A Comprehensive Faunal Analysis of Bushfield West (FhNa-10), Nipawin, Saskatchewan

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ABSTRACT

Bushfield West (FhNa-10) is a late precontact habitation site situated on a lower terrace of the Saskatchewan River valley near the town of Nipawin, in east central Saskatchewan. The site was discovered in 1976 by archaeologists from the Saskatchewan Research Council during an extensive environmental study of the Saskatchewan River valley between Nipawin and Thompson Island. The study was commissioned by the Saskatchewan Power Corporation in preparation for the construction of a 252 megawatt hydroelectric dam on the Saskatchewan River adjacent to the town of Nipawin. Construction of the facility did not begin until 1981 and in compliance with the Saskatchewan Heritage Property Act, Bill No. 88, the Saskatchewan Power Corporation funded the mitigation of heritage resources located in the dam construction site area, the reservoir area, and a 200 m wide buffer zone.

Mapping, initial assessment, and salvage excavation of Bushfield West began in 1981 since the site was in immediate danger due to gravel quarrying activities on the northern edge of the flat by the Saskatchewan Department of Highways. The research potential provided by the extensive, largely undisturbed cultural deposit quickly became evident and the site was recommended for large scale mitigation in the summers of 1982 to 1984. Mitigation of Bushfield West entailed the excavation of 624 m^2, uncovering numerous pieces of debitage, stone tools, ceramic sherds, bone tools, and over 100 kg of bone, as well as cultural features such as hearths, ash dumps, and rock pits. The artifact assemblage, particularly the ceramics, small side-notched projectile points, adze blades, barbed bone harpoons, bone whistles, shell beads and pendants, is characteristic of the Pehonan complex of the Selkirk Composite. Radiocarbon dates suggest that the occupation of the river terrace occurred at approximately A.D. 1600.

The focus of this thesis is the description and analysis of the faunal material recovered from the three largest excavation blocks at Bushfield West, representing 529.5 m^2 of the site (this does not include the fine-screen microfauna). Both are requirements for the interpretation of subsistence strategies and resource exploitation procedures carried out by the people who occupied Bushfield West. Altogether 108,135 animal bones were examined and eventually separated into unidentifiable bone fragments (93,545 pieces weighing 42.5 kg) and identifiable specimens (14,590 bones weighing 128.0 kg). A wide variety of mammal, bird, and fish resources are represented in the identifiable faunal material: bison, moose, elk, bear, canids, lynx, marten, badger, striped skunk, snowshoe hare, white-tailed jackrabbit, beaver, muskrat, red squirrel, swans, geese, teal, mallard, grouse, crane, sturgeon, northern pike, suckers, silver redhorse, shorthead redhorse, and walleye.

Several factors suggest that Bushfield West was occupied in the spring of the year: most of the bird species represented at the site are spring migrants to the Nipawin region; the presence of medullary bone in some of the grouse elements; the recovery of eggshell fragments; the majority of fish species represented at the site are spring spawners; the presence of foetal and/or newborn ungulate specimens and juvenile beaver elements; and the eruption schedules and wear patterns of the bison mandibles. These are all strong indicators that the site was occupied in April, May and possibly as late as early June.

The gender profile of the bison represented at the site is established using Walde's step-wise discriminant function analysis for long bone portions and Morlan's bimodiality measurements of carpals and tarsals. Economic utilization indices are used to interpret bison processing decisions. Cut marks, bone fragmentation, articulation units, and burning and calcining of large ungulate, medium-sized mammal, small-sized mammal and bird bones are described in order to identify butchering and dismemberment patterns. The results of this detailed examination of the faunal material contributes valuable information concerning the day to day activities of the occupants of Bushfield West.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDIX A - LIST OF TABLES

APPENDIX B - LIST OF FIGURES

APPENDIX C - LIST OF FIGURES

APPENDIX D - LIST OF FIGURES

APPENDIX E - LIST OF TABLES

LIST OF ABBREVIATIONS USED IN TEXT, TABLES, AND CHARTS

(S)MAVGGRE: standardized modified averaged grease fat model
(S)MAVGMAR: marrow utility index
(S)MAVGTP: standardized modified averaged data total products model

1st metac.: 1st metacarpal
1st Phal.: 1st phalanx
2nd metat.: 2nd metatarsal
2nd Phal.: 2nd phalanx
2nd/3rd T.: fused 2nd/3rd tarsal
2nd/3rd tar.: fused 2nd/3rd tarsal
3rd Phal.: 3rd phalanx
5th metac.: 5th metacarpal

acces. carp.: accessory carpal
acetabul.: acetabulum
acrom. pro.: acromion process
art. facet: articular facet
asc. ramus: ascending ramus
aud. bulla: auditory bulla
aud. meat.: auditory meatus

basioccipit.: basioccipital
basisphen.: basisphenoid
bony oss.: bony ossicle
branchiot.: branchiostegal ray
BUI: bone utility index

Cal.: calcaneus
carp. facet: carpal articular facet
carpometa.: carpometacarpus
caudal bor: caudal border
Cen./4th T.: fused central/4th tarsal
cen./4th: fused central/4th tarsal
cmpt. fem.: complete femur
cmpt. inn.: complete innominate
cmpt. man.: complete mandible
cmpt. ulna: complete ulna
cor. process: coronoid process
cora. facet: coracoid facet
costal cart.: costal cartilage
Cutmks: cut marks
cranial bor: cranial border

D. Depth: distal depth
D. Width: distal width
dec. i4: deciduous fourth incisor or canine
dec. incisor: deciduous incisor
dec.: deciduous
diast./sym.: diastema and mandibular symphysis
Dist. Hum.: distal humerus
Dist. Metata.: distal metatarsal
Dist. Rad.: distal radius
Dist. Tibia: distal tibia
dpre/mo.: deciduous premolar or molar

ext. aud.: external auditory meatus
ext. cunei.: external cuneiform

Fem. D.: femur distal
Fem. P.: femur proximal
Fem. S.: femur shaft
Fem./Sub.: females and/or sub-adults
freq.: frequency
FUI: food utility index
fused r./u.: fused radius and ulna

GI: grease utility index
glen./neck: glenoid fossa and neck
glenoid: glenoid fossa
Ground Squir.: Ground Squirrel
GUI: general utility index

head/neck: head and neck
hor. ramus: horizontal ramus
Hum. D.: humerus distal
Hum. D.: humerus distal
Hum. P.: humerus proximal
Hum. S.: humerus shaft
hyomand.: hyomandibular

ili./ish. sp.: ilium and ischial spine
indt. art.: indeterminate long bone articular end
indt. cran.: indeterminate cranial fragment
indt. I: indeterminate incisor
indt. metac.: indeterminate metacarpal
indt. metat.: indeterminate metatarsal
indt. molar: indeterminate molar
indt. phal.: indeterminate phalanx
indt. ses.: indeterminate sesamoid
indt. shaft: indeterminate long bone shaft fragment
indt. teeth: indeterminate teeth
indt. vert.: indeterminate vertebra(e)
infer. ses.: inferior sesamoid

Int. C.: internal carpal
int. cunei.: internal cuneiform
intern. carp.: internal carpal
interpariet.: interparietal

jug. pro.: jugular process

L. Depth: lateral depth
L.Len.: lateral length
Lat. mall.: lateral malleolus
lat. cond.: lateral condyle
lat. epico.: lateral epicondyle
lat. fossa: lateral fossa
lat. mall.: lateral malleolus
Len.: length
Lc: length of fused cen/4th facet
lg. shaft: indeterminate long bone shaft
low. M3: lower third molar
low. molar: lower molar
low. pre.: lower premolar
lower P/M: lower premolar or molar
Lt: length of astragalus facet

M. Depth: medial depth
M. Len.: medial length
maj. troch.: major trochanter
maj. tub.: major tuberosity
man. cmpt.: complete mandible
man. sym.: mandibular symphysis
mand. con.: mandibular condyle
mand./th.: mandible with teeth
Mand.: mandible
manub.: manubrium
MAU: minimum number of animal units
maxilla/th.: maxilla with teeth
med. cond.: medial condyle
med. cune.: medial cuneiform
med. epico.: medial epicondyle
med. fossa: medial fossa
med. mall.: medial malleolus
Metac. D.: metacarpal distal
Metac. P.: metacarpal proximal
Metac. S.: metacarpal shaft
metac.: metacarpal
metapod.: metapodial
Metat. D.: metatarsal distal
Metat. P: metatarsal proximal
metat. shaft: metatarsal shaft
metat.: metatarsal
MGUI: modified general utility index
MI: marrow index
min. troch.: minor trochanter
min. troch.: minor trochanter
min. troch.: minor trochanter

MNE: minimum number of elements
MNI: minimum number of individuals
MUI: meat utility index
Mult.: multiple modifications
mus. lines: muscle lines

n. compt. h.: nearly complete humerus
near compt.: nearly complete
neck/body: neck and body
neck/tub.: neck and tubercle (or tuberosity)
NISP: number of identified specimens per taxonomic unit
N. P. Gopher: Northern Pocket Gopher

occip. con.: occipital condyle
olec. proc.: olecranon process
olecra foss.: olecranon fossa

P. Depth: proximal depth
P. Width: proximal width
parashpen.: parasphenoid
pat. groove: patellar goove
peroperc.: peroperculum
phal.: phalanx
phary. arch: pharyngeal arch
pit.: pitting
post temp.: post temporal
postcleith.: postcleithrum
pre/molar: premolar or molar
preoperc.: preopercular
presphen.: presphenoid
Prox. Metac.: proximal metacarpal
Prox. Metata.: proximal metatarsal
Prox. Rad.: proximal radius
punct.: puncture

R. Carpal: radial carpal
R. G. Squirrel: Richardson's Ground Squirrel
Rad. D.: radius distal
Rad. P.: radius proximal
Rad. S.: radius shaft
rad./ulna: fused radius/ulna
radial carp.: radial carpal
radial fossa: radial fossa
Red squir.: red squirrel
rib cmpt.: complete rib
rib ncmpt.: nearly complete rib

s. lat. ses.: superior lateral sesamoid
s. med. ses.: superior medial sesamoid
scapholun.: scapholunar carpal
scor.: scoring

semi. lun.: semi-lunar notch
subopercu.: subopercular
sup. cond.: supracondyloid fossa
supracleith.: supracleithrum
supraoccip.: supraoccipital

tarsal art.: tarsal articular surface
tarsometa.: tarsometatarsus
Tib. D.: tibia distal
Tib. P.: tibia proximal
Tib. S.: tibia shaft

Ul. C.: ulnar carpal
Ulna P.: ulna proximal
Ulna S.: ulna shaft
ulnar carp.: ulnar carpal
Un. C.: unciform carpal
Ung., unid.: ungulate, unidentified
uncif. carp.: unciform carpal
unfused Epip.: unfused epiphysis
ung.: ungulate sp?
upper M: upper molar
upper P/M: upper premolar or molar
upper pre.: upper premolar

CHAPTER 1

Introduction

1.1 Introduction

Bushfield West (FhNa-10) is a large habitation site situated on a lower terrace of the Saskatchewan River valley on the southern edge of the boreal forest in east central Saskatchewan. The site was discovered in 1976 by archaeologists from the Saskatchewan Research Council during a survey of the Saskatchewan River valley and associated uplands between Nipawin and Thompson Island. The archaeological survey was part of an environmental study of the potential impacts of a proposed Saskatchewan Power Corporation hydroelectric development on the Saskatchewan River adjacent to the town of Nipawin.

In 1978 an environmental board of inquiry recommended that the position of the dam be relocated 4 km upstream from its original location (Burley 1982: 2). Relocation of the dam resulted in changes to the boundaries of the reservoir that had been proposed in 1976, thus requiring a review of the potential impacts that the reservoir would have on heritage resources. First, the area of the river valley that would be affected by inundation was extended 2.5 km upstream from Thompson Island. Second, the full supply level had been increased by three metres. Third, heritage resources situated in areas where the dam and its ancillary developments—reservoir spillway, construction camps, and gravel quarries—were planned would have to be adequately assessed and mitigated. Fourth, it became apparent that certain sections of the reservoir area had been more intensively surveyed than others during the 1976 project creating information gaps in the archaeological data base. (ibid: 5). A two phase archaeological research project was developed to address these concerns.

Construction of the Francois-Finlay Hydroelectric dam began in the fall of 1981 and was completed in 1985. The dam created a large reservoir, Codette Lake, within the confines of the Saskatchewan River valley extending 65 km upstream and having a maximum width of approximately 2 km. Full supply level of Codette Lake is 348 m, resulting in the inundation of approximately 2950 ha of the valley, predominantly the lower terraces and adjacent valley slopes (Burley et al. 1982a: 3).

In the fall of 1981 it was discovered that Bushfield West was in imminent danger of being destroyed as a result of salvage quarrying by the Saskatchewan Department of Highways of gravel and sand deposits located on the lower terrace. Due to the threat of immediate impact, site mapping, assessment, and salvage excavation of Bushfield West began in October of 1981 as part of Phase 1 mitigation. Assessment results indicated the presence of an extensive intact occupation beneath the plough zone and a thin stratum of alluvial sand on the northwest section of the flat. Excavation of large block areas over a period of three summers from 1982 to 1984 resulted in the discovery of several cultural features such as hearths, ash dumps, and rock pits, as well as hundreds of thousands of artifacts—debitage, stone tools, ceramic sherds, bone tools—and in excess of 100 kg of bone. The ceramics, small side-notched projectile points, adze blades, barbed bone harpoons, and bone awls indicate that the assemblage is associated with the Pehonan complex of the Selkirk Composite. Based on radiocarbon dating, site occupation occurred at approximately 350 years ago or A.D. 1600.

Four main research goals or issues are addressed in this thesis. The first goal is to provide an accurate identification of the faunal resources represented at Bushfield West. This is a necessary initial step toward the interpretation of subsistence strategies and resource exploitation by the ancestral Cree people who occupied the site. Second, the faunal resources provide multiple lines of evidence for identifying the seasonality of site occupation. Third, this site is characterized by relatively good preservation of the fauna providing an opportunity to examine butchering, processing, and utilization strategies at a single component habitation site in the southern boreal forest. Ethnoarchaeological, archaeological and experimental research models are used to interpret these activities. Fourth, the large sample provides a relatively accurate indication of the range of taphonomic processes affecting the faunal assemblage and the degree to which it has been altered.

Chapter 2 is an overview of the culture chronology of the Nipawin region from approximately 10,000 years ago with the retreat of Glacial Lake Agassiz from the region until the end of the Late Prehistoric period cira 250 years ago. Chapter 3 presents a detailed description of the biophysical environment of the region including landforms, climate, flora, and fauna with particular emphasis on the resources which would have been important to the subsistence economy of the people inhabiting the area. Chapter 4 is a review of the site history; its discovery, the assessment and excavation procedures, the stratigraphy, and the radiocarbon dating results. Chapter 5 is a discussion of the computer data base designed for cataloguing the faunal material recovered from the site and the quantification methods followed in analyzing the data. Chapter 6 is a description of the fauna recovered from the excavation of Block 1. Chapter 7 describes the fauna represented in excavation Block 2. Chapter 8 is a compilation of the fauna recovered from the excavation of Block 3. Chapter 9 is a description and discussion of the taphonomic history of the faunal assemblage. Chapter 10 presents the results and interpretations of site seasonality, age, and gender analysis. Chapter 11 discusses the butchering and processing of mammals of various sizes; large, medium, and small; and birds which are represented in the faunal assemblage at Bushfield West. Chapter 12 focuses on possible bison carcass utilization strategies, as well as bone density and survivorship. The final chapter is a synthesis of the information derived from the analysis of the faunal material and general conclusions regarding intrasite activities and seasonal movements.

CHAPTER 2

Culture Chronology of the Nipawin Region

2.1 Introduction

Christiansen's (1979) history of the deglaciation of Saskatchewan indicates that the Late Quaternary Wisconsinan deglaciation of east central Saskatchewan extended over a period of approximately 11,500 to 10,000 years ago. Within a short interval between circa 11,500 and 11,000 years ago Glacial Lake Saskatchewan, which covered a large portion of the region, drained as the glacier retreated along the Manitoba Escarpment and glacial meltwaters flowed directly into Glacial Lake Agassiz (Christiansen 1979: 933).

In 1982 Christiansen undertook a geological study of the Cretaceous bedrock and glacial and postglacial deposits in the Nipawin region as part of the Nipawin Reservoir Heritage study. This study depicted the history of the deglaciation of the Nipawin region in 5 phases (Christiansen 1982: 34). Prior to Phase 4 a rapid drop in the water levels of Glacial Lake Agassiz to the lower Campbell waterplane resulted in downcutting and the formation of the upper terraces of the river valley. A subsequent rise in water levels to the Upper Campbell waterplane resulted in the inundation of the Saskatchewan River valley. During phase 4 (11,000 years ago) the Campbell Strandline was formed by the erosion of lacustrine and deltaic deposits that were previously deposited in Glacial Lake Saskatchewan. Between Phase 4 and Phase 5, approximately 10,000 years ago, Glacial Lake Agassiz fell to the McCauleyville level; this marks approximately the time at which Glacial Lake Agassiz retreated from the Nipawin region. At this time the water level of Glacial Lake Agassiz corresponds with the upper reaches of the lower terraces (ibid.: 46). Of particular interest with regard to the deglaciation history of the area is a radiocarbon date of 10,265 $\pm$ 585 years ago from a paleosol developed on the Saskatchewan Delta Deposits which indicates that Glacial Lake Agassiz had receded from the Nipawin region prior to this date (ibid.: 48). A second sharp drop in the level of Glacial Lake Agassiz occurred at approximately 8000 years ago when the water level fell to the Stonewall waterplane. This initiated further downcutting of the river valley and resulted in the formation of the lower terraces. Glacial Lake Agassiz disappeared at approximately 7300 years ago and at this time the Saskatchewan River incised to its base level. By this time all of the major landforms within the Saskatchewan River valley had been formed (ibid.: 51).

Glacial retreat from the area and subsequent draining of Glacial Lake Saskatchewan resulted in the exposure of uplands west of the present-day Nipawin-Codette area. The uplands would have been capable of sustaining sufficient flora and fauna to enable human occupation of the area at approximately 11,000 to 10,000 years ago (Finnigan et al. 1983: 12). Two dramatic drops in the level of Glacial Lake Agassiz occurred during the glacial retreat from the region resulting in rapid downcutting of the valley and subsequent formation of terraces suitable for human habitation. By approximately 7000 years ago the lower terraces would have been suitable for human utilization (Burley et al. 1982b: 17).

2.2 The Early Prehistoric Period (12,000-7500 B.P.)

Clovis and Folsom projectile points representative of the earliest human occupants have not been found in the Nipawin region. The earliest projectile point types in east central Saskatchewan consist of a few Agate Basin, Alberta and Cody complex points. The Agate Basin point types date to a period of 10,500 to 10,000 years ago and the Alberta and Cody complex point types date to a time period of 9500 to 8500 years ago (Frison 1978: 31-34). The dates for these point types have been derived from sites on the Northwestern American Plains and it is assumed that these dates are also applicable to Early Prehistoric Period sites in central Saskatchewan. All of the points from the Early Prehistoric Period have been collected by avocational archaeologists in areas to the west and southwest of Nipawin. Only Alberta complex projectile points have been found in the region of Glacial Lake Agassiz, east of Nipawin (Meyer 1977: 98).

The first occupation of the Saskatchewan River valley in the Nipawin region occurs during the latter part of the Early Prehistoric period (8500 - 7500). This time period is represented by late-Plano projectile points of the Nipawin complex (Finnigan et. al. 1983: 12). These are lanceolate-shaped projectile point fragments, similar to Lusk and Frederick types, collected from the surfaces of cultivated fields at the following sites—Windrow (FhNa-93), Horudko (FhNb-60), Running Elk (FhNa-41), Breaking (FhNa-81) and a find spot near the Gronlid Ferry (FhNc-26) (Meyer 1977: 99-101; Finnigan et. al. 1983: Table 3.3). Local lithic materials; quartz and Swan River chert; were selected for the manufacture of these points. The margins of these projectile points narrow towards the base and they may or may not be ground. The base is slightly concave and usually unground, and a few exhibit extensive basal thinning. Although these points are described as being similar to those of the Frederick and Lusk complexes in terms of shape, grinding of the lateral edges, and occasional basal thinning they are also recognized as being different, thus the suggestion of a distinct complex—the Nipawin complex (Meyer 1977: 102).

Thirteen whole and fragmentary projectile points which can be assigned to the latter complex have also been found in the nearby Carrot River district (Meyer 1970: 9-10). Most of these points were found on the surfaces of cultivated fields in close proximity to creeks and streams which dissect the bed of Glacial Lake Agassiz (ibid.: 8). These points are lanceolate in shape with no stemming or notching, exhibit heavily ground lateral edges; generally the bases are unground, and occasionally they have long thinning flakes removed from the base. The flaking appears to be quite irregular with only a few specimens demonstrating oblique flaking. All except one of the points are manufactured from local cherts of varying colors and texture. The exception is a translucent Knife River flint or brown chalcedony lithic material (ibid.: 14-15).

Contiguous with the Frederick and Lusk complexes are several other projectile point types namely, Pryor Stemmed, James Allen, Angostura, Lovell Constricted, and Browns Valley. All of these are parallel-oblique flaked projectile points; however, the Pryor Stemmed, Lovell Constricted, and the Browns Valley have distinctive shapes which distinguish them from the other point types. The remaining four types; Angostura, Frederick, Lusk, and James Allen; are often difficult to differentiate and they were the focus of a study by Jeani Borchert (1989) as she attempted to identify quantitative attributes which could be used to characterize these point types. Upon finishing her research she recommended that Lusk and Frederick point types be subsumed under the Angostura point type (Borchert 1989: 76). However, only three Frederick points were used in her study and although they did cluster with Angostura points in the analysis the sample size is too small on which to base any conclusive statements. Any changes in nomenclature will certainly require further studies with larger samples and hands-on evaluation of the specimens (which was apparently not possible for Borchert's study).

2.3 The Middle Prehistoric Period (7500-2000 B.P.)

At the beginning of the Nipawin Hydroelectric Project the early part of the Middle Prehistoric period (7500 - 5000 B. P.) appeared not to be well represented. Only three surface sites, with isolated projectile point finds, were associated with the Early side-notched or Mummy Cave complex (Burley et. al. 1982b: 73). When the survey and limited assessment stages of the Nipawin Hydroelectric Project had been completed an additional 13 sites with associated Early side-notched projectile points were identified. All except two of the sites with Early side-notched material were found in cultivated fields. The exceptions include the Eight Ball site (FhNa-110) and the Unexpected site (FhNd-16). The Eight Ball site is located near the edge of a creek ravine on an upper terrace above Bushfield's Flat (Finnigan et. al. 1983: 268). The Unexpected site is situated along a small creek which flows into the Saskatchewan River upstream from Thompson Island (ibid.: 353). The Early side-notched point was found at the Unexpected site during the mitigation phase and has not yet been reported on (James Finnigan 1995, per. com.).

The Early side-notched or Mummy Cave complex is better known on the plains largely due to the excavation and analysis of Gowen I and II materials by Walker (1980, 1992). Part of the research undertaken in association with the analysis of Gowen site materials was an overview of projectile point types associated with the Early Middle Prehistoric Period. A discriminant function analysis of projectile points associated with this time period resulted in the identification of five projectile point types each associated with a specific time span: Blackwater side-notched (7600-7200 B.P.), Northern or Bitterroot side-notched (7200-6000 B.P.), Hawken side-notched (6500-5300 B.P.), Gowen side-notched (6000-5500 B.P.), and Mount Albion corner-notched (5700-4500 B.P.). The Early side-notched points from the Nipawin Hydroelectric project have not been compared to points from the same time period in other regions so it is impossible to say if they are representative of any of the types described by Walker (1992: 132-142).

The Oxbow complex (5000-3500 B.P.) is well represented in the Nipawin region. Fourteen sites with associated Oxbow components were identified in 1976 (Burley et. al. 1982b: 75). Nine sites produced Oxbow projectile points during the 1982 and 1983 surveys (Finnigan et. al.: 1983). The majority of Oxbow diagnostics have come from disturbed contexts; i.e. cultivated fields, the exception being an Oxbow point recovered from the third occupation level (40-50 cm below the surface) at the Hamilton site (FhNc-5) (ibid.: 118).

McKean complex sites (4150-3350 B.P.) are as abundant as those of the previously discussed Oxbow complex with at least 15 sites being recorded during the two Nipawin studies. The McKean complex includes three projectile point types: the McKean Lanceolate, Duncan, and Hanna. Projectile points representative of the McKean complex were found on the surfaces of cultivated fields, as well as in buried *in situ* contexts. These sites are located within various topographical regions along the Saskatchewan River: on the valley rim, on valley terraces, and on the river flats (Burley et. al. 1982b: 77). Certainly the most extensively excavated (92 m^2) and significant McKean complex site in the Nipawin region is the Crown site (FhNa-86). Hanna and McKean projectile points were recovered from separate occupations at this site. The McKean occupation radiocarbon dates ranged from 3800 to 4300 B.P., while the Hanna occupation dates ranged from 3300 to 3630 B.P. (Quigg 1986: 229-230). Excavation of 46 m^2 at the Broken Axle site yielded five Hanna-like projectile points (Ramsay 1993: 326-327). The Broken Axle site is situated on a low terrace on the north side of the Saskatchewan River. Two other sites situated on low terraces produced McKean Lanceolate projectile points in undisturbed contexts—Tantalized (FhNa-108) and Elk Traps (FhNb-4) (Finnigan et. al. 1983: 139).

The end of the Middle Prehistoric period is only sparsely represented by Pelican Lake (3000 - 2000 B. P.) and Besant occupations (2000-1150 B. P.). Seven surface sites and two undisturbed sites in forested areas yielded Pelican Lake projectile points. These sites are located either on the valley edge or on upper terraces. A single Pelican Lake point was recovered from the eastern area of the Gravel Pit site (FhNa-61) in a small 2 x 3 m^2 excavation block. The projectile point was associated with a lithic reduction area in which debitage, a few cores, and two hammerstones were found (Klimko 1985: 100). The Gravel Pit site is located on the upper reaches of a lower terrace above the Saskatchewan River. A Pelican Lake point was also found in an assessment pit at the Trail's Edge site (FhNa-107). This site is situated on an intermediate terrace of the valley above Bushfield's Flat. Further excavations were not carried out at this site. Two Pelican Lake points were found at the Broken Axle site in the same stratigraphic levels that Hanna-like points were recovered from (Ramsay 1993: 327). The poor occupational separation at the site makes it difficult to provide any statements concerning their association with other cultural materials. Two of the Pelican Lake components found in disturbed contexts are also situated below the valley rim. The remaining sites are all located on the valley top. Meyer (1977: 94) speculates that the site locations indicate that Pelican Lake people were focusing on resources (specifically bison) which were available in the upper regions of the valley and beyond rather than along the river itself.

Besant projectile points were recovered from eight surface sites and one heavily forested area. The surface sites are all located on the valley edge while the undisturbed Besant site (Boggy View, FhNa-111) is situated on a lower terrace (Finnigan et. al. 1983: 135). It has been suggested that several of the Besant projectile points that were recovered from disturbed contexts may in fact be Early side-notched projectile points (Prentice et. al. 1983: 21). The ambiguity of Besant and Early side-notched point identifications makes it difficult to provide concrete statements concerning the settlement and utilization of the region by people associated with these two complexes.

2.4 The Late Prehistoric Period (2000 B.P.- historic period)

The Late Prehistoric period (2000 B. P.. - historic period) is characterized by the introduction of a new technology; the bow and arrow; along with correspondingly smaller projectile points. It is at the beginning of this time period (1750-1150 B.P.) that delicate Avonlea side-notched projectile points appear, as well as conical shaped net-impressed or textile impressed pottery vessels (ibid.: 22). Ten sites with Avonlea projectile points and/or associated pottery have been identified in the Nipawin area (Meyer et. al. 1988: 35). Several of these sites are located in undisturbed forested areas situated on well-elevated river terraces—Mineral Creek (FhNc-53), Wallington Flat (FhNa-112), Crown (FhNa-86), and Gravel Pit (FhNa-61). Net-impressed pottery was also recovered from one other undisturbed site which is situated on a low terrace just above the river flat; the Municipal Camp site (FhNa-113). The remaining Avonlea projectile points and/or net-impressed pottery sherd were recovered from the surfaces of cultivated fields (ibid.: 39).

Contemporaneous with the occurrence of Avonlea at the beginning of the Late Prehistoric period is the Laurel complex. The identification of this complex is based on a distinctive pottery type known as Laurel ware. Meyer (1983: 5) has identified Laurel ware on the basis of several characteristics including method of manufacture, decoration, profile, paste, and surface finish. These conical vessels are usually made by coiling and are decorated with dentate or pseudo-scallop shell-impressions, as well as punctates, bosses and incisions. The exterior surfaces of the vessels are smoothed or "appear to have been floated, bringing small mineral particles to the surface" (ibid.: 5). The rim generally tapers towards the lip which is either rounded or flat and sometimes everted. The vessel walls are compact and while they may break along the coil joins they are rarely laminated or split vertically.

By 1983, a total of 31 sites in northern Saskatchewan yielded Laurel ware pottery; however only one of these sites is located in the Nipawin region (the River House site, FhNc-6) (ibid.: 22). By the completion of the Nipawin Hydroelectric Project in 1985, only two additional sites with associated Laurel components were identified (Crown site, FhNa-86 and the Peterson Creek site, FhNb-72). At the River House site, two triangular projectile points were found within the same excavation block; consisting of 16 one metre square units, as the Laurel ceramics. In a second excavation block situated approximately 15 m. to the southeast of the Laurel excavation area, six triangular projectile points and four small side-notched points were recovered. The Laurel sherds are smoothed on the interior and exterior although the exterior does exhibit shiny mineral particles on the surface. The rims are tapered and the lip slopes from the interior to the exterior (Meyer and Carter 1978: 104). One Laurel ware vessel was found at the Crown site in the same occupation level as Avonlea net-impressed pottery vessels and in association with side-notched and triangular flake points (Meyer et. al. 1988: 37). The Laurel ceramics exhibit a smooth exterior surface finish with a few mineral particles visible on the surface, interior punctates and corresponding exterior boss decoration, and obvious coil breaks. The rim is slightly tapered and the lip is rounded (Quigg 1986: 193-195). One occupation level at the Peterson Creek site (FhNb-72) produced 72 ceramic sherds representing at least two vessels that were identified as Laurel ware. No projectile points were found in association with the ceramics. The only stone tools recovered from this level include three scrapers, one spokeshave, and one biface. Analysis of the Laurel ceramics has not been completed at this date; however, a general description of the vessels are as follows. The interior and exterior surfaces of the body sherds are smoothed and the paste consists of crushed granite. The rims of both vessels have rounded lips. One vessel has been decorated with a row of alternating bosses and punctates. The second vessel has been decorated with a lightly incised design or image on the exterior surface (Meyer and Epp 1990: 331).

In the boreal forest region of central and southern Manitoba, the Laurel complex is followed by and occasionally overlaps with the Blackduck complex. Blackduck vessels are globular in shape with constricted necks and out-flaring rims. The exteriors are cord-impressed and the rims are heavily decorated with a cord-wrapped tool impressions forming intricate bands of horizontal and diagonal impressions (ibid.: 334). The Blackduck complex is sparsely represented in the south eastern boreal forest region of Saskatchewan and only two Blackduck sherds were found on the surface of the cultivated portion of the Mollberg site (FhNa-1) (Finnigan et. al. 1983: Figure 3.5). The discovery of only a few sherds in a disturbed context which also includes diagnostic materials that span from the Early side-notched complex to the historic period is not solid evidence on which to make a cultural designation. As noted by Prentice et. al. (1983: 24) "a few sherds assigned to the Blackduck complex are not considered indicative of a homogeneous occupation." Therefore, during the extensive surveys of the Nipawin region sufficient evidence was not obtained to establish the presence of a Blackduck occupation in the area.

The Old Women's phase dates from 1150 B.P. to 650 B.P. and is "characterized by assemblages containing projectile points of the Prairie side-notched type, in association with thick-walled, often coarse pottery" (Meyer 1988: 55). The dates and associated materials which define this phase in Saskatchewan are based on comparisons with materials recovered from Old Women's phase components in Alberta. Reeves (1983: 19) described the Old Women's phase as being characterized by ceramics, late side-notched projectile points which are micro-stylistically discrete, extensive use of the split pebble techniques to produce blanks from which tools such as endscrapers, points, pieces esquillees, and burin-like spalls are manufactured, and heavy utilization of local lithic materials. In his analysis Reeves (1983: 20) also suggested that the Old Women's phase be divided into two periods based on the associated projectile point styles. The Early Old Women's phase is associated with the recovery of Prairie side-notched points and dates to approximately 1150 B.P.to 650 B.P. The Late Old Women's phase is associated with the occurrence of an increasing number of Plains side-notched points and dates from about 650 B.P. to 200 B.P..

Byrnes (1973) has classified the Late Prehistoric period as being comprised of two pottery complexes: Saskatchewan Basin and Cluny. The Saskatchewan Basin complex is further subdivided into two forms; an 'Early Variant' and a 'Late Variant'. Pottery of the type described by Byrnes and termed Saskatchewan Basin, Late Variant pottery has been used to characterize Old Women's phase pottery (Meyer 1988: 56). The vessels are globular in shape with thick walls, obvious shoulders and either rounded or flat bottoms. The surface finish is a vertical cord or fabric impression that is often obscured by smoothing the clay. A large percentage of the vessels are not decorated. However, those that are decorated frequently exhibit punctates, cord-wrapped tool impressions, and incised lines on the rim, lip, and shoulder portions of the vessels. The paste and temper are both quite variable. Occasionally the paste is hard and compact: however, it is often blocky or laminated. The crushed granite temper can vary in size from microscopic grains to extremely large particles 15 mm in size (Byrnes 1973: 331-335).

The Old Women's phase is not well represented in the southern boreal forest region of east central Saskatchewan. In the course of intensive investigations of the Saskatchewan River valley during the Nipawin Hydroelectric study only one site was found which yielded Prairie side-notched points in association with thick, coarse potsherds (Meyer 1988: 60). The Willis Creek site (FhNc-103) site is located on an upper terrace on the east side of a ravine that joins with the Saskatchewan River. This is a single occupation site at which six metre square units were excavated. Along with a single Prairie side-notched projectile point, a few pieces of debitage, bone, and several sherds of "poor quality pottery" were found (Finnigan et al. 1983: 141; Figure 3.18).

The pottery from this site is characterized by thick sherds with coarse poorly consolidated paste that results in frequent exfoliation of the interior and/or exterior surfaces.

2.5 The Selkirk Composite

Succeeding Blackduck occupations of the southern boreal forest in Manitoba and late Avonlea and Laurel in Saskatchewan is the Selkirk Composite, originally termed the Selkirk focus by MacNeish (1958). As will become evident from the following overview, Selkirk materials have undergone various taxonomic revisions as the number of sites containing Selkirk components have increased substantially and the information from these sites has been pulled together and critically examined (Rajnovich 1983; Meyer and Russell 1987; Lenius and Olinyk 1990).

The Selkirk focus as defined by MacNeish (1958: 67) is characterized by globular vessels usually with excurvate rims, slightly angled shoulders, and rounded bases; grit, sand or crushed rock temper; and a smooth fabric impressed exterior. The vessels are manufactured using a paddle-and-anvil technique. The paddle is usually covered with "tightly woven babiche" or occasionally it is wrapped with a cord. Most of the vessels are undecorated; however, some exhibit oblique or parallel oblique cord-wrapped paddle impressions on the lip or rim and a few are decorated with a row of punctates on the neck (MacNeish 1958: 69). Other materials associated with these vessels include small side-notched and/or triangular flake projectile points, larger triangular and tear-drop-shaped points, ovoid bifaces, hide working tools, and bone awls (ibid.: 69-70).

Within the Selkirk focus MacNeish recognized three pottery types—Alexander Fabric-impressed, Sturgeon Falls Fabric-impressed, and Sturgeon Punctate. These pottery types are categorized on the basis of the presence or absence of certain decorative attributes. Alexander Fabric-impressed vessels are undecorated. Sturgeon Falls Fabric-impressed vessels have decorations consisting of cord-wrapped paddle impressed edges on the lip and upper rim and occasionally punctates on the neck. Sturgeon Punctate vessels have one to three rows of punctates of varying shapes—ovoid, crescentic, rectangular, and round—encircling the rim (ibid.: 166-170).

Meyer (1981: 27) first proposed the idea that related Selkirk assemblages which were being identified in various regions of the boreal forests of Saskatchewan, Manitoba, and Ontario, be incorporated within a single composite, known as the Selkirk Composite. After intensive examination of Selkirk materials from southeastern Manitoba and northwestern Ontario Grace Rajnovich (1983) renamed MacNeish's original Selkirk focus the 'Winnipeg River' complex. Subsequent reconsideration of Selkirk by Meyer and Russell (1987: 1) resulted in the identification of the following Selkirk complexes: the Winnipeg River (Rajnovich 1983), Clearwater Lake (Hlady 1970), Kame Hills (Dickson 1980), Kisis (Millar 1983), Pehonan (Meyer 1981), and possibly Grass River (Hlady 1970).

The complexes which make up the Selkirk Composite all "share a set of traits, both technological and stylistic"; however, differences between complexes are also apparent (Meyer and Russell 1987: 4). Characteristics that are shared by Selkirk complexes include small side-notched or triangular projectile points, globular vessels with constricted necks and generally excurvate rims, smoothed fabric impressed exteriors, and a variety of rim and lip decorations (ibid.: 1). A major difference between the northern complexes and the southeastern Winnipeg River complex is as follows:

> there is a consistent difference between the northern Selkirk complexes, all of which are characterized by decoration with a single punctate row, and southeastern Selkirk (e. g., Winnipeg River complex) which normally does not have the punctate row. If this north-south difference is supported by future archaeological investigations, it may eventually be appropriate to recognize a grouping of northern Selkirk complexes which form a composite distinct from a composite composed of southern Selkirk complexes (ibid.: 21).

Minor differences are attributed to either adaptations to specific environments or to interactions with other cultural groups.

Lenius and Olinyk (1990) present a revision of Late Woodland taxonomy as it applies to the ceramics of northern Minnesota, Ontario and Manitoba. The taxonomic revisions which they present in their paper are based on a long term study that involved the examination of 676 vessels from 69 sites in Minnesota, Manitoba, Ontario, Saskatchewan, and North Dakota (Lenius and Olinyk 1990: 1). They propose that the Winnipeg River complex materials be removed from the Selkirk Composite and be placed within a new composite known as the Rainy River Composite. The Rainy River Composite as defined by Lenius and Olinyk (1990: 103) consists of "at present three regional and/or temporal complexes—Duck Bay, Bird Lake, and Winnipeg River." They further hypothesize that the Rainy River Composite resulted from the coalescence of Blackduck and Laurel cultures at approximately 950 B.P. (ibid.: 83). This supposition is based on the observation that Rainy River ceramics possess characteristics of both Blackduck and Laurel ceramics. Attributes acquired from Blackduck include oblique and horizontal cord wrapped object impressions, globular vessel shape, and cord or textile impressed exterior surface finishes. Adopted Laurel attributes include stamped designs, decoration of the shoulder/body area of the vessel, and plain or smooth exterior surface finishes (ibid.: 83-84). The Rainy River Composite is apparent in the archaeological record until approximately 300 B.P. (ibid.: 84).

Two pottery types—Alexander Fabric-impressed and Sturgeon Falls Fabric-impressed—previously identified by MacNeish as forming part of the Selkirk focus are suggested to be "the utilitarian pottery which forms the ceramic nucleus" of the Winnipeg River complex (ibid.: 100). These two pottery types are also found, however, in lower numbers in assemblages belonging to Duck Bay and Bird Lake complexes.

Several similarities between Selkirk composite and Rainy River composite pottery lead Lenius and Olinyk (1990: 101) to suggest that both composites were produced by the ancesters of historic Algonkian speaking groups. Therefore, taxonomically these two composites are placed within a new configuration called the Western Woodland Algonkian Configuration.

Originally, sites within the Nipawin region were assigned to the Clearwater Lake phase (Meyer 1977). Several of these sites are concentrated in one locale, known as the 'Nipowiwinihk' area (originally spelt Nipowiwin) (see Meyer et al. 1992). 'Nipowiwinihk' refers to a specific section of the Saskatchewan River valley approximately 3.5 km northwest of the village of Codette. This area on the valley edge consists of eolian cliff-top deposits of sand dunes which have been stabilized by a mixed vegetation consisting of grasses, shrubs, aspen, birch, and conifers. When standing on this high cliff on the valley rim the sweeping view of the Saskatchewan River valley and areas to the southwest and north is certainly impressive (Meyer 1977).

The site at Nipowiwinihk (Mollberg, FhNa-1), has been occupied extensively on a seasonal basis over the last 5000 years. This section of the Saskatchewan River valley where the Mollberg site is situated has been described as a major aggregation place where regional bands congregated in the spring or early summer (Meyer et al. 1992: 218). Areas of the site yielded numerous potsherds that were assigned to the Clearwater Lake phase (Meyer 1977: 60-68). Other Clearwater Lake phase sites were located on the river flat below (Francois, FhNa-3; Bushfield East, FhNa-13; and Bushfield West, FhNa-10). Examination of the materials collected from these sites eventually led Meyer (1981: 24) to conclude that certain aspects of these assemblages differed from Clearwater Lake; namely the occasional occurrence of vessels with angular and decorated shoulders and the association of horizontally impressed pottery with punctated pottery. Therefore, material associated with these sites from the Nipowiwinihk area were identified as distinct from Clearwater Lake and became known as Pehonan. Within the Pehonan complex three different pottery styles were recognized—Francois Punctate, Nipawin Horizontal, and Clearwater Lake Punctate (ibid.: 24).

The Nipowiwinihk area sites, as well as the Lloyd site (FhNa-35) which is located on a river flat on the north side of the Saskatchewan River approximately 2 km downstream from the main aggregation location, became the focus of intensive excavations during the Nipawin Reservoir Heritage Study. Small scale excavations were also carried out at several other sites in the study area that were identified as having Pehonan components. The data obtained from this study resulted in a reevaluation of the Pehonan complex (Meyer 1984). The recovery of only one 'Nipawin Horizontal' vessel and single sherds of horizontal impressed pottery from three other sites indicated that this style of pottery was not an integral part of Pehonan complex assemblages. It was therefore, excluded from the pottery styles which characterize Pehonan assemblages (ibid.: 43).

However, information obtained from these sites also demonstrated that Pehonan should be maintained as a recognized complex characterized by the following vessel attributes—occasional angular shoulders and decorated shoulders, the presence of 'S' shaped rim profiles, and a significant number of rims decorated with interior punctates (ibid.: 43). Small side-notched and triangular projectile points, endscrapers and other unifacial tools, fully and partially ground mauls, notched schistose slabs, adze blades, unilaterally and bilaterally barbed harpoon heads and bone awls are also integral to Pehonan components (Meyer 1981: 26, Meyer 1984: 17).

Meyer (1981: 33) describes the Pehonan complex as a "Selkirk manifestation (Clearwater Lake complex) which has been heavily modified as a result of plains contacts." He also proposed the following:

> the Pehonan complex developed as a result of the occupancy of the forest/parkland interface by northern Algonkians from the forests to the north and east. These Algonkians brought with them a material culture, the remains of which we know as the Clearwater Lake complex; however, it is apparent that in their new territory they came into contact with the occupants of the parkland zone. This contact is believed to have resulted in the introduction of grassland traits into the material culture of these northern Algonkians. The outcome was a modification of the original technology (Clearwater Lake), a modification which is here designated the Pehonan complex (Meyer 1981: 34).

In the Nipawin region, Pehonan components date from the mid to late A.D. 1300s through to approximately A.D. 1700 (600 or 550 B.P.-250 B.P) (Meyer and Russell 1987: 17).

CHAPTER 3

Biophysical Environment

3.1 Site Location

Bushfield West is located on a lower terrace of the Saskatchewan River valley near the town of Nipawin in east central Saskatchewan (Figure 3.1). The site is situated on the northwestern edge of the terrace which is referred to by residents of the area as "Bushfield's Flat". The legal land description of Bushfield's Flat is the north half of Section 13, Township 50, Range 16, west of the 2nd meridian. The flat is situated immediately upstream from the location of the Francois-Finlay hydroelectric dam and is currently under about 100 m of water impounded within the reservoir, Codette Lake.

3.2 Site Physiography

On a broad physiographic scale, the area is situated within the Central Lowlands Province. The Central Lowlands Province consists of two physiographic regions; the Saskatchewan River Plains and the Manitoba Lowlands. The Saskatchewan Plains Region is the largest region consisting of a vast area of low gentle relief of ground moraine cover and lake plains (Richards 1969: 41). Only a small portion of the Central Lowlands Province consists of the Manitoba Lowlands Region, a poorly drained lacustrine plain surrounding Cumberland House (ibid.: 41).

On a smaller regional scale the Nipawin area is within the Saskatchewan River Lowlands of the Saskatchewan Plains Region. The Saskatchewan River forms the boundary between the Whitefox Plains subregion to the north and the Carrot River Plains subregion to the south (ibid.: 41). The Whitefox Plains is an area characterized by an undulating topography formed on glacio-lacustrine silts and clays with deltaic deposits and reworked till. The soils are mainly dark gray Chernozemic, Dark Gray Wooded, and Podzolized Gray Wooded (Ellis and Clayton 1970: 45). The Carrot River Plain is an area of gently undulating topography on sandy alluvial materials. The soils are poorly drained Calcareous Dark Gray Chernozemic soils with peaty

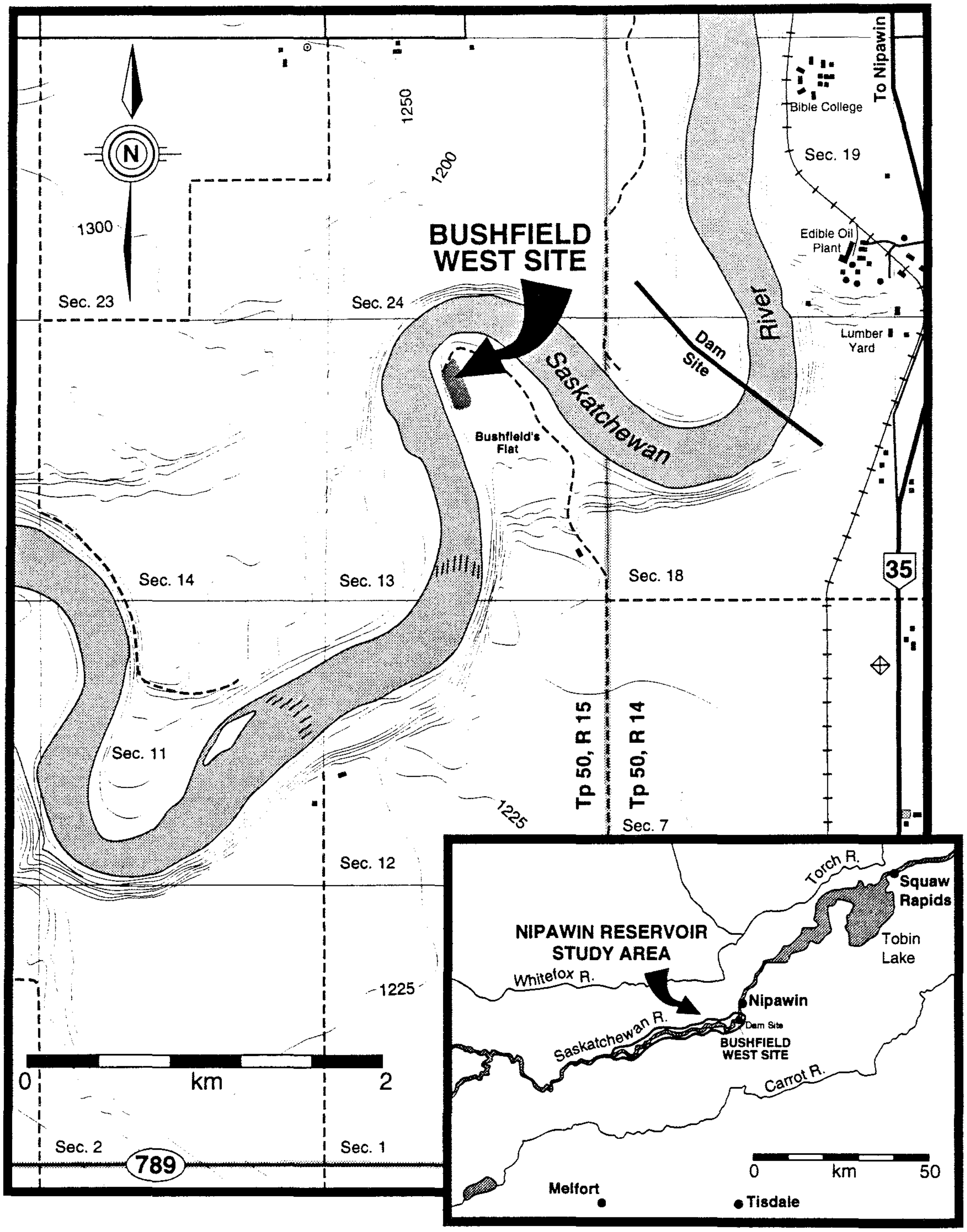


Figure 3.1 Map of the Study Area Showing Location of Bushfield West

meadows (ibid.: 48-49). The prominent uplands in the region consist of the Wapawekka Upland situated to the north, the Lake Lenore Upland situated to the south, and the Pasquia and Porcupine Hills to the southeast (Richards 1969: 41).

In a recent revision of the province's ecological land classification system, the site and surrounding area would be located in the landscape area called the Nipawin Plain of the Boreal Plain ecozone (Padbury and Shields 1994). The soils are Dark Gray Chernozemic or Dark Gray Luvisolic which are either strongly calcareous, silty clay loam or very fine sandy loam lacustrine materials.

The Saskatchewan River which drains a large portion of the Central Lowlands constitutes the major topographical feature of the province. The two branches of the Saskatchewan River join east of Prince Albert and flow into Lake Winnipeg and eventually into the Hudson Bay. This drainage system is significant to the archaeology of the region since it would have served as a major transportation route through the province (Burley et al. 1982b: 9).

The Saskatchewan River valley in the area west of Nipawin is approximately 1 km wide and between 50 to 70 m deep (Campbell 1988: 11). It is characterized by steep sides, alluvial terraces and a series of upper terraces formed by downcutting through glacial till deposits (Burley 1982: 9). Within the valley the soils of the upper terraces are Chernozemic Brown to Dark Gray or Dark Gray Wooded, while those of the valley slopes and bottoms are classified as Regosolic soils (Moss and Clayton 1969: 72).

The site which is the focus of this thesis, Bushfield West, is located on a Lower Terrace of the Saskatchewan River immediately upstream from the Francois-Finlay Dam. These deposits are more than 3600 ± 90 years old (Christiansen 1982: 50). The point bar sediments which form the Lower Terrace Deposits are characterized by an alluvially deposited "fining upward sequence" consisting of gravel and sand, sand and silt, and capped by eolian sand and silts and a minor amount of clay (ibid.: 22). Prior to the formation of the reservoir, the lower terrace was approximately 10 to 12 m above the level of the river.

3.3 Climate

The Nipawin area is within the Humid-Continental climatic region and according to the Koeppean classification system it is known as the Cold "Forest" Climate. This climatic designation corresponds to areas of aspen groves and mixed forest vegetation "with dark-brown and black to dark-gray wooded soil zones. The summers are cool with mean daily July temperatures between 60° F [15° C] and 66° F [19° C], and winters are cold with mean January temperatures between +4° F [-15° C] and -5° F [-20° C]"

(Chakravarti 1969: 60). The total annual precipitation in the region is 452 mm and the annual snowfall is 143 cm (Padbury and Acton 1994). The heaviest periods of snowfall occur in the late fall or early winter, as well as in the late winter and early spring (Chakravarti 1969: 60).

Over time changes in climatic conditions have been shown to be closely associated with changes or shifts in the occurring vegetation. Bryson and Wendland (1967) present a reconstruction of late glacial and post-glacial climatic episodes based on hypothesized air mass movements, ice front positions, and palynological information. Deglaciation of east central Saskatchewan corresponds with the Pre-boreal climatic episode (Burley et al. 1982b: 18). Analysis of pollen core samples "suggest that as the ice disintegrated, ice-free surfaces as well as extensive areas of till-rich stagnant ice were covered by a spruce forest" (Ritchie 1976: 1805). A few areas also provide evidence of a tundra or tree-less vegetation zone between the spruce forest and the ice front (ibid.: 1813). The climatic conditions of the Pre-boreal were thought to be characterized by periods of prolonged dry weather (Bryson and Wendland 1967: 286).

The Boreal (circa 9300-8500 B. P.) and Atlantic (8500-4600 B. P.) climatic episodes were warmer and dryer (Burley et al. 1982b: 18). During a time period of approximately 3000 years which straddles these two climatic episodes (9500 and 6500 years ago), Ritchie (1976: 1811) suggests that a narrow band consisting of deciduous forest tree species dominated by birch and poplar developed between the boreal forest and the grassland. Between approximately 6000 and 5000 years ago the species which comprise the modern boreal forest had established themselves and since then have remained constant.

The warmest and driest period of the Atlantic episode is suggested to have occurred at approximately 7000 to 5500 B. P (Wendland 1978: 279). These conditions are associated with the rapid expansion of the spruce forest northward and an equally rapid replacement of the forests in the southern regions by grasslands. In fact, during the Boreal Bryson and Wendland (1967: 289) suggest that the grasslands almost reached the ice front. However, Mott, who studied pollen core samples taken from lakes in central Saskatchewan, suggests that the grassland extended only 80 to 112 km north of its present position (Mott 1973 cited in Meyer 1977). As the grasslands expanded northward the boundaries of the parkland and boreal forest also shifted to the north. During this period it is possible that the region surrounding Bushfield West would have been situated in a parkland environment within close proximity to open grasslands (Burley et al. 1982b : 20). This assumption is strengthened by the results of a pollen core sample taken from a lake within the Nipawin region which demonstrates a marked increase in herb pollen at approximately 4855 B.P. indicating that the area was situated within an open woodland or grassland (Wilson 1982: 303). The presence of Chernozemic soils also suggests that the area was at one time covered by grassland vegetation (Harris et al.1983: 30).

Following the Atlantic is the Sub-boreal climatic episode (5060-2760 B.P.) which is depicted as being substantially wetter and colder than the preceding climatic episode. Ritchie (1976: 1812) hypothesizes that just prior to the Sub-boreal and continuing through this climatic episode there is a gradual movement of the forest southward encroaching on the northern edge of the grassland. Following the Sub-boreal is the Sub-Atlantic climatic episode (2760 B.P.) which is described as a period of climatic deterioration. From the Sub-Atlantic until the present the major ecozones become well established at approximately their present-day locations (Wendland 1978: 281). The Scandic episode exhibits conditions that are warmer and dryer. Subsequent climatic episodes—Neo-Atlantic, Pacific, and Neo-boreal—are characterized as either wetter or cooler. Logically, these climatic changes should also have resulted in fluctuations of the vegetation zones. However, Ritchie's (1976: 1812) work supports Wendland's suggestion that there has been very little change in the positions of the boreal forest and grassland zones since 2500 years ago. The Neo-boreal climatic episode ends at 100 B.P. and the climatic episode which we are currently in is known as the Recent episode (Wendland 1978: 281).

3.4 Regional Flora

The modern vegetation patterns of the Nipawin region have been identified as conforming to the mixedwood section of the southern boreal ecoregion (Kabzems et al. 1976: 8). Coupland and Rowe (1969: 75) describe the mixedwood section:

> At the southern edge of the boreal forest where the conifers thin out and aspen becomes dominant the vegetation pattern is simplified. Black spruce and tamarack are confined to wet places or at least are very rare on uplands where white spruce mixes with the poplar. As usual, jack pine characterizes the fire prone sites and the dry soils. A rich undergrowth of tall shrubs and herbs typifies the forests that have a predominant broadleaf component.

Kabzems et al. (1976: 104) list eleven species of trees which commonly occur in the mixedwood section—trembling aspen (*Populus tremuloides*), jack pine (*Pinus banksiana*), black spruce (*Picea mariana*), white spruce (*Picea glauca*), balsam fir (*Abies balsamea*), tamarack (*Larix laricina*), balsam poplar (*Populus balsamifera*), white birch (*Betula papyrifera*), American elm (*Ulmus americana*), green ash (*Fraxinus *pennsylvanica*), and Manitoba maple (*Acer negundo*). Also associated with the tree species which comprise the forest cover is an understory vegetation consisting of numerous species of shrubs, herbs, grasses, mosses, and lichens (ibid.: 38-39, 107-111).

In 1983 an ecology based land classification study was undertaken for the province by Harris et al. (1983). The result of this study was the identification of six major ecoregions and associated subdivisions or ecodistricts (Harris et al.1983: 4). According to this classification scheme, the Nipawin region falls within the Mixedwood-Parkland Transition Ecodistrict of the Southern Boreal Ecoregion (Figure 3.2). Tree species found in the Mixedwood-Parkland Transition Ecodistrict are the same as those identified previously for the Mixedwood Forest Section; however, variation in stand composition does occur. Aspen and white spruce dominate well drained areas of Chernozemic soils, jack pines are found in areas of sandy soils, black spruce grows in areas of poorly drained organic soils, as do tamaracks (ibid.: 31-32).

Zoltai (1975) recognized the presence of a narrow zone separating the Aspen Parkland and the Boreal Forest. He suggested that this zone be termed the 'Parkland-Boreal Forest Transition Zone and that it be considered as part of the Boreal Forest (Zoltai 1975: 10-11). This zone is differentiated from the Parkland by the occurrence of certain species of coniferous trees and from the Boreal Forest by the lack of continuous stands of spruce, birch, pine, and aspen forests in upland regions (Ritchie 1976: 1796). Zoltai's study was undertaken in order to identify the southernmost natural occurrence of certain species of coniferous trees—white spruce, black spruce, tamarack, jack pine, and lodgepole pine—and thus the extent of the southern edge of the boreal forest (Zoltai 1975: 1). The survey consisted of a systematic ground inspection of transects placed at predetermined intervals at right angles to the approximate forest boundary. This study places the section of the Saskatchewan River that is west of Nipawin (which includes the location of Bushfield West) on the southern edge of the Boreal Forest adjacent to the Parkland-Boreal Forest Transition Zone (Figure 3.3). The study conducted by Harris et al. (1983: 3) did not entail field surveys but relied on existing data, reports, articles, soil survey maps, and forest inventory maps and reports. Therefore, it is likely that Zoltai presents a more accurate representation of the Boreal Forest and Transition Zone boundaries.

Bushfield West is situated within a Valley Complex where vegetation is affected by several aspects of the topography—slope direction, steepness of slope, depth of valley, soil type and salinity. As part of the initial Nipawin Reservoir study Blood et al.

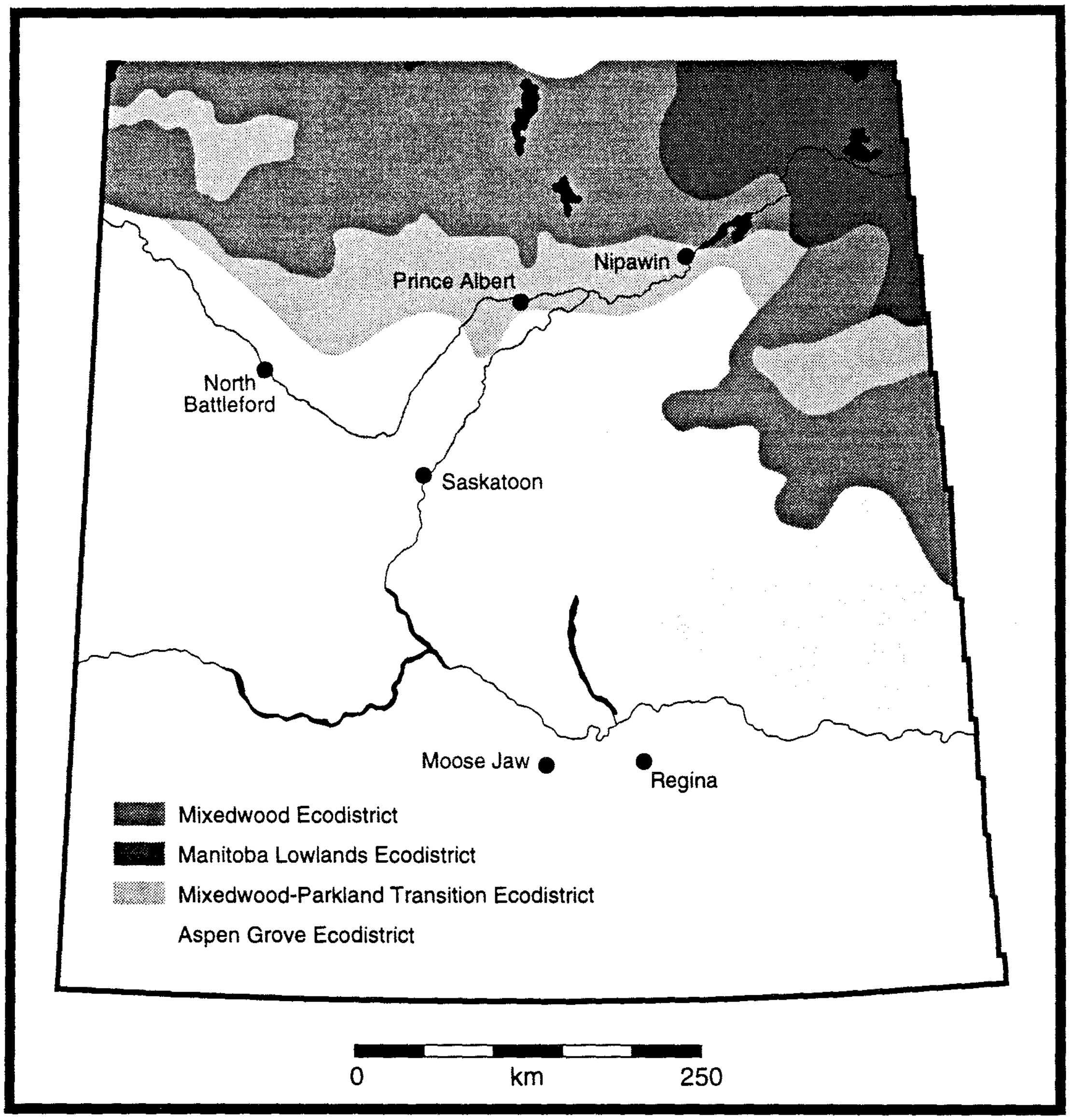


Figure 3.2 Map of Central and Southern Saskatchewan Showing Locations of Ecodistricts, after Harris et al. (1983)

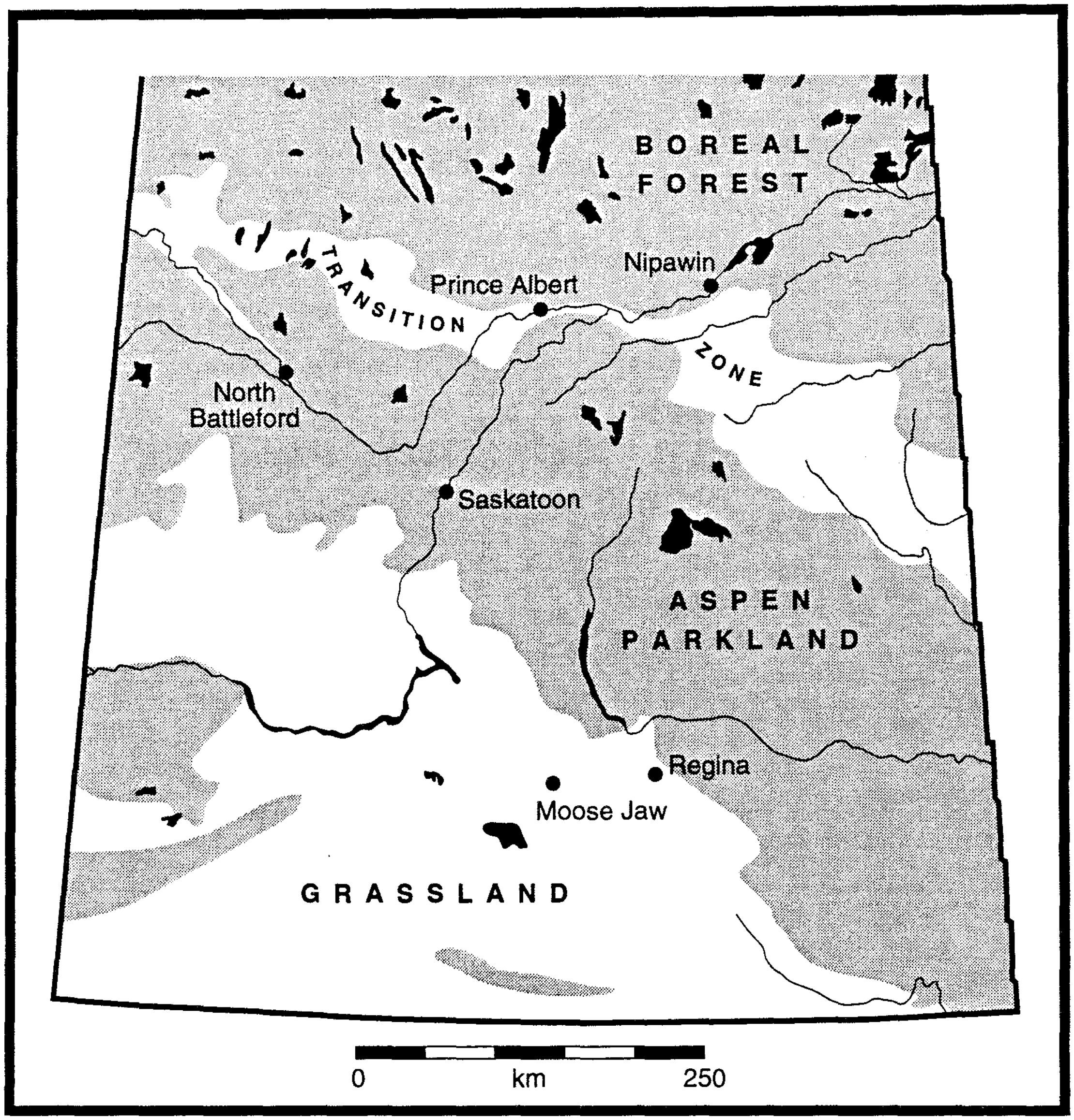


Figure 3.3 Map of Central and Southern Saskatchewan Showing Location of Parkland-Boreal Forest Transition Zone, after Zoltai (1975)

(1977) identified 11 vegetation communities and associated landforms within and adjacent to the Saskatchewan River between Nipawin and Thompson Island. Burley et al. (1982b: Table 2.2) provides a summary of the biophysical classifications of vegetation communities found within the Saskatchewan River valley west of Nipawin. Bushfield West falls within the Type G biophysical classification. The landform consists of a fluvial terrace of silty to fine sands occasionally subjected to ice scouring and characterized by a vegetation community that is dominated by balsam poplar and trembling aspen with an understory of red osier dogwood and chokecherry.

For people occupying the region plants which are seen as potential food resources are especially important. In the summer and fall people would focus on those plant species that produced large quantities of berries and nuts such as chokecherries, saskatoons, raspberries, blueberries, cranberries and hazelnuts. Plants which have starchy roots—water parsnip, cattail, bulrush, western red lily, and Jerusalem artichoke—are also important food resources. Burley et al. (1982b: Table 3.1) presents a list of the floral species which were of potential economic importance to the people occupying the region.

Ethnographic studies have shown that several plant species were commonly used as herbal remedies, food and teas, and building materials (Leighton 1982: 5). The ethnobotanical work of Leighton (1982) was carried out among the Woods Cree of east central Saskatchewan. Leighton (1982: Table 1) provides a list of plant species used for herbal remedies (78 plants), as well as documentation concerning which part of the plant was collected and how it was prepared. The collection of plants for herbal remedies is considered to be complex in terms of the proper procedures that had to be followed, not just in collecting the material but also in its preparation and storage. In contrast, plants that are utilized for food and herbal teas (37 plants) seemed to require less time and energy in terms of following prescribed procedures (Leighton 1982: Tables 2, 3 and 4). Leighton (1982: Table 5) also provides information regarding plant materials that were collected to be used in the manufacturing of utensils, for building structures and equipment such as toboggans, snowshoes, and canoes (5 species not including willow species).

As noted in the previous section, the frequency with which these various plant species occur is closely related to climatic conditions. As environmental conditions changed from the Boreal episode to the Atlantic episode and through the subsequent climatic episodes the composition of the plant communities altered significantly. Evidence of such changes are seen in the palynological studies referred to earlier (Ritchie 1967, Mott 1973, and Wilson 1982). Bryson and Wendland (1967: 281) suggest that variations in the plant communities in response to climatic changes are more evident along the boundaries of the ecoregions and that ecotones are particularly sensitive.

3.5 Regional Fauna

Wildlife research conducted in the area by Blood et. al. (1977) documents the abundant and diverse nature of the faunal resources in the region. A total of 46 mammal species, 252 bird species, five amphibian species, and one reptile were identified as occurring in the area on a scale from rare or transitory to abundant or common. This study also identified range extensions for seven species—short-tailed shrew, white-tailed jackrabbit, Richardson's ground squirrel, western jumping mouse, raccoon, long-tailed weasel, and badger (Blood et. al 1977:44). A list of mammals found either seasonally or year round in the southern boreal forest and adjacent transitional zone is presented in Appendix A, Table 1. The information contained in this list is abstracted from Blood et al. (1977) and Burley et al. (1982b). Additional information concerning the ranges of mammals which include the Nipawin region or those which previously coincided with the area can be found in Bird (1961), Banfield (1974), and Gilbert (1980).

The list of mammals (Appendix A,Table 1) includes six species of ungulates—moose, elk, woodland caribou, bison, white-tailed deer, and mule deer. It should be noted that white-tailed deer although common in the area at the present time are considered to be recent 'immigrants' as their range has expanded into this region following the beginning of agriculture. Mule deer prefer open mixedwood forest stands with grassy areas as opposed to dense coniferous forest stands, as well as rough timbered or non-timbered stretches along river valleys and brushy streambeds (Wallmo 1981: 21-22; Mackie et al. 1982: 869). However, mule deer were found to be very rare during the Nipawin study (Blood et al. 1977: 27). It is possible that the study area is north of the limit at which mule deer are commonly found (51-52 degrees north latitude) with only small isolated groups of mule deer located further north (55-56 degrees north latitude) (J. W. Skene in Wallmo 1981: 7).

The status of woodland caribou in the southern boreal forest is not clearly defined. Their preferred habitat consists of climax forests of mixed age stands of the following tree species; black and white spruces, balsam fir and white birch with tree and ground lichens (Miller 1982: 928). Up until the 1930s woodland caribou were found to the east of Nipawin in the Kennedy Creek area and are presently found in small numbers in the Pasqua Hills (Meyer 1985: 180). However, they have not yet been identified in any of the archaeological faunal assemblages from the area.

Klimko (1989: 2) suggests that bison should have occasionally moved into the area "since the Nipawin region is only 40 km northeast" of the parklands which is considered to be the main wintering grounds of the bison. However, historical documents including the Hudson Bay Company records rarely mention the occurrence of bison in the southern boreal forest (Meyer 1977: 6; Burley et al. 1982b: 37). One reference to bison occurring in the area was made by the post master at Cumberland House with regard to an Indian trading party which was "amongst the Buffalo which have been within 40 miles of this place" (cited in Klimko 1989: 2). On the other hand, analysis of faunal material from several Late Prehistoric sites in the Nipawin area show that bison formed an important part of the subsistence base (Burley et al. 1982a: 78; Burley 1982: 10; Quigg 1986: 212).

Moose are occasionally observed on the north side of the Saskatchewan River in the study area; however, they are most frequently encountered west of Nipawin in the Fort a la Corne Provincial Forest. In terms of landforms wildlife biologists consider ponds, lakes, marshes and flood plains of large rivers to be important moose habitat (Telfer 1984: 161). Regenerating stands of shrubs such as willow, dogwood, and beaked hazel or deciduous tree species, such as aspen and birch, and aquatic plants provide suitable forage for moose in the summer, while the browse from these shrubs and trees provide winter forage (Banfield 1974: 396).

Numerous elk are recorded as inhabiting the Fort a la Corne Provincial Forest ,and they are regularly seen in the Saskatchewan River valley between Fort a la Corne and Nipawin. During the Nipawin study Blood et al. (1977: 29) noted that "elk showed their expected predilection for areas producing grass-forb vegetation—south-facing slopes, wetlands, the riparian herb zone and weedy gravel pits."

Carnivores present in the Nipawin area include black bear, wolf, coyote, red fox, cougar, and lynx. Of the large carnivores the black bear is of significant economic importance. They are generally hunted in the fall because of large amounts of fat which can be obtained from the carcass (Rogers 1972: 111). Bears are difficult to locate in winter since they go into hibernation and by the spring they have depleted their fat reserves. Lynx, in terms of food yield, are of lesser economic importance but are taken whenever the opportunity arises (ibid.: 112). Fur bearers such as mink, fisher, marten, and red squirrel may have been important for a variety of reasons, as were snowshoe hare and white-tailed jackrabbit.

Aquatic and semi-aquatic fauna; beaver, muskrat, and river otter; are also considered to be of importance to the subsistence economy of the people. Beaver are especially valued as a food source because of their high fat content. Their range is extensive and includes most of the boreal forest wherever favorable habitat can be found, such as protected shorelines of large lakes and, in regions of poorly developed drainage systems, where there are numerous bogs, small ponds and slow moving streams. Such areas are not subject to severe fluctuations in water level or rapid flowing water and are considered to be stable which is an important factor for building lodges and dams (Novakowski 1965: 29). Within the Nipawin region beavers are abundant, especially along the smaller tributaries that drain into the Saskatchewan River. Muskrats, mink, and river otters are also utilized as a food resource but are likely of lesser importance. In terms of numbers of animals recorded during the study, muskrats are second only to the beaver.

Porcupines occur throughout the mixedwood forest region. This slow moving animal represents a food source which, once encountered, is easily dispatched by clubbing. The quills are also used to decorate baskets and clothing.

Several species of small rodents and microrodents were trapped during the wildlife survey, and others are suggested by Maher (1969: 80-82) to occur in the area (Appendix A, Table 2). The most commonly occurring include the deer mouse, masked shrew, Gapper's red-backed vole, meadow vole, least chipmunk, western jumping mouse, thirteen-lined ground squirrel, and northern pocket gopher. These species are not expected to play a part in the economy of precontact peoples; however, they are frequently found in the faunal assemblages of archaeological sites including those in the Nipawin area.

Of the 252 species of birds recorded in the Nipawin area, 23 are duck species, four are species of geese and one is a swan (Appendix A, Table 3). Several avian species which were not known to occur in the area in the summer months, but which currently do, include the common loon, western grebe, white pelican, tundra swan, and black duck. Their extended length of stay in the area is attributed to the presence of Tobin Lake which formed when the E. B. Campbell Hydro Electric Station was built in the mid 1960s.

Two species of geese—the Canada goose and the white fronted goose—are common spring and/or fall migrants while, the snow goose and Ross' goose have been spotted in the area but are considered to be rare migrants. The three most common breeding species of ducks observed are the mallard, common goldeneye and common merganser.

Currently, the Nipawin region is within the migration corridor of the tundra swan as they migrate to an important staging area on the Athabasca delta, from which they depart two to three weeks later for their breeding grounds in more northern regions

(Yukon Delta and Mackenzie Delta). In the fall the Athabasca delta is again an important staging area from which they migrate southeast to a second staging area near Whitewater Lake in Manitoba (Bellrose 1976: 95). However, in the 19th century the range of the trumpeter swan was much more extensive with their breeding grounds extending probably as far north as Fond du Lac, Saskatchewan. Hudson Bay Company records indicate that between the years 1853 to 1877 an average of 707 trumpeter swan skins per year were sold (ibid.: 88). Today, the range of the trumpeter swan is generally restricted to wintering grounds on the west coast, and breeding grounds in the Cypress Hills of Saskatchewan and Alberta, and the Yellowstone-Centennial Valley of Wyoming and Montana (ibid.: 88). However, in the last three to four years a pair of adult trumpeter swans and young cygnets were reported in the area of Greenwater Lake, southeast of Nipawin. The adult pair was captured, identified, and marked and were reported to be wintering in the Lacreek National Wildlife Refuge in South Dakota (Shandruk et al. 1992: 107-108).

