categories. This includes ochre, a number of fragments of limestone and dolostone, and a possible fragment of steatite. There were 475 specimens of ochre are present in the assemblage. These are all small grains, with a total mass of only 23.3g. The ochre specimens are most likely artifactual. Large blocky fragments of limestone are locally available, exposed in roadcuts and outcrops on the valley margin to the north, but it is likely that their presence in the excavation area is anthropogenic. These limestone fragments may simply be thermally altered stone. The single fragment of possible steatite is of indeterminate origin.

4.6. Ceramics:

Distribution

The ceramic assemblage collected from the excavation area includes 832 pottery fragments. Only six of these were recovered from the upper excavation levels, and are suspected to be intrusive from below, displaced by a variety of processes, including but not limited to rodent activity and frost heave. The distribution of the remaining 826 fragments from the lower occupation is presented in Fig. 24. The distribution appears to indicate two, or possible three, overlapping scatters of potsherds. The largest scatter centers in subunit 204.0 N 101.0 E. A second scatter appears to extend from the southern limit of the excavation area, centered at 102.0 m E. A possible third scatter may be present in the east-central portion of the excavation area, around 203.0 N, 103.0 E. This area may simply be an extension of the first, largest scatter.

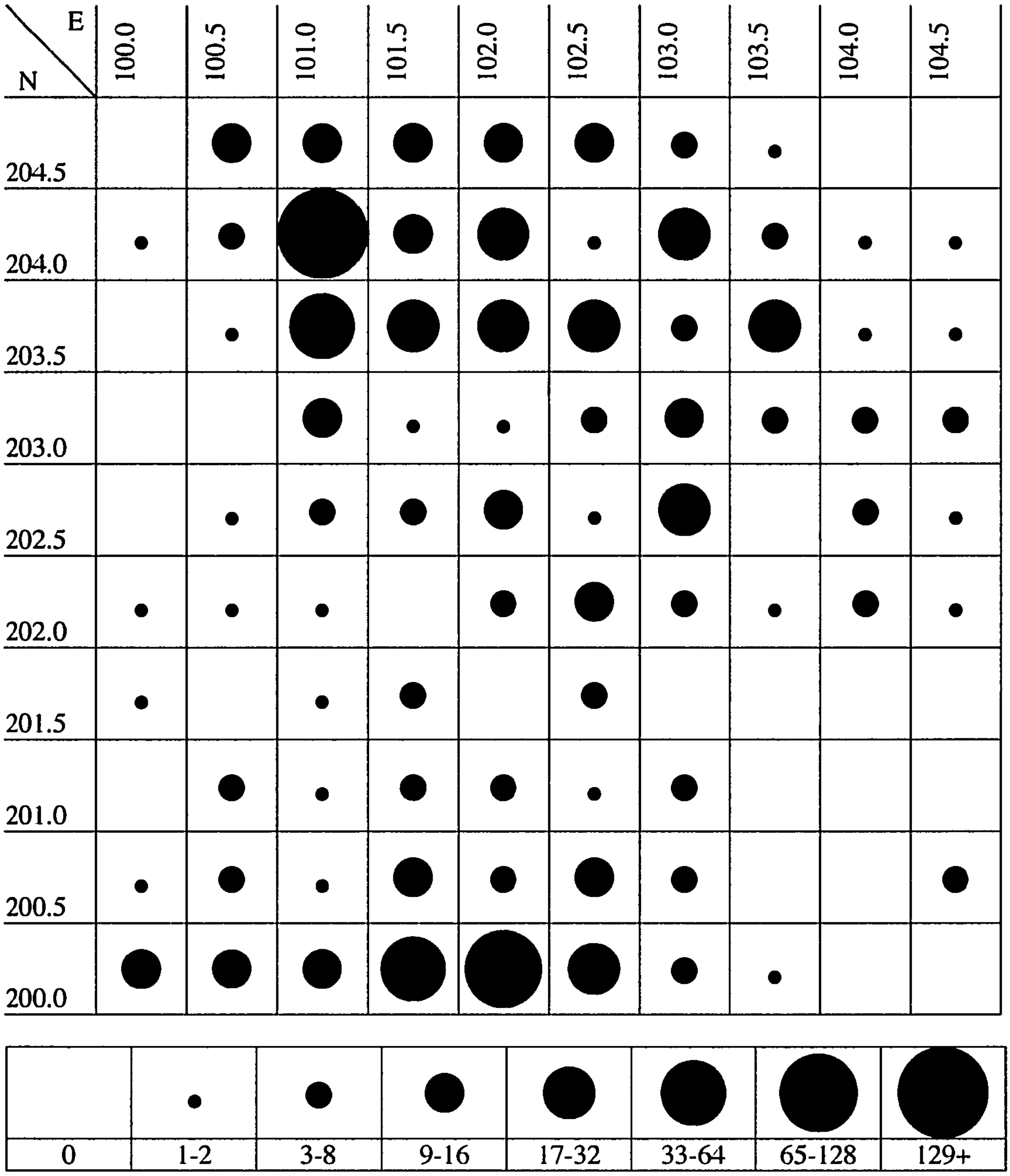


Fig. 24: Distribution of pottery fragments.

The potsherds present in the ceramic assemblage exhibit two distinct surface treatments. Figure 24 presents the distributions of potsherds with visible surface treatment.

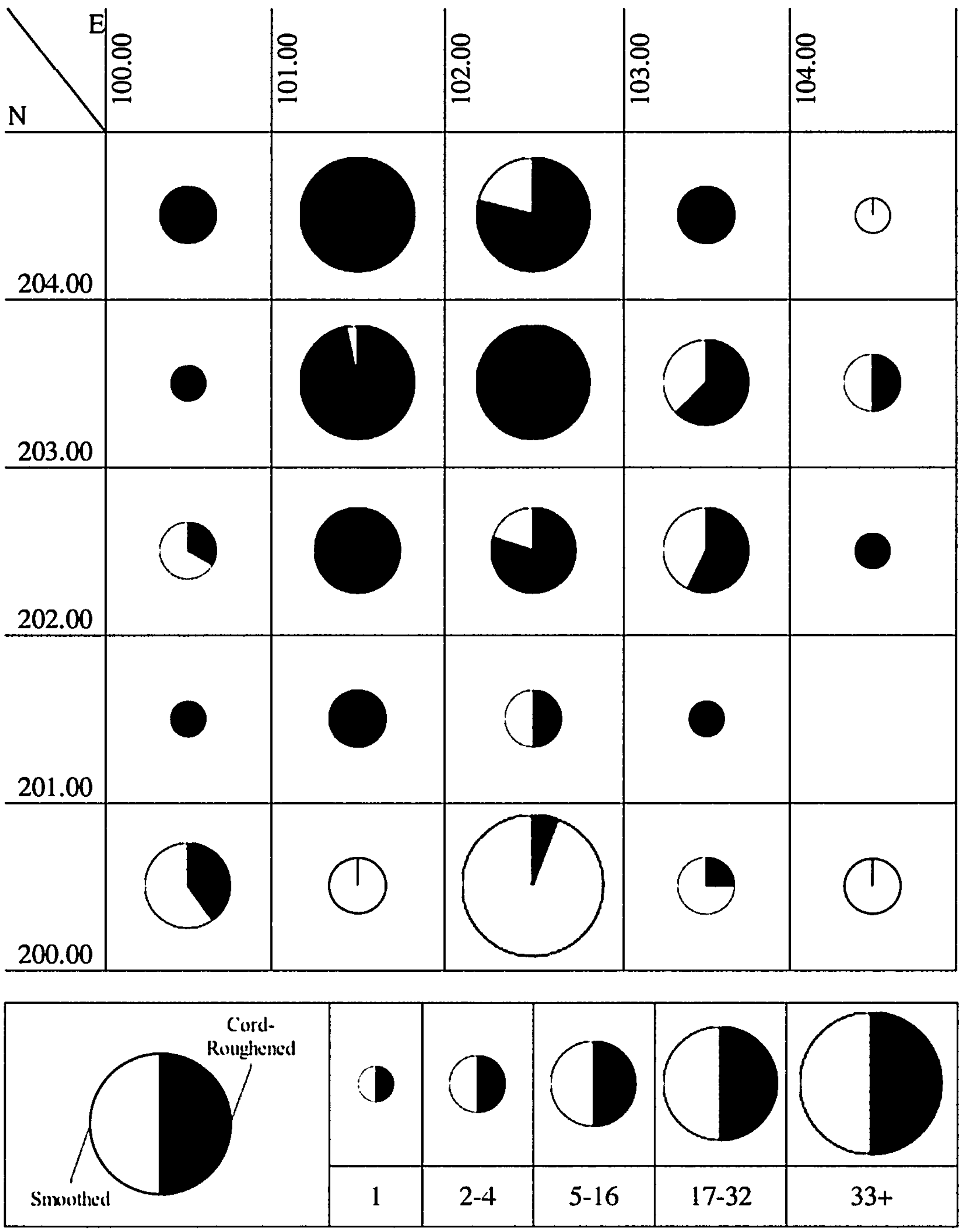


Fig. 25: Distribution of potsherds, by surface treatment.

The distribution of cord-roughened sherds correlates well with the primary ceramic scatter, centered in 204.0 N, 101.0 E, and extending southeast to include the ambiguous third concentration. In contrast, the distribution of smoothed finish sherds is greatest along the southern edge of the excavation area, centered at 102.0 E, correlating with the second ceramic scatter defined above. The two distinct surface finishes also exhibit different patterns of distribution by depth. Table 7 presents a summary of the number and percent of potsherds exhibiting the two surface treatments, by excavation level. Cord-roughened potsherds show a significant concentration in excavation level 5, the bottom of the lower occupation, while smooth-finished sherds are concentrated in excavation level 4, the top of the lower occupation. The differential distribution of fragments with different surface treatments strongly suggests that the ceramic assemblage represents at least two separate vessels, possibly from separate occupation episodes, rather than different portions of a single vessel.

	Level 3		Level 4		Level 5		Total	
	N	%	N	%	N	%	N	%
Cord Roughened	1	0.75	38	28.36	95	70.90	134	100.00
Smoothed	1	1.28	70	89.74	7	8.97	78	100.00
Indeterminate Finish	4	0.65	270	43.55	346	55.81	620	100.00
Total	6	0.72	378	45.43	448	53.85	832	100.00

Table 7: Distribution of pottery fragments, by surface treatment, by excavation level.

Ceramic Typology

Ceramic material in the artifact assemblage from Area 7 includes fragments exhibiting two distinct surface treatments, representing two or more vessels. Cord roughened sherds are the most numerous of the fragments retaining their surface features. The majority of these sherds are believed to represent a single vessel, on the basis of general uniformity in various characteristics of paste, finish and vessel form. A large portion of the vessel is represented in the assemblage. This vessel exhibits the somewhat coarse paste, and crushed or disintegrated granite temper characteristic of pre-contact pottery in Alberta. External surface treatment consists of parallel vertical cord impressions, generally interpreted as the result of shaping with a cord-wrapped paddle or similar implement. Where retained, the internal surface of all sherds is smooth. The vessel's profile is complex, exhibiting a flattened lip, a somewhat flared and possibly thickened rim, a concave neck, a sharply angled shoulder, and a flattened base. Decoration on the cord-roughened vessel includes a series of oblique incised lines across the lip, and a row of pinched decoration around the shoulder. Examples of cord-roughened sherds exhibiting various profile and decorative attributes are pictured in Plate 19. This vessel is consistent with Byrne's Saskatchewan Basin Late Variant, specifically, his Class A, pottery (1973: 331, 356). This vessel is also consistent with Ethridge Ware, as initially described by Wedel (1951), expanded by Kehoe (1959), and recently described by Walde and Meyer (2003:141-142).

Potsherds with smoothed exterior finish comprise a minority of the ceramic assemblage. These sherds exhibit similar paste and disintegrated granite temper to the cord roughened sherds, above. The sherds appear to be from a relatively thin-walled vessel. Exterior and interior surfaces are smoothed. A single smoothed finish sherd exhibits a simple, undecorated rim. No smoothed sherds exhibit other complex profile features or other decoration. The smoothed finish sherds probably represent a thin-walled, simple-profiled globular or coconut-shaped vessel with smoothed exterior finish. A number of smoothed finish sherds are presented in Plate 20. This vessel would likely fall into Byrne's indeterminate Class Gb1 pottery. Smoothed surfaces and simple profiles are also occasionally associated with Ethridge ware (Walde and Meyer 2003: 141-142).

Byrne (1973) identified Saskatchewan Basin Complex pottery in assemblages from throughout his study period, roughly A.D. 150 to 1870, but notes that the Late Variant is dominant in the later periods, from A.D. 1150 to 1870. Byrne associated Saskatchewan Basin Late Variant pottery primarily with the Old Women's phase in southern Alberta, and noted that the association of Early Variant pottery with the Avonlea phase suggested continuity between the two late pre-contact phases (1973:559). Byrne acknowledged the similarity of Saskatchewan Basin: Late Variant pottery to pottery assemblages from Ethridge and other sites in Montana and other Northern Plains states, but noted that they "frequently differed from the Canadian ceramics considerably in details of surface finish, vessel form, and/or decoration" (1973: 387-8). Byrne also noted "considerable similarity" (1973:394) between Late Variant pottery and some assemblages from Saskatchewan.

Walde and Meyer's (2003) recent synthesis of precontact pottery in Alberta takes into account a number of discoveries and a great deal of analysis done since Byrne's seminal work. Walde and Meyer incorporate Byrne's Late Variant ceramics into Ethridge Ware. Ethridge Ware's earliest appearance is in association with late Avonlea Horizon assemblages (2003: 142), and it continues through the rest of the Late Pre-Contact period, in association with the Old Women's Phase (2003: 143). Walde and Meyer (2003:142), like Byrne, note that the presence of this ware in assemblages dating to both of these Late Pre-Contact phases strongly suggests cultural, and probably ethnic, continuity. They also note that the distribution of Ethridge Ware across the northwestern plains is similar to the earliest recorded distribution of the Blackfoot and associated tribes (Walde and Meyer 2003:142). Also following Byrne, Walde and Meyer note stylistic differences between the Ethridge Ware of Alberta, and that of Montana, and suggest that "regionally distinct Ethridge Ware pottery types" may be forthcoming (Walde and Meyer 2003: 144).

Reconstruction

Ceramic material from Area 7 was submitted to Dr. Mary Malainey of Brandon University, along with ceramic assemblages from other areas of the Bodo Bison Skulls Site, for her Winter 2005 Pottery Analysis class. Malainey, her assistant Timothy Fogol, and the students of the class were able to reconstruct three large portions of the cord-roughened vessel. These reconstructions include a portion of the flattened base and adjacent body; a large portion of the body exhibiting the relationship between the body, shoulder and neck; and another portion extending from the shoulder to the rim. These reconstructed fragments, and the probable vessel profile, are exhibited in Plate 21. The vessel was estimated to have had a volume of approximately 3.7 L. It was noted that a relatively large amount of residue was present on the interior surfaces of the sherds. This residue was identified as being derived from a large herbivore (Malainey personal communication, 2005).

4.7. Faunal Material

4.7.1. Introduction

The main, lower occupation level excavated at Area 7 produced 54 845 faunal artifacts, the vast majority of which are bison bone fragments. The total mass of bone recovered from the 25 square meters excavated is 113.7 kilograms. Faunal material from only 11 square meters has been fully identified by the staff of Western Heritage Services Inc. This limited sample still includes 24 596 bone fragments, with a total mass of 54.6 kilograms. Aside from a small number of artifacts identified to other taxa, which will be discussed further, this material is assumed to be almost entirely fragmentary bison bone.

4.7.2. Distribution

Figures 26 and 27 display the distribution of bone in the excavated area by number of fragments and total mass of fragments per 50 cm square sub-unit. These figures show somewhat contrasting patterns, with numerical concentrations of fragments in the northwest corner, the center, and the south edge of the excavation area, but concentrations by mass being greatest in the eastern and central areas. Figure 28 displays the mean mass of fragments in each subunit, indicating the dominance of extremely small fragments in the northwest corner, and to a lesser extent, the center of the excavation area. This contrasts with a much larger mean fragment size in the southwest corner and along the east side of the excavation area. These differences in mean fragment size may represent patterned distribution of fragments subjected to differential modification by taphonomic agents, specifically human activity.

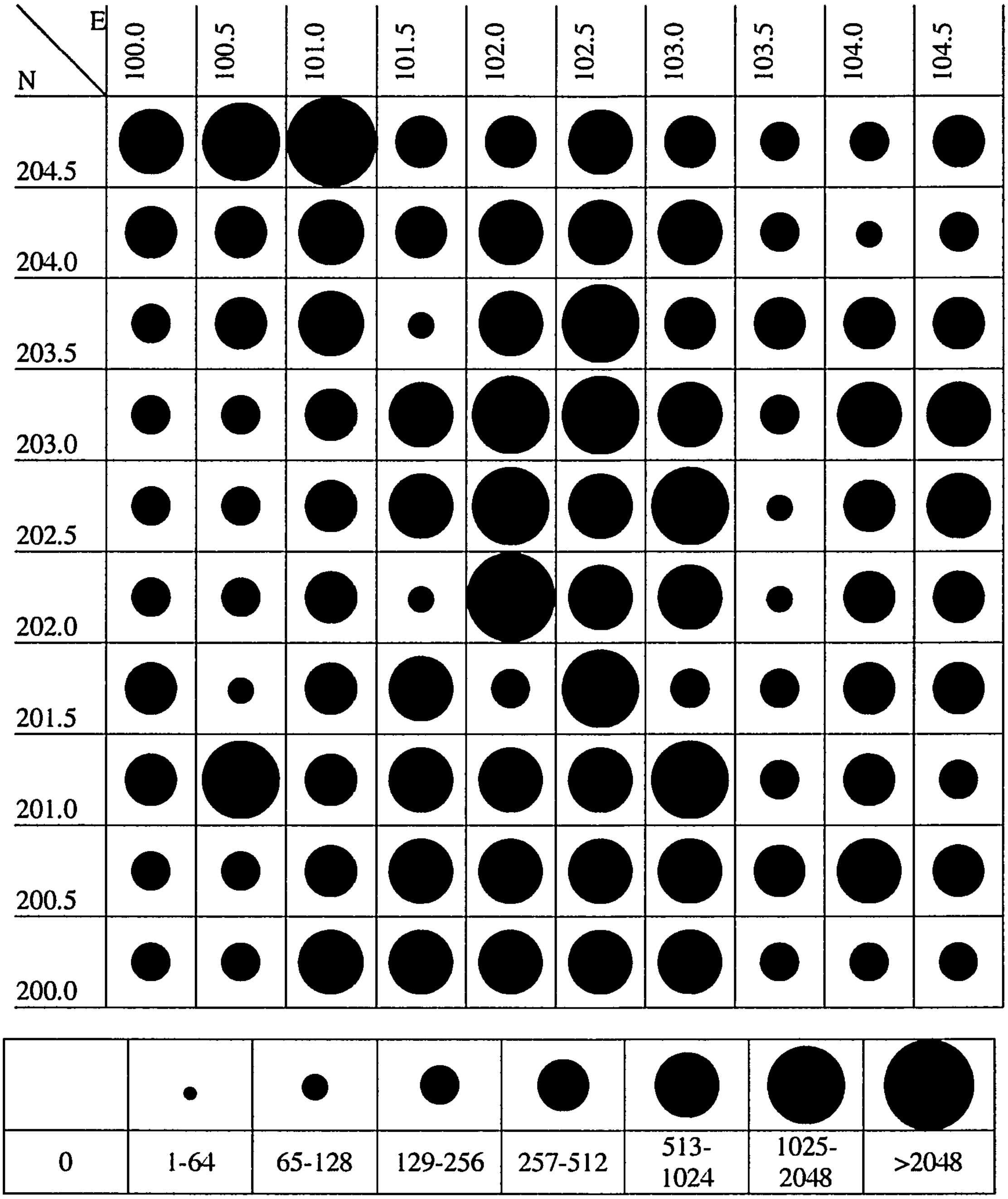


Fig. 26: Lower occupation distribution of bone fragments; total number per subunit.

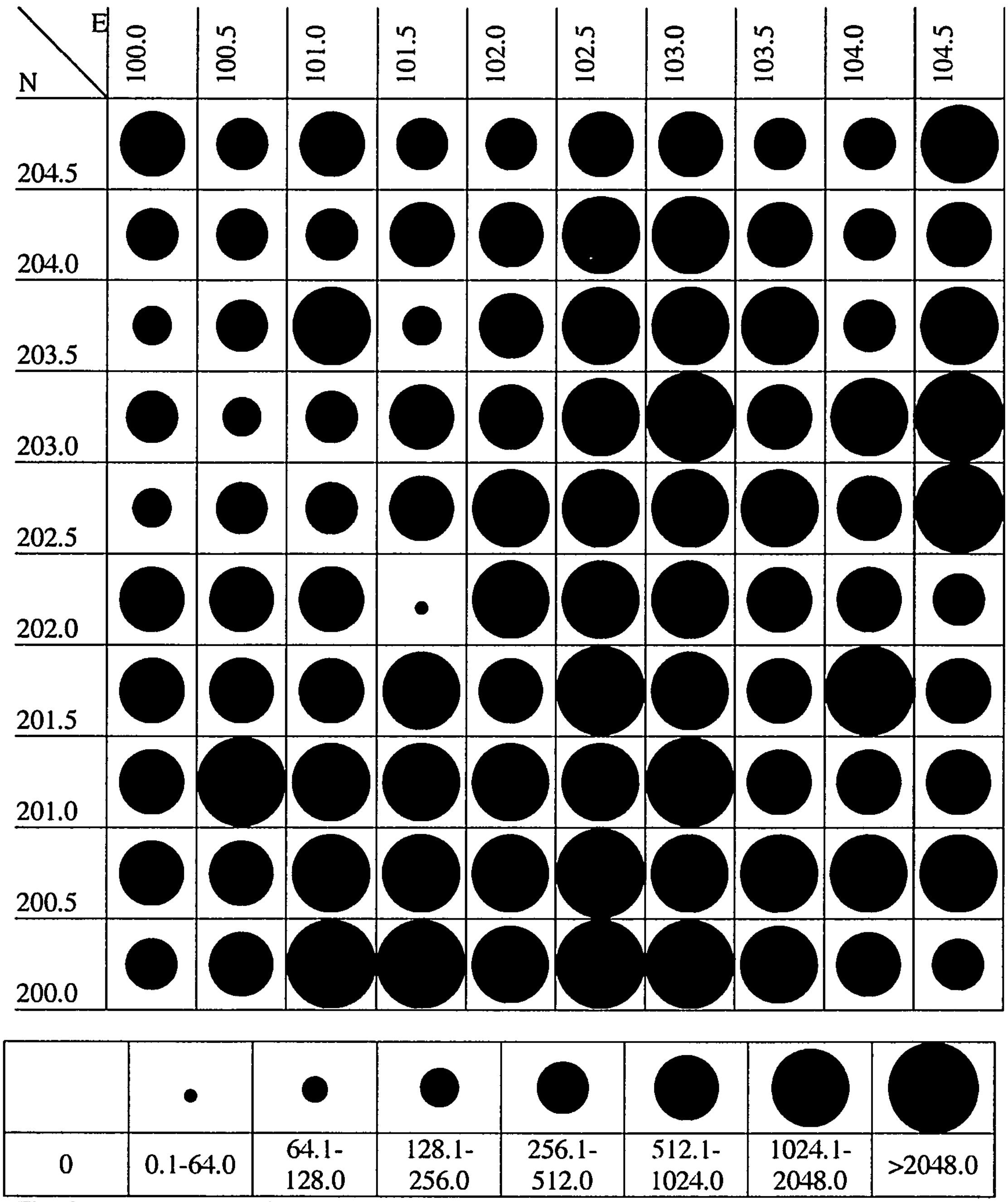


Fig. 27: Lower occupation distribution of bone; total mass (g) per sub unit.

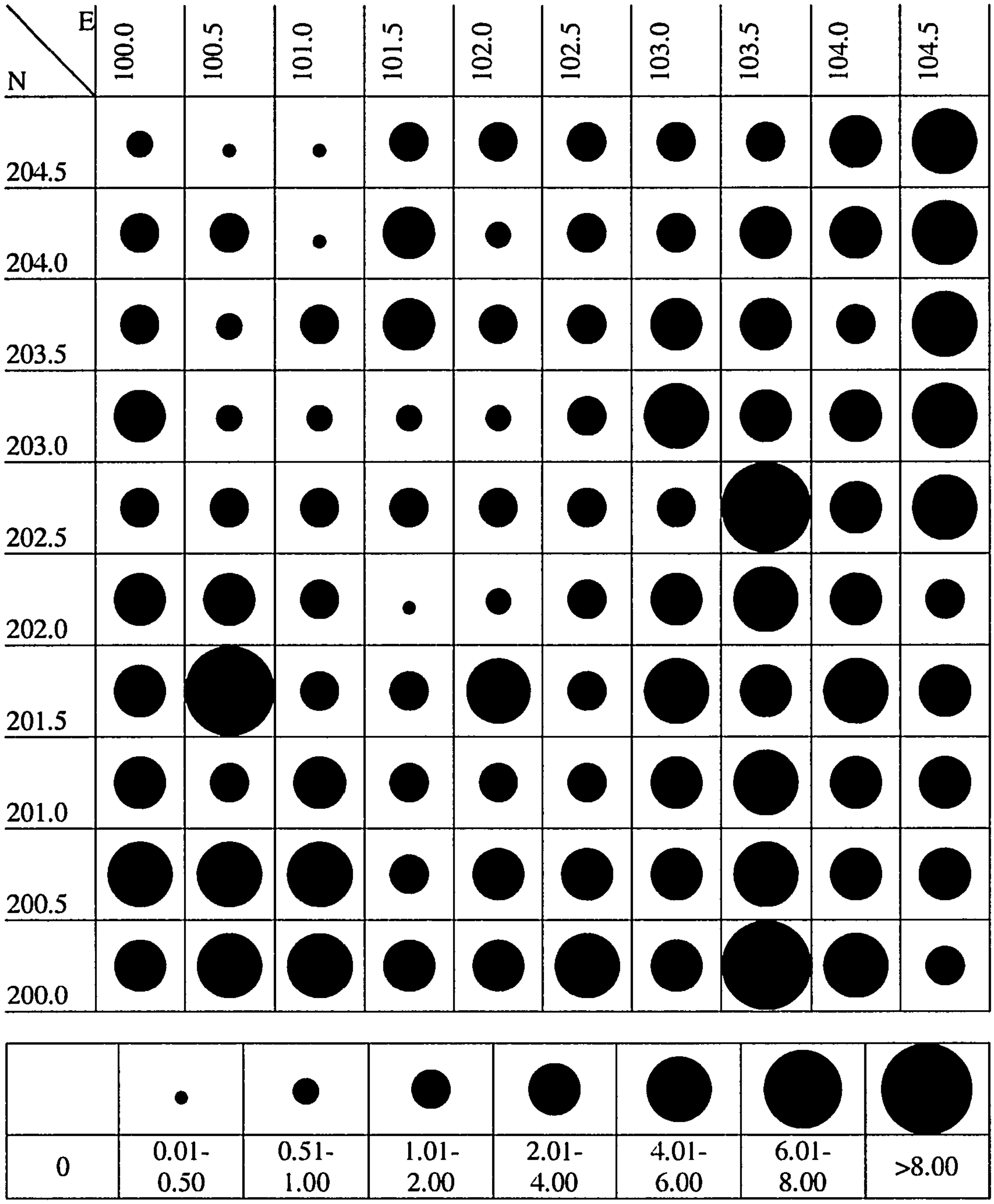


Fig. 28: Lower occupation mean bone fragment mass (g) by subunit.

4.7.3. Inventory

4.7.3.1. Bison

Element Representation

Identified non-bison faunal material in the faunal sample will be discussed further below. The staff of Western Heritage Inc. and the author identified 1492 bone fragments as belonging to *Bison bison*, on the basis of comparison to published references (Olsen 1960; Brown and Gustafson 1979; University of Wyoming Anthropology Department 2005; Todd 2005). A complete summary of identified bison bone is presented in Table 25 in Appendix II. Portions of nearly every element were present in the sample. A minimum number of individuals of 10 was determined from the presence of 10 left maxilla fragments that include the 4th premolar. The calculation of the minimum number of elements for each element takes into account differences in age, as represented by epiphyseal fusion and size. Comparison of the minimum number of elements present to the expected number of elements from 10 individuals presents some distinct patterns, displayed in Figure 29.

The best-represented skeletal areas are the snout and jaws, including the maxilla, incisive, and mandible; and the proximal tarsals, the calcaneus and astragalus. Other tarsals and the long bones of the limbs are nearly as numerous.

Nearly unrepresented skeletal portions are the sternal area, including the sternum, costal cartilage and sternal ends of the ribs, and the bones of the cranial vault and the horn cores. Only three rib fragments preserve the sternal end, in contrast to at least 11 vertebral ends. Only one fragment of costal cartilage is present in the identified sample. No fragments of the sternum were identified. Similarly, bones of the cranial vault are typically represented only by fragments of various process and features. This includes the condyles and jugular process of the occipital, the petrous portion and zygomatic process of the temporal, and the orbital margin of the frontal. These portions and features are all located on either the basal or anterior portions of the cranium. Very few fragments of bone are identified as being of the cranial vault.

The vertebrae are identified in significantly lower numbers than expected, and although many fragments of the vertebral spines and ribs are present, the minimum number of elements represented by these fragments is low.

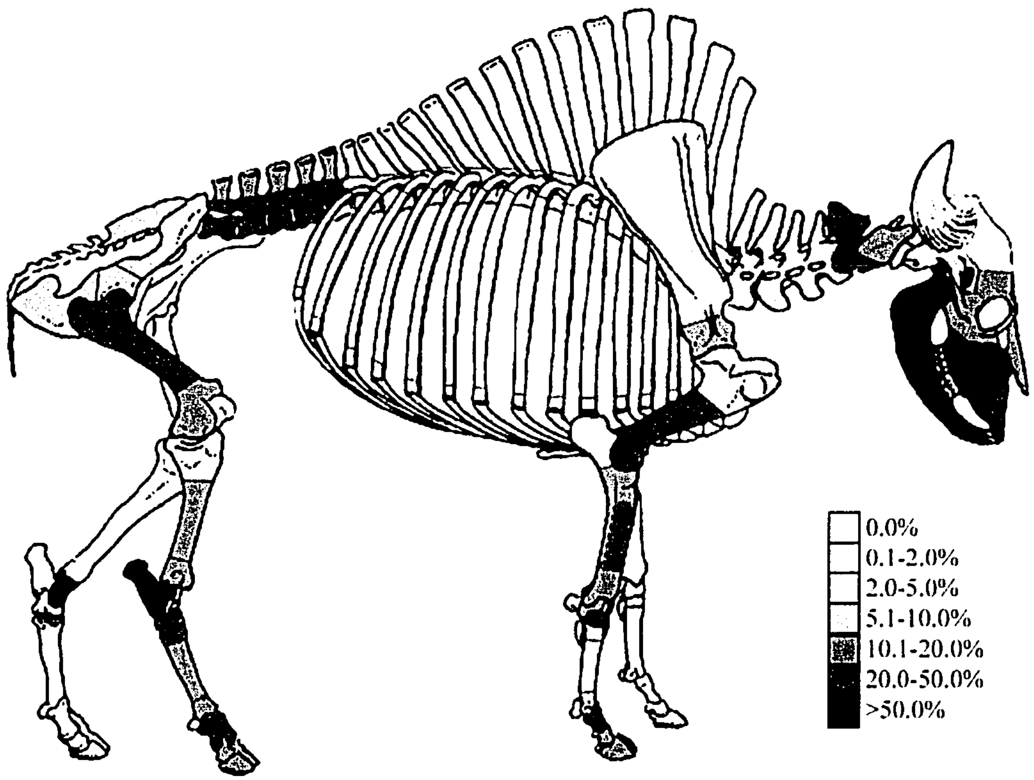


Fig. 29: Bison element portion representation; % of expected number of elements. (after Olsen 1960: Figure 4)

Population

The absence of horn cores, and the fragmentary nature of the faunal sample prevents the determination of sex for the bison present. The excavated faunal sample is more amenable to the determination of the age structure of the represented population.