Five species of upland game birds are found in the Nipawin study area. These include three species of grouse—spruce, ruffed and sharp-tailed—the gray partridge and the willow ptarmigan (Blood et. al. 1977: 64). It should be noted that the gray partridge is not native to the area and has been introduced. In the coniferous forest the spruce grouse inhabits forest openings, old burns, clear-cut blocks, marshes and bogs (Godfrey 1986: 163). The range of the ruffed grouse coincides with the boreal forest and aspen parkland vegetation zones of the province. The preferred habitat of the ruffed grouse is successional growth communities of deciduous or mixedwood trees with understories of willows, viburnums, hazel, and red ozier dogwood (Barber et al. 1989: 16, Godfrey 1986: 161). The spruce grouse is a resident of the coniferous and mixedwood forests in muskegs, forest edges, opening and older burn areas (Godfrey 1986: 156). The willow ptarmigan inhabits the low tundra regions of the Arctic; however, in the winter the willow ptarmigan migrates to regions well south of the tree line "inhabiting muskegs, lake and river margins and forest openings" (ibid.: 158). They have only occasionally been reported as far south as Nipawin. During the Nipawin survey the most common resident game bird was the ruffed grouse inhabiting deciduous and mixedwood stands. Only a few spruce grouse were noted in stands of conifers and no sharp-tailed grouse were seen.

Sandhill and whooping cranes are also listed as rare and transitory to the area (Blood et. al. 1977: 71). Sandhill cranes were seen on the river flats on the south side of the Saskatchewan River near Thompson Island during both Nipawin reservoir heritage surveys. The Nipawin area appears to be on the southern edge of the breeding grounds of the sandhill crane. This area is also on the migratory route of the whooping crane as they flock to their breeding grounds in Wood Buffalo National Park (Johnsgard 1983: 179, 185-186).

Ten species of migrating and three species of breeding shorebirds, five species of gulls and four species of terns were also recorded during the study. Spotted sandpipers and killdeer are numerous in the spring, summer, and fall, while Franklin's gulls occur by the hundreds during the spring (Blood et. al. 1977: 56-60).

Twenty -six raptor species which include the turkey vulture, nine species of hawks—of which the Red-tailed hawk and American kestrel are the most common—bald and golden eagles, prairie and peregrine falcons, and three owl species (great horned, long-eared and saw-whet) occur in the area (Blood et. al. 1977: 60-62). The eagles, falcons and three other species of owls—short-eared, hawk and boreal—are rare in the region and are considered to be transitory (ibid.: 62).

The remaining bird species found in the Nipawin area consist mainly of woodpeckers, passerines or songbirds (sparrows, warblers, et.) and corvids (ravens, magpies and crows) (ibid.: 66). Remains of these species of birds may occur in archaeological sites not because they are a significant source of food but because their plumage may have been used to decorate clothing or bags.

According to Blood et. al (1977: 73) four species of amphibians and one reptile commonly occur in the study area. The amphibians include the Canadian toad (*Bufo hemiophrys*), leopard frog (*Rana pipiens*), boreal chorus frog (*Pseudacris triseriata*) and wood frog (*Rana sylvatica*). The red-sided garter snake (*Thamnophis sirtalis*) is the only reptile in the area.

Atton (1969: 83-84) lists 11 species of fish as occurring in the Saskatchewan River or nearby lakes. However, during the 1976 environmental study of the proposed Nipawin reservoir, 17 species of fish were collected in the study area. The sampling method consisted of gillnetting, and the most abundant fish caught using this method was goldeye. Sauger, walleye, and northern pike were the next most frequently caught species. This study also involved the evaluation of tributary streams draining into the Saskatchewan River for potential spawning sites. It was determined "that the river itself with its sandbars, back-waters, and eddies is much more important as a spawning area than the small streams" (Abougendia et al. 1980: 70). Burley et al. (1982b: 33) lists 10 species of fish which would be available for economic exploitation in the Nipawin region. Appendix A, Table 4 presents a list of the fish species recorded in the Saskatchewan River or nearby lakes; the information is abstracted from the three sources mentioned previously. The smaller fish such as the cisco, shiners, daces , minnows, and sculpin are prey for the larger species such as the northern pike and would not have been of direct economic importance.

The wide variety of faunal resources available in the Nipawin area would have been of variable importance to the subsistence economy of the prehistoric inhabitants. Depending on availability, all of the large ungulates would have been important food resources. Bear, beaver, various waterfowl, and certain species of fish are especially valued for their fat content. The abundance of faunal resources in the spring and fall make this region particularly attractive during these seasons. Spawning runs of several of the fish species which are found in the Saskatchewan River occur in the spring. The area is also inundated for short periods of time in the spring and fall by migrating waterfowl and other birds.

CHAPTER 4

Site History

4.1 Site Discovery, Assessment, Excavation

In the early 1960s personnel from the Royal Saskatchewan Museum recorded several sites in the Codette-Pontrilas area (Meyer 1977: 7). One of the areas surveyed was Bushfield's flat where they recorded one site located on the southwest corner of the flat (Bushfield Southwest, FhNa-6). The flat was under cultivation at the time of the survey and they collected lithics, bone, ceramics, and one Prairie side-notched projectile point from the surface of the field.

In 1976 the Saskatchewan Power Corporation contracted archaeologists from the Saskatchewan Research Council to conduct an archaeological survey and initial assessment of heritage sites in the Saskatchewan River valley and adjacent uplands between the town of Nipawin and Thompson Island. This work was undertaken as part of a larger environmental study to assess the impacts that would result from the construction of a hydroelectric dam on the Saskatchewan River adjacent to the town of Nipawin. Archaeologists recorded a second concentration of lithics, ceramics, and a small side-notched point on the northwest side of Bushfield's Flat near the cut bank (ibid.: 69). This latter concentration of artifacts was designated Bushfield West (FhNa-10). A third site on the far east side of the flat; Bushfield East (FhNa-13) was also recorded in 1976. Most of this site was located in the cultivated field; however, a small undisturbed portion extended from the field edge to the bank of a spring fed stream. Excavations in 1976 concentrated on this Bushfield's Flat site (ibid.: 71-82).

Further surface collections were made from Bushfield West by Saskatchewan Research Council archaeologists in 1978 and at this time a fourth site was also recorded on the flat—Bushfield Flat (FhNa-20). Archaeologists from the Saskatchewan Research Council again visited Bushfield West in 1980 and collected additional artifacts including several rim and shoulder pottery sherds, as well as four Plains side-notched projectile points (Burley et al. 1982a: 246).

Phase 1 of the archaeological resource impact study of the Francois-Finlay reservoir began in the fall of 1981. Archaeologists from the Saskatchewan Research

Council, under the direction of Dr. David Burley, Nipawin Reservoir Project Director, and Jean Prentice began mapping, assessing, and salvage excavation of Bushfield West (FhNa-10). Salvage excavation was deemed necessary for two reasons. First, the Saskatchewan Department of Highways had begun gravel quarrying operations on the northern edge of the flat. Second, an impressive hearth feature consisting "of a 2.5 cm thick stratum of white ash, followed by a 2 cm layer of orange ash which was subsequently underlain by a 2 cm thick stratum of black carbonaceous material" had been turned over on to the cut bank edge by gravel quarrying activities (ibid.: 250).

Mapping the surface scatter of artifacts entailed walking parallel transects across the cultivated field with individuals spaced 10 m apart. The locations of artifacts which were visible on the surface were marked with flags. Once the site perimeters had been established a series of 10 x 10 m grid units were then superimposed over the site. Artifact locations were recorded within each 10 x 10 m grid by pacing from one of the corner stakes and then marking the position on the map. The artifact type; e.g.,. flake, shatter, bone; and lithic material type; e.g.,. Swan River chert, quartz, basalt; were recorded on the map. The artifact was collected only if it consisted of a formed tool, ceramic sherd, or if the lithic material was exotic, such as jasper, Knife River flint, or obsidian.

The surface distribution of artifacts indicated that the site was extensive extending over an area measuring 337.5 m north-south and 112 m east-west (ibid.: Figure D-2). The map shows a continuous scatter of artifacts extending from the northwest corner of the flat south along the edge of the flat adjacent to the cut bank. This area encompasses both the Bushfield West and Bushfield Flat sites; therefore, they were combined and recorded as one site—Bushfield West (Figure 4.1). The surface distribution map also shows that even though there is a continuous scatter of artifacts there are three discernable areas in which material is concentrated. Two of the concentrations are along the field edge close to the cut bank, while the third is close to the north end of the site but approximately 50 m east of the cut bank (ibid.: 248).

Testing to determine the extent of intact site deposits consisted of excavating a series of 30 x 30 cm test holes placed at varying intervals of 3, 6, or 12 m along two intersecting lines running north-south and east-west. Shovels and occasionally trowels were used in the excavation of the test holes. The soil matrix from each test hole was passed through a 6 mm screen mesh. Artifacts recovered from the screen were bagged and the provenience and depth of the occupation level noted on the tag. Assessment revealed that in areas with heavy surface scatters there was little cultural material that remained undisturbed. However, in areas where there was little or no surface material there existed an extensive buried cultural occupation (ibid.: 252).

The 1981 excavation units were concentrated in the northwest corner of the site near the edge of the cut bank. A series of 1 x 1 m units was established over the area in a 'checker-board' pattern. In each unit the soil above the occupation zone was shovelled off. The occupation zone itself was excavated using trowels, removing 2 to 3 cm of soil at a time and then planviewing the exposed artifacts. A total of 20 complete 1 m^2 units, as well as several partial 1 m^2 units along the cut bank were excavated in this fashion. The soil matrix was sifted through 6 mm screening mesh to recover artifacts that had been missed while troweling (ibid.: 248-255).

From 1982 through to 1984 extensive assessment and excavations were carried out at Bushfield West under the supervision of Terry Gibson. The primary objectives of continued site assessment in 1982 were similar to those of the previous season; "to determine the condition and extent of archaeological deposits, and to locate areas within the site which harboured a concentration of archaeological features and artifacts" (Gibson 1994: 10). A series of 50 x 50 cm test pits was placed across the flat usually at 12 m intervals along east-west and north-south surveyed transects covering an area

Figure 4.1 Location of Bushfield West on Lower Terrace of the Saskatchewan River Valley

approximately 15 ha in size. Due to the irregular nature of the eroded river cut bank the assessment test pits could not be placed at regular intervals along the field edge and were positioned wherever it was suitable. On the west edge of the site in an area where further bulldozing and gravel quarrying activities were planned the east-west assessment lines were placed at 1 and 2 m intervals and the north-south lines were placed at 6 m intervals. In a second area of the site on the north side of the flat adjacent to a section that had previously been disturbed by bulldozing, the assessment pits were placed at 6 m intervals on both the north-south and east-west lines (ibid.: 11).

These assessment pits were excavated in natural levels using shovels and trowels following the stratigraphy identified by Burley et al. (1982a: 256). The soil matrix was passed through a 6 mm screen mesh and artifacts were bagged according to the level in which they had been found. The depth and thickness of the occupation zone, as well as a description of the soil profile was recorded for each assessment pit. When the initial test pits indicated the presence of a productive intact occupation, additional test holes were dug between the 12 m intervals. Each productive pit was also excavated to a depth of 15 to 20 cm below the occupation zone. Non-productive assessment pits were excavated to a depth of 50 cm below the surface (Gibson 1994: 10-11).

In addition to using the standard method of digging test pits to assess an archaeological site, a magnetic survey was conducted over a 10 x 20 m area of the site. The objective of this survey was to pin point the locations of underlying features such as hearths, ash dumps, concentrations of fire-cracked rock, and pottery sherd clusters (ibid.: 16). Using this procedure a number of possible hearth features and pottery concentrations were identified.

From 1981 to 1984, a total of 624 m^2 were excavated at Bushfield West (ibid.: 11). Excavated areas consisted of 18 blocks varying in size from 4 to 234 m^2. These excavation blocks were positioned wherever the assessment test pits indicated that a potentially productive occupation zone remained intact. Excavation procedures consisted of shovelling off the plough zone and the top portion of a sterile sand lens. The remaining sand was then carefully shovel-shaved until the paleosol was encountered. Trowels were used to expose the artifacts and features of the occupation floor. During the 1981 excavations the exposed cultural material was planviewed and the material was removed according to point provenience (Burley et al. 1982a: 255). The soil matrix from the units was sifted through a 6 mm mesh to ensure that as much of the cultural material as possible was recovered. In 1982 to 1984 the exposed cultural material was photo-mapped prior to removal in 50 cm quadrants from each 1 m^2 unit (Gibson 1994: 15). Soil from the lower part of the sand lens and the paleosol was sifted through a 6 mm screening mesh. Samples of the soil matrix were arbitrarily selected for water screening through 2 mm window screen mesh in the field lab.

Exceptions to recording artifacts by quadrant provenience included features (e.g.,. hearths, ash dumps, bone pits), articulated bone units, lithic, and fire-cracked rock concentrations, which were recorded with exact provenience, photographed and mapped *in situ*. Soil samples were generally taken from hearths and ash features and saved so that they could be processed for seeds, charcoal, microdebitage, and microfauna.

The largest areas excavated at Bushfield West were Block 1 (85.5 square metres), Block 2 (234 square metres), and Block 3 (200 square metres) (Figure 4.2). Block 1 was a continuation of the 1981 salvage excavation area along the edge of the cut bank in the northwest portion of the site. The eastern side of the block was arbitrarily placed at 53E, while the northern boundary was located at 195S. All of the units contained within these boundaries west towards the cut bank, including the unexcavated units of the checker-board pattern that had been established in 1981, were excavated.

Block 2 was situated 25 m east of the river cut bank in close proximity to Block 1. Exposure of a large portion of this block revealed extremely dense concentrations of cultural material including numerous pottery concentrations, debitage, microdebitage, bones, hearth features, and rock-filled pits. The northern extent of Block 2 was limited by intersection with the portion of the flat that had been bulldozed in preparation for gravel quarrying.

Block 3 was located further out in the cultivated field at approximately 55 m east of the river cut bank. The presence of an intact occupation had been initially established during assessment. Intensive testing of the area failed to locate activity areas; therefore, a 10 x 12 m area was re-assessed using a magnetic surveying technique devised by Terry Gibson (ibid.: 16). This area was eventually excavated using a variety of techniques which will be described in greater detail in the section discussing the distribution of faunal material recovered from Block 3 in Chapter 8.

Block 12 (10 m^2) was also placed along the cut bank edge in the northwest section of the site. It was a continuation of the southern boundary of Block 1. This area had also been partially disturbed by gravel quarrying operations which exposed a hearth feature in the west cut bank profile (ibid.: 68). For the purposes of this thesis the excavated area along the cut bank on the northwest side of Bushfield West (Block 1 and Block 12) is considered to be one large excavation block referred to as Block 1.

Hearth features, pottery concentrations and a substantial amount of lithic debitage, stone tools, bone tools, and bone fragments were exposed in these three

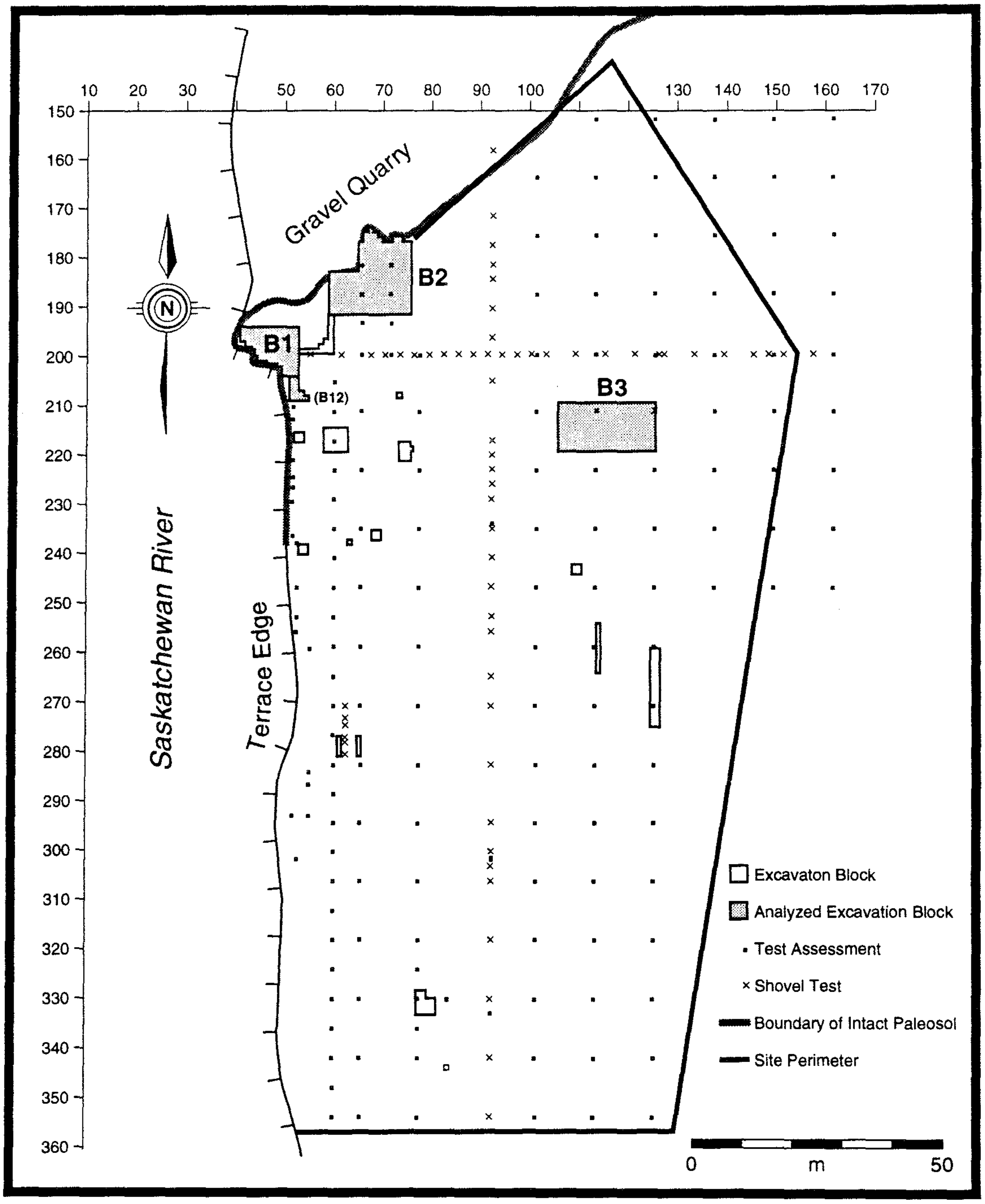


Figure 4.2 Location of Assessment Pits and Excavation Blocks at Bushfield West
***NOTE (B12) has been combined with Block 1.**

excavation blocks. Analysis of the faunal material (except for the microscopic bone fragments and microfauna recovered from the fine-screen samples) and the interpretation of their importance to the subsistence economy of the people inhabiting the site is the focus of this thesis.

4.2 Site Stratigraphy

In the area of the site where salvage excavations were carried out in 1981 four stratigraphic levels which included both artificial and natural layers were encountered: a plough zone which varied in thickness from 8 to 10 cm, a 4 cm thick lens of yellowish tan sand, a mottled black/brown paleosol varying in thickness from 3 to 6 cm, and sterile yellowish silt with buried paleosols (Burley et al. 1982a: 256, Figure D-4). The cultural material was consistently found at the top of the mottled black/brown paleosol. In some areas of the site cultivation had intersected the paleosol, either partially or completely disturbing. As a result the cultural material, which was normally found on top of the paleosol, was mixed into the plough zone and exposed on the surface of the field.

With one exception, the stratigraphic sequence identified by Gibson (1994: 9-10, Figure 2.6) in his assessment of Bushfield West is similar to that observed in the salvage excavation area by Burley et al. (1982a: 256). The upper layer consists of the plough zone varying in thickness from 8 to 15 cm. This is followed by a layer of grey-yellow alluvial sand. In some areas of the site the sediment grain size is coarser "indicating that the deposit had been created by flowing rather than standing water" (Gibson 1994: 10). The next layer is a 3 to 6 cm thick paleosol consisting of a silty black, very fine grained sand. The majority of the cultural material was discovered on the surface of this paleosol, while features such as hearths and rock pits extended either into or through the paleosol (ibid.: 10).

Excavations at Bushfield West were only concerned with approximately the upper 50 cm of eolian and alluvial deposits on the flat. The cut bank on the north end of the site revealed three metres of "interbedded sand and silt layers, with many organic layers among the beds" (ibid.: 27). One paleosol situated at 2.45 m below the surface dated to 3345±205 B.P. (S-2287), while a second paleosol located at 1.9 m below the surface dated to 2855±190 B.P. (S-2288) (ibid.: 27).

4.3 Radiocarbon Dating

Four radiocarbon dates were obtained from material collected during the course of excavations at Bushfield West (Table 4.1). These dates were calibrated by Morlan

(1993: 7) with the CALIB computer program and the ranges for the calibrated dates were presented at 2-sigma and 1 sigma limits. The intercept date represents the age in solar years which corresponds to the mean radiocarbon years.

Table 4.1 Bushfield West Radiocarbon Dates

Lab. No.	^{14}C years B.P. Uncalibrated	Calibrated Age B.P. 2s max	1s max	Intercept	1s min	2s min
AECV-151c	280 ± 120	540T	490	308	0*	0*
S-2363	355 ± 155	660T	530	461	0*	0*
S-2203	415 ± 65	550	519	500	440	310
S-2771	475 ± 60	631	542	518	500	460
Average	422.7 ± 40.0	529	515	503	476	335

Samples AECV-151c and S-2363 are truncated (T) at the maximum 2-sigma limit indicating that for each date there is an outlying interval that could possibly contain the true age. The outer limit range for sample AECV-151c is given as cal 1744-1693 and the outer limit range for sample S-2363 is given as cal 1692-1628. These samples also have "negative" minimum sigma B.P. limits (0*) as a result of the effects of bomb ^{14}C (the introduction of large quantities of ^{14}C into the atmosphere due to the testing of nuclear weapons in the 1950s and 1960s) (Morlan 1993: 8). It is not unusual to receive varying radiocarbon dates or dates with large standard deviations from recent sites since such sites are known to be "difficult to date with radiocarbon because of the hazards of contaminants in shallow burial environments and the vagaries of the deVries effect during recent centuries" (Morlan 1993: 41).

The dates produced by samples S-2203 and S-2771 are associated with low standard deviations and fall within one standard deviation of each other. These radiocarbon dates and the resultant average date also fall within the range of radiocarbon and thermoluminescence dates produced by other sites with Pehonan components in the Nipawin region, mid to late A.D. 1300s to A.D. 1700, and are considered to be acceptable dates (Meyer and Russell 1987: 17).

Sample AECV-151C was a composite of nine raw bone fragments weighing a total of 397 g which was collected from unit 218S 61E, within the vicinity of a hearth located in Block 2. S-2363 consists of a sample of charcoal collected from the SW$^{1/4}$ of unit 201S 49E of a hearth, towards the south side of Block 1. S-2203 was also a composite sample of raw bone fragments, 21 pieces of bone weighting 243 g collected from unit 211S 47E, on the southern edge of Block 1. The material was associated with a hearth feature. S-2771 was a paleosol sample collected from 23-30 cm below the surface in unit 256S 114E in Block 16 located in the central region of the flat approximately 60 m east of the river cut bank. One of the bone samples, AECV-151c was submitted to the radiocarbon and tritium laboratory in Vegreville, Alberta. The remaining samples (those preceded by S-) were submitted to the Saskatchewan Research Council radiocarbon dating laboratory in Saskatoon.

The occupation paleosol date is earlier than the dates received from material associated with the site occupation indicating that the terrace surface on which the habitation site was situated was established approximately 450 years ago or A.D. 1500. The three radiocarbon dates associated with the cultural remains suggest that the terrace was not occupied until a few decades later, possibly 350 years ago or approximately A.D. 1600 (Gibson 1993: 100).

CHAPTER 5

Analytical Methods

5.1 Faunal Cataloguing Methods

In order to record and process the large amount of faunal material recovered from Bushfield West, a computer-based data management system was developed by Terry Gibson of Western Heritage Services Inc. in collaboration with the author (Gibson 1991). The logistics and various stages of analysis were outlined by the author in a flowchart format and Mr. Gibson developed the necessary software. The computer program is designed for Macintosh computers. The ultimate goal of this data management system is to incorporate as much descriptive information about the faunal material recovered from an archaeological site as possible. Therefore, laboratory catalogue number, three-dimensional provenience, weight, counts, skeletal elements, patterns of element portions, age, cultural and natural modifications, and several invertebrate and vertebrate taxa are entered into the computer program at various stages of cataloguing.

Initially all items are classified as either identifiable or unidentifiable. Identifiable specimens are those which are determined to be identifiable as to skeletal element and to at least a general taxonomic level. Skeletal element and taxon identifications were made using the Department of Anthropology and Archaeology comparative faunal collection at the University of Saskatchewan, aided by illustrated resource material including the following: Sisson and Grossman (1938), Glass (1951), Olsen (1960), Gilbert (1980), Gilbert, Martin and Savage (1981), Brown and Gustafson (1989), and Balkwill and Cumbaa (1992). The minimum amount of information that is recorded for unidentifiable faunal material includes provenience (three-dimensional), weight (g), counts or frequency, cultural and natural modifications, and size (mm).

Following the recording of provenience, counts, weight, and size of identifiable bones, an extensive hierarchical system of branching menus is used to record element type. The skeleton is divided into two basic categories; axial elements and appendicular elements. Mammalian axial elements consist of the cranium (including the mandible), vertebrae, sternum, ribs, and costal cartilage. Mammalian appendicular elements include—the hyoid, scapula, clavicle, elements of the forelimbs, elements of the hindlimbs, the pelvic girdle, metapodials, and indeterminate long bone shaft fragments. Category headings for bird sternal and cranial elements, fish cranial and vertebral elements, and turtle carapaces are also included under axial element choices, then each category branches off to a separate menu selection screen. Bird, amphibian, and reptilian appendicular element choices are combined with mammalian appendicular element choices.

There exists considerable variability in the terminology used by faunal analysts for carpals and tarsals (Cornwall 1956: 146-147; Klein and Cruz-Uribe 1984: 11; Hesse and Wapnish 1985: 47; and Morlan 1991: 218). For this faunal program the terminology used for ungulate carpals and tarsals follows closely, with two exceptions, that recommended by Morlan (1991: 218,222) . The exceptions are unciform rather than carpal 4 and astragalus instead of talus. The terms used for carnivore carpals and tarsals are those recommended by Klein and Cruz-Uribe (1984: 15-16) and Olsen (1973: 73-75).

The majority of axial and appendicular elements are divisible into individual element components as demonstrated in the following example. The humerus is divided into the following components: head, head/major tuberosity, major tuberosity, neck, deltoid crest, shaft, lateral epicondyle, medial epicondyle, condyle, other humerus part, and indeterminate humerus part. The element component terminology follows that of Sisson and Grossman (1938).

Skeletal elements are then categorized as to bone condition (complete, nearly complete, or fragment) and element portion (proximal, distal, medial, anterior/proximal, etc.). The choices for element portions are extensive and there may be overlapping choices; therefore, the analyst or recorder must decide how to interpret each category and then remain consistent throughout the cataloguing procedure. In the element portion category the term "element" indicates complete or nearly complete bones. If possible the elements are sided and a general age estimation is made. The age estimation categories also includes several choices which may be considered to overlap, such as foetal and immature, and again the analyst or recorder must be consistent. Foetal is used to refer to unborn individuals, whereas immature will refer to elements with unfused epiphyses, porous cortical bone, or small size when compared to fully developed elements.

In the analysis of teeth the evolutionary nomenclature is used; therefore, when referring to the bison dentition the terms second to fourth premolar are used rather than first to third premolar. Standard abbreviations that are used when referring to teeth consist of the following: 'I' indicating incisor, 'C' indicating canine, 'P' indicating premolar and 'M' indicating molar. The letters are generally suffixed by a number; e.g. 1, 2, 3 and 4; to indicate the tooth position (first, second, third and fourth). Letters which are not capitalized indicate a deciduous dentition; e.g. 'dp2' indicates a deciduous second premolar.

Observable cultural and natural taphonomic alterations are recorded under separate categories. Cultural modifications or alterations include burning, calcining bone flaking, cut bone, cut marks, drilling, incising or grooving, polish, and the formation of bone tools. Shovel trauma which occurred during excavation and post-excavation breakage are also recorded under cultural modifications. Natural taphonomic modifications include both biological alterations such as scavenging and chewing by carnivores, gnawing by rodents, porcupines, and ungulates, and root erosion, as well as geological alterations such as weathering (including bleaching, bone discoloration, surface cracking, and exfoliation), mineralization, and water rolling. Any observable pathologies are noted under the category of natural modifications.

The weathering of faunal material recovered from Bushfield West is recorded using a series of five stages which progress from only slight alteration of the bone cortex to extensive damage. Stage 1 consists of dry bone which exhibits discoloration of the cortical surface or bleaching. Stage 2 indicates that small cracks usually oriented parallel to the bone structure are visible on outer surface. The edges of the specimen also show a certain amount of deterioration. Stage 3 specimens show deterioration of the bone surface and edges, as well as occasionally pitting of the bone surface. Stage 4 includes bones that have longitudinal, as well as right angled cracking of the cortical bone and occasional exfoliation of the bone surface. Stage 5 bones demonstrate extensive cracking and exfoliation and are often impossible to remove from the soil matrix as intact specimens. These stages of weathering are similar to those defined by Behrensmeyer (1978: 151); however, due to the manner in which the site was excavated some of the weathering stages have been modified to describe specific alterations observed on Bushfield West material. Stage 1 begins with dry bone rather than unweathered fatty elements and in stage 2 there are no remnants of ligaments, cartilage, or skin.

The taxonomic identification from class to species level (if possible) is then recorded. Often if a species or genus level can not be identified the family level or at least order, preceded by a size qualifier (e.g. small canid or small mammal), can be determined. The majority of the faunal material recovered from archaeological sites is fragmented to varying degrees. Skeletal elements such as vertebrae and ribs are difficult to assign to a species even when complete. Fragments of the cranium, teeth, and long bone shafts are equally difficult to identify as to species (Klein and Cruz-Uribe 1894:

18). Therefore, unless such specimens are found to be relatively complete and in association with parts assigned to the species level they are classified at a general level (e.g. unidentified ungulate). It is postulated that for Bushfield West "unidentified ungulate" will be a major taxonomic classification for cranial, indeterminate teeth, vertebrae, and rib fragments since there are three species—bison, moose and elk—represented in this size category which all occur within the site area.

Faunal items are sized using either graded geological sieves or by placement on grid paper with the following size categories outlined: 0.1 - 2.0 mm, 2.0 - 6.0 mm, 6.0 - 13.0 mm, 13.0 - 25 mm, 25 - 50 mm, 50 -100 mm, 100 - 200 mm, and 200+ mm. The various size categories are selected to reflect the degree of bone fragmentation resulting from either cultural or natural processes , as well as the presence of micro-fauna recovered from coarse screening (6 mm).

Finally, comments concerning bone articulations and butchering units, processing and butchering procedures, feature associations, and specific types of pathologies are included in a note file at the end of each catalogue record. These notes are restricted to 100 characters in length.

5.2 Faunal Quantitative Methods

The number of identified specimens per taxonomic unit (NISP), the minimum number of individuals (MNI) and bone weight are well established standard methods of quantifying faunal remains. However, presently, the weight of elements per taxonomic grouping is rarely used to estimate taxonomic abundance. Recently, the minimum number of elements (MNE) and the minimum number of animal units (MAU) have been employed as the standard means of quantifying faunal assemblages associated with archaeological sites. According to Lyman (1994b: 48-49) this reflects the differences in research questions being asked by zooarchaeologists and taphonomists. NISP and MNI units are used to estimate taxonomic abundances; that is they are meant to measure how many of each taxon are represented in a faunal assemblage (Lyman 1994a: 48). The taxon being measured can be highly variable, representing either a species, genus, family or order. MNE and MAU values are designed to measure frequencies of skeletal portions of individual taxa and the effects of taphonomic processes (Lyman 1994b: 102).

5.2.1 NISP and MNI

The number of identified specimens (NISP) is a basic counting unit (Grayson 1984: 17). NISP values are readily apparent and easy to calculate as the faunal assemblage is being catalogued. The NISP values derived from different aggregates are also additive if the analyst subsequently decides that areas or levels of a site should be combined. It is considered to be an observational unit since it can be directly measured (Lyman 1994a: 100). However, the use of NISP as a means of determining taxonomic abundance has been criticised by faunal analysts since the mid-1950s (Grayson 1984: 20-24; Klein and Cruz-Uribe 1984:24-25). NISP calculations do not take into account that skeletons of certain species have more elements than the skeletons of others and therefore, the NISP may over emphasis the abundance of one species in comparison to a second species. NISP calculations are biased in favor of individuals which reach the site intact as opposed to those which are butchered with only selected portions transported back to the site. NISP values are greatly affected by fragmentation. The more fragmented a faunal assemblage, the higher the NISP count. However, it should be noted that Marshall and Pilgram (1993: 266) contend that NISP values are inflated by fragmentation only to a certain point. In instances of severe fragmentation the specimens are no longer identifiable and, therefore, no longer contribute to NISP values. The NISP is also affected by differential preservation of skeletal elements, both in terms of different skeletal elements of a single individual, and between individuals of different taxa. Perhaps the strongest criticism of NISP values is the interdependence of specimens. When calculating NISP values the specimens being counted may represent the same element or they may represent different elements, e.g., five complete femora are represented in the same manner as five fragments of the same femur.

The use of MNI as a means of quantifying taxonomic abundance was first introduced by Theodore White (1953). The manner in which White calculated the minimum number of individuals per taxon was to "separate the most abundant element of the species found ... into right and left components and use the greater number as the unit of calculation" (White 1953: 397). Klein and Cruiz-Uribe (1984: 26) define MNI as "the number of individuals necessary to account for all the identified bones." MNI is considered to be an analytical unit since it may or may not take into account individual variation such as age, sex or size. The analyst is required to make a decision concerning how the data set is to be manipulated mathematically (Lyman 1994b: 38).

Although White did not introduce MNI as a means solving the problem of interdependence of specimens, it does just that (Grayson 1984:27). MNI counts also alleviate the problem of differential species representation at a site due to processing, transportation and size factors. It is likely that only portions of large animals killed at some distance from the site will be returned to the site; whereas, small animals are generally returned as complete units and a larger percentage of medium to large-sized animals killed within the vicinity of the site will be returned to the site. Using MNI as a method of quantification, whether a portion of an animal or a complete animal is returned to the site the value will be the same (Klein and Cruz-Uribe 1984: 26).

However, MNI as a means of quantifying faunal data is not without its own shortcomings. It does not address the problems of differential preservation or fragmentation within a skeletal unit or between individuals of different taxa (Grayson 1984: 28). As Marshall and Pilgram (1993:266) point out, MNI values are based on the ability of the analyst to recognize significant landmarks which indicate that the fragments could not possibly come from the same element. As the level of fragmentation increases the ability of the analyst to demonstrate that the fragments are from different elements decreases as does the calculated MNI. There is no agreed upon means by which MNI values should be calculated and MNI values for different site aggregates are not additive as NISP values are (Klein and Cruz-Uribe 1984: 28). Therefore, if two samples from a site, such as the fauna from two excavation blocks, are combined the MNI for the combined sample has to be re-calculated. Rather than simply adding together the previously determined MNI values for the two samples.

Grayson (1973:433-434, 1984:29) goes to great lengths to demonstrate that the values derived from MNI calculations will vary with the manner in which the faunal assemblages are combined. This is the main reason why Grayson favors NISP counts (which are not affected by aggregation) over MNI counts as a means of quantifying faunal assemblages. If the assemblage is divided on the basis of arbitrary levels or site features such as middens, pits or living areas the total MNI values for the site will increase. If there are fewer aggregates consisting of larger groupings of faunal material the total MNI values will decrease. Grayson (1978:64) also indicates that MNI calculations are affected by sample size, especially small sample sizes.

5.2.2 MNE and MAU

As mentioned previously, the MNE and MAU are quantitative methods specifically designed to measure skeletal part representation and the taphonomic effects on the recovered faunal assemblage, rather than taxonomic abundances (Ringrose 1993: 129; Lyman 1994b: 48). MNE is defined as "the minimum number of elements necessary to account for the specimens of a particular skeletal element or element portion of a taxon, such as the number of proximal bison humeri" (Lyman 1994b: 102). Since the MNE can be calculated for skeletal parts such as the proximal, shaft, or distal portions of an element, it allows for fragmentation (Ringrose 1993: 130). Depending upon the comminuted nature of the faunal assemblage a dramatic reduction in calculated values will occur as the analyst moves from NISP counts to MNE counts. MNE is an analytical unit since the analyst must determine if two specimens represent the same element or are representative of two different elements (Lyman 1994a: 102). The age, sex, and size of elements may or may not be considered when calculating the MNE values.

"*MAU* stands for the minimum number of animal units necessary to account for the specimens in a collection" (Lyman 1994b: 105, emphasis in original) . This measure was initially recommended by Binford (1978:70) during his study of the Nunamiut; (these calculations were actually defined as MNI values). Binford attempted to emphasize that as a result of butchering, an animal is divided into smaller segments or animal units for storage, transport or consumption. Thus the calculation of MAU focuses on the dismembered portions of the animal rather than the entire individual which is what MNI counts do. MAU is calculated by dividing the MNE for each element by the number of times that element occurs in a complete skeleton (Lyman 1994b: 104). A flaw of MAU values, pointed out by Grayson (1984: 90), is that MAU are subject to the same effects of assemblage aggregation which plague MNI values.

5.3 Quantifying Bushfield West Fauna

Even though Klein and Cruz-Uribe (1984:29) stress that MNI has several advantages over NISP, they suggest that the two counts be used together. MNI represents the minimum number of individuals necessary to account for the species represented in the sample. NISP represents the theoretical maximum number of individuals. In all likelihood, the actual number of species lies somewhere between these two values. They also suggest that NISP and MNI be "calculated and presented for each skeletal part of each species and not simply for the species as a whole" (Klein and Cruz-Uribe 1984: 32). Grayson (1984: 92) argues that "specimen counts provide the same sort of information on relative abundances that is provided by minimum numbers, yet are not affected by aggregation". NISP is, therefore, the best measure of relative taxonomic abundance.

NISP, MNE, MNI and MAU counts and bone weights will be used in quantifying the faunal assemblage of each excavation block at Bushfield West. An abbreviated form of NISP (=N) will also be used when referring to the number of specimens identified in the faunal assemblage. The reason for quantifying Bushfield West fauna by several different methods is so that questions concerning taxonomic abundance, skeletal element representation and taphonomy can all be examined. It will also allow other researchers to utilize the data in inter-site comparisons and to explore other avenues of research using the data from this site.

MNI values are calculated for each species using the traditional methodology defined by White (1953), where the maximum value of the most abundant element is used taking side, age and fragmentation into account. Pair-matching was not attempted in the determination of MNI values. Therefore, if three complete proximal left metacarpals, one left metacarpal proximal fragment and two complete right metacarpals were recovered from an excavation block the resultant MNI would be 4. A second example is two immature left calcanei and one right mature calcaneus will result in an MNI of 3. For isolated and socketed teeth, an MNI is calculated for the isolated teeth and an MNI is calculated for mandibles or maxilla with socketed teeth. If there is overlap between the types of teeth represented as isolated and socketed teeth, the two MNIs are summed to provide a total MNI. For example, the MNI for individual lower right M1 teeth is determined to be 10 and two right mandibles have socketed M1 teeth giving an MNI of 2; the total MNI would be 12. For multiple elements such as phalanges, sesamoids and vertebrae, the number of specimens represented is divided by the number of skeletal elements in a complete individual. If the calculated value is a fraction, the number is rounded upward. For example: the MNI for 20 inferior sesamoids would be 3 (20/8=2.5 rounded upward to 3).

MNE values are determined for articular ends, shafts, and complete elements. In deriving MNE values for mandibles and long bone shafts, recognizable bone portions described by Morlan (1994) are used, and the most abundant portion provides the MNE for that element. The MNE calculations allow for fragmentation, but side, age and gender are ignored. As an example: if two right distal femur fragments and three left distal femur fragments are recovered and a visual examination indicates that all fragments come from separate elements the resultant MNE is 5.

MAU is derived by dividing the MNE for a skeletal element by the number of times that element occurs in a single individual (similar to the manner in which MNI is calculated for multiple skeletal elements). Therefore, in the example of the MNE calculation for the distal femur given previously, the MAU is determined as follows: 5/2=2.5.

Two additional terms, specimen and element, often seen in definitions of taxonomic quantification units are used as defined by Lyman (1994a: 39, 1994b: 100-101). A specimen is an observable unit that can either be a complete bone or tooth or fragment thereof. An element is a complete "discrete, natural anatomical unit of a skeleton, such as a humerus, tibia or a tooth" (Lyman 1994b: 100). Therefore, a specimen can be a complete bone or skeletal element or fragment of a skeletal element such as the distal end of a humerus. A specimen that is a fragment or portion of a bone represents, but is not technically considered to be, an element.

CHAPTER 6

Bushfield West - Block 1 Faunal Remains

6.1 Introduction

The excavation of 95.5 square metres resulted in the recovery of 18,576 bone specimens weighing 37,110.1 g. All of the bone specimens were analyzed and catalogued according to the procedures outlined in the "Faunal Cataloguing Methods" section of the previous chapter. The faunal material recovered from Block 1 is highly comminuted and as a result a high percentage (83%) of the sample is unidentifiable, 15,374 specimens weighing 10,250.2 g. Analysis of the unidentifiable bone material entailed recording, aside from frequencies and weights, size categories and both cultural and natural taphonomic modifications. The results are presented in the following section.

The remaining 17% of the faunal assemblage from Block 1 consists of material that is identifiable as to skeletal element and to at least a general taxonomic classification, such as class - Mammalia. The systematic descriptions and analysis of the 3202 identifiable bone specimens (26,859.9 g) makes up the bulk of the material presented in this chapter. Mammals are discussed first, followed by birds, fish, and then amphibians. Within each class a hierarchical system of general to specific taxonomic classification such as order, family, genus, and species is followed. The mammals are not presented according to an evolutionary taxonomic classification system as is found in Banfield (1976). Instead, they are organized according to order beginning with the largest animals and then proceeding through the list of identified orders according to diminishing size. It should be noted that although beavers are larger than leporids the remaining members of the Order Rodentia are of equal size or smaller; therefore, the Order Lagomorpha is presented first. Within each order those specimens which cannot be assigned to a lower taxonomic classification are discussed first since they may represent any of the subsequent families, genera, or species of that order. Birds are presented according to the taxonomic classification system followed by Godfrey (1986). Specimens which are assigned to a general taxonomic classification are discussed first, followed by more specific identifications. Fish are presented according to the taxonomic classification system followed by Scott and Crossman (1973). Fish remains which cannot be identified to order are dealt with first. Detailed discussions of the cultural and natural taphonomic modifications recorded during the analysis of the identifiable faunal specimens are found in Chapter 9.

6.2 Unidentifiable Faunal Specimens

As indicated in the introduction, the majority of the faunal material recovered from Block 1 is unidentifiable as to either skeletal element or taxonomy. The category of unidentifiable bone includes a total of 15,374 pieces weighing 10,250.2 g. Cultural modifications of the unidentifiable bone fragments consist of burning, calcining, cut marks, and the formation of tools. Burned bone fragments (N=1482) account for 10% of the unidentifiable bone fragment sample. Calcined bone fragments (N=1298) make up 8% of the unidentifiable bone sample. Clearly, the largest portion of the unidentifiable bone sample is unburned or raw bone, 12,594 fragments or 82%. The breakdown of unidentifiable bone fragments according to size categories for raw, burned and calcined specimens is presented in Table 6.1.

The greatest number of unidentifiable bone fragments fall in the 6-13 mm size range (N=9087), followed by the 13-25 mm size range (N=5206), the 25-50 mm size range (N=729), the 2-6 mm size range (N=348), and finally the 50-100 mm size range (N=4). None of the unidentifiable bone fragments fell in either the 2-6 mm, 100-200

Table 6.1 Block 1 - Unidentifiable Bone Fragments

Size	Raw		Burned		Calcined	
	Freq.	Weight	Freq.	Weight	Freq.	Weight
0-2 mm	0	0.0	0	0.0	0	0.0
2-6 mm	318	5.1	8	0.0	22	0.6
6-13 mm	7296	997.3	863	195.2	928	228.2
13-25 mm	4293	6875.2	576	460.1	337	271.4
25-50 mm	683	1067.5	35	108.3	11	30.1
50-100 mm	4	11.1	0	0.0	0	0.0
100-200 mm	0	0.0	0	0.0	0	0.0
200+ mm	0	0.0	0	0.0	0	0.0
Total	12594	8956.2	1482	763.7	1298	530.3

*Weight is in grams.

mm or 200+ size categories. The ranking of the size categories changes slightly when weight is considered. The greatest amount of unidentifiable bone material falls in the 13-25 mm size category (7606.7 g), followed by the 6-13 mm size category (1420.7 g), the 25-50 mm size category (1205.9 g), the 50-100 mm size category (11.1 g), and then the 2-6 mm size category (5.8 g).

Other forms of cultural taphonomic modifications such as cut marks and the manufacture of bone tools is apparent on six of the unidentifiable bone fragments. Multiple shallow cut marks were recorded on two bone fragments. One bone fragment, which is either a rib shaft fragment or a spinous process fragment from a thoracic vertebra, has a serrated edge. Three bone tools from Block 1 are heavily modified and the skeletal element from which they were manufactured cannot be identified. One item is a fragment of a barbed bone harpoon. This artifact has been thinned by whittling and abrasion resulting in heavy polish on the surfaces. There is a notch on the lateral edge and a hole has been drilled at the distal end. A second item is the distal portion of a piercer or awl with a long pointed tip that is heavily smoothed and polished. The third item is a bone bead that is cut at both ends and is heavily polished.

Fragmentation of a certain percentage of the sample may be due to compaction of the soil by agricultural and/or gravel quarrying equipment.

One thin unidentifiable cortical bone fragment exhibits multiple circular holes which extend through the bone. The perforations are quite small, less than 2 mm in diameter and they appear to be either bored or chemically dissolved, rather than punctured (the edges are clean and do not show crushed bone). Since these marks are unlike any of those which are generally attributed to modification by humans, carnivores, rodents, plant roots, or weathering, the analyst was unable to identify the taphonomic agent responsible for the alteration of the bone.

6.3 Identifiable Faunal Specimens

Five classes (mammals, birds, fish, amphibians, and bivalves) are present in the assemblage of 3202 identifiable faunal specimens (26,859.9 g) from Block 1. The bivalve specimens are included in the general Bushfield West catalogue; however, they do not form part of the faunal assemblage that was analyzed for the purposes of this thesis. The largest class is Mammalia with 2357 identified specimens (26,676.0 g) forming 74% of the identifiable faunal assemblage from Block 1 of Bushfield West. The second largest class is Osteichthyes with 704 identified specimens (64.5 g), constituting 22% of the assemblage. Aves is the third largest class with 140 identified specimens (119.3 g) making up 4% of the assemblage. The class Amphibia is represented by one specimen weighing 0.1 g.

Several taxa are represented in each class, except for Amphibia. A summary by NISP, weight, and where applicable MNI of the taxa is presented in Table 6.2.

Table 6.2 Block 1 - Identified Taxa by NISP, %NISP, MNI, and Weight

Taxon	NISP	%NISP	MNI	Weight (g)
Mammals				
Small mammal	5	0.2	-	1.4
Ungulate, unidentified	1304	40.7	-	9030.1
Bison	257	8.0	6	14,722.7
Moose or Elk	3	0.1	-	17.2
Moose	10	0.3	1	345.6
Elk	54	1.7	2	1914.2
Bear	3	0.1	1	73.9
Canid, unidentified	25	0.8	-	10.4
Gray Wolf or Domestic Dog	33	1.0	-	23.7
Coyote	3	0.1	1	6.0
Red Fox	6	0.2	1	2.7
Striped Skunk	2	0.1	1	0.4
Leporid	6	0.2	-	1.3
White-tailed Jackrabbit	6	0.2	1	1.6
Snowshoe Hare	129	4.0	5	4.7
Small rodent	2	0.1	-	0.1
Beaver	472	14.7	5	509.7
Muskrat	9	0.3	1	4.3
Red Squirrel	11	0.3	3	2.0
Ground Squirrel	1	0.0	1	1.3
Northern Pocket Gopher	6	0.2	1	2.2
Least Chipmunk	1	0.0	1	0.1
Birds				
Small bird	1	0.0	-	0.1
Medium bird	15	0.5	-	1.9
Large bird	14	0.4	-	3.9
Common Loon	1	0.0	1	3.1
Medium waterfowl	7	0.2	-	1.0
Large waterfowl	7	0.2	-	3.5
Swan	34	1.1	1	87.3
Geese, unidentified	1	0.0	-	1.9
Duck, unidentified	2	0.1	-	0.5
Teal	1	0.0	1	0.1
Mallard	8	0.3	1	3.9
Hawk	1	0.0	-	0.1
Grouse, unidentified	47	1.5	4	11.8
Perching bird	2	0.1	-	0.2
Fish				
Fish, unidentified	543	17.0	-	35.7
Lake Sturgeon	41	1.3	1	7.7
Goldeye	1	0.0	1	0.1
Northern Pike	32	1.0	2	4.4
Longnose Sucker	2	0.1	2	0.2
White Sucker	24	0.7	3	3.0
Silver Redhorse	12	0.4	4	2.2
Shorthead Redhorse	7	0.2	2	1.5
Sauger	1	0.0	1	0.3
Walleye	41	1.3	3	9.4

6.4 Class Mammalia - Mammals

The unidentified ungulate classification contains the greatest number of identified specimens (N=1304) accounting for 55% of the mammalian specimens found in Block 1. The next largest mammalian taxon is beaver with 472 identified specimens (20% of the assemblage), followed by bison with 257 specimens (11%), snowshoe hare (N=129, 6%), canids (N=67, 3%) and elk (N=54, 2%). The remaining taxa account for much smaller percentages of the mammalian fauna, 3% altogether.

Six specimens can only be identified to a very general taxonomic level, unidentified small mammal. The size range of mammals included in this category are animals that are smaller in size than the red fox, but larger than a small rodent (ground squirrel) The specimens assigned to this category include a left zygomatic arch fragment of the temporal bone, an anterior epiphyseal fragment of an indeterminate vertebra, three rib shaft fragments, and an indeterminate long bone shaft fragment.

6.4.1 Order Artiodactyla, [Ungulate, Unidentified]

The largest category of identifiable faunal material from Block 1 consists of ungulate specimens which can not be identified to the level of species; therefore, they are classified as unidentified ungulate. They account for 41% of the identifiable specimens recovered from Block 1. Without complete or relatively complete elements or complete element portions, it is difficult to make a taxonomic identification to the level of species. All of the unidentified ungulate specimens, except for two deciduous incisors, are fragmented. Some are so fragmented that only a general skeletal element identification can be made, i.e. long bone shaft fragment, long bone articular end fragment, or metapodial fragment.

The category of unidentified ungulate specimens consists of 1304 bone fragments weighing 9030.1 g. This sample is made up of both axial (N=558) and appendicular (N=749) skeletal specimens. Axial specimens include vertebral fragments (N=212), rib fragments (N=170), cranial fragments (N=113), indeterminate tooth fragments (N=31), mandible fragments (N=18), incisor fragments (N=9), and premolar/molar tooth fragments (N=5). Table 6.3 presents a summary of the unidentified ungulate axial specimens by NISP.

Table 6.3 Block 1 - Unidentified Ungulate Axial NISP

Specimen	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Skull:							
-frontal	8	2	3	0	13	112.1	2.3
-petrous	0	1	3	0	4	6.3	0.7
-zygomatic	1	1	1	0	3	4.7	0.5
-premaxilla	2	0	0	0	2	1.4	0.4
-temporal	2	2	2	0	6	22.2	1.1
-nasal	2	2	4	0	8	51.4	1.4
-palatine	1	0	0	0	1	0.4	0.2
-sphenoid	0	0	0	1	1	0.2	0.2
-parietal	0	2	0	0	2	5.5	0.4
-interpariet.	1	1	0	0	2	4.7	0.4
-jug. pro.	0	1	0	0	1	0.4	0.2
-maxilla	0	1	1	0	2	0.8	0.4
-alveolus	0	0	5	0	5	8.9	0.9
-indt. cran.	0	0	63	0	63	67.2	11.3
-dec. incisor	4	2	1	0	7	1.6	1.3
-incisor	0	0	2	0	2	0.5	0.4
-lower P2	1	0	0	0	1	0.3	0.2
Mandible:							
-condyle	0	0	1	0	1	0.6	0.2
-asc. ramus	1	0	3	0	4	42.8	0.7
-hor. ramus	2	2	7	0	11	111.9	2.0
-diastema	1	0	0	0	1	23.9	0.2
-symphysis	1	0	0	0	1	1.0	0.2
Teeth:							
-molar	0	0	1	0	1	5.5	0.2
-pre/molar	0	0	3	0	3	12.2	0.5
-indt. teeth	0	0	31	0	31	9.0	5.7
Vertebra:							
-atlas	0	0	0	6	6	71.9	1.1
-axis	0	0	0	3	3	16.9	0.5
-cervical	0	0	0	54	54	204.3	9.7
-thoracic	0	0	0	95	95	324.7	17.0
-lumbar	0	0	0	29	29	126.7	5.2
-sacrum	0	0	0	4	4	45.5	0.7
-caudal	0	0	0	1	1	0.7	0.2
-indt. vert.	0	0	0	20	20	15.4	3.6
Rib:							
-head	0	0	5	0	5	11.6	0.9
-head/neck	0	0	8	0	8	77.0	1.5
-neck	0	0	12	0	12	75.0	2.2
-neck/tub.	0	0	1	0	1	1.2	0.2
-tubercle	0	0	3	0	3	2.2	0.5
-neck/body	0	0	1	0	1	1.6	0.2
-body	0	0	131	0	131	1027.9	23.5
-sternal end	0	0	4	0	4	50.2	0.7
-costal cart.	0	0	5	0	5	5.5	0.9
Total	27	17	301	213	558	2553.8	100.4

An examination of the size categories in which the unidentified ungulate axial specimens fall gives an indication of the degree of fragmentation of this material. The majority of axial specimens are found in the 25-50 mm size category (N=222), followed by the 13-25 mm size category (N=171), the 50-100 mm size category (N=86), and the 6-13 mm (N=60) size category. The axial specimens in each size category by NISP are presented in Table 6.4.

Table 6.4 Block 1 - Unidentified Ungulate Axial NISP by Size Categories

Size	Cranial	Mand.	Teeth	Indt. Teeth	Vert.	Rib	Total
0-2 mm	0	0	0	0	0	0	0
2-6 mm	0	0	0	0	0	0	0
6-13 mm	12	1	9	20	18	0	60
13-25 mm	57	3	2	11	68	30	171
25-50 mm	33	7	3	0	94	85	222
50-100 mm	11	7	0	0	30	39	87
100-200 mm	0	0	0	0	2	12	14
200+ mm	0	0	0	0	0	4	4
Total	113	18	14	31	212	170	558

When considered by weight there is a difference in the ranking of size categories—the 50-100 mm size category contains the greatest amount (986.6 g) followed by the 25-50 mm size category (775.7 g), the 100-200 mm size category (377.4 g), the 200+ mm size category (228.0 g), and finally the 13-25 mm size (172.1 g). The majority of material in the 50-100 mm and larger size categories consists of large ribs shaft segments that are identifiable as to element but which can not be identified as to species. The axial specimens by weight for each size category are shown in Table 6.5.

Table 6.5 Block 1 - Unidentified Ungulate Axial Specimen Weight (g) by Size Categories

Size	Cranial	Mand.	Teeth	Indt. Teeth	Vert.	Rib	Total
0-2 mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-6 mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6-13 mm	2.5	0.1	1.9	3.5	6.0	0.0	14.0
13-25 mm	42.9	3.2	3.8	5.4	85.6	31.2	172.1
25-50 mm	105.6	32.0	14.4	0.0	389.9	233.8	775.7
50-100 mm	135.2	144.9	0.0	0.0	297.1	409.4	986.6
100-200 mm	0.0	0.0	0.0	0.0	27.6	349.8	377.4
200+ mm	0.0	0.0	0.0	0.0	0.0	228.0	228.0
Total	286.2	180.2	20.1	8.9	806.1	1252.2	2553.8

The largest portion of the unidentified ungulate assemblage consists of appendicular specimens, 749 appendicular bone fragments weighing 6476.3 g. The majority of the appendicular specimens are from long bone elements, 84% of the sample or 627 specimens. The majority of long bone specimens cannot be identified as to specific element and are thus catalogued as long bone shaft fragments (N=364). The remaining unidentified ungulate specimens are from various regions of the skeleton: the hyoid (N=9), scapula (N=30), forelimbs (N=87), innominate (N=34), hindlimbs (N=141), phalanges (N=31), and sesamoids (N=6) (Table 6.6)

Table 6.6 Block 1 - Unidentified Ungulate Appendicular NISP

Specimen	Left	Right	Indt.	Total	Weight (g)	NISP%
Hyoid	1	3	5	9	8.1	1.2
Scapula:						
-glen./neck	0	1	0	1	59.3	0.1
-neck	1	2	3	6	41.3	0.8
-caudal bor	1	2	2	5	29.8	0.7
-cranial bor	0	0	7	7	31.8	0.9
-spine	1	1	0	2	13.4	0.3
-blade	0	1	8	9	50.8	1.8
Humerus:						
-shaft	11	8	12	31	578.6	4.0
-deltoid	5	1	1	7	56.0	0.9
-teres major	0	1	0	1	25.4	0.1
-radial fossa	4	2	1	7	68.7	0.9
-olecra foss	1	1	0	2	22.7	0.3
-capitulum	1	0	0	1	15.7	0.1
Radius:						
-shaft	5	10	3	18	434.6	2.4
-carp. facet	1	1	1	2	4.5	0.3
Ulna:						
-shaft	4	3	5	12	119.0	1.6
-trochlea	0	0	1	1	3.2	0.1
Acces. carp.	0	1	0	1	1.4	0.1
5th metac.	0	0	2	2	1.1	0.3
Metacarpal:						
-art. facet	1	0	0	1	8.5	0.1
-shaft	0	0	1	1	12.5	0.1
Innominate:						
-acetabul.	5	7	6	18	108.0	2.4
-ischium	5	1	2	8	81.6	1.1
-ilium	3	0	3	6	30.9	0.8
-pubis	0	1	1	2	34.0	0.3
Femur:						
-head	1	0	0	1	11.7	0.1
-neck	1	0	0	1	12.6	0.1
-min. troch.	1	1	4	6	59.9	0.8
-shaft	9	6	7	22	638.9	2.9
-sup. cond.	7	0	1	8	203.6	1.1
-pat. groove	1	2	0	3	27.3	0.4
-med. cond.	0	1	0	1	36.3	0.1
Tibia:						
-med. cond.	1	3	0	4	25.2	0.5
-lat. cond.	2	3	1	6	73.8	0.8
-condyle	0	0	1	1	0.8	0.1

Table 6.6 (Continued)

Specimen	Left	Right	Indt.	Total	Weight (g)	NISP%
-tibial crest	7	4	0	11	317.0	1.5
-mus. lines	3	0	5	8	127.4	1.1
-shaft	14	15	1	30	571.0	4.0
-med. mall.	1	2	0	3	27.0	0.4
-lat. mall.	2	0	0	2	6.4	0.3
-tarsal art.	2	5	0	7	42.9	0.9
Calcaneus	1	0	0	1	1.7	0.1
Astragalus	1	3	0	4	18.0	0.5
Cen./4th	0	2	0	2	21.5	0.3
2nd/3rd	1	0	0	1	0.8	0.1
Metatarsal:						
-shaft	0	1	16	17	263.3	2.3
-condyle	0	0	2	2	23.2	0.3
Long bone:						
-articular	0	0	28	28	79.8	3.7
-shaft	0	0	364	364	1763.7	48.6
Metapodial:						
-articular	0	0	1	1	6.0	0.1
-shaft	0	0	3	3	44.8	0.4
-condyle	0	0	13	13	127.8	1.7
1st phal.	0	0	12	12	27.0	1.6
2nd phal.	0	0	6	6	13.6	0.8
3rd phal.	0	0	13	13	31.0	1.7
S. med. ses.	0	0	3	3	2.0	0.4
S. lat. ses.	0	0	2	2	1.4	0.3
Infer. ses.	0	0	1	1	0.5	0.1
Total	105	96	548	749	6476.3	100.0

There are only two complete and two nearly complete unidentified ungulate appendicular elements. The complete elements are a basihyoid and a newborn superior lateral sesamoid. The nearly complete specimens are a first phalanx and a newborn third phalanx. The remaining unidentified ungulate specimens are highly fragmented. The appendicular specimens were measured to give an indication of the comminuted nature of the assemblage. In the analysis of the size categories of unidentified ungulate appendicular specimens those elements that are classified as long bones were group together and small dense elements were grouped with the hyoid, scapula, and innominate. In both groupings the majority of appendicular specimens fall in the 25-50 mm size category. For the long bone specimens the next most common size category is 50-100 mm, followed by the 13-25 mm size category. The second most frequent size category for the second grouping of appendicular specimens is 13-25 mm, followed by the 50-100 mm size range. The unidentified ungulate appendicular specimen size categories are presented in Tables 6.7 and 6.8

Table 6.7 Block 1 - Unidentified Ungulate Long bones NISP by Size Categories (mm)

Element	0-2	2-6	6-13	13-25	25-50	50-100	100-200	200+	Total
Humerus	0	0	0	1	31	17	0	0	49
Radius	0	0	0	3	9	7	2	0	21
Ulna	0	0	0	0	7	6	0	0	13
Metacarpal	0	0	0	0	2	0	0	0	2
Femur	0	0	0	0	17	24	1	0	42
Tibia	0	0	1	6	35	24	6	0	72
Metatarsal	0	0	1	0	6	12	0	0	19
Metapodial	0	0	0	4	9	4	0	0	17
Indt. shaft	0	0	0	61	262	41	0	0	364
Indt. art.	0	0	0	16	12	0	0	0	28
Total	0	0	2	91	390	135	9	0	627

Table 6.8 Block 1 - Unidentified Ungulate Other Appendicular NISP by Size Categories (mm)

Element	0-2	2-6	6-13	13-25	25-50	50-100	100-200	200+	Total
Hyoid	0	0	0	3	6	0	0	0	9
Scapula	0	0	0	2	15	13	0	0	30
Innominate	0	0	0	3	25	6	0	0	34
5th meta	0	0	2	0	0	0	0	0	2
Accessory	0	0	0	1	0	0	0	0	1
Tarsals	0	0	0	5	3	0	0	0	8
Phalanges	0	0	1	20	9	1	0	0	31
Sesamoids	0	0	2	4	0	0	0	0	6
Bony oss.	0	1	0	0	0	0	0	0	1
Total	0	1	5	38	58	20	0	0	122

The weight per size category for unidentified ungulate long bone specimens and other appendicular specimens shows that the 50-100 mm size category contains the greatest amount of unidentified ungulate specimens material, followed by the 25-50 mm size category. The remaining size categories have substantially less bone by weight. The appendicular specimens by weight per size category is shown in Tables 6.9 and 6.10.

Variation in the ages of some of the unidentified ungulate appendicular specimens is indicated by unfused epiphyses and partially fused epiphyses and diaphyses. Unfused epiphyses include a femoral head, a lateral condyle of a left tibia, a tibial condyle (the specimen is indeterminate as to whether this is a medial or lateral condyle fragment), and a long bone articular end fragment. Partially fused specimens, bones on which the fusion line between the shafts and condyles are still visible, include two metatarsal shaft and condyle fragments.

Table 6.9 Block 1 - Unidentified Ungulate Long bone Weight (g) by Size Categories (mm)

Element	0-2	2-6	6-13	13-25	25-50	50-100	100-200	200+	Total
Humerus	0.0	0.0	0.0	3.2	309.3	454.6	0.0	0.0	767.1
Radius	0.0	0.0	0.0	6.6	84.3	200.4	147.8	0.0	439.1
Ulna	0.0	0.0	0.0	0.0	33.3	88.9	0.0	0.0	21.0
Metacarpal	0.0	0.0	0.0	0.0	21.0	0.0	0.0	0.0	21.0
Femur	0.0	0.0	0.0	0.0	209.1	725.8	55.4	0.0	990.3
Tibia	0.0	0.0	1.0	14.5	302.2	496.4	377.4	0.0	1188.0
Metatarsal	0.0	0.0	0.7	0.0	51.0	234.8	0.0	0.0	286.5
Metapodial	0.0	0.0	0.0	9.2	79.8	89.6	0.0	0.0	178.6
Indt. shaft	0.0	0.0	0.0	110.7	1225.2	416.9	0.0	0.0	1745.2
Indt. art.	0.0	0.0	0.0	26.9	52.9	0.0	0.0	0.0	79.8
Total	0.0	0.0	1.7	171.1	2368.1	2707.4	580.6	0.0	5828.9

Table 6.10 Block 1 - Unidentified Ungulate Other Appendicular Weight (g) by Size Categories (mm)

Element	0-2	2-6	6-13	13-25	25-50	50-100	100-200	200+	Total
Hyoid	0.0	0.0	0.0	0.8	7.3	0.0	0.0	0.0	8.1
Scapula	0.0	0.0	0.0	1.9	57.4	167.1	0.0	0.0	226.4
Innominate	0.0	0.0	0.0	7.9	144.2	102.4	0.0	0.0	254.5
5th meta	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.0	1.1
Accessory	0.0	0.0	0.0	1.4	0.0	0.0	0.0	0.0	1.4
Tarsals	0.0	0.0	0.0	8.5	33.5	0.0	0.0	0.0	42.0
Phalanges	0.0	0.0	0.7	28.9	44.5	36.0	0.0	0.0	110.1
Sesamoids	0.0	0.0	1.1	2.8	0.0	0.0	0.0	0.0	3.9
Bony oss.	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Total	0.0	0.1	2.9	52.2	282.5	305.5	0.0	0.0	647.4

6.4.2 Unidentified Ungulate Foetal/Newborn Remains

Sixty-one of the unidentified ungulate axial specimens are foetal or newborn. The youngest comparative ungulate specimen at the Department of Anthropology and Archaeology at the University of Saskatchewan is a 1 week bison. The unidentified ungulate foetal or newborn specimens recovered from Block 1 are similar in size or are slightly smaller than the elements of the 1 week bison skeleton. The specimens are very lightweight and the texture of the cortical bone is spongy and porous. The foetal or newborn axial specimens include 24 cranial fragments, one mandible fragment, seven incisors, 15 vertebral fragments, and 14 rib fragments. If these specimens were from a single species, i.e. bison, moose, or elk, they would represent a minimum of one individual. The unidentified ungulate foetal/newborn axial specimens recovered from Block 1 are presented in Table 6.11.

Table 6.11 Block 1 - Unidentified Ungulate Axial Foetal/Newborn Specimens

Specimen	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Skull:							
-frontal	3	0	2	0	5	26.0	8.2
-zygomatic	1	1	1	0	3	4.7	4.9
-premaxilla	1	0	0	0	1	0.2	1.6
-temporal	2	0	1	0	3	3.5	4.9
-palatine	1	0	0	0	1	0.4	1.6
-parietal	0	1	0	0	1	1.0	1.6
-interpariet.	1	1	0	0	2	4.7	3.3
-jug. pro.	0	1	0	0	1	0.4	1.6
-maxilla	0	1	1	0	2	0.8	3.3
-indt. cran.	0	0	5	0	5	5.0	8.2
-dec. incisor	4	2	1	0	7	1.6	11.5
Mandible:							
-condyle	0	0	1	0	1	0.6	1.6
Vertebra:							
-atlas	0	0	0	2	2	1.9	3.3
-cervical	0	0	0	3	3	0.7	4.9
-thoracic	0	0	0	7	7	5.4	11.5
-lumbar	0	0	0	1	1	0.4	1.6
-indt. vert.	0	0	0	2	2	0.5	3.3
Rib:							
-head/neck	0	0	5	0	5	5.2	8.2
-neck	0	0	1	0	1	1.6	1.6
-neck/body	0	0	1	0	1	1.6	1.6
-body	0	0	7	0	7	7.1	11.5
Total	13	7	26	15	61	73.3	99.8

Thirteen of the unidentified ungulate appendicular specimens are also foetal or newborn (1 week or less). There are also 16 appendicular specimens that are slightly more mature and compare closely in size with the 3 week bison comparative specimen. Therefore, based on the size differences of the two groups in general, there are at least two individuals represented. One specimen which compares closely in size with the 1 week bison element is the radial fossa and shaft portion of a right humerus. A second specimen consisting of the radial fossa and shaft portion of a left humerus compares closely with a 3 week bison specimen. These specimens may represent two individuals of the same species or they may represent two different ungulate species. Unidentified ungulate appendicular foetal/newborn specimens are listed in Table 6.12.

Table 6.13 shows those unidentified ungulate appendicular specimens which compare closely in size to the 3 week comparative specimen.

Table 6.12 Block 1 - Unidentified Ungulate Appendicular Foetal/Newborn Specimens

Specimen	Left	Right	Indt.	Total	Weight (g)	NISP%
Hyoid	1	0	0	1	0.1	7.7
Scapula	0	3	0	3	7.6	23.1
Humerus	0	2	0	2	26.8	15.4
5th metac.	0	0	1	1	0.3	7.7
Ilium	1	0	0	1	2.6	7.7
2nd/3rd tar.	1	0	0	1	0.8	7.7
Lg. shaft	0	0	1	1	3.7	7.7
1st phalanx	0	0	1	1	1.9	7.7
3rd phalanx	0	0	1	1	1.8	7.7
Sesamoid	0	0	1	1	0.6	7.7
Total	3	5	5	13	46.2	100.1

Table 6.13 Block 1 - Unidentified Ungulate Appendicular Immature (3 week) Specimens

Specimen	Left	Right	Indt.	Total	Weight (g)	NISP%
Scapula	0	0	3	3	4.5	18.8
Humerus	2	0	0	2	11.4	12.5
Radius	0	1	0	1	1.8	6.3
Ilium	1	0	0	1	9.1	6.3
Ischium	1	0	0	1	3.5	6.3
Tibia shaft	2	1	0	3	43.2	18.8
Metat. shaft	0	0	1	1	8.8	6.3
Lg. shaft	0	0	1	1	2.8	6.3
1st phalanx	0	0	2	2	5.1	12.5
Sesamoid	0	0	1	1	0.3	6.3
Total	6	2	8	16	90.5	100.4

6.4.3 Family Bovidae, *Bison bison* [American Bison]

Bison comprise 8% of the identifiable faunal assemblage recovered from Block 1 at Bushfield West. A total of 257 complete and fragmented bison bones weighing 14,722.7 g were recovered. The identified bison axial skeletal elements (NISP) are presented in Table 6.14. The number of bison axial specimens (N=36) is considerably less than the number of bison appendicular specimens (N=221). The main reason for this is the difficulty of identifying fragmented vertebrae and ribs to the level of species when there is more than one large ungulate species represented in the sample—in this case bison, elk, and moose.

Identified bison axial specimens include isolated mandibular teeth (N=7), mandible fragments (N=8), horizontal ramus portions of mandibles with socketed teeth (N=5), isolated maxillary teeth (N=4), maxillae with teeth (N=2), cranial fragments (N=5), and vertebral fragments (N=6). The maxillae represent two individuals, one juvenile and one adult. The juvenile dentition consists of dp3, dp4, M1, and M2 (fragmented). The adult dentition consists of P3, P4, M1, M2, and M3.

The five horizontal ramus mandible portions possess varying numbers of socketed teeth: dp2, dp3, dp4, M1, and M2 (fragmented); dp2, dp4, and M1; P2 and P3; P2, P3, P4, and M1; and P2, P3, P4, M1, M2, and M3. These specimens, as well as isolated mandibular and maxillary teeth, are used to determine bison age groups and site seasonality. The only complete bison axial specimens are individual teeth—three incisors, three premolars, and one molar—as well as the socketed maxillary and mandibular teeth mentioned above.

Table 6.14 Block 1 - Bison Axial NISP

Specimen	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Frontal	1	0	0	0	1	25.8	2.8
Petrous	1	0	0	0	1	9.3	2.8
Zygomatic	1	0	0	0	1	18.4	2.8
Premaxilla	1	0	0	0	1	22.5	2.8
Temporal	1	0	0	0	1	7.9	2.8
Maxilla/th.	2	0	0	0	2	288.2	5.6
Upper P2	1	0	0	0	1	9.6	2.8
Upper M2	0	2	0	0	2	50.4	5.6
Upper M3	1	0	0	0	1	52.6	2.8
Mandible	5	2	0	0	7	255.0	19.4
Mand./th.	3	2	0	0	5	747.0	13.9
Dec. incisor	1	1	0	0	2	0.9	5.6
Incisor	1	1	0	0	2	4.4	5.6
Lower dp3	0	1	0	0	1	4.0	2.8
Lower P2	1	0	0	0	1	3.3	2.8
Lower M3	0	1	0	0	1	11.9	2.8
Axis	0	0	0	2	2	47.8	5.6
Thoracic	0	0	0	4	4	118.5	11.1
Total	20	10	0	6	36	1677.5	100.4

Bison appendicular elements recovered from Block 1 are representative of all portions of the bison skeleton. Forelimb (N=67) and hindlimb specimens (N=66) are almost equally represented, as are scapula (N=5) and innominate (N=7) specimens. The remaining appendicular specimens include one hyoid, 62 phalanges, and 14 sesamoids. A summary of the identified bison appendicular specimens (by NISP) are listed in Table 6.15.

The majority of bison appendicular specimens are highly fragmented. There are only 74 complete appendicular elements present in sample associated with Block 1. All of the elements are from the lower limb region of the bison skeleton. They include 15 carpals, one 5th metacarpal, one patella, six lateral malleoli, 10 tarsals, one metatarsal, one 2nd metatarsal, 17 first phalanges, eight second phalanges, four third phalanges, six superior medial sesamoids, two superior lateral sesamoids, and two inferior sesamoids.

Table 6.15 Block 1 - Bison Appendicular NISP

Specimen	Left	Right	Indt.	Total	Weight (g)	NISP%
Hyoid	1	0	0	1	9.0	0.5
Scapula	0	5	0	5	1403.9	2.3
Humerus	5	6	0	11	2157.4	5.0
Radius	7	7	0	14	1226.8	6.3
Ulna	4	6	0	10	310.3	4.5
Rad./ulna	0	2	0	2	160.3	0.9
Radial carp.	4	1	0	5	91.2	2.3
Intern. carp.	5	0	0	5	87.2	2.3
Ulnar carp.	4	0	0	4	66.0	1.8
2nd/3rd	2	0	0	2	35.8	0.9
Uncif. carp.	4	0	0	4	36.6	1.8
Accessory	2	0	0	2	19.7	0.9
5th metac.	1	0	1	2	5.7	0.9
Metac.	5	1	0	6	451.4	2.7
Innominate	5	2	0	7	1105.4	3.2
Femur	1	3	0	4	491.3	1.8
Patella	1	2	0	3	76.9	1.4
Tibia	9	10	1	20	2191.3	9.0
Lat. mall.	3	3	0	6	57.0	2.7
Calcaneus	4	2	0	6	412.0	2.7
Astragalus	3	3	0	6	549.8	2.7
Cen./4th	4	1	0	5	117.6	2.3
2nd/3rd tar.	1	0	0	1	4.3	0.5
1st tarsal	1	0	0	1	0.4	0.5
Metatarsal	4	4	5	13	961.4	5.9
2nd metat.	0	0	1	1	1.1	0.5
1st phal.	0	0	30	30	506.8	13.5
2nd phal.	0	0	20	20	295.3	9.0
3rd phal.	0	0	12	12	154.5	5.4
S. med. ses.	0	0	8	8	43.1	3.6
S. lat. ses.	0	0	4	4	10.7	1.8
Infer. ses.	0	0	2	2	5.0	0.9
Total	80	58	84	222	13045.2	100.5

The recovery of 48 nearly complete elements and complete or nearly complete element portions of long bones helped to increase the MNI, MNE, and MAU values. A minimum of six individuals are represented, based upon the recovery of six right distal tibia portions. The bison NISP, MNE, MNI, and MAU counts are shown in Table 6.16.