The bison sample includes many juvenile elements. Due to the small size of the sample, and the highly fragmentary and disarticulated nature of the faunal assemblage, epiphyseal fusion sequences could not be used to provide anything beyond the most basic demographic data.

The entire excavated assemblage was inspected for possible foetal and neonatal bone. The presence of a number of foetal or neonatal elements and fragments can provide some information regarding demographics and seasonality. Identifiable elements present include the complete diaphysis of a right humerus, the majority of the diaphysis of a right femur, the centrum of a 5th lumbar vertebra, as well as a number of unidentifiable fragments. Comparisons of measurements from the two long bones from the assemblage to published measurements of foetal and newborn bison element measurements from a number of archaeological and modern samples are presented in Tables 8 and 9. These elements are pictured in Plate 23. On the basis of this comparison, the elements from the Bodo assemblage appear to be consistent with a neonatal bison, probably around one month of age.

Site	Specimen No.	Specimen Developmental Age	Minimum Ant.-Post. Diameter (mm)	Minimum Transverse Diameter (mm)
Modern	unnumbered	¾ term (7 mo.)	13.5	13.0
Casper (Wyo. ca. 10000 BP)	NC 625	¾ term (ca. 7 mo.)	13.8	13.8
Wardell (Wyo. ca. 900 BP)	Wardell-2	near full-term	15.0	14.6
Wardell (Wyo. ca. 900 BP)	Wardell-3	near full-term	15.1	14.5
Wardell (Wyo. ca. 900 BP)	Wardell-1	near full-term	15.1	14.4
Wardell (Wyo. ca. 900 BP)	Wardell-1	near full-term	15.1	14.5
Casper (Wyo. ca. 10000 BP)	NC 2484	near full-term	18.8	18.7
Casper (Wyo. ca. 10000 BP)	NC 2124	near full-term	19.2	18.5
Cactus Flower (AB ca. 3500 BP)	FS 1604-1	newborn	20.5	18.0
Modern	91-1.65	3 day old	19.3	17.1
FaOm-1 Area 7 (AB ca. 250 BP	28753	young calf	22.8	20.2

Table 8: Foetal and Neonatal bison humeri mid-shaft measurements. (after Wilson 1974: 148)

Site	Specimen No.	Specimen Developmental Age	Minimum Ant.-Post. Diameter (mm)	Minimum Transverse Diameter (mm)
Casper (Wyo. ca. 10000 BP)	NC 903	¾ term (ca. 7 mo.)	14.5	14.1
Casper (Wyo. ca. 10000 BP)	NC 32	near full-term	20.3	20.1
FaOm-1 Area 7 (AB ca. 250 BP)		young calf	29.8	27.2

Table 9: Foetal and neonatal bison femora mid-shaft measurements. (after Wilson 1974: 150)

Dental material from the entire assemblage was also examined. Though the amount of dental material is in fact quite large, like the rest of the faunal assemblage, the dental material is extremely fragmentary. Mandibles are somewhat more complete than maxillae; however, the small number and fragmentary state still preclude detailed demographic analysis based on tooth wear. It was hoped that dental eruption sequences, compiled from a number of sources (Table 10) might be used to obtain limited demographic information and indicate seasonality. Fifteen mandible fragments with teeth in situ were examined. A summary of the elements examined is presented in Table 11. Bison mandibles with intact teeth are pictured in Plate 22, in Appendix I. The examined elements indicate the presence of at least five mature animals greater than five years of age, at least one animal in the fourth year of life, one in the second year, and two calves.

Age (Months)	Changes
0 (birth)	i1-p4 erupted
1	p4 in wear, M1 visible in crypt, mandible 'much larger'
2	p3 in wear; anterior M1 erupted
3 – 4	p2 in wear; posterior M1 erupted
5 – 6	p2,3,4 worn; M1 erupted; tooth row 9-10 cm; mandible 26-28 cm.
7	anterior M1 in wear
8 – 9	posterior M1 in wear, M2 visible in crypt
10 – 11	M1 in slight wear, M2 erupting, M3 bud
13-14 (1.1-1.2 y)	p2,3,4 in full wear; anterior M1 in moderate wear; M2 erupting
18 (1.5 yr)	I1 erupting; p2,p3,p4 worn & roots exposed; M1 worn; M2 slightly worn; M3 visible; tooth row 11-12 cm; mandible 33cm.
19-22 (1.6-1.8 y)	p2,3,4 in place & worn; M1 worn; M2 in wear; P4 below alveolus
24 (2 y)	I1 in place, I2 erupting
25-26 (2.1-2.2 y)	p2,3,4 worn; M1 ectostylid may be in wear;
30 (2.5 yr)	I1 in wear; i2,i3,c1 heavily worn; I2 visible; tooth row 14-15 cm; mandible 34-37 cm.
31-32 (2.6 y)	I2,P2,P3 erupting; p4 well worn; anterior M3 above alveolus
31-35 (2.6-2.9 y)	I2,P2,P3 in place, P4 in crypt, M1 ectostylid in wear; M2 in wear; M3 erupting
36 (3 y)	I3 in place
37-38 (3.1-3.2 y)	P2 unworn; P3 light wear; P4 erupting; M1 ectostylid may be connected; M2 in wear; anterior M3 in light wear;
42 (3.5 yr	I1,I2 in wear; I3 erupting; P2,P3 in wear; P4 erupting; tooth row 16-17 cm; mandible 37-38 cm.
43 (3.6 yr)	P2, P3 slight wear; P4 erupting; M3 above alveolus anterior in wear
43-47 (3.6-3.9 y)	P2, P3 in wear; P4 in occlusion; M2 ectostylid not yet in wear; M3 in wear
48 (4 y)	C1 erupting
54 (4.5 yr)	I1,2,3 worn; C1 erupting; P2,3,4, M1,2 in wear; anterior M3 slightly worn; tooth row 15-16 cm; mandible 40 cm.
55 (4.6 yr)	P2, P3, P4 in wear; M1,M2 in wear; posterior M3 in slight wear
55-59 (4.6-4.9 y)	All P&M in wear

Table 10: Bison mandibular tooth eruption sequences. (Frison 1982a: 240-245; Frison 1970b: 70; Frison, Wilson and Wilson 1976: 39-40; Fuller 1959; Niven and Hill 1998:10,14,18; Reher 1974: 115-116)

Accession Number	Side	P2	P3	P4	M1	M2	M3	Age
25148	R	full wear	full wear	heavy wear	heavy wear	full wear	full wear	Mature (5yr +)
12190	R						full wear	Mature (5yr +)
22372	R			heavy wear	heavy wear	heavy wear	heavy wear	Mature (5yr +)
61686	L	broken	full wear	full wear	full wear	full wear	full wear	Mature (5yr +)
12032	L			heavy wear	heavy wear	heavy wear	heavy wear	Mature (5yr +)
38371	L		broken	broken	broken	full wear	full wear	Mature (5yr +)
29550	L						full wear	Mature (5yr +)
27929	L						full wear	Mature (5yr +)
25577	R	in wear	full wear					4.0 yr +
30181	R					ectostylid not in wear	anterior in wear	3.0-4.0 yr
28748-9	R	d, heavy wear	d, heavy wear	d, heavy wear	ectostylid not in wear			1.5-2.5 yr
13764	R			d, in wear				1-2 mo
12205	L			d, in wear				1-2 mo
41561	L	d, no wear	d, in wear	d, in wear				ca. 2 mo
36929	R			d, in wear	visible in crypt			1-2 mo

Table 11: Observed bison mandibular dentition.

Taphonomy

Taphonomic analysis of the faunal sample is limited to gross observations of preservation, fragmentation and element representation. Though the faunal material is highly fragmentary, preservation of these fragments is relatively good. Some fragments exhibit increased weathering over portions of their surfaces, while the remainder of the fragment is well preserved. This may indicate a period of partial exposure of the occupation level. Preservation of bone in the lower occupation is significantly better than in the upper occupation. Generally good preservation, including the preservation of extremely fragile elements such as the ethmoid and sphenoid, suggests that differential representation of elements has been influenced to a greater degree by human or other animal behaviour, than by the sedimentary environment. Evidence of human and animal activity, beyond fragmentation, includes cutmarks, burning, and gnawing by carnivores and rodents. A summary of the recorded human and animal modification in the assemblage is presented in Table 12.

	Number of fragments	% of total number	Mass (g) of fragments	% of total mass (g)
Cutmarks	319	0.58	10098.6	8.88
Polish	6	0.01	188.0	0.17
Striations	3	0.01	6.9	0.01
Split	7	0.01	172.0	0.15
Carnivore Chewed	118	0.22	2706.8	2.38
Rodent Gnawed	38	0.07	530.5	0.47
Weathered	11	0.02	411.5	0.36
Burnt	3580	6.55	1571.9	1.38
Calcine	2220	4.06	556.3	0.49
Total fragments	54648	100.00	113696.3	100.00

Table 12: Lower occupation bone modification summary

Extreme fragmentation of the bone is reflected in the size distribution of the sample, with nearly 80% of the bone fragments falling into the 12-25 mm fraction. This fragmentary nature has contributed to the failure to identify the vast majority of the sample. Only 6.16% of the bone fragments were identifiable to the genus level. The vast majority, 98.35%, of this identified bone belongs to the genus *Bison*. It is assumed that the vast majority of the unidentified bone is also *Bison*.

Binford (1981) noted that destructive processes, specifically the action of "ravaging carnivores", affect some elements and portions of elements, more than others. He posited that the humerus and tibia are particularly useful in "*diagnosing* the relative role bone destruction plays in modifying an assemblage" (1981: 217, emphasis in original). Binford identified the proximal portions of these elements as more vulnerable to destruction, and a ratio of proximal to distal ends of approximately 1:2 as separating the "area of no destruction" above from the "zone of destruction" below (1981: 219). The identified sample from Area 7 exhibits a proximal to distal ratio of 1:3.5 for the humerus, and 1:1.5 for the tibia, indicating that the assemblage has been subjected to substantial attrition. Binford's diagnosis of destruction is based specifically upon the action of scavenging carnivores; however, evidence of carnivore activity is relatively limited in the faunal assemblage. As stated above, mechanical and chemical erosion from the sedimentary environment are also limited. The extent of general destruction at the site is therefore believed to be associated with human activity.

Carnivore activity is represented by chewing and gnawing on 118 fragments. While many of these fragments exhibit only isolated toothmarks, some (33649, Plate 31d) exhibit evidence of relatively extensive gnawing. Binford noted that he observed extensive gnawing "only on bones from wolf dens and dog yards. *No examples* of bones so extensively gnawed were observed on the wolf kills ... Bone gnawing as such is rare at kills but very common at dens and the "sleeping" places of canids that I have observed" (1981: 46, emphasis in original). Excavation area 7 is certainly not the location of a wolf den. This suggests that the evidence of canid activity in the assemblage is more probably the result of the action of domestic dogs present during the human occupation of the location, than of scavenging carnivores present after the human occupation.

Rodent gnawing is present on 38 fragments. Rodent activity is nearly always reported in plains faunal assemblages. This is interpreted as occurring at some point after human occupation of the site, and is most likely unrelated to the human occupation.

Cutmarks and other evidence of human modification of bone are present on a large number of specimens, and likely represent butchering and processing activities. Varying levels of burning are evident on more than 10% of the recovered fragments, and are interpreted to also result from intensive processing activities and disposal of faunal material in or near hearths. All elements, except the carpals and tarsals, appear to exhibit patterned breakage, which is discussed in detail below.

Skull

The best represented elements in the identified sample are the mandibles and maxillae; however, neither of the dentaries escaped the extensive breakage typical of the assemblage. Teeth, while numerous, are also highly fragmentary. It was noted by Brink et al., in their analysis of the faunal material from the Head-Smashed-In Buffalo Jump processing area, that "Teeth, although the hardest tissue in the body, are very brittle and tend to exfoliate when subjected to fluctuations in temperature" (Brink, et al. 1985: 166).

Mandibles are typically fractured behind the third molar or through the gonial angle, separating the bone into ascending and horizontal rami. This is a pattern seen at many bison kill sites, and may be associated with either the removal of the mandible to gain access to the tongue (Frison 1970b: 38), or the extraction of marrow from the body of the mandible (Zierhut 1967: 34-35). The coronoid process also is often fractured. This pattern of fracture is also recorded at a number of bison kill and processing sites. Frison attributes the fracture of the coronoid process and the zygomatic arch to the removal of the mandible via a number of "direct, sharp blows ... to the temporal condyles" with a "reasonably heavy but blunt-pointed hammerstone" (Frison 1970b: 35); however, the fracture of this relatively fragile process could also result from trampling.

The maxillae and incisives are two of the best represented elements in the sample. The maxillae are somewhat fragmentary, generally fractured into separate sides and separated from the other bones of the snout. Surprisingly, other bones of the snout, including the ethmoid and the sphenoid, are also relatively well represented, despite their fragility. The only identified fragments of the posterior cranium present are the various processes, listed previously, and even these resilient portions are under-represented relative to snout elements. The bones of the cranial vault, and especially the horn cores, are conspicuously absent.

This pattern of cranial representation is counter to that described by Binford for carnivore ravaged crania. Binford notes that "Animals appear to begin gnawing from the nose inward, removing the face and finally collapsing the cranium, leaving the palate and occiput in two parts ... When the skull is eaten in the manner described, few skull fragments remain at the location of consumption; they appear to have been ingested" (Binford 1981:60). This pattern, based as it is on the general resilience of the portions of the cranium, is also to be expected from situations of mechanical and chemical weathering. It is of note that the preserved fragments of anterior cranial elements in the sample exhibit evidence of neither carnivore activity, nor exceptional weathering.

The pattern of differential representation of the cranial elements is interpreted as an effect of human activity. The presence of fragmentary elements of the anterior cranium may be associated with the roasting or boiling of the snout, as recorded historically and ethnographically for both the Blackfoot and Plains Cree (Wissler 1910:

41; Harmon 1911:287; Frison 1970b: 38) or for the extraction of bone grease or soup. One of Kidd's Blackfoot informants said that the "head, cut and pounded to pieces" could be made into a soup (Kidd 1986: 108). The contrasting absence of the posterior portion of the cranium, the bones of the cranial vault, cannot be attributed to differential preservation. A possible human activity which may result in this pattern is that the cranial vault was removed, intact, for the transport of the brain to another location, either to be eaten, or for use in hide tanning (Wissler 1910: 41, 64; Harmon 1911: 287; Zierhut 1967: 36).

Vertebral Column and Pelvis

The vertebral column and pelvis, while present in the sample, are generally under represented. It may be of note that the sample includes many nearly complete vertebrae with unfused epiphyses. The epiphyses of the vertebral column fuse to the vertebral bodies during the seventh year from the anterior to the posterior (Duffield 1973: 133). At least four animals under the age of six years, one of them a calf and another a yearling, were indicated by the sample of mandibles, in contrast to at least five mature animals. The apparent over representation of unfused vertebrae may therefore be a result of differential treatment of one or more immature, but fully-grown, animals.

The lumbar vertebrae are better represented than the thoracic or cervical vertebrae. The spinous and transverse processes of the vertebrae have typically been removed, and are present only as small fragments. The pelvis is under represented and fragmentary. The os coxae are represented only by fragments, and the sacral and caudal vertebrae are nearly absent.

This pattern of absence and fragmentation is not interpreted as a result of carnivore activity or general preservation. The fragments present are generally well preserved and do not exhibit evidence of extensive carnivore activity. The pattern again contrasts with that of scavenged assemblages, in which the vertebral column is generally well represented at kill-sites (Binford 1981: 222-223). The under representation of these elements is therefore interpreted as a result of human activity.

The fracture and under representation of the spinous processes of the thoracic vertebrae are likely related to the removal of the hump or "boss ribs", as recorded by Wissler (1910: 41) and Harmon (1911: 287). Wissler also notes that "the back bone was cut into two pieces" (1910: 41), which may explain the differential representation of the thoracic and lumbar vertebrae. Harmon does not record the selection of the spine for transport (Harmon 1911: 287). The general under representation of the vertebral column and pelvis may therefore be due to differential transport, either previous abandonment (i.e. at the kill-site), or transport out of the excavation area. This pattern may also be a result of differential treatment. The presence of some identifiable fragments, and one half of a split vertebra (26523, Plate 24), suggest the fragmentation of the vertebrae for the extraction of bone grease, as cited by Vehik (1977:170). Finally, the near absence of caudal vertebrae may be a result of their small size, or it may be due to their removal from the assemblage, attached to the hides of the bison.

Ribs and Sternum

Like the rest of the post-cranial axial skeleton, the ribs are generally poorly represented in the faunal sample. The majority of fragments identifiable as ribs are short pieces, approximately ten centimeters in length. The vertebral end of the ribs is somewhat over represented, relative to the body of the rib and the sternal end, which is nearly absent. The patterned fracture of the ribs approximately ten centimeters from the vertebral end is consistent with the removal of the rib cage, both as a butchering unit, and in order to access internal organs (Wissler 1910: 41; Harmon 1911: 287; Frison 1970b: 31). The fracture of the ribs into short segments may also be related to the production of bone grease (Zierhut 1967: 35; Vehik 1977: 170). The absence of the sternal ends of the ribs, the costal cartilage, and the sternum, is probably due to the removal of the brisket, a primary and preferred cut of meat, to another site (Wissler 1910:41; Harmon 1911:287; Frison 1970b: 31-32; Frison 1974: 45).

Proximal Limb Elements

The shafts of all long bones, including the humerus, radio-ulna, femur, tibia, and metapodials, are nearly entirely fractured into small fragments. Some fragments exhibit flake scars on opposing internal surfaces of the shaft. Examples are presented in Plate 25. These scars and the pattern of fracture are consistent with the controlled fracture of long bones in order to extract marrow, probably using bipolar percussion with a hammerstone and anvil. The use of bipolar percussion in order to access marrow in caribou long bones was recorded by Binford among the Nunamiut (1981: 157-158). Binford also reported flake scars on the internal surfaces of diaphyses resulting from 'marrow-cracking' (1981: 163). Zierhut (1967: 35) recorded bone breaking with an axe among the Calling Lake Cree . Wissler (1910: 41) reports that "The marrow from the leg bones was usually eaten raw during the butchering" by the Blackfoot.

As discussed above, the articular ends of the long bones of the limbs express a pattern of absence consistent with a situation of patterned destruction of softer portions. Binford (1981: 217) recorded a similar pattern among carnivore ravaged assemblages. In situations of carnivore gnawing, he noted that the softer articular portions of bones were entirely destroyed, ingested, and thereby deleted from the assemblage (Binford 1981:60). In the identified sample from Area 7, evidence of carnivore activity was limited to a small number of bone fragments, and the articular portions of long bones were in fact present, but in such a fragmentary condition as to be mostly unidentifiable. This suggests a mode of destruction other than carnivore activity. Combined with evidence of bipolar bone breaking, and the presence of features and artifacts suggesting bone grease production, I would argue that the patterned under-representation of softer articular ends is a result of bone grease production, rather than non-cultural taphonomic processes. Harmon (1911: 282) describes the destruction and boiling of the articular ends of bones for the production of 'marrow fat', and Vehik notes that in some accounts of bone grease extraction, the size of fragments was “similar to that of finger-nails” (Vehik 1977:171).

The irregular bones of the proximal portions of the limbs, specifically the scapula and ulna, also exhibit extensive fragmentation. The patterned under representation of these elements is most likely a result of this fragmentation, and the unidentifiable nature of the majority of the fragments. The possibility of patterned absence, particularly of the scapula, being a result of other activity must also be considered. Wissler records that

"The fore-quarters were removed by cutting down through the shoulder joints" (Wissler 1910:41). It is unclear whether this indicates separation of the scapula and distal elements from the thorax, or separation of the scapula from the humerus. While I hesitate to make archaeological inferences on the basis of personal experience, the separation of the forelimb, including the scapula, from the thorax, is significantly easier to accomplish than separation of the actual 'shoulder joint', which is attached by a substantial amount of tough connective tissue. It is therefore probable that the scapula was introduced to the assemblage with the more distal elements of the forelimb. Binford (1981:42-43) notes that the scapula is one of the earliest elements disarticulated at scavenged assemblages, and that 'carnivore ravaging' of the scapula generally proceeds from the blade to the glenoid fossa (Binford 1981:69-70). While these processes may contribute to the under representation of this element, the general absence of evidence of extensive gnawing and the pattern of fragmentation are more suggestive of human fragmentation for bone grease production.

A number of long bone fragments exhibit variable degrees of polish, wear, chipping, flaking and battering along fractured edges and points created at the junctions of fractures, beyond that exhibited on the majority of bones. The exceptional nature of this modification, and the absence of associated carnivore or rodent gnawing strongly suggest a human origin for this modification. Frison and others (Frison 1970a, 1970b, 1974, 1982b; Johnson 1982; Wheat 1982) have suggested that this modification results from the manufacture and use of expedient bone choppers from long bone epiphyses, such as the proximal tibia and distal radius. Binford, however, has proposed alternative origins for the observed chipping, flaking and battering. He observed that the Nunamiut sometimes tapped the broken ends of long bones on anvils "so that the marrow will pop out", and that this "may result in "retouch" on the apex of the bayonet break" (Binford 1981:153). He also cites ethnographic examples of similar tapping and chipping associated with marrow extraction from the Near East and Patagonia (Binford 1981:163). At this point, marrow extraction seems the more likely explanation for this specific pattern of modification (chipping and battering on apices) on some of the fragments, although it is notable that Wissler reports that "the bone of the fore leg was often used as a club to break smaller bones and joints" (Wissler 1910:42). There is also extensive wear and polish exhibited on some fragments, which it is difficult to ascribe to repeated and enthusiastic licking by dogs or wolves, as suggested by Binford (1981:55). Faunal tools will be discussed further below.

Distal Limb Elements

Metapodials are discussed with long bones, above. The carpals, tarsals, and phalanges present are generally unmodified and well preserved. It is of note that a small number of tarsals are the only elements in the assemblage recovered in articulation. Differential representation in this case is most probably attributed to deletion from the assemblage either through early abandonment of the distal portion of the limbs, as recorded by Wissler (1910: 41), or the loss or misidentification of smaller elements.

Of note is the presence of a number of proximal and intermediate phalanges subjected to modification similar to that of long bones, above. A number of phalanges have been split longitudinally into superior and inferior portions, others have had a hole punched through the superior surface into the small marrow cavity. These elements are presented in Plate 26. The lack of other evidence of gnawing on these elements suggests that this pattern is not a result of carnivore scavenging, as reported by Binford (1981: 45). A similar pattern of fracture, in antelope phalanges, is recorded at the Lost Terrace site, an Avonlea Phase winter occupation in Montana (Davis et al. 2000: 62). Davis et al. interpret this pattern of fracture of the relatively small, and minimally nutritious, phalanges as "reflecting thorough processing to extract nutrients" (Davis et al. 2000:62), possibly as a result of "severe subsistence stress" (Davis et al. 2000: 64). Vehik (1977: 170) also lists the "foot bones" as one of the most often cited sources of bone grease, however it is unclear whether this indicates the phalanges, metapodials, or carpals and tarsals.

4.7.3.2. Non-Bison

The entire assemblage was inspected for identifiable non-bison bone. These specimens were identified on the basis of comparison to specimens in the University of Alberta Department of Anthropology zooarchaeological comparative collection. Elements from a number of mammal and bird species, as well as a single fish bone, and fragments of mollusc shell, were identified, and are summarized in Table 26 in Appendix II.

Mammal

Elements from at least three canids are present at the site. The larger are believed to represent large domestic dogs or wolves, while the smaller represent either a fox, or a small dog. None of these elements exhibited readily apparent evidence of cultural modification, although canid elements from nearby excavation areas do.

Canid elements are present in nearly every bison kill or processing assemblage, and are commonly interpreted as representing domestic dogs; however, canid remains are rarely subjected to the extensive analysis granted to bison. Kroszer (1991) posited that canid remains in bison kill and processing sites may represent domestic dogs that were accidentally entangled in jumping or pounding activities, or domestic dogs or scavenging wild canids that were killed when they became a nuisance during butchering activity.

While the hunting of scavenging animals is reported, ethnographic accounts of bison pounding activity note that domestic dogs were regularly muzzled and restrained, often by tethering them to a stump or log, during bison pounds in order to prevent them from interfering in and possibly spoiling, the hunt. It is presumable that if dogs might become a nuisance, they would have remained tethered during processing activities. The presence of evidence of canid metapodial bead manufacture in other excavation areas in Lease 10-32 (Plate 27) also suggests that canids may be included in the assemblage as a result of more patterned and organized behavior. It is possible that domestic dogs and scavenging wild canids might be conveniently killed and processed for meat and bone bead blanks while their owners are already engaged in butchery and animal product processing activities. Wissler states that the Blackfoot and other northern plains tribes had a "special antipathy toward" dogflesh (Wissler 1910: 44), but also notes the ceremonial consumption of dog among the Gros Ventre, Piegan and possibly the Blackfoot (1910: 44). Kidd's informants' statements varied significantly on the issue. In addition to ceremonial consumption, one stated that "dogs were eaten ... as a change from buffalo meat", another that "they were resorted to when "hard up"; however a third "declared that "not even the Crazy Dogs would eat dog" and implied it was a reprehensible Cree custom" (Kidd 1986: 104). Of course, a distaste for dog meat certainly doesn't preclude its consumption, and Kidd concluded "dog-eating to be more firmly established than is generally supposed" (1986: 104).

The remaining identifiable mammal elements all belong to various rodent species. Included in the rodent assemblage are the ubiquitous Richardson's ground squirrel, the thirteen-lined ground squirrel, and a probable vole. A number of rodent elements exhibit possible signs of burning, and some were recovered in association with hearth features. While there is no reason to exclude Richardson's ground squirrel from a list of possible food species, evidence is here inconclusive, and rodent remains are generally assumed to be intrusive.

Bird

A number of avian species are also represented in the assemblage. Although none of the avian elements present in the assemblage exhibit obvious evidence of cultural modification, most are interpreted as representing probable prey species.

On the basis of size differences, duck elements are interpreted as being from two individuals, one slightly smaller, and the other slightly larger, than comparative mallard specimens in the University of Alberta collection. A single element was identified as probably representing a grouse. There is little ethnographic information regarding the role of various birds in the diet of Northern Plains people; however, ducks and geese, and their eggs, are known to have been a preferred food (Kidd 1986:103).

Three bones compared favourably with corvid specimens. These may represent a single individual, probably a crow or magpie. The inclusion of this individual in the assemblage may be due to chance, or the hunting of scavengers attracted to the bison processing activity.

Two raptors have been identified in the assemblage. A number of elements, including a number of sequential vertebrae and proximal portions of both humeri, have been identified as belonging to a large hawk. These specimens were similar in size to a red-tailed hawk and a rough legged hawk in the comparative collection. The presence of a large number of elements, and the apparently patterned breakage of both humeri are suggestive of an anthropogenic cause for the inclusion of this bird in the assemblage. This could again be attributed to the hunting of scavenging animals. Hawk, bobcat and badger remains identified at the Ruby Bison Pound, Wyoming, were similarly interpreted as representing hunted scavengers (Frison 1971: 82). A single element, an unfused vertebra centrum, compared very favorably to a bald eagle in the University of Alberta Department of Anthropology comparative collection, but was somewhat larger. This element is therefore believed to be from either a bald eagle or golden eagle. As a single element, its inclusion in the assemblage is unexplainable. It is worth noting, however, that eagle elements have been identified in other assemblages from the Bodo site complex (Christie Grekul, personal communication 2005). The hunting of eagles is recorded by Wissler (1910:40) and is associated with ritual activity.

Fish

The assemblage contains a single fish vertebra, believed to be that of a relatively large pike. The vertebral foramen appears to have been artificially enlarged. This bone may have been introduced into the assemblage as a bead. The consumption of fish apparently varied between tribes and clans, and possibly with circumstances. Sources state that the "Blackfoot never ate fish" (Kidd 1986: 107); however, one of Kidd's informants stated that "a clan of Bloods called the Fish-eaters ... are said to be very fond of fish" (Kidd 1986: 107).

Mollusc

Seven fragments of mollusc shell, probably belonging to large freshwater clams, are included in the assemblage, and presented in Plate 28. One of these fragments is a complete shell bead, several others exhibit evidence of grooving and drilling associated with bead manufacture. These specimens are interpreted as having been introduced into the assemblage as bead-making material. Similar shell fragments and beads have been recovered from a number of Late Pre-Contact sites on the Canadian prairies. Kidd notes that "Clam shells were in common use for the eating of soups" (Kidd 1986: 117), so the fragments may also have been introduced as utensils.

4.7.3.3. Faunal Tools

The faunal assemblage includes a number of bone fragments that exhibit evidence of modification and utilization. A summary of bone tool metric and non-metric traits is available in Table 27, in Appendix II. Pictures of bone tools and other modified bone fragments are presented in Plates 29-33.

Perforators / Awls

There are two bone perforators or awls. Both are approximately 80 mm long, 8 mm wide, and 4 mm thick. The first (17501, Plate 29d) appears to be manufactured from a fortuitously broken splinter of cortical bone, most likely bison long bone. The narrow end of this bone appears to have been sharpened. The tool exhibits limited use-wear, and appears to have been lost or discarded shortly after its creation. The second awl (45903, Plate 29c) appears to have been in use much longer. It is manufactured from an unidentified long bone fragment, possibly a bird bone. The awl appears to have been manufactured on a blank produced by parallel grooving. The pointed tip of the awl has been shaved or whittled. The tool exhibits extensive prehensile and use polish over its entire surface, as well as numerous longitudinal and oblique scratches. A third piece (32953, Plate 29a and b) exhibits extensive prehensile wear and polish, and is believed to be the handle of a bone awl, however, determination of the actual nature of the tool is impossible without the distal portion.

Blunt Modified Pieces

One probable tool (33649, Plate 31d) has been fashioned from the vertebral end of a rib. The head of the rib appears to have served as the proximal end of the tool, while the body of the rib narrows down to a roughly cylindrical, blunt end. This tool may have served as a pressure flaker; however, the generality of the form, weathering, and canid gnawing, make any determination difficult.

Three other tool fragments (23005; 64222; 40904, Plate 31a-c) have been fashioned on fragments of cortical bone from either ribs or long bones. These tools feature rounded, blunt ends, similar to the rib head tool above. These may represent fragments of bone pressure flakers, as above, or may be fragments of tools like those discussed below.

Spatulate Modified Pieces

Ten bone tools have been manufactured on fragments of ribs, and feature variably square to pointed, rounded to spatulate, working ends. These tools also feature variable amounts of wear and polish. These all appear to be variations on a broad class of tool, interpreted as an expedient butchering and processing implements. These tools are believed to have served in the stripping of flesh from bones, the separation of muscles, and the extraction of marrow from long bone cavities. Longitudinal and oblique scratches on the surfaces of some of the better-preserved specimens would be consistent with the scraping and scooping of marrow from long bones with inserting and twisting motions. These tools and tool fragments are presented in Plates 30 and 32.

Modified Long Bone Fragments

A number of long bone fragments exhibit variable degrees of polish, wear, flaking, chipping and battering along fractured edges and points created at the junctions of fractures. These artifacts have been discussed under taphonomy but are mentioned here because it is impossible to exclude the possibility of tool manufacture and use being their origin. Similar artifacts have been interpreted as expedient bone choppers, scrapers and fleshers at a number of bison kill sites (Frison 1970, 1974, 1982b; Johnson 1982; Wheat 1982). Elements that appear to exhibit the strongest evidence for use as butchering tools include the proximal tibia and distal radius. Examples of these fragments are presented in Plate 33.

5. Chronology

5.1. Stratigraphy

The instability of the stratigraphic environment typifying the Bodo Sand Hills has been discussed above, and is one of the major obstacles in the construction of the archaeological history of the area. Excavation Area 7 is no exception to this instability. Only two occupational levels appear to be present in the excavation area, and of these only one is present in an apparently intact paleosol. Within Excavation Area 7, the only statement that can be made regarding the relative ages of the two occupation levels, based upon the law of superposition, is that the upper occupation material was deposited on the site after the lower occupation material. The absence of an intact paleosol, and the significant weathering of faunal material in the upper occupation, suggest that this material is in secondary context, and the true age of the occupation, relative to the lower occupation, is therefore indeterminate.

5.2. Diagnostic Artifacts

Two classes of artifact are generally interpreted as being temporally diagnostic on the Northern Plains, projectile points and pottery. Fortunately, both of these artifact classes are present in the Excavation Area 7 assemblage. Unfortunately, these diagnostic artifacts can only be firmly associated with the lower occupation, rendering the relationship between the lower and upper occupations still indeterminate.

The projectile point sample from Area 7 is consistent with the Cayley Series of late pre-contact small side-notched points, as defined by Peck and Ives (2001). The ceramic sample is consistent with both the Saskatchewan Basin Late Variant defined by Byrne (1973) and Ethridge Ware (Walde and Meyer 2003). Both of these diagnostic artifact classes associate the lower occupation of Area 7 with the Late Pre-Contact Period, specifically the Old Women's Phase. This is the terminal pre-contact archaeological manifestation in much of the Northern Plains region, following which the appearance of European trade goods marks the horizon of the Proto-Contact and Post-Contact periods. Absolute dating at other archaeological sites bearing Old Women's components have provided a range from ca. 1250 B.P. to ca. 250 B.P. for this phase.

5.3. Radiocarbon Dating

The large amount, and relatively good preservation, of faunal material in the lower occupation was amenable to obtaining a suite of radiocarbon dates. Funding was available for six conventional radiocarbon dates. In order to obtain as accurate a date as possible for the main occupation and associated living floor, samples were selected in association with features. Features 3 and 4 were selected because of the availability of large, well-preserved bone fragments surrounding both, and the relatively great stratigraphic depth of the deposits in those two areas. A set of three samples was selected for each, one above the feature, one below the feature, and one from the living floor adjacent to the feature. It was hoped that bracketing the occupation level in this manner would provide an idea of the overall time depth of the occupation, rather than pinpoint the age of a specific feature.

The first set of samples centered on Feature 4, a hearth in the northeast corner of the excavation area, around 203.0 m N 104.5 m E. Sample RC-1 was a bison distal left humerus (62125), recovered from excavation level 3, the upper occupation, in subunit 203.0 N 104.0 E, above the feature. This sample was significantly more weathered than faunal material in the lower excavation levels. Sample RC-2 consisted of a number of cortical bone fragments (62428, 62429, 62431,62438) and a bison distal right metatarsal (62418), collected from excavation level 5, below the hearth feature, also in subunit 203.0 N 104.0 E. Sample RC-3 was a bison distal right humerus, collected from excavation level 5, in subunit 202.5 N 104.5 E, adjacent to the hearth feature. Both this specimen, and the metatarsal portion in RC-2 exhibited cutmarks, making their association with human activity relatively secure.

The second set of samples centered on Feature 3, the hearth in the southwestern corner of the excavation unit, centered about 201.5 m N 101.5 m E. Sample RC-4 consisted of a number of cortical bone fragments (10454-10459, 10462-10464, 10466-10516) recovered from excavation level 4, the "upper hearth and hearth" (catalog notes), in subunit 201.0 N 101.5 E. Sample RC-5 also consisted of a number of cortical bone fragments (11282, 11295-11299, 11301-11313) recovered from excavation level 5, the "hearth and below" (catalog notes), in subunit 201.0 N 101.5 E. Sample RC-6 consisted of a number of cortical bone fragments (30189, 30198-30201) and a large bison right tibia shaft fragment (30179), collected from excavation level 4, on the living floor associated with the hearth, in subunit 200.0 N 102.0 E.

A summary of the results of the radiocarbon assays, including corrected and calibrated ages provided by the laboratory, is presented in Table 13. Due to fluctuations in the radiocarbon calibration curve in recent periods, the dates from Area 7 all have multiple calibrated intercepts. Intercepts, and the 95% confidence interval for each date are presented in Table 14. All of the samples from the lower occupation level overlap completely at the 95% confidence interval. The radiocarbon dates indicate that the activities that resulted in the formation of the lower occupation level occurred sometime between ca. 1650 and the modern era. It is tantalizingly suggestive that the five dates from the lower occupation appear to be distributed according to stratigraphy, with the upper sample slightly younger and the lower samples slightly older, than the samples from the living floor; however, the variation is minimal, the entire range being subsumed within two standard deviations.

Sample Number	RC-1	RC-2	RC-3	RC-4	RC-5	RC-6
Brock Laboratory Sample Number	BGS 2553	BGS 2554	BGS 2555	BGS 2556	BGS 2557	BGS 2558
Calculated age (yrs BP)	245 ± 35	137 ± 35	20 ± 35	65 ± 35	133 ± 35	60 ± 40
C12/13 Isotope correction	-19.34‰	-20.89‰	-15.33‰	-20.86‰	-20.93‰	-18.84‰
Corrected age (yrs BP)	335 ± 35	203 ± 35	175 ± 35	131 ± 35	198 ± 35	159 ± 40
Calibrated age (yrs BP)	370 ± 35	200 ± 35	120 ± 35	130 ± 35	200 ± 35	150 ± 40

Table 13: Summary of radiocarbon assays. Calibrated ages after Stuiver et al. 1998.

Sample	Stratigraphic Position	max age 2δ (intercepts) min age 2δ
RC-1	upper occupation	1453 (1520, 1587, 1625) 1647
RC-2	below feature	1644 (1667, 1782, 1794) 1948
RC-3	occupation level	1654 (1675, 1776, 1801, 1940, 1946) 1950
RC-4	above feature	1667 (1688, 1729, 1810, 1923, 1948) 1952
RC-5	below feature	1645 (1668, 1781, 1796) 1949
RC-6	occupation level	1656 (1679, 1740, 1753, 1756, 1804, 1935, 1947) 1951

Table 14: Calibrated age ranges obtained from intercepts, years AD. After Stuiver et al. 1998.

Sample RC-1, from the upper occupation, was dated as being significantly older than the samples from the lower occupation. This is contrary to normal expectations based on the law of superposition; however, the absence of an associated paleosol and the weathered state of the upper occupation faunal material are suggestive of a deposit in secondary context. This date is therefore interpreted as being correct, and being a result of the complex depositional environment of the Bodo sand hill complex, rather than contamination or sampling error. It is suspected that the faunal material in the upper occupation represents the remains of an older occupation, similar in character to the main occupation in Area 7. This older occupation deposit was likely located upslope to the northeast, was destabilized at some point in the last 2 centuries, and redeposited atop the younger main occupation. This period of exposure would account for the more weathered appearance of the upper faunal material. The lithic and ceramic artifacts recovered from the upper occupation level may be associated with the redeposited faunal material; however, on the basis of excavation in other areas of the Bodo site complex, the author's experience is that dense lithic and ceramic artifacts exposed in blowouts tend to remain more or less in place, but lose their original context as the paleosol and less dense faunal material is removed or weathered into oblivion. The lithic and ceramic artifacts are therefore more likely intrusive from the lower occupation, redeposited by various disturbance processes, including rodent burrowing and frost heave.

6. Conclusions

The goals of this investigation were to answer a number of basic archaeological questions: (1) Who occupied this area? (2) What did they do here? (3) When were they here? (4) Where did they focus their activity, and where might associated occupations be? (5) Why did the occupants choose this site?

6.1. Who?

The first of these questions, regarding who occupied the site, can be broken down into a number of constituent questions:

With what archaeological phase is this occupation associated?

Can this occupation be related to a historic ethnic group?

What was the size and makeup of the group or groups that occupied the site?

Archaeological Phase

Archaeological phases on the Northern Plains are largely defined and identified on the basis of two diagnostic artifact types: projectile points and pottery. The artifact assemblage recovered from excavation Area 7 included both of these diagnostic materials. Fragments of 25 projectile points were recovered from the main occupation. They were all small, irregularly flaked, triangular, side-notched arrow points. The analysis of a suite of metric and non-metric attributes showed that the point assemblage is consistent with the Cayley Series of projectile points, as defined by Peck (1996) and Peck and Ives (2001). This series of projectile points was extant on the plains of Alberta from ca. AD 700 to 1780, and is associated with the Old Women's Phase.

The pottery assemblage included more than 800 pottery fragments, from at least two vessels. One of the vessels exhibited no attributes of paste, manufacture, morphology, or surface characteristics that would enable its classification into a ceramic ware, but by its very presence indicated that the assemblage was associated with one of the ceramic bearing phases of the Northern Plains. Sherds of the second vessel exhibited characteristics of paste, manufacture, morphology, and decoration characteristic of Saskatchewan Basin: Late Variant pottery, and Ethridge Ware. These ceramics were present on the Northwestern Plains from ca. AD 500 to 1780, and are associated with the Avonlea and Old Women's Phases.

Ethnic Association

On the basis of the presence of both Cayley Series points, and Ethridge Ware pottery, the occupation at Area 7 can be firmly associated with the Old Women's Phase. This is the terminal pre-contact archaeological phase on much of the Northern Plains, existing until the rapid adoption of European trade goods over the 18th century. Late Old Women's Phase archaeological material is distributed across the Northwestern Plains, from approximately the North Saskatchewan River to the Missouri Couteu or Missouri River, and from the foothills of the Rocky Mountains to the sandhills and prairies of western Saskatchewan. The people inhabiting this region at the time of the earliest European fur trade expeditions onto the plains were referred to by the European explorers' Cree guides as *ayahcidiniw*, transcribed by many of the explorers as Archithinue, and meaning stranger (Meyer and Russell 2004: 247). This word is later glossed as Blackfoot, slave, enemy, and stranger (Meyer and Russell 2004: 247). It is generally believed that these earliest historic accounts of 'Archithinue natives' refer to the Blackfoot, or Siksika, people. It is notable that the distribution of the late Old Women's Phase very closely approximates the historic range of the so-called Blackfoot Confederacy including the Peigan, Blood and Blackfoot proper, and their sometime allies, the Sarsi and Gros Ventre (Magne et al. 1987). The Blackfoot proper occupied the northeastern-most portion of this range, in which the Bodo sand hills are located. The very late Pre-Contact occupation in Area 7 is therefore interpreted as being associated with the Late Pre-Contact ancestors of the historic and modern Blackfoot people.

Demography

The size and composition of the group or groups that occupied Area 7 is impossible to determine with any certainty; however, the ethnographic and historic record of Blackfoot social organization and their seasonal round suggests that people spent the majority of the year dispersed in extended family or multifamily bands (Peck 2000; Kidd 1986). Communal hunting involved the organized labour of all members of a multifamily band, or a congregation of bands (Kidd 1986: 98-99), but the post-kill processing, like most activity, appears to have been organized around the family unit. Initial butchering was primarily the responsibility of the men (Kidd 1986: 100; Wissler 1910: 41); however, Wissler states that "When game was killed near the camp, the women took a hand in the butchering" (Wissler 1910:41). Final processing of animal products, including meat, fat, and hides, appears to have been primarily the responsibility of women. Wissler states that "when the meat was brought home it became at once the property of the women" (Wissler 1986:41), and Kidd states "all the labour performed within the camp was done by the women" including the preparation of pemmican, hide tanning, and cooking (Kidd 1986: 43). Children were primarily educated by the same-sex parent, and could be expected to have assisted in the duties of the parent during periods of intense activity. Kidd specifically mentions that boys were "taught the art of making [arrows]" and "the cutting up of the buffalo was demonstrated as opportunity offered" (Kidd 1986: 38), and that girls "learned how to tan hides, cut moccasins and dresses ... slice, dry and pack meat, make pemmican", etc. (Kidd 1986: 41-43). Otherwise, children were "free to do as they liked for a great part of the time" (Kidd 1986:38). The activities represented by artifactual material at Area 7 therefore probably represent the coordinated labour of an entire family group, or groups.

6.2. What?

Bison Processing

Evidence for a great number of activities is present in the assemblage from Area 7. The primary activity appears to have been the butchery and processing of bison. The extensive disarticulation, and differential element representation of bison remains in the excavation area suggest that bison were not introduced to the excavation area as complete carcasses, and that Area 7 is therefore not part of the actual kill-site. Both Wissler and Harmon describe the primary butchering of bison for transportation to a base camp or processing area (Wissler 1910: 41; Harmon 1911: 287). While the two accounts differ in some details, in both cases primary butchering at the kill site involved the skinning of the animal and the separation of the carcass into a number of large portions. The major portions include the four limbs, the sides of ribs (in one section according to Harmon, two according to Wissler), the loins (Harmon's "sinews on each side of the backbone"; Wissler's "back fat") probably including the 'depuyer' or *depouille*, the brisket, the "croup" or rump, and the hump or "boss ribs" (Harmon's "backbone"). A number of organs were also collected. Both Harmon and Wissler agree that the tongue, heart, paunch (rumen) and small intestines (Harmon's "some part of the entrails") were taken. Harmon also lists the liver and head. Wissler includes the brain and sometimes "some of the head meat". Wissler's description also states that "the back bone was cut into two pieces", and that "the parts of the loin containing the kidneys", "a chunk of meat ... from the neck", and "sometimes the hoofs" were retained (Wissler 1910: 41). Harmon's account appears to describe a more selective pattern of transportation, in which the pelvis and vertebrae were abandoned at the kill-site. The pattern of disarticulation and element representation at Area 7 is suggestive of a situation in which this primary, "heavy butchering" (Wissler 1910: 41) occurred elsewhere, and portions were selectively transported to Area 7 for more complete secondary butchering and processing. The presence of some pelvic and vertebral elements suggests that in some cases transportation was more selective, and in others more complete. The absence of the sternum and sternebrae, the majority of the thoracic spines, and the cranial vault suggest that the richest portions, and possibly the brain, were removed to another location for further processing.

Secondary butchering activity is represented in the assemblage by cutmarks and other modification of bones, as well as by the presence of a large number of lithic tools, including edge modified and retouched pieces, and bifacial tabular knives, as well as debitage associated with the manufacture and maintenance of these tools. Wissler states that "The marrow from the leg bones was usually eaten raw during the butchering" (1910:41), and bison long bones in the assemblage exhibit a pattern of midshaft breakage consistent with marrow extraction. The presence of hammerstone fragments and large stones exhibiting evidence of use as anvils are also consistent with bone breaking for marrow during secondary butchering. A number of spatulate bone tools also may be related to secondary butchery and marrow extraction activities.

Another major activity that likely occurred at Area 7 is the processing of bone for the production of bone grease. Bone grease production is briefly described by Harmon (1911: 282) and by Kidd (1986: 111), and involved the fracturing of the articular ends of long bones, which were then boiled with heated stones, either in pits lined with a fresh hide, or in a hide or paunch suspended upon sticks (Kidd 1986: 106; Wissler 1910: 27).

The presence of a prepared hearth in close proximity to a pit feature, a large amount of exhausted thermally altered stone, and hammers and anvils are all suggestive of this activity. While concerns over the interpretation of bone grease production on the basis of these features and tools, which could also be associated with simple cooking activities, have been raised by some investigators (Brink et al. 1985: 179), the presence of a large amount of extremely fragmented bone, including the articular ends of long bones, and the patterned nature of this fragmentation support the interpretation of bone grease production at Area 7, at least for some of the bison carcass portions introduced to the location.

The final stage in the processing of bison products, cooking, may also be represented at Area 7. The aforementioned hearths were likely also associated with cooking activity during the butchery process, probably including the roasting of marrow bones prior to cracking, spit-roasting and stone boiling. The numerous pottery fragments, which were reconstructed to form a 3.7 L vessel containing residue derived from a large herbivore, are suggestive of the preparation of soups, as described by Kidd (1986: 108). Kidd states that the "rump made the most highly esteemed soup; but the head, cut and pounded to pieces, the bones, or dried stomach could also be used" (Kidd 1986: 108). The large number of bison anterior cranial fragments may be related to the cooking of head soup.

Other Camp Activities

There is also evidence for a large number of peripheral camp activities at Area 7. The large amount of chipped-stone lithic debitage and broken and abandoned tools indicate a number of episodes of lithic reduction. Fragment size-class distributions, and cortex presence ratios indicated that the majority of the lithic reduction undertaken at the site involved relatively late-stage tool manufacture and maintenance. Complete assemblage tool complexity, as indicated by the ratio of tool flake scars to mass, fell into the range of one dorsal flake scar per gram, identified by Magne (1985) as representing a generalized or typical occupation. This ratio is, however, skewed by the presence of a number of projectile points, a relatively complex tool type. Many of these points may have been introduced to the assemblage embedded in bison primary butchery units, although projectile points may also have functioned as cutting implements. Excluding the projectile points, the tool assemblage is significantly less complex, consisting primarily of simple retouched pieces and bifacial tabular knives of silicified wood and silicified peat. Lithic reduction on-site appears to center on the manufacture and maintenance of expedient tools needed for the processing of bison. There is evidence of the differential use of a variety of lithic materials, with fine-grained materials apparently imported to the site as prepared cores, bifaces or tools and undergoing significant curation and recycling, while coarse, locally available materials appear to have undergone earlier-stage reduction on-site, and were discarded earlier in their use-life.

There is circumstantial evidence for the hunting and processing of migratory game birds, as well as a possible grouse. Elements from a probable crow and a hawk, and a possible eagle bone, may represent the hunting of scavenging birds, independent hunting activity peripheral to the primary occupation, or may not be associated with the occupation. The presence of numerous limb elements from at least three canids likely represents the convenient butchering of domestic dogs, probably for food, and the processing of canid metapodial elements for the manufacture of bone beads. The aversion to dog meat reported by a number of Kidd's informants, who either flatly denied its consumption outside ritual situations, or referred to it as an emergency food (Kidd 1986: 104) suggests that the presence of butchered dogs may be a sign of resource stress. One of Kidd's informants, however, simply stated that "dogs were eaten also as a change from buffalo meat" (1986: 104), which may indicate that dog meat was much more commonly eaten than generally presumed.

While none of the canid metapodial elements recovered from Area 7 directly exhibited evidence of bone bead manufacture, such beads and bead blanks were recovered from other excavation areas on Lease 10-32, within one hundred meters of excavation Area 7. Mollusc shell beads and bead blanks were recovered in Area 7, along with probable graving tools. These factors suggest that bead manufacture, both from bone and shell, was likely a peripheral activity. Similarly, the presence of bone awls and lithic endscrapers may indicate some hide working activity. The presence of numerous fragments of at least two ceramic vessels, the availability of clay in the local area, and the large amount of disintegrated granite similar to that incorporated in the paste the vessels as temper, suggests the possibility of pottery manufacture. Finally, the presence of a relatively large number of lithic wedges, or pièces esquillées, is unexplained. These tools have been interpreted as wedges for the splitting of wood or bone, but are the subject of extended debate. They may be related to the bone processing activities referred to above, or may represent wood working activities of some sort, along with the numerous endscrapers. Unfortunately, no wooden artifacts were recovered, though the presence of wooden stakes, spits, drying racks, shelter frames, etc. is probable.

Summary

The occupation is consistent with intense bison processing and peripheral camp activities. Killing and primary butchering appear to have occurred elsewhere, with butchered units transported to this location for secondary butchery and bone processing. Finished meat, fat, organ and possibly hide products appear to have been transported away from this location. It is impossible to determine where associated kill and camp sites might be, though based on the representation of nearly all elements, it is suggested that the associated kill-site is relatively nearby, or more selective transportation would be expected. Spatial relationships will be discussed further below.

6.3. When?

There are a number of aspects to the question of when the site was occupied, including:

During which historical period was this location occupied?

At what time of year did people occupy this location?

How long, and how frequent, were the occupation episodes?

Historical Period

The association of the diagnostic artifacts recovered from the lower occupation with the Old Women's Phase provides an initial range of approximately A.D. 800 to 1780. This spans the period from the appearance of the Cayley Series of projectile points, to their complete replacement by metal points and firearms in the late eighteenth to early nineteenth century. In order to narrow this temporal range, a number of samples of bison bone were submitted for radiocarbon assay. The samples were selected with the intent of determining the maximum temporal range of the occupation by selecting samples from the top, middle and bottom of the stratigraphic profile in the vicinity of two hearth features. One of these samples, from the upper occupation level, dated from the late fifteenth to early seventeenth century. On the basis of this date, and the context of the material, the upper occupation was interpreted to be a scatter of redeposited older material, from an area slightly upslope to the northeast. The five radiocarbon dates from the main, lower occupation all overlapped completely at two standard deviations, dating from the late seventeenth century to the modern period. On the basis of these dates, and the absence of any fur-trade era materials of European origin, the occupation is interpreted to most probably date from ca. A.D. 1650 to 1780. The first voyages of European travelers, associated with the fur trade, through this area occur in the later decades of this range. Burpee's reconstruction of Anthony Henday's voyage to the plains in 1754-1755 has him passing just south of the Bodo sand hills (Burpee 1907). It is appealing to imagine that the people who inhabited this site might have interacted with these early voyagers, and be recorded in their journals.

Seasonality

There is a significant amount of direct and circumstantial evidence for the seasonality of the occupation at Area 7, some of it apparently contradictory. The first evidence comes in the form of the presence of the remains of a number of migratory birds, including ducks, a probable crow, and a hawk, all of which are present in the Alberta plains from approximately March to November (Kavanagh 1991). While none of these materials exhibit direct evidence of human modification, their inclusion in the assemblage is suggestive of an early spring to late autumn occupation. A second faunal source of seasonality evidence comes from the presence of neonatal bison elements, including a femur, humerus, and two sets of paired mandibles. These elements are estimated, on the basis of size and dental eruption sequences, to derive from at least two, one to two month old calves. Bison calving season extends, at the outside range, from roughly March to July, peaking from mid April to June (Peck 2001). This would place the death of these animals from April to September, probably late May through July. Both of these sources of relatively direct evidence suggest a late spring to early summer occupation.

Other, more circumstantial, sources of evidence are contradictory. Bone grease production is interpreted to have occurred at this location. This activity may have occurred year-round, but was most strongly associated with late fall and winter hunting (Vehik 1977: 170), when bones contained the most grease, cool weather slowed spoilage, and stores were needed for the lean periods of late winter. Brink et al. (1985) questioned the intensity of bone grease production at major summer and autumn mass kills, such as the Head-Smashed-In Buffalo Jump, where the processing of the vast amounts of meat would be a priority. The apparent intensity of this activity at Area 7 is therefore somewhat suggestive of a winter kill and processing event, when fewer animals were typically taken, cool weather allowed time for intense processing, and necessity may have demanded the maximum exploitation of scarce resources. The presence of a number of split and punched phalanges is similarly suggestive of a winter to early spring kill. This pattern of breakage was identified at a winter antelope kill in Montana (Davis et al. 2000), and attributed to resource stress. The presence of avian bone in the assemblage, though lacking definitive evidence of an anthropogenic origin, is also suggestive of a late winter to spring occupation. Fowl and fish are generally considered to be somewhat marginal foods in the Northern Plains diet, of greatest importance during the late spring, when the unpredictability of bison behaviour, the leanness of bison that were hunted, and difficulties in storage may have necessitated the exploitation of other meat resources (Smith 1988). While there is therefore relatively secure evidence for spring to summer occupation, circumstantial evidence is also suggestive of winter to late spring occupation.

The historic period during which the occupation of Area 7 is believed to have occurred, roughly AD 1650 to 1780, approximately coincides with the peak of the Little

Ice Age, a period of cooler and moister conditions. During this period, vegetation cover may have expanded, resulting in increased stabilization of the sedimentary environment and soil development. Seasonal and permanent bodies of water in the Bodo Sand Hills and surrounding region, including ponds, sloughs, and streams such as Eyehill Creek, would have increased in number, size and duration, providing increased access to aquatic resources such as waterfowl and fish. Winters may have been somewhat harsher, increasing the role of shelter for both bison and man, and increasing the need for wood for fire and the construction of shelters. Fortunately, the expansion of vegetation would have increased the availability of this resource in the Bodo Sand Hills.

Duration and Frequency

The activities undertaken at this location, focusing on bison processing, were typically relatively short-term; however, the extremely high density of artifactual material argues for a substantial overall occupation intensity. It is therefore suggested that the occupation deposit is the result of a number of short-term bison processing episodes, with some attendant peripheral camp activities. The large amount, and especially the diversity, of chipped stone debitage is particularly suggestive of multiple episodes of lithic reduction. The complete exhaustion of the majority of the thermally altered stone suggests significant reuse. The presence of three hearths in close proximity is also suggestive of multiple occupations. Finally, the presence of the remains of at least ten, but probably more, bison, and three dogs, in a $25m^2$ area, should all but exclude the possibility that all of this activity was simultaneous or continuous. The apparently inconsistent seasonality indications, and the variable intensity of bison processing may therefore be explained by multiple short-term occupations during different seasons, with different resource priorities. The apparent stratification of radiocarbon dates, and their overall similarity, suggests that these multiple occupation episodes must have occurred over a relatively short historic period, in the range of decades.

Summary

The main occupation in excavation Area 7 is interpreted as representing multiple overlapping short-term occupation episodes. These episodes may have occurred during different seasons, ranging from late winter to mid-summer, and therefore have had different resource priorities. All of the occupations, however, appear to have focused on bison processing and associated camp activities. All of these occupations would have occurred within a multi-decadal period, but may have occurred over the course of only a few seasons, at some point from the late seventeenth to late eighteenth century. This would place the occupation period within the Little Ice Age, during which temperatures would have been somewhat cooler, and precipitation somewhat greater than the modern climate. This would have resulted in a period of soil stability and development. The environment around the Bodo Sand Hills during this climatic period would have included vegetation similar to that of the modern period, though possibly somewhat more extensive, and may have included more extensive seasonal or permanent wetlands.

6.4. Where?

Spatial relationships are of interest at a number of scales, from the organization of activities within the occupation area, to the relationships between occupation areas, to the role of the entire site complex in the region.

Area 7

The identification of spatial patterns of activity within an excavation area of only 25m^2, in a depositional environment subject to significant disturbance by rodents and frost heave, must be approached with caution. Fortunately, the distribution of two well-defined ceramic scatters indicates that the deposit has maintained some horizontal integrity. On the basis of the distribution of various artifact types, and the locations of features, a number of distinct activity areas are apparent.

The majority of the assemblage appears to be associated with a major activity area in the northwest third of the excavation area, extending into the center. Activity Area 1 includes Features 1 and 2, the prepared hearth and pit feature in the northwest corner. It also includes the scatter of cord-roughened potsherds, which were reconstructed into a fairly typical Ethridge Ware vessel. This area includes the largest concentration of lithic debitage, with high proportions of Swan River Chert, silicified peat, and silicified wood, and a concentration of white chalcedony not present in other parts of the excavation area, as well as the less well-defined central debitage concentration. Many lithic tools were found in this area, included a large number of projectile points, and many retouched pieces and bifaces. A number of faunal tools were also recovered from this activity area, including a number of spatulate tools or gouges, and both of the bone awls. This activity area also appears to include the majority of the fragmented bison bone and exhausted thermally altered stone, scattered to the east of the hearth and pit features. The surrounding areas to the south and east are typified by a predominance of larger, more complete bones and larger fragments of thermally altered stone. Excavation records also consistently report the most well-defined living floor in this area. Activity in this area appears to have focused on bison secondary butchery and bone processing, possibly with some attendant hide working.

There appears to be a similar, but less dense and well-defined activity area in the southwestern and south-central part of Area 7, possibly including Feature 3, the hearth at 201.5 m N 101.5 m E. The minor southwestern concentration of lithic debitage, with a large amount of silicified wood, surrounds the hearth. Lithic tools in the area include retouched pieces, bifaces and a few points. There is little thermally altered stone in the southwest corner, but more along the southern edge of the excavation area. There also appears to be an increased concentration of faunal material along the southern margin. The center of the southern wall of the excavation area is also the location of the scatter of smoothed potsherds. This concentration of potsherds, faunal material, and thermally altered stone may be associated with Feature 3, or it may represent the northern edge of an unexcavated activity area, similar in character to that in the northwest corner.

A third distinct activity area appears to center on Feature 4, the hearth located at 203.0 m N 204.5 m E. This area contains a minor concentration of fragmented faunal material, thermally altered stone, and chipped stone debitage. The concentration of lithic debitage includes large amounts of Swan River Chert, silicified peat, and silicified wood; however, rather than a minor constituent, other lithic materials comprise approximately half the total. Siltstone, various cherts, and a jasper-like material are present in the northeast corner in very significant amounts. The tool assemblage from this area also differs significantly from the typical scatter. The majority of the endscrapers were recovered from this area, as well as a number of wedges, and all of the anvils. These tools may indicate that activities other than bison processing played a greater role in this occupation episode, possibly including the working of hides or wood. It may also be of note that the living floor in this area was reported as being less defined, with large pieces of faunal material appearing both above and below the main occupation.

These vaguely defined, apparently overlapping activity areas would be consistent with the interpretation of this occupation as an overlapping series of relatively short-term bison processing events. Bison killed nearby would have been subjected to primary or heavy butchering at the kill-site, and the major butchering units brought to Area 7 for secondary butchering and processing. This likely falls into one of two patterns:

In the case of a medium to large mass kill, such as a pound or ambush, Area 7 might represent a temporarily occupied processing location near, or adjacent, to the kill-site. Primary butchery would have occurred within the pound or ambush location, with butchered units transported out of the kill-site for further processing. The signs of multiple occupations would therefore represent multiple uses of the pound or ambush location. These multiple uses might have occurred over the course of a single year, from winter to summer, but more likely represent repeated use of the pound or ambush location over a number of years, whether subsequent or separated by some span of time. Variability in processing intensity might result from differential selection of carcasses on the basis of age, sex or condition, from differences in resource priorities based on season of occupation or idiosyncratic conditions such as weather or the state of provision reserves.

In the case of smaller kills, either small winter pounds or ambushes, or perhaps solitary stalking, Area 7 would likely represent a processing location associated with a camp-site. Bison primary butchering units would have been transported some distance to the camp for secondary butchery and processing. Therefore, the primary determinants of differential bison carcass processing intensity would have been the distance between the kill-site and camp-site, and the availability of labour for transport, though the conditions listed above would also have been considered.

At the scale of the excavation, and given the depositional context, determining which of these situations, or what mix of them, is represented by the artifact assemblage, is effectively impossible.