Variation in the ages of the bison skeletal elements are indicated by the presence of unfused epiphyses and shafts and immature elements. Immature elements are recognized on the basis of small size, lightweight, spongy texture, and porous appearance of the bone. Using these criteria nine bison specimens are classified as

Table 6.16 Block 1 - Bison NISP/MNE/MNI/MAU

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
Skull:						
-petrous	1	1	1	0	1	0.5
-other	6	2	2	0	2	1.0
Mandible:						
-cor. process	3	3	3	0	3	1.5
condyle	3	3	2	1	2	1.5
-asc. ramus	2	2	2	0	2	1.0
-diastema	4	4	2	2	2	2.0
Vertebra:						
-axis	2	1	-	-	1	0.1
-thoracic	4	1	-	-	1	0.1
Hyoid	1	1	0	1	1	0.5
Scapula:						
-glenoid	3	3	0	3	3	1.5
-other	2	2	2	0	2	1.0
Humerus:						
-proximal	1	1	0	1	1	0.5
-shaft	3	1	1	0	1	0.5
-distal	7	6	3	3	3	3.0
Radius:						
-proximal	7	7	3	4	4	3.5
-shaft	5	3	2	1	2	1.5
-distal	3	3	1	2	2	1.5
Ulna:						
-proximal	6	4	1	3	3	2.0
-shaft	3	2	1	1	1	1.0
-distal	3	1	0	1	1	0.5
Carpals:						
-radial	5	5	4	1	4	2.5
-internal	5	5	5	0	5	2.5
-ulnar	4	4	4	0	4	2.0
-2nd/3rd	2	2	2	0	2	1.0
-unciform	4	4	4	0	4	2.0
-accessory	2	2	2	0	2	1.0
5th metac.	2	1	1	0	1	0.5
Metacarpal:						
-proximal	4	3	2	1	2	1.5
-distal	2	2	2	0	2	1.0
Innominate:						
-acetabul.	5	4	2	2	2	2.0
-other	2	1	1	0	1	0.5
Femur:						
-shaft	2	2	1	1	1	1.0
-distal	2	1	0	1	1	0.5
Patella	3	2	1	1	1	1.0
Tibia:						
-proximal	3	2	1	1	1	1.0
-shaft	9	2	1	1	1	1.0
-distal	8	8	2	6	6	4.0
Lat. mall.	6	6	3	3	3	3.0

Table 6.16 (Continued)

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
Tarsals:						
-calcaneus	6	4	3	1	3	2.0
-astragalus	6	6	3	3	3	3.0
-cen./4th	5	3	2	1	2	1.5
-2nd/3rd	1	1	1	0	1	0.5
-1st	1	1	1	0	1	0.5
2nd metat.	1	1	0	1	1	0.5
Metatarsal:						
-proximal	5	5	2	3	3	2.5
-shaft	5	1	1	0	1	0.5
-distal	2	2	1	1	1	1.0
-complete	1	1	1	0	1	0.5
1st phal.	30	16	-	-	3	2.0
2nd phal.	20	11	-	-	2	1.4
3rd phal.	12	9	-	-	2	1.1
S. med. ses.	8	7	-	-	1	0.9
S. lat. ses.	4	4	-	-	1	0.5
Infer. ses.	2	2	-	-	1	0.3

immature: one 1st tarsal, one fused 2nd/3rd tarsal, one fused central/4th tarsal, one astragalus, one metatarsal (these elements form one articular unit), two third phalanges, and one superior lateral sesamoid.

Rates of epiphyseal fusion indicate broad age categories for the time of death of some of the bison recovered from Block 1 at Bushfield West. Unfused appendicular specimens, either unfused shafts or epiphyses or both, include a proximal ulna, one distal radius, one distal metacarpal, one pubic symphysis, one proximal tibia, one distal metatarsal, four calcanei, eight first phalanges, and three second phalanges. These specimens represent an undetermined number of individuals ranging in age from 2 to 7 years. The proximal epiphysis of both the first and second phalanges fuses by the beginning of the 2 year, the distal epiphysis of both the metacarpal and metatarsal fuses in the 3rd year, both the tuber calcis of the calcaneus and the distal epiphysis of the radius fuse during the 5th year in male bison and during the 6th year in female bison, the proximal end of the tibia fuses to the shaft during the 6th year (Empel and Roskosz 1963 cited in Dyck and Morlan 1995: 564-583). Fusion rates for the proximal epiphysis of the ulna and the pubic symphysis of the innominate are not presented in Dyck and Morlan (1995). It should also be noted that these fusion rates are based on studies of European bison, *Bison bonasus*.

Small bone spurs or growths and a heavily pitted distal articular surface are apparent on the bison 2nd metatarsal element. Such characteristics are generally the result of a pathology, possibly an inflammatory response which has resulted in the production of sclerotic bone.

Four of the distal humerus specimens recovered from Block 1 show that the most common form of fragmentation occurs at the distal end of the shaft just above the radial and olecranon fossae and medial and lateral epicondyles. On one specimen the medial epicondyle is also smashed away. A fifth specimen, which consists of a complete distal end with a portion of the shaft, shows that access to the medullary cavity was achieved by breaking the anterior shaft just above the radial fossa and then breaking the posterior shaft much higher up across the top of the teres major tubercule. Another variation in the fragmentation of the distal humerus occurs on one specimen which is broken transversely across the top of the radial fossa and then longitudinally between the medial condyle (trochlea) and the lateral condyle (capitulum). The medial epicondyle of this specimen is missing due to carnivore chewing. Spiral fractures of the shafts were noted on four of the humeri and flaking of the shaft edges and impact points are evident on two of these specimens. The only proximal humerus fragment found in Block 1 consists of the head and neck, infraspinatus tendon attachment and deltoid tuberosity. The medial tuberosity and bicipital groove are missing.

Four of the radius specimens are broken below the proximal end exhibiting spiral fractures extending from the medial side below the major muscle attachment (the depressed fossa for the brachialis muscle) across to the lateral side below the nutrient foramen. Flaking and impact marks can be seen on two of these radii. Two radii are fractured near the distal end of the shaft at the interosseous space. Three radius fragments show that the proximal end is also split longitudinally through the medial fossa terminating at a point on the medial side of the shaft. Distal/medial fragments of the distal end of the radius are also present in the sample, perhaps resulting from the removal of the ulna. The recovery of several radius shaft fragments also indicate that the radius was broken to obtain access to the medullary cavity.

Three ulna specimens have relatively complete proximal ends (the olecranon process of one is missing due to carnivore chewing) and are broken across the shaft, well below the trochlear notch. Exposure of the medullary cavity of a fourth specimen was accomplished by removal of the olecranon process, as well as smashing the posterior shaft behind the semi-lunar and trochlear notches. One specimen consists of the lateral projection of the trochlear notch which was probably broken when attempting to separate the ulna and radius.

Various forms of metacarpal fragmentation were noted. Shafts are broken at various locations—mid-shaft region, between the mid-shaft and proximal end, and between the mid-shaft and distal end. Two specimens show that the proximal end was split between the medial and lateral articular facets retaining a small portion of the shaft and resulting in exposure of the medullary cavity. Flaking of the fractured shaft edge resulting from multiple blows are apparent on one of the proximal metacarpal specimens.

Very few femora were found in Block 1. One specimen consists of the complete shaft with the proximal end removed above the third trochanter and the distal end removed below the supracondyloid fossa and across the top of the condyles. Fragments of the distal end of the femur consist of a lateral condyle and a portion of the distal shaft, and a medial condyle and a portion of the distal shaft. Also present is a portion of the medial condyle of a femur which is heavily pitted due to carnivore chewing.

One type of fracture commonly observed on the tibia is the complete distal end of the tibia with the break near the distal end of the shaft. In three instances this resulted in a spiral fracture around the complete circumference of the distal shaft. In one case the shaft is fractured between the mid-shaft region and the distal end of the shaft on the posterior side, while a large segment of the anterior shaft including the tibial crest is still intact. In a second instance the tibia is broken across the shaft above the nutrient foramen. One tibia is fractured longitudinally through the medial and lateral condyles, exposing the cancellous tissue, while a second tibia is broken transversely through the condyles with the anterior portion and tibial crest being recovered. One nearly complete tibia shaft with a complete shaft circumference and jagged step fractures at either end was also recovered. The remaining tibia shaft specimens are fragments of the shaft with recognizable landmarks such as the tibial crest, muscle lines and nutrient foramen. Distal end fragments consisting of the medial malleolus and a portion of the tarsal articular facet or the lateral malleolus and tarsal articular facets were also found.

Metatarsals are fractured in a manner similar to that seen for metacarpals. Two complete distal portions were found with the shafts broken above the nutrient foramens. Three complete proximal ends show variation in the locations of where the shaft is broken. On one specimen the anterior shaft is broken below the nutrient foramen and the posterior shaft terminates at a point further down the shaft. Another specimen exhibits the reverse condition with the anterior shaft extending further than the posterior shaft. On the third proximal metatarsal the shaft is broken below the medial facet and extends diagonally across to the lateral side. As was the case with the metacarpals, fragments of the proximal end of the metatarsal were also found. These consist of a portion of the medial facet and the anterior/medial shaft, and a lateral facet and a portion of the anterior/lateral shaft. Five of the metatarsal breaks are spiral fractures and one of these has a flaked edge due to repeated blows while trying to expose the medullary cavity.

Three types of breaks are commonly seen on first phalanges. When fragmented they are either broken just above the distal end thus exposing the medullary cavity, broken below the proximal end at approximately the mid-shaft region, or just under the proximal end and either diagonally or longitudinally through the proximal end. The only fragmented second and third phalanges found in Block 1 are burned and it is difficult to say if fragmentation occurred before, as a result of, or after burning.

Several articular units consisting of two or more specimens were found in Block 1. Two units consist of proximal radii and ulnar trochlear notch or semi-lunar notch articular portions. A third radius/ulna articular unit consists of unfused shaft fragments which fit together. The specimens which form these articular units were all found within the same quadrant of the same unit, the northwest quadrant of unit 197S 46E.

Three carpal articular units were also found in Block 1. These units include varying numbers of carpals which articulate with each other. One unit consists of five left carpals: ulnar, internal, radial, unciform, and fused 2nd/3rd. All of these carpals were found in the southeast quadrant of unit 196S 46E. A second articular unit also consisting of five left carpals (ulnar, internal, radial, unciform, and fused 2nd/3rd), as well as the proximal end of a metacarpal was found nearby in the southeast quadrant of unit 197S 45E. The third carpal articular unit was found 1 m to the east in the southeast and the southwest quadrants of unit 197S 44E. This articular unit consists of four left carpals—radial, internal, ulnar, and accessory.

Block 1 also yielded articular units from the lower portion of the hindlimb. One consists of a right tibia, astragalus, and calcaneus found in the southwest quadrant of unit 196S 49E. The second consists of a right fused central/4th tarsal and the proximal end of a right metatarsal found in the northwest quadrant of unit 197S 48E. An articular unit consisting of four immature left tarsals—fused 2nd/3rd, fused central/4th, 1st, and astragalus—and the proximal end of an immature metatarsal was found in northeast quadrant of unit 200S 44E.

The remaining articular unit is a first and second phalanx from the northeast quadrant of unit 199S 51E.

6.4.4 Family Cervidae

Sixty-seven specimens representing 2% of the identifiable faunal assemblage from Block 1 are cervid remains. Almost all of the specimens are identifiable to the level of species; however, three specimens can only be identified to the level of family and represent either moose or elk.

The three moose or elk specimens, weighing 17.2 g, include a posterior metatarsal shaft fragment, an antler fragment, and a superior medial sesamoid. The metatarsal shaft fragment and the antler specimen are quite small, within the 25-50 mm size range.

6.4.5 Family Cervidae, *Alces alces* [Moose]

Ten of the cervid specimens, weighing a total of 345.6 g, are moose. As can be seen in Table 6.17 these items include both cranial (N=5) and lower appendicular specimens (N=5). The cranial specimens include antler tines, mandible fragments, and a petrous portion of the temporal bone. Appendicular specimens consist of tarsals, a phalanx, and metacarpal fragments. Complete elements include the left petrous portion of the temporal bone and surrounding temporal bone, including the external auditory meatus, a left fused central/4th tarsal, and a left fused 2nd/3rd tarsal. The third phalanx is nearly complete.

Table 6.17 Block 1 - Moose NISP

Element	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Skull:							
-petrous	1	0	0	0	1	36.3	10.0
-antler	0	0	2	0	2	129.4	20.0
Mandible:							
-condyle	0	1	0	0	1	32.6	10.0
-hor. ramus	0	1	0	0	1	58.1	10.0
Appendicular:							
-2nd/3rd	1	0	0	0	1	8.0	10.0
-cen./4th	1	0	0	0	1	36.3	10.0
-1st metac.	0	0	2	0	2	5.8	20.0
-3rd phal.	0	0	1	0	1	18.7	10.0
Total	3	2	5	0	10	345.6	100.0

The right mandible, horizontal ramus portion, has four socketed teeth: P3 (partial), P4, M1, and M2. The wear on the occlusal surfaces of the teeth indicates that this is a mature adult. The enamel-root lines of all of the teeth are exposed above the alveolus. There is very little of the crown left, approximately 3.7 to 6.9 mm, on P3, P4 and M1. The occlusal surfaces are cupped and the buccal and lingual crests, as well as the infundibulums of these teeth are worn away. The crown height of M2 is 13.5 mm. The buccal and lingual crests are worn; however, the infundibulums are still present although somewhat narrowed.

The moose specimens recovered from Block 2 represent a minimum of eight elements and a minimum of one individual (Table 6.18).

Table 6.18 Block 1 - Moose NISP/MNE/MNI/MAU

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
Petrous	1	1	1	0	1	0.5
Antler	2	1	-	-	1	0.5
Mandible-						
condyle	1	1	0	1	1	0.5
hor. ramus	1	1	0	1	1	0.5
2nd/3rd tar.	1	1	1	0	1	0.5
Cen/4th	1	1	1	0	1	0.5
1st metacar	2	1	-	-	1	0.5
3rd phalanx	1	1	-	-	1	0.1

The left fused central/4th tarsal and a left fused 2nd/3rd tarsal form an articular unit. Both elements were found in the south half of unit 197S 43E. The 1st metacarpal was found in two pieces in adjacent quadrants of the same unit, 196S 45E. These specimens are actually an unfused proximal end and an unfused distal shaft portion which together to form a complete element.

6.4.6 Family Cervidae, *Cervus canadensis* [Elk]

The majority of cervid specimens recovered from Block 1 are elk (N=54). The items represent both axial specimens (N=9) and appendicular specimens (N=45). As can be seen in Table 6.19 the axial specimens are either cranial (N=2) or mandible fragments (N=7).

Table 6.19 Block 1 - Elk Axial NISP

Element	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Skull:							
-petrous	1	0	0	0	1	12.1	11.1
-antler	0	0	1	0	1	130.3	11.1
Mandible:							
-coronoid	2	0	0	0	2	12.0	22.2
-condyle	1	0	0	0	1	18.4	11.1
-asc. ramus	2	0	0	0	2	7.6	22.2
-hor. ramus	2	0	0	0	2	4.6	22.2
Total	8	0	1	0	9	185.0	99.9

Six of the elk mandible specimens, all found in the northwest quadrant of unit 206S 52E, fit together to form the posterior portion of a single left mandible. The porous appearance of the cortical bone indicates that this specimen is from a juvenile animal. A second coronoid process from a left mandible is from a mature animal. The age differences in the two left coronoid processes show that a minimum of two individuals are represented.

The majority of elk remains from Block 1 are appendicular specimens and they represent both the forelimb (N=15) and hindlimb (N=19) portions of the skeleton, as well as phalanges (N=11) which are not separated into forelimb or hindlimb elements. Seventy-three percent of the elk appendicular specimens are either complete or nearly complete (N=22) or are complete portions of elements (N=11). A summary of the identified elk appendicular specimens is presented in Table 6.20.

Table 6.20 Block 1 - Elk Appendicular NISP

Element	Left	Right	Indt.	Total	Weight (g)	NISP%
Humerus	0	1	0	1	23.9	2.2
Radius	2	2	0	4	239.6	8.9
Ulna	1	1	0	2	22.7	4.4
Radial carp.	1	0	0	1	14.5	2.2
Intern. carp.	1	0	0	1	12.9	2.2
Ulnar carp.	1	0	0	1	14.5	2.2
2nd/3rd	1	0	0	1	14.2	2.2
Uncif. carp.	1	0	0	1	9.6	2.2
Metacarpal	1	1	0	2	150.2	4.4
5th metac.	1	0	0	1	1.5	2.0
Tibia	2	3	0	5	504.1	11.1
Lat. mall.	1	0	0	1	6.1	2.2
Metatarsal	2	0	1	3	261.9	6.7
Calcaneus	0	2	0	2	122.5	4.4
Astragalus	1	2	0	3	159.1	6.7
Cen./4th	2	1	0	3	122.9	6.7
2nd/3rd	1	0	0	1	6.8	2.2
1st phal.	0	0	2	2	11.1	4.4
2nd phal.	0	0	4	4	19.8	8.9
3rd phal.	0	0	4	4	8.6	8.9
Dew claw	0	0	1	1	1.9	2.2
Sesamoid	0	0	1	1	0.8	2.2
Total	19	13	13	45	1729.2	99.4

The MNI estimate based on the recovery of two left coronoid processes of different ages is also substantiated by the recovery of two right astragali, two right calcanei, two left fused central/4th tarsals, and two left metatarsal proximal portions. Table 6.21 also demonstrates that such a small sample produces low MNE and MNI estimates that are similar to NISP values.

Table 6.21 Block 1 - Elk NISP/MNE/MNI/MAU

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
Skull:						
-petrous	1	1	1	0	1	0.5
-antler	1	1	0	0	1	0.5
Mandible:						
coronoid	2	2	2	0	2	1.0
-condyle	1	1	0	1	1	0.5
-asc. ramus	2	1	1	0	1	0.5
-hor. ramus	2	1	1	0	1	0.5
Appendicular:						

Table 6.21 (Continued)

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
Humerus						
-distal	1	1	0	1	1	0.5
Radius						
-proximal	3	3	1	2	2	1.5
-distal	1	1	1	0	1	0.5
Ulna						
-proximal	1	1	0	1	1	0.5
-distal	1	1	1	0	1	0.5
Radial carp.	1	1	1	0	1	0.5
Intern. carp.	1	1	1	0	1	0.5
Ulnar carp.	1	1	1	0	1	0.5
2nd/3rd	1	1	1	0	1	0.5
Uncif. carp.	1	1	1	0	1	0.5
Metacarpal						
-proximal	1	1	1	0	1	0.5
-distal	1	1	0	1	1	0.5
5th metac.	1	1	1	0	1	0.5
Tibia						
-proximal	1	1	1	0	1	0.5
-shaft	1	1	1	0	1	0.5
-distal	3	2	2	1	2	1.5
Lat. mall.	1	1	1	0	1	0.5
Metatarsal						
-proximal	2	2	2	0	2	1.0
-shaft	1	1	0	1	1	0.5
Calcaneus	2	2	0	2	2	1.0
Astragalus	3	3	1	2	2	1.5
2nd/3rd	1	1	1	0	1	0.5
Cen./4th	3	3	2	1	2	1.5
1st phal.	2	2	-	-	1	0.3
2nd phal.	4	4	-	-	1	0.5
3rd phal.	4	4	-	-	1	0.5
Dew claw	1	1	-	-	1	0.1
S. med. ses.	1	1	-	-	1	0.1

Four juvenile elk appendicular specimens are included in the sample. These specimens include a medial condyle of a right humerus, a left metacarpal shaft fragment, and two third phalanx fragments (which were refitted in the laboratory). Other sub-adult animals are represented by the carpal articular epiphysis of a left radius and a left ulnar styloid process epiphysis. Knight (1966) developed a key for aging elk radius-ulna specimens. According to this key the unfused radius-ulna epiphyses and diaphyses, as well as the absence of a medial tuberosity indicate that these specimens are from a calf (calves are classified as being as old as one-half year-old).

Two of the proximal radius specimens are fractured 30 to 35 mm below the articular surface with impact points visible on the anterior surface in the middle of the shaft. A longitudinal fracture runs down the medial side to below the roughened muscle attachment area. On one specimen a jagged rectangular fracture extends over to the medial side below the lateral tuberosity. On the other specimen the fracture extends upwards between the lateral and medial fossae. The third radius specimen is fractured in the mid-shaft region. The medullary cavity is exposed mainly from the anterior side.

The tibia specimens are fractured at various points along the shaft. One is fractured at the distal end of the shaft approximately 45 mm above the articular surface. The fracture line is jagged and runs roughly perpendicular to the long axis of the bone. Two other tibiae have spiral shaft fractures near the mid-shaft region. The proximal tibia shaft specimen is fractured anteriorly through the tibial crest at the proximal end of the shaft a considerable portion of the posterior shaft remains, terminating in sharp projections on the medial and lateral sides.

Two of the metatarsal specimens are fractured in the mid-shaft region. One exhibits a spiral fracture, while the other shows an irregular fracture perpendicular to the long axis of the shaft. The third metatarsal specimen is fractured in the mid-shaft region, as well as diagonally through the proximal articular end.

One first phalanx specimen is broken diagonally through the shaft just below the articular surface allowing the medullary cavity to be scooped out. One second phalanx is split in half longitudinally, thus exposing the medullary cavity.

Three articular units of two or more specimens are represented in the assemblage. The first consists of five left carpals—radial, internal, ulnar, fused 2nd/3rd, and unciform. These elements were found in three different units: the west half of unit 200S 48E, the northeast quadrant of unit 201S 47E and the southwest quadrant of unit 199S 48E. The second articular unit consists of the proximal end of a left metatarsal and two tarsals: a fused central/4th tarsal and a fused 2nd/3rd tarsal. All of these specimens were found in the northwest quadrant of unit 203S 48E. The third articular unit consists of a right calcaneus and a right fused central/4th tarsal. These two elements were found in the northwest quadrant of unit 205S 48E.

6.4.7 Order Carnivora, Family Ursidae *Ursus americanus* [American Black Bear]

Three black bear specimens weighing 73.9 g were found in unit 198S 46E, immediately southeast of a hearth. One specimen is the trochlear notch and posterior shaft of a right ulna. The remaining black bear specimens are tarsals, a right calcaneus and a right astragalus. These specimens form an articular unit. The proximal portion of the calcaneus is missing as a result of carnivore gnawing.

6.4.8 Family Canidae, *Canis* sp.

Sixty-seven canid specimens weighing 42.8 g were found in Block 1. This represents 2% of the identifiable faunal assemblage. It is difficult to identify these specimens to the level of species since the bones are either fragmentary cranial specimens, complete individual teeth, and complete or fragmented post-cranial specimens. The species identification of canids is generally based on measurements of complete craniums, mandibles, and dentitions which are used in multivariate analysis (Lawrence and Bossert 1967, Walker and Frison 1982, and Morey 1992). Tentative species assignments may be made, based on size comparisons and measurements of certain post-cranial elements. It is possible that the canid faunal assemblage represented at Bushfield West includes four different canid species: red fox, coyote, gray wolf, and domestic dog.

Twenty-five specimens are either severely fragmented, thus lacking distinctive landmarks and characteristics to allow size comparisons, or are complete and fall between the size ranges represented by the comparative specimens. These items include 11 axial specimens and 14 appendicular specimens. The axial specimens consist of an upper left canine, a zygomatic arch fragment, a frontal fragment, and eight rib shaft fragments. The canine is complete; however, it is larger and longer than any of the canines of the red fox specimens in the comparative collection and it is smaller and more slender than those of the coyote specimens.

The majority of appendicular specimens consist of indeterminate long bone shaft fragments (N=8), followed by upper forelimb (N=5) and hindlimb (N=1) specimens (Table 6.22).

Table 6.22 Block 1 - Unidentified Canid Appendicular NISP

Element	Left	Right	Indt.	Total	Weight (g)	NISP%
Scapula:						
-glenoid	1	0	0	1	0.4	7.1
Radius:						
-shaft	0	2	1	3	2.8	21.4
Ulna:						
-shaft	0	1	0	1	0.3	7.1
Fibula:						
-shaft	0	0	1	1	0.5	7.1
Long bone:						
-shaft	0	0	8	8	2.3	57.1
Total	1	3	10	14	6.3	99.8

6.4.9 Family Canidae, *Canis lupus* or *Canis familiaris* [Gray Wolf or Domestic Dog]

Half of the canid specimens (N=33) represent either gray wolf or domestic dog. Only two of the elements are from the axial region of the skeleton—an upper right I3 and a parietal bone of the cranium.

All of the appendicular specimens (N=31) are from the lower portion of the leg. Twenty of the appendicular specimens are either phalanges (N=12) or sesamoids (N=8) which are not identified as from either the manus or pes. However, the remaining appendicular specimens are from the hindlimb. Table 6.23 presents the gray wolf/domestic dog appendicular specimens recovered from Block 1.

Table 6.23 Block 1 - Gray Wolf or Domestic Dog Appendicular NISP

Element	Left	Right	Indt.	Total	Weight (g)	NISP%
Femur:						
-shaft	0	0	1	1	1.3	3.2
Ext. cunei.	1	0	0	1	0.3	2.0
2nd metat.	3	0	0	3	3.5	5.9
3rd metat.	2	0	0	2	4.2	3.9
4th metat.	2	1	0	3	6.0	5.9
5th metat.	2	1	0	3	2.8	5.9
1st phal.	0	0	4	4	5.0	7.8
2nd phal.	0	0	4	4	2.1	7.8
3rd phal.	0	0	4	4	1.1	7.8
Sesamoid	0	0	8	8	0.8	15.7
Total	9	1	21	31	19.5	100.1

The left metatarsal specimens were recovered in a fragmented state; however, they were refitted in the laboratory to form complete elements. They also represent an articular unit and it is likely that the phalanges and sesamoids are also part of this left foot. All of the elements were found approximately 0.5 m north of a large hearth in the northwest corner of the excavation block. The femur was also found near the hearth, approximately 0.5 m to the west.

6.4.10 Family Canidae, *Canis latrans* [Coyote]

Three of the canid specimens, representing a minimum of one individual, are coyote. The specimens include a lower right canine, a right 4th metatarsal, and a right 5th metatarsal (6.0 g in total). All of the specimens are complete and are similar in size to the coyote specimens in the comparative collection. The metatarsals are quite slender indicating that they are representative of a coyote rather than a dog.

6.4.11 Family Canidae, *Vulpes vulpes* [Red Fox]

Six specimens, weighting 2.7 g, representing a minimum of one individual are red fox. The remains include two axial specimens and four appendicular specimens. The axial specimens consist of a zygomatic process of the temporal bone and a petrous portion of the temporal bone. The appendicular specimens include a radius shaft fragment, two femur shaft fragments, and a nearly complete patella.

6.4.12 Family Mustelidae, *Mephitis mephitis* [Striped Skunk]

Striped skunk is represented in the faunal assemblage from Block 1 by two specimens weighing 0.4 g. They include an upper left P4 crown and the proximal/medial portion of a left calcaneus.

6.4.13 Order Lagomorpha, Family Leporidae, *Lepus* sp.

One hundred and forty-two specimens from Block 1 at Bushfield West are lagomorphs. This represents 4% of the identifiable faunal assemblage. Almost all of the specimens are identified to the level of species. However, six specimens (1.3 g) are either not complete enough or do not have distinctive landmarks to enable classification to the level of species (as either snowshoe hare or white-tailed jackrabbit). These specimens include three small rib shaft fragments in the size range of 6-13 mm, two indeterminate long bone shaft fragments, and one metapodial medial/distal specimen, 13-25 mm in size. The long bone shaft fragments have no distinctive landmarks and are fairly small specimens. One falls in the 13-25 mm size range and the other is from the 25-50 mm size category.

6.4.14 Family Leporidae, *Lepus townsendii* [White-tailed Jackrabbit]

Seven lagomorph specimens recovered from Block 1 are considerably larger than the snowshoe hare specimens. They were compared with both male and female snowshoe hare specimens, as well as male and female white-tailed jackrabbit comparative specimens. Based on size they are classified as white-tailed jackrabbit remains.

The white-tailed jackrabbit specimens consist of one axial specimen and five appendicular specimens weighing a total of 1.6 g. The axial specimen is a left zygomatic arch fragment. The five white-tailed jackrabbit appendicular specimens are shown in Table 6.24. The fibula and tibia are fused in the leporid skeleton; however, the proximal shaft portions are separated by a large interosseous space. It is this portion of the fibula shaft separated by the interosseous space that was recovered.

Table 6.24 Block 1 - White-tailed Jackrabbit NISP/MNE/MNI/MAU

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
Humerus:						
-shaft	1	1	1	0	1	0.5
Femur:						
-proximal	1	1	1	0	1	0.5
-shaft	1	1	0	1	1	0.5
Tibia:						
-shaft	1	1	1	0	1	0.5
Fibula:						
-shaft	1	1	0	1	1	0.5
Tarsals:						
-astragalus	1	1	1	0	1	0.5

The humerus, femur, and tibia specimens are all incomplete shaft fragments. Therefore, no breakage patterns can be described.

6.4.15 Family Leporidae, *Lepus americanus* [Snowshoe Hare]

The majority of lagomorph specimens (N=129) are snowshoe hare remains, accounting for 92% of the sample. The recovered specimens are from both the axial (N=32) and appendicular (N=97) regions of the skeleton. Axial specimens include cranial fragments (N=5), mandible fragments (N=4), isolated teeth (N=18), and vertebral fragments (N=5). Fifteen of the axial specimens are complete and two are nearly complete. These specimens are all individual teeth. The identified snowshoe hare axial specimens are presented in Table 6.25.

Three of the mandible specimens are horizontal ramus portions with socketed teeth. The left mandible specimen has a socketed fourth premolar. One right mandible horizontal ramus fragment is quite small, 6-13 mm, and has a socketed premolar or molar tooth. The second right mandible horizontal ramus portion is larger and has three socketed teeth: P4, M1, and M2.

Table 6.25 Block 1 - Snowshoe Hare Axial NISP

Element	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Skull:							
-temporal	1	0	0	0	1	0.1	3.1
-zygomatic	3	0	0	0	3	0.5	9.4
-maxilla	1	0	0	0	1	0.1	3.1
-upper I	0	1	1	0	2	0.2	6.3
-upper P2	0	1	0	0	1	0.1	3.1
-upper P3	1	0	0	0	1	0.1	3.1
-upper M1	1	0	0	0	1	0.1	3.1
-upper M	0	1	0	0	1	0.1	3.1

Table 6.25 (Continued)

Element	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
-upper P/M	0	0	6	0	6	0.6	18.8
Mandible:							
-hor. ramus	1	2	0	0	3	1.3	9.4
-diast./sym.	1	0	0	0	1	0.3	3.1
-lower I	0	1	1	0	2	0.2	6.3
-lower P3	1	1	0	0	2	0.2	6.3
-lower P/M	1	0	0	0	1	0.1	3.1
-premolar	0	0	1	0	1	0.1	3.1
Vertebra:							
-atlas	0	0	0	1	1	0.1	3.1
-lumbar	0	0	0	4	4	0.5	12.5
Total	11	7	9	5	32	4.7	100.0

The 97 snowshoe hare appendicular specimens are from both the forelimb (including the scapula) and hindlimb (including the innominate) regions of the skeleton. They also include phalanges which are not identified as being from either the forelimb or the hindlimb. Table 6.26 shows that there are 23 forelimb specimens, 49 hindlimb specimens, 19 phalanges, and six metapodial specimens. The only complete or nearly complete elements are carpals (N=4), metacarpals (N=3), tarsals (N=8), metatarsals (N=4), and phalanges (N=5). They represent 26% of the sample of snowshoe hare appendicular specimens.

Table 6.26 Block 1 - Snowshoe Hare Appendicular NISP

Element	Left	Right	Indt.	Total	Weight (g)	NISP%
Scapula	1	0	0	1	0.2	1.0
Humerus	4	3	1	8	1.2	8.3
Radius	2	0	0	2	0.4	2.1
Ulna	2	1	0	3	0.2	3.1
Scapholun.	1	0	0	1	0.1	1.0
Magnum	0	1	0	1	0.1	1.0
Trapezoid	1	0	0	1	0.1	1.0
Trapezium	0	1	0	1	0.1	1.0
1st metac.	1	0	0	1	0.1	1.0
3rd metac.	0	1	0	1	0.1	1.0
4th metac.	0	1	0	1	0.1	1.0
5th metac.	1	0	0	1	0.1	1.0
Metacarpal	0	0	1	1	0.1	1.0
Innominate	2	1	0	3	1.4	3.1
Femur	6	5	0	11	2.5	11.3
Tibia	7	6	0	13	5.6	13.4
2nd metat.	1	1	0	2	0.6	2.1
3rd metat.	2	0	0	2	0.5	2.1
4th metat.	2	0	0	2	0.6	2.1
5th metat.	1	0	0	1	0.3	1.0
Metatarsal	0	0	1	1	0.1	1.0
Calcaneus	4	5	0	9	2.7	9.3
Astragalus	2	2	0	4	0.4	4.1

Table 6.26 (Continued)

Element	Left	Right	Indt.	Total	Weight (g)	NISP%
Navicular	1	0	0	1	0.1	1.0
1st phal.	0	0	10	10	0.9	10.3
2nd phal.	0	0	1	1	0.1	1.0
Indt. phal.	0	0	8	8	0.8	8.2
Metapodial	0	0	6	6	0.4	6.2
Total	41	28	28	97	19.9	99.7

The assemblage of snowshoe hare remains associated with Block 1 represent a minimum of five individuals. This is based on the recovery of five left femoral heads and five right calcanei. The snowshoe hare fauna NISP, MNE, MNI and MAU values are presented in Table 6.27.

Table 6.27 Block 1 - Snowshoe Hare NISP/MNE/MNI/MAU

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
Skull:						
-zygomatic	3	2	2	0	2	1.0
-other	2	1	1	0	1	0.5
Mandible:						
-hor. ramus	3	2	1	1	1	1.0
-diast./sym.	1	1	1	0	1	0.5
Scapula:						
-glenoid	1	1	1	0	1	0.5
Humerus:						
-proximal	1	1	1	0	1	0.5
-distal	7	7	4	3	4	3.5
Radius:						
-shaft	1	1	1	0	1	0.5
-distal	1	1	1	0	1	0.5
Ulna:						
-proximal	3	3	1	2	2	1.5
Carpal:						
-scapholun.	1	1	1	0	1	0.5
-magnum	1	1	0	1	1	0.5
-trapezoid	1	1	1	0	1	0.5
-trapezium	1	1	0	1	1	0.5
1st metac.	1	1	1	0	1	0.5
3rd metac.	1	1	0	1	1	0.5
4th metac.	1	1	0	1	1	0.5
5th metac.	1	1	1	0	1	0.5
Innominate:						
-acetabul.	3	3	2	1	2	1.5
Femur:						
-proximal	7	7	5	2	5	3.5
-shaft	2	2	1	1	1	1.0
-distal	2	1	0	1	1	0.5
Tibia:						
-proximal	4	4	2	2	2	2.0
-shaft	2	2	2	0	2	1.0
-distal	7	6	3	3	3	3.0

Table 6.27 (Continued)

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
2nd metat.	2	2	1	1	1	1.0
3rd metat.	2	2	2	0	2	1.0
4th metat.	2	2	2	0	2	1.0
5th metat.	1	1	1	0	1	0.5
Tarsals:						
-calcaneus	9	9	4	5	5	4.5
-astragalus	4	4	2	2	2	2.0
-navicular	1	1	1	0	1	0.5
1st phal.	10	10	0	0	1	0.5
2nd phal.	8	8	0	0	1	0.5

Two appendicular specimens are unfused. One is an unfused femoral head and the other is an unfused proximal tibia shaft. The remaining appendicular specimens are fully fused.

All seven of the distal humerus portions are fractured at the distal end of the shaft just above the olecranon fossa. The majority of femur specimens are from the proximal end and consist of the head broken through the neck. Two specimens are fractured at the proximal end of the shaft just below the major trochanter. This likely resulted while attempting to dislocate the head of the femur from the acetabulum. Three of the proximal tibia specimens are broken at the proximal end of the shaft immediately below the articular surface. One is broken much further down in the mid-shaft region. Two of the distal tibia specimens are broken at the distal end of the shaft and two are broken further up either at the mid-shaft region or between the distal end and the mid-shaft region.

Two articular units from the lower hindlimb region are present among the snowshoe hare appendicular specimens. One articular unit consists of a right distal tibia portion, a right calcaneus and a right astragalus. All three specimens were found in the southeast quadrant of unit 204S 51E. The second articular unit consists of four left metatarsals (the 2nd, 3rd, 4th, and 5th). All of the metatarsals are complete elements. They were found on the southern edge of Block 1.

6.4.16 Order Rodentia

A large percent (16%) of the faunal assemblage associated with Block 1 represent the order Rodentia (N=513), which includes both aquatic and terrestrial mammals. Beaver specimens (N=472) constitute the bulk of the rodent remains, 92%. The remaining 41 specimens represent muskrats, red squirrels, small rodents, and micro-rodents.

Often the specimens are identifiable beyond the level of family to species. However, two specimens are only identifiable to the level of order. These specimens represent small rodents and consist of a right ulna shaft fragment and a humerus shaft fragment which cannot be sided.

6.4.17 Family Castoridae, *Castor canadensis* [Beaver]

Beaver remains comprise a large portion, 15%, of the faunal assemblage associated with Block 1. In terms of the number of identified specimens (N=472) this represents the third largest taxon. Axial (N=257) and appendicular specimens (N=217) were found in almost equal numbers. Axial specimens consist of cranial fragments (this includes skull and mandible specimens, as well as isolated maxillary and mandibular teeth, N=98), vertebral fragments (N=95), rib fragments (N=63), and a sternum specimen (N=1, Table 6.28). Only 15 complete and nine nearly complete axial elements are represented in the sample. The remaining axial specimens are highly fragmented. However, beaver skeletal elements are quite distinctive and easily identified even when fragmented. This may be one reason for such high NISP counts. The complete and nearly complete elements consist mainly of individual cheek teeth (N=22) and one vertebra. The remaining nearly complete specimen is a nasal bone.

Table 6.28 Block 1 - Beaver Axial NISP

Element	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Skull:							
-frontal	2	3	2	0	7	5.2	2.7
-nasal	2	0	0	0	2	1.2	0.8
-palatine	0	0	0	1	1	0.2	0.4
-premaxilla	1	4	0	0	5	9.6	2.0
-temporal	0	6	0	0	6	4.6	2.3
-zygomatic	2	4	0	0	6	4.0	2.3
-sphenoid	0	1	0	0	1	0.5	0.4
-basisphen.	0	0	0	1	1	0.7	0.4
-parietal	1	1	0	0	2	1.3	0.8
-maxilla	1	1	1	0	3	3.5	1.2
-maxilla/th.	1	1	0	0	2	11.2	0.8
-indt. cran.	0	0	2	0	2	0.4	0.8
-upper M1	1	2	0	0	3	3.2	0.8
-upper M2	2	2	0	0	4	5.2	1.6
-upper M3	2	5	0	0	7	8.3	2.7
-indt. molar	0	2	0	0	2	2.5	0.8
-pre/molar	1	0	0	0	1	0.6	0.4
Mandible:							
-coronoid	1	0	0	0	1	0.9	0.4
-condyle	0	1	0	0	1	0.8	0.4
-man. sym.	1	1	0	0	2	2.1	0.4
-lower I	2	5	2	0	9	19.8	3.5
-indt. I	0	0	20	0	20	10.4	7.8
-lower P4	0	3	0	0	3	3.0	1.2
-lower M1	1	0	0	0	1	1.6	0.4
-pre/molar	0	0	5	0	5	3.6	2.0

Table 6.28 (Continued)

Element	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Vertebrae:							
-atlas	0	0	0	1	1	0.2	0.4
-axis	0	0	0	1	1	1.0	0.4
-cervical	0	0	0	4	4	3.5	1.6
-thoracic	0	0	0	14	14	4.3	5.5
-lumbar	0	0	0	16	16	11.4	6.3
-sacrum	0	0	0	3	3	2.3	1.2
-caudal	0	0	0	51	51	23.4	19.9
-indt. vert.	0	0	0	5	5	1.1	2.0
Rib:							
-head	0	0	6	0	6	1.1	2.3
-head/neck	0	0	4	0	4	1.2	1.6
-neck/tub.	0	0	5	0	5	2.5	2.0
-neck	0	0	3	0	3	0.7	1.2
-neck/body	0	0	4	0	4	1.3	1.6
-body	0	0	41	0	41	11.5	16.0
Sternum:							
-xiphoid	0	0	0	1	1	0.2	0.4
Total	22	42	95	98	257	171.2	100.1

Two maxilla specimens have socketed teeth. One specimen is an anterior portion of the maxilla with P4 and M1 teeth. P4 is single rooted and therefore a permanent tooth; however, the annual deposition of layers of cementum has not yet closed at the base of the root. Also, the maxilla and premaxilla are not fused. Therefore, this specimen represents an immature individual. The second specimen is part of a crushed portion of the upper skull, consisting of the frontal and maxilla with a socketed P4 tooth.

Other immature teeth include the following: one incisor, one premolar, two first molars, three second molars, five third molars, one indeterminate molar, and one indeterminate premolar/molar. The incisor is classified as immature on the basis of its small size. The premolars and molars are identified as immature since root closure is incomplete. By 3 to 4 years the base of M1 is closed, while small openings may remain at the bases of M2 and M3. At 4.5 to 5 years all of the basal opening of the molar teeth have closed (van Nostrand and Stephenson 1964).

Unfused, partially fused and immature cranial, vertebral, and rib specimens also indicate that juvenile beaver were being processed at the site. Six cranial fragments (frontal, nasal, sphenoid, temporal, and parietal) are unfused. One premaxilla and four zygomatic specimens are immature based upon small size and porous appearance of the bone. By far, the majority of unfused specimens are vertebral centra (N=25) and epiphyses (N=24). On two vertebral specimens the line of fusion is still visible between the centrum and epiphysis. One thoracic vertebral centrum is unfused and the bone has a porous, spongy texture and is, therefore, classified as immature. The anterior portion of a sacral vertebra is also immature. Eight rib proximal end portions which include the head, neck, and tubercule are unfused.

Every appendicular beaver skeletal element is represented in the sample from Block 1 (Table 6.29). As noted earlier, almost half of the beaver bones from Block 1 are appendicular specimens (N=217). Forelimb specimens (N=79) and hindlimb specimens (N=86) are almost equally represented constituting 36% and 40% of the sample. Phalanges (N=45) also make up a large part of the assemblage, 21%. The remaining appendicular specimens are seven metapodial fragments.

Table 6.29 Block 1 - Beaver Appendicular NISP

Element	Left	Right	Indt.	Total	Weight (g)	NISP%
Clavicle	2	1	0	3	2.9	1.4
Scapula	3	5	0	8	7.0	3.7
Humerus	11	5	1	17	65.3	7.9
Radius	6	8	1	15	13.6	6.9
Ulna	10	8	1	19	36.5	8.8
Cuneiform	2	0	0	2	0.3	0.9
Unciform	2	0	0	2	0.3	0.9
Accessory	1	0	0	1	0.2	0.5
2nd metac.	0	1	0	1	0.2	0.5
3rd metac.	0	3	0	3	1.1	1.4
4th metac.	2	1	0	3	0.8	1.4
5th metac.	1	2	0	3	0.6	1.4
Indt. metac.	0	0	2	2	0.3	0.9
Innominate	8	10	2	20	74.3	9.3
Femur	6	15	4	25	50.1	11.5
Patella	2	1	0	3	2.9	1.4
Tibia	3	7	0	10	46.8	4.6
Fibula	1	7	0	8	4.9	3.7
Calcaneus	0	1	0	1	0.2	0.5
Astragalus	1	1	0	2	2.9	0.9
Ext. cunei.	0	4	0	4	1.3	1.9
Med. cune.	1	0	0	1	0.3	0.5
1st metat.	0	1	0	1	0.3	0.5
2nd metat.	0	1	0	1	1.0	0.5
3rd metat.	0	1	0	1	0.4	0.5
4th metat.	2	1	0	3	5.2	1.4
5th metat.	1	1	0	2	0.6	0.9
Indt. metat.	0	0	4	4	1.7	1.9
Metapodial	0	0	7	7	2.0	3.2
1st phal.	0	0	23	23	9.7	10.6
2nd phal.	0	0	13	13	3.2	6.0
3rd phal.	0	0	8	8	1.5	3.7
Indt. phal.	0	0	1	1	0.1	0.2
Total	65	85	67	217	338.5	100.3

There are 40 complete and 17 nearly complete specimens. Small elements such as carpals, tarsals, patellae, metacarpals, metatarsals, and phalanges are generally complete. Scapulae, clavicles, and long bones are usually fragmented. The exception is one complete humerus. However, these specimens are not highly fragmented and complete proximal or distal portions are common.

The sample of beaver remains associated with Block 1 at Bushfield West represent a minimum of five individuals. This MNI estimate is based on the recovery of five upper right third molars, five left proximal ulna specimens, and five right and five left femoral greater trochanter portions. The NISP, MNE, MNI, and MAU values are presented in Table 6.30.

Table 6.30 Block 1 - Beaver NISP/MNE/MNI/MAU

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
Skull:						
-frontal	7	5	2	3	3	1.5
-other	37	4	1	3	3	1.5
Mandible:						
coronoid	1	1	1	0	1	0.5
-condyle	1	1	0	1	1	0.5
-man. sym.	2	2	1	1	1	1.0
Clavicle	3	3	2	1	2	1.5
Scapula:						
-glenoid	2	2	0	2	2	1.0
-other	6	3	1	2	2	1.5
Humerus:						
-proximal	7	5	4	1	4	2.5
-shaft	5	2	1	1	1	1.0
-distal	5	5	4	1	4	2.5
Radius:						
-proximal	8	8	4	4	4	4.0
-shaft	5	4	1	3	3	2.0
-distal	2	2	1	1	1	1.0
Ulna:						
-proximal	8	8	5	3	5	4.0
-shaft	8	3	2	1	1	1.5
-distal	2	2	1	1	1	1.0
Carpals:						
-cuneiform	2	2	2	0	2	1.0
-unciform	2	2	2	0	2	1.0
-accessory	1	1	1	0	1	0.5
2nd metac.	1	1	0	1	1	0.5
3rd metac.	3	3	0	3	3	1.5
4th metac.	3	3	2	1	2	1.5
5th metac.	3	3	1	2	2	1.5
Innominate:						
-acetabul.	4	4	2	2	2	2.0
-other	16	5	4	1	4	2.5
Femur:						
-proximal	17	10	5	5	5	5.0
-shaft	3	3	1	2	2	1.5
-distal	5	4	0	4	4	2.0

Table 6.30 (Continued)

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
Patella	3	3	2	1	2	1.5
Tibia:						
-proximal	7	5	1	4	4	2.5
-shaft	2	2	2	0	2	1.0
-distal	1	1	0	1	1	0.5
Fibula:						
-proximal	2	2	1	1	1	1.0
-shaft	4	3	1	2	2	1.5
-distal	2	2	0	2	2	1.0
Tarsals:						
-calcaneus	1	1	0	1	1	0.5
-astragalus	2	2	1	1	2	1.0
-ext. cunei.	4	4	0	4	4	2.0
-med. cune.	1	1	1	0	1	0.5
1st metat.	1	1	0	1	1	0.5
2nd metat.	1	1	0	1	1	0.5
3rd metat.	1	1	0	1	1	0.5
4th metat.	3	3	1	2	2	1.5
5th metat.	2	2	1	1	1	1.0
1st phal.	23	23	0	0	1	1.2
2nd phal.	13	13	0	0	1	0.7
3rd phal.	8	8	0	0	1	0.4

The presence of juvenile individuals as indicated by axial specimens is also indicated by the recovery of partially fused, unfused, and immature appendicular specimens. Thirty-seven percent of the appendicular specimens are not fully fused. One scapula specimen consists of an unfused acromion process. Seven humerus specimens are either unfused head or major trochanter epiphyses and two humerus shaft specimens are also unfused. Five radius specimens are either unfused proximal or distal epiphyses. Two radius shaft fragments are also unfused. Unfused ulna specimens consist of five olecranon process or styloid process epiphyses and two unfused shafts. Five of the metacarpal specimens are unfused medial/distal segments with the proximal epiphysis missing and one is an unfused proximal epiphysis. The majority of innominate specimens are mature. However, one ilium epiphysis was found. A second ilium specimen is quite small in size and the bone is porous in appearance, indicating that it is immature. Eleven femur specimens are either unfused major trochanter, head or condyle epiphyses. There is only one unfused femur shaft. Six tibia specimens are unfused proximal epiphyses and one is a partially fused proximal epiphysis. Unfused fibula specimens include two proximal epiphyses and two distal epiphyses. The calcaneus specimen is an unfused proximal epiphysis and one astragalus is immature. Four of the metatarsal specimens are unfused distal epiphyses and one metatarsal specimen is immature. Five of the metapodial specimens are unfused distal epiphyses. Nine phalanges are medial/distal specimens with unfused proximal epiphyses which were not recovered and three specimens are unfused proximal epiphyses.

Fragmentation of three of the humerus specimens occurs at the neck just above the deltoid crest. On one specimen fragmentation occurs just below the deltoid crest. Radii are broken at various positions along the shaft with no apparent consistency. Four ulna specimens are broken towards the distal end of the shaft. Fragmentation of the innominate occurs below the acetabulum through the branches of the ischium and either just above the acetabulum through the ilium or mid-way along the ilium below the sacral articular surface. One femur specimen was highly fragmented during excavation and the remaining femur specimens consist of either proximal or distal epiphyses or small shaft fragments. Two tibia specimens are broken at the proximal end of the shaft. One tibia specimen is broken at the distal end of the shaft, as well as at the proximal end of the shaft. Fibula specimens are broken at various points along the shaft.

6.4.18 Family Cricetidae, *Ondatra zibethicus* [Muskrat]

Nine muskrat specimens, representing a minimum of one individual, were found in Block 1. Just over half of the muskrat remains are axial specimens including two ribs, one thoracic vertebra, and two lumbar vertebrae. All of the axial specimens are fused.

The muskrat appendicular elements include one left clavicle, one right humerus, one right radius, and one right ulna. The humerus, radius, and ulna were all found in the southwest quadrant of unit 205S 52E and they form an articular unit. The proximal end of the humerus shaft is unfused and the epiphysis is missing.

6.4.19 Family Sciuridae, *Tamiasciurus hudsonicus* [Red Squirrel]

Eleven red squirrel specimens were recovered during the excavation of Block 1. A minimum of three individuals are represented in this small sample, based on the recovery of three left mandible specimens. All of the red squirrel specimens, except for a left tibia shaft, are from the axial region of the skeleton. The axial specimens consist of the following—one upper right I1, two upper left I1s, one lower left I1, two right mandibles with socketed teeth, two left mandibles with socketed teeth, one left mandibular horizontal ramus portion, and a right temporal fragment.

All of the mandibles with socketed teeth are complete or nearly complete elements. One right mandible has socketed teeth I1 and M3. The other right mandible has a complete complement of socketed teeth including I1, P4, M1, M2, and M3. One left mandible specimen also had a complete set of socketed teeth (I1, P4, M1, M2, and M3). The other left mandible has only socketed I1 and P4 teeth.

6.4.20 Family Sciuridae, *Spermophilus* sp. [Ground Squirrel]

Seven ground squirrel specimens,were found at Bushfield West in Block 1. All except one specimen are from the axial region of the skeleton. The exception is a nearly complete right ulna. The axial specimens include one lower right incisor, one upper left incisor, one left and one right petrous portion of the temporal bone, and two lumbar vertebral fragments.

6.4.21 Family Geomyidae, *Thomomys talpoides* [Northern Pocket Gopher]

Six specimens, representing a minimum of one individual, were found in Block 1. The northern pocket gopher remains are evenly divided between axial specimens (N=3) and appendicular specimens (N=3). All of the axial specimens are from the cranium. One specimen is a crushed rostrum portion of the skull including the frontal and maxilla and premaxilla with socketed teeth (right I1, M2, and M3), and individual premolars and molars. The other specimens are a lower right incisor and a left mandible with socketed teeth (I1, M1, and M2).

The appendicular specimens include a complete left humerus, a complete proximal portion of a right ulna, and a nearly complete right femur.

6.4.22 Family Sciuridae, *Eutamias minimus* [Least Chipmunk]

Least chipmunk is represented in the faunal assemblage associated with Block 1 by one left mandible. The mandible is complete and has a socketed incisor.

6.4.23 Family Cricetidae, *Microtus* sp. [Vole]

Voles are represented in the faunal assemblage from Block 1 by three specimens weighing 0.4 g. All are mandibular specimens including a left mandibular horizontal ramus portion and two right mandibles with socketed teeth. Both right mandibles have I1, M1, and M2 teeth.

6.5 Class Aves - Birds

A small but significant portion, 4%, of the identifiable faunal assemblage recovered from Block 1 consists of bird remains, 140 specimens. However, these bones are highly fragmented making family, subfamily, genus, and species identifications extremely difficult. Another factor which makes species identification difficult is that several species of the same subfamily commonly occupy the same range and the skeletal elements of these species are often indistinguishable. One hundred and eleven or 79% of the avian specimens are identifiable to the level of family. The remaining 29 specimens are unidentified bird specimens. They are sub-divided into general categories—small bird, medium bird, and large bird—based on specimen size.

Only one specimen is classified as representative of a small bird. It is a left tibiotarsus shaft fragment that was found in the northeast corner of Block 1.

The number of specimens assigned to each of the medium bird and large bird categories is almost equal, 15 and 14 specimens respectively. In the medium bird category most of the items are appendicular specimens. The only exception is a fragment of the synsacrum.

The medium bird appendicular specimens consist of wing (N=4), leg (N=5), and indeterminate long bone fragments (N=5). The identified appendicular specimens are presented in Table.6.31 None of these specimens are complete and the only nearly complete specimen is a first phalanx.

Table 6.31 Block 1 - Medium Bird Appendicular NISP

Element	Left	Right	Indt.	Total	Weight (g)	NISP%
Scapula:						
-blade	0	0	1	1	0.1	7.1
Coracoid:						
-shaft	0	1	0	1	0.2	7.1
-distal	0	0	1	1	0.1	7.1
Radius:						
-shaft	1	0	0	1	0.1	7.1
Femur:						
-shaft	0	0	2	2	0.2	14.3
Tibiotarsus:						
-shaft	0	0	2	2	0.3	14.3
1st phal.	0	0	1	1	0.1	7.1
Long bone:						
-shaft	0	0	5	5	0.8	35.7
Total	1	1	12	14	1.9	99.8

Almost all of the large bird material also consists of appendicular specimens (N=13). The one axial specimen that was found is a small fragment of the coracoid facet region of the sternum. Half of the large bird appendicular specimens are indeterminate long bone shaft fragments (N=7). The remaining appendicular specimens are from the wings (N=3), legs (N=2), and innominate (N=1). The large bird specimens are presented in Table 6.32.

Table 6.32 Block 1 - Large Bird Appendicular NISP

Element	Left	Right	Indt.	Total	Weight (g)	NISP%
Humerus:						
-shaft	2	0	1	3	0.5	23.1
Innominate:						
-acetabul.	0	1	0	1	0.3	7.7
Tibiotarsus:						
-shaft	0	0	1	1	0.2	7.7
Fibula:						
-shaft	0	0	1	1	0.1	7.7
Long bone:						
-shaft	0	0	7	7	2.1	53.9
Total	2	1	10	13	3.0	100.1

6.5.1 Order Gaviiformes, Family Gaviidae, *Gavia*, [Common Loon]

A right humerus shaft fragment, weighing 3.1 g, is from a loon. The humerus is broken above the condyles, approximately one-third of the way up the shaft. The key feature of this specimen is the attachment area of the brachialis anticus.

6.5.2 Order Anseriformes, Family Anatidae [Swans, Geese, and Ducks]

The majority, 43%, of the avian material found in Block 1 are waterfowl remains (N=60). Most of these are identifiable to the subfamily level; however, 14 specimens can only be classified as either medium waterfowl or large waterfowl. As was the case with the unidentified bird categories, the waterfowl sub-divisions are made on the basis of specimen size. The 14 unidentified waterfowl specimens are evenly divided between medium waterfowl (N=7) and large waterfowl (N=7).

Three of the medium waterfowl specimens are from the axial portion of the bird skeleton and four are from the appendicular region of the skeleton. The axial specimens include two sternal rib facet fragments and one sternum body fragment.

Medium waterfowl appendicular specimens consist of the proximal end of a right radius, a left ulna shaft fragment, the proximal end and shaft fragment of a right tibiotarsus, and a first phalanx. The first phalanx is complete.

There is only one large waterfowl axial specimen, a cervical vertebral centrum fragment. The six large waterfowl appendicular specimens are presented in Table 6.33.

The 2nd phalanx of the 2nd digit of the wing is a complete element, while the indeterminate phalanx is nearly complete.

Table 6.33 Block 1 - Large Waterfowl Appendicular NISP

Element	Left	Right	Indt.	Total	Weight (g)	NISP%
Humerus:						
-shaft	1	0	0	1	0.4	16.7
2nd digit:						
-2nd phal.	0	0	1	1	0.2	16.7
Femur:						
-shaft	0	1	1	2	1.8	33.3
Long bone:						
-shaft	0	0	1	1	0.6	16.7
Indt. phal.	0	0	1	1	0.3	16.7
Total	1	1	4	6	3.3	100.1

6.5.3 Order Anseriformes, Tribe Cygnini, *Cygnus* sp. [Swan]

Over half of the waterfowl remains, 57%, associated with Block 1 are swan (N=34) comprising 24% of the total avian material found in association with Block 1. Only eight of the specimens are from the axial region (Table 6.34). The only complete axial element is a right quadrate.

Table 6.34 Block 1 - Swan Axial NISP

Element	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Quadrate	0	1	0	0	1	0.5	12.5
Furculum	0	0	0	1	1	0.4	12.5
Sternum	0	0	0	1	1	0.4	12.5
Synsacrum	0	0	0	2	2	9.3	25.0
Rib	0	0	3	0	3	1.0	37.5
Total	0	1	3	4	8	11.6	100.0

The majority of swan appendicular specimens are from the wings (N=21). The remaining appendicular specimens are from the innominate (N=2) and the upper leg region (N=3). The swan appendicular specimens are presented in Table 6.35.

Table 6.35 Block 1 - Swan Appendicular NISP

Element	Left	Right	Indt.	Total	Weight (g)	NISP%
Coracoid	2	5	0	7	10.1	26.9
Scapula	1	2	0	3	9.1	11.5
Humerus	1	2	1	4	10.6	15.4
Radius	1	1	0	2	14.0	7.7
Ulna	2	0	0	2	10.5	7.7
Carpometa.	0	3	0	3	1.8	11.5
Innominate	0	2	0	2	2.3	7.7
Femur	0	1	0	1	2.8	3.8
Tarsometa.	2	0	0	2	4.5	7.7
Total	9	16	1	26	65.7	99.9

All of the swan specimens in the assemblage are highly fragmented; however 19 elements are represented. If the specimens are from a single species then a minimum of one individual is present in the sample. The swan NISP, MNE, MNI, and MAU estimates are presented in Table 6.36 (assuming the specimens represent one species).

Table 6.36 Block 1 - Swan NISP/MNE/MNI/MAU

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
Skull:						
-quadrate	1	1	0	1	1	0.1
Sternum:						
-body	1	1	0	0	1	1.0
Furculum:						
-body	1	1	0	0	1	1.0
Scapula:						
-glenoid	2	2	1	1	1	1.0
-blade	1	1	0	1	1	0.5
Humerus:						
-shaft	3	2	1	1	1	0.5
-distal	1	1	0	1	1	0.5
Radius:						
-shaft	2	2	1	1	1	1.0
Ulna:						
-shaft	1	1	1	0	1	0.5
-distal	1	1	1	0	1	0.5
Carpometapus:						
-proximal	1	1	0	1	1	0.5
-shaft	1	1	0	1	1	0.5
Synsacrum	2	1	0	0	1	1.0
Femur:						
-shaft	1	1	0	1	1	0.5
Tarsometatarsus:						
-shaft	1	1	1	0	1	0.5
-distal	1	1	1	0	1	0.5

6.5.4 Order Anseriformes, Family Anatidae, Tribe Anserini [Geese]

Geese are represented in the faunal material from Block 1 by only one specimen (1.9 g), a right radius shaft fragment.

6.5.5 Order Anseriformes, Family Anatidae [Ducks]

Two avian specimens, weighing 0.5 g, can only be identified to the general taxonomic classification of duck. The ranges of seven duck "tribes" cover east central Saskatchewan and within each there are several species. The duck specimens recovered from Block 1 include a left humerus shaft fragment and an indeterminate phalanx. The indeterminate phalanx is nearly complete.

6.5.6 Order Anseriformes, Family Anatidae, Tribe Anatini, *Anas* sp. [Teal]

Teal are represented in Block 1 by one specimen (0.1 g), the proximal end of a right coracoid. A species identification cannot be made for this specimen.

6.5.7 Order Anseriformes, Family Anatidae, *Anas platyrhynchos* [Mallard]

Eight avian specimens, weighing a total of 3.9 g, found in Block 1 are mallard. They represent a minimum of one individual. Three of the mallard remains are axial specimens: the distal anterior fragment of a furculum, the coracoid facet portion of the sternum, and a right mandible fragment.

The appendicular specimens include three wing specimens and two leg specimens (Table 6.37).

Table 6.37 Block 1 - Mallard Appendicular NISP

Element	Left	Right	Indt.	Total	Weight (g)	NISP%
Radius:						
-shaft	0	1	0	1	0.6	20.0
Ulna:						
-proximal	0	1	0	1	0.3	20.0
Carpometa.	0	1	0	1	0.4	20.0
Tibotarsus:						
-complete	0	1	0	1	0.4	20.0
-shaft	1	0	0	1	0.7	20.0
Total	1	4	0	5	2.4	100.0

6.5.8 Order Falconiformes, Family Acciptridae [Hawk]

Only one hawk specimen, a right 3rd digit of the wing weighing 0.1 g, is present in the avian fauna from Block 1.

6.5.9 Order Galliformes, Family Phasianidae, Subfamily Tetraoninae, [Grouse]

Grouse (N=47, 11.8 g) is the second largest avian taxon represented in Block 1 containing 33% of the avian specimens. Only five of the specimens are from the axial region of the skeleton. All of them are sternum fragments, four keel fragments and one coracoid facet fragment.

The majority of grouse appendicular specimens are from the wing region of the skeleton (N=39). The remaining specimens consist of one innominate fragment and two femur fragments. Six of the appendicular elements are complete and eight are nearly complete. Complete elements include one 1st phalanx of the 2nd digit, two ulnae, and three carpometacarpi. The nearly complete elements include five 1st phalanges of the 2nd digit, two carpometacarpi, and one radius. A summary of the identified grouse appendicular specimens is given in Table 6.38.

Table 6.38 Block 1 - Grouse Appendicular NISP

Element	Left	Right	Indt.	Total	Weight (g)	NISP%
Coracoid	3	2	0	5	1.0	12.2
Scapula	4	0	0	4	0.5	9.8
Humerus	2	0	0	2	0.8	4.9
Radius	5	2	0	7	1.3	14.6
Ulna	3	3	0	6	2.5	14.6
Carpometa.	5	3	0	8	2.3	19.5
1st phalanx 2nd digit	3	4	0	7	0.7	17.1
Innominate	0	1	0	1	0.1	2.4
Femur	1	1	0	2	0.8	4.9
Total	26	16	0	42	10.0	100.1

If all of the grouse specimens are from the same species, this sample represents a minimum of four individuals. The MNI estimate is based upon the recovery of four right 1st phalanges of the 2nd digit of the wing, four left carpometacarpi, and the four keel portions of the sternum. The NISP, MNE, MNI, and MAU estimates (based on the assumption that only one grouse species is represented) are presented in Table 6.39.

Table 6.39 Block 1 - Grouse NISP/MNE/MNI/MAU

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
Sternum:						
-keel	4	4	0	0	4	4.0
-cora. facet	1	1	0	0	1	1.0
Coracoid:						
-proximal	1	1	1	0	1	0.5
-shaft	1	1	1	0	1	0.5
-distal	3	3	1	2	2	1.5
Scapula:						
-glenoid	3	3	3	0	3	1.5
-blade	1	1	1	0	1	0.5
Humerus:						
-shaft	1	1	1	0	1	0.5
-distal	1	1	1	0	1	0.5
Radius:						
-proximal	1	1	1	0	1	0.5
-shaft	3	2	2	1	1	1.0
-distal	1	1	1	0	1	0.5
-complete	2	2	1	1	1	1.0
Ulna:						
-shaft	2	2	1	1	1	1.0
-distal	1	1	0	1	1	0.5
-complete	2	1	1	1	1	1.0

Table 6.39 (Continued)

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
Carpometapus:						
-proximal	1	1	1	0	1	0.5
-distal	2	2	2	0	2	1.0
-complete	5	5	2	3	3	2.5
Innominate:						
-acetabul.	1	1	0	1	1	0.5
Femur:						
-proximal	1	1	1	0	1	0.5
-shaft	1	1	0	1	1	0.5
1st phalanx:						
-2nd digit	7	7	3	4	4	3.5

Medullary bone growth can be seen on the inner surface of the cortical bone of three of the grouse appendicular specimens. Female birds use medullary bone as a source of calcium in the development of eggshell. It is a granular or powdery substance adhering to the inner cortical bone surface. The specimens which have medullary bone include two radius specimens and one ulna element. The medullary bone growth is fairly thick, almost filling the entire cavity of the radius specimens. The cavity of the ulna is much larger than that of the radius; however, the medullary bone is quite obvious in the ulna and can be seen with the naked eye.

One of the radius specimens and the ulna element were found on the northern edge of the block, approximately 1 m north of a large hearth. They are both right elements and it is possible that they are from the same individual. The second radius specimen was found approximately 1 m southwest of the same hearth.

6.5.10 Order Passeriformes [Perching Birds]

Two specimens, a nearly complete right carpometacarpus and a left carpometacarpus shaft fragment, are from perching birds. The perching bird specimens weigh a total of 0.2 g.

6.6 Class Osteichtyes - Fish

In terms of the number of identified specimens the second largest class of fauna associated with Block 1 is fish (N=704). Nine species of fish are represented in the sample; however, a large portion (543 specimens or 77%) of the fish specimens cannot be identified to the level of species. The largest categories of these unidentified fish specimens consist of indeterminate cranial fragments (N=217) and rib fragments (N=203). Most of the cranial bones are highly fragmented and thus difficult to identify as to skeletal element. The remaining unidentified fish specimens include vertebrae (N=94), scales (N=26), one dentary fragment, one Weberian vertebral complex fragment, and one pterygiophore fragment.

6.6.1 Order Acipenseriformes, Family Acipenseridae *Acipenser fulvescens* [Lake Sturgeon]

The lake sturgeon has no scales but possesses a distinctive outer armor of bony scutes. The skeleton of the lake sturgeon is cartilaginous; therefore, the only sturgeon specimens found in Block 1 are scutes. Forty-one sturgeon scute specimens weighing a total of 7.7 g were found, representing 26% of the identifiable fish specimens associated with this block. Only four complete sturgeon scutes are present in the sample; the rest are highly fragmented.

6.6.2 Order Osteoglossiformes, Family Hiodontidae *Hiodon alosoide* [Goldeye]

Only one fish specimen, a lingual plate, from Block 1 is representative of goldeye.

6.6.3 Order Salmoniformes, Family Esocidae *Esox lucius* [Northern Pike]

Thirty-two specimens from the sample of fish remains are northern pike (Table 6.40). While this appears to be a large portion of the total sample of identified fish material (20%), 20 specimens are teeth. The remaining 12 northern pike specimens are cranial specimens. Complete elements include all of the teeth, the vertebra, and one of the parasphenoid specimens. The two palatine specimens were refitted in the laboratory and form a nearly complete element. The second parasphenoid specimen is also nearly complete.

Table 6.40 Block 1 - Northern Pike NISP

Element	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Teeth	0	0	20	0	20	0.1	62.5
Dentary	0	1	0	0	1	0.3	3.1
Quadrate	0	1	0	0	1	0.4	3.1
Palatine	0	2	0	0	2	0.8	6.3
Angular	0	1	0	0	1	0.6	3.1
Parashpen.	0	0	0	2	2	0.7	6.3
Operculum	1	0	0	0	1	0.4	3.1
Cleithrum	0	1	0	0	1	0.4	3.1
Supraoccip.	0	0	0	2	2	0.4	6.3
Vertebra	0	0	0	1	1	0.3	3.1
Total	1	6	20	5	32	4.4	100.0

The sample of northern pike specimens represents a minimum of two individuals. This estimate is based on the recovery of two supraoccipital specimens and two parasphenoid specimens. A MNE of nine elements are also present. The northern pike NISP, MNE, MNI, and MAU counts are presented in Table 6.41 (teeth and the vertebra are not included in this table).

Table 6.41 Block 1 - Northern Pike NISP/MNE/MNI/MAU

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
Dentary	1	1	0	1	1	0.5
Quadrate	1	1	0	1	1	0.5
Palatine	2	1	0	1	1	0.5
Angular	1	1	0	1	1	0.5
Parasphen.	2	2	0	0	2	2.0
Operculum	1	1	1	0	1	0.5
Supraoccip.	2	2	0	0	2	2.0

6.6.4 Order Cypriniformes, Family Catostomidae *Catostomus catostomus* [Longnose Sucker]

Two left supracleithrum specimens, weighing 0.2 g, indicate the presence of at least two longnose suckers in the fish fauna associated with Block 1.

6.6.5 Order Cypriniformes, Family Catostomidae *Catostomus commersoni* [White Sucker]

Several of the fish specimens recovered from Block 1 are white sucker (N=24) which account for 15% of the identifiable fish remains from Block 1 (Table 6.42). Three of the white sucker specimens are scales and the remaining 21 specimens are from the cranium. The scales are complete or nearly complete which aided in their species identification. Four of the other white sucker specimens are complete elements and five are nearly complete.

Table 6.42 Block 1 - White Sucker NISP

Element	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Scales	0	0	3	0	3	0.1	12.5
Dentary	2	0	0	0	2	0.2	8.3
Maxillary	1	2	0	0	3	0.3	12.5
Hyomand.	1	1	0	0	2	0.3	8.3
Ceratohyal	3	2	1	0	6	0.6	25.0
Parashpen.	0	0	0	1	1	0.2	4.2
Operculum	2	0	0	0	2	0.7	8.3
Supracleith.	3	2	0	0	5	0.7	20.8
Total	12	7	4	1	24	3.1	99.9

A minimum number of 20 elements and three individuals are represented in the white sucker faunal remains from Block 1. The MNI value is based on the recovery of three left ceratohyal elements and three left supracleithrum specimens. Table 6.43 presents the white sucker NISP, MNE, MNI, and MAU values (scales are not listed in this table).

Table 6.43 Block 1 - White Sucker NISP/MNE/MNI/MAU

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
Dentary	2	2	2	0	2	1.0
Maxillary	3	3	1	2	2	1.5
Hyomand.	2	2	2	1	1	1.0
Ceratohyal	6	5	3	2	3	2.5
Parasphen.	1	1	0	0	1	1.0
Operculum	2	2	2	0	2	1.0
Supracleith.	5	5	3	2	3	2.5

6.6.6 Order Cypriniformes, Family Catostomidae *Moxostoma anisurum* [Silver Redhorse]

Silver redhorse are represented in the fish fauna from Block 1 by 12 specimens (8% of the identifiable fish remains) (Table 6.44). All of them are from the head region of the skeleton. Only one specimen is complete and a second is nearly complete. The remaining specimens are fragments possessing key diagnostic features.

Table 6.44 Block 1 - Silver Redhorse NISP

Element	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Maxillary	1	0	0	0	1	0.2	8.3
Quadrate	2	4	0	0	6	0.6	50.0
Prefrontal	1	0	0	0	1	0.2	8.3
Hyomand.	1	0	0	0	1	0.2	8.3
Operculum	1	1	0	0	2	0.6	16.7
Cleithrum	1	0	0	0	1	0.4	8.3
Total	7	5	0	0	12	2.2	99.9

A minimum of four individuals are also represented in the sample, based on the recovery of four right quadrates. The NISP, MNE, MNI, and MAU values for the silver redhorse specimens are presented in Table 6.45.

Table 6.45 Block 1 - Silver Redhorse NISP/MNE/MNI/MAU

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
Maxillary	1	1	1	0	1	0.5
Quadrate	6	6	2	4	4	3.0
Prefrontal	1	1	1	0	1	0.5
Hyomand.	1	1	1	0	1	0.5
Operculum	2	2	1	1	1	1.0
Cleithrum	1	1	1	0	1	0.5

6.6.7 Order Cypriniformes, Family Catostomidae *Moxostoma macrolepidotum* [Shorthead Redhorse]

A second species of *Moxostoma*, shorthead redhorse, is represented in the fish fauna from Block 1 by seven specimens (4% of the identifiable fish material). All of the specimens are from the cranium. Three of the shorthead redhorse bones are complete elements. The identified shorthead redhorse specimens are presented in Table 6.46.

Table 6.46 Block 1 - Shorthead Redhorse NISP

Element	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Dentary	2	1	0	0	3	0.5	42.9
Maxillary	0	1	0	0	1	0.1	14.3
Operculum	0	1	0	0	1	0.6	14.3
Subopercu.	0	0	0	0	1	0.1	14.3
Supraoccip.	0	0	0	1	1	0.2	14.3
Total	2	3	0	1	7	1.5	100.1

As is the case with most small samples all specimens which contribute to the NISP calculation also contribute to the MNE count. A minimum of seven elements are represented in the sample and a minimum number of two individuals are present. This count is based on the recovery of two left dentaries. Shorthead redhorse NISP, MNE, MNI, and MAU counts are presented in Table 6.47.

Table 6.47 Block 1 - Shorthead Redhorse NISP/MNE/MNI/MAU

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
Dentary	3	3	2	1	2	1.5
Maxillary	1	1	0	1	1	0.5
Operculum	1	1	0	1	1	0.5
Subopercu.	1	1	0	1	1	0.5
Supraoccip.	1	1	-	-	1	1.0

6.6.8 Order Perciformes, Family Percidae *Stizostedion canadense* [Sauger]

Sauger are represented in the fish fauna from Block 1 by one specimen, a right ceratohyal element.

6.6.9 Order Perciformes, Family Percidae *Stizostedion vitreum* [Walleye]

Forty-one walleye specimens (26% of the identifiable fish remains) were also found in Block 1. All of the identified walleye specimens are from the head region. Nine of the walleye specimens are complete and eight are nearly complete. In order to make skeletal element and species identifications, even the fragments must comprise a substantial portion of the element. The identified walleye specimens are presented in Table 6.48.