Lease 10-32

Relating the occupation at excavation Area 7 to the cultural deposits encountered in other areas of Lease 10-32 is difficult. None of these other assemblages has been fully analyzed, and no absolute dates are available for any of them; however, excavation and initial reporting (Gibson 2001) has identified Area 5, approximately 75 m northwest of Area 7 as a thick, dense bed of bison bone. Bone is also eroding out of the base of a dune along the north edge of the lease, and appears to be continuous with the intact deposit in Area 5. Initial interpretations suggest that this may represent a kill-site with attendant primary butchery activity. Excavation Area 5 produced a number of projectile points consistent with the Cayley series, associating the occupation with the Old Women's

Phase. The state of preservation, with hair and viscera included in the bone bed, and the relatively shallow depth of the bone layer, suggest that the occupation is relatively recent. Unfortunately, the complex depositional environment precludes any attempts to associate this occupation with that at Area 7; however, as mentioned above, on the basis of evidence for heavy butchering, if Area 7 is associated with a major kill, it would be expected to be very nearby.

The other major excavation on Lease 10-32 was Area 3, a $5m^2$ block, approximately 60 m north of Area 7. Initial analysis of this area identified it as the butchery location of a single bison (Gibson 2001: 20). It is not clear whether this refers to primary or secondary butchery. In the latter case, Area 3 may represent a very similar occupation to Area 7. In the former situation, Area 3 may represent a primary butchery location, possibly associated with the Area 5 kill-site. Again, it is impossible to determine the association of this occupation with that of Areas 7 and 5, but it does appear consistent with the interpretation of a series of occupations over the entire lease, probably including kill, processing and camp occupations. Test excavations on the lease produced scattered evidence of bison processing and other camp activities, supporting this view.

Bodo Sand Hill Complex

Survey and excavation at other areas of the Bodo Bison Skulls site complex have identified similarly variable deposits, including apparent camp site living floors, kill sites, and processing sites, sometimes apparently overlying other occupations. The interpretation posited for Area 7 of Lease 10-32 can be expanded to the entire lease, and beyond, to the entire site complex. Relatively short-term occupations, varying broadly in terms of seasonality, activities, and resource priorities, overlie and abut one another, resulting in the dense and ubiquitous archaeological deposits that have been recorded throughout the entire sand hill complex.

6.5. Why?

The assemblage from Area 7 is comprised of material derived from the exploitation of a number of important resources, including bison, birds, wood and water. Analysis of the assemblage suggests that it represents multiple occupation episodes, possibly during a variety of seasons, with a variety of resource priorities. In all cases, bison was an important resource, and its exploitation is readily apparent. During summer months, water was of primary importance, both to human and bison populations. In addition to its use in cooking, evidence for the probable hunting of waterfowl suggests the exploitation of ephemeral or more permanent ponds, sloughs and wetlands in the region. In winter, the primary determinant resource was wood (Vickers and Peck: 2004), for efficient, clean and hot fire, the manufacture of pounds and other structures, and for the shelter that low tree-covered ground provides from winter storms. Evidence for winter occupation at Area 7 is more circumstantial than that for summer occupation, but suggests that the availability of wood and shelter, and bison drawn to that shelter, were of great importance.

Semi-stabilized sand dune environments, like the Bodo sand hills, are attractive because of the presence of a wide variety of microenvironments within a localized area. The complex and constantly shifting environment produces a variety of floral and faunal resources. The unstable and shifting nature of the area means that while individual resource concentrations, such as ponds, meadows, berry patches and wooded areas, are constantly shifting, similar environments are always present in the area. Additionally, the variety of resources present means that while one resource may fail, alternatives are available. This holds true whether discussing short-term, seasonal to multi-annual changes, or long-term, multi-decadal to centennial changes. The resources of primary importance to past human groups during the various seasons: water, wood, shelter, and edible plants and animals, are nearly always available in this complex microregion. It is this richness, variety and instability that has resulted in the patchwork of palimpsests that characterize the archaeological record of the Bodo sand hills. The richness and reliability of sand hill complexes like the Bodo hills was recognized by the Blackfoot in the identification of a similar complex as the location of paradise (Kidd 1986:181). The Sand Hills were a place "abounding in all sorts of game, and interspersed here and there with new tents, pitched in agreeable situations" where "The sun shone brighter, the weather was finer, the buffalo fatter and the lodges more comfortable" (Kidd 1986: 181-182).

7. Future Research:

Although this study has attempted to sufficiently document and analyze the artifactual assemblage from the study area, there is a great deal of investigation yet to be done.

Lithic Material

Detailed analysis of the lithic assemblage could follow a number of directions. Complete analysis of the debitage sample, focusing on individual fragment attributes, may provide a better understanding of the lithic reduction sequences and processes that occurred in the study area. A refitting study may be similarly productive, but extremely labour intensive. Minimum core analysis could be integrated into either of the previous analyses, or undertaken on its own, and might provide a better impression of the number of reduction and occupation episodes represented by the assemblage. These analytical methods may also provide an improved understanding of the organization of activities within the study area. Detailed lithic source analysis, based upon chemical, rather than visual, characteristics, might provide information regarding the relationship of the Bodo site complex to other sites in the region, and the range and trade relationships of its occupants.

The lithic tool assemblage is also ripe for continued study, including a more detailed typological analysis, technological analysis, microwear analysis and residue analysis. These various methods could improve the understanding of activities at the site, possible answering questions regarding some of the peripheral activities, including the possible working of wood, bone and hide.

Thermally altered stone is an historically neglected artifact class, and though some research has begun to focus upon it (Brink and Dawe 2003), there is still a great deal to be learned about the use of stone in cooking and processing animal products. The large quantity and high density of thermally altered stone in excavation Area 7 may be amenable to further analysis. The focus on granite and sandstone, rather than quartzite, and the presence of a number of pieces of limestone, some exhibiting evidence of thermal alteration, may be of particular interest.

Ceramic Material

It may be possible to further reconstruct the ceramic material in the assemblage. Details of manufacture and decoration should also be subjected to more intensive analysis and documentation, possibly more tightly delimiting the period of occupation, or contributing to the further development of pottery wares and styles in the Northern Plains region.

Faunal Material

The first priority in continued analysis of the faunal material from excavation Area 7 must be the complete identification and analysis of the full sample. Beyond this, complete documentation and analysis of all evidence of modification, including cutmarks, burning, and all evidence of other animal activity and environmental processes, would provide a better understanding of the taphonomy of the assemblage, including human activity. Chemical or isotopic analysis may also assist in this regard, and may clarify the nature of the assemblage, in terms of the number and character of occupation episodes (Widga 2004).

A complete enumeration and analysis of butcher marks, in particular, may help to determine the origin of some of the patterns of differential element representation exhibited by the analyzed faunal sample, and may also clarify some of the questions regarding Pre-Contact butchery patterns. More complete analysis of evidence of modification may also clarify some of the issues regarding the processing of bone, specifically which elements were subjected to intensive processing, the extent of that processing, and the exact process by which it was undertaken.

More detailed, and invasive, analysis of dental material could clarify some of the temporal issues. Complete eruption and wear documentation, of both mandibular and maxillary dentition, may answer questions regarding the number of occupation episodes represented by the assemblage, and the seasonality of those episodes. The examination of dental cementum increments in thin-sectioned teeth may provide evidence to corroborate, dispute, or clarify the eruption sequence information.

Non-bison faunal material may also be subject to more detailed microscopic analysis for evidence of human modification, which might better explain its presence in the assemblage, the role of various peripheral camp activities, and issues of seasonality.

The findings from excavation Area 7 also need to be more fully integrated into a regional and microregional history, and may help to clarify that history. In order to do this, assemblages from other areas of the Bodo site complex need to be fully documented and analyzed, and a better understanding of the Bodo sand hills microenvironment, its climate, ecology, sedimentology and stratigraphy, needs to be constructed. In terms of the analysis of artifact assemblages, hopefully some of the methods and models used in this study can be applied, so that the data sets will be comparable. A number of the research directions outlined above have already been undertaken by other researchers, and will hopefully clarify some of the issues that have not been dealt with satisfactorily in this study.

6. REFERENCES

Ahler, Stanley A.

1989a Mass Analysis of Flaking Debris: Studying the Forest Rather Than the Tree. In *Alternative Approaches to Lithic Analysis*, edited by Donald O. Henry and George H. Odell. Archaeological Papers No. 1. pp. 85-118. American Anthropological Association, Arlington.

1989b Experimental Knapping with KRF and Midcontinent Cherts: Overview and Applications. In *Experiments in Lithic Technology* edited by Daniel S. Amick & Raymond P. Mauldin, pp. 199-234. BAR International Series 528. British Archaeological Reports, Oxford.

Albright, Sylvia L.

1984 *Tahltan Ethnoarchaeology*. Publication Number 15. Department of Archaeology, Simon Fraser University, Burnaby.

Arthur, George W.

1975 *An Introduction to the Ecology of Early Historic Communal Bison Hunting among the Northern Plains Indians*. Mercury Series. Archaeological Survey of Canada Paper No. 37. National Museum of Man, Ottawa.

Bamforth, Douglas B.

1987 Historical Documents and Bison Ecology on the Great Plains. *Plains Anthropologist* 32: 1-16.

Beaudoin, Alwynne B.

2003 Climate and landscape of the last 2000 years in Alberta. In *Archaeology in Alberta: A View from the New Millennium*, edited by Jack W. Brink and John F. Dormaar, pp. 10-45. Archaeological Society of Alberta, Medecine Hat.

Binford, Lewis R.

1981 *Bones: Ancient Men and Modern Myths*. Academic Press, New York.

Binnema, Theodore

2004 *Common & Contested Ground: A Human and Environmental History of the Northwestern Plains*. University of Toronto Press, Toronto.

Brink, Jack, Milt Wright, Bob Dawe, and Doug Glaum

1985 *Final Report of the 1983 Season at Head-Smashed-In Buffalo Jump Alberta*. Manuscript Series No. 1. Archaeological Survey of Alberta, Edmonton.

Brink, Jack, and Bob Dawe

2003 Hot Rocks as Scarce Resources: The Use, Re-Use and Abandonment of Heating Stones at Head-Smashed-In Buffalo Jump. *Plains Anthropologist* 48: 85-105.

Brown, Christopher L. and Carl E. Gustafson
1979 *A Key to Postcranial Skeletal Remains of Cattle/Bison, Elk, and Horse.* Reports of Investigations No. 57. Laboratory of Anthropology, Washington State University, Pullman.

Burpee, Lawrence J. (editor)
1907 *York Factory to the Blackfeet Country: The Journal of Anthony Hendry, 1754-55.* Royal Society of Canada.

Byrne, William J.
1973 *The Archaeology and Prehistory of Southern Alberta as Reflected by Ceramics.* Mercury Series. Archaeological Survey of Canada Paper No. 14. National Museum of Man, Ottawa.

Campbell, Celina
1998 Late Holocene Lake Sedimentology and Climate Change in Southern Alberta, Canada. *Quaternary Research* 49: 96-101.

Campbell, Celina, Ian D. Campbell, and Edward H. Hogg
1994 Lake Area Variability Across A Climatic and Vegetational Transect in Southeastern Alberta. *Geographie physique et Quaternaire* 48(2): 207-212.

Campbell, I.D., and C. Campbell
2000 Late Holocene vegetation and fire history at the southern boreal forest margin in Alberta, Canada. *Palaeogeography, Palaeoclimatology, Palaeoecology* 164:263-280.

Campling, N.R.
1980 Identification of Swan River Chert. In *Directions in Manitoba Prehistory*, edited by Leo Pettipas, pp. 291-302. Association of Manitoba Archaeologists, Winnipeg.

Clayton, Lee, W.B. Bickley, Jr., and W.J. Stone
1970 Knife River Flint. *Plains Anthropologist* 15: 282-290.

Davis, Leslie B., John W. Fisher, Jr., Michael C. Wilson, Stephen A. Chomko and Richard E. Morlan
2000 Avonlea Phase Winter Fare at Lost Terrace, Upper Missouri River Valley of Montana: The Vertebrate Fauna. *Plains Anthropologist* Vol. 45, No. 174, Memoir 32, pp. 53-69.

Duffield, Lathel F.
1973 Aging and Sexing the Post-Cranial Skeleton of Bison. *Plains Anthropologist* 18: 132-139.

Duke, Philip G.
1981 *Systems Dynamics in Prehistoric Southern Alberta: 2000 B.P. to the Historic Period*, Doctoral Dissertation, University of Calgary.

Dyck, Ian G.
1970 Two Oxbow Settlement Types in Central Saskatchewan. *Na'pao: A Saskatchewan Anthropology Journal* 2(2): 1-29.

Ebert, James I.
1979 An Ethnoarchaeological Approach to reassessing the Meaning of Variability in Stone Tool Assemblages. In *Ethnoarchaeology: Implications of Ethnography for Archaeology*, edited by Carol Kramer, pp.59-74. Columbia University Press, New York.

Ferguson, Les
1996 South Dakota 'Knife River' flint. *Prehistoric American* 30(2): 11.

Foor, Thomas Allyn
1985 Archaeological Classification in the Northwestern Plains Region. *Plains Anthropologist* 30: 123-135.

Frison , George C.
1970a The Kobold Site, 24BH406: A Post-Altithermal Record of Buffalo-Jumping for the Northwestern Plains. *Plains Anthropologist* 15: 1-35.
1970b The Glenrock Buffalo Jump, 48CO304: Late Prehistoric Period Buffalo Procurement And Butchering. *Plains Anthropologist* Memoir 7, Vol. 15, No. 50, part 2.
1971 The Buffalo Pound in North-Western Plains Prehistory: Site 48 CA 302, Wyoming. *American Antiquity* 36(1): 77-91.
1974 Archaeology of the Casper Site. In *The Casper Site: A Hell Gap Bison Kill On The High Plains*, edited by George C. Frison. pp.1-112. Academic Press, New York.
1978 *Prehistoric Hunters of the High Plains*. Academic Press, New York.
1982a Bison Dentition Studies. In *The Agate Basin Site: A Record of the Paleoindian Occupation of the Northwestern High Plains*, edited by George C. Frison & Dennis J. Stanford, pp. 240-260. Academic Press, New York.
1982b Bone Butchering Tools in Archaeological Sites. *Canadian Journal of Anthropology* 2(2): 159-167.

Frison, George C., Michael Wilson and Diane J. Wilson
1976 Fossil Bison and Artifacts from an Early Altithermal Period Arroyo Trap in Wyoming. *American Antiquity* 41(1): 28-57.

Fritz, Sherilyn C., Emi Ito, Zicheng Yu, Kathleen R. Laird, and Daniel R. Engstrom
2000 Hydrologic Variation in the Northern Great Plains During the Last Two Millennia. *Quaternary Research* 53: 175-184.

Fuller, W.A.
1959 The Horns and Teeth as Indicators of Age in Bison. *Journal of Wildlife Management* 23(3): 342-344.

Gibson, Terrance H.
2001 *Permit 2000-116 - Management Summary of Archaeological Work Undertaken in the South Bodo Oilfield (FaOm-1) for Murphy Oil Company in 2000.* Report on File, Heritage Resource Management Branch, Alberta Community Development, Edmonton.

Goodyear, Albert C.
1993 Tool kit entropy and bipolar reduction: A study of interassemblage lithic variability among paleo-indian sites in the northeastern United States. *North American Archaeologist* 14(1): 1-23.

Grasby, Stephen E., Eugene M. Gryba and Ruth K. Bezys
2002 A Bedrock Source of Swan River Chert. *Plains Anthropologist* 47: 275-281.

Grove, Jean M., and Roy Switsur
1994 Glacial Geological Evidence for the Medieval Warm Period. *Climatic Change* 26: 143-169.

Harmon, Daniel Williams
1911 *A Journal of Voyages and Travels in the Interior of North America.* Courier Press, Toronto.

Hayden, Brian
1980 Confusion in the Bipolar World: Bashed Pebbles and Splintered Pieces. *Lithic Technology* 9(1): 2-7.

Hlady, Walter M.
1965 A Manitoba Source of "Knife River flint". *Manitoba Archaeological Newsletter* 2(2): 3-7.

Hogg, Edward H.
1994 Climate and the southern limit of the western Canadian boreal forest. *Canadian Journal of Forest Research* 24: 1835-1845.

Hu, Feng Sheng, Emi Ito, Thomas A. Brown, B. Brandon Curry and Daniel R. Engstrom
2001 Pronounced climatic variations in Alaska during the last two millennia. *Proceedings of the National Academy of Sciences* 98(19): 10552-10556.

Hulett, G.K., R.T. Coupland, and R.L. Dix
1966 The Vegetation of the Dune Sand Areas within the Grassland Region of Saskatchewan. *Canadian Journal of Botany* 44(10): 1307-1331.

Humphreys, James T.
1999 *Record in Stone: Familiar Projectile Points From Alberta.* 3rd edition. edited by Neil A. Mirau, James McMurchy and Carlton R. Stewart. Archaeological Society of Alberta, Lethbridge.

Johnson, Eileen
1982 Paleo-Indian Bone Expediency Tools: Lubbock Lake and Bonfire Shelter. *Canadian Journal of Anthropology* 2(2): 145-157.

Kavanagh, James
1991 *Nature Alberta: An Illustrated Guide to Common Plants and Animals.* Lone Pine, Edmonton.

Kehoe, Alice B.
1959 Ceramic Affiliations in the Northwestern Plains. *American Antiquity* 25:237-246.

Kehoe, Thomas F.
1966 The Small Side-Notched Point System of the Northern Plains. *American Antiquity* 31(6): 827-841.

Kidd, Kenneth E.
1986 *Blackfoot Ethnography.* Manuscript Series No. 8. Archaeological Survey of Alberta, Edmonton.

Krozser, Kit
1991 Canid Remains at Kill Sites: A Case Study from the Oldman River Dam Project. In *Archaeology in Alberta 1988 and 1989*, edited by Martin Magne, pp. 81-100. Occasional Paper No. 33. Archaeological Survey of Alberta, Edmonton.

Laird, Kathleen R., Sherilyn C. Fritz, Kirk A. Maasch, and Brian F. Cumming
1996 Greater drought intensity and frequency before AD 1200 in the Northern Great Plains, USA. *Nature* 384: 552-554.

Laird, Kathleen R., Sherilyn C. Fritz and Brian F. Cumming
1998 A diatom-based reconstruction of drought intensity, duration, and frequency from Moon Lake, North Dakota: a sub-decadal record of the last 2300 years. *Journal of Paleolimnology* 19: 161-179.

Le Blanc, Raymond
1992 Wedges, Pièces Esquillées, Bipolar Cores, and Other Things: An Alternative to Shott's View of Bipolar Industries. *North American Archaeologist* 13(1): 1-14.

Low, Bruce
1996 Swan River Chert. *Plains Anthropologist* 41: 165-174.

Luckman, B.H.
1988 Dating the Moraines and Recession of Athabasca and Dome Glaciers, Alberta, Canada. *Arctic and Alpine Research* 20(1): 40-54.
1994 Evidence for Climatic Conditions Between ca. 900-1300 A.D. in the Southern Canadian Rockies. *Climate Change* 26: 171-182.

Magne, Martin P.R.
1985 *Lithics and Livelihood: Stone tool technologies of central and southern interior British Columbia.* Archaeological Survey of Canada Paper No. 133. National Museum of Man, Ottawa.

Magne, Martin, and Contributors to the Saskatchewan-Alberta Dialogue
1987 Distributions of Native Groups in Western Canada, A.D. 1700 to A.D. 1850. In *Archaeology in Alberta 1986*, edited by Martin Magne, pp. 220-232. Occasional Paper No. 31. Archaeological Survey of Alberta, Edmonton.

Malainey, Mary E. and Barbara L. Sherriff
1996 Adjusting our Perceptions: Historical Evidence of Winter on the Plains of Western Canada. *Plains Anthropologist* 41: 333-357.

Meyer, David and Dale Russell
2004 "So Fine and Pleasant, Beyond Description": The Lands and Lives of the Pegogamaw Crees. *Plains Anthropologists* 49: 217-252.

Michlovic, Michael G.
1986 Cultural Evolutionism and Plains Archaeology. *Plains Anthropologist* 31: 207-218.

Moodie, D.W. and A.J. Ray
1976 Buffalo Migrations in the Canadian Plains. *Plains Anthropologist* 21: 45-52.

Morgan, R. Grace
1980 Bison Movement Patterns on the Canadian Plains: An Ecological Analysis. *Plains Anthropologist* 25(1): 143-160.

Mulloy, W.T.
1958 A Preliminary Historical Outline for the Northwestern Plains. *University of Wyoming Publications in Science* 22(1).

Natural Resources Canada
2005 Terrestrial Ecozones. Electronic Document, http://atlas.gc.ca/site/english/maps/environment/forest/forestcanada/terrestrialecozones/, accessed August 2005.

Niven, Laura B. and Matthew Glen Hill
1998 Season of Bison Mortality at Three Plains Archaic Kill Sites in Wyoming. *Plains Anthropologist* 43: 5-26.

Olsen, Stanley J.
1960 *Post-Cranial Skeletal Characters of Bison and Bos.* Papers of the Peabody Museum of American Archaeology and Ethnology Vol. 35, No. 4. Harvard University, Cambridge.

Peck, Trevor Richard
1996 *Late Side-Notched Projectile Points on the Northwestern Plains.* Unpublished MA Thesis, Department of Anthropology, University of Alberta, Edmonton.
2001 *Bison Ethology and Native Settlement Patterns During the Old Women's Phase on the Northwestern Plains.* Unpublished PhD Thesis, Department of Archaeology, University of Calgary, Calgary.

Peck, Trevor R. and John W. Ives
2001 Late Side-Notched Projectile Points in the Northern Plains. *Plains Anthropologist* 46: 163-193.

Pokotylo, David L., and Christopher C. Hanks
1989 Variability in Curated Lithic Technologies: An Ethnoarchaeological Case Study From the Mackenzie Basin, Northwest Territories, Canada. In *Experiments in Lithic Technology* edited by Daniel S. Amick & Raymond P. Mauldin, pp. 49-65. BAR International Series 528. British Archaeological Reports, Oxford.

Ranere, Anthony J.
1975 Toolmaking and Tool Use Among the Preceramic Peoples of Panama. In *Lithic Technology: Making and Using Stone Tools*, edited by Earl Swanson. World Anthropology, pp. 173-209. Mouton Publishers, the Hague.

Reeves, B.O.K.
1970 *Culture Change in the Northern Plains 1000 B.C. – A.D. 1000.* Unpublished Ph.D. dissertation, University of Calgary, Alberta.
1983 *Culture Change in the Northern Plains 1000 B.C. – A.D. 1000.* Occasional Paper No. 20. Archaeological Survey of Alberta, Edmonton.

Reher, Chales A.
1974 Population Study of the Casper Site Bison. In *The Casper Site: A Hell Gap Bison Kill on the High Plains*, edited by George C. Frison, pp.113-124. Academic Press, New York.

Roe, Frank Gilbert
1970 *The North American Buffalo: A Critical Study of the Species in Its Wild State.* University of Toronto Press, Toronto.

Shang, Y., and W.M. Last
1999 Mineralogy, Lithostratigraphy, and Inferred Geochemical History of North Ingebrit Lake, Saskatchewan. In *Holocene Climate and Environmental Change in the Palliser Triangle: A Geoscientific Context for Evaluating the Impact of Climate Change in the Southern Canadian Prairies*, edited by D.S. Lemmen and R.E. Vance, pp. 95-295. Geological Survey of Canada Bulletin 534. Geological Survey of Canada, Ottawa, ON.

Shott, Michael J.
1989 Bipolar Industries: Ethnographic Evidence and Archaeological Implications. *North American Achaeologist* 10: 1-24.
1999 On Bipolar Reduction and Splintered Pieces. *North American Archaeologist* 20(3): 217-238.

Smith, Brian J.
1988 An Ethnohistorical Evaluation of the Role of Bison and Fish in the Social Organization of Northern Plains and Parkland Native Society: 1790-1850. *Manitoba Archaeological Quaterly* 12(1): 13-25.

Strong, W.L. and K.R.Leggat
1992 *Ecoregions of Alberta.* Alberta Forestry Lands and Wildlife, Land Information Services Division, Edmonton.

Stuiver, M., P.J. Reimer, E. Bard, J.W. Beck, G.S. Burr, K.A. Hughen, B. Kromer, F.G. McCormac, J. v.d. Plicht, M. Spurk
1998 INTCAL98 radicoarbon age calibration, 24,000-0 cal BP. *Radiocarbon* 40(3): 1041-1083.

Todd, L.C.
2005 Bison Osteology. Electronic document. http://lamar.colostate.edu/~lctodd/bison.htm, accessed June 11, 2005.

Trigger, Bruce G.
1989 *A History of Archaeological Thought.* Cambridge University Press, Cambridge.

University of Wyoming Anthropology Department
2005 Virtual Bison. Electronic Document, http://www.uwyo.edu/RealLearning/bisonindex.html, accessed June 11, 2005.

Valero-Garces, Blas L., Kathleen R. Laird, Sherilyn C. Fritz, Kerry Kelts, Emi Ito and Eric C. Grimm.
1997 Holocene Climate in the Northern Great Plains Inferred from Sediment Stratigraphy, Stable Isotopes, Carbonate Geochemistry, Diatoms, and Pollen at Moon Lake, North Dakota. *Quaternary Research* 48: 359-369.

Vance, R.E., R.W. Mathewes, J.J. Clague
1992 7000 year record of lake-level change on the northern Great Plains: A high-resolution proxy of past climate. *Geology* 20: 879-882.

Vance, R.E., W.M. Last, and A.J. Smith
1997 Hydrologic and Climatic Implications of a Multidisciplinary Study of Late Holocene Sediments from Kenosee Lake, Southeastern Saskatchewan, Canada. *Journal of Paleolimnology* 18: 1-29.

Van Stempvoort, D.R., T.W.D. Edwards, M.S. Evans, and W.M. Last
1993 Paleohydrology and Paleoclimate Records in a Saline Prairie Lake Core: Mineral, Isotope and Organic Indicators. *Journal of Paleolimnology* 8:135-147.

Vehik, Susan C.
1977 Bone Fragments and Bone Grease Manufacturing: A Review of Their Archaeological Use and Potential. *Plains Anthropologist* 22: 169-182.

Vickers, J. Roderick
1994 Cultures of the Northwestern Plains: From the Boreal Forest Edge to Milk River. In *Plains Indians, A.D. 500-1500: The Archaeological Past of Historic Groups*, edited by Karl H. Schlesier. University of Oklahoma Press, Norman.

Vickers, J. Rod and Trevor Peck
2004 Islands in a Sea of Grass: The Significance of Wood in Winter Campsite Selection on the Northwestern Plains. In *Archaeology on the Edge: New Perspectives from the Northern Plains*, edited by Brian Kooyman and Jane H. Kelley, pp. 95-124. Canadian Archaeological Association Occasional Paper No. 4. Calgary University Press, Calgary.

Walde, Dale, and David Meyer
2003 Pre-contact pottery in Alberta: an overview. In *Archaeology in Alberta: A View from the New Millennium*, edited by Jack W. Brink and John F. Dormaar, pp. 10-45. Archaeological Society of Alberta, Medecine Hat.

Walde, Dale, David Meyer and Wendy Unfreed.
1995 The Late Period on the Canadian and Adjacent Plains. *Revista de Arqueologia Americana* 9:7-66.

Wedel, Waldo
1951 Notes on Aboriginal Pottery From Montana. *Journal of the Washington Academy of Sciences* 41(4): 130-138.

Wheat, Joe Ben
1982 Bone Technology at Jurgens, Olsen-Chubbock and Little Box Elder. *Canadian Journal of Anthropology* 2(2): 169-177.

Widga, Chris
2004 Early Archaeic Subsistence in the Central Plains: The Spring Creek (25FT31) Fauna. *Plains Anthropologist* 49: 25-58.

Wilson, Michael
1974 The Casper Local Fauna and Its Fossil Bison. In *The Casper Site: A Hell Gap Bison Kill on the High Plains*, edited by George C. Frison, pp. 125-172. Academic Press, New York.

Wissler, Clark
1910 *Material Culture of the Blackfoot Indians.* Anthropological Papers Vol. 5, Pt. 1. American Museum of Natural History, New York.

Zierhut, Norman W.
1967 Bone Breaking Activities of the Calling Lake Cree. *Alberta Anthropologist* 1(3): 33-36.

APPENDIX I: PLATES

Plate 1: Bodo Site Complex.

Plate 2: Lease 10-32 excavation areas. Map courtesy of Dr. Terry Gibson.

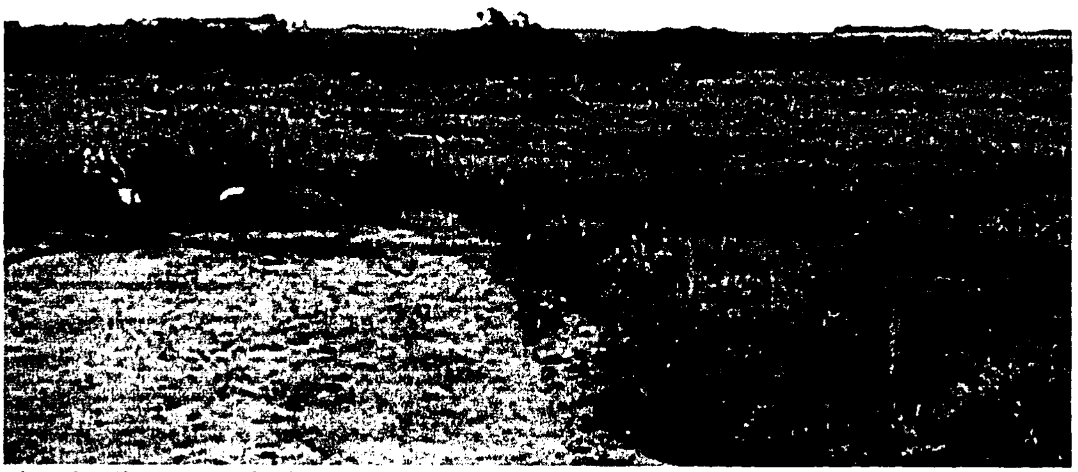


Plate 3: View to south along west edge of lease 10-32, past excavation Area 7. Photo courtesy of Dr. Terry Gibson.

Plate 4: View to north along west edge of lease 10-32. Photo courtesy of Dr. Terry Gibson.

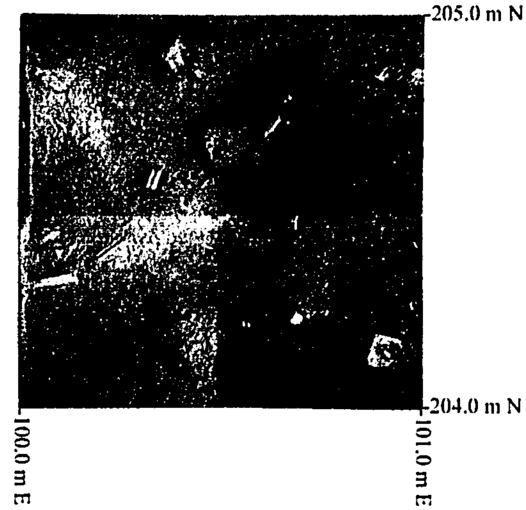


Plate 5: Feature 1, basin hearth.

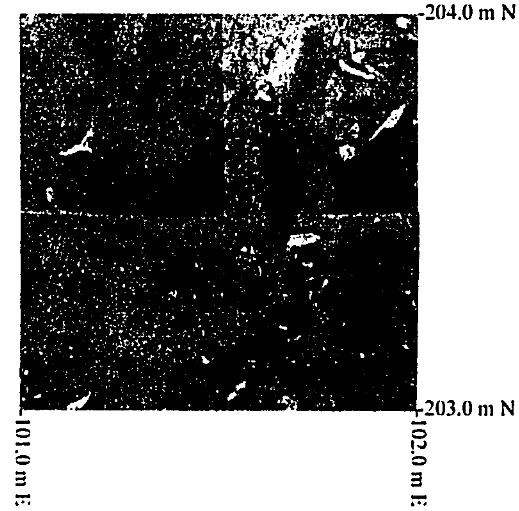


Plate 6: Feature 2, pit.