Table 6.48 Block 1 - Walleye NISP

Element	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Dentary	2	1	0	0	3	1.0	7.3
Premaxilla	2	3	0	0	5	0.8	12.2
Maxillary	1	3	0	0	4	0.7	9.8
Quadrate	1	2	0	0	3	0.6	7.3
Palatine	1	0	0	0	1	0.2	2.4
Angular	1	2	0	0	3	1.0	7.3
Frontal	0	2	0	0	2	0.5	4.9
Preoperc.	2	1	0	0	3	1.0	7.3
Hyomand.	1	0	0	0	1	0.2	2.4
Post temp.	0	0	1	0	1	0.2	2.4
Ceratohyal	3	1	0	0	4	0,9	9.8
Epihyal	3	1	0	0	4	0.5	9.8
Cleithrum	2	1	0	0	3	1.2	7.3
Basioccipit.	0	0	0	3	3	0.5	7.3
Branchiot.	0	0	1	0	1	0.1	2.4
Total	19	17	2	3	41	9.4	99.9

Several specimens indicate that at least three individuals are represented in the sample of walleye remains recovered from Block 1. Three right premaxillae, three right maxillae, three left ceratohyals, and three basioccipitals were used to calculate the MNI value. The NISP, MNE, MNI, and MAU walleye estimates are presented in Table 6.49. The branchiostegal ray specimen is not included in this table.

Table 6.49 Block 1 - Walleye NISP/MNE/MNI/MAU

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
Dentary	3	3	2	1	2	1.5
Premaxilla	5	4	1	3	3	2.0
Maxillary	4	4	1	3	3	2.0
Quadrate	3	3	1	2	2	1.5
Palatine	1	1	1	0	1	0.5
Angular	3	3	1	2	2	1.5
Frontal	2	2	0	2	2	1.5
Preoperc.	3	3	2	1	2	1.5
Hyomand.	1	1	0	0	1	0.5
Post temp.	1	1	0	0	1	0.5
Ceratohyal	4	4	3	1	3	2.0
Epihyal	4	4	3	1	3	2.0
Cleithrum	3	3	2	1	3	1.5
Basioccipit.	3	3	-	-	3	3.0

6.7 Class Amphibia

6.7.1 Order Anura [Frog]

A frog radio-ulna element was found in the northwest quadrant of unit 200S 48E. This is the only amphibian specimen represented in the fauna associated with Block 1.

6.8 Distribution and Diversity

The distribution and diversity of fauna recovered from Block 1 were examined as an important part of the site structure. The locations of features; specifically hearths and rock pits; and a visual examination of the distribution maps of the identified fauna were used to gain an overall picture of the subsistence activity areas. The faunal distribution maps are presented in Appendix B. The locations, sizes, and associated features (when applicable) of the subsistence areas are presented in Table 6.50 and are shown in Figure 6.1. Gibson (1994: 18) uses a cumulative concentration coefficient index to identify multi-class clusters in the various excavation blocks at Bushfield West. The numbers and sizes of the activity areas identified by Gibson (1994: 39) do not generally correspond with subsistence activity areas identified here. However, the locations and types of features found in Block 1 are those identified by Gibson (1994: 39).

Table 6.50 Block 1 - Subsistence Activity Areas

Area	South	East	Size (m^2)	Features
1.1	196.50 - 199.00	43.50 - 47.00	8.75	hearth #1
1.2	199.00 - 201.00	43.50 - 47.50	7.25	none
1.3	195.00 - 198.00	47.00 - 51.00	12.0	hearth #2
1.4	198.00 - 200.00	50.00 - 53.00	6.0	none
1.5	199.00 - 201.00	47.50 - 50.00	5.0	hearth #3
1.6	201.00 - 203.00	47.50 - 50.00	4.5	hearth #4
1.7	200.00 - 203.00	50.00 - 53.00	9.0	rock pit
1.8	203.00 - 205.00	50.00 - 53.00	6.0	hearth #5
1.9	205.00 - 208.00	50.00 - 53.00	9.0	none
1.10	208.00 - 210.00	50.00 - 54.00	9.0	none
1.11	195.00 - 196.50	41.00 - 45.00	6.0	none
1.12	196.00 - 198.00	41.00 - 43.50	6.5	none

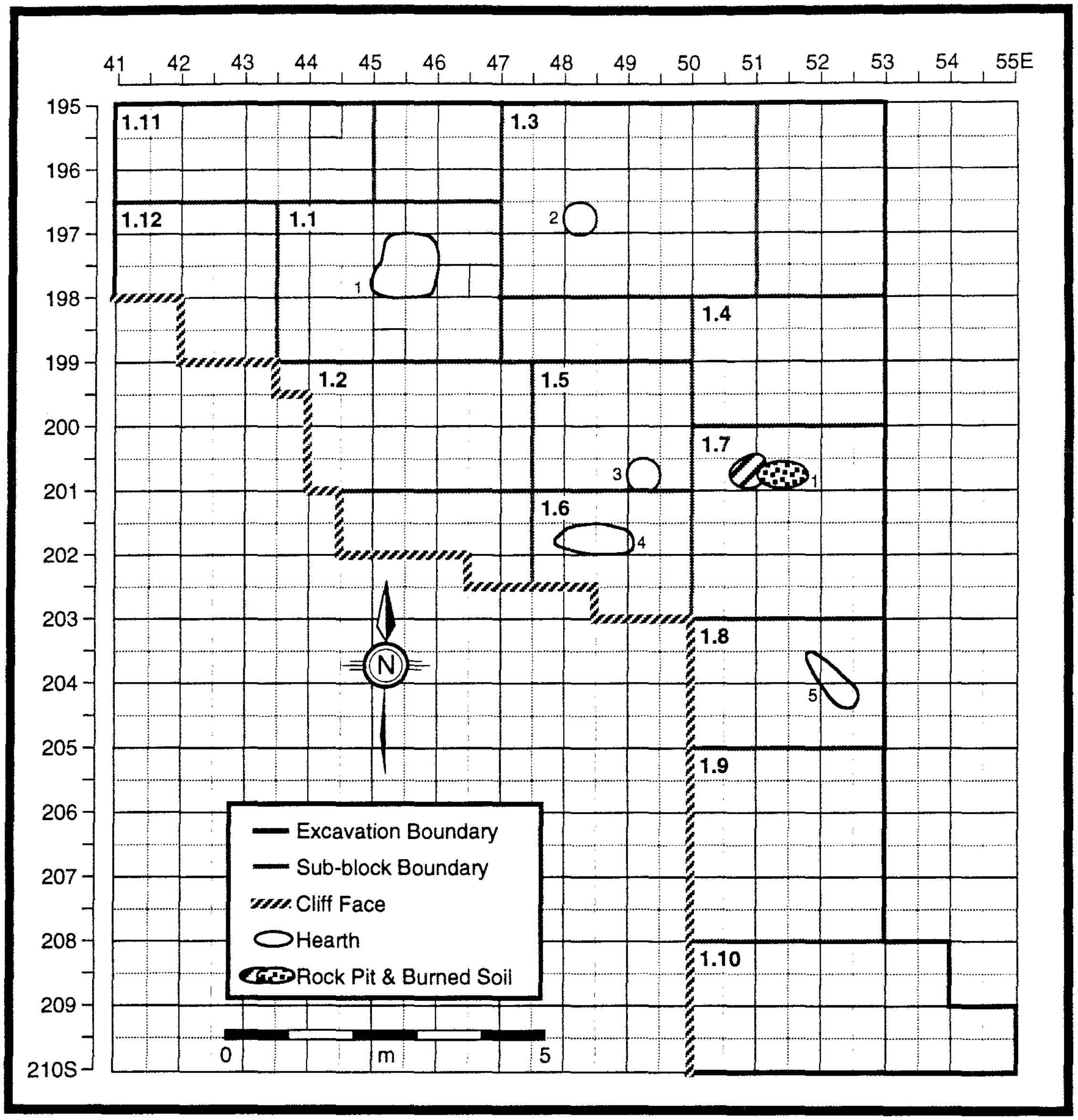


Figure 6.1 Block 1 – Subsistence Activity Areas

The identified taxa by NISP for each area of Block 1 are presented in Table 6.51.

Table 6.51 Block 1 - Identified Fauna by NISP in Subsistence Areas by NISP

Species	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	1.10	1.11	1.12
Ung., unid.	324	112	113	131	53	49	21	48	177	112	143	95
Bison	87	24	34	11	2	5	4	7	38	23	7	21
Moose or elk	1	0	0	0	0	0	1	0	0	0	0	1
Moose	1	3	0	0	0	0	0	1	0	0	1	3
Elk	7	3	0	2	9	3	0	1	12	5	1	3
Bear	3	0	0	0	0	0	0	0	0	0	0	0
Canid	9	1	0	0	0	2	1	0	2	1	40	9
Striped Skunk	0	0	1	0	0	0	0	0	0	0	1	0
Leporid	29	16	3	1	10	40	10	22	27	8	4	1
Beaver	113	91	38	23	6	14	22	23	65	49	31	18
Muskrat	4	1	0	0	0	0	0	0	3	0	0	1
Red Squirrel	5	0	0	2	1	0	0	0	1	0	0	2
Ground Squir.	3	2	0	0	0	0	0	0	2	0	0	0
N. P. Gopher	0	0	6	0	0	0	0	0	0	0	0	0
Least Chipmunk	1	0	0	0	0	0	0	0	0	0	0	0
Vole	0	1	1	0	0	1	0	0	0	0	0	0
Bird	87	20	5	0	3	0	2	3	5	2	15	3
Fish	557	86	7	1	1	2	1	1	4	1	47	14
Total	1231	340	208	171	85	116	62	106	336	201	290	171

Area 1.1, situated in the northwest corner of Block 1, surrounds hearth #1. The central part of the hearth was approximately 0.6 m in diameter; however, burned soil surrounding the hearth extended it to almost 1 m in diameter (Gibson 1994: 53). It measured only a few centimetres in depth, therefore, it appears to have been a surface hearth rather than a confined hearth situated in a pit. An inspection of the fauna represented by % NISP shows that fish (46%) and large ungulate (35%) remains dominate the faunal assemblage recovered from area 1.1.

The majority of refuse is located on the periphery of the hearth forming an arc on three sides: east, south, and west. The refuse consists of large ungulate remains (including foetal or newborn specimens) beaver, snowshoe hare, canid, bird, and fish. This zone of dense debris extends from within the burned soil of the hearth to approximately 1.25 m away from the hearth. The zone includes material of all sizes—2-6 mm up to 100-200 mm and even a few specimens that measured more than 200 mm in size. The frequency of bone debris decreases in a second zone of approximately 1.5 to 2 m away from the hearth. There are then heavy concentrations of bone debris in an area 2 to 2.5 m from the hearth, mainly on the southwest side along the river cut bank edge. This area of material is linear, approximately 3 m in length, extending into area 1.2. Debris in this area is generally larger than 25 mm in size.

The unidentified ungulate skeletal specimens found within the hearth and immediately adjacent to it include cranial fragments, vertebral fragments, rib fragments, and long bone shaft fragments. This is also the area in which many of the foetal/newborn specimens were found. Two bison carpal articular units were also recovered from this zone, while a third was found approximately 0.5 m to 1 m to the northeast. The majority of long bone portions recovered in association with hearth #1 are shaft fragments; very few are long bone articular ends.

Based on the size of the hearth and the density of the associated bone debris, this feature appears to have been a primary nuclear area hearth (Bartram et al. 1991: 141). The preparation and consumption of small mammals, birds, fish, as well as large ungulates took place in the area surrounding hearth #1.The three bear specimens were discarded just to the southeast of the hearth. The large ungulate long bones were cracked for marrow and discarded near the hearth, as well as in a linear area to the southwest along the river bank and in a smaller area to the southeast of the hearth. The lack of articular long bone fragments suggests that bone grease from these portions was rendered elsewhere.

Area 1.2 is on the west side of Block 1 adjacent to the river cut bank and immediately south of area 1.1. No features are associated with this area. Large ungulates (40%) dominate the faunal assemblage, followed by almost equal percentages of beaver (26%) and fish (24%). Bison cranial fragments, forelimb specimens, and phalanges were found in the west half of the area. Unidentified ungulate axial and appendicular specimens were also found in the west half, as well as along the northern edge. One concentration of beaver vertebral fragments was found on the north edge, while heavy concentrations of appendicular specimens were found on the west and east sides of the area. Swan and walleye specimens were found in the northwest corner of the area. The material found on the west and north sides of this area appear to be extensions of the debris associated with hearth #1. The concentration of beaver appendicular specimens recovered from the east side is likely associated with hearth #4 in area 1.6.

Area 1.3 is located on the northern edge of Block 1, a small area of burned soil and ash, identified as hearth #2 was uncovered in this area. Bison and unidentified ungulate remains (74%) dominate the faunal material from this area, followed by beaver (19%). Small percentages of fish, bird, and leporid remains were also found in this area.

Unidentified ungulate long bone shaft and hindlimb fragments and bison hindlimb specimens and phalanges surround hearth #2 on the north, east, and south sides. Beaver axial and appendicular specimens, fish remains, bison forelimb specimens, and unidentified ungulate cranial, vertebral, long bone shaft fragments, and phalanges form a secondary arc approximately 1 to 1.5 m from the hearth. This appears to be a secondary hearth where beaver and fish, as well as large ungulates were cooked and consumed. One of the heaviest concentrations of unidentified ungulate long bone articular portions was found immediately north of the hearth suggesting that this was an area where bone grease rendering occurred.

Area 1.4 is situated on the east side of Block 1. Large amounts of bone debris were found in this area; however, no features were discovered during excavation. Ungulate remains (85%) including a few elk specimens (1%) is the most commonly identified material, followed by beaver (14%). The only other identified taxa from this area are leporids and fish. Heavy concentrations of unidentified ungulate vertebral, rib, long bone shaft, and hindlimb fragments were found in this area. The recovered beaver remains consist of a dense concentration of appendicular specimens. A few bison hindlimb specimens and phalanges were also found here. The debris recovered from this area appears to represent secondary deposits of primarily fragmented large ungulate elements. These deposits could represent the remains of bone grease extraction activities or they may have resulted from hearth maintenance activities where debris removed from areas surrounding the hearth was deposited in the less frequently occupied areas of the site.

Area 1.5 is located in the central region of Block 1. Hearth #3, consisting of a small area of burned soil with a cluster of fire-cracked rocks, is located on the south side of area 1.5 (Gibson 1994: 57). Once again, a large percent of the assemblage recovered from area 1.5 consists of large ungulates (76%); however, bison material drops to 2% and there is an increase in identified elk specimens (11%). Leporids and beaver are the most commonly found small mammal remains.

A light scattering of unidentified ungulate rib, vertebral, forelimb fragments, and long bone shaft fragments were found in and surrounding hearth #3. A linear distribution of elk specimens was found approximately 0.5 m to the west of the hearth. The light scattering of bone fragments indicates that hearth #3 was not heavily used; it appears to be a secondary hearth where meals were prepared and consumed.

Area 1.6 is also located in the central area of Block 1, with the river cut bank forming the southern boundary of the area. Hearth #4, a long linear hearth approximately 75 cm in length and 40 cm in width, is situated in the centre of this area. This feature consists of a large quantity of fire-cracked rock, ash, and fire-reddened soil (Gibson 1994: 56). The faunal material recovered from area 1.6 is equally divided between large ungulates (50%) and a combination of small mammals (37%), birds (12%), and fish (2%). The small mammal remains found in area 1.6 are predominantly leporid specimens (35%).

A heavy concentration of unidentified ungulate forelimb fragments was situated on the west side of the hearth, as were unidentified ungulate long bone shaft fragments, and beaver appendicular specimens. A dense concentration of snowshoe hare lower limb elements was found approximately 0.5 m southeast of the hearth. The main subsistence activity associated with hearth #4 and area 1.6 appears to have been the preparation and consumption of snowshoe hare, beaver, and some bird, as well as the extraction of bone marrow from unidentified ungulate long bones.

Area 1.7 is situated on the east side of Block 1. It contains a rock pit feature with associated burned soil to the east of the rock pit. The pit measured 70 cm in diameter and 20 cm in depth and was filled with fire-cracked rock (ibid : 57). In this area the percentage of large ungulate remains drops to 43%. Snowshoe hare, canids, birds, and fish were recovered from this area but the majority of small species remains are beaver (35%). Beaver rib fragments were found within a confined area on the east side of the rock pit. Unidentified ungulate vertebral fragments were also located to the east of this feature.

The rock pit feature appears to have been associated with the cooking of small mammals, primarily beaver, as well as a few birds and fish. It may also have been used in the processing of ungulate axial specimens (vertebrae and ribs) which were disposed of in secondary deposits to the north in area 1.4.

Area 1.8 has an almost equal division of large ungulate material (bison, moose, elk, and unidentified ungulate) and a combination of small mammals, birds, and fish. The small mammal remains are split between leporids (22%) and beaver (21%). A linear hearth (#5) with its long axis oriented southeast to northwest is located on the east side of area 1.8. The 62 faunal specimens recovered were scattered throughout the area. Very few were found in direct association with hearth #5. No specialized activity can be identified for this area.

Areas 1.9 is located at the southern end of Block 1; no features are associated with this area. The faunal material is dominated by large ungulate material (bison, elk, and unidentified ungulate) comprising 70% of the assemblage. Beaver dominates the small mammal remains, followed by leporids. Small percentages of canids, birds, and fish were also found in area 1.9. Most of the elk remains were found on the east side of the area. Unidentified ungulate material was scattered over the area; however, concentrations of cranial, long bone shaft fragments, and hindlimb specimens are also apparent. The majority of snowshoe hare elements found in this area were recovered from one unit in the northwest corner. Beaver axial fragments were scattered throughout the area, while a concentration of hindlimb specimens was found on the west side. This appears to be an area in which refuse from the processing of unidentified ungulate long bones and cranial elements was discarded.

Area 1.10 is located on the southern edge of Block 1. In 1981 preliminary work at Bushfield West included the salvage excavation of a hearth exposed by gravel quarrying operations along the west side of the site. The hearth appeared to be quite substantial, approximately 8 cm in depth consisting of a layer of black carbonaceous soil, orange ash, and white ash.. Although the exact location of the hearth could not be ascertained from the preliminary field report by Burley et al. (1982: 250) it is believed to be situated on the west side of area 1.10. Large ungulate remains, bison (11%), elk (3%), and unidentified ungulate (56%), dominate the faunal assemblage associated with this area. The remaining fauna consists mostly of beaver material (24%) and smaller percentages of canid, leporids, bird, and fish specimens.

The west side of area 1.10, where the 1981 hearth is believed to be situated, is also the location of a dense concentration of bone debris including unidentified ungulate cranial, rib, long bone shaft fragments, forelimb and hindlimb specimens. Several of the forelimb and hindlimb specimens are articular portions. A heavy concentration of beaver appendicular remains was also encountered on this side of area 1.10. The bones are heavily fractured, generally less than 50 mm in size. The size of the hearth (possible the largest uncovered at Bushfield West) and associated debris possibly indicates the presence of a second primary nuclear area hearth. The presence of long bone shaft fragments and fragmented articular ends indicates that in this area large ungulate long bones were processed for both marrow and grease.

Area 1.11 situated in the northwest corner of Block 1 is another area of heavy debris. In this area large ungulates account for just over half of the assemblage. Fish are the second most commonly found species (16%), followed by canids (14%), and beaver (11%).

Unidentified ungulate specimens include ribs, vertebral, hindlimb fragments, and long bone shaft fragments. Several of the long bone shaft fragments are burned. A large number of beaver axial and appendicular specimens were also found in this area. The majority of debris recovered from this area falls in the 25-50 mm size range. This concentration of material may be situated on the edge of a hearth located north of the boundary of the excavation block or it may represent an area of secondary deposition of debris from the primary hearth in area 1.1.

Area 1.12, located on the northwest side of Block 1, also contains a wide variety of identified species. Large ungulates (bison, moose, elk, moose or elk, and unidentified ungulate) dominate the assemblage, along with high percentages of beaver (11%) and fish (8%). The faunal remains are scattered over the area. Debris of sizes varying from 6 mm to 200 mm and even a few specimens larger than 200 mm were found in this area. It appears that the material found in this area is debris from the more intensively occupied areas 1.1 and 1.11.

CHAPTER 7

Bushfield West - Block 2 Faunal Remains

7.1 Introduction

The excavation of Block 2, 234 m^2 in size, resulted in the recovery of 74,775 bone specimens weighing 73,018.4 g. All of the faunal material was examined and catalogued according to the standardized procedures outlined in the "Faunal Cataloguing Methods" section in Chapter 5. The majority of faunal material associated with Block 2 is highly fragmented, therefore, 89% (66,786 pieces) of the fauna is unidentifiable as to skeletal element and species. When weight is taken into consideration 35% (25,165.8 g) of the bone material is unidentifiable. Analysis of the unidentifiable bone, aside from recording frequencies and weights, entailed determining size categories and documenting both cultural and natural taphonomic modifications. The results of this analysis are presented in the following section.

The remaining faunal assemblage from Block 2, 11% by frequency and 65% by weight, consists of material that is identifiable as to skeletal element and to at least a general taxonomic level. The systematic description and analysis of the 7969 identifiable bone specimens (47,852.8 g) makes up the bulk of this chapter. The organization of this chapter follows the guidelines presented in the "Introduction" section of the previous chapter. Also, detailed discussions of the cultural and natural taphonomic modifications recorded during the analysis of the identifiable faunal specimens are found in Chapter 9.

7.2 Unidentifiable Faunal Specimens

As stated previously, the category of unidentifiable bone is quite large consisting of 66,786 items weighing 25,165.6 g . Cultural modifications of the unidentifiable bone fragments consist of burning, calcining, cut marks, polishing, the formation of bone tools, and coloration due to contact with metal objects. Burned bone fragments (N=15,432) account for 23% of the unidentifiable bone sample. Calcined bone fragments (N=13,041) make up 20% of the unidentifiable bone sample. Clearly, the largest portion consists of unburned or raw bone, 38,313 fragments (57%). A summary of the unidentifiable bone fragments according to size categories for raw, burned, and calcined specimens is presented in Table 7.1.

The greatest number of unidentifiable bone fragments fall in the 6-13 mm size range (N=32,046), followed by the 13-25 mm size range (N=24,174), the 2-6 mm size range (N=6854), the 25-50 mm size range (N=3657), and finally the 50-100 mm size range (N=55). None of the unidentifiable bone fragments fall in either the 0-2 mm, 100-

Table 7.1 Block 2 - Unidentifiable Bone Fragments

Size	Raw		Burned		Calcined	
	Freq.	**Weight**	**Freq.**	**Weight**	**Freq.**	**Weight**
2-6 mm	187	3.4	133	2.2	6534	119.2
6-13 mm	19057	2472.5	8448	1736.4	4541	878.7
13-25 mm	15879	7503.4	6391	4434.1	1904	1267.6
25-50 mm	3135	5219.5	460	1150.1	62	129.5
50-100 mm	55	249.0	0	0.0	0	0.0
100-200 mm	0	0.0	0	0.0	0	0.0
200+ mm	0	0.0	0	0.0	0	0.0
Total	38313	15447.8	15432	7322.8	13041	2395.0

200 mm or 200+ mm size categories. Ranking of the size categories changes slightly when weight is considered. The greatest amount of unidentifiable bone material falls in the 13-25 mm size category (13,205.1 g), followed by the 25-50 mm size category (6499.1 g), the 6-13 mm size category (5087.6 g), the 50-100 mm size category (249.0 g), and the 2-6 mm size category (124.8 g).

Other forms of cultural taphonomic modifications including cut marks, polishing, discoloration, and the formation of tools are apparent on 36 of the unidentifiable bone fragments. Single shallow cut marks were noted on two unidentifiable bone fragments, while multiple parallel shallow cut marks were recorded on 17 unidentifiable pieces of bone. In instances where there are multiple cut marks they are oriented parallel to each other. One item is notched. Five unidentifiable fragments exhibit a greenish/blue discoloration of the cortical bone. This may have resulted from prolonged contact with a metal object (copper) after burial. Seven unidentifiable bones have rounded edges on which a slight amount of polishing is visible. One item is spatulate shaped and is heavily smoothed on the inner surface. This bone item may have been used to smooth pottery. A second item with a rounded and smoothed end may have functioned as a pressure flaker for flintknapping. Four other bone tools identified as piercers or awls form part of the unidentifiable faunal sample from Block 2. All of the bone tools have been altered to the extent that the bones from which they were manufactured cannot be identified as to element or species.

Natural taphonomic modifications of the unidentifiable bone fragments include water rolling (one fragment), root erosion (one fragment), rodent gnawing (five fragments), porcupine gnawing (three fragments), carnivore pitting (three fragments), and a type natural taphonomic modification which cannot be classified (four pieces). The bone fragments on which porcupine and rodent gnawing are apparent are characterized by deep, wide, parallel grooves on the cortical bone. Four unidentifiable pieces of bone which fall in the 13-25 mm size category exhibit multiple circular holes which range in size from 3 - 6 mm in diameter. These holes appear to have been bored or chemically dissolved, extending from the cortical surface to the inner cancellous bone. The taphonomic agent responsible for these modifications was not identified.

7.3 Identifiable Faunal Specimens

Four classes (mammals, birds, fish, and bivalves) are represented in the assemblage of identifiable faunal specimens (N=7969, 47,852.8 g) associated with Block 2. The largest class is Mammalia with 6457 identified specimens (47,646.8 g), forming 81% of the identifiable fauna recovered from Block 2. The second largest class is Osteichthyes with 1186 identified specimens (96.4 g), constituting 15% of the assemblage. Aves is the third largest class with 326 identified specimens (109.6 g) making up 4% of the assemblage. The bivalves are not included in this analysis of Bushfield West fauna.

Within each class several different taxa are represented. A summary by NISP, weight, and where applicable MNI of all taxa is presented in Table 7.2.

Table 7.2 Block 2 - Identified Taxa by NISP, %NISP, MNI, and Weight

Taxon	NISP	%NISP	MNI	Weight (g)
Mammals				
Small mammal	2	0.0	-	3.9
Ungulate, unidentified	4624	58.0	-	31,194.9
Bison	502	6.3	11	13,373.4
Elk	17	0.2	1	455.6
Moose	32	0.4	2	859.4
Moose or Elk	42	0.5	-	573.1
Canid, unidentified	40	0.5	-	12.9
Gray Wolf or Domestic Dog	11	0.1	-	21.9
Coyote or Domestic Dog	4	0.1	-	2.2
Red Fox	24	0.3	2	4.2
Lynx	5	0.1	1	11.1
Marten	9	0.1	1	1.2
Leporid	4	0.1	-	0.5
White-tailed Jackrabbit	2	0.0	1	1.3
Snowshoe Hare	44	0.6	4	7.1

Table 7.2 (Continued)

Taxon	NISP	%NISP	MNI	Weight (g)
Rodent	1	0.0	-	0.1
Micro-rodent	6	0.1	-	0.2
Beaver	1011	12.7	14	1110.4
Muskrat	23	0.3	2	7.5
Red Squirrel	3	0.0	1	0.4
Ground Squirrel	21	0.3	-	2.3
Richardson's Ground Squirrel	3	0.0	2	0.7
Northern Pocket Gopher	12	0.2	1	0.7
Least Chipmunk	10	0.1	2	0.6
Deer Mouse	3	0.0	1	0.3
Meadow Vole	2	0.0	1	0.4
Birds				
Small bird	1	0.0	-	0.1
Medium bird	53	0.7	-	6.6
Large bird	26	0.3	-	12.1
Medium waterfowl	2	0.0	-	0.3
Large waterfowl	2	0.0	-	0.4
Swan	12	0.2	2	27.0
Geese, unidentified	9	0.1	-	5.6
Duck, unidentified	5	0.1	-	1.5
Teal	2	0.0	1	0.8
Mallard	16	0.2	2	3.3
Grouse, unidentified	173	2.2	7	37.1
Crane	17	0.2	1	14.1
Owl, unidentified	3	0.0	-	0.1
Perching bird	5	0.1	-	0.5
Fish				
Fish, unidentified	1056	13.3	-	66.5
Lake Sturgeon	27	0.3	1	7.6
Northern Pike	2	0.0	1	0.3
Longnose Sucker	14	0.2	4	3.7
White Sucker	50	0.6	6	8.4
Silver Redhorse	13	0.2	2	4.0
Shorthead Redhorse	7	0.1	2	2.8
Walleye	17	0.2	3	3.1

7.4 Mammalia - Mammals

Unidentified ungulate is the classification with the greatest number of identified specimens (N=4624) accounting for 71% of the mammalian remains found in Block 2. The next largest mammalian taxon is beaver with 1011 identified specimens (17% of the assemblage), followed by bison (N=502, 7%). The remaining 22 taxa account for a much smaller percentage of the mammalian fauna, 5% in total.

Two specimens from Block 2 can be identified as to skeletal element but only to the very general taxonomic level, unidentified small mammal. The size range of mammals included in this category are animals which are smaller in size than the red fox and larger than a small rodent such as a ground squirrel. The specimens assigned to this category include a supraoccipital cranial fragment and a rib shaft fragment.

7.4.1 Order Artiodactyla, [Ungulate, Unidentified]

The majority of identifiable mammalian fauna associated with Block 2 consist of unidentified ungulate specimens, 4624 pieces of bone weighing 31,194.9 g. The unidentified ungulate fauna includes both axial (N=2655) and appendicular (N=1969) skeletal specimens. None of unidentified ungulate axial specimens are complete and only three are nearly complete elements: a zygomatic portion of the temporal bone and two caudal vertebrae. The remaining axial specimens are highly fragmented. Unidentified ungulate axial specimens include the following: ribs (N=1029), vertebrae (N=793), cranial portions (N=316), indeterminate teeth (N=298), mandible fragments (N=177), premolar/molar tooth fragments (N=23), incisors (N=13), molars (N=4), and premolars (N=2).

Table 7.3 presents a summary of the unidentified ungulate axial specimens by NISP. Each category contains a significant number of indeterminate specimens—indeterminate cranial fragments constitute 53% of the cranial specimens, indeterminate vertebral fragments make up 15% of the vertebra specimens, and indeterminate teeth fragments account for 88% of the unidentified ungulate teeth. The majority of rib portions consist of shaft fragments, 88%. Horizontal ramus and alveolar fragments are the most common mandible portions, 43% and 36% respectively.

Table 7.3 Block 2 - Unidentified Ungulate Axial NISP

Specimen	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Skull:							
-frontal	1	0	12	0	13	46.9	0.5
-petrous	1	2	16	0	19	61.0	0.7
-zygomatic	7	2	3	0	12	28.5	0.5
-premaxilla	5	4	1	0	10	56.8	0.4
-temporal	7	12	2	0	21	77.8	0.8
-nasal	2	0	2	0	4	3.3	0.2
-palatine	0	2	2	0	4	7.1	0.2
-presphen.	1	0	0	0	1	4.6	0.0
-sphenoid	2	2	3	0	7	16.5	0.3
-basisphen.	0	1	0	1	2	4.9	0.1
-ethmoid	0	0	1	1	2	0.4	0.1
-jug. pro.	1	0	1	0	2	2.1	0.1
-maxilla	4	6	31	0	41	100.0	1.5
-alveolus	0	0	2	0	2	1.3	0.1
-aud. meat.	0	0	1	0	1	1.0	0.0
-ext. aud.	0	0	1	0	1	0.6	0.0
-supraoccip.	0	0	0	1	1	4.7	0.0
-occipital	0	2	0	1	3	16.5	0.1

Table 7.3 (Continued)

Specimen	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
-occip. con.	0	2	1	0	3	17.4	0.1
-indt. cran.	0	0	167	0	167	199.8	6.3
-dec. incisor	1	0	0	0	1	0.1	0.0
-incisor	1	4	7	0	12	6.0	0.5
-low. pre.	2	0	0	0	2	7.1	0.1
-low. M3	0	1	1	0	2	11.3	0.1
-molar	0	0	2	0	2	18.6	0.1
-pre/molar	0	0	23	0	23	47.5	0.9
-indt. teeth	0	0	298	0	298	193.3	11.2
Mandible:							
-condyle	0	0	2	0	2	8.4	0.1
-cor. process	2	2	0	0	4	14.2	0.2
-asc. ramus	9	7	6	0	22	214.4	0.8
-hor. ramus	10	12	54	0	76	788.9	2.9
-alveolus	3	0	61	0	64	178.0	2.4
-diastema	1	4	0	0	5	40.1	0.2
-symphysis	2	2	0	0	4	10.3	0.2
Vertebra:							
-axis	0	0	0	6	6	49.1	0.2
-atlas	0	0	0	5	5	157.5	0.2
-cervical	0	0	0	86	86	500.7	3.2
-thoracic	0	0	0	360	360	895.0	13.6
-lumbar	0	0	0	195	195	690.4	7.3
-sacrum	0	0	0	8	8	32.8	0.3
-caudal	0	0	0	12	12	27.8	0.5
-indt. vert.	0	0	0	121	121	116.8	4.6
Rib:							
-head	0	0	28	0	28	31.6	1.1
-neck	0	0	39	0	39	151.8	1.5
-neck/tub.	0	0	2	0	2	5.8	0.1
-tubercle	0	0	7	0	7	9.9	0.3
-neck/body	0	0	20	0	20	265.3	0.8
-body	0	0	905	0	905	4009.8	34.1
-sternal end	0	0	3	0	3	3.2	0.1
-costal cart.	0	0	25	0	25	25.9	0.9
Total	62	67	1729	797	2655	2555.3	100.5

The size categories of the unidentified ungulate axial specimens gives an indication of the degree of fragmentation of the material. The majority of axial specimens are found in the 25-50 mm size category, followed by the 13-25 mm size category, the 50-100 mm size category, and finally the 6-13 mm size category Table 7.4.

When considered by weight (Table 7.5) there is a slight difference in the ranking of size categories—the 25-50 mm size category contains the greatest amount, followed by the 50-100 mm size category. The amount of material found in the 13-25 mm size category and the 100-200 mm size category is almost equal. Rib shaft fragments account for the substantial amount of material in the 200+ mm size category and the indeterminate teeth specimens are responsible for the largest portion of the smaller size category, 6-13 mm.

Table 7.4 Block 2 - Unidentified Ungulate Axial NISP by Size Categories

Size	Cranial	Mand.	Teeth	Indt. Teeth	Vert.	Rib	Total
0-2 mm	0	0	0	0	0	0	0
2-6 mm	0	0	0	0	0	0	0
6-13 mm	28	4	11	144	53	9	249
13-25 mm	159	38	24	143	372	198	934
25-50 mm	115	100	7	11	306	548	1087
50-100 mm	14	30	0	0	60	236	340
100-200 mm	0	5	0	0	2	29	36
200+ mm	0	0	0	0	0	9	9
Total	316	177	42	298	793	1029	2655

Table 7.5 Block 2 - Unidentified Ungulate Axial Specimen Weight (g) by Size Categories

Size	Cranial	Mand.	Teeth	Indt. Teeth	Vert.	Rib	Total
0-2 mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-6 mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6-13 mm	7.3	2.0	2.8	40.0	17.4	2.9	72.4
13-25 mm	155.7	55.1	43.6	106.9	407.9	167.3	936.5
25-50 mm	321.1	528.9	44.2	46.4	1202.3	1246.7	3389.6
50-100 mm	167.1	484.0	0.0	0.0	737.7	1734.2	3140.1
100-200 mm	0.0	184.3	0.0	0.0	105.8	642.6	932.7
200+ mm	0.0	0.0	0.0	0.0	0.0	645.8	645.8
Total	668.3	1254.3	92.1	191.8	2471.1	4439.5	9117.1

Eight percent or 204 unidentified ungulate axial specimens are either partially fused (N=7), unfused (N=45), unfused epiphyses (N=121), or immature (N=31). A summary (by NISP and weight) of the various unidentified ungulate axial specimens which are not fully mature is presented in Table 7.6.

Two indeterminate cranial specimens are partially fused, the suture line between cranial portions is still visible. The immature cranial specimens include two zygomatic portions of the temporal bone, one premaxilla, two maxillae, and one indeterminate cranial fragment. The unfused cranial specimens consist of one zygomatic portion of the temporal bone, two premaxillae, two temporal bone fragments, one palatine fragment, one maxilla fragment, and one supraoccipital fragment. The partially fused rib specimen consists of the epiphyses of the head and the head/neck portion Seven unfused rib heads account for all of the unfused rib epiphyses. The sternal end of a rib is the one unfused rib specimen.

Table 7.6 Block 2 - Sub-Adult Unidentified Ungulate Axial Specimens

Specimen	Partially Fused Freq.	Partially Fused Weight	Unfused Freq.	Unfused Weight	Unfused Epip. Freq.	Unfused Epip. Weight	Immature Freq.	Immature Weight
Cranial	2	3.3	9	42.6	0	0.0	6	8.6
Mandible	0	0.0	0	0.0	0	0.0	5	29.8
Teeth	0	0.0	0	0.0	0	0.0	0	0.0
Indt. teeth	0	0.0	0	0.0	0	0.0	13	4.3
Atlas	0	0.0	0	0.0	1	9.7	0	0.0
Axis	0	0.0	0	0.0	0	0.0	0	0.0
Cervical	0	0.0	2	5.6	1	0.6	2	2.0
Thoracic	1	1.0	10	25.9	26	42.9	2	2.7
Lumbar	2	11.9	3	17.0	9	10.9	1	0.3
Sacrum	0	0.0	1	7.6	1	3.8	0	0.0
Caudal	0	0.0	1	0.1	0	0.0	0	0.0
Indt. vert.	1	0.6	18	29.1	76	33.3	0	0.0
Rib	1	2.4	1	1.4	7	2.1	2	5.2
Total	7	19.2	45	129.3	121	103.3	31	53.0

*Weight is in grams.

A total of 1969 appendicular specimens weighing 22,094.9 g are identified as unidentified ungulate remains. This represents 43% of the unidentified ungulate faunal sample recovered from Block 2. The largest class of the appendicular specimens (40%) are fragments of long bones which can not be identified as to a specific skeletal element. Most of the long bone specimens are shaft fragments (N=731) and the remaining specimens are articular end fragments (N=59). Other unidentified ungulate specimens are from various regions of the skeleton: the hyoid (N=14), scapula (N=267), forelimbs (N=331), innominate (N=146), hindlimbs (N=353), metapodials (N=20), phalanges (N=34), sesamoids (N=6), and bony ossicles (N=8). Table 7.7 presents a list of the identified unidentified ungulate appendicular specimens.

Table 7.7 Block 2 - Unidentified Ungulate Appendicular NISP

Specimen	Left	Right	Indt.	Total	Weight (g)	NISP%
Hyoid	6	7	1	14	39.3	0.7
Scapula:						
-glenoid	1	0	3	4	17.7	0.2
-neck	5	5	5	15	226.7	0.8
-acrom. pro.	4	2	0	6	53.4	0.3
-caudal bor	10	10	18	38	482.0	1.9
-cranial bor	0	6	6	12	145.0	0.6
-spine	18	8	8	34	304.9	1.7
-blade	22	45	91	158	599.1	8.0
Humerus:						
-head	1	0	1	2	12.8	0.1
-neck	1	0	0	1	73.4	0.1
-maj. tub.	0	0	1	1	7.4	0.1
-shaft	40	39	30	109	2489.4	5.5
-deltoid	12	8	0	20	284.2	1.0

Table 7.7 (Continued)

Specimen	Left	Right	Indt.	Total	Weight (g)	NISP%
-radial fossa	2	1	2	5	63.4	0.3
-olecra foss	0	1	1	2	20.9	0.1
-lat. epico.	0	5	0	5	97.5	0.3
-med. epico.	1	0	0	1	4.9	0.1
-condyle	9	7	6	22	316.1	1.1
Radius:						
-med. fossa	2	2	1	5	71.6	0.3
-shaft	27	27	15	69	1457.0	3.5
-carp. facet	2	1	8	11	127.3	0.6
Ulna:						
-olecranon	0	2	0	2	40.9	0.1
-semi-lun.	3	4	0	7	63.6	0.4
-trochlea	3	3	0	6	56.3	0.3
-shaft	12	20	11	43	525.6	2.2
-styloid	0	3	0	3	5.8	0.2
Fused r./u..	0	2	2	4	47.0	0.2
Radial carp.	1	0	0	1	1.1	0.1
Metacarpal:						
-shaft	2	2	3	7	144.3	0.4
-condyle	0	1	4	5	46.7	0.3
Innominate:						
-acetabul.	11	18	8	37	331.5	1.9
-ischium	18	20	24	62	288.7	3.2
-ilium	11	14	12	37	341.3	1.9
-pubis	3	4	2	9	31.3	0.5
-ili./ish. sp.	0	1	0	1	61.5	0.1
Patella	2	0	0	2	36.7	0.1
Femur:						
-head	0	4	2	6	143.6	0.3
-neck	4	2	0	6	68.4	0.3
-maj. troch.	0	1	0	1	8.0	0.1
-min. troch.	4	6	2	12	132.7	0.6
-shaft	22	17	32	71	1963.8	3.6
-sup. cond.	12	8	3	23	457.0	1.2
-pat. groove	1	1	1	3	24.4	0.2
-condyle	1	0	2	3	10.7	0.2
Tibia:						
-med. cond.	0	1	3	4	27.1	0.2
-lat. cond.	2	1	1	4	38.2	0.2
-condyle	1	0	2	3	22.1	0.2
-tibial crest	13	17	2	32	1186.4	1.6
-mus. lines	25	22	17	64	1312.3	3.3
-shaft	43	21	23	87	1949.5	4.4
-med. mall.	1	2	0	3	23.4	0.2
-tarsal art.	7	2	1	10	73.0	0.5
Calcaneus	1	0	0	1	5.9	0.1
Cen./4th	0	1	0	1	3.9	0.1
Metatarsal:						
-art. facet	0	2	1	3	52.2	0.2
-shaft	0	1	9	10	126.7	0.5
-condyle	0	0	3	3	60.1	0.2

Table 7.7 (Continued)

Specimen	Left	Right	Indt.	Total	Weight (g)	NISP%
2nd metat.	0	0	1	1	0.8	0.1
Long bone:						
-articular	0	0	59	59	178.2	3.0
-shaft	0	0	731	731	5178.1	37.1
Metapodial:						
-shaft	0	0	10	10	51.7	0.5
-condyle	0	0	10	10	43.3	0.5
1st phal.	0	0	18	18	41.5	0.9
2nd phal.	0	0	9	9	20.7	0.5
3rd phal.	0	0	5	5	7.3	0.3
Indt. phal.	0	0	2	2	2.9	0.1
S. med. ses.	0	0	3	3	2.7	0.1
Indt. ses.	0	0	1	1	0.1	0.1
Infer. ses.	0	0	2	2	1.6	0.1
Bony oss.	0	0	8	8	2.9	0.4
Total	366	377	1226	1969	22094.9	101.0

All eight of the unidentified ungulate bony ossicles are complete and one sesamoid and one hyoid are nearly complete elements. The remaining unidentified ungulate specimens are highly fragmented. An indication of the comminuted nature of the unidentified ungulate appendicular material is given by specimen size (Table 7.8).

Table 7.8 Block 2 - Unidentified Ungulate Appendicular NISP Size Categories (mm)

Element	0-2	2-6	6-13	13-25	25-50	50-100	100-200	200+	Total
Hyoid	0	0	0	4	7	3	0	0	14
Scapula	0	0	0	44	133	83	7	0	267
Humerus	0	0	0	5	88	73	2	0	168
Radius	0	0	0	3	36	43	3	0	85
Ulna	0	0	0	4	37	17	3	0	61
Fused r./u.	0	0	0	0	2	2	0	0	4
Metacarpal	0	0	0	4	4	3	1	0	12
Carpal	0	0	0	1	0	0	0	0	1
Innominate	0	0	0	10	106	30	0	0	146
Femur	0	0	0	3	56	61	5	0	125
Patella	0	0	0	0	2	0	0	0	2
Tibia	0	0	0	6	75	106	20	0	207
Metatarsal	0	0	0	5	3	7	1	0	16
2nd metat.	0	0	0	0	1	0	0	0	1
Tarsals	0	0	0	0	2	0	0	0	2
Metapodial	0	0	0	9	9	2	0	0	20
Indt. shaft	0	0	0	30	575	126	0	0	731
Indt. art.	0	0	0	26	31	0	0	0	59
Phalanges	0	0	0	26	8	0	0	0	34
Sesamoids	0	0	3	3	0	0	0	0	6
Bony oss.	0	0	6	2	0	0	0	0	8
Total	0	0	11	186	1174	555	42	0	1968

The majority of scapula and innominate specimens are found in the 25-50 mm size category. For the long bone specimens the most common size category is also 25-50 mm, followed by the 50-100 mm size category, the 13-25 mm size category, and the 100-200 mm size category.

The weight per size category for each unidentified ungulate specimens shows a slight variation in rankings. The 50-100 mm size category contains the greatest amount of material for scapula fragments and long bone specimens. The largest weight category for innominate fragments is the 25-50 mm size category, followed by the 50-100 mm size category. The weight of unidentified ungulate specimens for each size category is listed in Table 7.9.

Table 7.9 Block 2 - Unidentified Ungulate Appendicular Specimen Weight by Size Categories (mm)

Element	0-2	2-6	6-13	13-25	25-50	50-100	100-200	200+	Total
Hyoid	0.0	0.0	0.0	2.8	14.9	21.6	0.0	0.0	39.3
Scapula	0.0	0.0	0.0	45.0	459.0	1042.1	282.7	0.0	1828.8
Humerus	0.0	0.0	0.0	13.4	883.5	2274.7	198.4	0.0	3296.6
Radius	0.0	0.0	0.0	6.1	315.5	1111.4	223.3	0.0	1656.3
Ulna	0.0	0.0	0.0	6.0	228.9	297.8	159.5	0.0	692.2
Fused r./u.	0.0	0.0	0.0	0.0	5.3	41.7	0.0	0.0	47.0
Metacarpal	0.0	0.0	0.0	6.0	31.7	74.0	79.3	0.0	191.0
Carpal	0.0	0.0	0.0	0.0	9.8	0.0	0.0	0.0	9.8
Innominate	0.0	0.0	0.0	16.5	571.8	423.4	0.0	0.0	1011.7
Femur	0.0	0.0	0.0	7.2	543.7	1970.0	287.7	0.0	2808.6
Patella	0.0	0.0	0.0	0.0	36.7	0.0	0.0	0.0	36.7
Tibia	0.0	0.0	0.0	13.7	608.7	2698.9	1310.7	0.0	4632.0
Metatarsal	0.0	0.0	0.0	9.7	32.2	162.9	34.2	0.0	239.0
2nd metat.	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.8
Tarsals	0.0	0.0	0.0	0.0	9.8	0.0	0.0	0.0	9.8
Metapodial	0.0	0.0	0.0	10.3	50.1	34.6	0.0	0.0	95.0
Indt. shaft	0.0	0.0	0.0	63.9	3416.8	1697.4	0.0	0.0	5178.1
Indt. art.	0.0	0.0	0.9	40.1	137.2	0.0	0.0	0.0	178.2
Phalanges	0.0	0.0	0.0	36.6	35.8	0.0	0.0	0.0	72.4
Sesamoids	0.0	0.0	1.3	3.1	0.0	0.0	0.0	0.0	4.4
Bony oss.	0.0	0.0	1.4	1.5	0.0	0.0	0.0	0.0	2.9
Total	0.0	0.0	3.6	283.8	7381.6	11850.5	2575.8	0.0	22095.3

Variation in the ages of some of the unidentified ungulate appendicular specimens is indicated by unfused epiphyses, partially fused epiphyses and diaphyses, as well as immature specimens. The 84 unidentified ungulate appendicular specimens which are not fully mature are listed in Table 7.10. This represents 4% of the unidentified ungulate appendicular material.

Table 7.10 Block 2 - Sub-Adult Unidentified Ungulate Appendicular Specimens

Specimen	Partially Fused Freq.	Partially Fused Weight	Unfused Freq.	Unfused Weight	Unfused Epip. Freq.	Unfused Epip. Weight	Immature Freq.	Immature Weight
Hyoid	0	0.0	0	0.0	0	0.0	1	0.3
Scapula	0	0.0	0	0.0	0	0.0	2	11.0
Humerus	0	0.0	2	78.1	1	4.1	0	0.0
Radius	0	0.0	3	48.2	1	6.0	2	10.0
Ulna	0	0.0	3	40.2	0	0.0	1	4.4
Metacarpal	0	0.0	0	0.0	0	0.0	2	93.9
Innominate	0	0.0	3	9.7	0	0.0	7	31.6
Femur	2	43.9	1	11.5	1	29.8	6	65.4
Tibia	0	0.0	1	19.5	11	63.9	2	10.4
Metatarsal	0	0.0	1	9.1	0	0.0	0	0.0
Metapodial	0	0.0	0	0.0	2	12.0	0	0.0
Indt. shaft	0	0.0	2	12.2	0	0.0	12	30.1
Indt. art.	0	0.0	0	0.0	11	31.7	0	0.0
Phalanx	0	0.0	0	0.0	2	2.8	1	0.5
Total	2	43.9	16	228.5	29	150.3	36	257.6

*Weight is in grams.

Unfused epiphyses include the following: a fragment of a humerus head, one distal radius fragment, a femoral head fragment, two tibia lateral condyle fragments, four tibia medial condyle fragments, two tibial condyle specimens (which are indeterminate as to whether they are medial or lateral condyles), three distal tibia specimens, two metapodial condyles, 11 long bone articular end fragments, and a first phalanx proximal fragment. Partially fused specimens, bones on which the fusion line between the shafts and condyles are still visible, include one femoral head and neck specimen and a femoral major trochanter and shaft specimen. The two immature metacarpal specimens are both left metacarpal shafts which are considerably different in size and thus age; if they represent individuals of the same species then a minimum of two individuals are present in the sub-adult unidentified ungulate appendicular fauna.

7.4.2 Unidentified Ungulate Foetal/Newborn Remains

Thirty-eight of the unidentified ungulate axial specimens recovered from Block 2 are foetal or newborn and are similar in size or smaller than the elements of the 1 week bison skeleton in the comparative collection The foetal/newborn axial specimens recovered from Block 2 include 11 cranial fragments, three mandible fragments, one incisor, six vertebral fragments, and 17 rib fragments (Table 7.11).

Table 7.11 Block 2 - Unidentified Ungulate Foetal/Newborn Axial Specimens

Specimen	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Skull:							
-frontal	0	0	1	0	1	0.3	2.6
-zygomatic	0	1	0	0	1	1.2	2.6
-nasal	2	0	0	0	2	1.5	5.3
-jug. pro.	0	0	1	0	1	0.5	2.6
-maxilla	0	3	0	0	3	2.6	7.9
-indt. cran.	0	0	3	0	3	0.6	7.9
-dec. incisor	1	0	0	0	1	0.1	2.6
Mandible:							
-cor. process	1	0	0	0	1	1.8	2.6
-hor. ramus	0	0	2	0	2	1.7	5.3
Vertebra:							
-cervical	0	0	0	3	3	2.9	7.9
-thoracic	0	0	0	2	2	4.0	5.3
-lumbar	0	0	0	1	1	0.2	2.6
Rib:							
-head	0	0	1	0	1	0.6	2.6
-neck/body	0	0	1	0	1	0.8	2.6
-body	0	0	15	0	15	9.7	39.5
Total	4	4	24	6	38	28.5	99.9

Fifteen of the foetal/newborn unidentified ungulate axial specimens were found in the north half of unit 180S 72E. These specimens include 11 of the cranial specimens, the lumbar vertebral specimen, and three of the rib specimens. All of these items are similar in density, porosity, texture, and color. It is possible that they represent a single individual. The remaining foetal/newborn axial specimens were found scattered throughout the block, south of the main concentration.

Twenty of the unidentified ungulate appendicular specimens are also foetal or newborn (1 week or less) (Table 7.12). The majority of the foetal/newborn unidentified

Table 7.12 Block 2 - Unidentified Ungulate Appendicular Foetal/Newborn Specimens

Specimen	Left	Right	Indt.	Total	Weight (g)	NISP%
Scapula	0	1	0	1	2.0	5.0
Humerus	3	3	0	6	30.7	30.0
Radius	1	0	0	1	8.0	5.0
Tibia	1	0	0	1	2.2	5.0
Metatarsal	0	0	1	1	1.6	5.0
Metapodial	0	0	2	2	6.8	10.0
Indt. shaft	0	0	7	7	9.6	35.0
Sesamoid	0	0	1	1	0.1	5.0
Total	5	4	11	20	60.9	100.0

ungulate appendicular specimens are long bone shaft fragments (N=7). The remaining items are forelimb specimens (N=8), hindlimb specimens (N=2), metapodials (N=2), and one sesamoid.

The six foetal/newborn humerus specimens are all similar in size. They represent a minimum of four elements. If they are from the same species then a minimum of two individuals, based on two right humerus shaft specimens, are represented in the foetal/newborn fauna.

7.4.3 Family Bovidae, *Bison bison* [American Bison]

Bison comprise 6% of the identifiable faunal assemblage recovered from Block 2. A total of 502 complete and fragmented bison bones weighing 13,373.4 g were found in this 234 m^2 excavation block. Table 7.13 presents the identified bison axial skeletal specimens (by NISP). The sample represents a minimum of 11 individuals. The MNI estimate is based upon individual left M1 teeth and left mandibles with socketed M1 teeth.

Table 7.13 Block 2 - Bison Axial NISP

Specimen	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Frontal	2	0	0	0	2	9.3	0.9
Petrous	2	3	0	0	5	51.2	2.2
Zygomatic	0	1	0	0	1	4.0	0.4
Premaxilla	6	3	0	0	9	117.7	4.0
Temporal	1	2	0	0	3	42.4	1.3
Nasal	0	1	0	0	1	20.7	0.4
Occipital	1	0	0	1	2	48.8	0.9
Palatine	1	1	0	0	2	6.1	0.9
Horn core	0	0	1	0	1	120.0	0.4
Maxilla	5	3	0	0	8	84.5	3.6
Maxilla/th.	0	1	0	0	1	30.7	0.4
Upper dp3	2	0	0	0	2	19.8	0.9
Upper dp4	2	0	0	0	2	29.6	0.9
Upper P2	3	4	0	0	7	74.4	0.3
Upper P3	3	1	0	0	4	43.7	1.8
Upper Pre.	0	1	0	0	1	8.9	0.4
Upper M1	2	3	1	0	6	114.9	2.7
Upper M2	2	3	0	0	5	191.0	2.2
Upper M3	1	3	0	0	4	196.4	1.8
Mandible	41	28	0	0	69	19.4	30.7
Dec. incisor	6	3	1	0	10	5.7	4.4
Incisor	5	12	0	0	17	35.6	7.6
Canine	1	2	0	0	3	2.5	1.3
Lower dp4	1	0	0	0	1	9.1	0.4
Lower P2	7	6	0	0	13	40.5	5.6
Lower P3	6	5	0	0	11	90.5	4.9
Lower P4	3	1	0	0	4	53.0	1.8
Lower M1	10	5	0	0	15	399.4	6.7

Table 7.13 (Continued)

Specimen	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Lower M2	3	1	0	0	4	166.7	1.8
Lower M3	3	5	0	0	8	273.8	3.6
Low. Molar	1	1	1	0	3	39.0	1.3
Cervical	0	0	0	1	1	132.0	0.4
Total	120	99	4	2	225	4136.4	99.8

A total of 225 axial elements or 45% of the bison remains were identified in the Block 2 faunal material. The large number of axial specimens is mainly due to the recovery of several mandible fragments (N=69), individual teeth (N=121), and skull fragments (N=34). Only one vertebra from Block 2 was sufficiently complete to enable identification to the level of species. As stated previously, fragmented ribs and vertebrae are difficult to assign to species, especially when more than one species of similar sizes are present in the assemblage. Most of bison axial specimens are highly fragmented with only 70 complete elements, 31% of the sample. All of the complete elements are individual teeth—20 incisors, two canines, 28 premolars, and 20 molars.

Twelve of the mandible fragments are horizontal ramus portions with socketed teeth. The length of the horizontal ramus fragment, as well as the number of socketed teeth varies. Six are short segments and have only one socketed tooth. The socketed teeth are as follow: P3; P4; M1; M2, and two specimens with M3. The remaining horizontal ramus portions have the following socketed teeth: P2 and P3; P2, P3, P4, and M1; M2 and M3; and three specimens with P3, P4, and M1. Only one maxilla has socketed teeth, dp2 and dp4. These specimens, as well as individual mandibular and maxillary teeth are used to estimate MNI values, as well as in determining bison age groups and site seasonality.

Over half of the bison remains (55%) recovered from Block 2 are appendicular specimens (N=277) representing all elements of the bison skeleton (Table 7.14). Forelimb specimens (N=104) and phalanges (N=77) dominate the assemblage, followed by hindlimb specimens (N=47) and sesamoids (N=42). Fewer scapula (N=7) and innominate (N=7) specimens are present but they are equally represented.

Complete appendicular specimens generally consist of small elements of the lower leg. A total of 94 appendicular specimens, 34% of the sample, are complete. They include the following: 18 carpals, one 2nd metatarsal, nine lateral malleoli, five tarsals, nine first phalanges, 20 second phalanges, 13 third phalanges, six superior sesamoids, eight superior lateral sesamoids, and five inferior sesamoids. The recovery of several (N=75) nearly complete elements and complete or nearly complete element

Table 7.14 Block 2 - Bison Appendicular NISP

Specimen	Left	Right	Indt.	Total	Weight (g)	NISP%
Hyoid	1	1	0	2	0.7	7.5
Scapula	1	6	0	7	2.5	580.6
Humerus	5	11	0	16	5.8	2140.9
Radius	11	15	0	26	9.0	1308.0
Ulna	3	14	0	17	6.1	492.7
Rad./ulna	2	2	0	4	1.8	115.4
Radial carp.	5	1	0	6	2.2	85.1
Intern. carp.	6	0	0	6	2.2	98.3
Ulnar carp.	4	0	0	4	1.4	78.2
2nd/3rd	2	2	0	4	1.4	86.1
Uncif. carp.	3	0	0	3	1.1	36.8
Accessory	0	1	0	1	0.4	14.4
Metac.	3	4	1	8	2.9	414.6
Innominate	6	1	0	7	2.5	169.7
Femur	1	2	0	3	1.1	111.5
Patella	3	0	0	3	1.1	94.2
Tibia	7	8	0	15	5.4	955.7
Lat. mall.	4	6	0	10	3.6	79.9
Calcaneus	0	2	0	2	0.7	189.8
Astragalus	0	2	0	2	0.7	178.5
Cen./4th	0	2	0	2	0.7	104.4
2nd/3rd tar.	1	0	0	1	0.4	8.2
1st tarsal	1	1	0	2	0.7	2.3
2nd metat.	0	1	0	1	0.4	2.9
Metatarsal	3	0	3	6	2.2	195.2
1st phal.	0	0	27	27	9.7	476.3
2nd phal.	0	0	24	24	8.7	559.3
3rd phal.	0	0	26	26	9.4	495.8
S. med ses.	0	0	13	13	4.7	75.6
S. lat. ses.	0	0	15	15	5.4	49.2
Infer. ses.	0	0	14	14	5.1	29.9
Total	72	82	123	277	100.0	9237.0

portions of long bones also helped to increase the MNI, MNE, and MAU counts (Table 7.15).

Table 7.15 Block 2 - Bison NISP/MNE/MNI/MAU

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
Skull:						
-petrous	5	5	2	3	3	2.5
-other	26	3	1	2	2	1.5
Mandible:						
-cor. process	9	5	3	2	3	2.5
-condyle	7	7	4	3	4	3.5
-asc. ramus	14	6	4	2	4	3.0
-diastema	6	6	4	2	4	3.0
Vertebra:						
-cervical	1	1	-	-	1	0.1
Hyoid	2	2	1	1	1	1.0

Table 7.15 (Continued)

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
Scapula:						
-glenoid	6	5	1	4	4	2.5
-other	1	1	-	-	-	0.5
Humerus:						
-shaft	8	4	2	2	2	2.0
-distal	8	5	1	4	4	2.5
Radius:						
-proximal	8	5	2	3	5	2.5
-shaft	6	2	1	1	1	1.0
-distal	16	10	6	4	6	5.0
Ulna:						
-proximal	9	4	1	3	3	2.0
-shaft	7	5	1	4	4	2.5
-distal	5	4	2	2	2	0.5
Carpals:						
-radial	6	6	6	0	6	3.0
-internal	5	5	5	0	5	2.5
-ulnar	4	4	4	0	4	2.0
-2nd/3rd	4	4	2	2	2	2.0
-unciform	3	3	3	0	3	1.5
-accessory	1	1	0	1	1	0.5
Metacarpal:						
-proximal	3	2	2	0	2	1.0
-shaft	2	1	0	1	1	0.5
-distal	3	2	0	2	2	1.0
Innominate:						
-acetabul.	3	3	1	2	2	2.0
-other	2	1	1	0	1	0.5
Femur:						
-proximal	3	2	1	1	1	1.0
Patella	3	3	3	1	3	1.5
Tibia:						
-shaft	5	3	1	2	2	1.5
-distal	10	9	4	5	5	4.5
Lat. mall.	11	11	4	7	7	5.5
Tarsals:						
-calcaneus	2	2	0	2	2	1.0
-astragalus	2	2	0	2	2	1.0
-cen./4th	2	2	0	2	2	1.0
-2nd/3rd	1	1	1	0	1	0.5
-1st	2	2	1	1	1	1.0
2nd metat.	1	1	0	1	1	0.5
Metatarsal:						
-proximal	2	2	1	1	1	1.0
-shaft	4	1	1	0	1	0.5
1st phal.	27	19	-	-	3	2.5
2nd phal.	24	22	-	-	3	2.8
3rd phal.	23	21	-	-	3	2.6
S. med. ses.	14	11	-	-	2	1.4
S. lat. ses.	14	13	-	-	2	1.6
Infer. ses.	14	10	-	-	2	1.3

Twenty-three sub-adult appendicular specimens are present in the collection of bison remains from Block 2. Sub-adult specimens include immature elements, unfused epiphyses and shafts, and partially fused specimens. Eleven immature elements—two radial carpals, two internal carpal fragments, one ulnar carpal, two unciform carpals, one second phalanx, two third phalanges, and one superior lateral sesamoid—were identified among the Block 2 bison appendicular elements.

Unfused appendicular specimens, which refer to either unfused shafts or epiphyses or both, include one distal humerus lateral epicondyle, three distal radii, one distal radial/ulnar styloid process and carpal articular facet, one femoral head, one distal tibia, three first phalanges, and one second phalanx. A partially fused distal tibia with the line of fusion between the shaft and epiphysis still visible, was also found in Block 2.

The appendicular specimens described above, particularly the unfused items, indicate that there is some variation in the ages of bison found in Block 2. These specimens indicate an age range of 2 to 7 years. The proximal epiphysis of both the first and second phalanges fuses by the 2 year, the distal epiphysis of the tibia is fused in individuals older than 3 years, the distal trochlea of the humerus fuses during the 2nd year and the epicondyles are fused in individuals older than 3-4 years,the head of the femur fuses during the 5th year, the distal epiphysis of the radius fuse during the 5th year in male bison and during the 6th year in female bison, (Empel and Roskosz 1963 cited in Dyck and Morlan 1995: 564-583). As mentioned in the previous chapter, these fusion rates are based on studies of European bison, *Bison bonasus*.

No proximal humerus portions were recovered from Block 2. Humerus specimens that were found consist of shaft fragments and distal portions. The one complete distal humerus portion that was found is fragmented on the anterior shaft approximately 37 mm above the radial fossa. The break extends to the lateral condyle on the anterior surface. The posterior shaft including the medial and lateral epicondyles is missing. A second distal humerus consists of two specimens, the medial condyle and the lateral condyle and groove, that were refitted in the laboratory. The medial condyle is fractured immediately above the condyle and then longitudinally through the groove between the medial and lateral condyles. The lateral condyle is also broken just above the condyle. A third specimen consists of the medial condyle which is broken through the radial fossa and just above the condyle. It is also split longitudinally along the groove between the medial and lateral condyles. One humerus shaft fragment consisting of the complete shaft circumference was found. The shaft was broken through the radial fossa, as well as at approximately the mid-shaft region, with a spiral fracture. The remaining shaft fragments possess distinctive landmarks: teres major muscle attachments, muscle lines, and nutrient foramina. Flake spalls were noted on one posterior shaft fragment.

Only one complete proximal radius portion was found in Block 2. It is fractured below the scar for the brachialis muscle with a rectangular fracture that runs across to the mid-point of the shaft, down and then across to the lateral side below the nutrient foramen. A second complete proximal radius portion consists of two specimens which were refitted in the laboratory. One specimen is the medial fossa and a portion of the medial side of the shaft; the other consists of the lateral fossa and a portion of the lateral shaft that extends to just below the nutrient foramen. Medial portions of both the anterior and posterior shafts between the two segments are missing, exposing the marrow cavity. Five other radius proximal portion fragments were also identified. These consist of either the medial fossa and brachialis muscle scar, or the lateral fossa and a small segment of the lateral shaft fractured above the nutrient foramen. Two complete radius distal ends are fractured across the shaft approximately 36 mm above the carpal articular facet. One distal radius portion was reconstructed from four fragments; however, the type of fragmentation cannot be determined since the specimen shows severe shovel trauma. Six radius distal end fragments are from the medial carpal articular side, while one is from the middle or internal carpal articular region. These fragments may have resulted from the attempted removal of the ulna. One almost complete shaft circumference from the mid-shaft region of the radius exhibits spiral fractures at both ends

The majority of ulnar fragments consist of portions of the semi-lunar notch, the lateral trochlear projection or the semi-lunar and trochlear notches. One specimen consists of the olecranon process broken above the semi-lunar notch. It appears as though these fragments have resulted from the disarticulation of the forelimb (humerus, radius and ulna) rather than from attempting to expose the marrow cavity of the ulna.

Only one complete metacarpal portion, consisting of the shaft and distal condyles, was found in Block 2. The anterior shaft is broken at approximately the mid-shaft region, while the posterior shaft is broken just above the nutrient foramen fully exposing the marrow cavity. Proximal metacarpal fragments include the following: the lateral facet and partial medial facet and anterior/lateral shaft segments; a portion of the medial facet and anterior/medial shaft; medial facet and a part of the lateral facet; and the anterior shaft. Metacarpal distal condyle fragments and shaft fragments are also present in the assemblage.

Three femur fragments were found in Block 2: a femoral head epiphysis, a fragment of the femoral neck, and a femoral head with a small segment of the neck. The femoral head and neck was likely broken during primary butchering when attempting to remove the femur from the acetabulum of the innominate.

The most commonly observed tibia fracture occurs near the distal end of the shaft. Nine complete distal tibia portions were found in Block 2. In most cases the break consists of a spiral fracture around the complete circumference of the distal shaft. In one instance it appears as though the cancellous tissue of the distal tibia was scooped out. In those cases where the shaft does not exhibit a spiral fracture, the breaks are jagged or long diagonals. On one specimen the anterior and posterior shafts have broken into sharp points. On a second, the shaft is broken higher up on the lateral side with the fracture running diagonally to the medial malleolus exposing the marrow cavity on the medial side. On a third specimen the posterior shaft is broken immediately above the distal articular surface, while the anterior shaft is a higher jagged projection. One tibia consists of the distal end and a significant portion of the shaft; the shaft has a spiral fracture across the mid-shaft region. A second tibia which was fragmented in a manner similar to the one just described consists of two refitted specimens; one is a section of the lateral shaft and the other is the distal end and a section of the medial shaft. The remaining tibia shaft specimens associated with Block 2 are shaft fragments with recognizable landmarks such as the tibial crest, muscle lines, and nutrient foramina. Distal end fragments consist of tarsal articular facets, particularly the distal/anterior portion which articulates with the astragalus.

Very few bison metatarsals were found in Block 2. Only one complete portion, that of the proximal end with a segment of the shaft, is represented in the sample. The shaft is broken at some distance below the nutrient foramina with pointed projections on both the anterior and posterior shafts. A second metatarsal specimen consists of a portion of the lateral facet and a segment of the lateral and posterior shaft.

Twelve first phalanges from Block 2 are fragmented. From these specimens five fragmentation patterns were noted. Some are fractured through the shaft just above the distal end and some are broken through the shaft just below the proximal end. One has the posterior/lateral portion of the shaft removed, thus exposing the marrow cavity. Four are fractured diagonally across the distal end but higher up on the anterior shaft, down through to the posterior side. Five fragments consist of the proximal end broken near the mid-shaft region, the proximal end is also fractured transversely. The marrow cavities of two distal fragments and one proximal fragment have been scooped out.

The only fragmented second phalanges are immature or unfused specimens. Therefore, fragmentation may be due to bone density with breakage occurring post-depositionally, rather than as a result of cultural processing. For the most part third phalanges from Block 2 are complete. Those that are not have been modified by carnivores or exhibit evidence of shovel trauma.

Only two appendicular articular units were identified in Block 2. One unit consists of the proximal radius and proximal/anterior ulnar trochlear notch. Both specimens were found in the northwest quadrant of unit 190S 66E. The second articular unit consists of four left carpals: internal, radial, unciform, and fused 2nd/3rd. These carpals were also found in the northwest quadrant of unit 190S 66E.

7.4.4 Family Cervidae

The identifiable faunal sample from Block 2 at Bushfield West includes 91 cervid specimens. This represents 2% of the identifiable faunal assemblage. The sample includes two species: moose (N=32) and elk (N=17). Forty-two of the specimens (47% of the sample) can not be identified to the level of species and are classified as moose or elk remains.

The assemblage of moose or elk items consist of both axial specimens (N=23) and appendicular specimens (N=19). The axial specimens weigh a total of 427.4 g and consist of 21 antler fragments, one fragment of the petrous portion of the temporal bone, and one left mandibular coroniod process. None of the antler specimens is complete enough in circumference to determine if the specimens are tines or beam segments.

The majority of the appendicular specimens are either phalanges (N=14) or dew claws (N=3). The remaining specimens include a right tibia shaft fragment and a metatarsal shaft fragment. Three of the appendicular specimens are complete: two dew claws and a second phalanx. The third phalanx specimen is immature. A summary of the moose or elk appendicular specimens is given in Table 7.16.

Table 7.16 Block 2 - Moose or Elk Appendicular NISP

Element	Left	Right	Indt.	Total	Weight (g)	NISP%
Tibia	0	1	0	1	35.1	5.3
Metatarsal	0	0	1	1	26.5	5.3
1st phal.	0	0	8	8	40.0	42.1
2nd phal.	0	0	5	5	37.9	26.3
3rd phal.	0	0	1	1	2.6	5.3
Dew claw	0	0	3	3	3.6	15.8
Total	0	1	18	19	145.7	100.1

The majority of incomplete phalanges are fractured at the proximal end of the shaft just below the articular surface, thus exposing the marrow cavity. One specimen consists of the distal end of the phalanx. This item is broken transversely through the shaft, as well as longitudinally through the distal end.

7.4.5 Family Cervidae, *Alces alces* [Moose]

Thirty-two of the cervid specimens or 35% of the sample, are moose. These items include both axial specimens (N=9) and appendicular specimens (N=23). The axial specimens include antler (N=1), individual teeth (N=1), and cranial fragments (N=7). The identified moose axial specimens are presented in Table 7.17. The only complete elements are the petrous portion of the temporal bone and the upper P4.

Table 7.17 Block 2 - Moose Axial NISP

Element	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Petrous	0	1	0	0	1	12.0	11.1
Premaxilla	3	0	0	0	3	15.8	33.3
Maxilla	3	0	0	0	3	11.5	33.3
Antler	0	0	1	0	1	9.5	11.1
Upper P4	1	0	0	0	1	13.7	11.1
Total	7	1	1	0	9	62.5	99.9

Two of the premaxilla specimens were refitted in the laboratory. The third premaxilla represents a separate element and it was cross-mended with two of the maxilla fragments. Therefore, based on the recovery of two left premaxillae, a minimum of two individuals are represented in the sample. The antler specimen is from the wide, flat palmar portion of the antler.

The 23 moose appendicular specimens are from the lower portions of the forelimbs and hindlimbs. Six of the appendicular specimens are complete elements and one is nearly complete. There are also five complete specimen portions; i.e. complete distal or proximal ends. The complete elements include the astragalus, the lateral malleolus, two sesamoids, and two of the dew claws. Table 7.18 lists the identified moose appendicular specimens.

Table 7.18 Block 2 - Moose Appendicular NISP

Element	Left	Right	Indt.	Total	Weight (g)	NISP%
Humerus	1	0	0	1	263.3	4.4
Radius	0	1	0	1	22.6	4.4
Ulna	0	2	0	2	93.7	8.7
Tibia	4	1	0	5	190.3	21.7
Lat. mall.	1	0	0	1	6.8	4.4
Calcaneus	1	0	0	1	78.9	4.4
Astragalus	1	0	0	1	83.7	4.4
1st phal.	0	0	2	2	30.5	13.0
2nd phal.	0	0	2	2	10.9	8.7
Dew claw	0	0	4	4	7.3	13.0
S. med. ses.	0	0	1	1	2.5	4.4
S. lat. ses.	0	0	2	2	6.4	8.7
Total	8	4	11	23	796.9	100.2

A summary of the calculated NISP, MNI, and MAU values is presented in Table 7.19.

Table 7.19 Block 2 - Moose NISP/MNE/MNI/MAU

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
Skull:						
-petrous	1	1	0	1	1	0.5
-premaxilla	3	2	2	0	2	1.0
-maxilla	3	1	1	0	1	0.5
-antler	1	1	0	0	1	0.5
Appendicular:						
Humerus:						
-distal	1	1	1	0	1	0.5
Radius:						
-shaft	1	1	0	1	1	0.5
Ulna:						
-olec. proc.	1	1	0	1	1	0.5
-semi. lun.	1	1	0	1	1	0.5
Tibia:						
-shaft	5	2	1	1	1	0.5
Lat. mall.	1	1	1	0	1	0.5
Calcaneus	1	1	1	0	1	0.5
Astragalus	1	1	1	0	1	0.5
1st phal.	2	2	-	-	1	0.3
2nd phal.	2	1	-	-	1	0.1
Dew claw	4	3	-	-	1	0.4

The humerus specimen consists of a complete distal portion. A spiral fracture runs diagonally through the shaft just above the radial and olecranon fossae. The first and second phalanges are both fractured through the shaft just below the proximal articular surface.

7.4.6 Family Cervidae, *Cervus canadensis* [Elk]

Seventeen of the cervid specimens recovered from Block 2 (18% of the sample) are elk. The majority of elk remains are axial specimens (N=12) and the remaining items are appendicular specimens (N=5). A minimum number of one individual is represented in this sample. As can be seen in Table 7.20 a variety of axial specimens—five individual teeth, three antler fragments, a cranial portion, one mandible fragment, and two lumbar vertebral fragments—were found. The cranial portion consists of the crushed posterior/dorsal part of the skull including the frontals, parietals and supraoccipital. The lumbar vertebral specimens fit together to form a nearly complete element and all of the individual teeth are complete elements.

Table 7.20 Block 2 - Elk Axial NISP

Element	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Skull:							
-cranium	0	0	0	1	1	330.0	8.3
-antler	0	0	3	0	3	361.0	25.0
Mandible:							
-asc. ramus	0	1	0	0	1	6.5	8.3
-di2	0	1	0	0	1	0.4	8.3
-di3	1	1	0	0	2	1.0	16.7
-d i4	1	1	0	0	2	0.7	16.7
Vertebra:							
-lumbar	0	0	0	2	2	61.7	16.7
Total	2	4	3	3	12	434.6	100.0

All of the individual elk teeth recovered from Block 2 are deciduous. According to Quimby and Gaab (1957: 438-440) the deciduous incisors are present in the calf (0.5 year) and di1 and di2 are replaced by permanent incisors in the yearling (1.5 years). Therefore, the teeth from Block 2 likely represent an elk calf (possibly as old as 0.5 year). All of the elk teeth were found in the same quadrant of one unit. The right mandibular ascending ramus fragment is also immature: the cortical bone is quite porous and the specimen is very light. The mandible and deciduous incisors were not found in the same unit.

The elk appendicular specimens include one right hyoid fragment, one left hyoid fragment, one left ischium/acetabulum innominate fragment, one second phalanx proximal epiphysis, and one dew claw. The total weight of the appendicular specimens is 21.0 g.

7.4.7 Order Carnivora, Family Canidae, *Canis* sp.

Seventy-nine canid specimens weighing 42.7 g were recovered from Block 2. This represents 1% of the identifiable faunal assemblage. Several of the specimens (N=40) lack distinguishing landmarks or are too incomplete to allow positive species identifications. Some of the specimens also fall between the size ranges represented by the comparative specimens; therefore, species identifications cannot be made with any degree of confidence. These items are classified as unidentified canid specimens. They may represent any of the following canid species: red fox, coyote, gray wolf, or domestic dog.

The majority of unidentified canid remains are axial specimens (N=36). They include cranial fragments (N=5), individual teeth (N=9), vertebral fragments (N=2), and rib fragments (N=20). The individual teeth are from the upper and lower tooth rows, all are unerupted permanent teeth that are small in size and very lightweight. These teeth consist of crown buds or tooth caps. The remaining axial specimens—cranial fragments, vertebrae, and ribs—are fully fused. Table 7.21 presents a summary of the unidentified canid axial specimens.

Table 7.21 Block 2 - Unidentified Canid Axial NISP

Element	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Skull:							
-petrous	0	0	2	0	2	0.5	5.6
-ext. aud.	0	0	1	0	1	0.1	2.8
-maxilla	1	0	0	0	1	0.4	2.8
-indt. cran.	0	0	1	0	1	0.1	2.8
-upper P4	2	1	0	0	3	0.5	8.3
-upper M1	1	1	0	0	2	0.5	5.6
-upper M2	0	1	0	0	1	0.2	2.8
Mandible:							
-lower C	1	0	0	0	1	0.1	2.8
-lower M1	1	0	0	0	1	0.2	2.8
Indt. dc	0	0	1	0	1	0.1	2.8
Vertebrae:							
-thoracic	0	0	0	2	2	0.6	5.6
Rib:							
-head	0	0	1	0	1	0.1	2.8
-neck	0	0	1	0	1	0.3	2.8
-body	0	0	18	0	18	6.9	50.0
Total	6	3	25	2	36	10.6	100.3

The four unidentified canid appendicular specimens consist of one right humerus shaft fragment, one femur shaft fragment, one fibula shaft fragment, and one indeterminate long bone shaft fragment.

7.4.8 Family Canidae, *Canis lupus* or *Canis familiaris* [Gray Wolf or Domestic Dog]

Eleven canid specimens weighing 21.9 g are either gray wolf or domestic dog remains, accounting for 14% of the canid remains found in Block 2. The sample includes six axial specimens and five appendicular specimens. The axial specimens consist of three cervical vertebral fragments, one thoracic vertebral fragment, and two rib heads.

One appendicular specimen is from the forelimb region, while the remaining four specimens are from the hindlimb (Table 7.22). The two innominate fragments were refitted in the laboratory to form a single specimen consisting of the ilium, acetabulum, and ischium. The patella and astragalus are nearly complete elements. The cortical bone of the innominate is quite porous and the item is therefore classified as immature.

Table 7.22 Block 2 - Gray Wolf or Domestic Dog Appendicular NISP

Element	Left	Right	Indt.	Total	Weight (g)	NISP%
Ulna:						
-shaft	1	0	0	1	1.1	20.0
Innominate:						
-acetabul.	0	2	0	2	11.1	40.0
Patella	0	1	0	1	0.7	20.0
Astragalus	0	1	0	1	2.9	20.0
Total	1	4	0	5	15.8	100.0

7.4.9 Family Canidae, *Canis latrans* or *Canis familiaris* [Coyote or Domestic Dog]

Four of the canid remains weighing a total of 2.2 g represent either coyote or domestic dog. The specimens consist of a supraoccipital cranial fragment, a complete upper right first molar, a second phalanx fragment, and a complete third phalanx. All of these specimens are larger than the red fox comparative material, but smaller than the gray wolf comparative material.

7.4.10 Family Canidae, *Vulpes vulpes* [Red Fox]

The most commonly identified canid is red fox, 24 specimens weighing 4.5 g, representing 30% of the canid remains associated with Block 2. These specimens compare closely in size with the red fox skeletal material represented in the comparative collect. The skeletal elements are distinguished from those of the domestic dog by their gracile appearance. Most of the red fox specimens are from the axial region of the skeleton (N=17). Axial specimens include cranial fragments (N=7), individual teeth (N=8), one mandible fragment, and one vertebral fragment (Table 7.23).

Table 7.23 Block 2 - Red Fox Axial NISP

Element	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Skull:							
-petrous	1	2	2	0	5	0.9	29.4
-aud. bulla	1	0	0	0	1	0.1	5.9
-temporal	0	0	1	0	1	0.2	5.9
-upper I2	1	1	0	0	2	0.1	11.8
-upper C	1	0	0	0	1	0.1	5.9
-upper P4	1	1	0	0	2	0.4	11.8
-upper M1	0	1	0	0	1	0.1	5.9
Mandible:							
-hor. ramus	0	1	0	0	1	0.6	5.9
-lower I1	1	1	0	0	2	0.2	11.8
Vertebrae:							
-atlas	0	0	0	1	1	0.1	5.9
Total	5	7	4	1	17	2.8	100.2

The unerupted permanent incisors, canine, and premolars are small in size and consist of buds or crown caps. Red fox deciduous teeth emerge between one and two months of age and are replaced by permanent teeth by six months (Hillson 1986: 216). The horizontal ramus portion of the mandible is small in size and the root sockets are positioned close together indicating that this is an immature specimen. The remaining red fox axial specimens are representative of mature individual(s).

The recovery of two right petrous portions of the temporal bone indicates that a minimum of two individuals are represented in the sample of red fox axial specimens.

The seven appendicular specimens are from the upper forelimb region and the mid-hindlimb region of the skeleton (Table 7.24). None of the appendicular specimens are complete.

Table 7.24 Block 2 - Red Fox Appendicular NISP

Element	Left	Right	Indt.	Total	Weight (g)	NISP%
Scapula:						
-glenoid	0	1	1	2	0.4	28.6
Ulna:						
-trochlea	0	1	0	1	0.3	14.3
Tibia:						
-shaft	0	1	0	1	0.6	14.3
Fibula:						
-shaft	0	0	3	3	0.4	42.9
Total	0	3	4	7	1.4	100.1

7.4.11 Family Felidae, *Lynx canadensis* [Lynx]

Lynx are represented in the Block 2 faunal assemblage by five specimens weighing 11.1 g. A minimum of one individual is estimated to be present in this sample. Four of the remains are axial specimens and one is an appendicular specimen. The axial specimens include—a lower right M1, a right mandible with P3 and P4 teeth, a right mandibular symphysis with a canine, and a left mandible with C1, P3, P4, and M1 teeth.

The single appendicular specimen is the distal portion of a right ulna. The ulna is broken at the distal end of the shaft just above the styloid process.

7.4.12 Family Mustelidae, *Martes americana* [Marten]

Nine marten specimens weighing 12.0 g are present in the faunal assemblage of Block 2. A minimum of one individual is represented by this sample. Five of the specimens are from the axial region of the skeleton and four are from the appendicular region. The axial specimens include a partial skull, a right zygomatic arch, a left canine, a left mandible, and one rib. The partial skull consists of the right side of the cranium with P2, P3, P4, and M1 teeth. The left mandible is complete and has socketed teeth: P2, P4, and M1. The left canine also fits into the canine socket of the left mandible.

The appendicular specimens are all from the right forelimb. Three of the specimens are complete elements—the humerus, radius, and ulna—and the scapula specimen is missing part of the distal portion of the blade. All of these specimens were found in the southeast quadrant of unit 187S 64E and they form an articular unit.

7.4.13 Order Lagomorpha, Family Leporidae, *Lepus* sp.

Fifty specimens from Block 2 at Bushfield West are lagomorphs. They comprise less than 1% of the identifiable faunal assemblage. All but four of the specimens (0.5 g) are identified to the level of species. The unidentified leporid specimens include one rib shaft fragment, two metapodials, and one tibial crest fragment.

7.4.14 Family Leporidae, *Lepus townsendii* [White-tailed jackrabbit]

Based on size, two lagomorph specimens from Block 2 are classified as white-tailed jackrabbit remains. These specimens are considerably larger than the male snowshoe hare comparative specimens and they are quite similar in size to the available comparative white-tailed jackrabbit specimens.

The jackrabbit specimens consist of one right humerus shaft fragment and one left femur shaft fragment. These specimens weigh a total of 1.3 g. The coloration of the specimens indicates that they are part of the cultural faunal assemblage associated with Block 2.

7.4.15 Family Leporidae, *Lepus americanus* [Snowshoe Hare]

Most of lagomorph specimens (N=44 or 92%) are snowshoe hare remains. Both axial (N=16) and appendicular (N=28) specimens are represented in the sample. Axial specimens include cranial fragments (N=3), individual teeth (N=5), vertebral fragments (N=2), and ribs (N=6) (Table 7.25). One cranial element, the palatine, and one individual third premolar are complete. The two vertebrae are nearly complete elements.

Table 7.25 Block 2 - Snowshoe Hare Axial NISP

Element	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Skull:							
-palatine	0	0	0	1	1	0.2	6.3
-temporal	0	1	0	0	1	0.2	6.3
-indt. cran.	0	0	1	0	1	0.1	6.3
-upper I	1	0	0	0	1	0.1	6.3
-upper M	0	0	1	0	1	0.1	6.3

Table 7.25 (Continued)

Element	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Mandible:							
-lower I	1	0	0	0	1	0.1	6.3
-lower P3	1	0	0	0	1	0.1	6.3
-lower P/M	0	0	1	0	1	0.1	6.3
Vertebra:							
-cervical	0	0	0	2	2	0.2	12.5
Ribs:							
-body	0	0	6	0	6	0.6	37.5
Total	3	1	9	3	16	1.2	100.4

The 28 snowshoe hare appendicular specimens include forelimb specimens (N=10), hindlimb specimens (N=13), phalanges (N=4), and one metapodial specimen (Table 7.26). The only complete elements are the four phalanges; however, there are three complete specimen portions including one distal radius, and two proximal metacarpal specimens. There are also two nearly complete appendicular specimen portions: one distal humerus and one proximal ulna.

Table 7.26 Block 2 - Snowshoe Hare Appendicular NISP

Element	Left	Right	Indt.	Total	Weight (g)	NISP%
Humerus	2	0	0	2	0.3	7.1
Radius	1	4	0	5	0.8	17.9
Ulna	1	0	0	1	0.2	3.6
2nd metac.	1	0	0	1	0.1	3.6
5th metac.	1	0	0	1	0.1	3.6
Innominate	1	4	0	5	1.3	17.9
Femur	0	2	3	5	1.0	17.9
Tibia	0	2	0	2	1.2	7.1
Navicular	0	1	0	1	0.1	3.6
1st phal.	0	0	2	2	0.2	7.1
3rd phal.	0	0	2	2	0.4	7.1
Metapodial	0	0	1	1	0.2	3.6
Total	7	13	8	28	5.9	100.1

The sample of snowshoe hare remains associated with Block 2 represent a minimum of four individuals, based on the recovery of four right radius shaft specimens. One of the radius shaft specimens is immature. NISP, MNE, MNI and MAU values for the snowshoe hare axial and appendicular remains are presented in Table 7.27.

The two humerus specimens are fractured at the distal end of the shafts just above the olecranon fossa. The ulna is broken through the shaft below the trochlea. The one distal radius specimen is fractured at the distal end of the shaft, just above the carpal articular surface, while the radius shaft fragments are generally from the mid-shaft region. Innominate specimens are heavily fragmented with only one complete acetabulum being found; this specimen is broken through the ischial branch, the pubic branch, and the branch of the ilium. The femoral head specimen is broken at the neck, while all of the shaft specimens are highly fragmented. The two tibia shaft specimens are also quite fragmentary. The two metacarpal specimens are broken in the mid-shaft region.

Table 7.27 Block 2 - Snowshoe Hare NISP/MNE/MNI/MAU

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
Skull:						
-palatine	1	1	-	-	1	1.0
-temporal	1	1	0	1	1	0.5
Humerus:						
-distal	2	2	2	0	2	1.0
Radius:						
-shaft	4	4	0	4	4	2.0
-distal	1	1	1	0	1	0.5
Ulna:						
-proximal	1	1	1	0	1	0.5
2nd metac.	1	1	1	0	1	0.5
5th metac.	1	1	1	0	1	0.5
Innominate:						
-acetabul.	2	2	1	1	2	1.0
-other	2	2	1	1	2	1.0
Femur:						
-proximal	1	1	0	1	1	0.5
-shaft	1	1	0	1	1	0.5
Tibia:						
-shaft	2	1	0	1	1	0.5
-navicular	1	1	0	1	1	0.5
1st phal.	2	2	0	0	1	0.1
2nd phal.	2	2	0	0	1	0.1

7.4.16 Order Rodentia

Rodents (N=1093) account for 14% of the faunal assemblage associated with Block 2 at Bushfield West. The bulk of the rodent remains are beaver (N=1011, 92%). The remaining 82 specimens or 8% of the rodent remains consist of five species of rodents and two species of micro-rodents, as well as unidentified rodents and micro-rodents.

Seven specimens are identifiable only to the level of order: one rodent specimen and six micro-rodent specimens. The unidentified rodent specimen is a small tooth fragment, possibly an incisor. The unidentified micro-rodent remains consist of two axial specimens and four appendicular specimens. The axial specimens are an upper left incisor and a caudal vertebra. The appendicular specimens include the greater trochanter portion of a femur, one right 3rd metatarsal, one right 4th metatarsal, and one right 5th metatarsal. The three metatarsal elements were found in the northwest quadrant of unit 186S 73E; they form an articular unit, representing a single individual.

7.4.17 Family Castoridae, *Castor canadensis* [Beaver]

One of the most commonly represented species in Block 2 at Bushfield West is beaver, 1011 specimens weighing 1110.4 g. In terms of NISP, beaver remains comprise 13% of the identified fauna. More than half of the beaver remains, or 54%, are axial specimens (N=546). Axial specimens consist of cranial fragments (N=114), mandible fragments (N=35), individual teeth (N=102), vertebral fragments (N=134), rib fragments (N=160), and one sternum fragment (Table 7.28). Within the sample of axial specimens there are only 19 complete and 21 nearly complete axial elements. The remaining axial specimens are highly fragmented. The majority of complete or nearly complete elements consist of individual incisors (N=3) and cheek teeth (N=27). Three other axial items, one caudal vertebra and two ribs, are nearly complete elements. Ten cranial elements are complete or nearly complete. Complete cranial elements consist of one auditory bulla, one frontal, two occipitals, one occipital condyle, one supraoccipital, and one petrous portion of the temporal bone. Nearly complete cranial elements consist of one right frontal, two interparietals, one parietal, and one petrous portion of the temporal bone. There are also three nearly complete mandible specimens with socketed teeth.

Table 7.28 Block 2 - Beaver Axial NISP

Element	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Skull:							
-frontal	4	6	1	0	11	10.5	2.0
-nasal	1	1	3	0	5	1.6	0.9
-palatine	0	0	0	4	4	5.0	0.7
-premaxilla	10	6	1	0	17	13.1	3.1
-temporal	2	9	1	0	12	8.5	2.2
-zygomatic	6	7	0	0	13	13.2	2.4
-parietal	5	2	1	0	8	7.8	1.5
-interpariet.	0	0	0	4	4	2.7	0.7
-maxilla	5	6	5	0	16	14.0	2.9
-maxilla/th.	1	2	0	0	3	10.3	0.5
-petrous	1	3	1	0	5	8.0	0.9
-supraoccip.	0	0	0	5	5	5.8	0.9
-occipital	0	0	0	1	1	0.4	0.2
-occip. con.	2	4	0	0	6	4.6	1.1
-aud. bulla	1	0	0	0	1	5.2	0.2
-indt. cran.	0	0	3	0	3	1.0	0.5
-upper I	4	8	3	0	15	21.0	2.7
-upper dp4	0	4	0	0	4	8.1	0.7
-upper P4	1	1	0	0	2	5.6	0.4

Table 7.28 (Continued)

Element	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
-upper dm1	2	2	0	0	4	6.7	0.7
-upper dm2	1	1	0	0	2	1.8	0.4
-upper dm3	1	4	0	0	5	5.1	0.9
-upper M1	2	2	0	0	4	5.5	0.7
Mandible:							
-coronoid	1	1	0	0	2	1.0	0.4
-condyle	3	3	0	0	6	8.9	1.1
-asc. ramus	0	4	0	0	4	5.2	0.7
-hor. ramus	2	1	0	0	3	3.0	0.5
-diastema	2	0	0	0	2	4.3	0.4
-man. sym.	5	10	0	0	15	16.7	2.7
-mandible	1	2	0	0	3	48.0	0.5
-lower I	9	14	2	0	25	45.6	4.6
-lower dp4	2	1	0	0	3	5.3	0.5
-lower dm1	1	0	0	0	1	1.4	0.2
-lower dm2	0	1	0	0	1	1.4	0.2
-lower dm3	1	0	0	0	1	1.1	0.2
-lower M2	0	1	0	0	1	1.3	0.2
Indeterminate Teeth:							
-indt. I	0	0	30	0	30	9.7	5.5
-Pre/Molar	0	0	3	0	3	2.0	0.5
-dpre/mo.	0	0	1	0	1	0.5	0.2
Vertebrae:							
-atlas	0	0	0	2	2	1.3	0.4
-axis	0	0	0	2	2	0.7	0.4
-thoracic	0	0	0	54	54	15.8	9.9
-lumbar	0	0	0	27	27	17.4	4.9
-sacrum	0	0	0	4	4	2.7	0.7
-caudal	0	0	0	42	42	32.9	9.2
-indt. vert.	0	0	0	3	3	1.2	0.5
Rib:							
-head	0	0	8	0	8	1.8	1.5
-head/neck	0	0	21	0	21	10.3	3.8
-neck/tub.	0	0	5	0	5	1.2	0.9
-neck	0	0	4	0	4	0.9	0.7
-tuberosity	0	0	5	0	5	2.3	0.9
-neck/body	0	0	7	0	7	8.1	1.3
-body	0	0	104	0	104	36.1	19.0
-sternal	0	0	4	0	4	1.6	0.7
-rib ncmpt.	0	0	2	0	2	3.2	0.4
Sternum:							
-manub.	0	0	0	1	1	0.2	0.2
Total	76	106	215	149	546	458.7	100.7

Two of the maxilla specimens with socketed teeth are actually fused premaxilla and maxilla portions with socketed incisor fragments. A third maxilla specimen has a socketed right third molar. As mentioned previously, the two complete and one nearly complete mandible specimens have socketed teeth. The two complete mandibles, one right and one left, each have the following teeth: P4, M1, M2, and M3. The nearly complete right mandible has a partial incisor and complete M1, M2, and M3 teeth.

A minimum number of seven individuals are represented in the sample of beaver axial specimens. This estimate is based upon the two right nearly complete mandibles and five right mandibular symphysis specimens.

Twenty-one of the individual cheek teeth—seven fourth premolars, five first molars, three second molars, and six third molars—are immature. Although longitudinal folds extend the full length of these teeth, the root bases are not yet closed. According to van Nostrand and Stephenson (1964) the folds extend the full length of the tooth in beavers 1 to 2 years old. The basal opening of M1 is closed by 3 to 4 years of age , while small openings may remain at the bases of M2 and M3. At 4.5 to 5 years all of the basal openings of the molar teeth have closed.

Unfused, partially fused and immature cranial, vertebral, and rib specimens also indicate that juvenile beaver form part of the beaver faunal sample of Block 2. Fourteen cranial fragments—four frontals, two premaxillae, one maxilla, four zygomatics, and three parietals—are unfused and one temporal specimen is partially fused. Two cranial specimens, one zygomatic and one occipital condyle, are immature. Thirty unfused specimens are vertebral centra, while 17 are vertebral epiphyses. One caudal vertebral centrum and epiphysis are partially fused. One thoracic vertebral centrum is unfused and the bone has a porous, spongy texture and is, therefore, classified as immature. Twenty-two ribs—two heads, 14 head and neck specimens, one neck, three neck and body specimens, one sternal portion, and one nearly complete rib—are unfused.

A total of 465 appendicular specimens weighing 651.7 g comprise 46% of the beaver fauna found in Block 2 (Table 7.29). Forelimb specimens (N=193) and hindlimb specimens (N=194) are equally represented in the sample. Phalanges (N=107), metapodials (N=2), and an indeterminate long bone articular end make up the remainder of the appendicular assemblage. The sample includes 52 complete and 22 nearly complete appendicular specimens. Most of the complete elements are phalanges (19 third phalanges, eight second phalanges, two first phalanges), followed by tarsals (N=13), carpals (N=7), and metacarpals (N=3). The nearly complete elements include eight tarsals, five third phalanges, one second phalanx, three metacarpals, two carpals, one innominate, one femur, and one ulna.

Table 7.29 Block 2 - Beaver Appendicular NISP

Element	Left	Right	Indt.	Total	Weight (g)	NISP%
Clavicle	5	1	0	8	3.2	1.7
Scapula	11	5	1	17	18.8	3.7
Humerus	27	23	4	54	99.7	11.7
Radius	12	14	2	28	19.3	6.1
Ulna	14	14	0	28	53.6	6.1
Cuneiform	0	1	0	1	0.1	0.2
Unciform	1	1	0	2	0.4	0.4
Accessory	3	2	0	5	0.7	1.1
Scapholun.	0	3	0	3	0.5	0.6
1st metac.	2	2	0	4	0.4	0.9
2nd metac.	2	2	0	4	0.8	0.9
3rd metac.	1	3	0	4	0.8	0.9
4th metac.	1	1	0	2	0.3	0.4
5th metac.	0	1	0	1	0.3	0.2
Indt. metac.	0	0	2	2	0.2	0.4
Innominate	6	17	2	23	91.0	5.0
Femur	13	16	4	33	142.7	7.1
Patella	3	0	0	3	2.1	0.6
Tibia	13	24	0	37	128.2	8.0
Fibula	10	18	1	29	18.2	6.3
Calcaneus	1	2	0	3	2.8	0.6
Astragalus	2	3	0	5	8.3	1.1
Navicular	4	5	0	9	4.2	1.9
Cuboid	1	3	0	4	1.3	0.9
Ext. cunei.	0	3	0	3	0.6	0.6
Med. cune.	0	3	0	3	0.9	0.6
Int. cunei.	5	6	0	11	3.8	2.4
1st metat.	1	0	0	1	0.2	0.2
2nd metat.	2	4	0	6	2.3	1.3
3rd metat.	1	9	0	10	7.9	2.2
4th metat.	1	3	0	4	5.0	0.9
5th metat.	2	4	0	6	3.6	1.3
Indt. metat.	0	0	2	2	0.7	0.4
Metapodial	0	0	2	2	0.3	0.4
Indt. art.	0	0	1	1	0.3	0.2
1st phal.	0	0	43	43	14.7	9.3
2nd phal.	0	0	32	32	6.7	6.9
3rd phal.	0	0	30	30	6.9	6.5
Indt. phal.	0	0	2	2	0.2	0.4
Total	144	193	128	465	652.0	100.4

The assemblage of beaver remains associated with Block 2 represents a minimum of 14 individuals. This MNI estimate is based on the recovery of 14 right tibia shafts. The NISP, MNE, MNI, and MAU values are presented in Table 7.30.

Table 7.30 Block 2 - Beaver NISP/MNE/MNI/MAU

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
Skull:						
-zygomatic	13	6	2	4	4	3.0
-other	6	4	2	4	4	2.0
Mandible:						
-coronoid	2	2	1	1	1	1.0
-condyle	6	6	3	3	3	3.0
-asc. ramus	4	1	0	1	1	0.5
-hor. ramus	3	2	1	1	1	1.0
-diastema	2	2	2	0	2	1.0
-man. sym.	15	8	3	5	5	4.0
-cmpt. man.	3	3	1	2	2	1.5
Clavicle	6	4	3	1	3	2.0
Scapula:						
-glenoid	7	7	5	2	5	3.5
-other	4	4	1	3	3	2.0
Humerus:						
-proximal	13	7	4	3	4	3.5
-shaft	20	11	4	7	7	5.5
-distal	17	16	8	8	8	8.0
-n. compt. h.	1	1	1	0	1	0.5
Radius:						
-proximal	3	3	1	2	2	1.5
-shaft	18	6	3	3	3	3.0
-distal	7	7	4	3	4	3.5
Ulna:						
-proximal	15	12	7	5	6	6.0
-shaft	8	2	1	1	1	1.0
-distal	4	4	1	3	3	2.0
-cmpt. ulna	1	1	0	1	1	0.5
Carpals:						
-cuneiform	1	1	0	1	1	0.5
-unciform	2	1	1	0	1	0.5
-accessory	5	5	3	2	3	2.5
-scapholun.	3	2	0	2	2	1.0
1st meta.	4	2	2	1	2	1.0
2nd metac.	4	3	1	2	2	1.5
3rd metac.	4	4	1	3	3	2.0
4th metac.	2	2	1	1	1	1.0
5th metac.	1	1	0	1	1	0.5
Innominate:						
-acetabul.	11	6	0	6	6	3.0
-other	6	3	2	1	2	1.5
-cmpt. inn.	1	1	1	0	1	0.5
Femur:						
-proximal	8	4	2	4	4	2.0
-shaft	9	7	4	3	4	3.5
-distal	10	4	2	2	2	2.0
-cmpt. fem.	1	1	0	1	1	0.5
Patella	3	3	3	0	3	1.5

Table 7.30 (Continued)

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
Tibia:						
-proximal	4	3	1	2	2	1.5
-shaft	24	17	3	14	14	8.5
-distal	9	5	5	3	3	2.5
Fibula:						
-proximal	3	3	1	2	2	1.5
-shaft	20	10	3	7	7	5.0
-distal	6	6	3	3	3	3.0
Tarsals:						
-calcaneus	3	2	1	1	1	1.0
-astragalus	5	5	2	3	3	2.5
-int. cunei.	11	11	5	6	6	5.5
-med. cunei	3	3	0	3	3	1.5
-ext. cunei.	3	2	1	2	2	1.0
-cuboid	4	3	1	2	2	1.5
-navicular	9	7	3	4	4	3.5
1st metat.	1	1	1	0	1	0.5
2nd metat.	6	3	1	2	2	1.5
3rd metat.	10	5	1	4	4	2.5
4th metat.	4	3	1	3	3	1.5
5th metat.	6	4	1	3	3	2.0
1st phal.	43	20	-	-	1	1.0
2nd phal.	32	28	-	-	1	1.4
3rd phal.	30	30	-	-	1	1.5

The sample of beaver remains also includes sub-adult or juvenile appendicular specimens (Table 7.31). Thirty-six percent of the remains or 166 appendicular

Table 7.31 Block 2 - Juvenile Beaver Appendicular Specimens

Specimen	Partially Fused		Unfused		Unfused Epip.		Immature	
	Freq.	Weight	Freq.	Weight	Freq.	Weight	Freq.	Weight
Clavicle	0	0.0	1	0.5	0	0.0	0	0.0
Humerus	1	0.1	5	2.9	11	6.6	1	0.4
Radius	0	0.0	1	1.9	6	1.7	0	0.0
Ulna	0	0.0	2	7.3	4	0.9	0	0.0
Metacarpal	0	0.0	6	0.3	0	0.0	0	0.0
Innominate	0	0.0	2	5.2	0	0.0	2	1.8
Femur	1	0.4	7	96.1	14	14.3	0	0.0
Tibia	0	0.0	6	34.1	11	11.7	0	0.0
Fibula	0	0.0	8	8.2	7	3.1	0	0.0
Metatarsal	0	0.0	5	7.0	7	1.4	1	0.3
Tarsals	0	0.0	1	1.7	0	0.0	2	1.2
Metapodial	0	0.0	1	0.1	1	0.2	0	0.0
Indt. art.	0	0.0	0	0.0	1	0.3	0	0.0
1 st phal.	1	0.6	19	8.3	11	1.6	0	0.0
2nd phal.	0	0.0	18	3.7	2	0.1	0	0.0
Total	3	1.1	82	177.3	75	57.2	6	3.7

*Weight is in grams.

specimens are partially fused, unfused, or immature. The majority of unfused specimens are first and second phalanges, 19 and 18 items respectively. Most of the unfused epiphyses are from femora, tibiae, humeri, and first phalanges.

Ten of the unfused humerus epiphyses are humerus heads while the remaining one is a major trochanter. All of the unfused radial epiphyses are distal carpal articular facets. Unfused ulnar epiphyses are distal styloid processes. Six of the unfused femoral epiphyses are femoral heads, while the remaining femoral epiphyses are either major trochanters, lateral condyles or medial condyles. Seven of the tibia epiphyses are distal epiphyses and four are proximal epiphyses. Fibula epiphyses include six distal epiphyses and one proximal epiphysis.

Humerus specimens exhibit four patterns of fragmentation. The most common pattern is to break the shaft between the head and above the deltoid crest, as well as at the distal end of the shaft above the wide, flaring lateral epicondyle. The second manner in which humeri are broken consists of a fracture either just above the deltoid crest or through the deltoid crest. Several shaft portions consisting of short segments extending from immediately below the deltoid crest to above the lateral epicondyle were also found. Two humerus specimens consisting of the distal portion of the shaft, the lateral and medial epicondyles, and condyles were also found. The only proximal humerus portions that were recovered were neck fragments, unfused major tuberosities, and unfused heads.

Radii are broken at various positions along the shaft with no apparent consistency. Ulna specimens are generally broken close to the distal end of the shaft. There are three specimens which are broken through the semi-lunar notch and through the shaft distal to the trochlea. There are also 10 specimens that consist of shaft segments from various positions below the trochlea and above the styloid process.

The innominate is highly fragmented, especially the ischium, ilium, and pubis portions. However, eight specimens consisting of the acetabulum and segments of the ischium and ilium were found. These items are fractured on the ilium just before the sacrum articular surface, on the branch of the ischium before it flares, and on the narrow pubis shaft.

Fragmentation of the femur appears to be somewhat variable. Nine specimens consist of small shaft segments, generally from below the minor or lesser trochanter and between the third trochanter and the distal end of the shaft. Two specimens consist of complete shafts, fractured through the neck and major trochanter and at the distal end just above the condyles. One specimen is fractured at the distal end of the shaft and consists of a nearly complete shaft and proximal end. Six fused medial and lateral condyle specimens were also found. Sixteen of proximal specimens are unfused heads and major trochanters.

The majority of tibia specimens consist of shaft segments broken towards the distal end of the tibial crest and at the distal end of the shaft. Most of the proximal or distal tibia specimens are unfused epiphyses. Fibulae are fractured randomly at various points along the shaft. Consistent with the other long bone specimens, the majority of proximal and distal fibula specimens are unfused epiphyses.

7.4.18 Family Cricetidae, *Ondatra zibethicus* [Muskrat]

A large number of the rodent remains recovered from Block 2 are muskrat, 23 specimens or 2% of the rodent fauna. The majority of muskrat remains (N=18) are axial specimens (Table 7.32) They include cranial fragments (N=5), mandible fragments (N=3), individual teeth (N=2), ribs (N=3), and vertebrae (N=5). One caudal vertebra is complete. Two of the other caudal vertebrae, the lumbar vertebra, one rib, and the left mandible are nearly complete elements. The epiphyses of the lumbar vertebra and two of the caudal vertebrae are unfused.

The maxilla specimens with socketed teeth consist of a small right maxilla portion with a socketed M3 and a fused right and left maxillae with palatines and right M1, M2, and M3 teeth. The two mandibles with socketed teeth both have a complete complement: I1, M1, M2, and M3. The recovery of two upper right M3 teeth indicates that a minimum of two individuals are represented in the sample of muskrat remains.

Table 7.32 Block 2 - Muskrat Axial NISP

Element	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Skull:							
-temporal	1	0	0	0	1	0.2	5.6
-zygomatic	0	1	0	0	1	0.1	5.6
-maxilla/th.	0	1	0	1	2	1.2	11.1
-occip. con.	0	1	0	0	1	0.1	5.6
-upper I	0	1	1	0	2	0.3	11.1
Mandible:							
-mand. con.	1	0	0	0	1	0.3	5.6
-mand./th.	1	1	0	0	2	3.2	11.1
Vertebrae:							
-lumbar	0	0	0	1	1	0.2	5.6
-caudal	0	0	0	4	4	0.6	22.2
Rib:							
-neck/body	0	0	1	0	1	0.1	5.6
-body	0	0	1	0	1	0.1	5.6
-rib ncmpt.	0	0	1	0	1	0.1	5.6
Total	3	5	4	6	18	6.5	100.3

All of the muskrat appendicular elements are fragmented. Most of the specimens are from the forelimb; however, one hindlimb specimen is also represented in the sample. A summary of the identified appendicular specimens is presented in Table 7.33.

Table 7.33 Block 2 - Muskrat Appendicular NISP

Element	Left	Right	Indt.	Total	Weight (g)	NISP%
Radius:						
-proximal	0	1	0	1	0.1	20.0
-shaft	1	1	0	2	0.3	40.0
Ulna:						
-proximal	0	1	0	1	0.4	20.0
Tibia:						
-distal	0	1	0	1	0.2	20.0
Total	1	4	0	5	1.0	100.0

The ulna is fractured at the distal end of the shaft. The proximal radius specimen is fractured at the proximal end of the shaft and the three radius shaft specimens are from near the mid-shaft region. The distal tibia is broken at the distal end of the shaft.

7.4.19 Family Sciuridae, *Tamiasciurus hudsonicus* [Red Squirrel]

Three red squirrel appendicular specimens weighing 0.4 g were recovered from Block 2. These include a left humerus proximal shaft fragment, a nearly complete left ulna, and a nearly complete left tibia.

7.4.20 Family Sciuridae, *Spermophilus* sp. [Ground Squirrel]

The third largest group of identified rodent fauna associated with Block 2 is ground squirrel (N=21, 2%). Six of the specimens are from the axial portion of the skeleton: one cranial element, one individual tooth, three vertebrae, and one rib (Table 7.34). Complete elements include the two vertebrae (the atlas and axis) and the upper incisor.

Table 7.34 Block 2 - Ground Squirrel Axial NISP

Element	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Skull:							
-petrous	0	1	0	0	1	0.1	16.7
-upper I	1	0	0	0	1	0.1	16.7
Vertebrae:							
-atlas	0	0	0	1	1	0.1	16.7
-axis	0	0	0	1	1	0.1	16.7
-lumbar	0	0	0	1	1	0.1	16.7
Rib:							
-body	0	0	1	0	1	0.1	16.7
Total	1	1	1	3	6	0.6	100.2

Twelve of the ground squirrel appendicular specimens are from the hindlimb region of the skeleton, while the remaining three specimens are phalanges (Table 7.35). Eight of the appendicular specimens are complete elements and two are nearly complete.

Table 7.35 Block 2 - Ground Squirrel Appendicular NISP

Element	Left	Right	Indt.	Total	Weight (g)	NISP%
Femur:						
-near cmpt.	1	1	0	2	0.4	13.3
Tibia:						
-distal	2		0	2	0.2	13.3
-near cmpt.	0	1	0	1	0.2	6.7
-complete	0	1	0	1	0.2	6.7
Fibula:						
-shaft	1	0	0	1	0.1	6.7
1st metat.	1	0	0	1	0.1	6.7
2nd metat.	1	0	0	1	0.1	6.7
3rd metat.	1	0	0	1	0.1	6.7
4th metat.	1	0	0	1	0.1	6.7
5th metat.	1	0	0	1	0.1	6.7
1st phal.	0	0	3	3	0.1	20.0
Total	9	3	3	15	1.7	100.2

The metatarsal elements were found together in the southeast quadrant of unit 190S 62E and they form an articular unit. One of the distal tibia specimens, the fibula, and the three phalanges were also found in this quadrant. It is possible that they are also part of the articular unit, representing a single left hindlimb.

7.4.21 Family Sciuridae, *Spermophilus richardsonii.* [Richardson's Ground Squirrel]

Three mandibles, one left and two right, with socketed teeth are identified as Richardson's ground squirrel. The left mandible has two teeth; I1 and M3. One right mandible has a complete set of teeth: I1, P4, M1, M2, and M3. The second right mandible has only one tooth, M3. Based on the recovery of the two right mandibles, a minimum of two individuals are represented in the sample.

7.4.22 Family Geomyidae, *Thomomys talpoides* [Northern Pocket Gopher]

Twelve specimens from Block 2, weighing a total of 0.7 g, are northern pocket gopher remains. Within this small sample there are eight axial specimens and four appendicular specimens. They represent a minimum of one individual. The axial specimens are all individual teeth—three incisors, one premolar or molar, and four molars.

The northern pocket gopher appendicular specimens are right and left innominates and right and left femora. The innominate specimens are nearly complete and the femora consist of complete proximal portions.

7.4.23 Family Sciuridae, *Eutamias minimus* [Least Chipmunk]

The least chipmunk is represented in the faunal assemblage associated with Block 2 by 10 specimens weighing a total of 0.6 g. Four of the items are axial specimens and six are appendicular specimens. The axial specimens consist of: two upper left incisors, one lower right incisor, and a right mandible. The mandible is nearly complete and has three socketed teeth: I1, P4, and M1.

All six appendicular specimens are from the hindlimb region of the skeleton (Table 7.36). Four of the specimens are complete elements and the remaining two are nearly complete elements. The recovery of two complete right tibiae indicates that a minimum of two individuals are represented in the sample.

Table 7.36 Block 2 - Least Chipmunk Appendicular NISP

Element	Left	Right	Indt.	Total	Weight (g)	NISP%
Femur:						
-complete	1	1	0	2	0.2	33.3
Tibia:						
-near cmpt.	1	0	0	1	0.1	16.7
-complete	0	2	0	2	0.2	33.3
Innominate:						
-near cmpt.	1	0	0	1	0.1	16.7
Total	3	3	0	6	0.6	100.0

7.4.24 Family Cricetidae, *Peromyscus maniculatus* [Deer Mouse]

The deer mouse is represented in the faunal assemblage associated with Block 2 by three specimens weighing 0.3 g. The specimens consist of the anterior portion of the cranium with upper right and left incisors, a left maxilla fragment with a M1 tooth, and the posterior portion of a left mandible.

7.4.25 Family Cricetidae, *Microtus pennsylvanicus* [Meadow Vole]

Two meadow vole specimens, one right mandible and one left mandible, weighing a total of 0.4 g were found in Block 2. The right mandible has the following socketed teeth: I1, M1, M2, and M3. The left mandible has I1, M1, and M2 socketed teeth.

7.5 Class Aves

Four percent (346 specimens) of the identifiable faunal assemblage associated with Block 2 are bird remains. Several of the bird bones are highly fragmented making family, subfamily, genus, and species identifications extremely difficult. Also, several species of a single subfamily commonly occupy the same range and the skeletal elements of these species are often indistinguishable. Eighty bird bones or 25% of the avian fauna cannot be identified to a taxonomic level other than order. They are classified as unidentified bird specimens and are sub-divided into general size categories—small bird, medium bird, and large bird. The remaining 246 specimens or 75% of the sample can be identified to the level of family or lower.

Only one specimen, a right humerus shaft fragment, is classified as small bird. In terms of length, the shaft fragment falls in the 13-25 mm size range and it weighs 0.1 g.

A total of 53 medium bird specimens weighing 6.6 g were identified in the avian faunal sample from Block 2. Only one axial specimen, a sternum coracoid facet fragment, is represented in the sample. The sternum coracoid facet fragment is quite small (6-13 mm) and does not possess distinctive landmarks that would allow a positive species identification. This specimen is porous in texture and is therefore classified as immature.

The remaining 52 medium bird items are appendicular specimens (Table 7.37). Over half of them, N=33 or 63%, are indeterminate long bone shaft fragments. One of the appendicular specimens is an ischium fragment of the innominate and the remaining specimens are from the wing (N=13) and leg regions of the skeleton (N=5). All of these specimens are highly comminuted; even the phalanx is fragmented.

Table 7.37 Block 2 - Medium Bird Appendicular NISP

Element	Left	Right	Indt.	Total	Weight (g)	NISP%
Coracoid:						
-proximal	0	1	0	1	0.1	1.9
-shaft	1	0	0	1	0.1	1.9
-distal	1	0	0	1	0.1	1.9
Humerus:						
-shaft	2	0	0	2	0.7	3.8
-distal	0	0	1	1	0.2	1.9
Radius:						
-shaft	0	0	1	1	0.1	1.9
Ulna:						
-shaft	2	0	3	5	0.9	9.6
-distal	0	1	0	1	0.2	1.9

Table 7.37 (Continued)

Element	Left	Right	Indt.	Total	Weight (g)	NISP%
Innominate:						
-ischium	0	0	1	1	0.1	1.9
Femur:						
-shaft	0	0	2	2	0.2	3.8
Tibiotarsus:						
-shaft	1	0	1	2	0.4	3.8
Indt. phal.	0	0	1	1	0.1	1.9
Long bone:						
-shaft	0	0	33	33	3.4	63.5
Total	7	2	43	52	6.6	99.7

The porous appearance of the cortical bone indicates that one of the coracoid specimens is immature. It was found in the same quadrant and unit (the northeast quadrant of unit 190S 62E) as the immature sternum coracoid facet fragment. It is possible that these two elements articulate and are from the same individual.

Twenty-six of the unidentified bird bones, weighing 12.1 g, are large bird remains. Two of the specimens are sternum fragments, the remaining large bird items are from the appendicular region of the skeleton. The appendicular specimens include innominate fragments (N=4), indeterminate long bone shaft fragments (N=4), wing specimens (N=3), and leg specimens (N=14) (Table 7.38).

Table 7.38 Block 2 - Large Bird Appendicular NISP

Element	Left	Right	Indt.	Total	Weight (g)	NISP%
Humerus:						
-shaft	0	0	1	1	1.6	4.2
Ulna:						
-shaft	0	0	1	1	0.5	4.2
Innominate:						
-acetabul.	1	0	0	1	0.1	4.2
-ilium	0	0	2	2	0.5	8.3
Tibiotarsus:						
-distal	0	0	2	2	0.3	8.3
-shaft	0	0	1	1	0.3	4.2
Fibula:						
-shaft	0	0	1	1	0.1	4.2
Tarsometatarsus:						
-shaft	0	1	9	10	5.7	41.7
Long bone:						
-shaft	0	0	4	4	2.7	16.7
2nd digit:						
-2nd phal.	0	1	0	1	0.1	4.2
Total	1	2	21	24	11.9	100.2

7.5.1 Order Anseriformes, Family Anatidae [Swans, Geese, and Ducks]

Waterfowl remains (N=48) make up 15% of the avian sample associated with Block 2. Most of these are identifiable to the subfamily level; however, four specimens weighing a total of 0.7 g, can only be classified as unidentified waterfowl. As was the case with the unidentified bird categories, the unidentified waterfowl sub-divisions are based on specimen size. The four unidentified waterfowl specimens include two medium waterfowl specimens and two large waterfowl specimens. The medium waterfowl items are wing specimens: a radius shaft fragment and the proximal end of a left ulna. The large waterfowl items are also appendicular specimens. They consist of a distal condyle fragment of a right humerus and the lateral condyle of a left femur.

7.5.2 Order Anseriformes, Tribe Cygnini, *Cygnus* sp. [Swan]

A small percentage (25% or N=12), of the waterfowl remains from Block 2 are swan specimens. All twelve specimens are from the appendicular region of the bird skeleton (Table 7.39). Most of the specimens are from the wing (N=9) and the remaining specimens are from the lower leg (N=3). The only complete element is a first phalanx of the foot.

Table 7.39 Block 2 - Swan Appendicular NISP

Element	Left	Right	Indt.	Total	Weight (g)	NISP%
Coracoid	1	0	0	1	2.5	8.3
Humerus	2	4	0	6	10.5	50.0
Radius	1	0	0	1	0.9	8.3
Ulna	0	1	0	1	0.8	8.3
Tibiotarsus	0	2	0	2	11.9	16.7
1st phal.	0	0	1	1	0.4	8.3
Total	4	7	1	12	27.0	99.9

Assuming that the sample of swan remains are from a single species, a minimum of two individuals are represented. The MNI is based upon the recovery of two right humerus deltoid crest portions. The two right distal humerus specimens were refitted in the laboratory to form a complete distal portion. The tibiotarsus shaft fragments were also refitted in the laboratory and they represent a single element. The swan NISP, MNE, MNI, and MAU counts are listed in Table 7.40.

Table 7.40 Block 2 - Swan NISP/MNE/MNI/MAU

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
Coracoid:						
-proximal	1	1	1	0	1	0.5
Humerus:						
-delt. crest	2	2	0	2	2	1.0
-distal	4	2	1	1	2	1.0
Radius:						
-distal	1	1	1	0	1	0.5
Ulna:						
-distal	1	1	0	1	1	0.5
Tibiotarsus:						
-shaft	2	1	0	2	1	0.5
Foot:						
-1st phal.	1	1	-	-	1	0.1

7.5.3 Order Anseriformes, Family Anatidae, Tribe Anserini [Geese]

Geese are represented in the faunal material from Block 2 by nine specimens weighing 5.6 g. All of the geese specimens are from the appendicular region of the skeleton (Table 7.41). The majority of appendicular items are wing specimens (N=6). One appendicular specimen is a pubis fragment of the innominate and the remaining two specimens are from the leg region. All of the specimens except one, the phalanx, are fragmented. The phalanx is nearly complete, missing only a portion of the distal end.

Table 7.41 Block 2 - Geese Appendicular NISP

Element	Left	Right	Indt.	Total	Weight (g)	NISP%
Scapula:						
-blade	0	1	0	1	0.2	11.1
Radius:						
-shaft	3	2	0	5	3.8	55.6
Innominate:						
-pubis	0	0	1	1	0.1	11.1
Tibiotarsus:						
-shaft	1	0	0	1	1.2	11.1
Foot:						
-1st phal.	0	0	1	1	0.3	11.1
Total	4	3	2	9	5.6	100.0

The sample of geese remains represents a minimum of one individual (if only one species is represented). Even though there are five radius shaft fragments they do not overlap and represent a MNE of two. The remaining specimens represent a total MNE of four. For most of the specimens the NISP value equals the MNE and MNI values; therefore, a separate table of NISP, MNE, MNI, and MAU values will not be presented.

7.5.4 Order Anseriformes, Family Anatidae [Ducks]

Five avian specimens, weighing 1.5 g, can only be given the general taxonomic classification of duck. The duck specimens identified in the avian faunal sample from Block 2 consist of one axial specimen and four appendicular specimens.

The axial specimen is a right mandible fragment. Two of the appendicular specimens are from the wing region of the skeleton and two are from the leg region. The wing specimens are a left radius shaft fragment and a left ulna shaft fragment. The leg specimens are the distal condyle of a left femur and a left tibiotarsus distal end fragment.

7.5.5 Order Anseriformes, Family Anatidae, Tribe Anatini, *Anas* sp. [Teal]

Teal are represented in the avian fauna associated with Block 2 by two specimens, the shaft and distal end of a right ulna and a right tibiotarsus shaft fragment. These items cannot be identified as to species.

7.5.6 Order Anseriformes, Family Anatidae, *Anas platyrhynchos* [Mallard]

Mallard, are represented in the avian faunal sample associated with Block 2 by 16 specimens weighing 3.3 g. A minimum of two individuals are present in the sample based on the maturity of the specimens. Four of the mallard items are from the axial region of the skeleton and 12 are from the appendicular region. The axial specimens include two right mandible fragments and two sternum rib facet fragments (one left and one indeterminate in siding). Even though both mandible specimens are from the right side they represent a MNE of one.

The 12 appendicular specimens include four wing specimens and eight specimens from the leg (Table 7.42). The carpal and four of the phalanges are complete elements. The remaining two phalanges are nearly complete elements.

Table 7.42 Block 2 - Mallard Appendicular NISP

Element	Left	Right	Indt.	Total	Weight (g)	NISP%
Humerus:						
-distal	0	1	0	1	0.3	8.3
Carpometacarpus:						
-distal	1	0	0	1	0.2	8.3
Carpal:						
-scapholun.	0	1	0	1	0.1	8.3
Tibotarsus:						
-shaft	1	0	0	1	0.3	8.3
Tarsometatarsus:						
-distal	1	0	0	1	0.4	8.3

Table 7.42 (Continued)

Element	Left	Right	Indt.	Total	Weight (g)	NISP%
2nd digit:						
-1st phal.	1	0	0	1	0.2	8.3
Foot:						
-1st phal.	1	0	0	1	0.2	8.3
-2nd phal.	3	0	0	3	0.3	25.0
-indt. phal.	0	0	2	2	0.2	16.7
Total	8	2	2	12	2.2	99.8

Seven of the appendicular specimens are classified as immature including the distal tibiotarsus and all of the phalanges of the foot. All seven items were recovered from the northeast quadrant of unit 177S 66E. It is likely that these specimens are from a single individual.

7.5.7 Order Galliformes, Family Phasianidae, Subfamily Tetraoninae, [Grouse]

In terms of identified specimens, grouse is the largest avian taxon represented in Block 2, 173 specimens or 53% of the avian faunal sample. Only 5% of the specimens (N=9) are from the axial region of the skeleton. The axial specimens include two premaxilla specimens, two furculum fragments, two sternum fragments, one thoracic vertebra, and two synsacrum fragments. The sternum fragments are portions of the coracoid facet fragment and the keel. If the premaxillae and furculum specimens are from the same species then a minimum of two individuals are represented.

The majority of the 164 grouse appendicular specimens are from the wing portion of the skeleton (N=121). The remaining specimens are from the innominate (N=3) and leg region (N=40). A summary of the identified grouse appendicular specimens is given in Table 7.43. Most of the complete or nearly complete elements are either carpometacarpi or smaller elements such as carpals and phalanges. There are 24 complete elements consisting of five carpometacarpi, four carpals, two pollicies, and 13 phalanges. There are 13 nearly complete elements including one radius, one ulna, two carpometacarpi, five carpals, and three phalanges.

One of the humerus specimens, a shaft portion, is immature.

If all of the grouse specimens are from the same species this sample represents a minimum of seven individuals. The MNI estimate is based upon the recovery of five complete or nearly complete right carpometacarpus elements and two right carpometacarpus shaft portions, as well as seven left tibiotarsus shaft portions.

Table 7.43 Block 2 - Grouse Appendicular NISP

Element	Left	Right	Indt.	Total	Weight (g)	NISP%
Coracoid	3	7	0	10	2.4	6.1
Scapula	1	5	0	6	1.0	3.7
Humerus	8	9	1	18	4.8	11.0
Radius	5	13	4	22	3.9	13.4
Ulna	7	16	3	26	7.2	15.8
Carpometa.	6	11	0	17	4.6	10.4
Scapholun.	1	4	0	5	0.5	3.0
Cuneiform	1	3	0	4	0.4	2.4
Pollex	0	2	0	2	0.1	1.2
Innominate	2	1	0	3	0.5	1.8
Femur	4	2	4	10	2.3	6.1
Tibiotarsus	10	4	0	14	5.7	8.5
2nd digit:						
-1st phal.	3	7	0	10	1.0	6.1
-2nd phal.	0	3	0	3	0.3	1.8
-3rd phal.	0	2	1	3	0.3	1.8
Foot:						
-1st phal.	0	0	3	3	0.3	1.8
-2nd phal.	0	0	2	2	0.2	1.2
-3rd phal.	0	0	2	2	0.2	1.2
-indt. phal.	0	0	4	4	0.4	2.4
Total	51	89	24	164	36.1	99.7

The NISP, MNE, MNI, and MAU estimates (based on the assumption that only one grouse species is represented) are presented in Table 7.44.

Table 7.44 Block 2 - Grouse NISP/MNE/MNI/MAU

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
Skull:						
-premaxilla	2	2	-	-	2	2.0
Sternum:						
-keel	1	1	-	-	1	1.0
-cora. facet	1	1	-	-	1	1.0
Furculum	2	2	-	-	2	2.0
Coracoid:						
-proximal	3	3	0	3	3	1.5
-shaft	4	4	2	2	2	2.0
-distal	3	3	2	1	2	1.5
Scapula:						
-glenoid	3	3	1	2	2	1.5
-blade	3	2	0	2	2	1.0
Humerus:						
-proximal	5	3	1	2	2	1.5
-shaft	8	6	4	2	4	3.0
-distal	5	4	2	2	2	2.0
Radius:						
-proximal	3	3	1	2	2	1.5
-shaft	14	9	4	5	5	4.5
-distal	4	4	0	4	4	2.0

Table 7.44 (Continued)

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
-near cmpt.	1	1	1	0	1	0.5
Ulna:						
-proximal	1	1	0	1	1	0.5
-shaft	16	10	4	6	6	5.0
-distal	8	8	3	5	5	4.0
-near cmpt.	1	1	0	1	1	0.5
Carpometacarpus:						
-proximal	3	3	0	3	3	1.5
-shaft	4	4	3	1	3	2.0
-distal	4	4	2	2	2	2.0
-complete	6	6	1	5	5	3.0
Carpals:						
-scapholun.	5	5	2	3	3	2.5
-cuneiform	6	6	1	5	5	3.0
Pollex	2	2	0	2	2	2.0
Innominate:						
-acetabul.	3	3	2	1	2	1.5
Femur:						
-shaft	9	5	4	1	4	2.5
-distal	1	1	0	1	1	0.5
Tarsometatarsus:						
-shaft	11	9	7	2	7	4.5
-distal	3	3	2	1	2	1.5
2nd digit:						
-1st phal.	10	10	2	8	4	5.0
-2nd phal.	2	2	0	2	1	1.0
-3rd phal.	2	2	0	2	1	1.0
Foot:						
-1st phal.	3	3	-	-	1	0.4
-2nd phal	2	2	-	-	1	0.3
-3rd phal.	2	2	-	-	1	0.3

Medullary bone growth can be seen on the inner surface of the cortical bone of five of the grouse appendicular specimens. The specimens which have medullary bone include two radius specimens, two ulna specimens, and a tibiotarsus shaft fragment. The two ulna specimens represent a minimum of two female birds. On two of the specimens the medullary bone growth almost fills the entire cavity of the shaft. In all cases the medullary bone is quite obvious and can be seen without the aid of a microscope.

The two radius specimens and one ulna specimen were found in the southeast quadrant of unit 189S 62E. All of these specimens are from the right wing and it is possible that they are from a single individual. The tibiotarsus shaft fragment was found in the southwest quadrant of unit 188S 73E. The second ulna specimen was found in the southwest corner of Block 2 in the southeast quadrant of unit 190S 62E.

7.5.8 Order Galliformes, Family Gruiidae, *Grus* sp. [Crane]

The comparative collection at the University of Saskatchewan does not have a whooping crane skeleton. The specimens are also too incomplete to enable measurements to be taken for comparative purposes; therefore, these specimens cannot be identified as to species. Five percent or 17 specimens from the avian sample associated with Block 2 are crane remains. Only four of the specimens are from the axial region of the skeleton. The axial specimens consist of three thoracic vertebrae, one furculum, and one sternum rib facet fragment. One thoracic vertebra is complete and the other two are nearly complete. The furculum is also nearly complete.

The 12 crane appendicular specimens include six wing specimens, and six leg specimens (Table 7.45). All of the appendicular specimens are fragmented.

Table 7.45 Block 2 - Crane Appendicular NISP

Element	Left	Right	Indt.	Total	Weight (g)	NISP%
Coracoid	2	0	0	2	1.1	16.7
Scapula	2	0	0	2	0.9	16.7
Humerus	0	1	0	1	0.2	8.3
Ulna	0	1	0	1	0.2	8.3
Femur	3	0	0	3	6.1	25.0
Tibiotarsus	1	1	1	3	2.9	25.0
Total	8	2	1	12	11.4	100.0

Two of the femur specimens were refitted in the laboratory to form a nearly complete distal portion. If all of the crane appendicular specimens are from one species then the sample represents a minimum of one individual. Table 7.46 is an account of the appendicular specimen NISP, MNE, MNI, and MAU values.

Table 7.46 Block 2 - Crane NISP/MNE/MNI/MAU

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
Scapula:						
-glenoid	1	1	1	0	1	0.5
-blade	1	1	1	0	1	0.5
Coracoid:						
-proximal	1	1	1	0	1	0.5
-distal	1	1	1	0	1	0.5
Humerus:						
-distal	1	1	0	1	1	0.5
Ulna:						
-distal	1	1	1	0	1	0.5
Femur:						
-shaft	1	1	1	0	1	0.5
-distal	2	1	1	0	1	0.5
Tibiotarsus:						
-shaft	1	1	-	-	1	0.5
-distal	2	2	1	1	1	1.0

7.5.9 Order Strigiformes, [Owls]

Three owl specimens weighing 0.7 g were found in the avian faunal material from Block 2. The specimens include the proximal portion of a left ulna, a right ulna shaft, and the distal portion of a left tarsometatarsus.

7.5.10 Order Passeriformes [Perching Birds]

Five of the specimens, weighing a total of 0.5 g, from the avian sample of Block 2 are perching bird remains. Three of the specimens are from the wing and two are from the leg region of the skeleton (Table 7.47).

Table 7.47 Block 2 - Perching Bird Appendicular NISP

Element	Left	Right	Indt.	Total	Weight (g)	NISP%
Radius:						
-proximal	0	1	0	1	0.1	20.0
-shaft	0	0	1	1	0.1	20.0
Ulna:						
-shaft	0	1	0	1	0.1	20.0
Tibiotarsus:						
-shaft	1	0	0	1	0.2	20.0
Tarsometatarsus:						
-shaft	0	1	0	1	0.1	20.0
Total	1	3	1	5	0.6	100.0

7.6 Class Osteichtyes

Fish specimens (N=1186) represent a substantial portion (15%) of the identifiable fauna associated with Block 2. Seven species of fish are identified in the sample. However, a large number of the fish specimens (N=1056 or 89%) can not be identified to the level of species. The remaining 138 fish specimens are classified to the level of species.

The largest categories of unidentified fish specimens consists of rib fragments (N=440), followed by indeterminate cranial fragments (N=330). The analyst did not attempt to determine the species represented by the vertebrae (N=166) found in Block 2 and only complete scales were examined in order to determine species. This left 112 incomplete scales for which species was not determined. The sample of unidentified fish specimens also includes eight items which are identified to skeletal part but not species. They include one dentary fragment, one quadrate, two pterygiophore fragments, and two Weberian vertebral complex fragments.

7.6.1 Order Acipenseriformes, Family Acipenseridae *Acipenser fulvescens* [Lake Sturgeon]

Twenty-seven sturgeon scutes weighing a total of 7.6 g are present in the fish faunal sample from Block 2. Sturgeon specimens represent 20% of the identifiable fish remains found in this excavation block. All of the sturgeon scutes are highly fragmented.

7.6.2 Order Salmoniformes, Family Esocidae *Esox lucius* [Northern Pike]

Northern pike are represented in the sample of fish fauna by two specimens weighing 0.3 g. The two specimens are cranial bones, a sphenotic bone and a left subopercular.

7.6.3 Order Cypriniformes, Family Catostomidae *Catostomus catostomus* [Longnose Sucker]

Longnose suckers are represented in the fish fauna associated with Block 2 by 14 specimens weighing 3.7 g (10% of the identified fish remains). One of the identified specimens is a scale, the remaining specimens are from the cranium (Table 7.48). The scale and two of the cranial specimens; a left operculum and a right maxilla are complete elements.

Table 7.48 Block 2 - Longnose Sucker NISP

Element	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Scales	0	0	1	0	1	0.1	7.1
Dentary	0	1	0	0	1	0.1	7.1
Maxillary	3	2	0	0	5	1.0	35.7
Operculum	1	0	0	0	1	1.6	7.1
Supracleith.	2	4	0	0	6	1.0	42.9
Total	6	7	1	0	14	3.8	99.9

A minimum of four individuals are represented in the longnose sucker sample from Block 2. This count is base on the recovery of four right supracleithrum specimens. The longnose sucker NISP, MNE, MNI, and MAU values are summarized in Table 7.49 (the scale is not listed in this table).

Table 7.49 Block 2 - Longnose Sucker NISP/MNE/MNI/MAU

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
Dentary	1	1	0	1	1	0.5
Maxillary	5	5	3	2	3	2.5
Operculum	1	1	1	0	1	0.5
Supracleith.	6	6	2	4	4	3.0

7.6.4 Order Cypriniformes, Family Catostomidae *Catostomus commersoni* [White Sucker]

The largest group of identified specimens are white sucker remains, 50 specimens weighing 8.4 g. (36% of the identifiable fish remains associated with Block 2). Seven of the white sucker specimens are scales, the remaining 43 specimens are cranial bones. The scales are complete, one quadrate is also complete and six other cranial bones are nearly complete. The nearly complete specimens include three ceratohyals, two supracleithrums, and one quadrate. The identified white sucker specimens are listed in Table 7.50.

Table 7.50 Block 2 - White Sucker NISP

Element	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Scales	0	0	7	0	7	0.1	14.0
Dentary	6	6	0	0	12	2.6	24.0
Quadrate	1	1	0	0	2	0.2	4.0
Maxillary	4	3	0	0	7	1.2	14.0
Hyomand.	1	1	0	0	2	0.4	4.0
Ceratohyal	4	3	0	0	7	0.7	14.0
Parasphen.	0	0	0	1	1	1.2	2.0
Operculum	1	2	0	0	3	0.7	6.0
Supracleith.	3	4	0	0	7	1.3	14.0
Supraoccip.	0	0	0	1	1	0.1	2.0
Phary. arch	0	1	0	0	1	0.2	2.0
Total	20	21	7	2	40	8.7	100.0

A minimum number of six individuals are represented in the sample of white sucker fauna associated with Block 2. The MNI value is based on the recovery of six left and six right dentary specimens. Table 7.51 presents the white sucker NISP, MNE, MNI, and MAU values (scales are not listed in this table).

Table 7.51 Block 2 - White Sucker NISP/MNE/MNI/MAU

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
Dentary	12	12	6	6	6	6.0
Quadrate	2	2	1	1	1	1.0
Maxillary	7	7	4	3	4	3.5
Hyomand.	2	2	1	1	1	1.0
Ceratohyal	7	5	4	3	4	2.5
Parasphen.	1	1	0	0	1	1.0
Operculum	3	3	1	2	2	1.5
Supracleith.	7	5	3	4	4	2.5
Supraoccip.	1	1	-	-	1	1.0
Phary. arch	1	1	0	1	1	0.5

7.6.5 Order Cypriniformes, Family Catostomidae *Moxostoma anisurum* [Silver Redhorse]

Thirteen specimens, weighing 4.0 g, recovered from Block 2 are silver redhorse (Table 7.52). All of them are from the cranial region of the skeleton. Three specimens, two left subopercles and a left hyomandibular, are complete elements. The remaining specimens are fragments possessing key diagnostic features.

Table 7.52 Block 2 - Silver Redhorse NISP

Element	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Maxillary	2	2	0	0	4	0.9	30.8
Quadrate	1	2	0	0	3	0.3	23.1
Hyomand.	1	0	0	0	1	0.6	7.7
Operculum	1	1	0	0	2	1.5	15.4
Subopercu.	2	0	0	0	2	0.6	15.4
Supracleith.	0	1	0	0	1	0.2	7.7
Total	7	6	0	0	13	4.1	100.1

Every specimen in this sample contributes to the MNE count (which is to be expected with small samples). A minimum of two individuals are represented in the sample. The MNI estimate is based on the presence of two left and two right maxillary specimens. The NISP, MNE, MNI, and MAU values for the silver redhorse remains are presented in Table 7.53.

Table 7.53 Block 2 - Silver Redhorse NISP/MNE/MNI/MAU

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
Maxillary	4	4	2	2	2	2.0
Quadrate	2	2	0	2	2	1.0
Hyomand.	1	1	1	0	1	0.5
Operculum	2	2	2	0	2	1.0
Subopercu.	2	2	2	0	2	1.0
Supracleith.	1	1	0	1	1	0.5

7.6.6 Order Cypriniformes, Family Catostomidae *Moxostoma macrolepidotum* [Shorthead Redhorse]

A second species of *Moxostoma*, shorthead redhorse, is represented in the fish fauna from Block 2 by seven specimens weighing 2.8 g (5% of the identifiable fish fauna). All of the specimens are from the skull (Table 7.54). Three of the shorthead redhorse specimens are complete elements and two are nearly complete elements.

The two right suboperculum specimens indicate that there are a minimum of two individuals represented in the sample of shorthead redhorse remains. The suboperculum specimens represent a minimum of three elements. The total NISP values of the remaining shorthead redhorse remains are equal to the MNE values; therefore, a separate table of shorthead redhorse NISP, MNE, and MNI values will not be presented.

Table 7.54 Block 2 - Shorthead Redhorse NISP

Element	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Operculum	1	1	0	0	2	0.8	28.6
Subopercu.	1	2	0	0	3	1.4	42.9
Supracleith.	0	1	0	0	1	0.4	14.3
Postcleith.	0	1	0	0	1	0.2	14.3
Total	2	5	0	0	7	2.8	100.1

7.6.7 Order Perciformes, Family Percidae *Stizostedion vitreum* [Walleye]

Seventeen walleye specimens weighing a total of 3.1 g were recovered from Block 2 (12% of the identifiable fish faunal assemblage). The majority of the walleye specimens are from the cranial region of the fish skeleton. Two scales were also identified as walleye. The scales are complete and two of the cranial bones are nearly complete. The identified walleye specimens are listed in Table 7.55.

Table 7.55 Block 2 - Walleye NISP

Element	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Dentary	0	1	0	0	1	0.2	5.9
Premaxilla	0	1	0	0	1	0.3	5.9
Quadrate	0	1	0	0	1	0.1	5.9
Vomer	0	0	0	1	1	0.2	5.9
Frontal	1	0	0	0	1	0.4	5.9
Preoperc.	0	1	0	0	1	0.2	5.9
Ceratohyal	1	1	0	0	2	0.4	11.8
Cleithrum	1	0	0	0	1	0.3	5.9
Parasphen.	0	0	0	3	3	0.5	17.6
Basioccipit.	0	0	0	1	1	0.3	5.9
Branchiot.	0	0	2	0	2	0.2	11.8
Scales	0	0	2	0	2	0.1	11.8
Total	3	5	4	5	17	3.2	100.2

A minimum number of three individuals are represented in the walleye sample. This estimate is base on the three axial parasphenoid specimens. The branchiostegal specimens represent two elements. The MNE estimates for the remaining walleye specimens are essentially the same as the NISP values or can be determined by adding left and right NISP counts. Therefore, a separate table listing walleye NISP, MNE, MNI, and MAU values will not be presented.

7.7 Distribution and Diversity

An examination of the distribution and diversity of fauna contributes valuable information to the understanding of the site structure at Bushfield West. Based on the locations of features such as hearths and rock pits, and a visual examination of the distribution maps of the identified fauna, Block 2 is divided into 10 subsistence areas (Figure 7.1). The faunal distribution maps are presented in Appendix C. The feature locations and types are those identified by Gibson (1994: 39) during the excavation of the site. Using a cumulative concentration coefficient index Gibson (1994: 71) identified 42 activity areas within Block 2. Faunal remains are only one component of the assemblage considered by Gibson in his identification of activity areas; therefore, the areas discussed here are not nearly as complex. The locations, sizes, and associated features (where applicable) of the subsistence areas are presented in Table 7.56.

Table 7.56 Block 2 - Subsistence Activity Areas

Area	South	East	Size (m^2)	Features
2.1	183.00 - 192.00	59.00 - 65.00	54.0	hearth #1, hearth #2 rock pit #1
2.2	189.00 - 192.00	65.00 - 71.00	18.0	hearth #3
2.3	180.00 - 189.00	65.00 - 71.00	54.0	hearth #7, hearth #8 hearth #9, hearth # 11, rock pit #2
2.4	177.00 - 180.00	65.00 - 68.00	9.0	hearth #14
2.5	174.00 - 177.00	66.00 - 70.00	8.0	none
2.6	177.00 - 180.00	68.00 - 72.00	12.0	none
2.7	176.00 - 180.00	72.00 - 76.00	14.0	hearth #12, hearth #13
2.8	180.00 - 186.00	71.00 - 76.00	30.0	hearth #10
2.9	186.00 - 191.00	71.00 - 76.00	25.0	hearth #6
2.10	191.00 - 194.00	71.00 - 76.00	13.0	hearth #4, hearth #5

The most commonly identified taxa found in Block 2 are generally the same as those in Block 1. Two species recovered from Block 2, lynx and marten, were not found in Block 1; however, striped skunk and bear were not identified in the Block 2 assemblage. The identified species by NISP for each area of Block 2 are presented in Table 7.57.

The predominant feature of area 2.1, located on the west side of Block 2, is a cluster of two hearths and one rock pit. This grouping of features covers an area approximately 2 m x 3 m. The rock pit measured 50 cm in diameter and approximately 20 cm in depth. Grey ash surrounded both hearths and the rock pit. Gibson (1994: 101) suggests that these features are relatively contemporaneous. An examination of the vertebrate fauna by %NISP shows that large ungulates dominate the faunal material recovered from this area (77%), followed by beaver (11%), and fish (10%). The

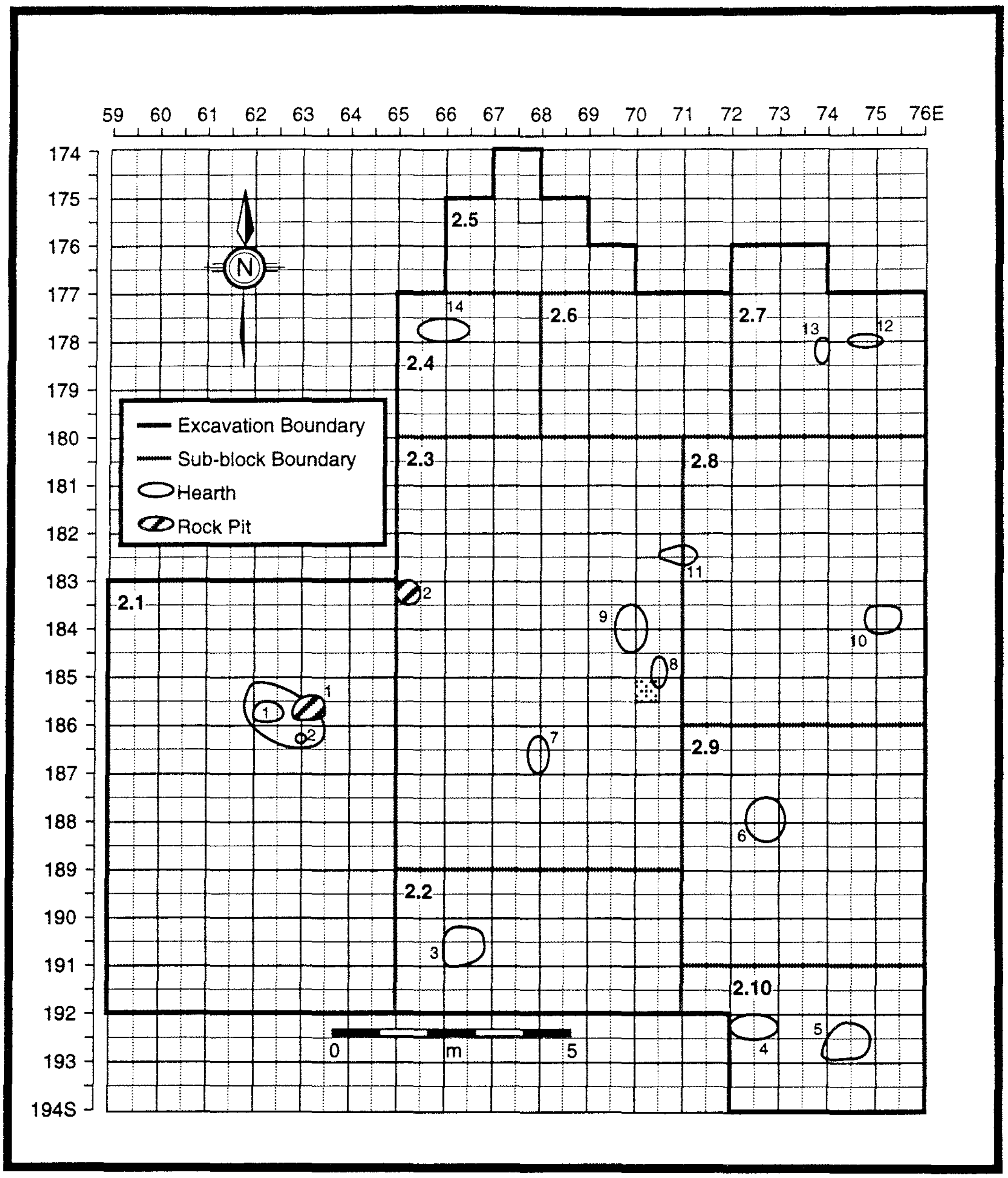


Figure 7.1 Block 2 – Subsistence Activity Areas

Table 7.57 Block 2 - Identified Fauna by NISP from Subsistence Activity Areas

Species	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	2.10
Ung., unid.	2354	213	1141	114	97	383	104	336	418	78
Bison	212	36	161	5	20	40	16	35	39	3
Moose or Elk	19	1	14	0	4	1	1	2	3	0
Moose	9	3	7	0	0	7	2	6	2	0
Elk	4	0	5	0	2	3	0	1	3	1
Canid	23	3	17	3	3	9	2	2	21	0
Lynx	1	0	1	0	0	0	0	3	0	0
Marten	5	0	2	0	0	2	0	0	0	0
Leporid	10	3	19	0	0	5	2	3	9	3
Beaver	366	76	302	29	20	87	58	37	129	22
Muskrat	6	2	2	0	0	0	1	2	11	1
Red Squirrel	1	0	0	0	0	1	0	0	0	1
Ground Squirrel	10	1	8	0	0	0	0	0	0	0
R. G. Squirrel	0	0	3	0	0	0	0	0	0	0
N. P. Gopher	4	0	0	0	0	0	0	0	5	0
Least Chipmunk	8	0	2	0	0	0	0	0	0	0
Micro-rodent	4	0	0	0	0	0	2	1	4	0
Bird	47	13	29	13	18	25	6	8	163	21
Fish	323	44	163	4	18	65	121	49	450	16
Total	3429	395	1876	168	182	628	315	485	1252	146

majority of the large ungulate specimens cannot be identified as to species; however, among those that are, bison is the most commonly identified.

The density of bone debris recovered from area 2.1, particularly in areas to the south, west, and northwest of the feature cluster, indicates that intense subsistence activities were focused in this area of the site. Unidentified ungulate cranial, rib, and long bone shaft fragments were located either within or immediately adjacent to hearth #2 and rock pit #1. Unidentified ungulate vertebral fragments were found either in or adjacent to hearth #1 and the rock pit feature. One moose specimen was also found within hearth #1. Beaver axial and appendicular specimens were heavily concentrated within hearth #2 and adjacent to rock pit #1. A few fish specimens were found in hearth #1; however, the majority of fish remains were situated approximately 0.7 m to 2 m west of the features. Almost all of the bison appendicular specimens and the majority of unidentified ungulate axial and appendicular remains were found to the west and south of the features at a distance of 2 to 3 m. Numerous beaver, axial and appendicular, specimens and bird, primarily grouse, were also found in the area to the south of the features.

Generally bone debris smaller than 50 cm was found concentrated within and around the hearths and rock pit, while debris of all size ranges was found at some distance to the south, west, and north of the features. The partial size sorting of the debris and density of bone debris indicates that this area of the site was occupied for a considerable length of time and that a certain amount of maintenance was undertaken. This likely involved the collection of larger sized bone fragments and their disposal in areas to the south of the hearths, as well as sweeping and brushing of debris of various sizes away from the hearths. The cooking and consumption of a variety of mammals, birds, and fish occurred here. The presence of large ungulate long bone shafts and articular end fragments indicates that elements were being cracked for their marrow and that articular ends were crushed and boiled to obtain grease. It is difficult to say if both activities were undertaken simultaneously or at different times. Gibson (1994: 110) states that the rock pit feature intrudes into the larger hearth (hearth #1) indicating the sequential use of the features. It is possible that the rock pit and hearths were used for bone grease processing, which is considered to be a "messy" activity, after other activities were discontinued or moved to other areas of the site (Carr 1991: 251).