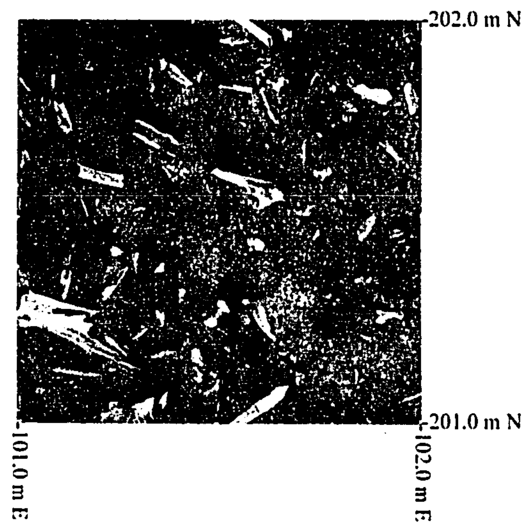


Plate 7: Feature 3, unprepared hearth.

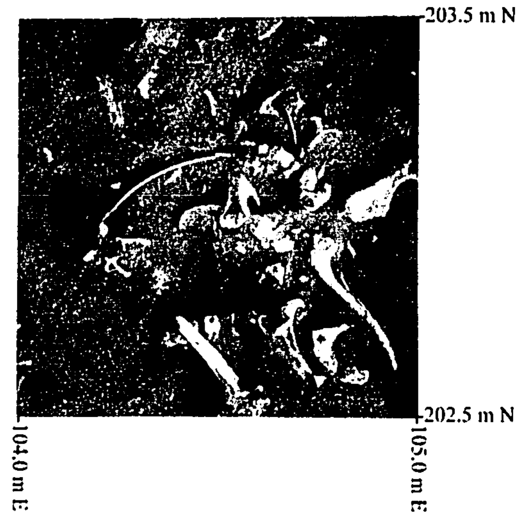


Plate 8: Feature 4, unprepared hearth.

Original photos courtesy of Dr. Terry Gibson.

Plate 9: Cores. a. 61069, b. 56751, c. 22939, d. 64396, e. 11169, f. 59727, g. 63894, h. 45906, i. 14716

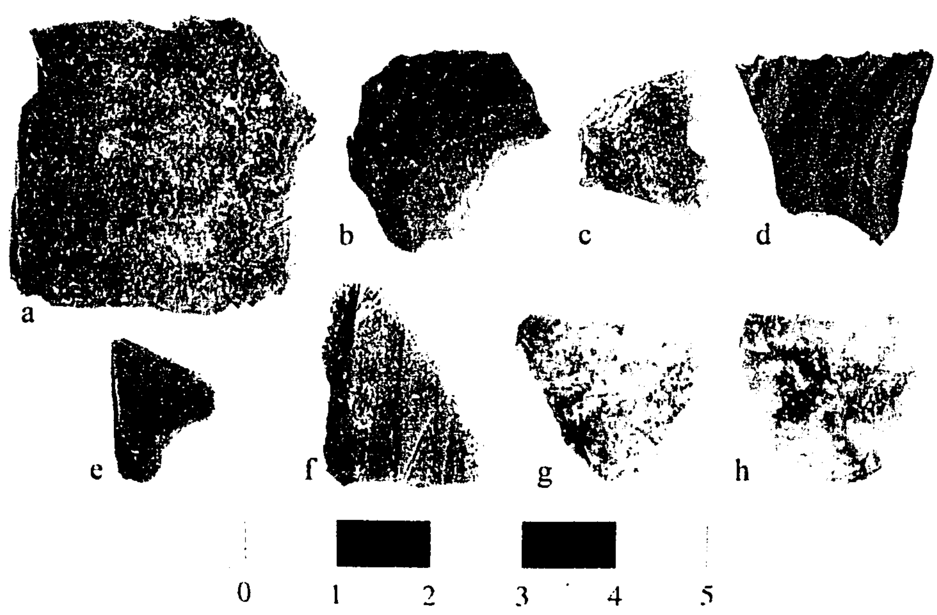


Plate 10: Edge modified pieces. a. 18375, b. 30156, c. 40076, d. 64548, e. 7657, f. 66079/66080, g. 36633, h. 58330

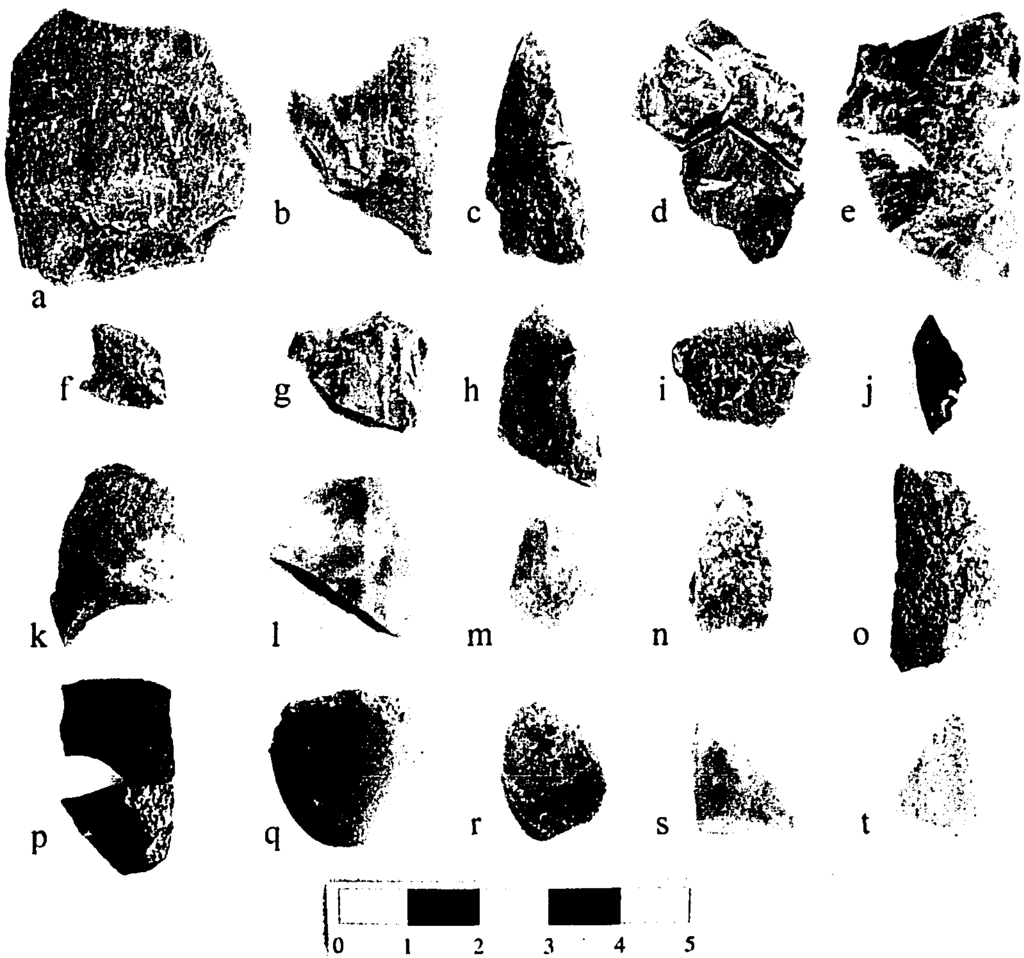


Plate 11: Retouched pieces. a. 64119, b. 30981, c. 11238/36634, d. 36636/48303, e. 61312, f. 40909, g. 24838, h. 65032/65150, i. 53271, j. 40906, k. 56750, l. 21704, m. 42617, n. 45918, o. 11497, p. 24844/49505, q. 65781, r. 46271, s. 56753, t. 43764

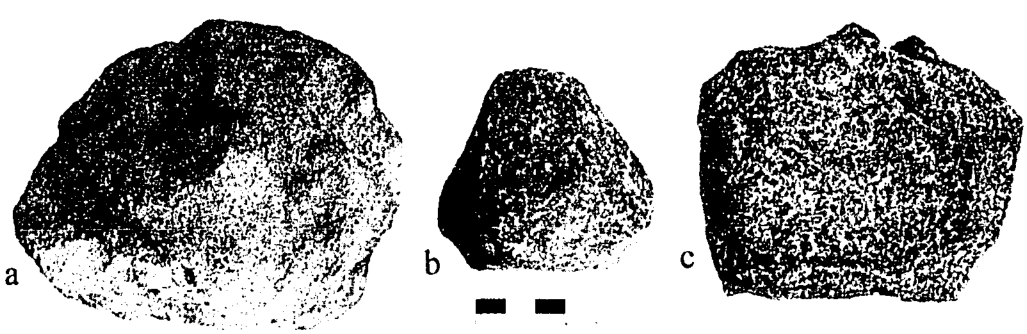


Plate 12: Choppers. a. 49120, b. 36676, c. 56762

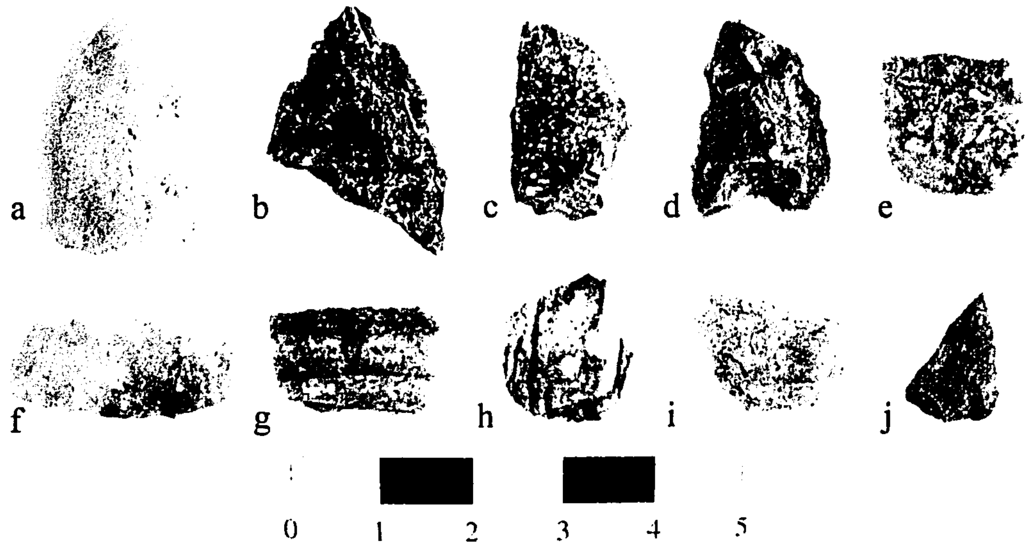


Plate 13: Bifaces. a. 59252, b. 10180, c. 63403, d. 61166, e. 48782, f. 53270, g. 58057, h. 43765, i. 8601, j. 48313

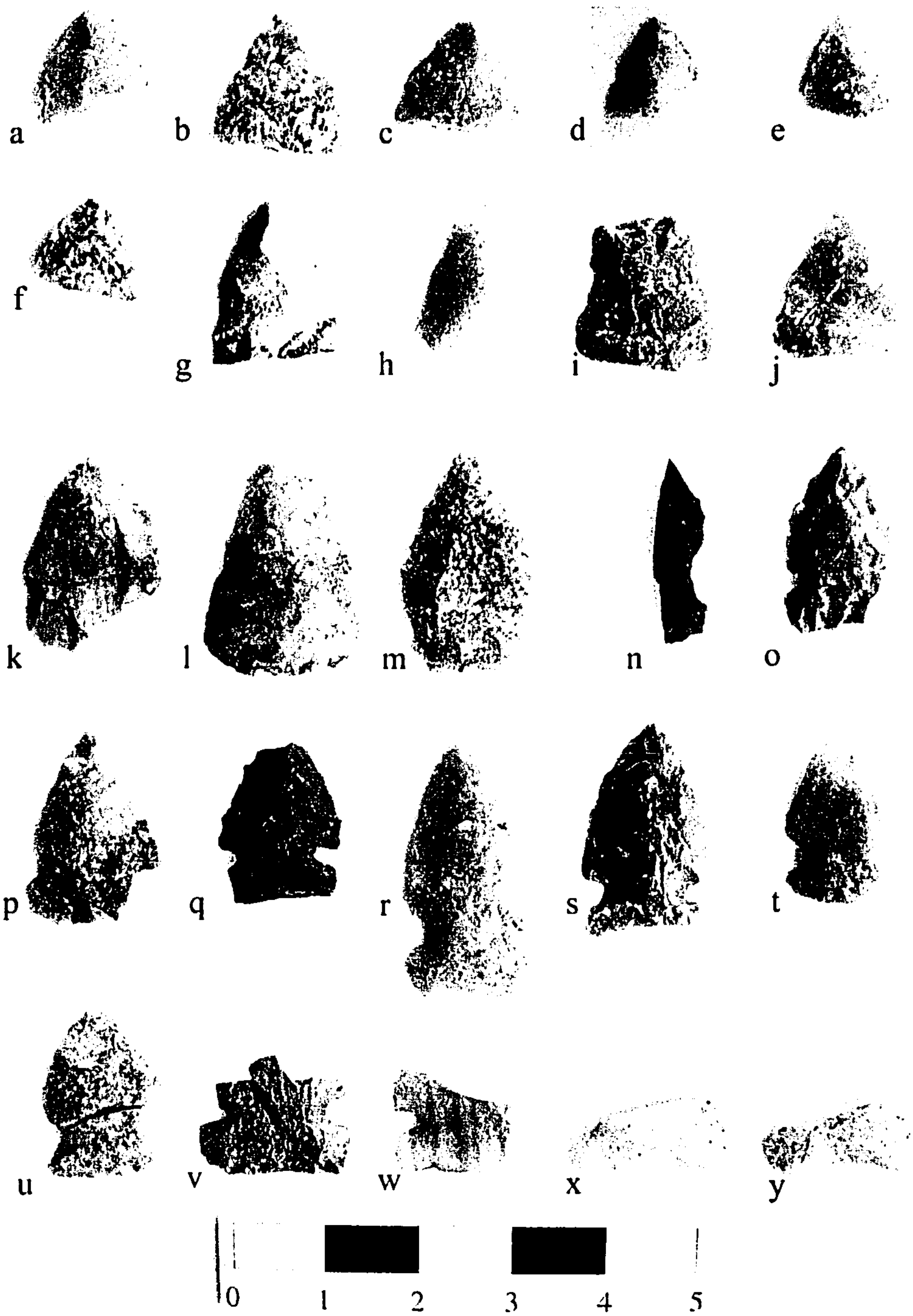


Plate 14: Projectile points. a. 7832, b. 7833, c. 40075, d. 40908, e. 46272, f. 48301, g. 27277, h. 43766, i. 20702, j. 49071, k. 44930, l. 32530, m. 30983, n. 22944, o. 60495, p. 17383, q. 48781, r. 18371, s. 61068, t. 11235, u. 48499/52406, v. 53269, w. 39348, x. 39347, y. 64596

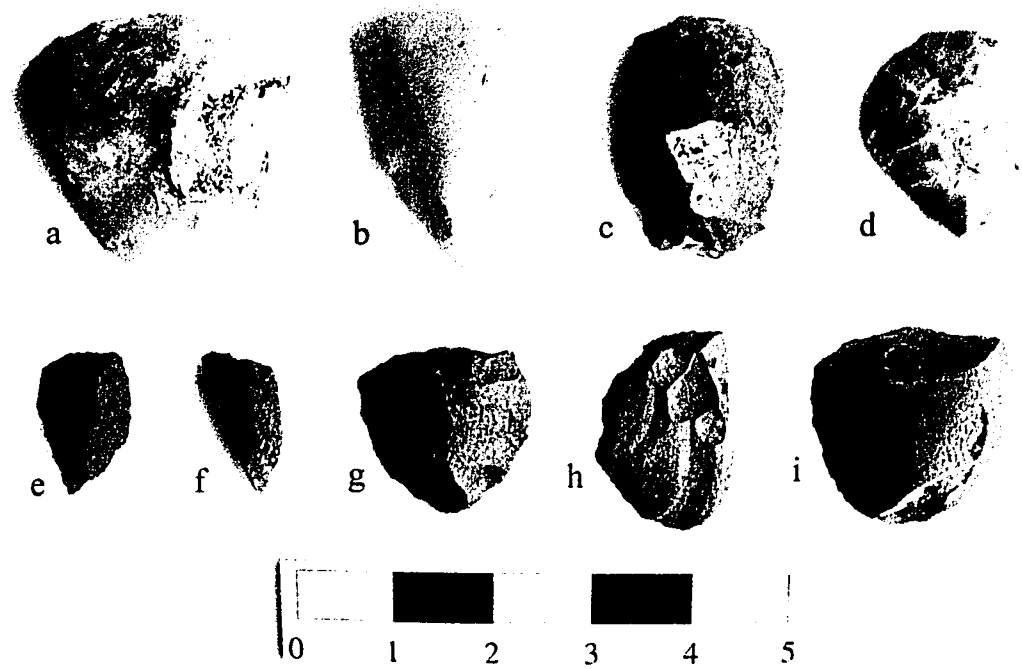


Plate 15: Unifaces. a. 37240, b. 48310, c. 42613, d. 62089, e. 67808, f. 64088, g. 66081, h. 62416, i. 18372

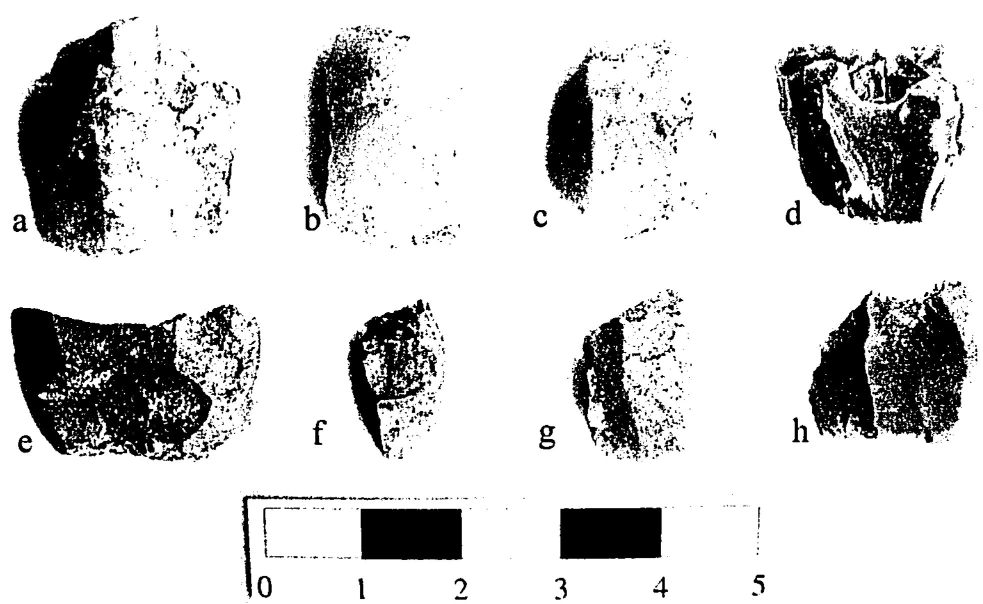


Plate 16: Wedges. a. 62194, b. 49180, c. 65639, d. 42619/43762/56752, e. 21703, f. 62095, g. 61070, h. 39349

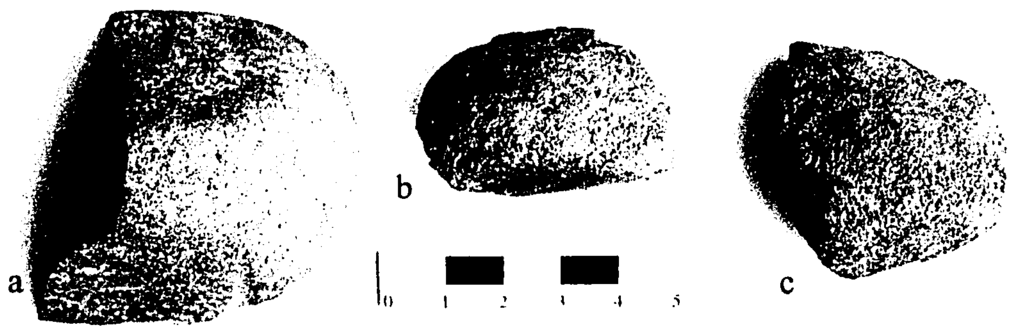


Plate 16: Hammerstone fragments. a. 59455, b. 25134, c. 34821

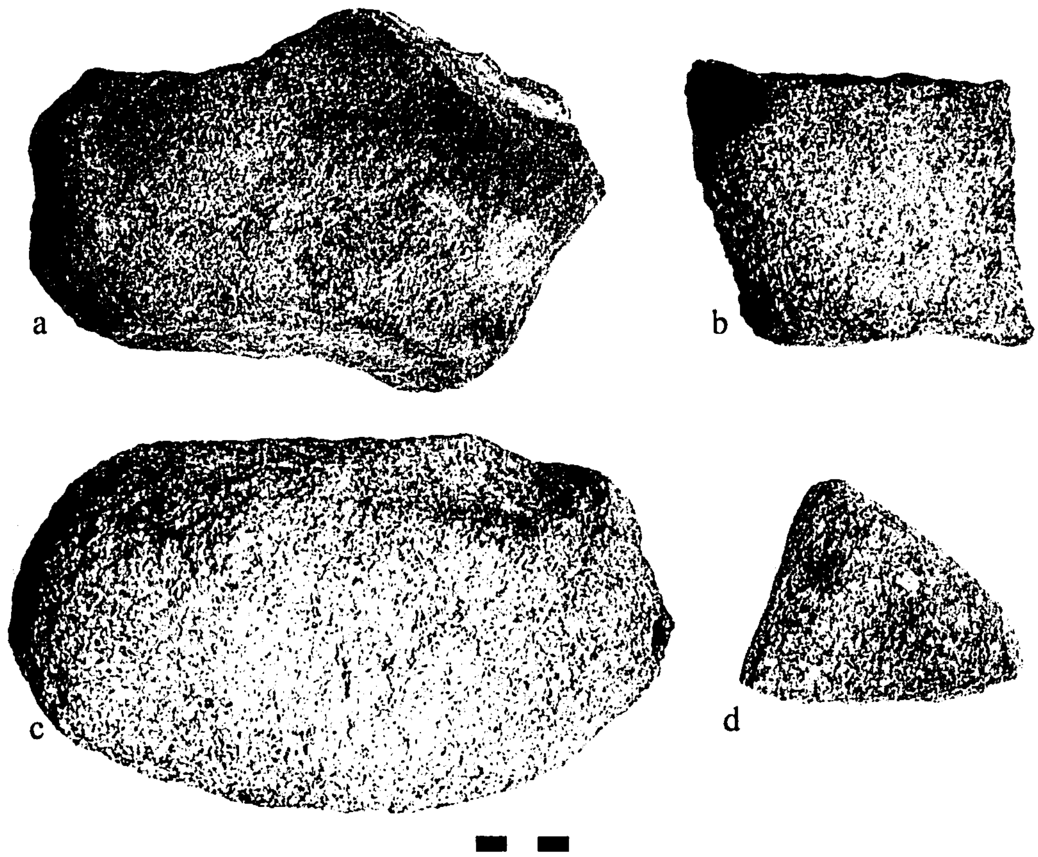


Plate 17: Anvils and anvil fragments. a. 62413, b. 40936, c. 61640, d. 63903

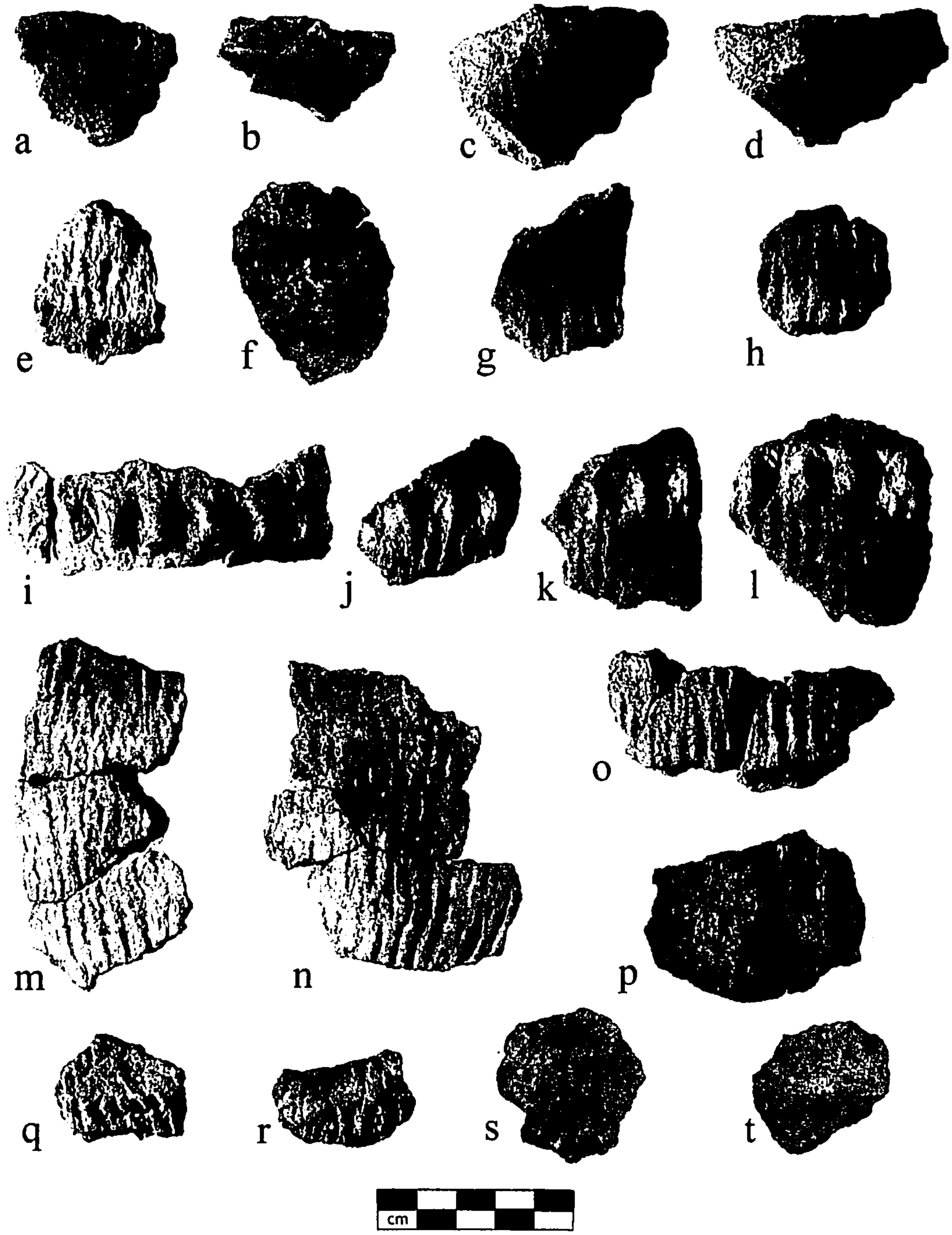


Plate 18: Cord roughened potsherds. a & c: rim fragments; b & d: rim detail; e-h: neck fragments; i-l: shoulder fragments; m-p: body fragments; q-t: base fragments

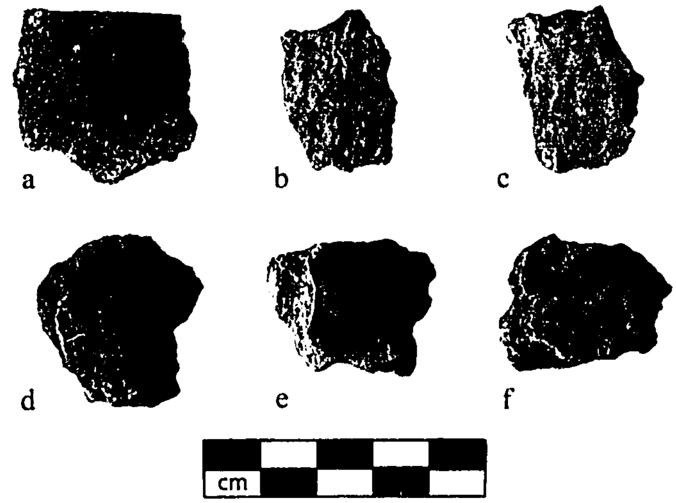


Plate 19: Smoothed-surface potsherds. a: rim fragment; b-f: body fragments.

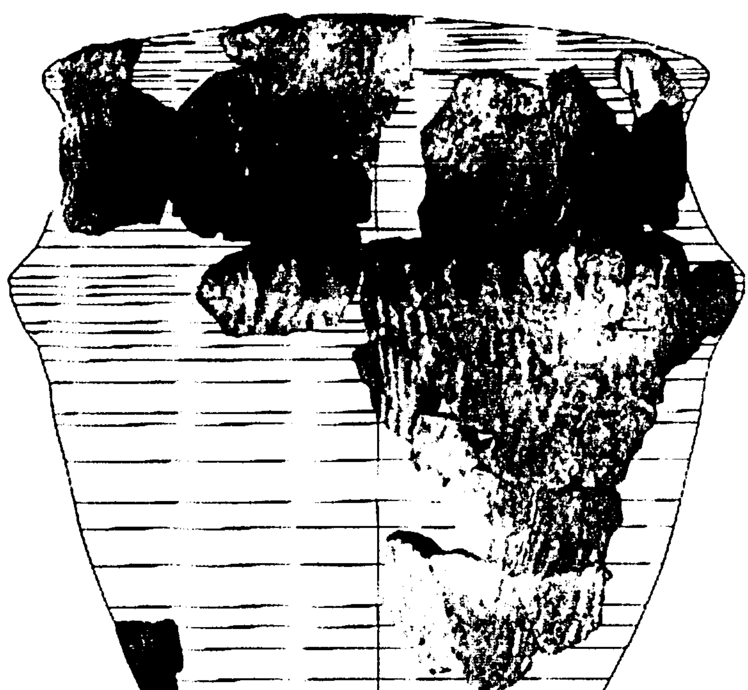


Plate 20: Cord roughened vessel reconstruction. Original photos & model by Dr. Mary Malainey & Timothy Fogol.

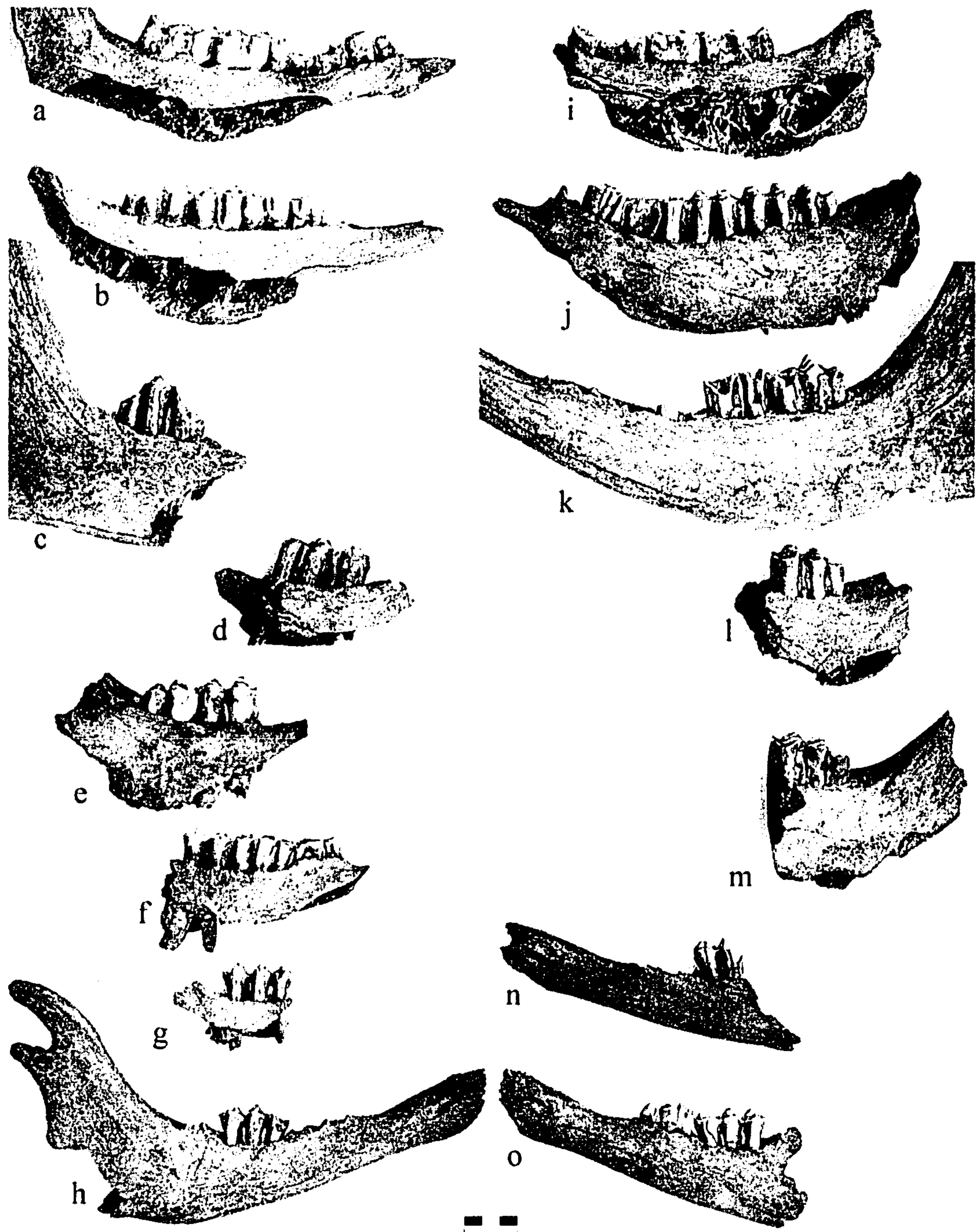


Plate 21: Bison mandibles. a. 25148, b. 22372, c. 12190, d. 25577, e. 30181, f. 28748-9, g. 13764, h. 36929, i. 12032, j. 61686, k. 38371, l. 29550, m. 27929, n. 12205, o. 41561.

Plate 22: Neonatal elements. a. 28753 - humerus, b. 30177 – femur.

Plate 23: Split vertebra (26523).

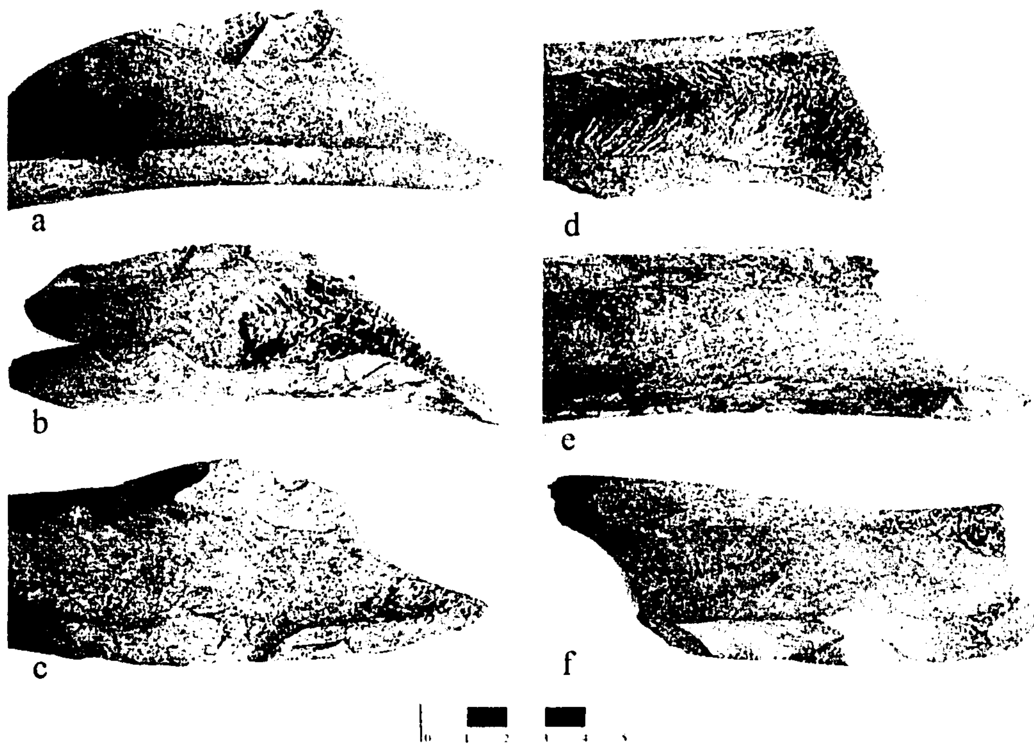


Plate 24: Long bone fragments exhibiting internal flake scars. a. 23154, b. 23482, c. 27352, d. 27930, e. 29554, f. 33654

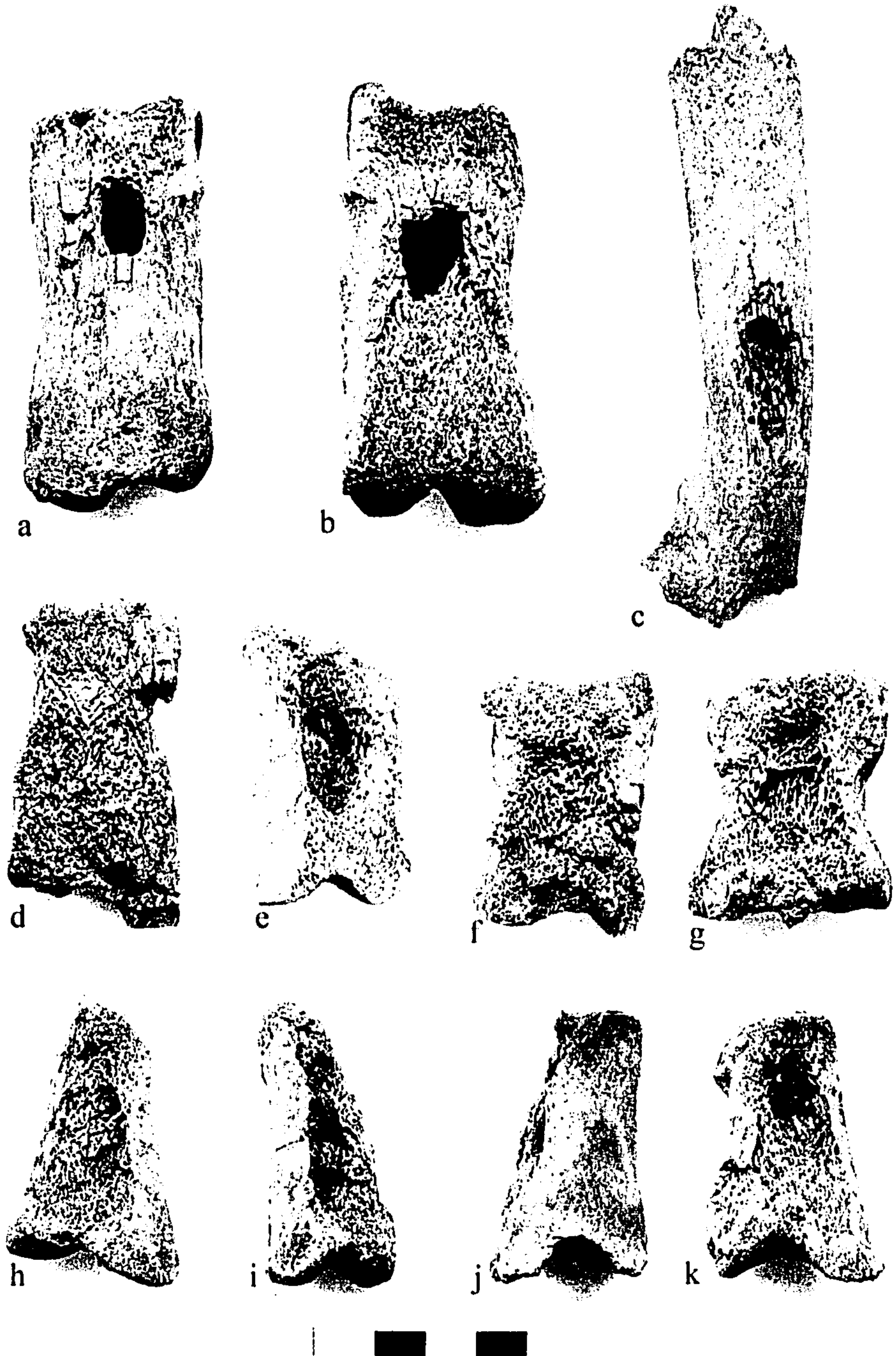


Plate 25: Split and punched bones. a. 43857, b. 56134, c. 22708, d. 63426, e. 15404, f. 37273, g. 65798, h. 37272 – external, i. 37272 – dorsal, j. 21041 – dorsal, k. 21041 – internal.

Plate 26: Canid bone beads and bead blanks from Lease 10-32.

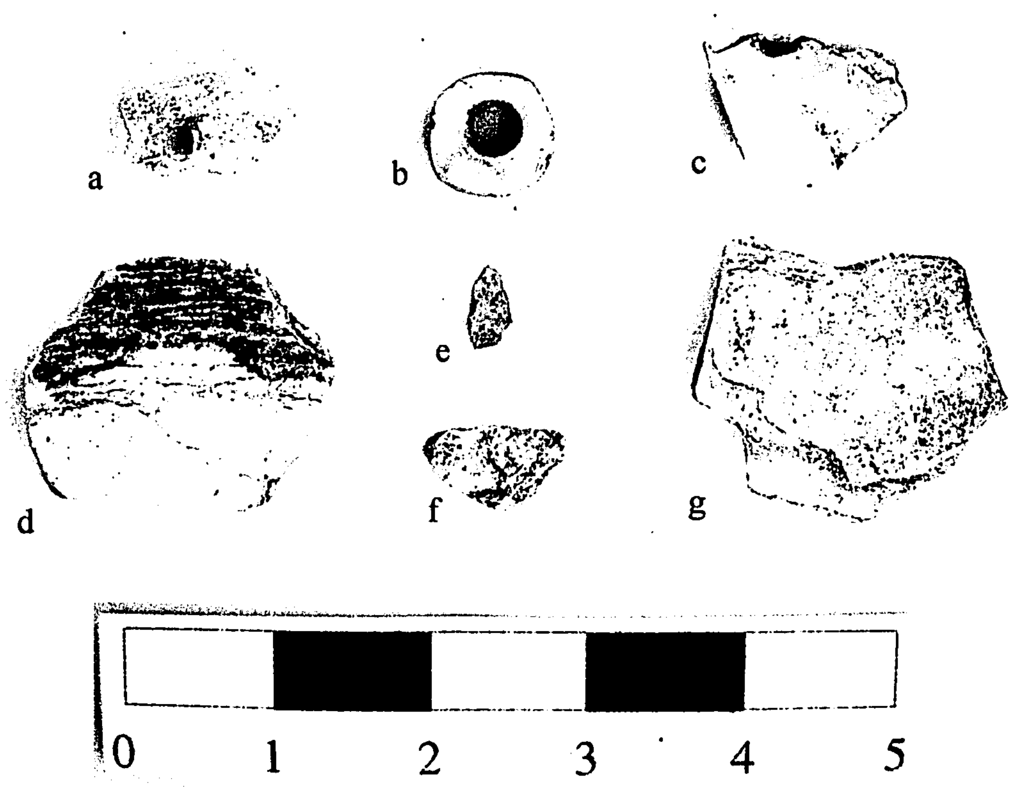


Plate 27: Mollusc shell beads and fragments. a. 60503, b. 54199, c. 21498, d. 21496, e. 54200, f. 54201, g. 21497

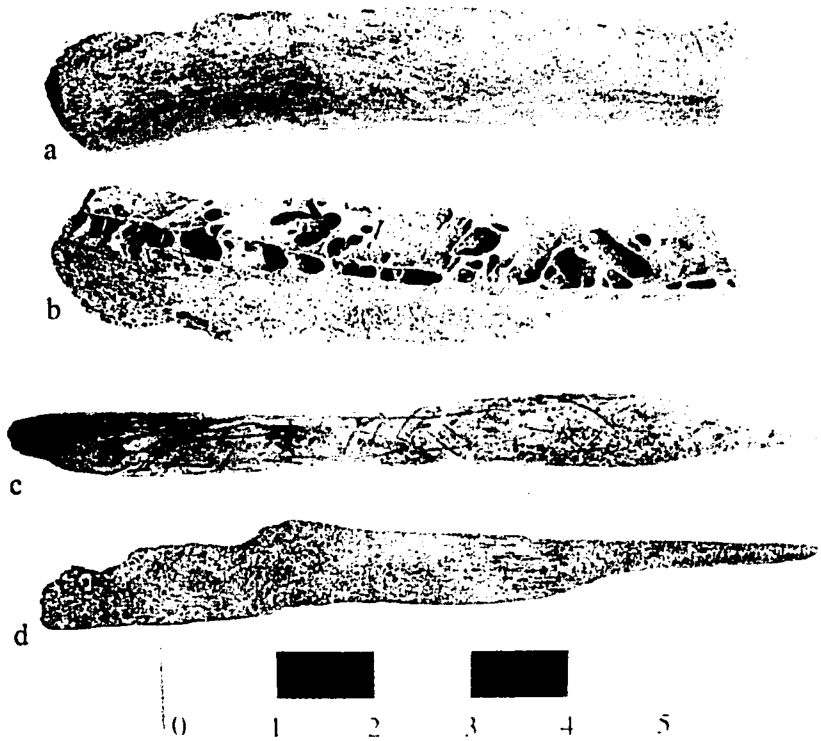


Plate 28: Indeterminate tool fragment. a. 32953 – external, b. 32953 – internal. Perforators / awls. c. 45903, d. 17501

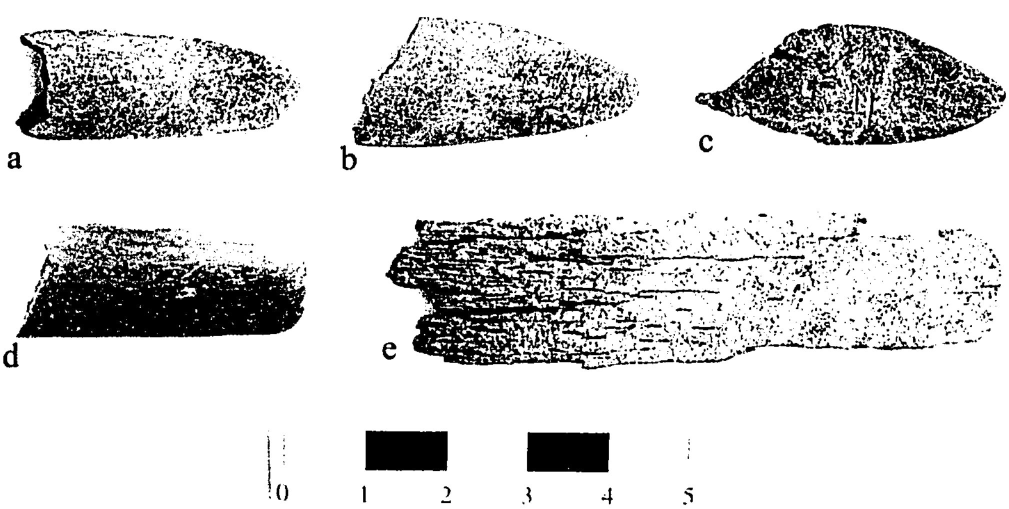


Plate 29: Spatulate bone tool tips. a. 27950, b. 62814, c. 53268, d. 61328, e. 53061

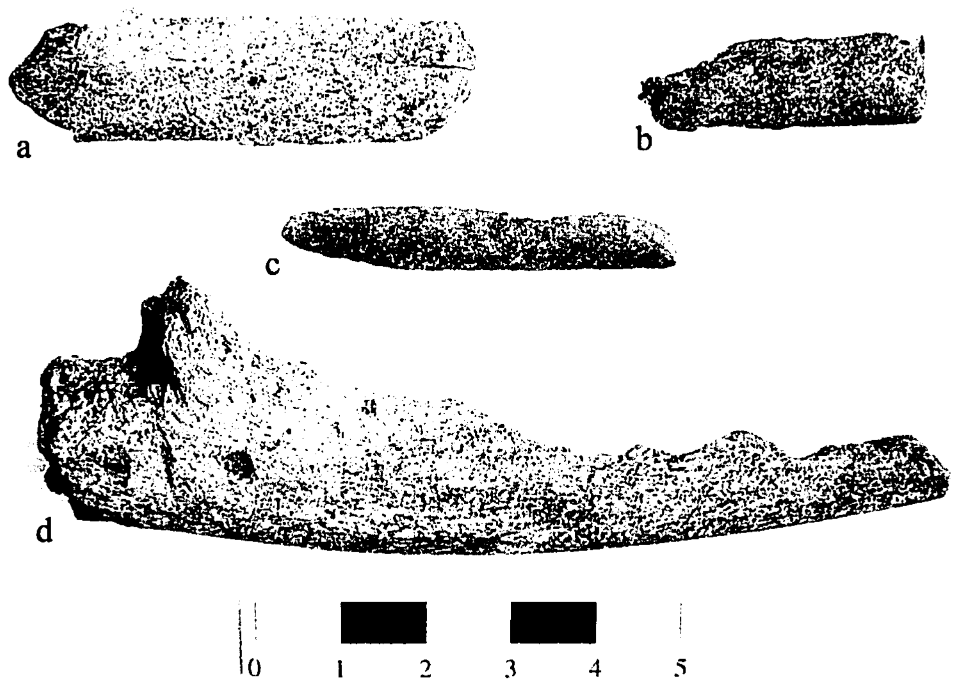


Plate 30: Blunt-tipped bone tool fragments: a: 23005, b. 64111, c. 40904, d. 33649

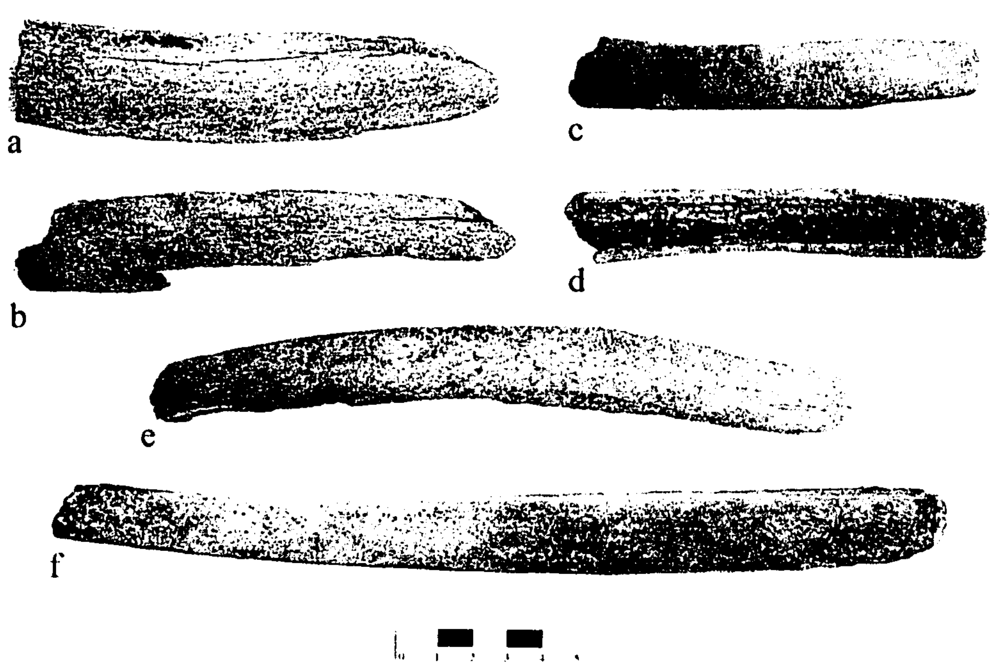


Plate 31: Spatulate rib tools. a. 10517, b. 26527, c. 36778 – external, d. 36778 – internal, e.26527, f. 63417

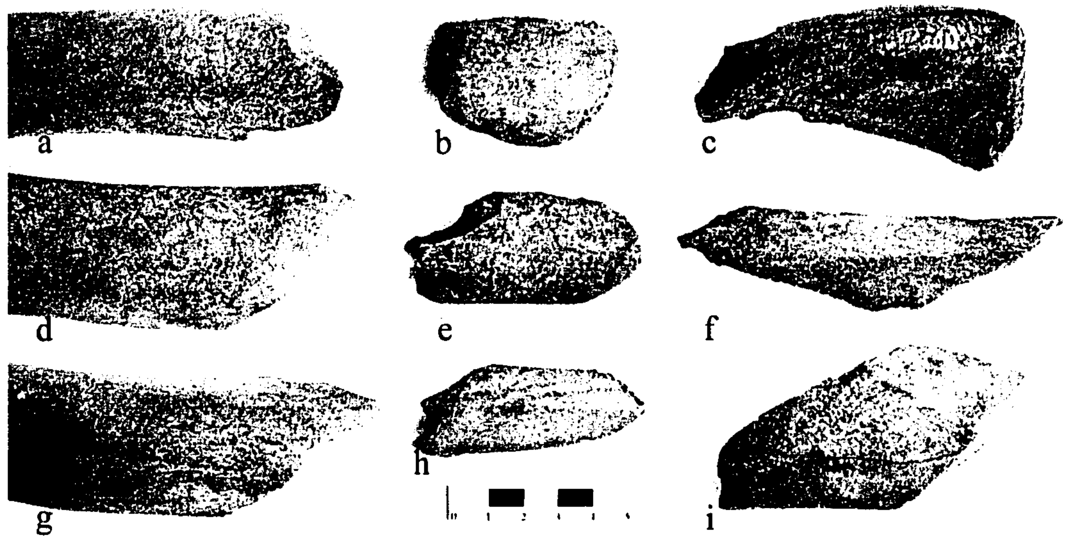


Plate 32: Modified long bone fragments, modified portion to right. a. 27930, b. 23914, c. 12207, d. 23154, e. 23586, f. 22576, g. 29554, h. 36779, i. 30713

APPENDIX II: TABLES

art. no.	11169	14716	22939	45906	56751	59727	61069
plate	8.e	8.i	8.c	8.h	8.b	8.f	8.a
north	201.00	201.00	200.00	203.00	204.00	204.50	203.50
east	101.50	102.50	100.50	101.50	102.50	104.50	104.50
level	4	4	4	5	5	5	5
mass	1.0	10.4	14.6	6.3	19.7	0.9	10.4
length	10.9	25.5	46.2	26.3	51.9	18.1	55.9
width	13.7	27.5	26.9	23.1	23.9	8.5	17.5
thickness	8.5	19.9	11.7	9.3	8	6.3	8.1
material	Chert	White Chalcedony	Quartzite	Pebble Chert	Silicified Wood	Swan River Chert	silicified wood
flake pattern	Ind.	multidirectional, bipolar	n/a	bipolar	bipolar	bipolar	bipolar
dorsal cortex	No Cortex	No Cortex	Cortex	Cortex	Cortex	No Cortex	No Cortex
notes	fragment	exhausted multidirectional core, then bipolar core	black residue, unflaked 'core'	tiny bipolar core, similar to microblade core	black residue		

Table 15: Cores.

art. no.	7657	18375	30156	36633	40076		58330		64548	66079/66080	
plate	9.e	9.a	9.b	9.g	9.c		9.h		9.d	9.f	
north	202.50	202.00	200.00	202.50	203.50		204.00		202.00	210.00	
east	101.00	102.50	102.50	103.00	102.00		103.50		104.00	104.00	
level	5	5	4	4	5		4		5	5	
mass	0.4	6.3	1	1.6	0.6		1.8		1.3	0.8	
complete	n	y	y	y	n		n		n	y	
length	15.6	31.7	17.7	21.9	16.3		18.5		20.5	22.3	
width	11.4	31.5	20.4	22.1	16.9		21.4		21.6	17.2	
thickness	2.7	6.4	3.7	4.3	2.4		4.2		2.6	2.5	
material	chert	silicified peat	chert	sil. peat	silicified peat		swan river chert		siltstone	silicified wood	
colour	dark grey 2.5Y 4/1	dark brown 7.5 YR 3/2	light brownish grey 10YR 6/2	dark brown 7.5 YR 3/2	dark brown 7.5 YR 3/3		mottled reddish grey 5YR 5/2 & white 8/		black N2/0	very dark greyish brown 10YR 3/2	
flake pattern	n/a	n/a	n/a	n/a	n/a		irregular: unifacial		n/a	n/a	
outline form	triangular	square	triangular	irregular	triangular		triangular		triangular	triangular	
cross-section	plano-convex	biplano	asymmetrical biconvex	plano-convex	biplano		asymmetrical biconvex		plano-convex	biplano	
dorsal cortex	0	1	0	0	0		0		5	0	
dorsal flake scar count	0	5	5	0	3		4		2	0	
ventral flake scar count	0	2	2	0	1		0		5	0	
blank type	flake	flake	bipolar flake	flake	flake		flake		bipolar flake	ind. / flake	
edge location	distal	R. lat	L. lat	distal	L. lat	L. lat	L. lat	R. lat	L. lat	L. lat	R. lat / dist
edge retouch	none	unimarginal: discontinuous	none	none	none	none	none	none	none	none	none
edge mod.	use-wear	use-wear	use-wear	use-wear	use-wear	use-wear	use-wear	use-wear	use-wear	use-wear	use-wear
edge shape	straight	irregular	straight	straight	straight	straight	straight	convex	straight	straight	straight
edge length	11.1	30.7	18.9	17.7	5.1	13.3	23.2	14.0	23.2	17.8	21.4
edge angle	20	30	25	25	35	40	25	30	25	30	15
notes											

Table 16: Edge Modified Pieces.

art. no.	7651	7726	7840	11238/36634	11497	21704		22941		
plate				10.c	10.o	10.l				
north	202.50	202.50	202.50	201.00/202.50	201.00	202.50		200.00		
east	101.00	101.50	101.50	101.50/103.00	101.50	100.00		100.50		
level	5	3	5	4, 4	5	4		4		
mass	0.7	0.2	0.4	1.8	2.4	3.3		0.3		
complete	n	n	n	n	n	y		n		
length	18.9	9.1	15.9	34.0	28.8	18.8		13.5		
width	14.1	8.6	10.7	13.7	15.0	24.7		10.9		
thickness	3.3	2.8	2.7	3.8	5.0	10.7		1.9		
material	sil. wood	silicified peat	sil. wood	sil. peat	quartzite	swan river chert		silicified wood		
colour	pale brown 10YR 6/3	dark brown 7.5 YR 3/4	dark brown 7.5 YR 5/3	dark reddish grey 2.5YR 3/1	dark grey N 4/0	pale red 2.5YR 6/2		dark brown 7.5 YR 3/3		
flake pattern	irregular: unifacial	irregular: bifacial	irregular: unifacial	irregular: bifacial	irregular: bifacial	irregular: unifacial		irregular: unifacial		
outline form	sub ovoid	triangular	triangular	triangular	triangula r	irregular		triangular		
cross-section	biplano	plano convex	biplano	biplano	biconvex	plano-convex		biplano		
dorsal cortex	0	3	0	0	0	2		0		
dorsal flake scar count	9	4	8	26	5	10		5		
ventral flake scar count	3	4	0	33	3	1		0		
blank type	ind.	ind.	ind.	ind. / flake	flake	flake		indeterminate		
edge location	L. lat / dist	R. lat	L. lat	L. lat	L. lat	L. lat	R. lat / dist	L. lat / dist	R. lat	distal
edge retouch	unimarginal: continuous	bimarginal: continuous	unimarginal: continuous	bimarginal: continuous	bifacial: discont.	none	unimarg. cont.	unimarg cont.	bimarg. cont.	unimarg cont.
edge mod.	use-wear	use-wear	use-wear	use-wear	none	use-wear	use-wear	use-wear	use-wear	
edge shape	straight	straight	straight	straight	convex	convex	straight	straight	straight	irregular
edge length	9.7	7.8	12.7	33.9	43.3	15.7	19.1	11.7	17.7	10.6
edge angle	70	50	45	40	55	30	40	35	65	35
notes										

Table 17.a: Retouched Pieces.

art. no.	23464	24838	24844/49505	30981	30982		33193		33606	
plate			10.p	10.b						
north	201.50	201.00	201.0/204.5	200.00	200.00		201.50		201.00	
east	100.00	100.50	100.5/100.0	102.00	102.00		103.00		103.50	
level	4	5	5,5	4	4		4		5	
mass	0.9	1.4	2.1	1.9	1.5		1.6		3.4	
complete	n	n	n	n	n		n		n	
length	17.1	17.1	27.9	31.7	20.7		19.1		29.1	
width	14.4	19.8	18.4	22.3	21.2		17.0		22.8	
thickness	13.7	4.7	4.1	3.2	4.1		5.6		5.5	
material	silicified peat	silicified wood	siltstone	sil. wood	silicified wood		swan river chert		silicified wood	
colour	dark brown 7.5 YR 3/2	light brownish grey 7.5YR 6/2	black N 2/0	brown 10YR 4/3	brown 10YR 4/3		white N 8/		dark reddish brown 2.5YR 3/3	
flake pattern	irregular: unifacial	irregular: bifacial	irregular: unifacial	irregular: bifacial	irregular: bifacial		irregular: unifacial		irregular: bifacial	
outline form	ovoid	triangular	ovoid	irregular	sub-triangular		ovoid		irregular	
cross-section	biplano	plano-convex	plano-convex	biplano	biplano		asymmetric biconvex		plano-convex	
dorsal cortex	0	0	3	0	0		0		0	
dorsal flake scar count	15	15	12	14	17		14		3	
ventral flake scar count	3	4	0	12	14		4		7	
blank type	flake	indeterminate	flake	ind. / flake	indeterminate / flake		flake		indeterminate/ flake	
edge location	R. lat / dist	distal	R. lat	L. lat / dist	L. lat	R. lat / dist	L. lat	R. lat	L. lat / dist	R. lat / prox
edge retouch	unimarginal: discontinuous	unimarginal: continuous	unimarginal: continuous	bimarginal: continuous	bimarg. cont.	bimarg. cont.	unifac. discont.	unifac. discont.	bimarg. contin.	unimarg. contin.
edge mod.	use-wear	none	use-wear	use-wear	use-wear	grinding	use-wear	none	none	none
edge shape	rounded	concave	straight	straight	straight	convex	convex	convex	straight	pointed
edge length	15.9	11.2	23.8	12.6	13.1	17.3	15.4	12.5	7.8	15.9
edge angle	30	75	40	25	25	50	45	50	40	40
notes									manufact. break?	