Area 2.2 is located on the southern edge of Block 2. A small hearth (#3) containing a considerable amount of ash was uncovered in this area. Large ungulates consisting of bison, moose, moose or elk, and unidentified ungulate are the most abundant fauna (64%), followed by beaver (19%), and fish (11%). Bison forelimb and hindlimb fragments were found on the east side of hearth #3 and a second concentration of forelimb specimens was found approximately 1 m to the southeast. A clustering of burned unidentified ungulate cranial fragments was situated approximately 50 cm to the southwest of the hearth. A second group of burned unidentified ungulate long bone shaft fragments was found 1 m west of hearth #3; this is also where several unburned unidentified ungulate forelimb and hindlimb fragments were found. Beaver cranial and rib fragments were located south of the hearth. The fish specimens were found within and scattered around hearth #3. The few canid and leporid remains from this area were located within 1 m of the hearth.

The majority of bone debris was found on the southwest, south, and southeast sides of hearth #3. The preparation and cooking of small mammals, particularly beaver and leporids, as well as fish appear to have been important subsistence activities carried out in this area. Concentrations of large ungulate axial and appendicular specimens indicate that marrow removal and grease extraction were also conducted here.

Area 2.3, situated in the centre of the excavation block ,is one of the larger subsistence areas in Block 2, covering a 6 x 9 m area. Multiple features, including four hearths and one small rock pit, are found in this area. The largest hearth (#9), located on the eastern edge of the area, measures at least 70 cm in diameter and consists of burned soil and a thick layer of ash. Two smaller hearths were also found in this area. Hearth

#11, situated approximately 2 m to the northeast of hearth #9, consists of an area of burned soil and a small amount of ash. Hearth #8, found less than 1 m to the southeast of hearth #9, measures approximately 50 cm in diameter and consists of burned soil and a large quantity of ash (Gibson 1994: 131). Hearth #7, located in the central southern third of the area, was partially destroyed by gravel quarrying equipment (ibid.: 112). Again, large ungulate remains (73%), particularly bison and unidentified ungulate, dominate the fauna recovered from this area, as do beaver (16%) and fish (9%).

Bison cranial specimens were found in an arc on the east, south, and west sides of hearth #7 at a distance of 1 to 2.5 m. A small concentration of bison forelimb specimens were found approximately 1.5 m west of hearth #7. Unidentified ungulate axial and appendicular specimens were also found in a semi-circle on the south half of hearth #7 at a distance of 1 to 3 m. The heaviest concentrations consisted of forelimb and hindlimb specimens on the southwest and west sides. Beaver and fish remains were also situated on the south and west sides, again at a distance of 1 to 3 m.

The area surrounding hearth #7 was kept relatively clear of bone debris. Fragments smaller than 50 cm in size were recovered from this area; however, bone debris larger than 50 cm was rarely recovered in this area. This hearth fits Binford's (1978: 345) exterior hearth model in which the area immediately surrounding the hearth consists of a drop zone and a second area approximately 1.5 to 2.0 m from the hearth consists of a toss zone. Small-sized debris is found within the drop zone and larger items accumulate in the toss zone. Stevenson (1991: 278) expands upon this model by incorporating a displacement zone between the drop and toss zones. Material is both intentionally and unintentionally moved into the displacement zone by brushing, sweeping and trampling. A mixture of material sizes would be found in this area, depending on the amount of intentional cleaning that occurred around the hearth (Stevenson 1991: 275).

Hearths #8, #9, and #11 were all found within close proximity to each other. Unidentified ungulate cranial fragments were found within hearth #8, to the northwest of hearth #9, and to the north of hearth #11. Several of the cranial fragments recovered from hearth #8 are burned. A heavy concentration of rib fragments was found north of hearth #9. Unidentified ungulate hindlimb specimens and long bone fragments were concentrated northwest of hearth #9 and west of hearth #11. Elk specimens were found adjacent to each hearth. Beaver cranial, rib, forelimb fragments, and phalanges were found within and immediately adjacent to all three hearths. Snowshoe hare remains were also found within or in the vicinity of the hearths. Fish remains were found within and surrounding hearth #8, to the northwest of hearth #9, and to the northwest of hearth #11.

Only fish and small mammal remains were found in direct association with the hearths or between the hearths. Several of the beaver remains were either burned or calcined.

The areas immediately surrounding the hearths, as well as between the hearths were kept relatively clear of large ungulate debris. Heavy concentrations of bone debris 6-13 mm in size and 13-25 mm in size were found between and on the west sides of hearths #8 and #9. Debris 25-50 mm and 50-100 mm in size were concentrated northwest of hearths #9 and #11. Areas to the south, east, northeast, as well as between the three hearths contain only a few large-sized pieces of debris. Although several long bone shaft fragments were found in association with hearth #8 and northwest of the other hearths, very few articular end fragments were found. Fish, beaver, and snowshoe hare remains are strongly associated with hearths #8 and #9 indicating that they were cooked, consumed, and disposed of in this area. The remains of large ungulates were found in a three-quarter circle encompassing the three hearths on the east, south, west, and northwest sides. Large ungulate long bones were cracked for marrow; however, the articular ends do not appear to have been processed for grease at these hearths. The high frequency of ungulate axial elements, particularly cranial and rib fragments, indicates intensive processing for whatever nutrition could be gained from these elements.

Gibson (1994: 134) hypothesizes the hearths #8, #9, and #11 were contained within a structure. The distribution patterns of the bone debris associated with these hearths appears to support this hypothesis. The area around the hearths was kept relatively clear of larger sized debris, which was pushed to the less intensively utilized outer areas. The area to the northeast of the hearths that is relatively clear of debris would represent areas where people were seated. The densest concentrations to the northwest of hearths #9 and #11 may represent secondary deposits of debris removed from the areas surrounding the hearths.

Very little faunal material was found in association with the rock pit feature situated on the west side of area 2.3. The feature was located near an area in which the paleosol had been removed by blading in preparation for gravel quarrying and it was noted that a considerable quantity of rock had been removed from the area (Gibson 1994: 137). The rock pit fell outside of the major activity areas defined by Gibson (1994); therefore, the possible function of this feature was not addressed. One possible interpretation is that the feature was situated within a sweat lodge. A similar rock pit feature found at the Lloyd site has been interpreted as possibly been associated with a sweat lodge structure (Prentice et al. 1983: 98). This feature was located away from the main camp area and very little cultural material was recovered from the area excavated around it.

Area 2.4 is located in the northwest corner of Block 2. One feature, hearth #14, is situated in the northwest corner of the block. Large ungulate specimens (71%), beaver (17%), and birds (8%) are the most commonly identified faunal material in this area. A large portion (68%) of the ungulate specimens are unidentifiable as to species, the remaining 3% are bison. Unidentified ungulate cranial and vertebral fragments were found in a concentration approximately 1 m southeast of hearth #14. A few beaver forelimb specimens were found approximately 0.5 m to 1.5 m east of the hearth and a few canid elements were found 1 m to the southeast. Bird remains, predominantly mallard were recovered immediately adjacent to the hearth. Hearth #14 appears to be a small secondary hearth where small mammals, birds, and some portions of large ungulates were cooked and consumed.

Area 2.5 is a small area on the northern edge of Block 2. This area had been disturbed by gravel quarrying equipment; however, a natural depression—possibly an ice push scour—was still visible. A variety of species including bison (11%), elk (1%), moose or elk (2%), unidentified ungulate (53%), as well as small mammals—canids (2%), beaver (11%), muskrats (10%)—birds (10%), and fish (10%) were recovered from this area. Bison cranial fragments and unidentified ungulate specimens—cranial, vertebral, ribs, long bone shafts, forelimb, and hindlimb fragments—were concentrated in one unit. Bird and fish remains were also found in this unit. Beaver cranial portions, forelimb fragments and phalanges, and canid specimens were recovered from other units in this area. The bone debris from this area and the unit in which the majority of material was concentrated ranged in size from 6 to 200 mm. This area appears to have been the location of secondary deposition or dumping of faunal debris. Gibson (1994: 138) suggests that the natural depression of the ice scour may have served as a convenient pit in which to dump debris.

Area 2.6, also situated on the northern edge of Block 2, does not have any associated features. Although large ungulate remains dominate the faunal assemblage (69%), a variety of small mammals, birds, and fish are also present. Beaver (14%) is the most commonly identified small mammal and fish comprise a significant portion of the fauna (10%). Unidentified ungulate vertebral and ribs fragments, as well as long bone shaft fragments, forelimb, and hindlimb specimens were found on the south side of this area. Moose and elk remains were also recovered from this area, as were beaver ribs and forelimb fragments, snowshoe hare, canid, and bird specimens. Fish remains were spread over the west half of the area. It is likely that the material in area 2.6 represents an extension of the debris associated with hearth #11 and possibly hearth #9 in area 2.3.

Area 2.7, located in the northeast corner of Block 2, contains two hearths (#12 and #13) which are situated less than 1 m apart. The northern edge of the area was heavily disturbed by gravel quarrying equipment (Gibson 1994: 142). In terms of identified taxa this area is considerably different from those discussed previously. Fish constitute 39% of the total assemblage, large ungulates account for 39.3%, followed by beaver (19%). Canid, leporid, muskrat, and bird specimens were also recovered from this area. A few unidentified ungulate axial specimens, long bone shaft fragments, and forelimb fragments were found in the area. A dense concentration of beaver hindlimb specimens was situated between the two hearths. Beaver forelimb specimens, rib and vertebral fragments were recovered from areas surrounding the hearths. A couple of snowshoe hare elements were also found between the hearths. A few bird remains were found on the west side of the area. Fish were found scattered throughout the area with one concentration situated approximately 50 cm northwest of hearth #13. The two hearths in this area appear to have been associated with the cooking and consumption of mainly fish, small mammals, and a few birds.

Area 2.8, positioned on the east side of Block 2 covers 30 square metres. A small hearth, less than 50 cm in diameter, was uncovered on the east side this area (ibid.: 85). Seventy-nine percent of the faunal material in area 2.8 consists of large ungulate remains—bison (7%), moose (1%), elk (<1%), moose or elk (<1%), and unidentified ungulate (70%). The remaining assemblage consists of fish (10%), beaver (8%), and small percentages of canids, leporids, muskrat, and birds. Bison remains were found at a distance of 1 to 2 m north and south of hearth #10. Unidentified ungulate cranial and vertebral fragments were found south and west of the hearth and a dense concentration of rib fragments were found within and immediately around the hearth. Large ungulate forelimb and hindlimb fragments were situated on the west side of hearth #10. Very few long bone shaft fragments were found in this area; however, a concentration of long bone articular end fragments was located 1 m to the north of the hearth. This area appears to have mainly been associated with the processing of large ungulate remains, including marrow and grease extraction.

Area 2.9, located in the southeast corner of Block 2, encompasses a large central hearth (#6). This hearth is almost 1 m in diameter and it consists of large quantities of ash, charcoal, and fire-reddened soil. The composition of the faunal remains found in this area is similar to that of area 2.7. The percentage of large ungulate remains is reduced (38%), while fish account for a large portion of the total assemblage (36%), along with birds (13%) and beaver (10%).

Bison cranial fragments were found on the southeast edge of the hearth and hindlimb specimens were situated 1 to 1.5 m away from the hearth on the northeast and east sides. Concentrations of unidentified ungulate vertebral and rib fragments were found on the southern edge of hearth #6, while two concentrations of rib fragments were found northeast and south of the hearth. Heavy concentrations of unidentified ungulate hindlimb specimens and long bone shaft fragments were found approximately 0.5 m to 1 m south and southwest of the hearth. Several unidentified ungulate foetal or newborn specimens were recovered from the south side hearth #6. Beaver axial fragments were found adjacent to hearth #6, on the south and west sides, as well as in units located 1.5 to 3 m from the hearth on the east, south, and southwest sides. Several beaver phalanges were recovered from the south side of the hearth. Canid specimens were also found on the south and east sides of hearth #6. A dense concentration of bird specimens (mainly grouse and unidentified bird) extended from the south half of the hearth to approximately 1.5 m south. Some of the heaviest concentrations of fish found in Block 2 were also associated with hearth #6.

Heavy concentrations of bone debris ranging in size from 2 mm to 50 mm were found immediately east and south of the hearth. The heaviest concentrations of larger debris were situated in the same areas but at approximately 50 cm from the edge of the hearth. This is the only area of the block in which relatively small pieces of bone debris (2-6 mm) were found in large quantities. Debris of this size was found within and immediately surrounding hearth #6.

Area 2.9 yielded large amounts of bone debris, especially on south and east sides of hearth #6. Large ungulates, a variety of small mammals, birds, and fish were all found within a relatively confined area associated with the hearth. Some sorting of material by size has occurred in that large pieces were generally found 50 cm from the edge of the hearth, while small debris extended from within the hearth to an area approximately 2 to 3 m from the hearth. There is little evidence of bone grease processing associated with this feature; however, numerous large ungulate long bone shaft fragments were found indicating that marrow extraction was one of the activities undertaken here. Gibson (1994: 89) suggests that the confined nature of the material associated with hearth #6 indicates that it was situated within a structure. However, the quantity of debris on the south and east sides of the hearths would severely limit the amount of useable space within such a structure.

Area 2.10 is located on the southeast periphery of Block 2. Two hearths are situated within this area; hearth #4 is 15 cm deep and consists of fire-reddened soil and ash, hearth #5 contains charcoal, ash, and a small amount of fire-reddened soil. Most of the faunal material found in this area is large ungulate—bison, elk, and unidentified ungulate (57%); however, a significant portion of the assemblage consists of beaver (15%), birds (15%), and fish (11%). Unidentified ungulate vertebral fragments, rib fragments, long bone shaft fragments, and hindlimb specimens were found on the west side of hearth #5. A concentration of beaver vertebral fragments was located approximately 75 cm north of hearth #5 and a concentration of phalanges was situated 1 m to the south of these features. Bird remains, primarily grouse, were found on the west side of hearth #5. Separate concentrations of fish remains were found in association with each hearth.

CHAPTER EIGHT

Bushfield West - Block 3 Faunal Remains

8.1 Introduction

The excavation of an area of 10 x 20 metres, designated as Block 3, resulted in the recovery of 14,777 bone specimens weighing 60,379.9 g. For the purposes of this thesis all of the bone material was examined and catalogued according to the standardized procedures outlined in the "Faunal Cataloguing Methods" section. The majority of faunal material associated with Block 3 is highly fragmented resulting in a substantial amount of unidentifiable bone material, 11,358 pieces weighing 7124.2 g. When considered by frequency, the unidentifiable material comprises 77% of the faunal assemblage. When weight is taken into consideration the unidentifiable material makes up only 12% of the assemblage. Analysis of the unidentifiable bone, besides recording frequencies and weights, consisted of determining size categories and documenting both cultural and natural taphonomic modifications. The results of this analysis are presented in the following section.

The remaining 33% by frequency and 88% by weight consists of bone that is identifiable as to skeletal element and/or taxonomy. In comparison to the two previously discussed excavation blocks, Block 3 has a considerably higher percentage of identifiable faunal material. The systematic description and analysis of the 3419 identifiable bone specimens (53,255.7 g) makes up the bulk of this chapter. The organization of the chapter follows the guidelines presented in the "Introduction" section of Chapter 6. Also, detailed discussions of the cultural and natural taphonomic modifications recorded during the analysis of the identifiable faunal specimens are found in Chapter 9.

8.2 Unidentifiable Faunal Specimens

A total of 11,385 pieces of bone weighing 7124.4 g recovered from Block 3 are unidentifiable as to skeletal element and taxonomy. Cultural modifications of the unidentifiable bone fragments consist of burning, calcining, cut marks, notching, polishing, and the formation of bone tools. Burned bone fragments (N=1539) account for 14% of the unidentifiable bone sample, while calcined bone fragments (N=844) make up 7%. By far, the largest portion of the unidentifiable bone sample consists of unburned or raw bone, 8975 fragments or 79% of the assemblage. A summary of the unidentifiable bone fragments according to size categories for raw, burned, and calcined specimens is presented in Table 8.1.

Table 8.1 Block 3 - Unidentifiable Bone Fragments

Size	Raw		Burned		Calcined	
	Freq.	Weight	Freq.	Weight	Freq.	Weight
2-6 mm	0	0.0	0	0.0	0	0.0
6-13 mm	2906	396.0	652	84.0	394	70.3
13-25 mm	4725	2600.8	741	595.7	413	242.7
25-50 mm	1315	2478.0	145	423.0	37	82.7
50-100 mm	29	143.0	1	8.0	0	0.0
100-200 mm	0	0.0	0	0.0	0	0.0
200+ mm	0	0.0	0	0.0	0	0.0
Total	8975	5617.8	1539	1110.7	844	395.7

The greatest number of unidentifiable bone fragments fall in the 13-25 mm size range (N=5879), followed by the 6-13 mm size range (N=3952), the 25-50 mm size range (N=1497), and finally the 50-100 mm size range (N=30). Ranking of the size categories changes only slightly when weight is considered instead of frequency. The greatest amount of unidentifiable bone material falls in the 13-25 mm size category (3439.2 g), followed by the 25-50 mm size category (2983.7 g), the 6-13 mm size category (550.3 g), and the 50-100 mm size category (151.0 g).

Seven unidentifiable bone fragments show other forms of cultural taphonomic modifications such as cut marks, notching, polishing, and bone tool formation. Three parallel shallow cut marks were noted on one unidentifiable bone fragment. A calcined unidentifiable bone fragment has two rectangular notches on one side. One bone fragment is rounded and smoothed at one end, it may have functioned as a pressure flaker for flintknapping. Four bone tools identified as piercers or awls were recovered from Block 3. Three of these items have long pointed tips with rounded edges and heavy polishing on the tips. The fourth item is rectangular with polished surfaces, both ends are broken. It is possible that this is the shaft of an awl or needle.

Natural taphonomic modifications of the unidentifiable bone fragments include root erosion, porcupine gnawing, carnivore pitting, and weathering. Root erosion was noted on only two bone fragments. Five bone fragments have wide parallel deep grooves which are the result of porcupine gnawing. All of these bone fragments are burned. Carnivore pitting was observed on only one bone fragment. Stage 1 weathering was recorded on three fragments.

8.3 Identifiable Faunal Specimens

The identifiable faunal assemblage (N=3419, 53,255.7 g) recovered from Block 3 is composed of four classes: mammals, birds, fish, and bivalves. Mammalia is the largest class represented in the sample with 2905 identified specimens (53,089.4 g). This class comprises 85% of the identifiable fauna associated Block 3. The second largest class is Osteichthyes with 425 identified specimens (114.5 g), constituting 12.0% of the assemblage. Aves is the third largest class with 89 identified specimens (51.8 g) making up 3% of the assemblage. As stated in the previous chapters, bivalves are not included in the analysis of the Bushfield West fauna.

Several different taxa are represented in each class. A summary by NISP, weight, and where applicable MNI of all taxa identified in the Block 3 faunal assemblage is presented in Table 8.2.

Table 8.2 Block 3 - Identified Taxa by NISP, %NISP, MNI, and Weight

Taxon	NISP	%NISP	MNI	Weight (g)
Mammals				
Ungulate, unidentified	1945	56.9	-	31,194.9
Bison	408	11.9	9	20,024.1
Moose or elk	8	0.2	-	170.6
Moose	10	0.3	1	591.9
Elk	1	0.0	1	110.3
Bear	2	0.1	1	1.3
Gray Wolf or Domestic Dog	7	0.2	-	20.6
Coyote or Domestic Dog	4	0.1	-	4.5
Lynx	1	0.0	1	4.1
American Badger	2	0.1	1	7.9
Snowshoe Hare	21	0.6	2	17.2
Beaver	491	14.4	8	940.4
Muskrat	3	0.1	1	1.2
Northern Pocket Gopher	2	0.1	1	0.4
Birds				
Medium bird	6	0.2	-	1.1
Large bird	21	0.6	-	18.8
Swan	1	0.0	1	0.6
Geese, unidentified	36	1.1	-	10.2
Teal	1	0.0	1	0.3
Mallard	1	0.1	1	0.6
Grouse, unidentified	19	0.6	3	4.4
Crane	4	0.1	1	15.8
Fish				
Fish, unidentified	254	7.4	-	33.9
Lake Sturgeon	82	2.4	1	56.5
Goldeye	2	0.1	1	0.1
Northern Pike	2	0.1	1	1.0
Flathead Chub	1	0.0	1	0.1

Table 8.2 (Continued)

Taxon	NISP	%NISP	MNI	Weight (g)
Longnose Sucker	1	0.0	1	0.5
White Sucker	4	0.1	1	0.8
Silver Redhorse	5	0.2	1	2.0
Shorthead Redhorse	3	0.1	1	0.6
Burbot	1	0.0	1	0.9
Walleye	70	2.0	7	18.1

8.4 Mammalia - Mammals

The mammalian taxon with the greatest number of identified specimens consists of unidentified ungulates (N=1945). Unidentified ungulate specimens account for 67% of the mammal remains recovered from Block 3. The next largest mammalian taxon is beaver with 491 identified specimens (17% of the mammalian fauna), followed by bison (N=408, 14%). The remaining 11 taxa account for 2% of the mammalian faunal sample of Block 3.

8.4.1 Order Artiodactyla, [Ungulate, Unidentified]

As was the case with the two previously described Bushfield West excavation blocks, the majority of identifiable mammalian fauna associated with Block 3 consists of unidentified ungulate material. A total of 1945 unidentified ungulate specimens weighing 31,194.9 g were identified in the Block 3 faunal assemblage. The unidentified ungulate fauna includes both axial (N=1053) and appendicular (N=892) skeletal specimens. None of unidentified ungulate axial specimens are complete elements, but there are two nearly complete elements: a petrous portion of the temporal bone and a cervical vertebra. The remaining axial specimens are highly comminuted. The majority of unidentified ungulate axial specimens are ribs (N=419), followed by vertebrae (N=259), indeterminate teeth (N=169), cranial portions (N=156), mandibles (N=47), and finally indeterminate molars and premolar/molars (N=3). A large percentage of each category consists of indeterminate specimens—53% of the cranial specimens are indeterminate cranial fragments, 98% of the unidentified ungulate teeth are indeterminate teeth (crown or root fragments). Vertebral fragments generally possess sufficient landmarks to enable identification of vertebra type; however, 7% of the sample are indeterminate vertebral specimens. The unidentified ungulate rib specimens are heavily fragmented and the largest category consists of rib shaft fragments, 86% of the sample. Most of the mandible specimens, 66%, are alveolar fragments. Table 8.3 presents a summary by NISP of the unidentified ungulate axial specimens recovered from Block 3.

Table 8.3 **Block 3 - Unidentified Ungulate Axial NISP**

Specimen	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Skull:							
-frontal	1	0	1	0	2	10.9	0.2
-petrous	1	0	0	0	1	11.1	0.1
-zygomatic	0	1	1	0	2	4.1	0.2
-premaxilla	0	1	0	0	1	7.4	0.1
-temporal	5	3	1	0	9	26.4	0.9
-nasal	0	0	1	0	1	0.6	0.1
-palatine	0	1	0	0	1	3.8	0.1
-sphenoid	1	0	0	0	1	2.4	0.1
-basisphen.	0	0	0	1	1	6.7	0.1
-maxilla	2	2	37	0	41	162.2	3.9
-parietal	0	0	1	1	2	2.8	0.2
-ext. aud.	0	0	2	0	2	4.7	0.2
-occipital	0	0	0	2	2	4.0	0.2
-occip. con.	1	1	1	0	3	11.7	0.3
-indt. cran.	0	0	83	0	83	95.2	7.9
Mandible:							
-condyle	1	2	1	0	4	90.0	0.4
-cor. process	0	0	1	0	1	1.5	0.1
-asc. ramus	1	1	0	0	2	28.7	0.2
-hor. ramus	1	2	4	0	7	146.4	0.7
-alveolus	0	0	31	0	31	63.2	2.9
-symphysis	2	0	0	0	2	7.4	0.2
Teeth:							
-molar	0	0	2	0	2	16.3	0.2
-pre/molar	0	0	1	0	1	1.7	0.1
-indt. teeth	0	0	173	0	173	143.7	16.4
Vertebra:							
-cervical	0	0	0	23	23	249.0	2.2
-thoracic	0	0	0	137	137	970.7	13.0
-lumbar	0	0	0	65	65	306.4	6.2
-sacrum	0	0	0	7	7	16.7	0.7
-caudal	0	0	0	7	7	82.4	0.7
-indt. vert.	0	0	0	20	20	26.0	1.9
Rib:							
-head	0	0	19	0	19	41.6	1.8
-head/neck	0	0	5	0	5	135.2	0.5
-neck	0	0	10	0	10	64.5	0.9
-neck/body	0	0	4	0	4	62.2	0.4
-neck/tub.	0	0	3	0	3	77.1	0.3
-tubercle	0	0	5	0	5	10.1	0.5
-body	0	0	361	0	361	3267.8	34.2
-sternal end	0	0	1	0	1	3.6	0.1
-costal cart.	0	0	11	0	11	23.6	1.0
Total	16	14	760	263	2655	2555.3	100.2

Analysis of the unidentified ungulate axial specimens by size categories gives some indication of the extent to which the material is fragmented. The majority of axial specimens are found in the 25-50 mm size category, followed by the 13-25 mm size category, and the 50-100 mm size category. The 6-13 mm and 100-200 mm size categories have almost equal numbers of axial specimens. Table 8.4 lists by NISP the unidentified ungulate axial specimens in each size category.

Table 8.4 Block 3 - Unidentified Ungulate Axial NISP by Size Categories

Size	Cranial	Mand.	Teeth	Indt. Teeth	Vert.	Rib	Total
0-2 mm	0	0	0	0	0	0	0
2-6 mm	0	0	0	0	0	0	0
6-13 mm	3	0	0	38	6	1	48
13-25 mm	68	17	2	104	80	49	320
25-50 mm	76	19	1	31	126	185	438
50-100 mm	5	10	0	0	43	135	193
100-200 mm	0	1	0	0	4	37	42
200+ mm	0	0	0	0	0	12	12
Total	152	47	3	173	259	419	1053

When the amount of material is considered by weight the 50-100 mm size category contains the greatest amount, followed by the 25-50 mm size category, the 100-200 mm size category, the 200+ size category, and the 13-25 mm size category. The 6-13 mm size category contains only a small amount of material. Rib shaft fragments account for all of material in the 200+ mm size category. Indeterminate teeth and vertebral specimens account for 66% of the material in the 13-25 mm size category. Vertebral and rib fragments make up the bulk of the material in the 25-50 mm size range, 87%. The weight of unidentified ungulate axial material found in each size category is presented in Table 8.5.

Table 8.5 Block 3 - Unidentified Ungulate Axial Specimen Weight (g) by Size Categories

Size	Cranial	Mand.	Teeth	Indt. Teeth	Vert.	Rib	Total
0-2 mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-6 mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6-13 mm	0.7	0.0	0.0	9.9	2.4	0.2	13.2
13-25 mm	43.1	14.5	5.6	72.7	152.8	49.9	338.6
25-50 mm	195.5	52.8	12.4	61.1	630.1	459.8	1411.7
50-100 mm	73.7	221.2	0.0	0.0	724.8	1180.2	2199.9
100-200 mm	0.0	53.0	0.0	0.0	141.1	1122.5	1316.6
200+ mm	0.0	0.0	0.0	0.0	0.0	873.1	873.1
Total	313.0	341.5	18.0	143.7	1651.2	3685.7	6153.1

Unfused epiphyses (N=45), unfused specimens (N=20), and immature specimens (N=14) comprise 8% of the unidentified ungulate axial sample. The majority of unfused epiphyses are either anterior or posterior vertebral centrum epiphyses—six cervical, 14 thoracic, five lumbar, two sacral, and 11 indeterminate. There are also seven rib epiphyses consisting of one unfused rib tubercule and six unfused rib heads.

The unfused axial specimens consist of one temporal fragment, two rib fragments, and 17 vertebral centrum fragments (one cervical, eight thoracic, four sacral, and four indeterminate). Six cranial specimens are identified as immature: one occipital, one temporal, and four indeterminate. The posterior portion of a right mandible consisting of the coronoid process, condyle, and ascending ramus is also immature. The remaining immature specimens include one rib head, six rib shaft fragments, and one thoracic vertebral spinous process and post-zygapophysis.

Unidentified ungulate appendicular specimens (N=893) weighing a total of 12,204.4 g represent 46% of the unidentified ungulate sample recovered from Block 3 (Table 8.6). The majority of the appendicular specimens are long bone shaft fragments (N=350). There are also 42 long bone articular end fragments present. Neither the long bone shafts nor the articular ends can be identified as to a specific skeletal element. Together they account for 43% of the unidentified ungulate appendicular sample. The remaining unidentified ungulate specimens are from various regions of the skeleton: scapula (N=44), forelimbs (N=150), innominate (N=66), hindlimbs (N=202), metapodials (N=17), phalanges (N=18), sesamoids (N=3), and one bony ossicle.

Table 8.6 Block 3 - Unidentified Ungulate Appendicular NISP

Specimen	Left	Right	Indt.	Total	Weight (g)	NISP%
Scapula:						
-glenoid	1	1	1	3	44.7	0.3
-neck	0	1	1	2	33.8	0.2
-acrom. pro.	0	1	0	1	2.9	0.1
-caudal bor	2	0	6	8	151.9	0.9
-cranial bor	2	0	1	3	57.3	0.3
-spine	3	3	3	9	80.7	1.0
-blade	0	0	18	18	85.7	2.0
Humerus:						
-head	1	1	5	7	227.0	0.8
-maj. tub.	1	2	0	3	32.7	0.3
-shaft	24	12	7	43	1060.2	4.8
-deltoid	8	5	1	14	290.4	1.6
-radial fossa	2	0	2	4	89.4	0.5
-condyle	1	3	1	5	52.4	0.6
Radius:						
-med. fossa	2	4	0	6	63.6	0.7
-lat. fossa	1	0	0	1	7.0	0.1
-shaft	10	14	3	27	932.3	3.0
-carp. facet	2	4	0	6	41.3	0.7
Ulna:						
-olecranon	1	0	0	1	38.9	0.1
-semi-lun.	0	2	0	2	11.6	0.2
-trochlea	2	1	0	3	54.7	0.3
-shaft	7	6	3	16	267.5	1.8
-styloid	1	0	0	1	0.9	0.1

Table 8.6 (Continued)

Specimen	Left	Right	Indt.	Total	Weight (g)	NISP%
Fused r./u..	2	0	0	2	10.5	0.2
Uncif. carp.	1	0	0	1	4.5	0.1
Metacarpal:						
-art. facet	1	0	0	1	2.8	0.1
-shaft	1	1	4	6	119.7	0.7
-condyle	0	0	1	1	21.0	0.1
Innominate:						
-acetabul.	11	9	4	24	185.9	2.7
-ischium	9	4	5	18	177.1	2.0
-ilium	7	2	7	16	140.9	1.8
-pubis	3	4	1	8	49.2	0.9
Patella	3	0	0	3	68.6	0.3
Femur:						
-head	1	2	6	9	225.8	1.0
-neck	5	2	0	7	64.2	0.8
-maj. troch.	1	1	0	2	8.5	0.2
-min. troch.	3	5	0	8	223.8	0.9
-shaft	21	9	8	38	1159.8	4.3
-sup. cond.	6	11	1	18	431.2	2.0
-pat. groove	1	0	0	1	8.2	0.1
-condyle	5	3	2	10	188.1	1.1
Tibia:						
-med. cond.	3	3	3	9	141.2	1.0
-lat. cond.	1	4	0	5	91.1	0.6
-condyle	3	0	1	4	65.7	0.5
-tibial crest	10	4	3	17	509.1	1.9
-mus. lines	11	6	5	22	579.0	2.5
-shaft	12	11	6	29	717.2	3.2
-med. mall.	1	3	0	4	65.5	0.5
-tarsal art.	2	2	0	4	27.0	0.5
Lat. mall.	1	1	0	2	7.8	0.2
Astragalus	0	0	1	1	6.3	0.1
2nd/3rd tar.	0	1	0	1	5.3	0.1
Metatarsal:						
-art. facet	1	1	0	2	18.6	0.2
-shaft	0	1	4	5	55.7	0.6
-condyle	0	0	1	1	38.7	0.1
Long bone:						
-articular	0	0	42	42	159.1	4.7
-shaft	0	0	350	350	2741.7	39.2
Metapodial:						
-art. facet	0	0	1	1	3.8	0.1
-shaft	0	0	5	5	8.2	0.6
-condyle	0	0	11	11	159.0	1.2
1st phal.	0	0	12	12	28.3	1.3
2nd phal.	0	0	2	2	20.3	0.2
3rd phal.	0	0	4	4	19.0	0.5
S. lat. ses.	0	0	2	2	4.2	0.2
Infer. ses.	0	0	1	1	1.2	0.1
Bony oss.	0	0	1	1	0.6	0.1
Total	197	150	546	893	12204.4	99.9

The bony ossicle is the only complete unidentified ungulate appendicular element. The remaining unidentified ungulate specimens are highly fragmented. In order to demonstrate the comminuted nature of the unidentified ungulate appendicular material, the size ranges in which the various specimens fall are presented in Table 8.7. The majority of innominate, and indeterminate long bones shaft specimens are found in the 25-50 mm size category. Long bones specimens of the forelimb and hindlimb—scapula, humerus, radius, ulna, femur, and tibia—fall in the 50-100 mm size category.

Table 8.7 Block 3 - Unidentified Ungulate Appendicular NISP by Size Categories (mm)

Element	0-2	2-6	6-13	13-25	25-50	50-100	100-200	200+	Total
Scapula	0	0	0	2	17	22	3	0	44
Humerus	0	0	0	0	28	47	1	0	76
Radius	0	0	0	5	10	21	4	0	40
Ulna	0	0	0	1	8	11	3	0	23
Fused r./u.	0	0	0	0	2	0	0	0	2
Metacarpal	0	0	0	1	2	5	0	0	8
Carpal	0	0	0	0	1	0	0	0	1
Innominate	0	0	0	4	44	18	0	0	66
Femur	0	0	0	0	36	53	4	0	93
Patella	0	0	0	0	2	1	0	0	3
Tibia	0	0	0	2	39	43	10	0	94
Lat. mall.	0	0	0	1	1	0	0	0	2
Metatarsal	0	0	0	1	3	4	0	0	8
Tarsals	0	0	0	1	1	0	0	0	2
Metapodial	0	0	0	3	12	2	0	0	17
Indt. shaft	0	0	0	14	253	81	2	0	350
Indt. art.	0	0	0	15	27	0	0	0	42
Phalanges	0	0	1	9	8	0	0	0	18
Sesamoids	0	0	0	3	0	0	0	0	3
Bony oss.	0	0	0	1	0	0	0	0	1
Total	0	0	1	63	494	308	27	0	893

Table 8.8 is a summary of the weight per size category for unidentified ungulate appendicular specimens. The 50-100 mm size category contains the greatest amount of material, followed by the 25-50 mm size category, the 100-200 mm size category, and the 13-25 mm size category. The largest amount of material for innominate and long bone shaft fragments is still in the 25-50 size range; however, for scapula specimens the largest amount is found in the 50-100 mm size range. The greatest amount of long bone material is also found in the 50-100 mm size range.

Abnormal bone growth is visible on one ulna shaft fragment. This pathology may have been caused by a stress related injury resulting in the production of sclerotic bone.

Table 8.8 Block 3 - Unidentified Ungulate Appendicular Specimen Weight by Size Categories (mm)

Element	0-2	2-6	6-13	13-25	25-50	50-100	100-200	200+	Total
Scapula	0.0	0.0	0.0	4.3	115.4	208.5	128.8	0.0	457.0
Humerus	0.0	0.0	0.0	0.0	238.4	1451.2	62.5	0.0	1752.1
Radius	0.0	0.0	0.0	12.4	81.3	737.0	213.5	0.0	1044.2
Ulna	0.0	0.0	0.0	0.9	48.7	205.3	118.7	0.0	373.6
Fused r./u.	0.0	0.0	0.0	0.0	10.5	0.0	0.0	0.0	10.5
Metacarpal	0.0	0.0	0.0	2.8	31.9	108.8	0.0	0.0	143.5
Carpal	0.0	0.0	0.0	0.0	4.5	0.0	0.0	0.0	4.5
Innominate	0.0	0.0	0.0	6.1	282.1	257.9	0.0	0.0	546.1
Femur	0.0	0.0	0.0	0.0	341.2	1682.8	308.1	0.0	2332.1
Patella	0.0	0.0	0.0	0.0	37.9	30.7	0.0	0.0	68.6
Tibia	0.0	0.0	0.0	4.3	394.0	1036.5	759.6	0.0	2194.4
Lat. mall.	0.0	0.0	0.0	4.3	3.5	0.0	0.0	0.0	7.8
Metatarsal	0.0	0.0	0.0	0.7	19.4	92.9	0.0	0.0	113.0
Tarsals	0.0	0.0	0.0	5.3	6.3	0.0	0.0	0.0	11.6
Metapodial	0.0	0.0	0.0	3.5	111.9	55.6	0.0	0.0	171.0
Indt. shaft	0.0	0.0	0.0	33.3	1496.7	1168.9	42.8	0.0	2741.7
Indt. art.	0.0	0.0	0.0	33.6	0.0	125.5	0.0	0.0	159.1
Phalanges	0.0	0.0	0.4	10.5	56.7	0.0	0.0	0.0	67.6
Sesamoids	0.0	0.0	0.0	5.4	0.0	0.0	0.0	0.0	5.4
Bony oss.	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.6
Total	0.0	0.0	0.4	128.0	3280.4	7161.6	1634	0.0	12204.4

Variation in the ages of some of the unidentified ungulate appendicular specimens is indicated by unfused epiphyses, partially fused epiphyses and diaphyses, as well as immature specimens. Fifty-three sub-adult unidentified ungulate specimens (6%) are represented in the unidentified ungulate appendicular sample from Block 3. Unidentified ungulate appendicular specimens which are not fully mature are listed in Table 8.9.

Table 8.9 Block 3 - Sub-Adult Unidentified Ungulate Appendicular Specimens

Specimen	Partially Fused		Unfused		Unfused Epip.		Immature	
	Freq.	Weight	Freq.	Weight	Freq.	Weight	Freq.	Weight
Humerus	0	0.0	1	7.0	2	31.4	1	17.8
Radius	0	0.0	0	0.0	0	0.0	1	8.2
Innominate	0	0.0	0	0.0	0	0.0	1	23.1
Femur	1	20.9	2	48.7	2	61.8	1	15.5
Tibia	1	44.6	5	77.3	3	25.4	0	0.0
Metatarsal	0	0.0	0	0.0	0	0.0	1	21.6
Metapodial	1	6.8	0	0.0	1	11.8	4	6.8
Indt. shaft	0	0.0	5	26.2	0	0.0	14	30.0
Indt. art.	0	0.0	0	0.0	3	13.5	0	0.0
Phalanx	0	0.0	0	0.0	0	0.0	2	2.2
Total	3	72.3	13	159.2	11	143.9	25	125.2

*Weight is in grams.

Unfused epiphyses include two humerus head fragments, a femoral head fragment and one medial condyle, three tibial condyle specimens, and one metapodial distal condyle. Partially fused specimens consist of one femoral minor trochanter and shaft, one tibial condyle and shaft, and one metapodial distal condyle and shaft.

8.4.2 Ungulate Foetal/Newborn Remains

A total of 17 unidentified ungulate axial specimens are foetal or newborn. They are similar in size or are smaller than the elements of the 1 week bison comparative skeleton. The foetal/newborn axial specimens consist of six cranial portions, one mandible fragment, six vertebral fragments, and four rib fragments. Table 8.10 summarizes the unidentified ungulate foetal/newborn axial specimens associated with Block 3.

Table 8.10 Block 3 - Unidentified Ungulate Foetal/Newborn Axial Specimens

Specimen	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Skull:							
-frontal	1	0	0	0	1	9.2	5.9
-parietal	0	0	0	1	1	1.8	5.9
-temporal	0	2	0	0	2	4.9	11.8
-occipital	0	0	0	1	1	2.5	5.9
-premaxilla	0	0	1	0	1	0.5	5.9
-maxilla	0	0	1	0	1	0.1	5.9
Mandible:							
-condyle	0	1	0	0	1	4.2	5.9
Vertebra:							
-thoracic	0	0	0	2	2	1.7	11.8
-lumbar	0	0	0	2	2	1.0	11.8
-indt. vert.	0	0	0	1	1	0.3	5.9
Rib:							
-head/neck	0	0	1	0	1	1.2	5.9
-neck	0	0	1	0	1	0.1	5.9
-neck/body	0	0	1	0	1	2.6	5.9
-body	0	0	1	0	1	1.3	5.9
Total	1	3	6	7	17	31.4	100.3

Four unidentified ungulate appendicular specimens are also foetal or newborn. These specimens include one left humerus shaft fragment, one right femur shaft, one left tibia distal shaft, and one metatarsal shaft fragment.

8.4.3 Family Bovidae, *Bison bison* [American Bison]

Bison comprise 12% of the identifiable faunal assemblage recovered from Block 3 at Bushfield West. A total of 408 complete and fragmented bison bones weighing 20,024.1 g were found in this 200 m^2 excavation block. Table 8.11 presents the identified bison skeletal elements (NISP). A minimum of nine individuals are represented in this sample based upon the recovery of nine left proximal radii, as well as nine left radial carpals.

The bison assemblage in Block 3 consists mainly of appendicular specimens (N=345). Far fewer bison axial specimens (N=63) were found and the majority of these are individual teeth (N=48). Only one vertebra from Block 3 was sufficiently complete to enable identification to the level of species. Even though numerous fragmented ribs and vertebrae were found in Block 3 they cannot be identified to species with any degree of confidence, especially since there are three species of similar sizes present in the Bushfield West faunal assemblage. Twenty-six of the axial specimens, accounting for 41% of the sample, are complete elements. Complete elements consist mainly of individual teeth and cranial portions—11 incisors, two canines, three premolars, 11 molar, and two petrous portions of the temporal bone.

Table 8.11 Block 3 - Bison Axial NISP

Specimen	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Skull:							
Petrous	1	2	0	0	3	34.4	4.8
Zygomatic	0	1	0	0	1	8.4	1.6
Premaxilla	0	1	0	0	1	63.0	1.6
Temporal	0	1	0	0	1	7.7	1.6
Horn core	1	0	0	0	1	74.2	1.6
Maxilla	0	1	0	0	1	20.0	1.6
Maxilla/th.	0	4	0	0	4	271.3	6.3
Upper P2	1	1	0	0	2	17.2	3.2
Upper P4	0	1	0	0	1	18.0	1.6
Upper M1	2	1	0	0	3	141.2	4.8
Upper M2	0	2	0	0	2	132.7	3.2
Upper M3	1	2	0	0	3	178.2	4.8
Upper M	0	1	0	0	1	44.9	1.6
Mandible	7	6	0	0	13	1243.4	20.6
Dec. incisor	1	1	0	0	2	1.6	3.2
Incisor	3	8	0	0	11	34.7	17.7
Canine	1	1	0	0	2	3.1	3.2
Lower dp4	3	0	0	0	3	15.0	4.8
Lower M1	1	1	0	0	2	59.9	3.2
Lower M2	2	0	0	0	2	58.8	3.2
Lower M	1	0	0	0	1	18.2	1.6
Molar	0	0	2	0	2	22.3	3.2
Vertebra:							
Thoracic	0	0	0	1	1	63.1	1.6
Total	25	35	2	1	63	2531.3	100.6

Three of the horizontal ramus mandible fragments found in Block 3 have socketed teeth. One specimen is from a juvenile animal, this right mandible has socketed dp4 and M1 teeth. The other two specimens with socketed teeth represent substantial portions of the mandible. The right mandible has the following socketed teeth: P2, P3, M1, M2, and M3. The left mandible has P2, P3, P4, M1, and M2 socketed teeth. One mandibular symphysis and diastema fragment from a left mandible has an erupting I2. Four of the cranial specimens are maxillae with one or two socketed teeth—dp4; P4 and M1; M2; and M3. These specimens, as well as the individual mandibular and maxillary teeth, are used to estimate MNI, as well as to determine bison age groups and site seasonality.

Bison axial elements were found in various units throughout Block 3; however, the anterior portion of a crushed skull was found in the far northeast corner of the block. The skull concentration consisted of a premaxilla fragment, two maxillae with socketed teeth, three upper molars, a right and a left mandibular diastema, and one incisor.

A relatively large portion, 85%, of the bison remains recovered from Block 3 are appendicular specimens (N=345). All portions of the bison skeleton are represented; however, forelimb specimens (N=120) dominate the assemblage followed by hindlimb specimens (N=81), phalanges (N=79), and sesamoids (N=40). Innominate specimens (N=17) greatly outnumber scapula specimens (N=3). Bison appendicular specimens by NISP are shown in Table 8.12.

Table 8.12 Block 3 - Bison Appendicular NISP

Specimen	Left	Right	Indt.	Total	Weight (g)	NISP%
Hyoid	2	3	0	5	15.6	1.4
Scapula	3	0	0	3	1184.2	0.9
Humerus	5	5	0	10	1724.9	2.9
Radius	16	8	0	24	2399.9	7.0
Ulna	7	6	0	13	793.9	3.8
Rad./ulna	0	5	0	5	126.6	1.4
Radial carp.	8	1	1	10	216.0	2.9
Inter. carp.	2	2	0	4	64.6	1.2
Ulnar carp.	5	2	0	7	132.7	2.0
2nd/3rd	5	0	0	5	110.4	1.4
Unciform	7	3	0	10	181.7	2.9
Accessory	3	1	0	4	23.0	1.2
5th metac.	2	0	1	3	6.9	0.9
Metacarpal	15	7	2	24	2175.6	7.0
Innominate	8	9	0	17	754.0	4.9
Femur	2	2	0	4	490.6	1.2
Patella	4	0	0	4	148.8	1.2
Tibia	4	4	0	8	614.8	2.3
Lat. mall.	1	1	0	2	23.3	0.6
Calcaneus	5	4	0	9	897.3	2.6
Astragalus	1	7	0	8	829.1	2.3
Cen./4th	3	7	0	10	577.2	2.9
2nd/3rd	4	6	0	10	107.1	2.9
1st tarsal	0	3	0	3	5.2	0.9
2nd metat.	0	1	0	1	2.3	0.3
Metatarsal	8	11	3	22	1837.2	6.4

Table 8.12 (Continued)

Specimen	Left	Right	Indt.	Total	Weight (g)	NISP%
1st phal.	0	0	30	30	888.8	8.7
2nd phal.	0	0	26	26	550.0	7.6
3rd phal.	0	0	23	23	468.8	6.7
S. med ses.	0	0	20	20	73.0	5.8
S. lat. ses.	0	0	12	12	49.0	3.5
Infer. ses.	0	0	8	8	0.3	2.3
Total	120	98	126	344	17492.8	100.0

A large number (N=166) of the lower limb specimens are complete elements—37 carpals, two 5th metacarpals, one metacarpal, one 2nd metatarsal, two lateral malleoli, 33 tarsals, 21 first phalanges, 23 second phalanges, 16 third phalanges, 15 superior medial sesamoids, nine superior lateral sesamoids, and six inferior sesamoids. Thirty-seven nearly complete elements and 45 complete or nearly complete element portions of long bones were also found resulting in generally higher estimates of MNI, MNE, and MAU than for similar bison elements found in Block 1 or Block 2. Block 3 bison NISP, MNI, MNE, and MAU values are shown in Table 8.13.

Table 8.13 Block 3- Bison NISP/MNE/MNI/MAU

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
Skull:						
-petrous	3	3	1	2	2	1.5
-other	6	2	0	2	2	1.0
Mandible:						
-cor. process	3	1	1	0	1	0.5
-condyle	3	3	1	2	2	1.5
-asc. ramus	4	3	2	1	3	1.5
-diastema	3	2	0	2	2	1.0
Vertebra:						
-thoracic	1	1	-	-	1	0.1
Hyoid	5	2	1	1	1	1.0
Scapula:						
-glenoid	3	3	3	0	3	1.5
Humerus:						
-proximal	1	1	0	1	1	0.5
-shaft	3	2	1	1	2	1.0
-distal	6	6	3	3	3	3.0
Radius:						
-proximal	16	12	9	3	9	4.0
-shaft	1	1	1	0	1	0.5
-distal	11	8	4	4	4	4.0
Ulna:						
-proximal	13	10	5	5	5	5.0
-shaft	1	1	0	1	1	0.5
-distal	5	4	0	4	4	2.0

Table 8.13 (Continued)

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
Carpals:						
-radial	10	10	9	1	9	5.0
-internal	4	4	2	2	2	2.0
-ulnar	7	7	5	2	5	3.5
-2nd/3rd	5	5	5	0	5	2.5
-unciform	10	10	6	4	6	5.0
-accessory	4	4	3	1	3	2.0
5th metac.	3	3	2	1	3	1.5
Metacarpal:						
-proximal	12	9	7	2	7	4.5
-shaft	5	2	1	1	1	1.0
-distal	6	6	3	3	3	3.0
-complete	1	1	0	1	1	0.5
Innominate:						
-acetabul.	16	10	4	6	6	5.0
-other	1	1	1	0	1	0.5
Femur:						
-shaft	2	2	2	1	2	1.0
-distal	2	2	1	1	1	1.0
Patella	4	4	4	0	4	2.0
Tibia:						
-shaft	4	3	1	2	2	1.5
-distal	4	3	1	2	2	1.5
Lat. mall.	2	2	1	1	1	1.0
Tarsals:						
-calcaneus	9	9	5	4	5	4.5
-astragalus	8	8	1	7	7	4.0
-cen./4th	10	10	4	6	6	5.0
-2nd/3rd	10	10	4	6	6	5.0
-1st	3	3	0	3	3	1.5
2nd metat.	1	1	0	1	1	0.5
Metatarsal:						
-proximal	9	9	2	7	7	4.5
-shaft	7	3	1	2	2	1.5
1st phal.	30	26	-	-	4	3.3
2nd phal.	26	26	-	-	4	3.3
3rd phal.	23	23	-	-	4	2.9
S. med. ses.	19	19	-	-	3	2.4
S. lat. ses.	13	13	-	-	2	1.6
Infer. ses.	8	8	-	-	1	1.0

Twenty-four sub-adult appendicular specimens are represented in the sample of Block 3 bison specimens. These sub-adult specimens include immature elements, unfused epiphyses and shafts, and partially fused items Ten immature elements were identified including one calcaneus, one fused 2nd/3rd tarsal, the proximal end and shaft of one metatarsal, one second phalanx, two third phalanges, and four superior medial sesamoids.

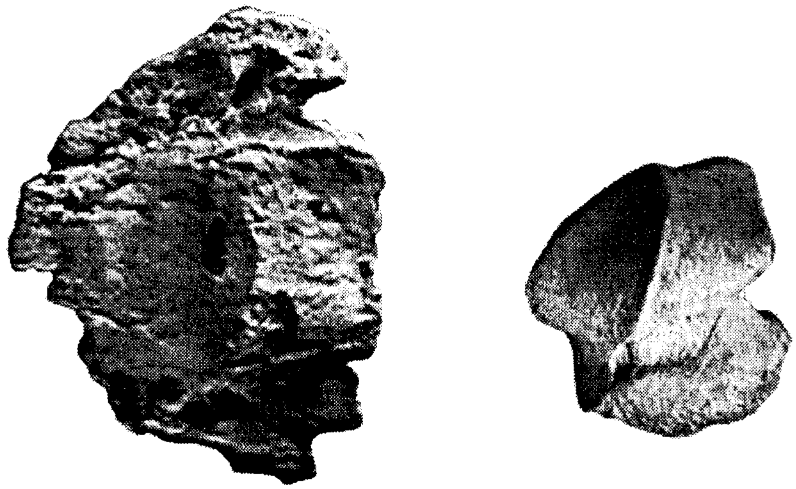
Unfused appendicular specimens, which refer to either unfused shafts, epiphyses or both, include one distal radial carpal articular facet, two metacarpal shafts, one distal femoral lateral condyle and patellar groove, two calcanei, two metatarsal shafts, and two first phalanges. Three partially fused appendicular specimens, identified as such since the line of fusion is still visible, were also found in Block 3. These specimens include a complete distal radius portion, a femoral medial condyle, and a complete metatarsal distal portion.

The unfused appendicular specimens described above indicate, as they do in Block 1 and Block 2, that there is some variation in the ages of the bison represented in the sample. The age range represented by these unfused appendicular specimens is, again, 2 to 6 years. The proximal epiphysis of the first phalanx fuses by the beginning of the 2 year, the distal epiphysis of both the metacarpal and metatarsal fuses in the 3rd year, both the tuber calcis of the calcaneus and the distal epiphysis of the radius fuse during the 5th year in male bison and during the 6th year in female bison, and the distal epiphysis of the femur fuses during the 5th year (Empel and Roskosz 1963 cited in Dyck and Morlan 1995: 564-583). One should be aware that these fusion rates have been determined from studies that utilized European bison, *Bison bonasus*.

Irregular bone growths caused by an inflammatory response can be seen on two of the carpals from Block 3. One is a left ulnar carpal and the other is a right unciform carpal (Figure 8.1a and Figure 8.1b). Although these elements were not found together, it appears as though they are from the same individual.

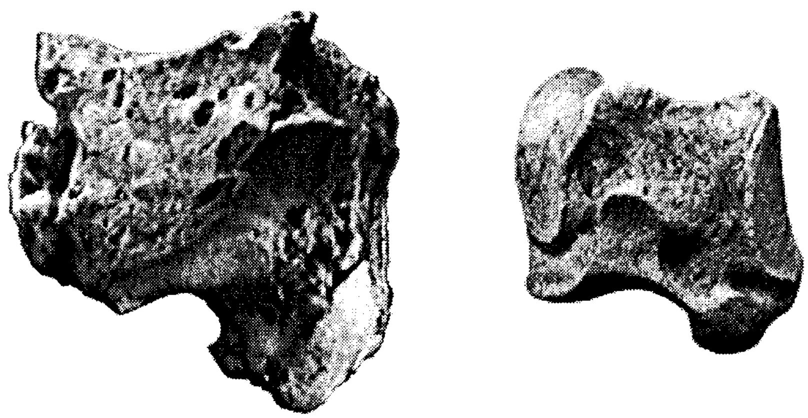
One of the nearly complete scapula from Block 3 has impact marks along the caudal border of the blade. They may have occurred during disarticulation of the skeleton in an attempt to separate the scapula from the axial region or in an attempt to loosen the infraspinatus muscle.

Humeri from Block 3 are commonly broken at the distal end of the shaft, above the radial and olecranon fossae. Breaks on the anterior and posterior shafts of these specimens are variable. On one specimen the anterior shaft is fractured approximately 56 mm above the radial fossa and the posterior shaft is fractured just above the olecranon fossa. On a second specimen the anterior shaft is fractured just above the radial fossa and the posterior shaft is fractured much higher up, approximately 107 mm above the olecranon fossa. On a third specimen the shaft is fractured near the mid-point; on the anterior shaft this is just above the nutrient foramen or 43 mm above the radial fossa, while on the posterior and medial side the shaft splinter extends higher, approximately 140 mm above the olecranon fossa. On the final nearly complete distal humerus portion the anterior shaft is broken approximately 25 mm above the radial fossa, but the break



FhNa-10-20907 FhNa-10-23563

Figure 8.1 a Bison Unciform Carpal on the Left Exhibits Abnormal Bone Growth. Bison Unciform Carpal on the Right is Normal.



FhNa-10-21957 FhNa-10-23562

Figure 8.1 b Bison Ulnar Carpal on the Left Exhibits Abnormal Bone Growth. Bison Ulnar Carpal on the Right is Normal

extends diagonally down to the medial condyle. Posteriorly, the fracture extends through the olecranon fossa. The lateral and medial epicondyles are missing due to carnivore chewing. Two other distal humerus fragments show that it was also common to break the distal end of the humerus longitudinally. In both instances the fracture runs longitudinally through the groove separating the medial and lateral condyles. Humerus shaft fragments possessing distinctive landmarks such as the teres major muscle attachments, deltoid tuberosity and posterior shaft muscle attachments were also recovered. The only proximal humerus fragment found in Block 3 is the articular surface of the humerus head and bicipital groove. It is broken between the head and the greater tuberosity. This likely resulted from disarticulation of the skeleton during butchering as the humerus and scapula were being separated.

Of the 24 radius specimens found in Block 3 six are complete proximal radius portions. These specimens are commonly broken on the medial side below the brachialis muscle scar across to the lateral side just below the nutrient foramen. On one specimen the fracture on the lateral side is closer to the proximal end occurring just under the lateral tuberosity. In three instances the fracture occurs further down the shaft at a point between the mid-shaft and the proximal end. In these cases the shaft of the ulna has been removed from the radius and impact marks can be seen on the anterior shaft of one specimen. Nine radius proximal portion fragments from Block 3 are also represented in the sample. These consist of either the medial fossa and brachialis muscle scar or the lateral fossa, tuberosity and a small segment of the lateral shaft. Two specimens are broken either through the medial fossa or between the medial and lateral fossae with the fracture extending down the shaft along the ulnar articular surface to the distal end of the shaft and then across to the medial side. Only one complete distal radial carpal articular facet and shaft portion was found. This partially fused specimen is fragmented on the lateral side approximately 35 mm above the carpal articular facet and shaft fusion line and the medial side terminates in sharp, jagged points higher up on the shaft. Five radius distal end fragments generally from the medial carpal articular side are also present in the collection.

Block 3 ulnae are generally broken along the shaft below the trochlear notch or in the semi-lunar notch and trochlear notch articular regions. Three specimens consist of fairly complete proximal portions broken immediately below the trochlear notch or along the shaft between the nutrient foramen and the radius/ulna shaft fusion region. Three other specimens consist of portions of the olecranon process broken above the semi-lunar notch. These fragments probably resulted from the disarticulation of the humerus, radius, and ulna elements. The remaining ulna specimens are fragments of the articular region created by the disarticulation of the ulna and radius.

Twenty-six metacarpal specimens were found in Block 3. They are commonly fractured along the shaft or through the proximal articular facets. Two complete proximal metacarpal specimens have spiral fractures of the shaft extending from just below the lateral facet diagonally across to well below the medial facet. The remaining two complete proximal metacarpal portions are broken across the shaft closer to the mid-shaft region. Two proximal fragments, one consisting of the lateral facet and a segment of the anterior shaft and the second consisting of the medial facet and posterior/anterior shaft, were refitted in the laboratory to form a complete proximal portion. A spiral fracture extends from below the lateral articular facet diagonally across the shaft to the medial side. The specimen was then split longitudinally between the medial and lateral articular facets. Four medial facet and shaft segments and three lateral facet and shaft segments complete the sample of proximal metacarpal specimens. Complete metacarpal distal portions are broken across the shaft generally between the nutrient foramen and the mid-shaft region. Two metacarpal shafts with complete circumferences were found. Both are unfused at the distal end. One is broken across the shaft just below the mid-shaft region and the other is broken just below the proximal articular surface.

Very few femur specimens were found in Block 3. One partially fused distal femur specimen consists of the medial condyle, patellar groove and a portion of the shaft. The anterior shaft is broken in a "V" approximately 20 mm above the fusion line, while posteriorly the shaft is broken closer to the proximal end. Two of the femur specimens are posterior shaft segments fractured just above the supracondyloid fossa and through the medial portion of the supracondyloid fossa.

Block 3 tibia specimens consist of shaft fragments with distinctive landmarks, fragments of the distal articular end, and one complete distal portion. The complete distal specimen is broken at the distal end of the shaft; however, the medial and lateral sides extend higher up terminating in jagged spikes.

Fragmentation of the metatarsal specimens is very similar to that seen in the metacarpal specimens. They are commonly fragmented in three areas of the shaft: near the proximal end, near the distal end or in the mid-shaft region. Fragmentation of metacarpals and metatarsals differ in that the latter are rarely broken longitudinally through the articular facets. Only one proximal metatarsal specimen is broken through the articular facets and in this case the fracture runs transversely in a medial to lateral direction, rather than longitudinally or anterior to posterior. Seven of the proximal metatarsal specimens are complete portions generally exhibiting spiral fractures running diagonally across the shaft. Five of the metatarsal specimens are complete distal portions with shaft segments of varying lengths. Two unfused metatarsal shafts have complete circumferences with the shaft broken near the mid-point.

In order to expose the medullary cavity of first phalanges, they are fragmented in a variety of ways. Two specimens are fractured through the shaft just above the distal end. Two are fractured transversely just below the proximal end, as well as longitudinally through the proximal surface. Two are fractured transversely across the shaft just above the distal end, as well as longitudinally through the distal articular surface. The medullary cavity and cancellous tissue of one of these specimens appears to have been scooped out. One first phalanx is split longitudinally.

The only fragmented second phalanx from Block 3 is calcined and all of the third phalanges are relatively complete. Those that are not have been modified by carnivores or show evidence of recent trauma.

Two articular units were recognized in the collection of appendicular specimens from Block 3. One grouping consists of four left tarsals—fused 2nd/3rd, fused central/4th, calcaneus, and astragalus—and a proximal metatarsal specimen. The fused 2nd/3rd tarsal and the metatarsal were found in the southwest quadrant of unit 213S 125E and the remaining tarsals were found in the northwest quadrant of unit 212S 124E. The second tarsal grouping consists of two tarsals, a right fused central/4th and a right fused 2nd/3rd tarsal. Both elements were found in the northwest quadrant of unit 212S 122E.

8.4.4 Family Cervidae

Less than 1% of the identified faunal sample from Block 3 are cervid specimens (N=19). The identified species include moose (N=10), elk (N=1), and moose or elk (N=8) remains. Moose or elk material consists of one axial specimen and seven appendicular specimens weighing a total of 170.6 g. The axial specimen is a right petrous portion of the temporal bone.

The moose or elk appendicular specimens consist of two right radius proximal fragments, one left tibia shaft fragment, and four phalanges. One radius specimen consists of the lateral fossa and tuberosity. The second radius specimen is split longitudinally through the proximal articular surface and the anterior shaft exhibits a rectangular fracture. An impact mark is also visible on the anterior shaft. The tibia consists of an unfused distal shaft, the distal epiphysis was not recovered. The shaft is broken at approximately 11.0 cm from the epiphysis/shaft fusion line. The phalanges consist of one first phalanx, one second phalanx, and two dew claws. The epiphyseal fusion line between the proximal epiphysis and shaft of the first phalanx is still visible. These two phalanges were recovered from the same area and they form an articular unit.

8.4.5 Family Cervidae, *Alces alces* [Moose]

Most of the cervid remains are moose, ten specimens weighing 591.9 g. Two of the moose specimens are axial items, a right premaxilla and an upper left P2.

The majority of moose specimens are from the appendicular region of the skeleton (Table 8.14). This sample represents a minimum number of one individual.

Table 8.14 Block 3 - Moose Appendicular NISP

Element	Left	Right	Indt.	Total	Weight (g)	NISP%
Humerus	1	0	0	1	411.1	12.5
Femur	0	1	0	1	79.1	12.5
Tibia	0	1	0	1	42.4	12.5
2nd phal.	0	0	2	2	19.5	25.0
3rd phal.	0	0	1	1	10.0	12.5
S. med. ses.	0	0	1	1	2.9	12.5
S. lat. ses.	0	0	1	1	3.2	12.5
Total	1	2	5	8	568.2	100.0

The tibia and femur specimens are shaft fragments containing distinguishing landmarks which enable a species identification to be made. The humerus consists of a complete distal end and the distal portion of the shaft. A spiral fracture extends through the shaft just above the nutrient foramen. The marrow cavities of the two second phalanx specimens have been exposed by fracturing the specimens just above the distal articular ends.

8.4.6 Family Cervidae, *Cervus canadensis* [Elk]

Only one elk specimen, weighing 110.3 g, is represented in the faunal material associated with Block 3. The specimen is the ilium portion of a right innominate.

8.4.7 Order Carnivora, Family Ursidae *Ursus americanus* [American Black Bear]

Two black bear specimens were identified in the faunal material associated with Block 3 of Bushfield West. One specimen is the centrum or body portion of the sacrum. The other specimen is a complete third phalanx.

8.4.8 Family Canidae, *Canis lupus* or *Canis familiaris* [Gray Wolf or Domestic Dog]

Seven specimens weighing 20.6 g from Block 3 represent either gray wolf or domestic dog. These specimens are larger and more robust than the coyote specimens in the comparative collection. The specimens are also incomplete; therefore, it is impossible to differentiate between the gray wolf and domestic dog, which can be similar in size.

The material includes two axial specimens and five appendicular specimens. The axial specimens consist of two atlas vertebral fragments. They are lateral portions of the atlas (pre-zygapophysis and wing) and represent a minimum of one element.

The appendicular items include a right scapholunar carpal fragment, an innominate fragment, a right calcaneus fragment, the proximal end of a right fibula, and one first phalanx.The first phalanx is nearly complete. Based on the porous appearance of the cortical bone, the scapholunar, calcaneus, and ilium are immature specimens.

8.4.9 Family Canidae, *Canis latrans* or *Canis familiaris* [Coyote or Domestic Dog]

Four specimens weighing 4.5 g represent either coyote or domestic dog. Only one item is an axial specimen, a complete rib. The appendicular specimens include a fibula shaft fragment, one complete left 4th metacarpal, and one right 5th metatarsal fragment. The 5th metatarsal is broken towards the distal end of the shaft and consists of the proximal end and shaft portion.

8.4.10 Family Felidae *Lynx canadensis* [Lynx]

One lynx specimen weighing 4.1 g was found in Block 3. The specimen is the anterior and medial portion of a left mandible without socketed teeth.

8.4.11 Family Mustelidae *Taxidea taxus* [American Badger]

Two specimens, weighing 7.9 g, recovered from Block 3 at Bushfield West are badger remains. The specimens are a right scapula and a left femur. The scapula specimen is the glenoid fossa and neck portion.

8.4.12 Order Lagomorpha, Family Leporidae, *Lepus americanus* [Snowshoe Hare]

Twenty-one specimens recovered from Block 3 are lagomorph remains and they represent a single species, snowshoe hare. Snowshoe hare remains make up <1% of the identifiable fauna associated with Block 3. Six of the snowshoe hare items are axial specimens. All of the axial specimens except for one; a nearly complete lumbar vertebra; are cranial portions. Table 8.15 lists the identified snowshoe hare axial specimens.

Table 8.15 Block 3 - Snowshoe Hare Axial NISP

Element	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Skull:							
-maxilla	1	3	0	0	4	1.1	66.7
-upper M	1	0	0	0	1	0.1	16.7
Vertebra:							
-lumbar	0	0	0	1	1	0.6	16.7
Total	2	3	0	1	6	1.8	100.1

The majority of snowshoe hare remains are appendicular specimens (N=15). Only one specimen is from the forelimb, one is a phalanx, one is a innominate fragment, and the remaining 11 specimens are from the hindlimb. Eleven of the appendicular specimens are complete or nearly complete elements. The fragmented items consist of the humerus, the innominate, and two tibia specimens. Table 8.16 lists the identified snowshoe hare appendicular specimens.

Table 8.16 Block 3 - Snowshoe Hare Appendicular NISP

Element	Left	Right	Indt.	Total	Weight (g)	NISP%
Humerus	1	0	0	1	0.2	6.7
Innominate	1	0	0	1	0.2	6.7
Femur	1	1	0	2	6.2	13.3
Tibia	2	1	0	3	5.8	20.0
Calcaneus	1	2	0	3	1.4	20.0
2nd metat.	0	1	0	1	0.5	6.7
3rd metat.	0	1	0	1	0.5	6.7
4th metat.	0	1	0	1	0.4	6.7
5th metat.	0	1	0	1	0.1	6.7
1st phal.	0	0	1	1	0.1	6.7
Total	6	8	1	15	15.4	100.2

Block 3 snowshoe hare remains represent a minimum of two individuals based on the recovery of two right calcanei. NISP, MNE, MNI, and MAU values are presented in Table 8.17.

Table 8.17 Block 3 - Snowshoe Hare NISP/MNE/MNI/MAU

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
Skull:						
-maxilla	4	2	1	1	1	1.0
Humerus:						
-proximal	1	1	1	0	1	0.5
Innominate:						
-acetabul.	1	1	1	0	1	0.5
Femur:						
-near compt.	2	2	1	1	1	1.0
Tibia:						
-proximal	1	1	1	0	1	0.5
-distal	1	1	1	0	1	0.5

Table 8.17 (Continued)

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
-near compt.	1	1	0	1	1	0.5
Tarsal:						
-calcaneus	3	3	1	2	2	1.5
Metatarsal:						
-2nd	1	1	0	1	1	0.5
-3rd	1	1	0		1	0.5
-4th	1	1	0	1	1	0.5
-5th	1	1	0	1	1	0.5
1st phal.	1	1	0	0	1	0.1

The humerus specimen is an unfused proximal epiphysis. The distal tibia specimen is fractured towards the distal end of the shaft. The second fractured tibia specimen is broken between the mid-shaft and the distal end of the shaft.

8.4.13 Order Rodentia, Family Castoridae *Castor canadensis* [Beaver]

A large percentage (37%) of the identified faunal remains associated with Block 3 are beaver, 491 specimens weighing 940.4 g. Most of the beaver remains (71%), are axial specimens (N=351). They consist of cranial fragments (N=104), mandible fragments (N=24), individual teeth (N=65), vertebral fragments (N=84), rib fragments (N=73), and one sternum fragment. The sample of axial specimens contains 27 complete and 29 nearly complete elements. The majority of complete or nearly complete elements are cranial portions (N=26), followed by individual teeth (N=16), vertebrae (N=7), ribs (N=4), and mandibles (N=3). Complete or nearly complete cranial elements include two nasals, three frontals, two interparietals, two occipitals, two occipital condyles, one basisphenoid, one sphenoid, two premaxillae, three zygomatic arches, one petrous portion of the temporal bone, and one external auditory meatus. Table 8.18 is a summary of the identified beaver axial specimens found in Block 3. The axial specimens represent a minimum number of eight individuals based on the recovery of eight right frontal specimens which represent separate elements.

One of the maxilla specimens with socketed teeth is actually the rostrum portion of the cranium with fused right and left maxillae and right and left premaxillae. The socketed teeth include the following: right I1 (partial), P4, M1, M2, and M3; left I1 (partial), M1, M2, and M3. The remaining two maxilla specimens with socketed teeth are from the right side of the cranium and they have the following teeth: M1, M2, and M3; P4 and M1. Three nearly complete mandibles, two left and one right, were also recovered from Block 3. The right mandible has the following socketed teeth: P4, M1, M2, and M3. One left mandible has a complete set of socketed teeth: I1, P4, M1, M2, and M3. The second left mandible has only three socketed teeth: I1, M1, and M2.

Table 8.18 Block 3 - Beaver Axial NISP

Element	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Skull:							
-frontal	3	8	0	0	11	13.5	3.1
-nasal	3	4	0	0	7	4.1	2.0
-premaxilla	2	2	0	0	4	20.7	1.1
-temporal	5	7	0	0	12	20.4	3.4
-zygomatic	4	7	0	0	11	17.9	3.1
-parietal	7	6	0	0	13	7.8	3.7
-interpariet.	0	0	0	2	2	2.9	0.6
-maxilla	2	7	1	0	10	6.9	2.8
-maxilla/th.	1	2	0	0	3	39.9	0.9
-sphenoid	1	1	0	1	3	2.2	0.9
-basisphen.	0	0	0	1	1	1.1	0.3
-petrous	0	1	0	0	1	4.4	0.3
-basioccipit.	0	0	0	1	1	1.0	0.3
-occipital	2	1	0	4	7	13.8	2.0
-occip. con.	4	2	0	0	6	6.5	1.7
-aud. bulla	1	0	0	0	1	0.9	0.3
-ext. aud.	0	4	0	0	4	2.7	1.1
-jug. pro.	2	0	0	0	2	0.6	0.6
-indt. cran.	0	0	4	0	4	2.6	1.1
-upper I	0	4	4	0	8	10.3	2.3
-upper dp4	0	2	0	0	2	3.9	0.6
-upper dm1	1	2	0	0	3	5.9	0.9
-upper dm2	1	0	0	0	1	1.6	0.3
-upper dm3	3	0	0	0	3	11.6	0.9
Mandible:							
-coronoid	2	3	0	0	5	64.1	1.4
-condyle	3	2	0	0	5	33.1	1.4
-hor. ramus	4	3	0	0	7	8.3	2.0
-man. sym.	2	2	0	0	4	3.4	1.1
-mandible	2	1	0	0	3	59.6	0.9
-lower I	1	2	1	0	4	7.4	1.1
-lower dp4	1	0	0	0	1	0.8	0.3
-lower P4	2	0	0	0	2	4.8	0.6
-lower dm2	0	2	0	0	2	4.1	0.6
-lower M3	1	0	0	0	1	0.8	0.3
Indeterminate Teeth:							
-indt. I	0	0	31	0	31	9.2	8.8
-Pre/Molar	0	0	3	0	3	3.0	0.9
Vertebra:							
-atlas	0	0	0	4	4	8.4	1.1
-axis	0	0	0	2	2	1.4	0.6
-cervical	0	0	0	1	1	0.9	0.3
-thoracic	0	0	0	38	38	20.3	10.8
-lumbar	0	0	0	14	14	18.6	4.0
-sacrum	0	0	0	1	1	0.8	0.3
-caudal	0	0	0	20	20	20.6	5.7

Table 8.18 (Continued)

Element	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
-indt. vert.	0	0	0	4	4	0.7	1.1
Rib:							
-head	0	0	1	0	1	0.4	0.3
-head/neck	0	0	25	0	25	14.1	7.1
-neck/tub.	0	0	4	0	4	1.8	1.1
-neck	0	0	4	0	4	0.9	1.1
-neck/body	0	0	4	0	4	2.8	1.1
-body	0	0	34	0	34	14.8	9.7
-sternal	0	0	1	0	1	0.2	0.3
-rib ncmpt.	0	0	3	0	3	1.8	1.1
-rib cmpt.	0	0	1	0	1	0.5	
Sternum:							
-xiphoid	0	0	0	1	1	0.2	0.3
Total	60	76	121	94	351	506.9	99.4

A total of 12 individual cheek teeth—three fourth premolars, three first molars, three second molars, and three third molars—are immature. On one specimen the longitudinal folds on the crown do not extend the full length of the tooth and the root base is open. This specimen represents an individual that is less than 2 years old (van Nostrand and Stephenson 1964). On the remaining specimens the longitudinal folds extend the full length of the teeth; however, the root bases are not yet closed. The basal opening of M1 is closed by 3 to 4 years of age, while small openings may remain at the bases of M2 and M3. At 4.5 to 5 years the basal openings of all of the molar teeth have closed (van Nostrand and Stephenson 1964). Therefore, these specimens represent individuals which are less than 5 years of age.

Unfused, partially fused, and immature cranial, vertebral, and rib specimens also form part of the beaver faunal assemblage associated with Block 3. Seventeen cranial fragments—four frontals, five parietals, one interparietal, one sphenoid, one maxilla, one premaxilla, two zygomatic arches, one temporal, and one indeterminate cranial—are unfused. One zygomatic arch is immature. Twenty-one unfused specimens are vertebral centra and 12 are vertebral epiphyses. Twenty-six rib specimens are unfused. They include—one rib head, 17 head/neck portions, two neck/tuberosities, three body portions, and the three nearly complete ribs.

Appendicular specimens (N=140) account for 29% of the beaver remains from Block 3 (Table 8.19). The majority of appendicular items are hindlimb specimens (N=78). Forelimb specimens (N=39) and phalanges (N=23) account for the remainder of the appendicular items. In the sample of appendicular specimens there are 14 complete elements and four nearly complete elements Most of the complete elements are from the lower regions of the forelimb and hindlimb—one carpal, three tarsals, two first phalanges, one second phalanx, and three third phalanges. There are also two complete clavicles present in the sample. The nearly complete elements are larger and consist of one scapula, one ulna, and one femur.

Table 8.19 Block 3 - Beaver Appendicular NISP

Element	Left	Right	Indt.	Total	Weight (g)	NISP%
Clavicle	0	2	0	2	3.9	1.4
Scapula	2	7	0	9	18.6	6.4
Humerus	4	6	0	10	42.8	7.1
Radius	3	3	0	6	5.9	4.3
Ulna	5	4	0	9	28.8	6.4
Accessory	0	1	0	1	0.3	0.7
2nd metac.	1	1	0	2	0.5	1.4
Innominate	6	15	1	22	71.1	15.7
Femur	8	4	1	13	154.8	9.3
Patella	0	1	0	1	1.3	0.7
Tibia	7	5	0	12	69.8	8.6
Fibula	7	9	0	16	10.7	11.5
Astragalus	1	2	0	3	4.0	2.1
Navicular	1	0	0	1	0.8	0.7
Cuboid	0	1	0	1	0.5	0.7
Med. cune.	1	0	0	1	0.5	0.7
Int. cunei.	1	0	0	1	0.1	0.7
1st metat.	1	1	0	2	1.5	1.4
2nd metat.	1	1	0	2	1.9	1.4
3rd metat.	0	2	0	2	2.2	1.4
4th metat.	0	1	0	1	2.9	0.7
1st phal.	0	0	13	13	9.2	9.3
2nd phal.	0	0	5	5	1.1	3.6
3rd phal.	0	0	5	5	1.2	3.6
Total	49	66	25	140	433.5	99.8

NISP, MNE, MNI, and MAU values shown in Table 8.20 give an indication of the degree of fragmentation and representation of element portions.

Table 8.20 Block 3 - Beaver NISP/MNE/MNI/MAU

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
Skull:						
-frontal	11	11	3	8	8	5.5
-other	11	9	3	6	6	4.5
Mandible:						
-coronoid	5	5	3	2	2	2.5
-condyle	5	5	2	3	3	2.5
-hor. ramus	7	3	2	1	2	1.5
-man. sym.	4	2	1	2	2	1.0
-n. compt.	3	3	2	1	2	1.5
Clavicle	2	2	0	2	2	1.0
Scapula:						
-glenoid	5	5	1	4	4	2.5
-other	3	3	1	2	2	1.5

Table 8.20 (Continued)

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
Humerus:						
-proximal	1	1	0	1	1	0.5
-shaft	4	4	1	3	3	2.0
-distal	5	5	3	2	3	2.5
Radius:						
-proximal	1	1	1	0	1	0.5
-shaft	5	4	2	2	2	2.0
-distal	1	1	1	0	1	0.5
Ulna:						
-proximal	5	5	1	4	4	2.5
-shaft	2	1	1	0	1	0.5
-distal	1	1	1	0	1	0.5
-n. compt.	1	1	0	1	1	0.5
Carpals:						
-accessory	1	1	0	1	1	0.5
2nd metac.	2	2	1	1	1	1.0
Innominate:						
-acetabul.	5	5	2	3	3	2.5
-other	7	4	3	1	3	2.0
Femur:						
-proximal	1	1	1	0	1	0.5
-shaft	9	9	6	3	6	4.5
-distal	1	1	1	0	1	0.5
-near cmpt.	1	1	0	1	1	0.5
Patella	1	1	0	1	1	0.5
Tibia:						
-proximal	3	3	1	2	2	1.5
-shaft	6	5	3	2	3	2.5
-distal	3	3	2	1	2	1.5
Fibula:						
-proximal	1	1	1	0	1	0.5
-shaft	9	4	1	3	3	2.0
-distal	6	6	3	3	3	3.0
Tarsals:						
-astragalus	3	3	1	2	2	1.5
-int. cunei.	1	1	0	1	1	0.5
-med. cunei	1	1	1	0	1	0.5
-cuboid	1	1	0	1	1	0.5
-navicular	1	1	1	0	1	0.5
1st metat.	3	3	1	2	2	1.5
2nd metat.	2	2	1	1	1	1.0
3rd metat.	2	2	1	1	1	1.0
4th metat.	1	1	0	1	1	0.5
1st phal.	13	13	-	-	1	0.7
2nd phal.	5	5	-	-	1	0.3
3rd phal.	5	5	-	-	1	0.3

Forty-four percent (N=61) of the beaver appendicular specimens are sub-adult or juvenile. These specimens are either partially fused, unfused, or immature. Most of unfused appendicular specimens are first phalanges (N=7). Unfused epiphyses consist of long bone and vertebral epiphyses. The various appendicular epiphyses, unfused, partially fused, and immature specimens are shown in Table 8.21.

Table 8.21 Block 3 - Juvenile Beaver Appendicular Specimens

Specimen	Partially Fused		Unfused		Unfused Epip.		Immature	
	Freq.	Weight	Freq.	Weight	Freq.	Weight	Freq.	Weight
Clavicle	0	0.0	1	0.5	0	0.0	1	1.1
Scapula	0	0.0	0	0.0	0	0.0	3	4.7
Humerus	0	0.0	2	18.2	1	7.8	1	2.1
Radius	0	0.0	5	5.7	1	0.2	0	0.0
Ulna	0	0.0	2	10.9	1	0.2	0	0.0
Metacarpal	0	0.0	2	0.5	0	0.0	0	0.0
Innominate	0	0.0	3	7.9	1	0.2	2	6.8
Femur	0	0.0	6	106.7	2	1.3	0	0.0
Tibia	1	0.7	2	35.2	4	7.8	0	0.0
Fibula	0	0.0	4	2.0	3	1.3	0	0.0
Metatarsal	0	0.0	3	4.4	1	0.2	0	0.0
1 st phal.	0	0.0	8	5.4	0	0.0	0	0.0
2nd phal.	0	0.0	1	0.1	0	0.0	0	0.0
Total	1	0.7	39	197.9	14	19.0	7	14.7

*Weight is in grams.

Most of the long bone epiphyses are separated into proximal epiphyses (N=5) and distal epiphyses (N=8). Proximal epiphyses include one radius proximal fossa, one femoral head, two tibial condyles, and one 1st metatarsal proximal epiphysis. Distal epiphyses consist of one humerus distal condyle, one ulnar styloid process, one femoral lateral condyle, two tibia distal epiphyses, and three distal fibula epiphyses. The unfused innominate specimen is an ilium tuber.

Most of fragmented humerus specimens consist of various shaft segments. A deltoid crest fragment and a distal condyle fragment were also recovered. Two specimens are broken through the shaft either just above or just below the deltoid crest. Two ulna shaft specimens are present. There are also two semi-lunar or trochlear notch specimens, with little or no shaft portion remaining. Most of the ulna specimens are broken towards the distal end of the shaft. Two of the radius specimens are broken near the distal end of the shaft, one is fractured at the proximal end, and one consists of a shaft segment.

The innominate is highly fragmented, especially the ischium and pubis portions. Two specimens consisting of the acetabulum and ilium are broken across the branches of the ischium and pubis. Ilium specimens are either broken at the acetabulum or the narrow area between the acetabulum and the sacral articular surface.

Four of the femur shaft specimens are broken at the distal end just above the condyles. The proximal ends of these specimens are unfused. One specimen is broken at both the proximal and distal ends of the shaft, as well as longitudinally down the mid-line of the shaft. Two broken third trochanter specimens were also found. The only proximal specimen is an unfused femoral head and the only distal specimen is a fractured lateral condyle. The fractured tibia specimens consist of various portions of the shaft. The proximal and distal specimens are unfused epiphyses. Fibulae appear to be fractured randomly at various points along the shaft. Only one proximal specimen is present and it is broken at the proximal end of the shaft. The distal specimens are unfused epiphyses.

8.4.14 Family Cricetidae *Ondatra zibethicus* [Muskrat]

Three muskrat specimens, weighing 1.2 g, were identified in the faunal material associated with Block 3. They represent a minimum of one individual. Two are axial specimens—a fused right and left frontal bone and a right maxilla fragment with a socketed M2 tooth. The other specimen is appendicular consisting of a left humerus shaft fragment.

8.4.15 Family Geomyidae *Thomomys talpoides* [Northern Pocket Gopher]

Two northern pocket gopher specimens, weighing 0.4 g, are represented in the fauna from Block 3. The specimens consist of a fused right and left maxillae, without socketed teeth, and a complete left tibia.

8.5 Class Aves

Bird remains form 3% of the identifiable faunal assemblage associated with Block 3. The sample of avian fauna consists of 89 specimens weighing 52.2 g. Several of the bird bones are highly fragmented and lack diagnostic characteristics; therefore, they cannot be identified as to species. Also, several species of a single subfamily commonly occupy the same range and the skeletal elements of these species are often indistinguishable. A total of 27 bird specimens (30% of the avian fauna) can only be identified to the taxonomic level of order and are classified as unidentified bird specimens. These are sub-divided into two general size categories—medium bird and large bird.

Six of the unidentified bird specimens, weighing 1.1 g, are medium-sized bird remains. This collection includes two axial specimens, two wing specimens, one leg specimen, and one indeterminate long bone shaft fragment. The axial specimens include a sternum body fragment and a rib fragment. Wing specimens include an ulna shaft fragment and a portion of the humerus head. A tibiotarsus shaft fragment is from the right leg.

The majority of unidentified bird specimens are large bird remains (N=21, 18.8 g). Almost all of the large bird specimens are from the appendicular region of the skeleton. Only one axial specimen, the parietal bone of the cranium, is present in the sample. Most of the specimens are indeterminate long bone shaft specimens (N=18). The remaining appendicular specimens are an ulna shaft fragment and a right tibiotarsus shaft fragment.

8.5.1 Order Anseriformes, Family Anatidae, Tribe Cygnini, *Cygnus* sp. [Swan]

Only one swan specimen, a humerus shaft fragment weighing 0.6 g, is represented in the avian faunal sample from Block 3.

8.5.2 Order Anseriformes, Family Anatidae, Tribe Anserini [Geese]

The majority of waterfowl remains associated with Block 3 are geese (N=36). Specimens identified as geese account for 40% of the avian faunal sample. Both axial specimens (N=23) and appendicular specimens (N=13) are present in the sample. All of the axial specimens are portions of the sternum—two keel, two sternal rib facets, two coracoid facets, and 17 body fragments. All of the sternum specimens were found in the same unit (212S 118E) along the northern edge of Block 3. Several of the fragments were refitted in the laboratory and it is quite likely that all of them form a single element.

The appendicular specimens are from both the upper and lower regions of the wings (N=9) and legs (N=4). Table 8.22 summarizes the geese appendicular specimens recovered from Block 3.

Table 8.22 Block 3 - Geese Appendicular NISP

Element	Left	Right	Indt.	Total	Weight (g)	NISP%
Scapula	1	0	0	1	0.3	7.7
Coracoid	2	2	0	4	2.6	30.8
Radius	0	1	0	1	0.3	7.7
Ulna	1	0	0	1	1.4	7.7
Scapholun.	1	0	0	1	0.2	7.7
Innominate	0	1	0	1	0.2	7.7
Tibiotarsus	1	2	0	3	0.7	23.1
2nd digit:						
-2nd phal.	0	1	0	1	0.2	7.7
Total	6	7	0	13	5.9	100.1

The sample of geese remains represents a minimum of one individual. The only complete element is the 2nd phalanx. The remaining specimens are highly fragmented resulting in inflated NISP counts and low MNE and MNI values. Table 8.23 shows the NISP, MNE, MNI, and MAU counts for the geese remains associated with Block 3.

Table 8.23 Block 3 - Geese NISP/MNE/MNI/MAU

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
Sternum:						
-keel	2	1	-	-	1	1.0
-cora. facet	2	1	-	-	1	1.0
-rib facet	2	1	-	-	1	1.0
-body	23	1	-	-	1	1.0
Scapula:						
-blade	1	1	0	1	1	0.5
Coracoid:						
-proximal	1	1	1	0	1	0.5
-distal	3	2	1	1	1	1.0
Ulna:						
-shaft	1	1	1	0	1	0.5
Radius:						
-distal	1	1	0	1	1	0.5
Carpals:						
-scapholun.	1	1	1	0	1	0.5
Innominate:						
-pubis	1	1	0	1	1	0.5
Tibiotarsus:						
-proximal	1	1	1	0	1	0.5
-shaft	1	1	0	1	1	0.5
-distal	1	1	0	1	1	0.5
2nd digit:						
-2nd phal.	1	1	0	1	1	0.5

8.5.3 Order Anseriformes, Family Anatidae, Tribe Anatini *Anas* sp. [Teal]

Teal are represented in the avian fauna associated with Block 3 by one specimen, weighing 0.3 g. The teal element is a nearly complete left carpometacarpus.

8.5.4 Order Anseriformes, Family Anatidae, *Anas platyrhynchos* [Mallard]

Mallard are represented in the avian fauna sample associated with Block 3 by one specimen weighing 0.6 g. This specimen is a left ulna shaft fragment.

8.5.5 Order Galliformes, Family Phasianidae, Subfamily Tetraoninae, [Grouse]

In terms of the number of identified specimens, the second largest avian taxon represented in Block 3 is grouse. A total of 19 specimens which represents 21% of the avian faunal sample associated with Block 3 are grouse. Only one item, a portion of the synsacrum, is from the axial region of the skeleton.

The majority of the grouse appendicular specimens are from the wing portion of the skeleton (N=14) (Table 8.24). The remaining items include three specimens from the leg region and one long bone shaft fragment. The sample consists of six nearly complete elements—three 2nd digit 1st phalanges, two carpometacarpi, and one tarsometatarsus.

Table 8.24 Block 3 - Grouse Appendicular NISP

Element	Left	Right	Indt.	Total	Weight (g)	NISP%
Coracoid	2	0	0	2	0.7	11.1
Humerus	1	0	0	1	0.5	5.6
Ulna	1	0	0	1	0.2	5.6
Carpometa.	3	4	0	7	1.2	38.9
Femur	1	0	0	1	0.3	5.6
Tibiotarsus	0	1	0	1	0.2	5.6
Tarsometa.	1	0	0	1	0.4	5.6
Lg. shaft	0	0	1	1	0.3	5.6
2nd digit:						
-1st phal.	1	2	0	3	0.3	16.7
Total	10	7	1	18	4.1	100.3

If all of the grouse specimens are from the same species this sample represents a minimum of three individuals. The MNI estimate is based upon the recovery of three right carpometacarpus specimens, two which are nearly complete and one shaft fragment. The NISP, MNE, MNI, and MAU estimates (based on the assumption that only one grouse species is represented) are presented in Table 8.25.

Table 8.25 Block 3 - Grouse NISP/MNE/MNI/MAU

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
Coracoid:						
-distal	2	2	2	0	2	1.0
Humerus:						
-proximal	1	1	1	0	1	0.5
Ulna:						
-distal	1	1	1	0	1	0.5
Carpometapus:						
-proximal	2	2	1	1	1	1.0
-shaft	1	1	0	1	1	0.5
-distal	2	2	2	0	2	1.0
-near cmpt.	2	2	0	2	2	1.0

Table 8.25 (Continued)

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
Femur:						
-proximal	1	1	1	0	1	0.5
Tibiotarsus:						
-shaft	1	1	0	1	1	0.5
Tarsometatarsus:						
-near cmpt.	1	1	1	0	1	0.5
2nd digit:						
-1st phal.	3	3	1	2	2	1.5

Medullary bone growth, a granular powdery substance, can be seen on the inner surface of the cortical bone of two of the grouse appendicular specimens. The specimens which have medullary bone are the femur and the indeterminate long bone. The medullary bone fills the entire cavity of the femur. There is still a small space visible in the cavity of the long bone specimen. These specimens were found in different areas of Block 3. The femur was found in the northeast corner and the long bone shaft fragment was found in the southwest corner.

8.5.6 Order Galliformes, Family Gruiidae, *Grus* sp. [Crane]

Four specimens, weighing 15.8 g, are identified as crane remains. One specimen is a right scapula consisting of the glenoid and neck portions. The remaining specimens include two right tibiotarsus shaft fragments and one tibiotarsus shaft fragment that cannot be sided. The two right tibiotarsus shaft fragments were refitted in the laboratory and; therefore, represent a single element.

8.6 Class Osteichtyes

A total of 425 specimens, weighing 114.5 g, are fish remains. They account for a significant percent (12%) of the identifiable fauna associated with Block 3. Seven species of fish are represented in the sample. However, over half of the fish specimens (N=254, 60%) cannot be identified to the level of species. The total weight of the unidentified fish specimens is 33.9 g. The largest categories of unidentified fish specimens consist of indeterminate cranial fragments (N=181), followed by vertebrae (N=49). As was the case with the previously described excavation blocks, the analyst did not examine the vertebrae to determine species. The remaining unidentified fish specimens consist of ribs (N=18), scales (N=5), and one premaxilla.

8.6.1 Order Acipenseriformes, Family Acipenseridae, *Acipenser fulvescens* [Lake Sturgeon]

The largest category of fish remains, according to NISP counts, is sturgeon. A total of 82 scute specimens, weighing 56.5 g, were recovered from Block 3, comprising 48% of the identifiable fish fauna. The majority of sturgeon scutes are highly fragmented, only six are complete elements and one is nearly complete.

8.6.2 Order Osteoglossiformes, Family Hiodontidae, *Hiodon alosoide* [Goldeye]

Two scales recovered from two different units in the central area of Block 3 are goldeye. They are complete specimens which aided in their species classification.

8.6.3 Order Salmoniformes, Family Esocidae, *Esox lucius* [Northern Pike]

Northern pike are represented in the sample of fish fauna by two specimens weighing 1.0 g. The two specimens are quadrates, one left and one right.

8.6.4 Order Cypriniformes, Family Cyprinidae, *Hiybopsis gracilis* [Flathead Chub]

Flathead chub is represented in Block 3 at Bushfield West by the recovery of one specimen weighing 0.1 g. The specimen consists of pharyngeal teeth.

8.6.5 Order Cypriniformes, Family Catostomidae, *Catostomus catostomus* [Longnose Sucker]

Longnose suckers are represented in the fish fauna associated with Block 3 of Bushfield West by only one specimen weighing 0.5 g. This specimen is a left operculum.

8.6.6 Order Cypriniformes, Family Catostomidae, *Catostomus commersoni* [White Sucker]

Only four white sucker specimens weighing 0.8 g were found in Block 3. These specimens represent 2% of the identifiable fish remains. All of the specimens are cranial bones—one left pharyngeal arch, one right maxilla, one right ceratohyal, and one left operculum.

8.6.7 Order Cypriniformes, Family Catostomidae, *Moxostoma anisurum* [Silver Redhorse]

Five specimens, weighing 2.0 g, are silver redhorse (Table 8.26). Silver redhorse specimens represent 3% of the identified fish fauna associated with Block 3. Four of the specimens are from the cranial region of the skeleton, one is from the caudal portion of the skeleton.

Table 8.26 Block 3 - Silver Redhorse NISP

Element	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Hyomand.	1	0	0	0	1	0.2	20.0
Operculum	1	1	0	0	2	1.5	40.0
Supracleith.	1	0	0	0	1	0.2	20.0
Hypural	0	0	0	1	1	0.1	20.0
Total	3	1	0	1	5	2.0	100.0

8.6.8 Order Cypriniformes, Family Catostomidae, *Moxostoma macrolepidotum* [Shorthead Redhorse]

A second species of *Moxostoma*, shorthead redhorse, is represented in the fish fauna from Block 3 by three specimens weighing 0.6 g. The identified specimens consist of one left operculum, one right operculum, and one left subopercle.

8.6.9 Order Gadiformes, Family Gadidae, *Lota lota* [Burbot]

One burbot specimen, a right ceratohyal weighing 0.9 g, was recovered from Block 3.

8.6.10 Order Perciformes, Family Percidae, *Stizostedion vitreum* [Walleye]

The second largest category of fish remains associated with Block 3 is walleye, 70 specimens weighing 18.1 g (Table 8.27) Walleye represent 41% of the identifiable fish assemblage. All of the walleye specimens are from the cranial region of the skeleton. Eleven of the cranial specimens are complete elements and 13 are nearly complete. Complete elements include one operculum, one frontal, one parasphenoid, two dentaries, one epihyal, two ceratohyals, two quadrates, and one preopercule. The nearly complete elements include two parasphenoids, one epihyal, one dentary, one angular, two preopercules, one basioccipital, one frontal, and four ceratohyals.

Table 8.27 Block 3 - Walleye NISP

Element	Left	Right	Indt.	Axial	Total	Weight (g)	NISP%
Dentary	5	6	0	0	11	3.7	15.7
Angular	3	5	0	0	8	2.9	11.4
Premaxilla	4	3	0	0	7	1.0	10.0
Maxilla	2	3	0	0	5	0.9	7.1
Quadrate	4	4	0	0	8	1.3	11.4
Frontal	2	0	0	0	2	0.8	2.9
Preoperc.	1	4	0	0	5	1.5	7.1
Operculum	0	1	0	0	1	0.2	1.4
Ceratohyal	6	4	0	0	10	2.4	14.3
Parasphen.	0	0	0	7	7	2.4	10.0
Basioccipit.	0	0	0	2	2	0.4	2.9
Epihyal	1	2	0	0	3	0.4	4.3
Hyomand.	0	0	1	0	1	0.2	1.4
Total	28	32	1	9	70	18.1	99.9

The walleye sample represents a minimum of seven individuals based on the seven axial parasphenoid specimens. Almost all of the identified specimens contribute to the MNE counts. The walleye NISP, MNE, MNI, and MAU values are presented in Table 8.28.

Table 8.28 Block 3 - Walleye NISP/MNE/MNI/MAU

Element	NISP	MNE	MNI-Left	MNI-Right	MNI	MAU
Dentary	11	10	5	5	5	5.0
Angular	8	8	3	5	5	4.0
Premaxilla	7	7	4	3	4	3.5
Maxillary	5	4	2	2	2	2.0
Quadrate	8	8	4	4	4	4.0
Frontal	2	1	1	0	1	0.5
Peroperc.	5	5	1	4	4	2.5
Operculum	1	1	0	1	1	0.5
Ceratohyal	10	10	6	4	6	5.0
Parasphen.	7	7	-	-	7	7.0
Basioccipit.	2	2	-	-	2	2.0
Epihyal	3	3	1	2	2	1.5
Hyomand.	1	1	-	-	1	0.5

8.7 Distribution and Diversity

Initial assessment of Block 3 indicated that a potentially productive intact occupation existed on the flat approximately 55 m west of the cut bank edge where Blocks 1 and 2 were situated. However, subsequent testing failed to locate heavy concentrations of artifacts or areas where major activities had taken place. The area was surveyed by Terry Gibson (1994) using a magnetic prospection technique resulting in the detection of six magnetic anomalies. These anomalies indicated the locations of possible features such as hearths, rock pits, and/or pottery concentrations. The plough zone and a layer of sterile sand were removed using a grader. A stratum of coarse grey sand (referred to by Gibson 1994: 145 as "reworked sand") that overlay the occupation paleosol was excavated in 2 x 2 m units with shovels and the sand was screening through a 6 mm mesh power screen. Since a 50 x 50 cm quadrant provenience was used in cataloguing the material was catalogued as being recovered from the northwest quadrant of the northwest unit of the 4 m^2 area. Therefore, distribution maps show heavy concentrations in the northwest quadrants of these units. This limits their use in the delineation of subsistence activity areas. Material in the occupation paleosol was exposed by troweling and brushing and then removed according to 1 x 1 m unit locations. This material was catalogued as being from the northwest quadrant of the 1m^2 unit.

Natural and cultural feature locations and a visual examination of the distributions of the identified fauna recovered from the paleosol were used to divide Block 3 into six subsistence areas (Figure 8.2). The distribution maps of faunal material are presented in Appendix D. The locations, sizes, and associated features (where applicable) of the subsistence areas are shown in Table 8.29.

Table 8.29 Block 3 - Subsistence Activity Areas

Area	South	East	Size (m^2)	Features
3.1	210.00 - 215.00	106.00 - 113.00	35.0	none
3.2	210.00 - 214.00	113.00 - 121.00	32.0	ice scours
3.3	210.00 - 214.00	121.00 - 126.00	20.0	none
3.4	215.00 - 220.00	106.00 - 113.00	35.0	none
3.5	214.00 - 220.00	113.00 - 121.00	48.0	hearth #1
3.6	214.00 - 220.00	113.00 - 121.00	30.0	hearth #2

The most commonly identified taxa found in Block 3 are generally the same as those found in Block 1 and Block 2. The only mammalian species found in either Block 1 or Block 2 that was not identified in the fauna from Block 3 is marten. One species, badger, was found in Block 3 but not in either Block 1 or Block 2. The identified species by NISP for each area of Block 3 are presented in Table 8.30.

Area 3.1, located in the northwest corner of Block 3, has no associated features. The vertebrate fauna recovered from this area is predominantly large ungulates (84%), followed by beaver (10%). The majority of large ungulate remains are unidentified ungulates, those that can be identified to species are bison (11%). The bison remains were scattered over the area. One concentration of unidentified ungulate forelimb and long bone shaft fragments was noted on the west side of the area. Beaver remains

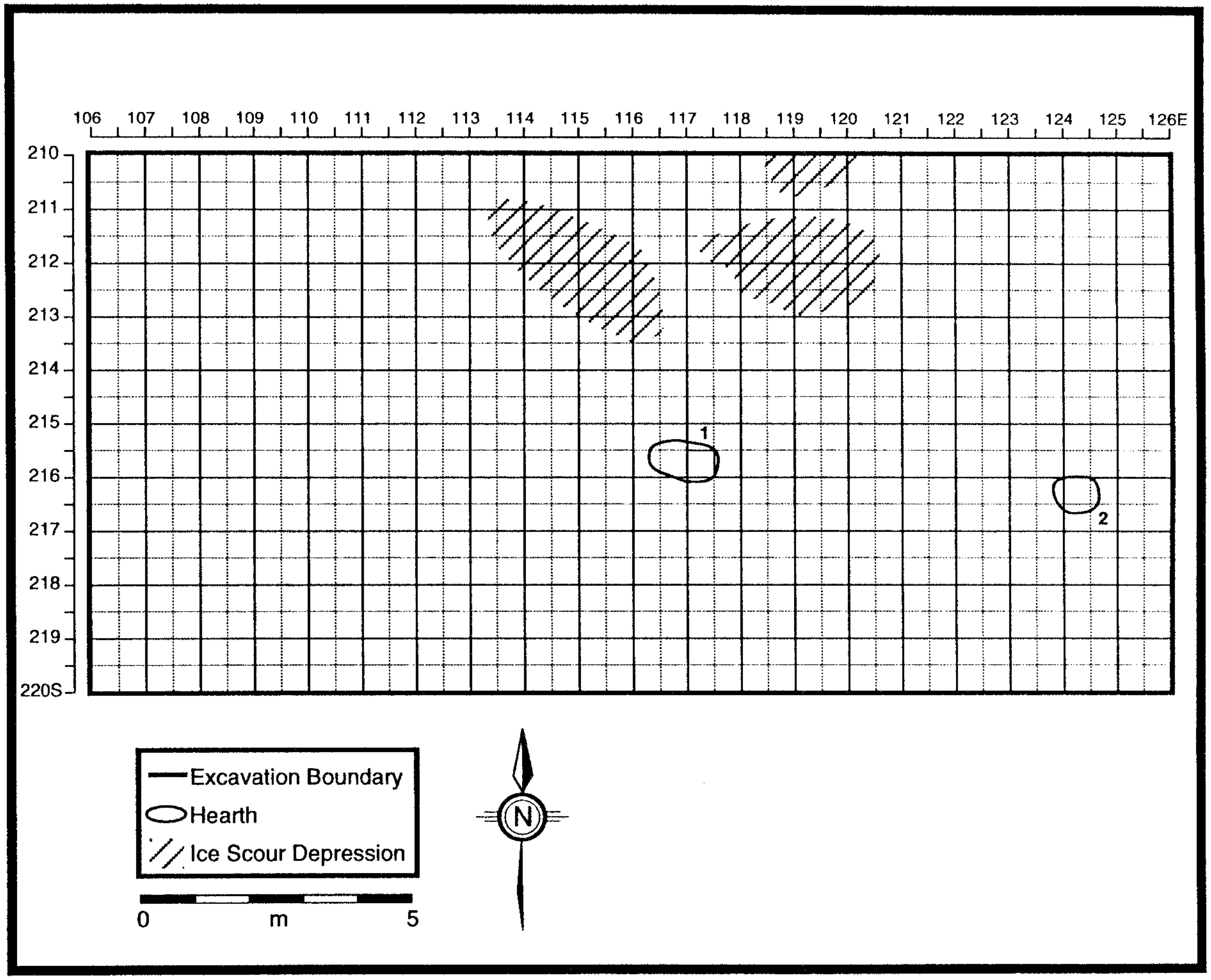


Figure 8.2 Block 3 – Subsistence Activity Areas

recovered from this area consist of cranial and vertebral fragments found on the west side of the area.

Table 8.30 Block 3 - Identified Fauna by NISP in Subsistence Areas

Species	3.1	3.2	33	3.4	3.5	3.6
Ung. unid.	218	716	335	201	534	95
Bison	30	84	121	53	106	14
Moose or Elk	0	2	2	1	5	0
Moose	0	3	1	1	5	0
Elk	0	0	0	0	1	0
Bear	0	1	0	0	1	0
Canid	0	0	5	1	5	0
Lynx	0	0	0	0	1	0
Badger	0	0	1	0	1	0
Leporid	1	13	3	0	2	0
Beaver	28	122	56	68	224	17
Muskrat	0	0	2	0	1	0
N. P. Gopher	0	1	1	0	0	0
Aves	0	41	6	8	38	2
Fish	5	77	54	24	262	3
Total	282	1060	542	357	1182	133

Area 3.2 situated on the central northern edge of Block 3 contains three elongated ice-scour depressions. These depressions are approximately 2 m in length and 0.6 m in depth. The occupation paleosol was found intact on top of the depressions; therefore, their formation pre-dates the site occupation (Gibson 1994: 146). The assemblage from this area is again dominated by large ungulates (78%); however, a wide variety of species are represented. Large ungulates include bison, moose, and moose or elk. Small mammals include beaver (12%) and leporids (1%) and the remaining assemblage consists of fish (7%) and birds (4%).

Concentrations of bison phalanges were found in each of the three ice-scours, as were unidentified ungulate axial and appendicular remains. An extremely dense concentration of unidentified ungulate teeth and mandible fragments, the majority of which are burned, was found at the northwest end of the largest ice-scour. Heavy concentrations of unidentified ungulate rib and long bone shaft fragments and forelimb specimens were located on the northern edge of the area outside of the ice-scours. Most of the beaver specimens found in this area were associated with the depressions. All of the bird remains recovered from this area are geese. They were found within and on the southwest edge of one of the ice-scours. Several fish specimens were found scattered over the area; however concentrations of sturgeon scutes were situated in two of the ice-scours.

Gibson (1994: 168) hypothesized that the depressions created by the ice-scours functioned as favoured discard areas. The mixture of species and skeletal elements found in the depressions, as well as the fact that several of the items are burned or calcined supports this supposition. Bone debris from the major hearth situated in area 3.5 could have been deliberately deposited in these natural features. However, natural downward movement or gravitation by soil creep may also have contributed to the concentration of material within the ice-scours.

Area 3.3 is located in the northeast corner of Block 3 and no features are associated with this area. This is also an area of diverse fauna, dominated by large ungulate remains. Although this is the smallest subsistence activity area outlined in Block 3 it contains the largest percentage of bison remains (23%). Even the large subsistence areas of Block 1 and Block 2 did not have this high a percentage of identified bison fauna. This area also had high percentages of beaver (10%) and fish (9%).

Bison cranial and appendicular specimens were heavily concentrated in the northeast corner of this area, as were unidentified ungulate axial and appendicular fragments. Beaver cranial and vertebral fragments were found in two concentrations in area 3.3: the northeast corner and the southwest corner. A few canid specimens were also found in this area. Concentrations of fish specimens were found mainly along the northern edge of the area.

Heavy concentrations of bone debris not associated with features are generally interpreted as areas of secondary deposition or middens. It is equally likely that features associated with these deposits are located to the north or east of the block and were not discovered during the course of excavations.

Area 3.4 is located in the southwest corner of Block 3. No features were encountered during the excavation of this area. As with other areas of this block the fauna consists predominantly of large ungulate material (73%). The majority are unidentified ungulate specimens; however 15% of the remains are bison and less than 1% are moose. Most of the remaining faunal material is beaver (19%) and fish (7%).

Bison remains were scattered over the area and only one concentration consisting of phalanges was found on the north edge of the area. Numerous unidentified ungulate axial and appendicular specimens were found in this area; however, the manner in which the location of the material was recorded makes it difficult to determine if there are any true clusters. Two concentrations of beaver cranial specimens were noted on the south side of the area. One concentration of beaver hindlimb fragments was found on the north side. The only bird remains found in area 3.4 consists of a small cluster of grouse elements. Fish specimens found in the area consist mainly of sturgeon scutes.

Area 3.5 covers the central southern part of Block 3, encompassing a major hearth (#1). The hearth consisted of an oval area of ash underlain by fire-reddened soil

(Gibson 1994: 161-162). The thickness (approximately 7 cm) and large size (0.6 m to 1 m in diameter) of the hearth, as well as the amount of debris associated with it indicates that it was the focal point of several activities. A variety of taxa were recovered from this area including bison (9%), moose (<1%), elk (<1%), moose or elk (<1%), unidentified ungulate (45%), canid (1%), leporid (<1%), beaver (19%), birds (3%), and fish (22%). Although large ungulate remains dominate the assemblage, beaver and fish comprise high percentages of the remaining fauna.

The majority of the bison specimens were found within 1 to 1.5 m of the hearth edge; however, one concentration of hindlimb specimens was also found on the southern edge of the area. Unidentified ungulate axial and appendicular specimens were found surrounding the hearth, with the heaviest concentrations being located on the south side. Two concentrations of long bone articular end fragments were noted: one approximately 50 cm southeast of the hearth and the second approximately 70 cm northwest of the hearth. Heavy concentrations of beaver cranial fragments, forelimb and hindlimb specimens, and phalanges were found within hearth #1. Several of these specimens are either burned or calcined. A large number of beaver axial elements and a few appendicular specimens were found surrounding the hearth. The few canid remains recovered from this area were located within hearth #1 and to the southwest, south, and southeast. A large cluster of unidentified bird remains were recovered approximately 1 m southeast of the hearth, while a concentration of grouse material was located 0.5 m to 1 m north. Fish specimens cover an area of approximately 2.5 m extending out from the hearth centre. An extremely heavy concentration of unidentified fish and walleye remains was located approximately 50 cm northwest of hearth #1.

The density of bone debris associated with hearth #1 indicates that it is a primary nuclear area hearth. The cooking and consumption of a variety of fauna, large ungulates, beaver, grouse, and walleye, occurred here. It is difficult to determine from the distribution maps if there are drop, discard, and toss zones characteristic of an exterior hearth. The densest concentrations of bone debris occur in areas southeast, southwest, west, and northwest of the hearth. A large area that appears to be relatively free of debris is situated to the northeast of the hearth. Therefore, the hearth may have been surrounded by a structure in which debris was intentionally and unintentionally moved to the sides keeping other areas clear for sitting and sleeping. However, one would have to examine all classes of debris recovered from this area in order to substantiate such an interpretation.

Area 3.6 is located in the southeast corner of Block 3. Hearth #2, a small 40 x 50 cm hearth, is situated towards the east side of this area. Area 3.6 contains the smallest number of identified specimens. The faunal assemblage is dominated by large ungulate remains, mostly unidentified ungulate (71%) and bison (11%). Beaver (13%) comprise the largest portion of the remaining fauna. A few moose or elk, bird, and fish specimens were also recovered in this area.

A heavy concentration of unidentified ungulate cranial fragments was found in association with hearth #2. Clusters of unidentified ungulate rib and vertebral specimens were found approximately 1.5 m to the south, west, and north of the hearth. The majority of beaver specimens found in this area were also recovered from within the boundaries of the hearth. This appears to be a secondary hearth where a limited amount of cooking and consumption of portions of large ungulates and beaver took place. It is possible that the hearth and associated faunal material were confined within a dwelling structure. Gibson (1994: 168) identifies this part of the site as a "work shelter area" with characteristics which are quite different from the residence area that was described previously.

CHAPTER 9

Taphonomy

9.1 Introduction

Taphonomy deals with the transition of organic remains into the fossil record. The word "taphonomy" is derived from the combination of two Greek root words, "taphos" which means burial and "nomos" which means law or systems of laws. Taphonomy was originally defined by a Russian paleontologist I. A. Efremov as the "study of the transition (in all its details) of animal remains from the biosphere into the lithosphere, i.e., the study of a process in the upshot of which the organisms pass out of the different parts of the biosphere and, being fossilized, become part of the lithosphere" (Efremov 1940 cited in Lawrence 1971: 394).

Within paleontology two different concepts of taphonomy developed. One group of paleontologists divide the study of taphonomy into two stages: the biostratinomy and diagenesis. Weighelt defined biostratonomy (now biostratinomy) as "the study of the environmental factors that affect organic remains between the organism's death and the final burial of the remains" (cited in Lawrence 1979: 99). Muller conceived of diagenesis as the study of the effects on organic remains between final burial and recovery by scientists (Lawrence 1971: 594; Gifford 1981: 367). Other paleontologists follow Efremov's concept of taphonomy as a continuum encompassing all of the processes and stages which affect an organism. Overviews of the history of taphonomy in paleontology and archaeology can be found in Lyman (1994a), Behrensmeyer and Kidwell (1985), Gifford (1981), Olson (1980), and Lawrence (1971).

Methodological uniformitarianism and actualism are the underlying premises of taphonomy. Methodological uniformitarianism assumes that natural laws are consistent through time and space and that natural processes are also consistent through time and space. Therefore, past results may be explained by observing similar results and their causes operating in the present (Lyman 1994a: 46; Gifford 1981: 367). Actualism is equivalent to methodological uniformitarianism in that it "asserts spatial and temporal invariance of natural laws, particularly those concerned with mechanical, chemical, and physical processes (but not behavioral ones). Actualism denotes the methodology of inferring the nature of past events by analogy with processes observable in action at the present" (Lyman 1994a: 49). In archaeology, replication experiments and ethnographic analogies are frequently used to identify artifacts or to interpret the life histories of archaeological assemblages.

Initially, taphonomic studies concentrated on identifying the temporal sequence of taphonomic events and the detailed processes that affect the organic remains. The temporal sequences of events subsequent to the death of an organism and prior to burial include decomposition of the soft tissue due to micro-organisms, vertebrate scavenging, insect activity, occasionally dehydration and mummification, but more often disarticulation and scattering or dispersal, as well as weathering of elements. The rate of burial, the nature of the soil matrix (chemical, mineral, and particle size composition), and oxidizing conditions all determine whether or not an organism will become part of the fossil record (Lawrence 1979: 795). All throughout the temporal sequences the taphonomic processes acting on the organism result in a loss of information or biasing of the fossil record.

Originally, the goal of taphonomy was to "strip away the taphonomic overprint" (Lawrence 1979: 903). As Gifford (1981: 384-385) points out this has resulted in a concentration on the negative aspects and does not focus research on what can be learned from the materials that are represented in the fossil record. This characterization of taphonomy lead Behrensmeyer and Kidwell (1985: 105) to devise a new definition of taphonomy as "the study of processes of preservation and how they affect information in the fossil record". This definition was meant to include not only the study of taphonomic processes from a negative biased perspective but also from the point of view of what positive information can be learned about the taphonomic processes.

Lyman (1994a: 33) suggests that, due to the perception that taphonomic research is concerned only with the biases of the fossil record, this has limited how archaeologists define taphonomy: many archaeologists do not consider humans to be taphonomic agents nor their actions to be taphonomic processes. The butchering of animal skeletons and the fragmentation of bones are generally not viewed as taphonomic processes. Cut marks, drilling, incising, burning, and calcining of faunal remains are not identified as taphonomic traces. However, I suspect that archaeologists do not classify humans as taphonomic agents because the concept of taphonomy has been borrowed from paleontology, where the fossil record is affected by natural processes rather than cultural processes.

9.2 Taphonomic Modifications of Bushfield West Fauna

During the analysis of faunal material from Bushfield West each specimen was examined for evidence of natural taphonomic modifications: weathering, water rolling, rodent gnawing, porcupine gnawing, carnivore modifications, root erosion, mineralization, trampling, and multiple natural modifications. Each specimen was also examined for evidence of cultural taphonomic modifications: cut marks, incising, drilling, polishing, striations, cut items, and multiple cultural modifications. The various forms of natural taphonomic modifications are discussed first.

Weathering is the physical and chemical changes to the overall structure of the bone which are the result of exposure to air, wind, water, temperature, and humidity. The physically observable affects of weathering include surface discoloration (bleaching); longitudinal, perpendicular, diagonal, or offset right angle cracking; and surface exfoliation (Johnson 1985: 185). Behrensmeyer (1978: 151) defines six stages of weathering in the decomposition of bone as it lies on the ground surface. Behrensmeyer's model of weathering is strongly correlated with time or years since death, although she does mention that other factors such as depth of burial, micro environmental conditions, age and animal size may affect the rates of weathering (Behrensmeyer 1978: 159-160). In a re-evaluation of bone weathering, Lyman and Fox (1989: 296) hypothesize that the factors mentioned by Behrensmeyer, as well as several others determine the rate of weathering: years since death, skeletal element, taxon, micro environment, length of exposure prior to burial and accumulation history all play a part in the formula for determining the stage of weathering. Lyman (1994a: 360) also notes that bone weathers in both surface and subsurface conditions, although little research has been devoted to the rates of subsurface weathering or even characteristics which could be used to distinguish weathering that has occurred prior to burial from post-burial weathering .

Behrensmeyer's stages of weathering are often the standard by which zooarchaeologists record weathering of elements recovered from archaeological sites. Excavations at Bushfield West entailed the exposure of large areas of the site leaving artifacts *in situ* while the living floor was photo-mapped. At the time of excavation the terrace on which the site was located was completely void of vegetation and temperatures often exceeded 30° C. The re-exposure of faunal material to sunlight, extreme temperatures, and wind resulted in a second phase of weathering. The most commonly observed effect was the discoloration or bleaching of exposed bone. Exposure during excavation also resulted in the formation of longitudinal cracks on the cortical surfaces due to the evaporation of moisture from the surfaces of the bone. Thus it was difficult to determine if weathering was the result of pre-burial processes, post-burial processes, post-excavation exposure or a combination of the above. This necessitated the definition of stages of weathering similar to Behrensmeyer's but applicable only to faunal material recovered from Bushfield West. Stage 1 consists of bones that exhibit discoloration of the cortical bone or bleaching. Bones included in Stage 2 exhibit small cracks of the outer surface oriented parallel to the bone structure and deterioration of the edges of the specimen. Stage 3 bones show deterioration of the bone surface and edges and occasional pitting of the surface. Stage 4 includes bones that have longitudinal, as well as right angled cracking of the cortical bone and occasional exfoliation of the bone surface. Stage 5 bones demonstrate extensive cracking and exfoliation. It was difficult to remove specimens exhibiting Stage 5 weathering from the ground without crumbling the bone. The deteriorated state of the bone required that the soil matrix in which it was found be removed with the bone and the sample wrapped in aluminum foil. Examination of these samples in the laboratory revealed that none of these bones are identifiable as to skeletal element or taxon.

Weathering was observed on 292 of the identifiable faunal specimens from Bushfield West. Weathered specimens constitute only 2% of the identifiable fauna. The various stages of weathering recorded for each taxon recovered from Bushfield West are presented in Table 9.1. Bear, lynx, badger, marten, and small rodent remains do not demonstrate evidence of weathering.

Table 9.1 Weathering Stages by NISP of Bushfield West Fauna

Taxon	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
Ungulate, unid.	47	50	21	2	0
Bison	37	11	16	1	0
Moose or Elk	0	0	2	1	0
Moose	1	0	3	0	0
Elk	2	2	1	0	0
Canid	1	3	4	1	0
Striped Skunk	0	1	0	0	0
Leporid	2	1	6	0	0
Beaver	14	34	21	2	0
Bird	1	3	0	0	0
Fish	1	0	0	0	0
Total	106	105	74	7	0

Stages 1 and 2 are the most common stages of weathering exhibited by Bushfield West fauna. The most advanced stage of weathering to be recorded is Stage 4, which is apparent on seven specimens. Behrensmeyer (1978: 160) states that "all species should have proportional numbers of carcasses in each weathering stage unless there is variability in weathering rates". Large-sized mammals (bison, moose, elk, moose or elk, and unidentified ungulate), medium-sized mammals (canids and beaver), and small-sized mammals (leporids and striped skunk) remains are all represented in Stages 1 to 3. When the %NISP of these groupings are compared there is a high percentage of medium-sized mammals in Stages 2 and 3, as well as small-sized mammals in Stage 3. The majority of large mammals are found in Stage 1. None of the small rodents or micro-rodents show signs of weathering. In the recovered sample of bird and fish specimens very few exhibit evidence of weathering.

There are several possible explanations for the variations observed in the rate of weathering in relation to body size. First, the results may indicate different rates of weathering in which smaller sized bones exposed on the surface reach more advanced stages of weathering in a shorter time period with the smaller rodent, bird, and fish elements eventually being eliminated from the assemblage (Gifford 1981: 417; Schiffer 1987: 187; and Lyman 1994a: 358). Second, the small rodent, micro-rodent, bird, and fish elements do not show evidence of weathering since they were protected from exposure to the sun and wind by vegetation and were more likely to be buried shortly after being discarded (Rapson 1990 cited in Dyck and Morlan 1995: 151) Third, the distribution of various sized animals though weathering Stages 1 to 3 may also be indicative of different rates of accumulation or times at which they were added to the faunal record (Lyman 1994a: 365-366). Four, the smaller bones including those of small rodents, birds, and fish were removed during the excavation of the occupation floor and recovered while screening the soil matrix rather than being left exposed on the surface during photo-mapping. The larger identifiable bones would have been left *in situ* resulting in rapid bleaching and cracking of the exposed surfaces.

The juvenile and foetal/newborn specimens are also classified according to the various stages of weathering (Table 9.2). None of the foetal/newborn and only a few of the juvenile large mammal specimens demonstrate evidence of weathering. The numbers of weathered medium and small-sized mammals would increase substantially if the recovery of individual or unsocketed beaver and leporid teeth were attributed to weathering (Lyman 1994a: 358).

Table 9.2 Weathering Stages by NISP of Juvenile Bushfield West Fauna

Taxon	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
Ungulate, unid.	2	1	0	0	0
Bison	3	0	1	0	0
Beaver	5	9	8	0	0

Discussion of fluvially transported bones has generally focused on the composition and orientation of the redeposited faunal assemblage (Behrensmeyer 1975; Shortwell 1955; Speth 1983; Voorhies 1969). Little work has been devoted to the analysis of how bone is physically and chemically modified by the mechanics of fluvial transport. It has been suggested that bone transported by water or exposed to running water exhibits rounded edges, smoothed features, and polished projections (Bonnichsen and Will 1980: 9; Johnson 1985: 189). These characteristics are the result of abrasion of the bone by sediment particles. The size of the sediment particles, the condition of the bone, and the distance the specimen is transported all affect the rate and intensity of abrasion (Lyman 1994a: 186). Other processes, namely eolian activity and trampling, also abrade bone. Lyman (1994a: 187) specifies that bones abraded by fluvial transport may be differentiated from those abraded by eolian action by the location and extent of the abraded areas. Fluvial activity modifies the entire surface of the bone, whereas eolian activity only modifies the exposed surface of the bone. Johnson (1985: 189) and Gifford (1981: 419) note that sand abrasion or wind erosion produces rounded and polished edges, as well as a pitted cortical surface. It is the pitted cortical surface that distinguishes eolian activity from fluvial activity. An abraded surface created by trampling will possess deep scratches, whereas fluvial transport does not produce deep scratches (Lyman 1994a: 187).

Nine specimens recovered from Bushfield West are water worn. The edges and surfaces of these specimens are smooth and often the surfaces are pitted. It is obvious that a portion of the outer cortical layer has been eroded away. The location of Bushfield West, on the edge of a terrace that has been subjected to frequent episodes of flooding, and the fact that long linear depressions uncovered during excavation are attributed to ice scouring, were taken into consideration when identifying the observed modifications to fluvial processes. However, the area of the site which Gibson (1994: 145) identifies as having a layer of "reworked sand" deposited by swift flowing water yielded only one specimen which is considered to be water worn. Several of the specimens have pitted surfaces, a characteristic of eolian processes. Although these items are catalogued as having been modified by fluvial action it is possible that they may have been modified by eolian processes or a combination of both.

Approximately 70% of bone material consists of a calcium phosphate mineral, hydroxyapatite (Lyman 1994a: 72). Phosphates are a major nutrient of plants which is actively sought out by plant roots. The acidic exudates from plant roots result in the dissolving of bone (Carbone and Keel 1985: 11; Morlan 1980: 36). One of these acidic exudates has been identified by Bonnichsen and Will (1980: 9) as carbonic acid. Others have identified fungi associated with decaying roots as the agent which secretes the acid responsible for dissolution of the bone (Lyman 1994a: 375). In both instances what usually results is an etched dendritic, "spaghetti-like" or "macaroni" pattern on the cortical surface of the bone (Bonnichsen and Will 1980: 9; Hesse and Wapnish 1985: 85; Morlan 1980: 36; 1984: 163). The marks left by plant roots are "U-shaped" in cross-section and have scalloped edges (Morlan 1984: 163). Plant roots and rootlets can also grow through openings, nutrient foramina and medullary cavities of bones, eventually resulting in the destruction of the bone (Morlan 1980: 36).

Root erosion or root etching is the most commonly observed taphonomic modification of fauna recovered from Bushfield West. A total of 705 specimens representing 5% of the identifiable fauna exhibit etched dendritic patterns which are the characteristic hallmark of root erosion. Root etchings were noted on a variety of specimens and a diverse number of taxa. Large mammal specimens showing evidence of root erosion include bison (N=79), moose (N=7), elk (N=11), moose or elk (N=2), and unidentified ungulate (N=436). Medium-sized mammals exhibiting evidence of root erosion include canids (N=8), lynx (N=2), and beaver (N=110). Small mammals demonstrating evidence of root erosion include leporids (N=8), red squirrel (N=1), and ground squirrel (N=1). Several bird remains (N=35) and a few fish specimens (N=5) are also affected by root erosion.

Rodent gnawing of bone results in distinctive parallel grooves produced by the rodent's incisors. The width and length of the grooves reflect the size of the gnawing agent. Porcupines also gnaw bones to keep their incisors in good condition; this produces wide broad continuous marks similar to those created small rodents (Lyman 1994a: 195). Ungulates reportedly chew bone and antler in an attempt to gain nutrients which are otherwise missing in their normal diet (Morlan 1980: 36).

Only one specimen from Bushfield West, an unidentified ungulate indeterminate long bone shaft fragment, exhibits evidence of rodent gnawing. Although porcupine gnawing was observed on unidentifiable bone fragments it is not apparent on any of the identifiable specimens. Neither unidentifiable bone fragments nor identifiable bones show markings which can be attributed to gnawing by ungulates.

Two specimens, a bison first phalanx and a beaver 3rd metatarsal, exhibit small circular holes. These holes are very consistent in their shape and appear to be bored or chemically dissolved rather than punctured. They are also considerably smaller in diameter (2 - 6 mm) than any of the puncture marks made by carnivore teeth which are visible on specimens at Bushfield West. Carnivore tooth marks also exhibit crushed bone in the bottom of the hole or around their edges (which these holes do not have).

The question of the identity of the taphonomic agent responsible for these modifications remains unanswered.

One mineralized specimen, an unidentified ungulate rib shaft fragment, was identified in the faunal assemblage. The rib shaft fragment is heavy and dense resulting from the replacement of chemicals within the skeletal bone by ground water minerals (Lyman 1994a: 420).

Archaeological faunal assemblages may be subjected to varying degrees of trampling by either humans or animals. Behrensmeyer et al. (1986: 768-771) conducted an experiment involving the trampling of bone fragments by humans wearing soft soled footwear. The fragments were scattered over two types of soil matrix: sand and loam. The bone fragments were then examined under a scanning electron microscope at 400 X magnification for evidence of modifications. Grooves and scratches with both "V-shaped" and rounded basal cross-sections and rounded outer edges, which closely resemble those created by stone tools, were observed on the trampled bone. These marks are often "multiple, parallel, shallow striations oriented oblique or transverse to the long axes" (Behrensmeyer, et. al. 1986: 770). The regions where trampling modifications were generally observed are flat, rounded and/or convex surfaces.

Trampling by animals is a much more destructive process. Axial elements including the skull, ribs and vertebrae are often splintered and crushed. Flat, thin elements such as scapulae and innominates exhibit similar modifications. These elements may be reduced to small, unidentifiable bone splinters. Long bones which have been trampled may exhibit partial spiral fracturing or spiral and linear fractured edges. The type of fracture depends upon the weathered state of the element, fresh or green bone versus dry bone (Haynes 1983: 111). Shipman (1981: 173) observed that trampling of dry bones may result in their reduction to columnar or rectangular fragments.

Trampling marks are differentiated from cut marks on the basis of orientation, location, and relative depth of the mark. Trampling marks are randomly oriented or multidirectional and tend to be located on the shafts of long bones rather than at the ends (Lyman 1994a: 381). None of the trace modifications observed on the bone from Bushfield West is attributed to trampling.

Archaeological faunal assemblages are often modified by carnivores. Carnivores generally attack the articular ends of long bones where the cortical structure is thin and the inner cancellous tissue is spongy. Evidence of bone altered by carnivores includes pitting, scoring, grooves, gouges, scratches, chipping, and relatively small impact point diameters (Gifford 1981: 408; Johnson 1985: 193). Chewing and gnawing of the cancellous tissue of the articular end results in a distinctive "scooped out" appearance

(Bonnichsen and Will 1980: 10). The compressive force of the carnassial teeth leaves crushed or pitted areas. If the diaphysis or shaft of the long bone is sufficiently weakened it may collapse into longitudinal splinters (Gifford 1981: 407). Bone fragments that are ingested exhibit smoothed, rounded and/or polished edges. The stomach acids may also produce etching of the bone surface (Gifford 1981: 408).

Binford (1981: 44-77) undertook an extensive study of carnivore modification of ungulate skeletal elements identifying four main types of tooth marks: punctures, pits, scores, and furrows. Punctures are defined as impressions left in the bone by the carnassial teeth. Thin bones which have been chewed may exhibit crenulated edges (Binford 1981: 45). Gnawing of denser bone may result in pitting or collapsed areas (ibid.: 46). Scoring is defined as "the result of either turning the bone against the teeth or dragging the teeth across relatively compact bone" (ibid.: 46). This results in linear parallel marks which follow the contour of the bone surface. However, Morlan (1980: 154; 1984: 162) has observed that scoring marks are of uniform depth regardless of the contour of the bone surface. Furrowing refers to the gnawing of cancellous tissue and is analogous to Bonnichsen and Will's (1980: 10) "scooping out" of cancellous articular ends.

Carnivore chewing of dense long bone shafts may result in "channeled" bone in which a transverse section of the shaft is punctured and subsequently removed (Binford 1981: 51). Accompanying identification marks include scoring and pitting. Another effect of carnivore chewing on dense bone is the "chipping back" of an edge (ibid.: 51). When a long bone shaft is positioned parallel to the teeth and subjected to pressure, small bone chips are broken off, producing an edge that appears to be pressure flaked. Additional markings that indicate bone chipping are parallel or oblique grooves below the chipped edge. These marks result from teeth sliding along the bone surface (ibid.: 51).

The faunal material from Bushfield West was examined for evidence of carnivore modifications including punctures, pitting, scoring, furrowing, channeling, chipping, and ingestion (Table 9.3). Carnivore modifications (N=223) are the third most common natural taphonomic modification noted in the sample of identifiable fauna, affecting 1.5% of the assemblage. The only form of carnivore modification that is not apparent on the Bushfield West material is channeling.

The majority of faunal remains demonstrating evidence of carnivore modifications fall within the category of large mammals—bison, moose, elk, moose or elk, unidentified ungulate, and bear. Carnivore tooth marks were noted on a variety of

Table 9.3 Carnivore Modifications by NISP of Bushfield West Fauna

Taxon	Punctures	Pitting	Scoring	Furrowing	Chipping	Ingestion
Ungulate, unid.	5	128	9	0	1	1
Bison	3	43	6	1	0	0
Moose or Elk	0	1	1	0	0	0
Moose	0	2	0	0	0	0
Elk	0	1	0	0	0	0
Bear	0	3	0	0	0	0
Badger	1	0	0	0	0	0
Leporid	1	0	0	0	0	0
Beaver	4	10	0	0	0	0
Bird	2	0	0	0	0	0
Total	16	188	16	1	1	1

large mammal skeletal elements including proximal, distal, and shaft portions (Table 9.4). Element portions containing high percentages of cancellous tissue (proximal or distal portions of long bones, innominates, and phalanges), as well as long bone shaft portions show evidence of carnivore modifications.

Table 9.4 Carnivore Modifications by NISP of Large Mammal Skeletal Elements

Element	Punctures	Pitting	Scoring	Furrowing	Chipping
Cranial	1	3	0	0	0
Mandible	1	3	1	0	0
Vertebrae	2	21	2	0	0
Ribs	1	28	1	0	0
Hyoid	0	2	0	0	0
Scapula	1	5	3	0	0
Proximal	0	21	2	0	0
Shaft	0	11	1	0	0
Distal	0	15	3	0	0
Innominate	1	7	0	0	0
Compact bones	2	34	3	1	0
Lg. bone shaft	0	11	0	0	1
Lg. art. ends	0	17	0	0	0
Total	9	178	16	1	1

*Long bone specimens identified as to skeletal element are divided into proximal, distal, and shaft portions. Compact bones include carpals, patellae, tarsals, phalanges, and sesamoids.

Carnivore punctures are visible on the horizontal ramus of a juvenile mandible (0.2-0.4 years) recovered from Block 1 (Figure 9.1). Three foetal/newborn unidentified ungulate appendicular specimens also found in Block 1 show evidence of carnivore pitting: a humerus shaft fragment, a tibia shaft fragment, and an indeterminate long bone shaft fragment. The foetal/newborn specimens found in Block 2 and Block 3 do not demonstrate evidence of carnivore tooth marks. However, carnivore pitting, scoring,

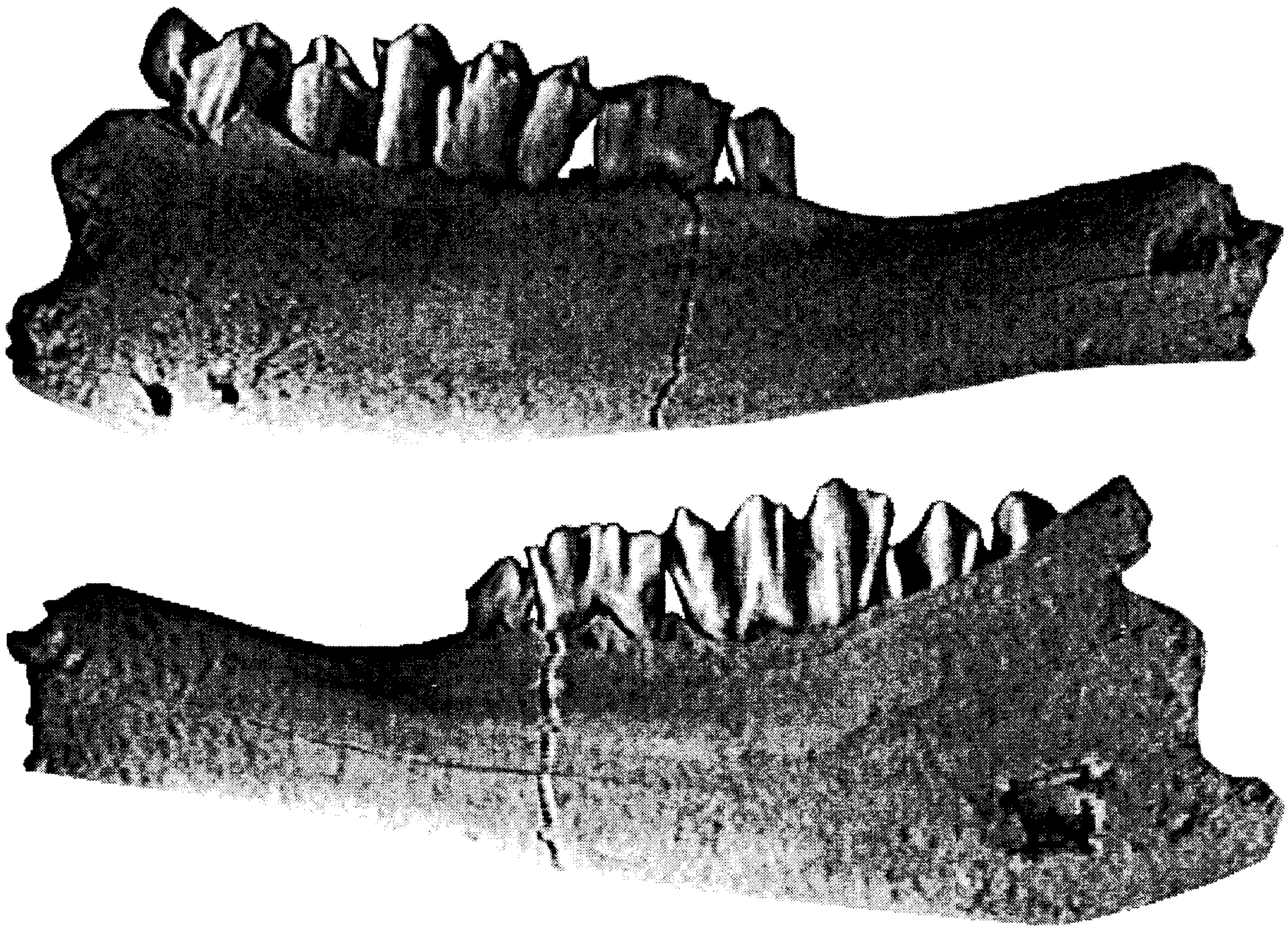


Figure 9.1 Carnivore Puncture Marks on Juvenile Bison Mandible (FhNa-10-15527 (Same mandible shown from lateral and medial sides)

and furrow markings are visible on unfused epiphyses, unfused shafts, and immature large ungulate specimens recovered from all three excavation blocks.

Medium-sized mammals on which carnivore tooth marks are apparent include one badger specimen and 14 beaver specimens. The badger specimen is a nearly complete scapula and the beaver remains include axial (N=2) and appendicular (N=12) specimens. The beaver appendicular specimens exhibit puncture marks and pitting on a variety of elements and in various locations including proximal, distal, and shaft portions. The only small-sized mammal showing evidence of carnivore tooth marks is a single leporid specimen. The relatively few medium and small-sized mammals, birds, and the lack of fish specimens that exhibit evidence of carnivore tooth marks may indicate that the bones of smaller species are completely consumed or destroyed beyond recognition by carnivores.

Researchers agree that elements and element portions containing a high percentage of porous spongy cancellous tissue are more susceptible to destruction by carnivores than the thick walled compact shafts (Binford 1981; Gifford 1981: 403; and Johnson 1985: 180). These elements are rich in nutrients (grease) that are easily accessed by destroying the thin outer layer of lamellar bone. Experimental studies of carnivore consumption of bovid skeletal elements by Blumenschine and Marean (1993: 275) indicate that carnivores selectively consume elements in a sequence which reflects the amount of available nutrients. Those elements that are high in nutrients are consumed first, while elements yielding the lowest amount of nutrients are consumed last. One experiment shows that vertebrae are removed for consumption first, followed by the pelvis, the distal and proximal femur, the proximal tibia, and the proximal metatarsal (forelimb elements were not included in this particular experiment) (Blumenschine and Marean 1993: 288). In a subsequent study on the dispersal of elements by carnivores Marean and Bertino (1994: 763) suggest that shaft fragments exhibiting carnivore tooth marks are created when carnivores consume limb bone ends with partial shaft portions.

Forty-eight identifiable bone specimens exhibit multiple natural taphonomic modifications. Almost all of the specimens show evidence of modification by two natural taphonomic processes. The exception is a bison scapula that demonstrates evidence of Stage 1 weathering, root erosion, rodent gnawing, and carnivore punctures. The specimens on which multiple modifications were observed are from a variety of taxa including the following: bison (N=13), elk (N=2), unidentified ungulate (N=28), canid (N=1), beaver (N=2), leporid (N=1), and bird (N=1). The majority of multiple modifications consist of either a combination of carnivore tooth marks and one other natural modification (N=26) or two forms of carnivore tooth markings (N=6). The most common carnivore tooth marking recorded in combination with a second taphonomic modification consists of carnivore pitting (N=28). The remaining bone fragments which do not exhibit carnivore tooth marks show a combination of either weathering and root erosion (N=15) or root erosion and water rolling (N=1).

As mentioned previously, the faunal remains were examined for evidence of the following cultural taphonomic modifications: cut marks, incising, drilling, polishing, striations, having being cut, staining, and multiple modifications. Fracture state (fresh, dry or recent) and impact point locations were inconsistently recorded during cataloguing and are therefore not discussed as a separate taphonomic category. It is assumed that the majority of fractures are the result of either human or carnivore activity occurring prior to burial. Occasionally several cranial fragments were recovered in close association and it is suggested that fragmentation of these specimens is due to soil compaction by agricultural equipment and vehicle traffic on the river flat . In a few instances striations were noted in association with cut marks or on specimens that are cut, but they were not observed as a separate or unassociated modification. A summary of the cultural taphonomic modifications observed on Bushfield West fauna are presented in Table 9.5.

Table 9.5 Cultural Taphonomic Modifications by NISP

Taxon	Burned	Calcined	Cutmks	Cut	Polished	Drilled	Stained	Multi
Ung., unid.	1164	36	50	3	11	4	2	0
Bison	64	10	4	1	0	0	0	1
Moose or Elk	7	1	0	4	1	0	0	0
Moose	2	1	0	2	0	0	0	0
Elk	4	0	1	1	1	0	0	0
Bear	0	0	0	1	0	0	0	0
Canid	45	5	0	0	1	0	0	0
Lynx	0	0	1	0	0	0	0	0
Badger	0	0	1	0	0	0	0	0
Leporid	3	3	0	0	0	0	0	0
Beaver	118	229	0	8	0	0	0	0
Muskrat	1	0	0	0	0	0	0	0
Red squir.	1	0	0	0	0	0	0	0
Bird	5	2	3	1	1	2	1	0
Fish	20	16	0	0	0	0	0	0
Total	1434	303	60	21	15	6	3	1

Distinctions between unburned or raw bone and burned and calcined bone are made on the basis of colour, as well as surface characteristics such as checking, cracking, and crazing which can be seen with the unaided eye. Specimens are recorded as burned if a portion or the complete bone is dark brown or black in colour. Calcining is recorded if a portion or all of the specimen is grey or white in colour. Several factors such as bone condition (fresh, dry, fleshed, defleshed) intensity of heat, duration of heat, and position within the fire affect the colouring of burned bone. Therefore, it can only be used as a rough estimate as to the temperature to which the specimen was heated (Nicholson 1993: 425; Lyman 1994a: 387). Bones heated to < 200° C generally do not change colour and have the macroscopic appearance of unheated or raw bone (Nicholson 1993: 421). Bone subjected to temperatures between 200° to 300° C are dark brown or black in colour and calcining occurs at temperatures exceeding 450° to 500° C (Nicholson 1993: 414; Lyman 1994a: 389).

Burned bones account for 10% of the identifiable faunal assemblage found at Bushfield West, while calcined bones make up 2% of the assemblage. The majority of burned bones are large ungulate specimens (N=1241), followed by beaver (N=118), canid (N=45), and fish (N=20). Only one small rodent specimen, a ground squirrel incisor, is burned. A breakdown of burned large ungulate items by %NISP consists of the following: metapodial fragments (24%), indeterminate long bone fragments (18%), cranial specimens (18%), vertebral fragments (17%), phalanges (17%), and indeterminate long bone articular end fragments (16%). When burned beaver specimens, axial and appendicular are compared, a larger portion of the appendicular specimens are burned. The largest percentages of burned items include forelimb specimens (44%), metapodial fragments (22%), and hindlimb specimens (13%). Eight percent each of the cranial and rib fragments are burned. A large portion of the burned canid items are accounted for by indeterminate long bone fragments (89%), sesamoids (88%), and phalanges (80%). Burned fish specimens consist of ribs (3%) and vertebrae (<1%).

The majority of calcined items are beaver bones (N=229), followed by large ungulate bones (N=48), and fish bones (N=16). Calcined beaver specimens consist of metapodials (33%), phalanges (28%), forelimbs (25%), clavicles (19%), and hindlimb specimens (17%). The largest frequency of calcined axial specimens consist of rib fragments (20%). Sesamoids (8%), phalanges (4%), and metapodial fragments (4%) constitute the greatest portions of calcined large ungulate remains. Calcined fish specimens include ribs (2%) and vertebrae (1%).

Burned and calcined large ungulate remains were found both in association with hearths, as well as discarded in areas away from the hearths. The medium-sized mammals, particularly beaver and fish specimens, that are burned and calcined were found within or adjacent to hearths. According to Nicholson (1993: 427) it is difficult if not impossible to identify bones exposed to low temperatures (< 200° C) associated with cooking. Lyman (1994a: 389) cites various researchers who speculate that burned articular portions of bones may be interpreted as evidence of roasting since these areas of the bone are less protected from heat than areas covered with meat.

Experimental studies by Walker and Long (1977: 608) indicate that the morphology of a cut mark varies with the type of tool used. Unmodified flakes will produce "V-shaped" cut marks with straight sides and a distinct apex at the base of the groove. Bifacially flaked stone tools will produce "U-shaped" or wide cut marks with concave sides displaying interconnected striations. In both instances the grooves are shallow and the width is greater than the depth. According to Binford (1981: 105) cut marks produced by stone tools "tend to be short, occurring in groups of parallel marks, and have a more open cross section" than cut marks produced by metal knives. Shipman lists four attributes that are used to identify cut marks created by stone tools: "V-shaped" or "U-shaped" cross section; elongate, multiple fine parallel striations on the walls of the groove; and occasionally shoulder marks or barbs (cited in Lyman 1994a: 297). Characteristics other than the physical features of the marks that are used to identify them as cut marks are location on the skeletal element, orientation, and frequency (Lyman 1987). These characteristics are often used to interpret the function of cut marks, e.g., skinning, dismembering, and removal of meat (Binford 1981: 106-107).

Cut marks are recorded on 60 of the identifiable specimens recovered from Bushfield West (< 1% of the sample). Almost all of the cut marks occur on large mammal remains—unidentified ungulate, bison, and elk. Multiple cut marks occur on the posterior shaft of the distal portion of an elk tibia. Four bison specimens, a mandibular diastema, a mandibular condyle, a hyoid, and a distal humerus shaft fragment, show evidence of cut marks (Figure 9.2 a). The remaining items on which cut marks are recorded are unidentified ungulate specimens. The majority of these are rib fragments (N=24), followed by vertebral fragments (N=10), long bone shaft fragments (N=8), scapulae (N=4), femurs (N=2), one radius, and one occipital condyle (Figure 9.2 b). All except two of the cut marks are multiple shallow parallel marks oriented obliquely to the long axis of the specimen. On two of the rib fragments the cut marks are located on the edge of the rib and the marks are wide and deep. The only other remains on which cut marks occur are a badger femur, a lynx mandible and three bird specimens (a mallard tibiotarsus and two swan carpometacarpi).

One unidentified ungulate humerus shaft fragment exhibits three wide deep cut marks which are more characteristic of chopping marks than slicing or sawing marks. The marks run parallel to each other and are 11.1 mm and 22.4 mm apart.

Cut marks are shallow and seldom penetrate more than a few millimeters into the outer layer of bone. Bone, antler, or dentine and enamel that is identified as cut are items which have been completely severed. In the faunal assemblage from Bushfield West the following items are cut: 13 large ungulate specimens, eight beaver specimens, and one

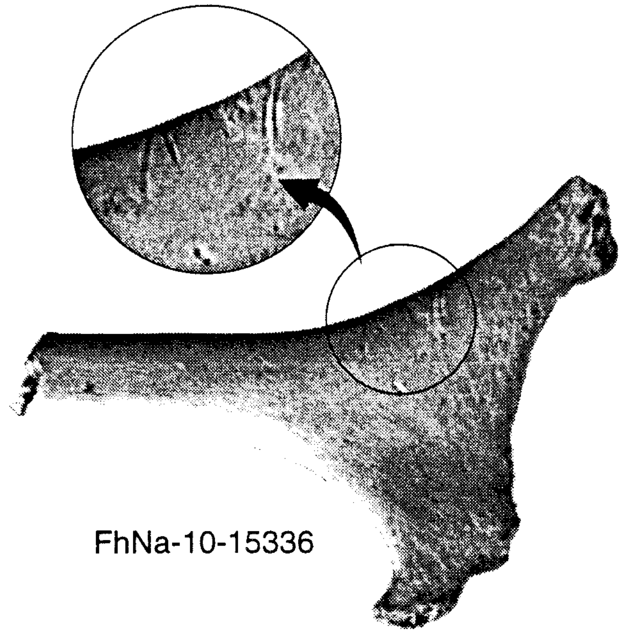


Figure 9.2 a Cut Marks on Bison Hyoid

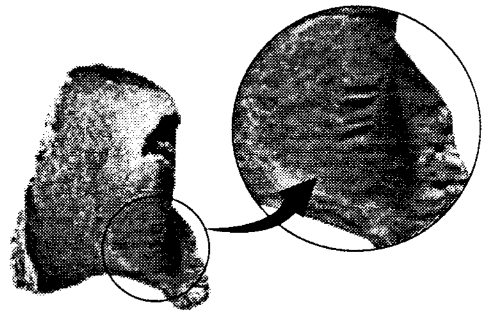


Figure 9.2 b Cut marks on Unidentified Ungulate Occipital Condyle

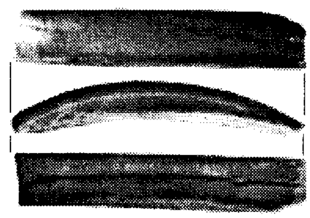


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Figure 9.2 c Cut Beaver Incisor

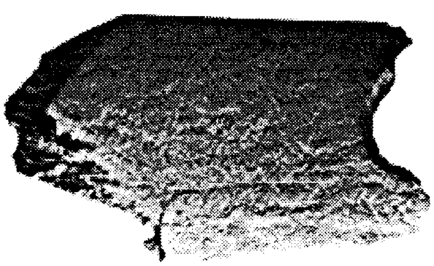

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Figure 9.2 d Drilled Unidentified Ungulate Rib Shaft

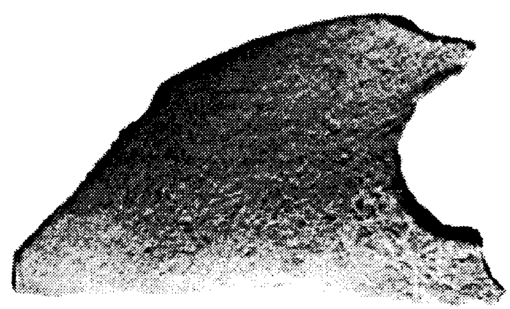

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Figure 9.2 e Drilled Unidentified Ungulate Distal Humerus Shaft bird specimen. The large ungulate specimens include one bison horn core, two moose antler tines, one elk antler tine, four moose or elk antler tines, three unidentified ungulate rib shaft fragments, an unidentified ungulate tibia shaft fragment, and a bear third phalanx.

The bison horn core has been removed from the skull by slicing or sawing through the bone near the base of the horn core with a sharp tool, creating a beveled edge. The moose or elk specimens are segments of antler cut at both ends, the cuts at each end are slightly beveled. The two moose antler fragments consist of the tines of the large palmar shaped antlers. The base of the tines are naturally broad and flattened on the anterior and posterior surfaces, the tips of both tines have been intentionally flattened by cutting away some of the antler and then smoothing the surfaces. The points of the tips are round and smoothed and also show some pitting. It is possible that these items were used as pressure flakers and formed part of a flintknapping tool kit. The elk antler specimen is a segment of a beam which has been cut perpendicular to the long axis of the beam at one end and diagonally at the opposite end. There is a second diagonal cut on the side of the beam where a tine has been removed. The beam segment is fairly large measuring 135 mm in length and 53 mm in diameter. A series of steps or ridges can be seen in the cut that was made to remove the tine. The resultant groove is wide, deep and "U-shaped" with several striations visible on the sides.