Table 17.b: Retouched Pieces cont'd.

art. no.			33607	34106		36636/48303	40909		41554
plate						10.d	10.f		
north			201.00	201.00		202.50/204.50	203.50		203.00
east			103.50	103.00		103.00/100.50	102.50		102.50
level			5	4		4, 5	5		4
mass			2.6	1.6		3.8	0.5		21.6
complete			n	n		n	n		n
length			18.5	20.6		35.2	13.4		45.0
width			21.4	18.4		24.4	10.6		35.1
thickness			5.7	4.0		6.4	4.4		13.1
material			swan river chert	sil. wood		silicified peat	silicified peat		swan river chert
colour			pale red 2.5 YR 7/2	grayish brown 10YR 5/2		dark greyish brown 7.5YR 4/2	reddish black 10R 2.5/1		mottled white N8/ & reddish brown 2.5 YR 4/3
flake pattern			irregular: bifacial	irregular: bifacial		irregular: bifacial	irregular: bifacial		irregular: unifacial
outline form			rhomboid	irregular		irregular	irregular		ovoid
cross-section			asymmetric biconvex	biplano		biplano	asymmetric biconvex		asymmetric biconvex
dorsal cortex			0	0		3	2		0
dorsal flake scar count			14	15		15	4		20
ventral flake scar count			8	6		19	7		2
blank type			flake	bipolar flake		ind. / flake	indeterminate		flake
edge location	L. lat	distal	R. lat	R. lat	R. lat / dist	L. lat / prox	distal	L. lat	R. lat
edge retouch	bifac. discont.	bifac. cont.	bifac. discont.	bimarginal: discontinuous	margino-facial contin.	unifac. contin.	bimarginal: continuous	unifacial: discontinuous	unifacial: discontinuous
edge mod.	none	none	none	use-wear	use-wear	none	heavy use-wear	use-wear	use-wear
edge shape	convex	straight	convex	straight	straight	pointed	straight	convex	straight
edge length	19.9	19.0	18.1	16.2	28.1	10.1	8.0	34.6	39.0
edge angle	45	45	40	50	40	40	60	50	60
notes			manufact. break?						

Table 17.c: Retouched Pieces, cont'd.

art. no.	42617		42625	43764		45918	46271		49509
plate	m			10.t		10.n	10.r		
north	203.00		203.00	203.00		203.00	203.00		204.50
east	102.50		102.50	102.00		101.50	101.00		100.00
level	5		5	5		5	5		5
mass	0.6		0.2	1.2		1.2	2.9		0.3
complete	n		n	y?		n	y		n
length	17.0		14.0	18.5		21.0	29.5		10.7
width	12.7		8.0	13.8		12.3	14.8		8.7
thickness	3.2		2.1	4.8		4.3	6.7		1.7
material	swan river chert		sil. wood	chert		swan river chert	silicified peat		chert
colour	light reddish brown 2.5YR 7/3		pale brown 10YR 6/3	light yellowish brown 2.5 Y 6/4		5YR 5/1	5 YR 3/1		7.5YR 4/4
flake pattern	irregular: unifacial		n/a	irregular: bifacial		irregular: bifacial	irregular: bifacial		n/a
outline form	triangular		ovoid	triangular		irregular	sub-ovoid		triangular
cross-section	plano-convex		asymmetic biconvex	biplano		asymmetric biconvex	biplano		biplano
dorsal cortex	0		0	0		0	0		0
dorsal flake scar count	14		2	10		6	22		5
ventral flake scar count	8		3	4		4	20		0
blank type	flake		indeterminate	indeterminate		flake	indeterminate / flake		ind. / flake
edge location	L. lat	R. lat	R. lat	L. lat	R. lat	R. lat	L. lat	R. lat	R. lat
edge retouch	unimarg. discont.	unimarg. discont.	bimarginal: discontinuous	margino-facial: contin.	none	bimarginal: discontinuous	bifacial contin.	unifacial: discontin.	unimarginal: discontinuous
edge mod.	use-wear	use-wear	use-wear	heavy use-wear	use-wear	none	heavy use-wear	use-wear	use-wear
edge shape	straight	straight	straight	straight	straight	convex	convex	straight	straight
edge length	14.0	15.7	9.6	17.5	19.7	20.4	37.8	32.2	10.6
edge angle	35	35	40	55	55	40	50	65	20
notes				heavy wear on three corners, possible graver					

Table 17.d: Retouched Pieces, cont'd.

art. no.	53271		54282		56750			56753	61312		63312
plate	10.i				10.k			10.s	10.e		
north	204.00		204.00		204.00			204.00	203.00		202.50
east	101.50		101.00		102.50			102.50	104.50		104.00
level	5		5		5			5	4		5
mass	0.4		1.2		3.2			0.7	9.5		2.2
complete	n		n		y			n	n		n
length	18.5		20.1		26.2			15.9	39.4		23.4
width	7.2		16.5		29.5			12.0	26.4		16.9
thickness	3.0		3.3		8.1			3.4	11.0		5.4
material	silicified wood		silicified wood		jasper			sil. wood	silicified peat		sil. wood
colour	banded pale brown 10YR 6/3		dark reddish brown 2.5YR 3/4		dark red 10R 3/6			white N 8/0	dark greyish brown 7.5YR 4/2		dark reddish brown 2.5 YR 3/3
flake pattern	irregular: bifacial		irregular: bifacial		irregular: bifacial			irregular: unifacial	irregular: bifacial		n/a
outline form	sub-rectangular		irregular		irregular			triangular	sub-triangular		irregular
cross-section	plano-convex		biplano		asymmetric biconvex			plano-convex	plano-convex		biplano
dorsal cortex	0		1		0			0	0		0
dorsal flake scar count	7		47		16			18	20		5
ventral flake scar count	7		13		13			0	13		2
blank type	indeterminate / flake		flake		indeterminate			indeterminate	indeterminate / flake		bipolar flake
edge location	R. lat	R. prox	L. lat	distal	L. lat	R. lat	distal	R. lat	L. lat	distal	distal
edge retouch	bimarg. contin.	unimarg. contin.	bimarg. contin.	bimarg. contin.	bimarg. contin.	bimarg. contin.	unimarg. contin.	unimarginal: continuous	bimarg. contin.	unimarg. discont.	unimarginal: continuous
edge mod.	use-wear	use-wear	use-wear	use-wear				heavy use-wear	use-wear	use-wear	use-wear
edge shape	straight	rounded	convex	straight	straight	straight	rounded	straight	straight	convex	rounded
edge length	13.4	7.6	15.9	3.4	19.7	17.5	15.3	15.5	39.7	16.3	17.5
edge angle	40	35	30	40	55	55	55	55	50	40	70
notes											

Table 17.e: Retouched Pieces, cont'd.

art. no.	64119		65032/65150		65781	67903	68065	40906	
plate	10.a		10.h					10.j	
north	202.00		201.5/201.5		201.00	200.00	200.00	203.50	
east	104.50		104.0/104.5		104.00	101.00	100.50	102.50	
level	5		5, 4		4	3	3	5	
mass	16.9		1.9		3.0	1.2	0.8	0.3	
complete	y		n		y	y	n	n	
length	37.7		25.9		22.0	14.8	19.5	16.9	
width	33.4		15.1		22.6	19.7	12.0	6.9	
thickness	10.1		5.5		5.2	2.5	4.0	7.7	
material	silicified wood		silicified wood		siltstone	silic. sediment	silicified peat	obsidian	
colour	dark yellowish brown 10YR ¾		dark reddish brown 2.5 YR 3/3		black N2/0	dark olive grey 5Y 3/2	very dark grayish brown 7.5YR 3/2	black N 2/0	
flake pattern	irregular: bifacial		irregular: unifacial		irregular: unifacial	irregular: unifacial	irregular: bifacial	irregular: unifacial	
outline form	rectangular		triangular		sub-ovoid	ovoid	triangular	triangular	
cross-section	asymmetric biconvex		biplano		concavo-convex	concavo-convex	biplano	biplano	
dorsal cortex	4		0		4	0	0	0	
dorsal flake scar count	20		21		25	16	26	9	
ventral flake scar count	11		4		2	2	7	0	
blank type	bipolar flake		bipolar flake		split pebble	bipolar flake	indeterminate	indeterminate	
edge location	L. lat	proximal	distal	proximal	distal	distal	L. lat / dist	L. lat / dist	R. lat
edge retouch	bimarginal: continuous	unimarginal: continuous	bimarginal: discontinuous	unimarginal: continuous	unimarginal: continuous	unimarginal: continuous	unimarginal: continuous	unifacial: discontin.	none
edge mod.	heavy use-wear	battered	use-wear	use-wear	none	use-wear	use-wear	none	use-wear
edge shape	convex	straight	pointed	straight	convex	convex	straight	convex	straight
edge length	36.7	21.5	12.1	16.6	32.7	24.4	16.8	9.8	6.8
edge angle	70	75	70	95	45	70	50		
notes									

Table 17.f: Retouched Pieces, cont'd.

art. no.	36676	49120	56762	
plate	11.b	11.a	11.c	
north	202.50	204.00	204.00	
east	103.00	100.00	102.50	
level	4	5	5	
mass	231.5	555.8	297.2	
complete	y	y	y	
length	66.1	119.4	86.3	
width	66.2	100.9	100.3	
thickness	48.2	54.6	22.9	
material	basalt	quartzite	schist	
colour	very dark grey N 3/	grey N 6/	grey N 3/	
flake pattern	irregular: bifacial	irregular: bifacial	irregular: bifacial	
outline form	triangular	ovoid	rectangular	
cross-section	plano-convex	asymmetrical biconvex	biplano	
dorsal cortex	2	2	4	
dorsal flake scar count	6	12	9	
ventral flake scar count	3	15	6	
blank type	core	core	core	
edge location	distal	circumference	L. lat	R. lat
edge retouch	bifacial: continuous	bifacial: discontinuous	bimarginal: continuous	bimarginal: continuous
edge mod.	heavy use-wear	heavy wear	heavy use-wear	use-wear
edge shape	rounded	convex	straight	convex
edge length	54.9	350.0	70.4	64.2
edge angle	65	90	85	70
notes		charred, fire-cracked	possibly hafted	

Table 18: Choppers.

art. no.	8601		10180	14717	14721		24846		43765	48313
plate	12.i		12.b						12.h	12.j
north	202.00		201.50	201.00	201.00		201.00		203.00	204.50
east	101.00		101.50	102.50	102.50		100.50		102.00	100.50
level	4		4	4	4		5		5	5
mass	1.0		1.5	0.4	2.7		0.3		1.1	0.5
complete	n		n	n	n		n		n	n
length	14.4		27.5	9.1	18.1		9.3		16.2	13.7
width	18.7		19.5	13.2	17.6		11.5		14.2	10.0
thickness	4.6		4.4	3.6	7.8		3.2		4.9	4.3
material	swan river chert		silicified peat	swan river chert	swan river chert		silicified peat		sil. wood	siltstone
colour	reddish yellow 5YR 7/4		reddish black 10R 2.5/1	very pale red 2.5YR 8/2	reddish brown 2.5 YR 5/3		very dark grayish brown 10 YR 3/2		banded red & white N 8/	black N 2.5/
flake pattern	irregular: bifacial		irregular: bifac.	irregular: bifac.	irregular: bifacial		irregular: bifacial		irregular: bifac.	irregular bifac.
outline form	semicircular		triangular	triangular	rectangular		triangular		irregular	triangular
cross-section	plano-convex		plano-convex	asymmetric biconvex	asymmetric biconvex		asymmetric biconvex		asymmetric biconvex	asymmetric biconvex
dorsal cortex	0		0	0	0		0		0	1
dorsal flake scar count	20		18	17	5		6		12	5
ventral flake scar count	13		12	14	4		9		6	8
blank type	flake		ind. / flake	indeterminate	indeterminate		indeterminate		bipolar flake	indeterminate
edge location	L. lat	R. lat	L. lat - R. lat	L. lat / dist	L. lat	R. lat	L. lat	R. lat	L. lat / prox	R. lat
edge retouch	bifacial: contin.	bifacial: contin.	bifacial: continuous	bifacial: continuous	bifacial: contin.	bifacial: contin.	bifacial: contin.	bifacial: contin.	bifacial: discontin.	bifacial: discontinuous
edge mod.	use-wear	use-wear		none	grinding	grinding	none	none	none	use-wear
edge shape	convex	convex	pointed	convex	straight	convex	sinuous	sinuous	convex	straight
edge length	17.2	12.6	48.8	12.2	10.1	19.0	11.4	13.3	8.5	13.8
edge angle	30	50	30	45	65	65	50	45	40	50
notes					prehensile wear on dorsal surface		possible point tip			resharpening fracture?

Table 19.a: Bifaces.

art. no.	48782			50121	53270			58057	59252
plate	12.e				12.f			12.g	12.a
north	204.00			204.50	204.00			204.50	204.00
east	100.50			100.00	101.50			103.00	103.00
level	5			5	5			5	5
mass	1.1			0.3	1.1			0.9	2.1
complete	n			n	n			n	n
length	15.5			14.1	11.6			11.9	25.8
width	15.7			7.6	25.6			13.6	15.0
thickness	4.0			2.4	3.5			3.5	5.1
material	swan river chert			swan river chert	swan river chert			silicified wood	swan river chert
colour	mottled reddish grey 5YR 5/2 & light brown 2.5YR 6/4			pale pink 7.5 YR 8/2	mottled white & pale red 10R 6/3			banded 10YR 4/2	5YR 8/2
flake pattern	irregular: bifacial			irregular: bifac.	irregular: bifacial			irregular: bifacial	irregular: bifacial
outline form	rectangular (lanceolate)			triangular	trapezoidal			rectangular	lanceolate
cross-section	asymmetric biconvex			asymmetric biconvex	plano-convex			asymmetrical biconvex	asymmetrical biconvex
dorsal cortex	0			0	0			0	0
dorsal flake scar count	49			15	17			30	24
ventral flake scar count	46			12	16			26	18
blank type	indeterminate / flake			ind. / flake	flake			ind. / flake	ind. / flake
edge location	L. lat	R. lat	proximal	L. lat	L. lat	R. lat	proximal	L. lat, dist, R. lat	L. lat - R. lat
edge retouch	bifacial: contin.	bifacial: contin.	bifacial: contin.	bifacial: continuous	bifac. contin.	unifac. discont.	bifac. contin.	bifacial: continuous	bifacial: continuous
edge mod.	use-wear	none	stepped	use-wear	none	none	none	heavy use-wear	use-wear
edge shape	convex	convex	straight	straight	straigh t	straight	convex	straight	pointed
edge length	15.9	16.8	10.2	15.2	9.9	12.0	29.7	39.8	42.5
edge angle	30	35	55	45	50	30	65	40	40
notes									

Table 19.b: Bifaces, cont'd.

art. no.	61166			63403
plate	12.d			12.c
north	203.00			202.50
east	104.50			104.50
level	3			4
mass	1.5			1.3
complete	y			n
length	22.0			21.5
width	15.6			13.0
thickness	6.0			4.7
material	silicified peat			chert
colour	reddish black 2.5YR 2.5/1			very dark grey 5YR 3/1
flake pattern	irregular: bifacial			irregular: bifacial
outline form	triangular			ovoid
cross-section	asymmetric biconvex			asymmetric biconvex
dorsal cortex	0			0
dorsal flake scar count	20			14
ventral flake scar count	27			7
blank type	indeterminate			indeterminate
edge location	R. lat - distal	L. lat.	proximal	L. lat
edge retouch	bifacial: contin.	bifacial: contin.	bifacial: contin.	bifacial: discontinuous
edge mod.	use-wear	none	none	use-wear
edge shape	convex	straight	concave	convex
edge length	21.3	24.4	12.0	13.2
edge angle	40	50	75	55
notes	basally notched, hafted knife?			

Table 19.c: Bifaces, cont'd.

Artifact Number	7832	7833	11235		17383	
Plate	13.a	13.b	13.t		13.p	
North	202.50	202.50	201.00		202.50	
East	101.50	101.50	101.50		102.50	
Level	5	5	4		5	
material	Swan River Chert	Swan River Chert	silicified wood		Swan River Chert	
colour	grey 5Y 6/1	mottled grey & light reddish brown 2.5 YR 6/3	brown 7.5YR 4/3		mottled red & white (10R 5/4)	
flaking pattern	irregular	irregular	irregular		irregular	
Dorsal Flake Scar Count	5	11	20		13	
Ventral Flake Scar Count	8	7	25		18	
outline form			asymmetrical		asymmetrical	
cross-section	asymmetric biconvex	plano-convex	biplano		convex asymmetrical	
base form			11		1	
basal edge shape			convex		concave	
mass (g)	0.30	0.40	0.60		1.10	
max lengt			17.55		20.85	
max width			10.05		13.30	
max thickness			3.20		4.50	
blade length			10.60		14.30	
blade width			10.05		13.30	
blade thickness			2.80		4.50	
shoulder width			10.05			
neck width			7.40		9.40	
max base width			9.80			
dist. base width			8.10			
prox. base width			9.60			
max base thick.			3.20		3.30	
side (L/R)			L	R	L	R
notch type			side-notched	side-notched	side-notched	side-notched
notch form			round, shallow	round, shallow	v-shaped, broad	v-shaped, broad
shoulder height			7.30	7.10	7.65	7.10
notch height			3.65	3.65	2.35	
base height			3.65	3.45	4.65	
notch depth			2.20	2.00	1.95	3.10
prox. base angle			117		120	
distal base angle			140	127	126	
shoulder angle			139	132		88

Table 20.a: Projectile points.

Artifact Number	18371		20702		22944	27277	30983
plate	13.r		13.i		13.n	13.g	13.m
North	202.00		202.00		200.00	200.00	200.00
East	102.50		102.00		100.50	101.50	102.00
Level	5		5		4	4	4
material	Swan River Chert		silicified peat		silicified wood	chert	Swan River Chert
colour	grey N 6/		reddish black 10R 2.5/1		reddish black 10R 2.5/1	mottled white & grey N 6/	
flaking pattern	irregular		irregular		marginal	irregular	irregular
Dorsal Flake Scar Count	32		12		9	10	21
Ventral Flake Scar Count	29		19		7	7	18
outline form	asymmetrical		asymmetrical			asymmetrical	symmetrical
cross-section	asymmetric biconvex		plano-convex		biplano	plano-convex	asymmetric biconvex
base form	2						
basal edge shape	concave				convex		concave
mass (g)	1.40		0.70		0.30	0.50	1.00
max lengt	29.10						21.90
max width	13.90		13.80				12.70
max thickness	3.80						4.05
blade length	20.90						
blade width	13.80		13.80				12.70
blade thickness	3.80		3.90				4.05
shoulder width	13.95		13.40				
neck width	8.15						
max base width	13.45						
dist. base width	13.30						
prox. base width	10.80						
max base thick.	3.70						
side (L/R)	L	R	L	R	R		
notch type	side-notched	side-notched	side-notch	side-notch	side-notch		
notch form	V-shaped	V-shaped, narrow			round, shallow		
shoulder height	8.60	8.60			9.30		
notch height	3.55	3.10			6.00		
base height	5.45	5.40			3.30		
notch depth	2.80	3.15		3.10	1.60		
prox. base angle	123	108			125		
distal base angle	115	110			110		
shoulder angle	115	87	86	94	138		

Table 20.b: Projectile points, cont'd.

<table>
<tr><td>Artifact Number</td><td colspan="2">31530</td><td colspan="2">39347</td><td colspan="2">39348</td><td>40075</td><td>40908</td></tr>
<tr><td>plate</td><td colspan="2">13.1</td><td colspan="2">13.x</td><td colspan="2">13.w</td><td>13.c</td><td>13.d</td></tr>
<tr><td>North</td><td colspan="2">200.50</td><td colspan="2">203.00</td><td colspan="2">203.00</td><td>203.50</td><td>203.50</td></tr>
<tr><td>East</td><td colspan="2">103.00</td><td colspan="2">103.00</td><td colspan="2">103.00</td><td>102.00</td><td>102.50</td></tr>
<tr><td>Level</td><td colspan="2">4</td><td colspan="2">4</td><td colspan="2">4</td><td>5</td><td>5</td></tr>
<tr><td>material</td><td colspan="2">Swan River Chert</td><td colspan="2">Swan River Chert</td><td colspan="2">Silicified wood</td><td>Swan River Chert</td><td>Swan River Chert</td></tr>
<tr><td>colour</td><td colspan="2">mottled red, white, black</td><td colspan="2">pinkish grey 5YR 7/2</td><td colspan="2">banded dark brown 7.5 YR 3/4</td><td>mottled grey & orange 2.5 YR 5/6</td><td>white 5YR 8/1</td></tr>
<tr><td>flaking pattern</td><td colspan="2">irregular</td><td colspan="2">irregular</td><td colspan="2">irregular</td><td>irregular</td><td>irregular</td></tr>
<tr><td>Dorsal Flake Scar Count</td><td colspan="2">20</td><td colspan="2">11</td><td colspan="2">6</td><td>9</td><td>10</td></tr>
<tr><td>Ventral Flake Scar Count</td><td colspan="2">16</td><td colspan="2">7</td><td colspan="2">11</td><td>7</td><td>11</td></tr>
<tr><td>outline form</td><td colspan="2">symmetrical</td><td colspan="2">asymmetrical</td><td colspan="2">asymmetrical</td><td></td><td></td></tr>
<tr><td>cross-section</td><td colspan="2">convex symmetrical</td><td colspan="2">convex asymmetrical</td><td colspan="2">plano-convex</td><td>plano-convex</td><td>convex asymmetrical</td></tr>
<tr><td>base form</td><td colspan="2"></td><td colspan="2">15</td><td colspan="2">2</td><td></td><td></td></tr>
<tr><td>basal edge shape</td><td colspan="2"></td><td colspan="2">concave</td><td colspan="2">concave</td><td></td><td></td></tr>
<tr><td>mass (g)</td><td colspan="2">1.20</td><td colspan="2">0.40</td><td colspan="2">0.30</td><td>0.40</td><td>0.20</td></tr>
<tr><td>max lengt</td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td></td><td></td></tr>
<tr><td>max width</td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td></td><td></td></tr>
<tr><td>max thickness</td><td colspan="2"></td><td colspan="2"></td><td colspan="2">2.65</td><td></td><td></td></tr>
<tr><td>blade length</td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td></td><td></td></tr>
<tr><td>blade width</td><td colspan="2">14.85</td><td colspan="2"></td><td colspan="2"></td><td></td><td></td></tr>
<tr><td>blade thickness</td><td colspan="2">3.55</td><td colspan="2"></td><td colspan="2">2.65</td><td></td><td></td></tr>
<tr><td>shoulder width</td><td colspan="2">13.95</td><td colspan="2"></td><td colspan="2"></td><td></td><td></td></tr>
<tr><td>neck width</td><td colspan="2">9.35</td><td colspan="2">11.05</td><td colspan="2">8.20</td><td></td><td></td></tr>
<tr><td>max base width</td><td colspan="2"></td><td colspan="2">16.05</td><td colspan="2">11.20</td><td></td><td></td></tr>
<tr><td>dist. base width</td><td colspan="2"></td><td colspan="2">15.60</td><td colspan="2">11.20</td><td></td><td></td></tr>
<tr><td>prox. base width</td><td colspan="2"></td><td colspan="2">14.85</td><td colspan="2">9.60</td><td></td><td></td></tr>
<tr><td>max base thick.</td><td colspan="2"></td><td colspan="2">3.50</td><td colspan="2">2.50</td><td></td><td></td></tr>
<tr><td>side (L/R)</td><td>L</td><td>R</td><td>L</td><td>R</td><td>L</td><td>R</td><td></td><td></td></tr>
<tr><td>notch type</td><td>side-notch</td><td>side-notch</td><td>side-notch</td><td></td><td>side-notch</td><td></td><td></td><td></td></tr>
<tr><td>notch form</td><td></td><td></td><td></td><td></td><td>angular narrow</td><td></td><td></td><td></td></tr>
<tr><td>shoulder height</td><td></td><td></td><td></td><td></td><td>6.45</td><td></td><td></td><td></td></tr>
<tr><td>notch height</td><td></td><td></td><td></td><td></td><td>2.50</td><td></td><td></td><td></td></tr>
<tr><td>base height</td><td></td><td></td><td>3.55</td><td>3.95</td><td>3.80</td><td>4.20</td><td></td><td></td></tr>
<tr><td>notch depth</td><td>3.10</td><td>2.30</td><td>3.25</td><td>1.75</td><td>2.50</td><td></td><td></td><td></td></tr>
<tr><td>prox. base angle</td><td></td><td></td><td>97</td><td>100</td><td>92</td><td></td><td></td><td></td></tr>
<tr><td>distal base angle</td><td></td><td></td><td>114</td><td>115</td><td>96</td><td></td><td></td><td></td></tr>
<tr><td>shoulder angle</td><td>112</td><td>108</td><td></td><td></td><td>97</td><td></td><td></td><td></td></tr>
</table>

Table 20.c: Projectile points, cont'd.

Artifact Number	43766	44930	46272	48301	48499(dist) / 52406(prox)	
plate	13.h	13.k	13.e	13.f	13.u	
North	203.00	203.50	203.00	204.50	204.00	
East	102.00	101.00	101.00	100.50	100.50	
Level	5	5	5	5	4 (dist) & 5 (prox)	
material	chert	silicified wood	Swan River Chert	Swan River Chert	Swan River Chert	
colour		banded brown 7.5YR 5/2	grey N 6/	mottled pinkish grey 7.5YR 6/2	mottled dark grey N 4/	
flaking pattern	irregular	irregular	irregular	irregular	irregular	
Dorsal Flake Scar Count	7	19	8	7	11	
Ventral Flake Scar Count	10	14	11	7	12	
outline form		asymmetrical			asymmetrical	
cross-section		biplano	asymmetric biconvex	asymmetric biconvex	plano-convex	
base form					8	
basal edge shape					convex	
mass (g)	0.40	0.90	0.30	0.40	0.70	
max lengt					17.90	
max width					12.50	
max thickness		3.00			3.10	
blade length		18.80			11.40	
blade width		14.30			12.65	
blade thickness		3.00			3.10	
shoulder width					12.60	
neck width					8.60	
max base width					11.65	
dist. base width					9.50	
prox. base width					11.65	
max base thick.					2.50	
side (L/R)	L	L			L	R
notch type		side-notched			side-notch	side-notch
notch form					round, shallow	round, shallow
shoulder height					6.30	7.30
notch height					2.15	1.75
base height					3.80	4.70
notch depth		4.10			1.80	1.20
prox. base angle					89	88
distal base angle					160	163
shoulder angle	106	102			118	116

Table 20.d: Projectile points, cont'd.

Artifact Number	48781		49071		53269		60495	
plate	13.q		13.j		13.v		13.o	
North	204.00		204.00		204.00		203.50	
East	100.50		100.00		101.50		104.00	
Level	5		5		5		4	
material	siltstone		silicified wood		silicified wood		silicified peat	
colour	black N2.5/		dark yellowish brown 10YR 3/6		dark reddish brown 2.5YR2.5/3		brown 7.5 YR 4/2	
flaking pattern	irregular		irregular		irregular		irregular	
Dorsal Flake Scar Count	17		18		18		27	
Ventral Flake Scar Count	22		14		13		23	
outline form	asymmetrical		asymmetrical		asymmetrical		asymmetrical	
cross-section	symmetric biconvex		plano-convex		biplano		asymmetric biconvex	
base form	4				6		2	
basal edge shape	straight				straight		concave	
mass (g)	0.70		0.60		0.50		0.70	
max lengt							20.00	
max width	12.75						11.90	
max thickness	3.55						3.10	
blade length			15.60				12.85	
blade width	12.75		13.80				11.80	
blade thickness	3.55		3.35				3.10	
shoulder width	12.60		11.80				11.65	
neck width	7.90				10.15		8.25	
max base width					15.70			
dist. base width					15.45			
prox. base width					13.80			
max base thick.	2.30						2.50	
side (L/R)	L	R			L	R	L	R
notch type	side-notch				side-notch	side-notch	side-notch	side-notch
notch form	U-shaped, narrow	V-shaped, broad			V-shaped, narrow	round, deep	V-shaped, broad	V-shaped, broad
shoulder height	4.95	5.90				8.20	6.60	
notch height	1.80					2.95	2.40	
base height	3.15				5.60	5.40	4.60	
notch depth	2.20	1.95			2.60	2.50	1.90	2.10
prox. base angle	108				137	103	113	
distal base angle	107				100	105	112	
shoulder angle	82	89	97	90		80	110	121

Table 20.e: Projectile points, cont'd.

Artifact Number	61068		64596		n	mean	s. d.	max	min
plate	13.s		13.y						
North	203.50		201.50						
East	104.50		104.00						
Level	5		4						
material	silicified peat		Swan River Chert						
colour	reddish black 10R 2.5/1		white N8						
flaking pattern	irregular		irregular						
Dorsal Flake Scar Count	30		9						
Ventral Flake Scar Count	30		7						
outline form	symmetrical								
cross-section	asymmetric biconvex		asymmetric biconvex						
base form			2						
basal edge shape			concave						
mass (g)	1.00		0.30		25	0.61	0.32	1.40	0.20
max lengt	22.70				7	21.43	3.88	29.10	17.55
max width	14.00				9	12.77	1.24	14.00	10.05
max thickness	3.60				10	3.46	0.55	4.50	2.65
blade length	16.75				8	15.15	3.58	20.90	10.60
blade width	14.00				12	13.15	1.29	14.85	10.05
blade thickness	3.60				13	3.46	0.53	4.50	2.65
shoulder width	13.20				9	12.58	1.26	13.95	10.05
neck width	8.70				11	8.83	1.07	11.05	7.40
max base width	13.20		15.30		8	13.29	2.29	16.05	9.80
dist. base width	13.10		14.20		8	12.56	2.73	15.60	8.10
prox. base width			13.30		7	11.94	2.09	14.85	9.60
max base thick.			3.00		10	2.91	0.49	3.70	2.30
side (L/R)	L	R	L	R					
notch type	side-notch	side-notch	side-notch	side-notch					
notch form	angular, broad	U-shaped, narrow		angular					
shoulder height	6.40				15	7.18	1.16	9.30	4.95
notch height	3.00	2.60			14	2.96	1.08	6.00	1.75
base height	3.35			5.70	18	4.32	0.89	5.70	3.15
notch depth	2.50	2.75		3.30	25	2.47	0.66	4.10	1.20
prox. base angle	97		95	80	17	105.41	15.40	137.00	80.00
distal base angle	112	110		99	18	117.83	19.06	163.00	96.00
shoulder angle	97	88			24	103.83	17.31	139.00	80.00

Table 20.f: Projectile points, cont'd.

art. no.	18372			37240		42613			48310		
plate	14.i			14.a		14.c			14.b		
north	202.00			202.00		203.00			204.50		
east	102.50			103.00		102.50			100.50		
level	5			4		5			5		
mass	2.8			8.7		4.0			2.9		
complete	y			y		y			y		
length	21.1			26.8		24.3			25.9		
width	19.4			26.9		17.0			17.3		
thickness	6.4			12.4		8.6			9.2		
material	siliceous siltstone			swan river chert		jasper			chert		
colour	black N 2/0			grey 2.5Y 6/1		dark red 2.5YR 2.5/4			white N 9/0		
flake pattern	irregular: unifacial			irregular: unifacial		irregular: unifacial			irregular: unifacial		
outline form	triangular			triangular		ovoid			triangular		
cross-section	plano convex			plano-convex		plano-convex			triangular		
dorsal cortex	2			2		0			0		
dorsal flake scar count	24			50		43			19		
ventral flake scar count	8			10		7			7		
blank type	split pebble			percussion core		percussion core			indeterminate		
edge location	L. lat	distal	R. lat	L. lat	distal	L. lat.	distal	R. lat	L. lat	distal	R. lat
edge retouch	unimarg. contin.	unimarg. contin.	unimarg. contin.	bimarginal: discontin.	unimargin. continuous	unifacial: contin.	unifacial: contin.	unifacial: discontin.	unifacial: discontin.	bifacial: discontin.	none
edge mod.	use-wear	use-wear	use-wear	use-wear	use-wear	use-wear	heavy use-wear	heavy use-wear	use-wear	heavy use-wear	use-wear
edge shape	convex	convex	convex	straight	convex	convex	convex	convex	convex	convex	straight
edge length	12.5	17.0	21.3	28.5	31.2	23.8	17.7	17.3	28.0	19.7	19.2
edge angle	55	40	70	75	65	70	65	70	60	60	70
notes									organic residue		

Table 21.a: Unifaces.

art. no.	62089		62416	64088		66081			67808		
plate	14.d		14.h	14.f		14.g			14.e		
north	203.00		203.00	202.00		201.00			200.50		
east	104.50		104.00	104.50		104.00			101.00		
level	5		4	4		5			3		
mass	1.8		1.0	0.3		1.6			0.6		
complete	y		n	n		y			n		
length	21.0		13.8	15.0		16.7			13.8		
width	16.0		19.9	6.9		12.0			9.3		
thickness	5.9		2.8	3.1		5.3			4.0		
material	chert		siltstone	chert		siltstone			siliceous siltstone		
colour	light olive grey 5Y 6/2		dusky red 10R 3/2	very dark grey N 3/0		black N2/0			black N2/0		
flake pattern	irregular: unifacial		irregular: unifacial	irregular: unifacial		irregular: unifacial			irregular: unifacial		
outline form	triangular		ovoid	triangular		triangular			rectangular		
cross-section	plano-convex		plano convex	plano-convex		plano-convex			plano-convex		
dorsal cortex	0		0	1		0			0		
dorsal flake scar count	53		5	18		44			16		
ventral flake scar count	2		1	2		16			5		
blank type	flake		bipolar flake	bipolar flake		flake			indeterminate		
edge location	L. lat / dist	R. lat	L. lat	R. lat / prox	R. lat / dist	L. lat	R. lat / dist	proximal	L. lat	R. lat	distal
edge retouch	unifacial: continuous	unifacial: continuous	unimarginal: continuous	unimarg. contin.	unimarg. discont.	unifac. contin.	bifacial contin.	unifacial: contin.	bifacial: discont.	bifacial: discont.	unifac. contin.
edge mod.	use-wear	use-wear	use-wear	use-wear	use-wear	use-wear	use-wear	use-wear	use-wear	use-wear	heavy use-wear
edge shape	convex	convex	straight	convex	straight	convex	convex	convex	straight	straight	straight
edge length	34.2	19.1	8.5	14.7	7.0	17.5	24.9	19.5	9.0	8.7	8.0
edge angle	50	60	45	30	40	55	40	65	50	55	25
notes			exhausted						hafted plane?		

Table 21.b: Unifaces, cont'd.

art. no.	21703		34812		39349		42619/43762				
plate	15.e				15.h		15.d				
north	202.50		201.00		203.00		203.0/203.0				
east	100.00		103.00		103.00		102.5/102.0				
level	4		4		4		5, 5				
mass	2.7		1.1		1.1		2.5				
complete	n		n		y?		y				
length	15.2		23.3		16.4		18.5				
width	24.4		17.3		17.0		22.1				
thickness	6.6		4.5		3.8		5.2				
material	siliceous siltstone		siliceous sediment		silicified peat		silicified peat				
colour	black N 2.5/		black N 2.5/		7.5 YR 3/2		reddish black 2.5YR 2.5/1				
flake pattern	irregular: bipolar		irregular: bipolar		irregular: bipolar		irregular: bipolar				
outline form	rectangular		irregular / rectangular		irregular		triangular				
cross-section	plano-convex		plano-convex		asymmetrical biconcave		concavo-convex				
dorsal cortex	2		0		0		0				
dorsal flake scar count	3		11		10		27				
ventral flake scar count	4		2		6		20				
blank type	split pebble		indeterminate / flake		indeterminate		indeterminate				
edge location	distal	R. lat	L. lat	distal	distal	proximal	proximal	L. lat	distal	distal R. lat	proximal R. lat
edge retouch	bimarginal: continuous	unifacial: discont.	unimarginal: continuous	bifacial: discontin.	bimarginal: discontinuous	bifacial: discont..	bifac. discont.	unifac. contin.	bimarg. contin.	unimarg. discont.	bimarg. contin.
edge mod.	battered	none	none	battered	crushed	crushed	crushed	none	battered	use-wear	crushed
edge shape	sinuous	convex	convex	straight	straight	irregular	convex	convex	concave	convex	straight
edge length	21.5	7.9	6.5	13.8	13.5	10.9	7.1	21.2	15.9	8.3	13.8
edge angle	60	75	40	45	40	50	55	65	70	50	80
notes					recycled exhausted scraper		recycled exhausted scraper, split longitudinally				

Table 22.a: Wedges.

art. no.	49180		61070		62095		62194	
plate	15.b		15.g		15.f		15.a	
north	204.50		203.50		203.00		203.00	
east	100.00		104.50		104.50		104.00	
level	4		5		5		3	
mass	3.0		1.2		0.4		4.8	
complete	n		y		y		y	
length	21.7		17.2		15.2		22.9	
width	15.1		10.5		9.6		21.7	
thickness	6.2		6.1		3.5		9.4	
material	chert		swan river chert		silicified wood		swan river chert	
colour	light grey N 7/0		weak red 10R 5/4		light yellowish brown 10YR 6/4		7.5 YR 7/6	
flake pattern	irregular: bipolar		irregular: bifacial		irregular: bifacial		irregular: bipolar	
outline form	rectangular		rectangular		rectangular		rectangular	
cross-section	asymmetrical biconvex		asymmetrical biconvex		asymmetrical biconvex		asymmetrical biconvex	
dorsal cortex	0		0		0		1	
dorsal flake scar count	8		4		8		4	
ventral flake scar count	6		7		7		6	
blank type	indeterminate / flake		bipolar core / flake		bipolar core / flake		indeterminate / flake	
edge location	distal	proximal	distal	proximal	distal	proximal	distal	proximal
edge retouch	bipolar	bipolar	bifacial: discontin.	bifacial: discontin.	bifacial: discontinuous	bifacial: discontinuous	bifacial: contin.	bifacial: discontin.
edge mod.	battered	crushed	battering	battering	battering	battering	crushed	crushed
edge shape	sinuous	sinuous	straight	straight	straight	pointed	straight	pointed
edge length	12.2	17.3	10.4	10.0	7.2	4.0	21.1	14.3
edge angle	50	60	55	35	30	30	70	80
notes								

Table 22.b: Wedges, cont'd.

art. no.	65639		
plate	15.c		
north	201.00		
east	104.50		
level	5		
mass	2.0		
complete	y		
length	19.2		
width	15.5		
thickness	6.0		
material	swan river chert		
colour	light reddish grey 5YR 7/1		
flake pattern	irregular: bipolar		
outline form	ovoid		
cross-section	asymmetrical biconvex		
dorsal cortex	0		
dorsal flake scar count	15		
ventral flake scar count	9		
blank type	indeterminate		
edge location	distal	R. lat	proximal
edge retouch	bifacial: discontinuous	unimarginal: discontinuous	bimarginal: discontinuous
edge mod.	crushed	use-wear	crushed
edge shape	straight	convex	convex
edge length	8.5	18.6	10.7
edge angle	40	65	65
notes			

Table 22.c: Wedges, cont'd.

Art. No.	25134	34821	59455
Plate	16.b	16.c	16.a
North	201.00	201.00	204.50
East	100.00	103.00	104.00
Level	4	4	5
Weight (g)	27.2	26.6	90.1
Material	Lithic	Lithic	Lithic
Size	25-50 mm	25-50 mm	50 + mm
Rock	Quartzite	Quartzite	Andesite
Cortex	Cortex	Cortex	Cortex
Tool type	Hammer	Hammer	Hammer
Notes	Possibly recycled as core		

Table 23: Hammers.

Art. No.	40936	61640	62413	63903
Plate	17.b	17.c	17.a	17.d
North	203.50	203.00	203.00	202.50
East	102.50	104.50	104.00	104.50
Level	5	4	4	5
Weight (g)	483.3	2253.0	1285.6	203.9
Modification	Grnd/Peck	Utilized	Grnd/Peck	Pecked
Tool type	Anvil	Anvil	Anvil	Anvil
Shape	Rectangular	Ovate Body	Rectangular	Triangular
Complete	n	y	y	n
Notes	Pitted; also, scorched, fire-cracked	East side of hearth; Groove in center possibly from bone smashing; white residue (bone) in groove & on dorsal surface; Scorched.	West side of hearth	utilized in center - pitted. Not sure for what use, could be mortar or anvil.

Table 24: Anvils.

Taxon	Element	Side	Portion	NISP	Weight	MNE	MNI
Bison							
	Occipital		**Total**	**2**	**95.4**	**1**	**1**
			complete				
			R condyle	1	77.7	1	
			L condyle	1	17.7	1	
			frag				
	Ethmoid		**Total**	**3**	**22.1**	**3**	**3**
			complete	2	21.5	2	
			cribriform plate	1	0.6	1	
	Sphenoid		**Total**	**2**	**12.7**	**1**	**1**
			complete				
			frag				
			R ala	2	12.7	1	
			L ala				
	Temporal	**R**	**Total**	**3**	**30.1**	**2**	**2**
			complete				
			zygomatic process	2	20.5	2	
			petrous portion	1	9.6	1	
			frag				
		L	**Total**	**1**	**105.8**	**1**	**1**
			complete	1		1	
			zygomatic process				
			petrous portion				
			frag				
		ind	**Total**	**1**	**3.7**	**1**	**1**
			complete				
			zygomatic process				
			petrous portion	1	3.7	1	
			frag				
	Frontal	**R**	**Total**	**1**	**56.6**	**1**	**1**
			complete				
			orbital margin	1	56.6	1	
		L	**Total**				
			complete				
			frag				
		ind	**Total**	**1**	**15.6**	**1**	**1**
			complete				
			frag	1	15.6	1	
	Zygomatic	**R**	**Total**	**2**	**24.9**	**1**	**1**
			complete				
			orbital margin	1	12.7	1	
			temporal process	1	12.2	1	
		L	**Total**	**2**	**36.6**	**2**	**2**
			complete				

Table 25: Summary of identified bison bone.

			orbital margin	2	36.6	2	
			temporal process				
		ind	**Total**	**1**	**7.6**	**1**	**1**
			complete				
			orbital margin				
			temporal process	1	7.6	1	
	Lacrimal	**R**	**Total**	**1**	**3.8**	**1**	**1**
			frag	1	3.8	1	
		L	**Total**				
			frag				
	Nasal	**R**	**Total**	**3**	**78.7**	**2**	**2**
			complete	1	56.5	1	
			frag	2	24.2	1	
		L	**Total**	**1**	**14.2**	**1**	**1**
			complete				
			frag	1	14.2	1	
		ind	**Total**	**1**	**7.4**	**1**	**1**
			complete				
			frag	1	7.4	1	
	Palatine	**R**	**Total**	**1**	**5**	**1**	**1**
			complete				
			frag	1	5	1	
		L	**Total**	**2**	**14.2**	**1**	**1**
			complete				
			frag	2		1	
		ind	**Total**	**1**	**5.7**	**1**	**1**
			complete				
			frag	1	5.7	1	
	Maxilla	**R**	**Total**	**10**	**417.25**	**3**	**3**
			complete				
			alveolar process	4	330.3	3	
			frag	2	86.95	1	
		L	**Total**	**18**	**1235.25**	**10**	**10**
			complete				
			alveolar process	15	1222	10	
			frag	3	23.25	1	
		ind	**Total**	**11**	**74**	**1**	**1**
			complete				
			frag	11	74	1	
	Premaxilla	**R**	**Total**	**8**	**135.6**	**7**	**7**
			complete	6	98.7	6	
			frag	2	36.9	1	
		L	**Total**	**2**	**13.6**	**1**	**1**
			complete				
			frag	2	13.6	1	

Table 25: Summary of identified bison bone.

		ind	**Total**	**2**	**1**	**1**	**1**
			complete				
			frag	2	1	1	
	Ind cranial		**Total**	**3**	**10.7**	**1**	**1**
			frag	3	10.7	1	
	Hyoid		**Total**	**5**	**13.2**	**2**	**2**
			complete				
			frag	5	**13.2**	2	
	Mandible	**R**	**Total**	**25**	**1830.9**	**8**	**8**
			complete				
			ascending ramus	8	595	5	
			horizontal ramus	17	1169.6	8	
		L	**Total**	**49**	**1810.2**	**8**	**8**
			complete				
			ascending ramus	25	715.9	8	
			horizontal ramus	24	1094.3	4	
		ind	**Total**	**4**	**39.1**		
			complete				
			ascending ramus				
			horizontal ramus	4	39.1		
	Atlas		**Total**	**4**	**257.9**	**2**	**2**
			complete				
			R ala	2	70.7	1	
			L ala	1	72	1	
			body	1	115.2	1	
	Axis		**Total**	**3**	**523.8**	**3**	**3**
			complete	1	363.8	1	
			body with dens	2	160	2	
	Cervical vert		**Total**	**28**	**1270**	**5**	**2**
			complete				
			body	6	799.7	4	2
			neural arch	7	331.4	5	2
			other	15	138.9	3	1
	Thoracic vert		**Total**	**57**	**2169.4**	**12**	**2**
			complete	3	389.1	3	2
			body	9	864.6	9	2
			neural arch	3	64.6	1	1
			spinous process	10	370.5	2	2
			other				
	Lumbar vert		**Total**	**36**	**1939.8**	**11**	**2**
			complete	3	293.1	3	1
			body	10	1218.9	8	2

Table 25: Summary of identified bison bone.

			neural arch	7	263.6	3	2
			spinous process	4	52.9	4	1
			transverse process	10	92.1	7	2
			other	2	19.2	1	1
	Ind vert		**Total**	**5**	**34.8**	**1**	**1**
			complete				
			body	2	6.3	1	1
			neural arch	2	22.6	1	1
			spinous process	1	5.9	1	1
			other				
	Sacrum		**Total**	**3**	**61.4**	**1**	**1**
			complete				
			body	1	11.4	1	1
			R ala				
			L ala				
			other	2	50	1	1
	Caudal vert		**Total**	**4**	**2.1**	**2**	**1**
			complete				
			body	2	1.3	2	1
			other	2	0.8	1	1
	Ribs	**R**	**Total**	**35**	**1049.8**	**5**	**2**
			complete				
			vertebral end	7	202.7	5	1
			sternal end				
			body	28	847.1	3	2
		L	**Total**	**25**	**782.2**	**6**	**1**
			complete	1	11.7	1	1
			vertebral end	6	138.4	5	1
			sternal end	1	108.3	1	1
			body	17	523.8	2	2
		Ind	**Total**	**144**	**1625**	**3**	**2**
			complete				
			vertebral end	4	41.8	2	1
			sternal end	4	48.8	3	1
			body	136	1534.4	2	2
	Costal cartilage			**1**	**3.2**	**1**	**1**
	Sternum						
	Scapula	**R**	**Total**	**20**	**1397.2**	**2**	**2**
			complete				
			blade	18	652.3	1	1
			head	2	744.9	2	2
			other				
		L	**Total**	**6**	**329.7**	**2**	**2**
			complete				
			blade	3	231.3	1	1
			head	2	98.4	2	2

Table 25: Summary of identified bison bone.

			other				
		ind	**Total**	**14**	**161.6**	**1**	**1**
			complete				
			blade	14	161.6	1	1
			head				
			other				
	Humerus	**R**	**Total**	**18**	**1042.4**	**3**	**3**
			complete				
			proximal	2	36.2	1	1
			distal	4	566.6	3	3
			shaft	12	439.6	3	3
		L	**Total**	**11**	**1616.2**	**5**	**5**
			complete				
			proximal	1	27	1	1
			distal	4	1209.5	4	4
			shaft	6	379.7	2	2
		ind	**Total**	**3**	**37**	**2**	**2**
			complete				
			proximal	1	18.3	1	1
			distal	1	9.3	1	1
			shaft	1	9.4	1	1
	Radius	**R**	**Total**	**8**	**251**	**2**	**2**
			complete				
			proximal	1	28	1	1
			distal				
			shaft	7	223	2	2
		L	**Total**	**13**	**589.1**	**4**	**4**
			complete	2	223.3	2	2
			proximal	1	18.2	1	1
			distal	1	49.5	1	1
			shaft	9	298.1	2	2
		ind	**Total**	**5**	**155.3**	**1**	**1**
			complete				
			proximal				
			distal				
			shaft	5	155.3	1	1
	Ulna	**R**	**Total**	**4**	**152.6**	**1**	**1**
			complete				
			proximal	1	112.4	1	1
			shaft	3	40.2	1	1
		L	**Total**	**4**	**338.3**	**2**	**2**
			complete				
			proximal	1	214.2	1	1
			shaft	3	124.1	2	2
		ind	**Total**	**1**	**8.8**	**1**	**1**
			complete				
			proximal				

Table 25: Summary of identified bison bone.

			shaft	1	8.8	1	1
	Radial Carpal	**R**	**Total**	**1**	**16.9**	**1**	**1**
			complete	1	16.9	1	1
			fragment				
		L	**Total**	**1**	**26.1**	**1**	**1**
			complete	1	26.1	1	1
			fragment				
	Internal carpal	**R**	**Total**	**3**	**64.6**	**3**	**3**
			complete	3	64.6	3	3
			fragment				
		L	**Total**				
			complete				
			fragment				
	Ulnar Carpal	**R**	**Total**	**2**	**56.8**	**2**	**2**
			complete	2	56.8	2	2
			fragment				
		L	**Total**	**1**	**25.6**	**1**	**1**
			complete	1	25.6	1	1
			fragment				
	2nd & 3rd Carpal / Magnum	**R**	**Total**				
			complete				
			fragment				
		L	**Total**				
			complete				
			fragment				
	4th Carpal / Unciform	**R**	**Total**	**3**	**50.5**	**3**	**3**
			complete	3	50.5	3	3
			fragment				
		L	**Total**	**2**	**27.8**	**2**	**2**
			complete	2	27.8	2	2
			fragment				
	Accessory Carpal	**R**	**Total**	**2**	**15.4**	**2**	**2**
			complete	2	15.4	2	2
			fragment				
		L	**Total**				
			complete				
			fragment				
	Metacarpal	**R**	**Total**	**2**	**118.9**	**1**	**1**
			complete				
			proximal	1	14.7	1	1
			distal	1	104.2	1	1
			shaft				
		L	**Total**	**4**	**278.9**	**1**	**1**
			complete				
			proximal	2	91.9	1	1
			distal	1	144.3	1	1
			shaft	1	42.7	1	1

Table 25: Summary of identified bison bone.

		ind	**Total**	**2**	**47.2**	**1**	**1**
			complete				
			proximal				
			distal				
			shaft	2	47.2	1	1
	Os Coxa	**R**	**Total**	**7**	**883.3**	**2**	**2**
			complete				
			Ischium	3	105.9	1	1
			Ilium	1	17.6	1	1
			Pubis	2	70.3	1	1
			Acetabulum	1	689.5	1	1
		L	**Total**	**8**	**619.9**	**2**	**2**
			complete				
			Ischium	3	127.7	1	1
			Ilium	3	192.9	1	1
			Pubis	1	28.4	1	1
			Acetabulum	1	270.9	1	1
		ind	**Total**	**5**	**52.2**	**1**	**1**
			complete				
			Ischium	4	15.6	1	1
			Ilium				
			Pubis	1	36.6	1	1
			Acetabulum				
	Femur	**R**	**Total**	**16**	**1439.1**	**4**	**4**
			complete				
			proximal	3	633.6	3	3
			distal	2	60.5	1	1
			shaft	11	745	4	4
		L	**Total**	**23**	**940.5**	**4**	**4**
			complete				
			proximal	3	132.2	2	2
			distal	3	190.9	2	2
			shaft	17	617.4	4	4
		ind	**Total**	**10**	**205.6**	**2**	**2**
			complete				
			proximal	5	43.5	2	2
			distal				
			shaft	5	162.1	1	1
	Patella	**R**	**Total**				
			complete				
			fragment				
		L	**Total**				
			complete				
			fragment				
	Tibia	**R**	**Total**	**21**	**1316.3**	**3**	**3**
			complete				

Table 25: Summary of identified bison bone.

			proximal				
			distal	3	623.8	3	3
			shaft	18	692.5	2	2
		L	**Total**	**24**	**1068.8**	**2**	**2**
			complete				
			proximal	2	321.1	2	2
			distal				
			shaft	22	747.7	1	1
		ind	**Total**	**8**	**129.6**		
			complete				
			proximal				
			distal				
			shaft	8	129.6		
	Lateral Malleolus	**R**	**Total**	**4**	**38.5**	**4**	**4**
			complete	4	38.5	4	4
			fragment				
		L	**Total**	**2**	**16.9**	**2**	**2**
			complete	2	16.9	2	2
			fragment				
	Astragalus	**R**	**Total**	**8**	**851.1**	**8**	**8**
			complete	8	851.1	8	8
			fragment				
		L	**Total**	**3**	**306.9**	**3**	**3**
			complete	3	306.9	3	3
			fragment				
	Calcaneus	**R**	**Total**	**8**	**763.5**	**6**	**6**
			complete	5	652.7	5	5
			tuber calci	2	24.9	2	2
			fragment	1	85.9	1	1
		L	**Total**	**6**	**562.7**	**5**	**5**
			complete	4	502.9	4	4
			tuber calci	1	12.6	1	1
			fragment	1	47.2	1	1
	Central & 4th Tarsal / Naviculo Cuboid	**R**	**Total**	**5**	**342.5**	**5**	**5**
			complete	5	342.5	5	5
			fragment				
		L	**Total**	**3**	**185.5**	**3**	**3**
			complete	3	185.5	3	3
			fragment				
	2nd & 3rd tarsal / Cuneiform	**R**	**Total**	**6**	**71.9**	**6**	**6**
			complete	6	71.9	6	6
			fragment				
		L	**Total**	**1**	**15.3**	**1**	**1**
			complete	1	15.3	1	1
			fragment				
	1st Tarsal	**R**	**Total**	**4**	**5**	**4**	**4**
			complete	4	5	4	4

Table 25: Summary of identified bison bone.

			fragment				
		L	**Total**	**1**	**1.6**	**1**	**1**
			complete	1	1.6	1	1
			fragment				
	Metatarsal	R	**Total**	**9**	**856.6**	**7**	**7**
			complete	2	261	2	2
			proximal	6	428.8	4	4
			distal	1	166.8	1	1
			shaft				
		L	**Total**	**4**	**368.3**	**2**	**2**
			complete				
			proximal	2	177.6	2	2
			distal	1	84.7	1	1
			shaft	1	106	1	1
		ind	**Total**	**4**	**98.2**	**1**	**1**
			complete				
			proximal				
			distal				
			shaft	4	98.2	1	1
	Metapodial	ind	**Total**	**7**	**223.5**	**4**	**4**
			complete				
			proximal	1	95.9	1	1
			distal	6	127.6	4	4
			shaft				
	Proximal Phalanx		**Total**	**25**	**811.6**	**24**	**6**
			complete	20	745.4	20	5
			proximal				
			distal	5	66.2	5	2
			shaft				
	Intermediate Phalanx		**Total**	**16**	**339.3**	**16**	**4**
			complete	15	325.3	15	4
			proximal				
			distal	1	14	1	1
			shaft				
	Distal Phalanx		**Total**	**15**	**315.3**	**15**	**4**
			complete	14	301.7	14	4
			proximal				
			distal	1	13.6	1	1
			shaft				

Table 25: Summary of identified bison bone.

Taxon	Element	Side	Portion	NISP	MNE	MNI	Weight
Canid (dog / wolf)				**11**	**10**	**2**	**4.3**
	Ind. Vert. (C6-T1)		frag	1	1	1	1
	Rib	L	body	1	1	1	1
	Radius	R	complete	2	2	2	73.5
	Scaphoid	L	complete	1	1	1	3.6
	MC3	L	proximal	1	1	1	2.6
	MC4	L	proximal	1	1	1	2.8
	Femur	R	Total	1	1	1	55.5
			shaft	1	1	1	8.1
			proximal	1	1	1	47.4
	MT5	L	complete	1	1	1	4.3
	Pedal 2nd Proximal Phalanx	L	complete	1	1	1	1
Canid (dog / fox)				**3**	**3**	**1**	**1.5**
	Mandibular P2	ind	complete	1	1	1	0
	Femur	R	proximal	1	1	1	0.7
	MT3	R	complete	1	1	1	0.8
Spermophilus richardsonii				**14**	**14**	**2**	**15.6**
	Maxilla	R	alveolar process	1	1	1	0.1
		L	alveolar process	1	1	1	0.1
	Maxillary I2	R	complete	1	1	1	0.1
	Temporal	L	complete	1	1	1	0.1
	Thoracic vert.		body	1	1	1	14
	Rib	R	vertebral end	1	1	1	0
		L	vertebral end	1	1	1	0.1
	Scapula	R	lateral	1	1	1	0
	Humerus	R	Total	2	2	2	0.5
			complete	1	1	1	0.3
			distal	1	1	1	0.2
	Os Coxa	L	acetabulum	1	1	1	0.2
	Tibia	R	complete	1	1	1	0.3
	Intermediate Phalanx	ind.	complete	2	2	1	0.1
Spermophilus tridecemlineatus				**2**	**2**	**1**	**0.2**
	Frontal		complete	1	1	1	0.1
	Os Coxa	R	acetabulum	1	1	1	0.1
Spermophilus sp.				**2**	**2**	**1**	**0**
	Ind. Tooth		complete	2	2	1	0
Microtus sp.				**2**	**2**	**1**	**0.1**
	Cranium		anterior	1	1	1	0.1
	Caudal vert.		anterior	1	1	1	0

Table 26: Summary of identified non-bison faunal material.

Buteo sp.				**8**	**7**	**1**	**2.7**
	Vertebra		complete	4	4	1	0.8
	Humerus	R	proximal	1	1	1	0.8
		L	proximal	1	1	1	0.5
	Radius	L	total	2	1	1	0.6
			distal	1	1	1	0.3
			shaft	1	1	1	0.3
Accipitridae (eagle)				**1**	**1**	**1**	**0.1**
	vertebra		centrum	1	1	1	0.1
Anas sp.				**10**	**9**	**2**	**5.1**
	vertebra		complete	4	4	1	0.6
	Humerus	R	shaft	1	1	1	1.5
	Radius	L	shaft	1	1	1	0.6
	Ulna	R	distal	1	1	1	1
	Carpometacarpus	R	total	2	2	1	1.1
			proximal	1	1	1	0.5
			distal	1	1	1	0.6
	2nd Proximal Phalanx	R	complete	1	1	1	0.6
Corvidae (crow / magpie)				**3**	**2**	**1**	**0.5**
	Femur	R	proximal	1	1	1	0.2
			distal	1	1	1	0.1
	Tibio-tarsus	R	complete	1	1	1	0.2
Tympanuchus phasianellus				**1**	**1**	**1**	**0.4**
	Tibio-tarsus	L	shaft	1	1	1	0.4
Esox lucius				**1**	**1**	**1**	**0.3**
	vertebra		complete	1	1	1	0.3
Clam (Lampsilis radiati siliquoidea or Lasmigona complanata)				7		1	
	valve			7	1	1	

Table 26: Summary of identified non-bison faunal material.

Art. No.	17501	45903	32953	23005	33649	40904	64111
North	202.0	203.0	201.5	200.0	201.0	203.5	202.0
East	102.5	101.5	103.0	100.0	103.0	102.5	104.5
Level	5	5	4	4	4	5	5
Length	78.4	84.8	68.7	52.1	106.8	44.9	32.6
Width	8.7	7.5	14.7	15.3	28.9	7.5	10.5
Thickness	4.3	3.0	8.9	8.5	15.1	4.1	9.0
Mass	1.9	1.5	3.9	3.9	13.9	1.2	0.8
Element	large mammal long bone	ind. (possible bird) long bone	ind. bone	mammal long bone	bison rib (head)	mammal long bone	mammal rib
Blank	fortuitous splinter	grooved splinter			fortuitous break		
Manufacture	whittled point	whittled point			possibly cut tip		
Distal form	pointed	pointed		round, beveled	round, blunt	round, blunt	square, blunt
Distal wear	limited polish & circumferential scratches	heavy polish & longitudinal scratches		minimal polish, longitudinal scratches	polish, circumferential scratches	limited wear	limited polish, step fracture
Prox. wear	some prehensile wear	extensive prehensile wear, oblique scratches	heavy polish, longitudinal scratches			limited prehensile wear	
Type	perforator / awl	perforator / awl	ind.	blunt	blunt	blunt	blunt
Portion	complete	complete	proximal	distal frag	complete	distal frag	distal frag
Taphonomy				weathered	carnivore chewed, weathered		
Notes							

Table 27.a: Faunal tools.

Art. No.	36778	10517	26527	27950	43861	53061	53268	61328	62814	63417
North	202.5	201.0	200.0	200.5	203.5	204.0	204.0	203.0	203.0	202.5
East	103.5	101.5	101.5	102.0	101.0	101.5	101.5	104.5	104.0	104.5
Level	5	4	4	4	5	5	5	4	5	5
Length	116.0	135.2	202.0	34.0	141.6	74.6	36.7	35.4	34.1	237.0
Width	19.2	32.7	23.9	13.9	27.7	17.8	14.4	14.0	15.6	24.0
Thickness	8.2	14.3	6.2	3.9	7.6	4.0	3.9	4.4	3.9	15.4
Mass	17.5	34.9	16.3	1.3	19.9	4.6	1.5	1.4	1.7	69.2
Element	Bison Rib (shaft)	R. Bison Rib (shaft)	Mammal Rib (shaft)	Mammal Rib (shaft)	Bison Rib (shaft)	Mammal Rib (shaft)	Mammal Rib (shaft)	Mammal Rib (shaft)	Mammal Rib (shaft)	R. Bison Rib (shaft)
Blank	split proximal shaft frag			cortex frag		cortex frag	cortex frag	cortex frag	cortex frag	
Manufacture									possibly grooved	
Distal form	square, spatulate	pointed, blunt	round, spatulate	pointed, spatulate	pointed, spatulate	square, beveled	pointed, spatulate	square, spatulate	pointed, spatulate	round, blunt
Distal wear	heavy wear, polish, longitudinal & oblique scratches	heavy wear	heavy wear	heavy wear, oblique scratches	heavy wear & polish	wear, oblique scratches	polish, oblique scratches	heavy polish, longitudinal and oblique scratches	heavy polish, oblique scratches	heavy wear, polish, longitudinal & oblique scratches
Prox. wear		transverse scratches								prehensile wear, transverse scratches
Type	spatulate	spatulate	spatulate	spatulate	spatulate	spatulate	spatulate	spatulate	spatulate	spatulate
Portion	distal	distal	distal	distal	distal	distal	distal	distal	distal	complete
Taphonomy		weathered	weathered		weathered	weathered		burnt		carnivore chewed
Notes				possible blood residue			possible blood residue	possible blood residue	possible blood residue	possible blood residue

Table 27.b: Faunal tools, cont'd.