All three cut specimens are rib shaft fragments that are split longitudinally (perhaps due to natural taphonomic processes). Two of the specimens have one end that is cut and the third has both ends cut. On one rib shaft fragment, the cut end is round but it has not been smoothed or polished. The remaining two rib shaft fragments have saw-toothed notches cut at one or both ends of the shaft. One specimen has two saw-toothed notches cut at one end and one saw-toothed notch at the other end. The remaining rib shaft fragment has one saw-toothed notch cut at one end of the shaft. The cut unidentified ungulate tibia fragment consists of the tibial crest with five saw-toothed notches cut at the proximal end on the medial side of the crest. These notches vary in depth from 2 to 5 mm and are 3 to 5 mm in width.

The bear third phalanx is cut on the posterior portion of the claw, removing the cortical bone and exposing part of the inner cancellous bone.

All of the beaver specimens are incisors that have been cut or split longitudinally, the split surface is smoothed, occasionally the proximal end is cut or squared off, and the distal end is beveled to form a chisel or graver (Figure 9.2 c).

The cut bird specimen is a swan ulna shaft segment measuring 17 cm in length. One end is cut perpendicular to the long axis of the bone while the opposite end is cut in the form of a "U-shaped" notch. The edges of both cut ends are round and smoothed. It is possible that this specimen is a portion of a bird bone whistle.

Six bone fragments found at Bushfield West are drilled. These include four unidentified ungulate specimens and two bird bone fragments. The drilled unidentified ungulate specimens consist of a rib shaft fragment, a thoracic vertebral spinous process fragment, a humerus distal shaft fragment, and a scapula spine fragment. The rib shaft segment has a hole drilled through the middle; it is broken so only a portion of the drill hole remains (Figure 9.2 d). The outside diameter of the hole is 12.2 mm and the inside diameter is 10.0 mm (measurements were made on the incomplete item). The hole appears to have been drilled inward from either side as both edges are beveled inward. An attempt was made to drill a hole through the spinous process of a thoracic vertebra; however, the specimen was discarded before the hole was completed. The sides of the drilled area are beveled inward. The humerus shaft fragment has a partial hole with an estimated diameter of 20.0 mm (Figure 9.2 e). On one side, the edge of the hole is smoothed and beveled inward. The scapula specimen is a portion of the spine with a partial hole on the fractured edge. The edge of the hole is smoothed and beveled inward. A diameter cannot be estimated from the portion of the hole that is present.

The bird items are unidentified large bird specimens, a tibiotarsus shaft fragment and an indeterminate long bone shaft fragment. The holes are located on the fractured edges of the specimens and the diameters of the holes cannot be estimated from the portion that remains. The edges of the holes are rounded, smoothed, and polished.

Polishing was observed on 15 of the identifiable bone fragments. The majority of polished bone fragments are large ungulate remains. There are two exceptions, a canid specimen and a bird bone fragment. The elk and moose or elk polished specimens are antler fragments. Eight of the polished unidentified ungulate specimens are rib shaft fragments, two are indeterminate long bone shaft fragments, and one is a scapula blade fragment. The polished canid specimen is a fibula shaft fragment that is rounded, smoothed, and polished on the medial and lateral surfaces. The bird bone is an indeterminate long bone shaft fragment that terminates in a sharp point which is heavily polished. The heavier large ungulate polished bone fragments (antlers, ribs, and long bone fragments) may have functioned as flintknapping tools. The scapula fragment could have been used to soften hides or smooth pottery. The more delicate canid and bird bones were likely used as piercers or awls.

A greenish blue staining or discoloration of the cortical bone was observed on three identifiable bone fragments. Two of the bone fragments are unidentified ungulate remains: a long bone shaft fragment and the transverse process of a sacrum. A tibiotarsus shaft fragment of a swan also exhibits similar staining. It is possible that the discoloration is the result of prolonged contact with a metal object (likely copper) after burial.

Two specimens, a bison mandibular condyle and an unidentified ungulate rib shaft fragment, demonstrate multiple cultural taphonomic modifications (fracturing is not taken into account). Both specimens show evidence of cut marks and are burned.

9.3 Discussion and Summary

The attempted reconstruction of the taphonomic histories of the vertebrate fauna recovered from Bushfield West indicates that several processes, both cultural and natural, are involved. A significant percent of the identifiable fauna are burned or calcined. These types of modifications are seldom found in combination with other forms of cultural or natural modifications. Taxa containing the highest percentages of burned specimens include large mammals, beaver, canid, and fish. The frequencies of burned and calcined specimens represented in each taxon may be an indication of food preparation activities, as well as refuse disposal methods. Large ungulate and medium-sized mammal elements may have been roasted in fires (indicated by burning of forelimb and hindlimb specimens). However, only small elements of large ungulates or small bone fragments resulting from the processing of long bones were discarded within the hearths, whereas various beaver elements appear to have been disposed of within hearths (indicated by the large percentages of calcined specimens). The larger bone fragments produced by processing large ungulate elements appear to have been discarded in areas away from the hearths.

The recovery of calcined fish ribs and vertebrae may be indicative of the manner in which the remains were disposed of. Observations of the processing of fish by contemporary Chipewyan shows that certain steps were generally followed in the disposal of the fish remains (Brumbach et al. 1982: 30). Initial preparation of the fish began at the edge of the lake or river, where the bodies were opened and the entrails were thrown into the water. This practice was a means of reducing the unpleasant odors and also kept scavengers away from the main camp. If the fish were not gutted near a source of water the entrails could also be discarded in nearby muskeg areas. At the camp the fish were roasted over the fire and bones and skin fragments were "normally discarded into the fire to keep the cooking/dinning area clean" (Brumbach et al. 1982: 30).

The recovery of burned or calcined elements may also be interpreted as evidence of the "ritual disposal" of certain bones, particularly those of fish and beaver, which are left over from religious feasts. Other bones may have been discarded according to other prescribed procedures. For example, the Mistassini Cree return the bones of water animals to the lake and place the bones of land mammals and birds on elevated platforms (Tanner 1979: 172). The cranial bones, antlers, and scapulae of moose are carefully displayed in trees. The forelegs of bears and beavers are occasionally wrapped in birch bark or cloth and tied in trees (ibid.: 171). The proper disposal of animal remains shows respect to the animals and assures that the animals will return to the area, thus the continued good hunting of the group (ibid.: 180).

Almost all of the cut marks occur on large ungulate bones, two are present on medium-sized mammal bones (none on beavers), and three are present on bird bones. Cut, polished, and drilled bone fragments generally reflect the initial stages of tool production. The majority of these items are large ungulate remains, birds or canids. Most of the specimens are not finished tools and are not modified to the extent that skeletal element or taxon identification is impossible.

The most common form of natural taphonomic modification observed on the Bushfield West fauna is root erosion (5%), followed by weathering (2%), and carnivore modifications (2%). The large ungulate bones demonstrate evidence of early stages of weathering, while the medium and small-sized mammal bones exhibit evidence of slightly more advanced stages of weathering. None of the small rodent or micro-rodent bones and very few bird or fish remains are weathered. Root erosion is apparent on all size categories of mammal bones and occasionally on bird and fish bones. The majority of carnivore modifications occur on large ungulate bones, while only a few medium and small-sized mammal bones, and the occasional bird bone exhibit signs of carnivore tooth marks.

Overall, the faunal assemblage recovered from Bushfield West is well preserved. The early stage of weathering exhibited by the large ungulate remains consists mainly of bleaching of the cortical bone while exposed during excavation and photo-mapping. The slightly more advanced stages of weathering shown by the medium and small-sized mammal bones is in agreement with arguments presented by Behrensmeyer (1978: 160, 1981: 606), Gifford (1981: 417), and Lyman (1994a: 358), elements with a high ratio of surface area to volume will deteriorate faster than those with lower ratios of surface area to volume. The lack of weathering noted on small rodent and micro-rodent specimens and the low percentage of bird and fish specimens showing evidence of weathering seems to indicate that these specimens were buried quickly and thus not exposed to surface weathering processes. This follows Rapson's hypothesis that smaller elements are protected from weathering by vegetation and rapid burial (Rapson 1990 cited in Dyck and Morlan 1995: 151). Therefore, the weathering profile exhibited by the various size categories of faunal remains appears to present conflicting results. However, the low percentage of weathered specimens and site location; on a river valley terrace that is subject to frequent flooding; indicates that the assemblage was capped by river sediments during an episode of flooding in which the depth of the deposited sediments was sufficient to cover all the elements; regardless of size; which were previously exposed on the surface.

CHAPTER 10

Seasonality, Aging, and Gender Analysis

10.1 Introduction

Seasonality is "the time of the year at or during which a particular event is most likely to occur" (Monks 1981: 178). Usually, the time of year is referred to in very general terms: spring, summer, fall, and winter, or a combination of these terms. It is extremely rare, if not impossible, to be able to determine a calendrical date for the time at which subsistence procurement activities took place. Determining site seasonality is related to the fact that resources which together make up a group's subsistence base are available in a particular area or are more easily obtained at a certain time of the year. This necessitates that groups move from area to area, as well as split into smaller groups or coalesce into larger groups depending on the availability of food resources (Monks 1981: 179). Hunter-gatherer groups are strongly influenced by the seasonal availability of resources and several models have been developed to explain their movements (Syms 1977; Nicholson 1988; and Meyer and Epp 1990). The presence or absence of species, foetal, immature or juvenile individuals, tooth eruption and wear patterns, herd composition, medullary bone growth, migratory birds, and fish spawning patterns can all be used as seasonal indicators.

10.2 Presence/Absence Seasonal Indicators

One of the first techniques used in determining site seasonality was the presence or absence of seasonal indicators. This method is based on the premise that certain species are only present in particular ecological regions, or are more easily procured, during known seasons of the year (Monk 1981:180). The use of presence/absence seasonality indicators is also based on the assumption that information concerning the distributions and seasonal movements of modern fauna applies to past populations. Grayson (1984: 177) warns that this approach may result in erroneous conclusions concerning site seasonality. Several of the bird, fish, and select mammalian fauna recovered from Bushfield West provide seasonal estimates for site occupation. The availability of migratory birds, the spawning seasons of fish, and the ages of certain mammalian species provide information as to the time of the year in which these individuals were most likely procured.

Several of the bird species found at Bushfield West are common spring and fall migrants to the Nipawin region and for some the area is also within their breeding ranges. These species include the following: Canada goose, white-fronted goose, tundra swan, trumpeter swan, mallard, green-winged teal, blue-winged teal, common loon, ruffed grouse, spruce grouse, sharp-tailed grouse, sandhill crane, and whooping crane. The times of the year during which these species can be found in the site region are summarized in Table 10.1.

Table 10.1 Seasonal Availability of Bird Species From Bushfield West

Species Feb.	Spring Summer Fall Winter Mar. Apr. May June July Aug.Sept. Oct. Nov.Dec. Jan.
Canada goose	———————------????????????—————————
White fronted goose	——————— ————————-
Tundra swan	————------ ???????
Trumpeter swan	————————————————————---
Mallard	—————————————————————
Green-winged teal	—————————————————————
Blue-winged teal	—————————————————————
Common loon	—————————————————
Sharp-tailed grouse	————————————————————————————
Spruce grouse	————————————————————————————
Ruffed grouse	————————————————————————————
Sandhill crane	—————————————————
Whooping crane	—————— ———

The geese remains from Bushfield West cannot be identified to species; however, according to Blood et al. (1977) only the Canada goose and white-fronted goose occur in the Nipawin region with any regularity or frequency. The occurrence of the snow goose and Ross' goose in the region is quite rare. The Canada goose is described "as a common spring and fall migrant, and as a very uncommon non-breeding summer visitor" (Blood et al. 1977: 49). The white-fronted goose is a common spring migrant, but was not recorded in the area in the fall (ibid.: 49). According to Bellrose (1976: 105), thousands of the eastern subpopulation of white-fronted geese stop in the Saskatchewan

River delta during their fall migration from the Queen Maud Gulf and the Thelon River on their way to wintering grounds in Louisiana and Texas. The Saskatchewan River delta, which is situated approximately 90 km to the northeast, may be outside of the range of hunter-gatherers located at Bushfield West.

Blood et al. (1977: 49) considers the tundra swan to be a common spring migrant, but an uncommon fall migrant although a few individuals were recorded in the region during their fall aerial surveys. A major migratory corridor of the tundra swan extends southeast of the Athabasca River delta to the southeast corner of the province, passing over the Nipawin region (Bellrose 1976: 95). These fall migratory birds may not stop in the east central part of the province or if they do it may only be for a brief rest. Bellrose (1976: 89-80) shows the former breeding range of the trumpeter swan as including all of Saskatchewan except for the far northeastern portion of the province. Currently, the population of the trumpeter swan is only a fraction of what it used to be.

Mallards are one of the earliest spring arrivals in the region and they have been reported in the Saskatchewan River delta as early as the beginning of April (ibid.: 236). They are also one of the last waterfowl species to leave for their wintering grounds. The breeding range of the mallard is extensive covering may different ecosystems: subarctic deltas, open boreal forests, bogs and marshes of closed boreal forests, the parkland, and the prairie, wherever there is an adequate supply of water.

Green-winged teal arrive in the region near the end of April and the population increases through May with the continued arrival of birds. They depart from the central breeding grounds in September through to the beginning of December (ibid.: 222). The breeding grounds of the green-winged teal are as extensive as those of the mallard. Several pairs of breeding green-winged teal were recorded by Blood et al. (1977: 52). Blue-winged teals reportedly arrive in the Nipawin region in May and leave towards the end of August. Several breeding pairs of these birds were also recorded in the area during the summer (ibid.: 51, 53).

Spring migration for the common loon begins in March and continues through June. The dates of these northward migrations are often dependent upon the rate of spring thaw. The peak of the fall migration is the end of August and the beginning of September (Dunning 1985). The breeding range includes most of northern Canada; however, large lakes with an adequate supply of fish are factors which determine where the common loon will nest (ibid.: 43).

Several of the bird bones recovered at Bushfield West are grouse and crane specimens. The ranges of three species of grouse—sharp-tailed, spruce, and ruffed—cover east central Saskatchewan. These three species of upland gamebirds inhabit the

Nipawin region year-round, although, during the 1977 Nipawin wildlife survey, the ruffed grouse was the most abundant species observed. No sharp-tailed grouse were recorded and only a few spruce grouse were seen.

The breeding grounds of the sandhill crane extend southward to include the Nipawin region. At the beginning of April sandhill cranes leave staging areas in Nebraska to head to their breeding ranges in central and northern Saskatchewan. The winter migration begins in late August reaching its peak in the third week of August and the last birds usually leave in mid October (Johnsgard 1983:179). The migratory route of the whooping crane extends over the Nipawin area as the birds move to their breeding grounds in Wood Buffalo National Park (ibid.: 185-186). The spring migration of the whooping crane starts at the beginning of April, extends through May and into June. The peak period is late April and early May. The fall migration occurs in September, October, and ends in mid November (ibid.: 21).

As was mentioned in the excavation block discussions, ten grouse long bones recovered from Bushfield West possess secondary bone growth known as medullary bone. Anne M. Rick (1975) introduced the use of bird medullary bone as a technique for determining archaeological site seasonality. The Bushfield West specimens were sent to Rick at the Zoological Identification Centre, Canadian Museum of Nature in Ottawa, who confirmed that they did indeed possess examples of medullary bone.

Medullary bone "consists of a system of bone spicules which grow out from the endosteal surfaces and may completely fill the marrow spaces of the long bones" (Simkiss 1967: 168). (Endosteal is the inner surface of the bone.) This type of bone structure was originally reported in 1916 in the femurs of pigeons and white pelicans and then again in pigeon long bones in 1934 when it was identified as a "physiological marrow ossification" (ibid.: 166). It occurs naturally only in female birds during their breeding cycle (Rick 1975: 183).

Medullary bone is most commonly identified in long bones where it can easily be seen without the aid of a microscope or hand lens. However, it also occurs in other parts of the skeleton including the flat bones of the skull, furculum, sternum, innominate, and ribs, as well as vertebrae; the tarsometatarsus and toe phalanges are elements in which only small amounts of medullary bone occurs (Simkiss 1967: 167). It has been observed in domesticated, as well as wild birds including wild turkey, sage grouse, Canada goose, and mallard (Rick 1975: 188; Simkiss 1961: 334; Simkiss 1967: 168).

At Bushfield West medullary bone is only found in grouse long bones . None of the other bird species, including geese and mallard, contain examples of this secondary bone growth. The grouse specimens possessing medullary bone include the following:

four radii, three ulnae, one femur, one tibiotarsus, and one indeterminate long bone (Figure 10.1 a and Figure 10.1 b). All of these bones were recovered in a fragmented state and the medullary bone is easily seen within the medullary cavity. On one specimen, the proximal femur, the entire cavity is filled with medullary bone. On the other specimens it appears as a solid layer lining the inner surface of the cortical bone.

Rick (1975: 183) describes medullary bone as a "granular or powdery bony substance." Taylor (1970: 92) compares it to the structure of cancellous or spongy bone that is found in the epiphyses of long bones. It can be converted rapidly into calcium ions which are used in the formation of eggshells (Simkiss 1967: 170). The development of medullary bone is initiated by the production of sex hormones during the reproductive cycle. Deposition of medullary bone begins either 7 - 14 days according to Rick (1975: 184) or 10 - 14 days according to Simkiss (1967: 168) prior to the laying of eggs. As soon as the egg shell starts to form the medullary bone begins to resorb. If more than one egg is laid the production of medullary bone begins again as soon as the previous egg shell is complete. This cycle of formation and resorption of medullary bone continues until the last egg in the clutch is laid. Within 10 - 20 days after the final egg is laid the medullary bone is completely resorbed and the marrow cavity appears normal (Simkiss 1967: 169). Simkiss (1967: 170) estimates that due to the rapid formation and breakdown of medullary bone it would only be found in wild birds during a period of three to four weeks.

The formation of medullary bone is an adaptation to the need to have large amounts of calcium readily available to the blood supply within a short period of time.

FhNa-10-18953 (shown twice actual size)

Figure 10.1 a Medullary Bone in Grouse Tibiotarsus

FhNa-10-19948 (shown twice actual size)

Figure 10.1 b Medullary Bone in Grouse Long Bone

Even if the bird's diet is high in calcium it cannot be absorbed from the digestive system quickly enough or in large enough quantities to be the sole source of calcium used in eggshell formation (Simkess 1961: 351).

The breeding season for grouse is from the end of April to the beginning of May (Bergrund and Gratson 1988: 510-511). However, the time of breeding and nesting can vary by as much as two weeks. The variation in breeding and nesting times appears to be strongly correlated with the disappearance of snow cover. If there is heavy snowfall in March and April nesting will occur later, perhaps not beginning until May; whereas a mild winter with early melting of the snow results in a earlier breeding season sometime near the beginning of April (Bergrund and Gratson 1988: 512).

Clutch sizes for grouse are divided into low and high modes. A low mode is defined as containing 5 to 8 eggs which are characteristic of grouse that have a >50% chance of survival (spruce grouse). A high mode is one which has from 9 to 13 eggs and is associated with grouse which have a <45% survival rate (ruffed and sharp-tailed grouse). Estimates for egg laying rates of grouse range from 1.1 egg per day to 1.5 per day (Johnsgard 1973: 66). The most detailed information on egg laying is given for ruffed grouse. The female lays eggs at a rate of two eggs every three days; therefore, it would take 17 days to lay a clutch consisting of 11 eggs (ibid.: 272). Of the three species of grouse found in the Nipawin region the spruce grouse is the least likely to renest, 10% - 20% of females renest. The percent of ruffed grouse females that renest is also low: 22% - 26%. Sharp-tailed grouse females have a very high rate of renesting: 88%. Renesting will occur in May, June, and as late as July depending on the date on which the first nest was abandoned. The peak hatching dates for grouse ranges from mid to late June (Bergrund and Gratson 1988: 513).

Using the time frame of 7-14 days prior to laying at which birds begin to produce medullary bone (provided by Rick 1975 and Simkiss 1967) this would place the date at which medullary bone first appears in grouse at mid April (11th - 17th). If mid May is used as a date for the end of the egg laying period and Simkiss' estimate that it takes 10-20 days for the medullary bone to be completely resorbed is used, the end of May to the beginning of June would be the latest at which medullary bone would be observed in the skeletal elements. Therefore, the possible dates of site occupation indicated by the presence of medullary bone in breeding female grouse recovered from Bushfield West extends from mid April to the beginning of June.

Researchers have observed medullary bone growth in two species of waterfowl: Canada goose and mallard. Specimens representing both geese and mallards are present in the Bushfield West faunal assemblage. However, none of the bones from these birds exhibit evidence of medullary bone. Canada geese begin to nest early in the spring near the end of March. However, breeding appears to be controlled by daylength and the disappearance of snow cover; therefore, the dates of when the first eggs are laid will vary. The average goose clutch contains four to seven eggs with the number of eggs being laid per day ranging from one egg per day to one egg every 1.87 days (Bellrose 1976: 160). Renesting does not appear to be a common occurrence of Canada geese breeding in the northern latitudes (ibid.: 162). No breeding pairs of geese were recorded by Blood et al (1977) during their survey of the area.

As mentioned previously, mallards arrive in east central Saskatchewan at the beginning of April. Hundreds of mallards were recorded during the spring aerial survey of the Nipawin study region on April 23, 1977 (Blood et al. 1977: 50). Several breeding pairs were also recorded in the area on May 6, 1977. The average size of the mallard clutch is nine eggs with one egg being laid per day. Females will frequently renest if their initial attempt fails (Bellrose 1976: 237).

From the preceding discussions it is apparent that geese may nest slightly earlier than grouse, and mallards nest at approximately the same time of the year as grouse. Therefore, the time frame during which medullary bone appears in these species should overlap with that of grouse. Three possible reasons for the geese and mallard specimens recovered from Bushfield West not to show evidence of medullary bone growth are apparent. First, the individuals represented in the sample may have already completed their breeding cycles. Second, these species (especially geese) may not have been breeding within the vicinity of the site. Third, the remains may represent males or non-breeding females. As mentioned by Rick (1975: 188) the latter emphasizes one of the limitations of using medullary bone growth as a seasonal indicator. Since it only occurs in breeding females it is present in a limited number of the population, thereby, reducing the probability of such specimens being recovered from a site.

Avian eggshell fragments were recovered during the excavation of Bushfield West. The majority of the eggshell fragments were found in the upper portion of the occupation paleosol in Block 2. A large quantity of eggshell remains were found to the west of the two hearths and rock pit feature on the west side of the excavation block, as well as in association with the hearths in the central area of the block (Gibson 1994: 71). A few eggshell fragments were also recovered from Block 3, near the large hearth in the central area of the block. No eggshell fragments were collected from Block 1; however, it is possible that they were not recognized as cultural material associated with the occupation of the site and were, unfortunately, discarded. The original pigmentation of the eggshell fragments has not been preserved and they are bleached or dull white in colour. Eggshell thickness can be used as a general indicator of the size of the species represented; however, the thickness of the eggshells from Bushfield West was not determined (Dyck and Morlan 1995: 137). But, the recovery of eggshell remains does suggest that the site was occupied in the spring or early summer.

Although several species of fish are present in the region throughout the year, their availability and the ease with which they can be procured are dependent on seasonal movements. Fish are generally easier to capture when they are concentrated in shallow waters during spawning runs. The fish species identified in the Bushfield West fauna include the following: lake sturgeon, walleye, northern pike, white sucker, longnose sucker, silver redhorse, shorthead redhorse, sauger, goldeye, burbot, and flathead chub. The spawning seasons of these fish are summarized in Table 10.2.

Table 10.2 Seasonal Availability of Fish Species From Bushfield West

	Spring			Summer			Fall		Winter			
Species	**Mar.**	**April**	**May**	**June**	**July**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**
Lake sturgeon			—	—								
Walleye			—	—								
Northern pike			—	—								
White sucker			—									
Longnose sucker		—	—									
Silver redhorse			—	—								
Shorthead redhorse		—	—									
Sauger			—	—								
Goldeye			—	—								
Burbot	—										—	—
Flathead chub				—	—							

The majority of the information regarding fish spawning seasons and spawning ground locations was obtained from Scott and Crossman (1973) and occasionally Atton (1993). Longnose suckers are one of the earliest spring spawners, with spawning runs occurring from mid April to mid May. The peak of the longnose sucker spawning run occurs several days prior to that of the white sucker, often taking place in the same stream. The white sucker spawns over a period extending from early May to early June when the temperature of the rivers first reaches 10° C. Walleye and northern pike are also spring spawners (May to June). Walleye spawning grounds are located in rocky areas of white water or along coarse graveled shoals of lakes. The spawning areas of northern pike are quite different from most of the other species: they spawn within heavily vegetated areas of river floodplains, marshes, and lake bays. Sauger spawn over a very restricted two week period, the last week in May and the first week in June. They generally spawn immediately after the walleye often utilizing the same spawning areas.

The spawning season of the goldeye is more extensive, covering a period of three to six weeks (May to the first week in July). Shorthead redhorse also spawn over an extended period, late April to June, when water temperatures reach 11.1° C. They spawn within the less turbid areas of small rivers and streams with gravelly bottoms. The silver redhorse spawns in May and June in swiftly flowing rivers and streams when the temperatures reach 13.3° C. Scott and Crossman (1973: 84) identify the spawning period for lake sturgeon as running from early May to late June, depending on location. Sturgeon generally begin their spawning migration as soon as the rivers are free of ice. Atton (1993: 21) identifies sturgeon as one of last spring spawners, spawning in June. Two non-spring spawning species were recovered from Bushfield West: flathead chub and burbot. The spawning period of the flathead chub is from mid to late summer. Burbot spawns under the ice in mid winter, January to March. Only one specimen of each of these species was found in the faunal assemblage of the site.

Atton (1993: 19) provides a summary of fish species identified at nine other archaeological sites in the Nipawin region. Yellow perch and tullibee were found in small numbers at other sites, but not Bushfield West. The yellow perch spawns in the spring beginning in mid May and continuing until the end of June (Scott and Crossman 1973: 686). Tullibee spawn in the fall when water temperatures decline to 4 or 5° C (Scott and Crossman 1973: 239). Both yellow perch and tullibee are small in comparison to other fish found in archaeological sites in the Nipawin region; therefore, they may have been difficult to capture using techniques such as spearing, netting (depending on the construction of the net), and the obstruction of their movements using weirs.

Of particular interest is the lack of whitefish at Bushfield West and the recovery of a significant number of them at other sites in the Nipawin region (Atton 1993: 19). Lake whitefish spawn in the fall, late September to October, in shallow water over hard stoney bottoms (Scott and Crossman 1973: 271). It is a medium to large fish which weighs anywhere from 1 lb. to 9 lb.. depending on age (ibid.: 273).

Fish otoliths, opercula, vertebral centra, and scales were not examined in order to determine seasonality. The large numbers of these specimens that were found and the variety of species represented is a potentially valuable source of seasonality data. However, the lack of available expertize and funding did not permit the author to undertake this avenue of research. It should also be noted that seasonality estimates based on annuli or growth rings provide only an approximation since there is considerable variation within species and false annuli are often present (Casteel 1972: 405; Monks 1981: 200).

Certain mammalian species can provide seasonality estimates based on the presence of foetal/newborn or juvenile individuals. One hundred and fifty-three unidentified ungulate foetal/newborn specimens are represented in the Bushfield West fauna. A variety of skeletal elements including axial (N=116) and appendicular (N=37) specimens are present indicating that virtually complete skeletons are represented in the sample. Three species of ungulates—bison, moose, and elk—are present in the Bushfield West assemblage. At the foetal/newborn stage of development the long bones have distinctive layering of the cortical bone and landmarks are obscured. Epiphyses, only a few of which were recovered, are amorphous in shape and also lack distinguishing characteristics. Therefore, it is difficult if not impossible to distinguish between foetal/newborn specimens of the three species represented in the assemblage. They do, however, indicate a spring season of procurement and site occupation. The main calving season for bison extends from mid April to the end of May with the peak period occurring the last week in April and the first week of May (Rutberg 1984: 418). Elk calves are born in late May to early June (Banfield 1974: 401). Moose calves are also born at approximately the same time as elk calves: late May or early June (ibid.: 396).

Several juvenile beaver are also present in the Bushfield West faunal remains. The young age of these individuals is indicated by the lack of root closure of numerous premolars and molars, as well as the recovery of a large number of unfused appendicular and axial specimens. According to Banfield (1974: 161) beaver kits are born between late April and late June. The majority of these teeth are unsocketed, therefore, it is difficult to determine a series of eruption patterns and ages groupings for the beaver specimens. Accurate ages can be obtained from first and second molars by counting the annual cementum layers in prepared thin-sections. Each annual cementum layer is comprised of a broad dark summer layer and a narrow light winter layer (van Nostrand and Stephenson 1964). Analysis of annual cementum layers was not done with the beaver teeth from Bushfield West. What can be concluded from an examination of the individual teeth is that a few individuals 1-2 years old and several animals 2-5 years old are represented in the sample indicating that a number of beaver of different ages were being trapped.

At least one juvenile red fox is represented in the faunal assemblage. Unerupted permanent teeth crowns still in the bud stage were recovered from Block 2. Red fox pups are born between March and May (ibid.: 300). According to Hillson (1986: 216-217) the permanent dentition of the red fox erupts between 2.5 to 6 months. Unerupted permanent incisors, which are the first permanent teeth to erupt, show that the individual was 2.5 - 4 months old. Depending on the date of birth, the juvenile fox may have been caught in spring or as late as August.

10.2.1 Discussion and Summary

Seasonality estimates provided by bird, fish, and select mammalian species recovered from Bushfield West indicate a spring or early summer occupation of the site (April to early June). Although several of the migratory birds represented in the sample are both spring and fall migrants, they are more abundant in the spring and in certain instances (white-fronted goose and tundra swan) do not stop in the region during their fall migration. The recovery of eggshell fragments within the occupation paleosol and the presence of medullary bone in some of the grouse limb elements are strong indicators that the site was occupied in the spring or early summer. The majority of fish species identified in the fauna are spring spawners. It is at this time of the year that fish congregate in large numbers in shallow waters and are easily captured. The exceptions are the flat head chub and burbot. The flathead chub is an early to mid summer spawner. If the occupation of Bushfield West extended into June than the presence of this species can be accounted for. Burbot spawn under the ice in winter, January to March. They spawn in masses of 10-12 intertwined individuals and although they generally spawn in lakes they have been known to move into rivers (Scott and Crossman 1973: 643). The fact that they do spawn under the ice does make them difficult to capture although nets can be set under the ice or they may be speared through holes in the ice. If the occupation of Bushfield West began in early spring (March) then the presence of the burbot specimen could be explained. When the fact that lake whitefish, which spawn in the fall, are represented at other sites in the Nipawin region but not Bushfield West is also taken into consideration a spring site occupation appears likely. The recovery of foetal/newborn unidentified ungulate remains, as well as juvenile beaver and red fox also indicate a spring occupation.

Monk (1981: 183-184) cautions that the presence/absence method of determining seasonality is susceptible to sample size. The smaller the sample the greater the probability that the seasonal estimate will be based on a single species. The larger the sample the greater the chance that multiple seasonal indicators will be recovered and thus the more reliable the seasonal estimate. Archaeological work at Bushfield West entailed the excavation of 624 m^2 and resulted in the recovery of over 100 kg of bone. The faunal sample recovered from the three excavation blocks that were analysed for the purposes of this thesis consists of 108,135 pieces of bone—certainly an adequate sample size for the use of the presence/absence seasonality method, especially since the majority of species discussed indicate the same season of occupation.

A second cautionary note mentioned by Monks (1981: 184) in reference to using presence/absence seasonality indicators is the storage and transport of food resources. Food resources may have been recovered, processed, and preserved at a site during one season and transported to a second site and consumed during a different season. The recovery of a variety of skeletal elements from each species—e.g., both axial and appendicular elements of bird and fish species—seems to indicate that these resources were acquired within close proximity to the base camp where they were processed and, for the most part, consumed within the same season.

10.3 Bison Tooth Eruption and Wear Schedules

The use of tooth eruption and wear patterns has become a widely accepted means of determining seasonality at archaeological sites. Initial studies of aging bison dentitions involved the examination of large samples of known-age mandibles to establish eruption and wear schedules (Brumley 1988; Frison 1982; Frison and Reher 1970; Frison et al. 1976; Frison et al. 1978; Reher 1973 and 1974; Reher and Frison 1980; Todd 1987; Todd and Hofman 1987; and Wilson 1980). Mandibles and lower molars are generally used to age animals since they are usually better preserved and, therefore, provide a larger sample. However, Wilson (1974 and 1980) and Frison et al. (1978) have used maxillae and upper molars, with considerable success, to determine site seasonality. The draw-backs of using maxillary teeth are small samples of both archaeologically recovered specimens and modern bison maxillae of known age with which to compare them.

Determining the season in which bison at a particular site have been killed is based upon the assumption that breeding and birthing periods are seasonally limited and consistent from year to year. This will result in discrete clusters of animals born in successive years. Frison et al. (1976: 38) identify the peak calving period as the last two weeks in April and the first two weeks in May. A study of bison births at the National Bison Range, Montana by Rutberg (1984: 418) determined that the main calving season "runs from 15 April to 31 May, with most births concentrated in the middle 2 weeks of this period" (27 April to 12 May).

A combination of tooth eruption and wear sequences are used to identify discrete clusterings of immature individuals, those which are younger than 4.6 years. At 4.6 years all permanent premolars and molars are in place (Frison 1982; Todd and Hofman 1987; Reher 1974). Tooth wear patterns observed on mature dentitions are not as accurate as using a combination of eruption and wear in determining age groupings. Wear patterns will vary according to a number of factors including diet, harshness of the environment and the amount of dirt, sand and grit that is ingested along with the vegetation (Haynes 1984: 488-490). However, when examining a large sample of mature mandibles and isolated molars, metaconid height measurements will fall into clusters which correspond to certain age groups. As the age of the individual increases the metaconid height decreases. The metaconid height of the first molar is generally selected for measurement since the base of M1 is exposed first in the normal growth sequence and it can therefore be measured without damaging the mandible. It is also the first molar to exhibit wear. The metaconid heights of M2 and M3 are also measured whenever possible. These measurements provide additional information if the anterior lingual crown is broken or if M1 is so worn that only the dentine portion of the tooth or the root remains (Reher and Frison 1980: 68). In the case of maxillary molars, paracone heights of M1, M2, and M3 are measured.

Originally, the terminology and method of identifying wear observed on mature molars was confusing, purely descriptive, and difficult to quantify when dealing with a large sample. Frison et al. (1976) devised a method which standardized the means of describing cusp facet wear of both upper and lower molars and which could also be adapted to the presentation of data in a table format (Wilson 1980: 96). The terminology devised by Frison et al. (1976) is used to describe Bushfield West bison dentition.

The eruption and wear schedules of immature mandibles from Bushfield West were compared with those developed for several precontact sites: Glenrock (Frison and Reher 1970), Wardell (Reher 1973), Casper (Reher 1974), Hawkens (Frison et al. 1976), Big Goose Creek (Frison et al. 1978), Vore (Reher and Frison 1980), Garnsey (Wilson 1980), Agate Basin (Frison 1982), Horner (Todd 1987; Todd and Hofman 1987) and Scottsbluff and Lipscomb (Todd et al. 1990). The wear patterns of mature mandibles and isolated molars are also compared to the wear patterns described for older individuals from these same sites. These references give descriptions of tooth eruption and wear schedules for individuals born through successive months of the year: N + 0.0, N + 0.4, N + 0.5, N + 0.6, N + 0.7 and N + 0.8-0.9. Lower deciduous premolar measurements are taken as described by Wilson (1974: 154) and lower molar tooth measurements are taken as described by Todd and Hofman (1987: 512-513) using a pair of dial sliding calipers (Appendix E). In the case of socketed mandibular molars, if the enamel-root base line is not above the level of the alveolus, metaconid heights are not recorded. The equipment necessary for sawing the mandibular alveolus to expose the roots was not available to the author. This is a very destructive procedure which, if not done with the proper equipment, can result in shattering the mandible.

Maxillary socketed and isolated teeth are compared to eruption and wear schedules from the Casper (Wilson: 1974) and Garnsey sites (Wilson: 1980). Upper deciduous premolar and permanent molar tooth measurements follow those described by Wilson (1974) (Appendix E). As is the case with socketed lower molars, if the enamel-root base line of the maxillary teeth is not at or above the level of the alveolus, the paracone height cannot be measured and no attempt has been made to cut the bone to expose the roots.

10.3.1 Mandible and Lower Molar Age Groups

Both left and right mandibles and lower molars from Bushfield West are included in the analysis. Even so, the sample is small consisting of 17 mandibles and 28 individual premolars and molars. Of the 17 mandibles included in the sample only two hold complete dentitions: socketed P2, P3, P4, M1, M2, and M3 teeth. The remaining specimens are mandible fragments with varying numbers of socketed teeth. Using a combination of metaconid heights and comparisons of tooth eruption and wear schedules developed from the sites mentioned previously, 10 age groups are defined for the sample of mandibles from Bushfield West (Table 10.3). The age groupings along with eruption stages and wear patterns identified in the site sample are as follows:

Group 1 (0.2-0.4 years)

#15527 and #15529 - two sections of a right mandible with dp2, dp3, dp4, and M1.

All deciduous premolars are in place. The dp3 and dp4 show wear on all facets, while dp2 shows slight wear on the highest area of the cusp. The enamel-root lines of dp2 and dp3 are above the alveolus. The anterior and mid cusp enamel-root line of dp4 is at the level of the alveolus, while the enamel-root line of the posterior cusp is below the level of the alveolus. Neither exostylid of dp4 is in wear. The anterior exostylid is 7.4 mm below the crown and the posterior exostylid is 2.8 mm below the crown. The M1 has erupted but is not yet at the level of the deciduous premolars and shows no wear on the cusps.

Group 2 (1.0 years)

#16600 - left mandible with dp2, dp3, dp4, M1, and M2 (partial).

#23067 - right mandible with dp4 and M1.

#23607 - left mandible with I2.

All deciduous premolars are in place with dp2 exhibiting slight wear and dp3 and dp4 showing heavy wear. The enamel-root line of dp2 and dp3 are just above the alveolus. The enamel-root line of dp4 is at the level of the alveolus. The anterior exostylid of dp4 is 5.1 mm below the crown and the posterior exostylid is almost at the level of wear. The M1 has erupted and is at the level of the deciduous premolars. Facets I, II, IV, V, and VI of M1 are in wear. The exostylid is above the level of the alveolus (4.6 mm), but still well below the level of the crown (10.2 mm). The M2 is just beginning to erupt.

The right mandible with dp4 and M1 is slightly more advanced. The premolar, dp4 is strongly bilophodont with the enamel-root line at and just below the level of the alveolus. The anterior exostylid is not in wear, however the posterior exostylid is just in wear. Cusp facets of M1 which are in wear include I, II, III, IV, V, and VI. The exostylid is above the level of the alveolus (2.8 mm) and still well below the level of the crown (11.9 mm).

The I2 is a completely formed bud in the mandible and it has not yet erupted.

Group 5 (4.0 years)

#21457 - left mandible with P2, P3, P4, M1, and M2.

All permanent premolars are in place and exhibit wear. The enamel-root line of P2 is above the level of the alveolus, while the enamel-root lines of P3 and P4 lie below the level of the alveolus. The M1 is moderately bilophodont with the enamel-root line just below the level of the alveolus. The postfossettid appears to be weakening and narrowing. The exostylid of M1 is in wear and the exostylid enamel just forms a continuous loop with the enamel of the tooth. The M2 is strongly bilophodont and the enamel-root line is well below the level of the alveolus. The exostylid is not in wear and is 3.7 mm below the level of the crown.

Group 6 (5.0 years)

#21547 - right mandible with P2, P3, P4, M1, M2, and M3.

#29416 - right mandible with P2, P3, P4, and M1.

#30169 - right mandible with P3, P4, and M1.

The enamel-root lines of P2 and P3 are above the level of the alveolus, while the enamel-root line of P4 is at the level of the alveolus. The metaconid enamel-root line of M1 is above the level of the alveolus while the entoconid enamel-root line is just at the level of the alveolus. M1 is moderately bilophodont with all facets showing wear. The prefossettid and the postfossettid are weakened and narrowed and both selenids are beginning to cup. The exostylid is in wear with the enamel around it forming a loop which is connected with the enamel of the tooth crown. The M2 is strongly bilophodont.

The enamel-root line is below the level of the alveolus. The exostylid is in wear; however, the enamel forms an oval around the exostylid and is not connected with the enamel of the tooth crown. The M3 is strongly bilophodont and exhibits slight to moderate wear on all cusp facets except IX' of the hypoconulid. The exostylid is not yet in wear but is near the level of the crown. Differences between Group 6 and Group 7 are based mainly on height of metaconid.

Group 7 (6.0 years)

#30812 - right mandible fragment with M1.

The M1 is moderately bilophodont and all cusp facets are in wear. Both the pre- and the postfossettids are beginning to weaken and narrow. The enamel-root line of the metaconid of M1 is at the level of the alveolus and the entoconid is below the level of the alveolus. The exostylid is in wear and the enamel forms a continuous loop with the remaining enamel of the tooth.

Group 8 (7.0 years)

#1101 - left mandible with P2, P3, P4, and M1.

The following teeth—P2, P3, and P4—exhibit heavy wear. Enamel-root lines of all premolars are well above the level of the alveolus. M1 enamel-root line is above the level of the alveolus. The M1 is weakly bilophodont. Both the pre- and postfossettids are weakened but still present. Pre- and postselenids are slightly cupped. The exostylid is in wear and the enamel forms a loop which is connected to the enamel of the crown.

Group 9 (8.0 years)

#28287 and #28289 - right mandible with P2, P3, P4, and M1.

#28374 and #28386 - left mandible with P3, P4, and M1.

#26252 - left mandible with M3.

#26396 - right mandible with M3

All teeth are heavily worn with enamel-root lines above the level of the alveolus, exposing roots. The M1 is only weakly to moderately bilophodont. The prefossettid is very weak and is almost worn away resulting in cupping of the preselenid. The postfossettid is also weakened and small and the postselenid is cupped. The exostylid is in wear with the enamel forming a continuous loop with the enamel of the crown.

The enamel-root line of M3 is below the level of the alveolus. All M3 cusp facets are in wear and the tooth is weakly bilophodont. The fossettids are weakened and narrow. The endostyle is in wear with the enamel forming an oval around the style which extends towards and touches the enamel of the main portion of the tooth.

Group 10 (9.0 years)

#15192 - left mandible with P2, P3, P4, M1, M2, and M3.

The roots of all premolars are well above the level of the alveolus and all crowns exhibit heavy wear. The enamel-root line of M1 is well above the level of the alveolus and the roots are exposed. M1 exhibits heavy wear with the prefossettid being worn away and the preselenid cupped. The postfossettid is weakened but still present. The enamel has broken down between M1 and P4, as well as between M1 and M2. The exostylid is heavily worn but not yet obscured as the enamel forms a loop with the crown of the tooth. The enamel-root line of M2 is above the level of the alveolus. The M2 is weakly bilophodont with both fossettids weakened and narrow. The exostylid is in wear and the enamel forms a loop with the crown of the tooth. The enamel-root line of M3 is at the level of the alveolus. The M3 is weakly bilophodont and the exostylid is in wear but the enamel forms an oval and is not connected to the crown.

Group 11 (10.0 years)

#24465 - right mandible fragment with M2.

The M2 is heavily worn. The prefossettid is a small oval and the preselenid is cupped. The postfossettid is weakened and narrow and the postselenid is also cupped. The exostylid is almost worn away and the enamel forms a "U-shaped" loop joining with the enamel of the tooth crown. The enamel-root line of M2 is above the level of the alveolus.

Group 12 (11.0 years)

#34502 - Right mandible fragment with M3.

The enamel of M3 is almost worn away. The prefossettid is weakened, narrowed and reduced in size and the postfossettid is weakening. The exostylid is in wear and the enamel forms a loop with the remaining enamel of the tooth. The enamel-root line is well above the level of the alveolus.

Five isolated deciduous incisors and three isolated deciduous premolars were also recovered from the excavations at Bushfield West. The deciduous incisors include one first incisor, three second incisors, and one third incisor. The deciduous first incisor (#31623) is extremely worn. The permanent first incisor begins erupting at 1.1 to 1.3 years and at 1.4 years di1 may or may not be present (Reher 1973: 91, Reher and Frison 1980: 64). Therefore, di1 (#31623) is approximately 1.0 to 1.4 years. One di2 (#20110) exhibits slight to moderate wear, the second shows moderate wear (#31956) and the third shows heavy wear (#20242). All deciduous teeth including the second incisor are in place by 0.4 months. By 2.4 years the permanent second incisor is close to erupting and by 3.4 years I2 is in place (Reher 1973: 91). Reher (1973: 91) also notes that at 2.4 years di2 is well to extremely worn. The slightly worn di2 appears to be 0.0 to 0.2 years, the moderately worn di2 teeth appear to be 1.0 to 1.4 years, and the heavily

Table 10.3 Metaconid Heights of Bushfield West Bison Mandibles

Group	Age (yr.)	Cat. #	Side	M1	M2	M3
1	0.2 - 0.4	15527/15529	R	--		
2	1.0	16600	L	--	--	
		23067	R	--		
3	2.0	20438	L	51.3		
		34366	R	48.5		
		31939	R		71.7	
		X Group 3		49.9		
4	3.0	19226	R	39.7		
		25057	L	39.0		
		27151	L	37.3		
		27757	R	36.5		
		31250	L		50.4	
		25643	L			63.3
		X Group 4		38.1		
5	4.0	21457	L	--	--	
		31251	L	31.8		
		26851	L	31.6		
		24071	L			42.5
		24070	R			42.4
		X Group 5		31.7		42.45
6	5.0	21547	R	30.2	--	--
		29416	R	26.1		
		30169	R	29.3		
		X Group 6		28.5		
7	6.0	24378	R	24.0		
		30812	R	23.6		
		X Group 7		23.8		
8	7.0	1101	L	16.1 (broken)		
9	8.0	28374/28386	L	22.5		
		25239	L	21.2		
		25518	L	20.9		
		28287/28289	R	18.9		
		26252	L			--
		26396	R		--	
		X Group 9		20.9		
10	9.0	15192	L	15.1	22.5	--
11	10.0	24458	L	9.6		
		24460	L	7.1		
		24465	R		14.5	
		X Group 11		10.6		
12	11.0	34502	R			13.7

worn di2 teeth appears to be 2.0 to 2.4 years. The third deciduous incisor (#19514) exhibits moderate wear. At 2.4 years di3 is also well to extremely worn. One isolated permanent I2 crown is also represented in the sample. This crown is unworn and classified as being close to eruption or just erupted. Reher (1973: 91) states that at 2.4 years I2 is close to erupting and by 3.4 years I2 has erupted and is in wear. Therefore, the I2 crown in the Bushfield West sample is approximately 2.0 to 2.4 years.

All of the deciduous premolars are fourth premolars. One dp4 (#19834) exhibits light to moderate wear. This tooth is strongly bilophodont, the posterior exostylid is polished on the tip and is just entering wear and the anterior exostylid is not in wear. This is close to Wilson's (1980: 93) description of dp4 at 1.0 years. The remaining dp4 teeth (#19834 and #31942) show heavy wear. Specimen #31942 appears to be slightly younger. The fossettids are weakened and narrowed and the anterior and medial selenids are beginning to cup. The anterior exostylid is in wear and the enamel forms a loop that is connected with the enamel of the tooth crown. The posterior exostylid is also in wear, however the enamel forms an isolated island which is not yet connected with the tooth crown. The fossetids of specimen #19834 are almost gone and the cusps are flattened. Both exostylids are in wear and in both instances the enamel around the exostylid forms a loop which is connected with the enamel of the tooth crown. By 3.5 years dp4 is pushed out and P4 is either partially erupted and unworn or fully erupted and slightly worn (Frison and Reher 1970: 47). The two dp4 teeth (#19834 and #31942) appear to fall in the age range of 3.0 to 3.4 years.

10.3.2 Discussion and Summary of Mandibles and Lower Molars

Metaconid height measurements of individual M1, M2, and M3 teeth are graphed in order to identify clusters which can be associated with age groups. The sample is quite small and although strong clusters indicative of discrete age groups are not apparent the stepwise pattern demonstrates different attritional levels of successive age groups (Figure 10.2). The rate of M1 attrition determined from the mean metaconid heights of each age group is 5.2 mm/yr.

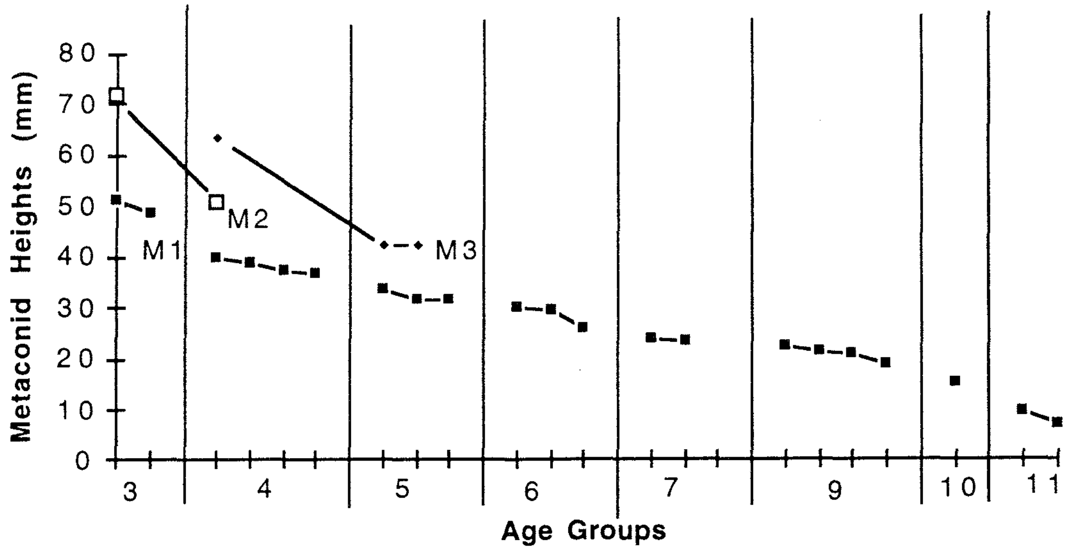

Figure 10.2 Metaconid heights of lower molars by age groups.

For the most part, the eruption schedules and wear patterns of the bison mandibular dentitions and loose lower molars from Bushfield West coincides with the schedules described by Wilson (1980) for the Garnsey site bison. The Garnsey site is a late prehistoric bison kill site in southeastern New Mexico. An analysis of the dentitions from this site established that the bison had been killed in the spring of the year (Wilson 1980: 93). Based on this comparison, the Bushfield West site also appears to be a spring occupation, late April or May.

The specimens assigned to Group 6 (5.0 - 5.1 years) from Bushfield West were problematic in that no specimens from this age group were found at the Garnsey site. However, comparisons with the age groups preceding Group 6 indicated differences in the wear of M2. In Group 5 the exostylid of M2 is below the height of the crown and is not in wear, whereas in Group 6 the exostylid of M2 is in wear with the enamel forming an oval around the exostylid. The differences between Group 6 and Group 7 are based on metaconid height.

The exception to this spring schedule of eruption and wear is one right mandible with dp2, dp3, dp4, and M1 teeth assigned to Group 1 (0.2 - 0.4 years). All of the deciduous teeth are in wear with only slight wear visible on dp2. The M1 is partially erupted from the jaw but is not yet at the level of dp4. This pattern does not fit the description of Garnsey site foetal and newborn animals; the M1 of mandibles in this group is not yet erupted and is still below the level of the alveolus. At the Vore site Reher and Frison (1980: 65) describe a "B" eruption category for immature mandibles (0.2 - 0.3 years) in which the first four cusps of the tooth are erupted and the tooth is approximately one-half to two-thirds the height of the preceding tooth. At the Wardell site M1 in mandibles assigned to 0.4 years have erupted from the jaw, but are still below the level of other teeth and show no evidence of wear (Reher 1973). Therefore, specimen #15527/15529 appears to fall between 0.2 and 0.4 years of age. As mentioned earlier, most modern bison are born between the end of April and the beginning of May; however, there are always instances of calves being born "out of season" (Todd and Hofman 1987: 509). It is possible specimen #15527/15529 represents an early calf. It may also be indicative of the length of occupation at Bushfield West, extending over two to three months.

The distribution of age groups based on lower mandibles appears to be bimodal due to the low number of juveniles and individuals represented in Group 8 (Figure 10.3). However, it should be kept in mind that the sample is small. The profile is interpreted as resulting from attritional predation rather than a single catastrophic kill episode (Reher 1974: 118). The low number of juveniles could also be explained by loss due to taphonomic factors.

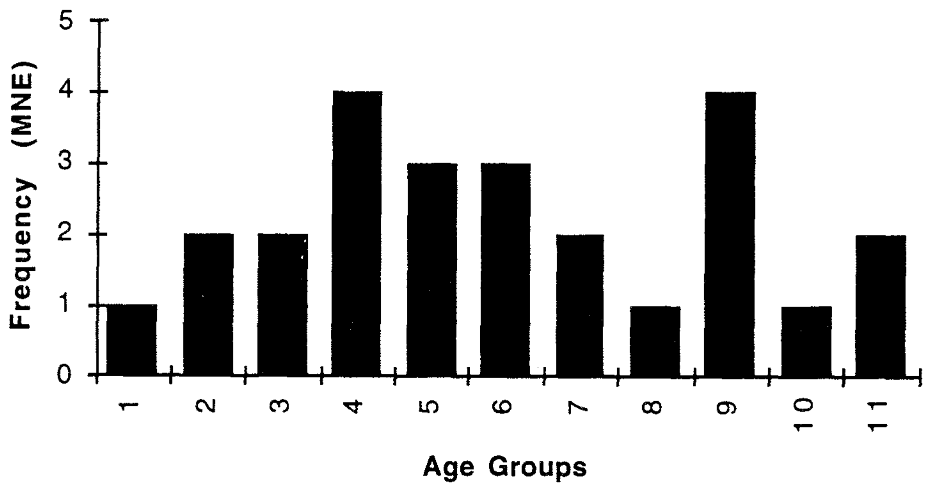

Figure 10.3 Age group distributions based on lower M1.

10.3.3 Maxillae and Upper Molar Age Groups

Both right and left maxillae and individual deciduous premolars and molars from Bushfield West are included in the study. Again, the sample size is very small consisting of only six maxillae with socketed teeth and 26 individual deciduous premolars and permanent molars. Only one maxilla held a complete set of socketed teeth. The remaining maxillae are fragmented and hold a varying number of socketed teeth. Four age groups were identified using a combination of paracone heights and comparisons with eruption and wear schedules established at the Garnsey site (Wilson 1980) and the Casper site (Wilson 1974) (Table 10.4). The age groupings of Bushfield West maxillary teeth and their associated eruption and wear patterns are as follows:

Group 2 (1.0 year)

#16656 - left maxilla with dp3, dp4, and M1.

dp3 is moderately bilophodont with the enamel-root line above the alveolus. There is moderate wear on all cusp facets. The enamel-root line of dp4 is at the level of the alveolus. The tooth is strongly bilophodont with unweakened fossettes. The endostyle is in wear and the enamel just forms a loop joining with the enamel of the tooth crown. The enamel-root line of M1 is well below the level of the alveolus; however, the crown is at the level of the deciduous premolars. There is wear on cusp facets I, II, III, and IV. The endostyle is just at the level of the alveolus.

Group 3 (2.0 years)

#23584 - right maxilla with dp4.

All cusp facets of dp4 are in wear and the tooth is moderately bilophodont. The enamel-root line is at the level of the alveolus. The endostyle is in wear and the enamel forms a loop which is connected with the enamel of the main portion of the tooth.

Group 6 (5.0 years)

#20446 - right maxilla with M3.

#22738 - right maxilla with M2.

M2 is moderately bilophodont with strong fossettes. The enamel-root line is well below the level of the alveolus. The endostyle of M2 is in wear and the enamel forms an irregular oval which extends towards the enamel of the tooth crown. M3 is moderately bilophodont and the fossettes are still strong. The enamel-root line is well below the level of the alveolus. The endostyle is almost in wear.

Group 7 (6.0 years)

#17548 and #17563 - left maxilla with P2, P3, P4, M1, M2, and M3.

#23644 - right maxilla with P4 and M1.

The enamel-root line of M1 is above the level of the alveolus. The crown is well worn and can be described as weakly bilophodont. The fossettes are weakened and narrow but still present and the selenids are cupped. The endostyle is in wear and the enamel forms a loop which is connected with the enamel of the tooth crown. The enamel-root line of M2 is at and just below the level of the alveolus. The fossettes are strong and the entostyle is in wear with the enamel forming a continuous loop with the crown of the tooth. The enamel-root line of M3 is below the level of the alveolus. The fossettes of M3 are strong. The endostyle is in wear; however, the enamel only forms an oval around the endostyle and it is not joined to the enamel of the tooth crown.

Table 10.4 Paracone Heights of Bushfield West Bison Maxillary Molars

Group	Age (yr.)	Cat. #	Side	M1	M2	M3
2	1.0	23617	R	54.5		
		16656	L	51.7		
		X Group 2		53.1		
3	2.0	25137	L	42.0		
		23880	R	40.4		
		X Group 3		41.2		
4	3.0	23608	R	38.4		
		20442	R	36.0		
		24567	L	35.9		
		23617	R		54.5	
		24566	L		52.3	
		24622	R		49.1	
		19627	R			63.9
		17678	L			61.6
		23881	L			50.6
		X Group 4		36.8	52.0	58.7
6	5.0	20446	R			--
		22738		--		
7	6.0	23879	L	25.2		
		23598	R		39.2	
		17566/17595	R		38.7	
		22737	R			48.5
		17548/17563	L	22.4	29.8	37.9
		23644	R	21.4		
		24180	R			26.8
		X Group 7		23.0	35.9	37.7

10.3.4 Discussion and Summary of Mandibles and Lower Molars

The paracone heights of loose upper molars, M1, M2, and M3, were graphed in an attempt to identify discrete clusters which would indicate specific age groups (Figure 10.4). As was the case with plotted metaconid heights, the maxillary teeth show a step-wise regression rather than clear age groupings. However, successive stages of tooth attrition and thus age is still demonstrated by paracone heights. The rate of attrition of upper M1 teeth based on paracone heights is 5.0 mm/yr.

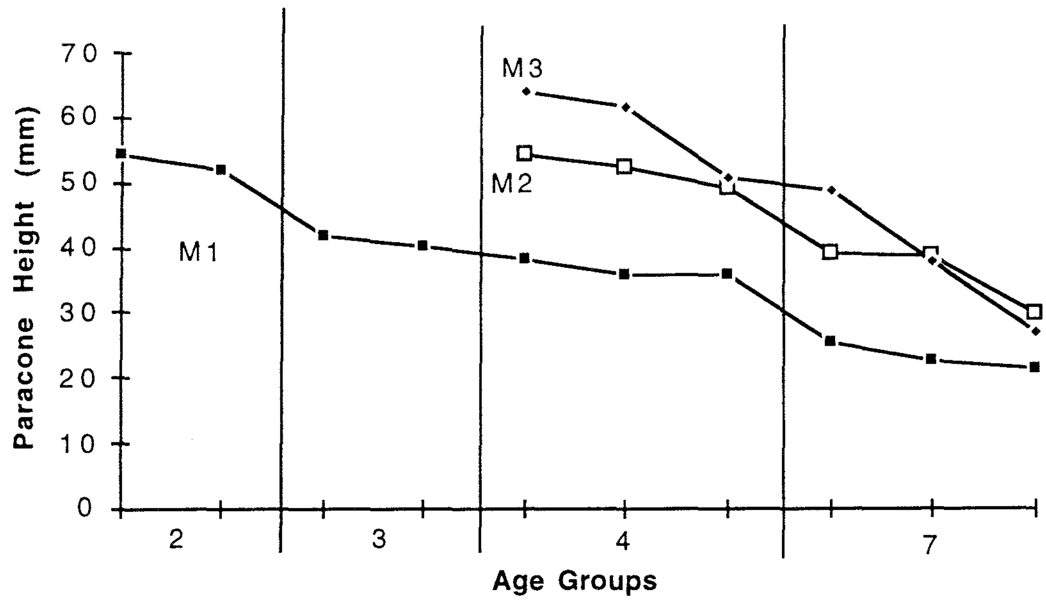

Figure 10.4 Paracone heights of upper molars by age groups.

The age distribution of bison from Bushfield West shows two ranges: juveniles (2.0 - 4.0 years) and prime adults (6.0 - 7.0 years) (Figure 10.5). Representation in each category is almost equal and a larger sample would likely result in an attritional predation mortality profile.

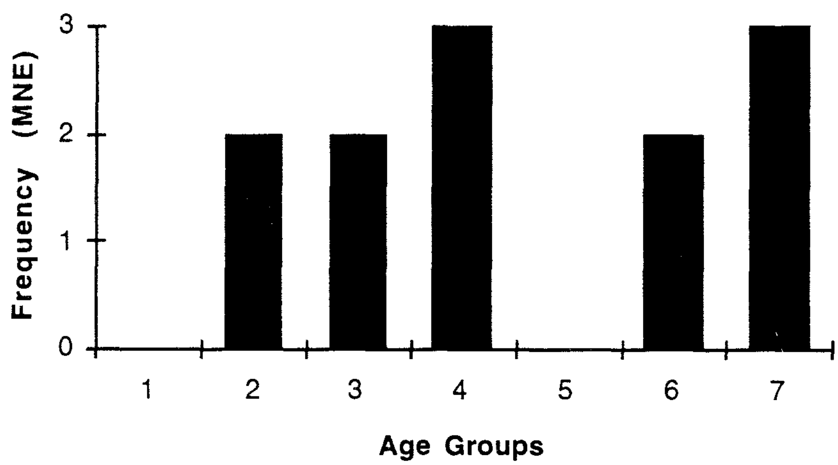

Figure 10.5 Age group distribution based on upper M1.

As was the case with the mandibles and lower molars, the maxillae and upper molars show a close correspondence with the eruption and wear patterns of upper dentitions from the Garnsey site. This evidence lends support to the hypothesis that the bison at Bushfield West were killed in the spring of the year.

10.4 Long Bone Measurements

Over the years researchers have devised various methods of determining the gender of bison long bones in an attempt to establish herd composition (Bedord 1974 and 1978; Hapsel and Frison 1987; Lorrain 1968; Speth 1983; and Walde 1985). Gender profiles have been used to address questions concerning site seasonality and preferential utilization of males or females in the extraction of nutrients (Speth 1983). The premise upon which these and other gender studies are based is the assumption that mature bulls are significantly larger than mature cows. Such sexual dimorphism is exhibited in the skeletal structure, particularly the long bones which are weight-bearing elements. Originally, the determination of gender was based on a visual examination of the elements: those which were more robust or massive were classified as males and those which were slender or smaller were identified as females (Bedord 1974: 204; Lorrain 1968: 84). These classifications were then checked using a series of measurements derived from the elements. However, such methods could only be applied to complete elements.

Recently, researchers have realized that this approach severely limits sample size and the results of such analyses may even be biased (Walde 1985: 7). As part of the analysis of bison elements from the Garnsey site, Speth (1983: 73-74, 171-181) uses cross-plots of various element measurements and ratios to determine the sex of complete and fragmented long bones. In building upon the idea that gender determination of bison elements should be applicable to element portions, Walde (1985) developed a series of sex determination equations for proximal and distal portions of long bones. A step-wise discriminant function analysis was used to develop the equations.

With a few exceptions, the procedures and measurements used by Walde (1985) are based on those outlined by Speth (1983). Methodological changes made by Walde (1983: 15) include the elimination of measurements that were difficult to duplicate, the use of only the left or right element from a single individual rather than both, and the identification of mature elements by the presence of completely fused epiphyses of that element portion. The use of immature elements would obscure the division between groups and could result in the misidentification of young males as females. When measuring fragmentary specimens to determine sex, Speth (1983: 180) uses only those element portions that are known to be mature, e.g.., proximal humerus fragments are included in the analysis but not distal humerus fragments. The distal epiphysis of the humerus fuses first, therefore, if a distal humerus portion is fused the corresponding proximal portion may not be and the element would be immature. However, as Walde (n.d.: 11) aptly points out, certain element portions are rarely recovered from archaeological sites. Therefore, even though the results of gender analysis of distal humeri, proximal radii, distal tibiae, etc. must be viewed with caution, using only their mature counterparts would severely limit the sample size.

Discriminant function analysis uses a combination of variables "whose values are as close as possible *within* groups and as far apart as possible *between* groups" (Lebart et al. 1984: 70, original emphasis). In the analysis of bison post-cranial elements the variables are the metric measurements of element portions and the groups are males and females. A set of classification function coefficients are produced which are then inserted into equations "which can be used to classify unknown cases into defined groups" (Walde 1985: 18). A series of equations were developed by Walde to determine gender for proximal and distal portions of the following elements: the humerus, radius, metacarpal, femur, tibia, and metatarsal. The validity and accuracy of the equations were tested on bison elements of known sexes. Each equation was proven to be highly accurate in assigning the element to the appropriate gender group. Fragmented long bones recovered from archaeological sites were then used to determine if the selected variables used in the equations could actually be measured on these elements. In a few instances this resulted in some modifications to the original equations; however, the end result was the formulation of equations which could accurately determine the gender of fragmented bison long bones (Walde 1985: 21).

Only two complete bison long bones; one metacarpal and one metatarsal; were recovered during the excavations at Bushfield West. Therefore, Walde's method of long bone gender analysis was deemed to be appropriate for the analysis of Bushfield West long bone specimens. The method of measuring the specimens follows the descriptions and illustrations provided by Speth (1983). Each measurement was taken twice with a sliding dial caliper, if the two measurements were not within 0.5 mm of each other a third measurement was recorded and an average of the three measurements was used in the analysis.

The measurements are then entered into the appropriate equation set: one is the male group equation and the second is the female group equation. To ensure the highest probability of a correct gender assignment the equation with the largest number of variables is used whenever possible. The equation values are examined and the specimen is assigned to the gender associated with the highest score. Originally, Walde (1985) recommended that if the difference in the equations was less than 1.6 then the specimen should be dropped from the analysis since it could not be assigned with any degree of confidence to either group. Further research showed that the "application of the elimination rule tends to inflate the apparent number of females in the sample by eliminating correctly assigned males" (Walde n.d.: 36). He has since discontinued the use of the 1.6 elimination rule. The sex determination equations used in this analysis are presented in Walde (n.d).

Proximal humerus portions are not complete enough to provide sufficient measurements to be included in this study. However, 11 distal humerus portions (Block 1 N=6, Block 2 N=1, Block 3 N=4) are sufficiently complete to enable the appropriate measurements to be taken. The sample consists of six right and five left humeri. The recorded distal humeri measurements are listed in Table 10.5.

Table 10.5 Distal Humerus Measurements

Cat. No.	Side	Measurements (cm) I	J	K	M	N	O
366	R	8.77	6.27	9.62	8.48	4.15	5.32
16191	R	8.05	5.51	8.35	7.60	3.85	4.44
17720	R	8.33	5.40	8.37	7.54	3.56	4.17
17917	L	8.16	-	-	7.57	3.67	4.21
17601/17602	L	9.47	5.79	9.47	8.45	4.02	4.91
16463	L	-	6.21	-	-	-	-
28170/32631	R	9.95	-	-	-	4.50	5.18
21438	R	7.89	5.39	8.03	7.43	3.55	4.26
19625	R	-	5.92	9.05	-	-	-
19967	L	10.00	7.85	9.97	9.37	4.43	5.42
23650	L	-	-	-	-	4.32	5.32

The distal humeri measurements are placed in the appropriate equations and the resultant scores examined to determine gender (Table 10.6)

Table 10.6 Distal Humerus Gender Analysis

Cat. No.	Side	Equation No.	Male	Female	Difference	Gender
366	R	8	316.60	309.93	6.67	Male
16191	R	8	258.05	260.87	2.82	Female
17720	R	8	261.26	265.55	4.29	Female
17917	L	2	229.90	233.43	3.52	Female
17601/17602	L	8	344.88	335.52	9.36	Male
16463	L	7	162.50	157.22	5.28	Male
28170/32631	R	4	239.26	228.50	10.76	Male
21438	R	8	233.29	240.68	7.38	Female
19625	R	6	201.09	198.36	2.74	Male
19967	L	8	350.91	344.40	6.51	Male
23650	L	4	224.24	215.04	9.20	Male
Male=7						
Female=4						

The analysis of distal humeri produced a ratio of seven males to four females (64% M, 36% F). Walde (n.d: 12) cautions that there may be a bias towards males in the sample of complete distal humeri since smaller female specimens are more likely to be split or to fracture between the medial and lateral condyles during processing or after discard due to natural taphonomic modifications. Therefore, additional equations which define variables for medial and lateral distal portions were derived. Six distal humerus specimens recovered from Bushfield West are split longitudinally between the medial and lateral condyles. Two of the specimens (#28170 and #32631) were refitted in the laboratory to form a complete distal portion of the humerus. The remaining four specimens consist of the medial condyle portion of the humerus. On two of the specimens the required length of the medial trochlea cannot be measured. This measurement was obtained on the remaining two medial condyles (#16463 and #23650). All of the specimens split longitudinally between the medial and lateral condyles on which measurements were taken are identified as males.

Thirteen complete or nearly complete proximal radii are included in the study (Block 1 N=4, Block 2 N=2, Block 3 N=7). The sample is made up of six right radii and seven left radii. The proximal radius measurements are shown in Table 10.7.

Table 10.7 Proximal Radius Measurements

Cat. No.	Side	Measurements (cm) A	B	C	D
15744	R	9.03	4.72	-	4.94
15707	R	8.58	4.43	-	4.33
2760	R	10.18	5.38	3.61	5.60
16192	L	8.73	4.63	3.01	4.70
29216	R	10.24	5.38	3.74	5.62
29058/29059	R	10.33	5.06	3.31	-
23655	L	9.05	4.39	3.00	4.54
23120	L	9.61	5.02	3.08	5.36
23654	L	8.13	4.20	2.78	4.80
23657	L	10.62	5.52	3.74	5.36
23354	L	10.05	4.89	3.26	5.61
20643	L	10.22	5.32	3.23	5.76
23302	R	8.48	4.46	2.90	4.74

The maximum number of variables are measurable on most of the proximal radius specimens. There are only three specimens on which all four measurements cannot be taken. Equation two is from Walde (1985) which contains three variables: greatest breadth, greatest depth, and capitular articular surface. In Walde's initial analysis this equation successfully identified 29 of 29 cases. There is no mention as to why it is not included in his latest paper on the sexing of bison post-cranial elements, therefore, it has been used for one of the Bushfield West specimens. The values obtained from the proximal radius equations are presented in Table 10.8.

Table 10.8 Proximal Radius Gender Analysis

Cat. No.	Side	Equation No.	Male	Female	Difference	Gender
15744	R	3	301.11	304.99	3.88	Female
15707	R	3	241.66	254.29	12.63	Female
2760	R	1	460.29	446.70	13.59	Male
16192	L	1	324.91	333.78	8.87	Female
29216	R	1	464.73	448.73	16.01	Male
29058/29059	R	2	362.20	357.66	4.54	Male
23655	L	1	298.80	311.15	12.35	Female
23120	L	1	399.50	399.69	0.20	Indt.
23654	L	1	279.60	295.11	15.51	Female
23657	L	1	469.32	454.19	15.13	Male
23354	L	1	407.16	403.71	3.44	Male
20643	L	1	453.65	446.19	7.46	Male
23302	R	1	306.46	317.76	11.30	Female
Male=6						
Female=6						
Indeterminate=1						

The analysis of the proximal radius specimens resulted in the identification of six males, six females, and one indeterminate specimen. Even though Walde (n.d: 23) recommends discarding the 1.6 rule of elimination the difference between the values of male and female equations for specimen #23120 is quite small. The proximal epiphysis of the radius is fused in the 2nd year while the distal end fuses some time later, during the 5th year in males and the 6th year in females (Empel and Roskosz cited in Dyck and Morlan 1995: 571). Therefore, specimen #23120 may actually represent a sub-adult male.

Only two distal radii, one from Block 1 and one from Block 2, are sufficiently complete so as to be included in the analysis. One distal radius portion is sided as right, the other is a left. Four of the five distal radius measurements are recorded from the left specimen and all five are recorded for the right specimen (Table 10.9).

Table 10.9 Distal Radius Measurements

Cat. No.	Side	Measurements (cm)				
		G	H	I	J	K
16174	L	8.11	4.48	3.78	-	3.85
35388	R	8.19	4.23	3.68	1.79	3.74

The measurements recorded for specimen #16174 fit two different distal radius equations, each containing three measurements. Both sets of equations were run with the appropriate specimen measurements. The results are the same, the two equation sets identified the specimen as male. Specimen #35388 is also identified as male. The results of the analysis are presented in Table 10.10.

Table 10.10 Distal Radius Gender Analysis

Cat. No.	Side	Equation No.	Male	Female	Difference	Gender
35388	R	1	183.09	178.13	4.96	Male
16174	L	2	226.00	218.01	7.99	Male
16174	L	4	178.48	176.88	1.86	Male
Male=2						
Female=0						

The gender analysis of proximal metacarpals is based on nine specimens (Block 1 N=2, Block 2 N=0, Block 3 N=7). The breakdown according to side is as follows: three rights and six lefts. Both proximal measurements, the greatest breadth and the greatest depth, are recorded for all nine specimens. These measurements are presented in Table 10.11.

Table 10.11 Proximal Metacarpal Measurements

Cat. No.	Side	Measurements (cm)	
		A	B
15669	L	6.80	4.18
16146	L	6.69	3.87
21689/22061	L	7.18	4.11
23594/23631	L	6.58	3.83
22577	R	6.63	3.88
20319	L	6.42	3.85
20221	R	7.29	4.32
20238	L	7.56	4.40
23642	R	6.74	4.13

Equation one was used to determine gender of the proximal metacarpal specimens. The results are listed in Table 10.12.

Table 10.12 Proximal Metacarpal Gender Analysis

Cat. No.	Side	Equation No.	Male	Female	Difference	Gender
15669	L	1	283.55	283.82	0.27	Indt.
16146	L	1	257.97	261.01	3.03	Female
21689/22061	L	1	298.01	295.68	2.33	Male
23594/23631	L	1	249.88	254.04	4.15	Female
22577	R	1	255.62	259.07	3.45	Female
20319	L	1	243.18	248.48	5.30	Female
20221	R	1	317.11	312.63	4.48	Male
20238	L	1	335.79	328.67	7.11	Male
23642	R	1	277.31	278.36	1.05	Female
Male=3						
Female=5						
Indeterminate=1						

The analysis of the proximal metacarpals resulted in the assigning of three as males, five as females, and one as indeterminate. Specimen #15669 has a small equation value difference; however, it articulates with five carpals—#15673 - radial, #15674 - internal, #15673 - ulnar, #15670 - fused 2nd/3rd, and #15675 - unciform. The ulnar carpal was not measurable since the accessory carpal facet was eroded away. The remaining carpals were analyzed using Morlan's (1991) method of gender analysis for carpals and tarsals and all of the carpals were identified as females and/or sub-adult males and females (see next section). Walde (1985: 24) cautions that the lack of a separate proximal epiphysis which fuses to the diaphysis at maturity makes it difficult to identify mature specimens. Therefore, the equations establish two groupings: one of mature males and the second is a combination of mature females and sub-adult animals (females and males). At Bushfield West the two groups consist of three adult males and six adult female and sub-adult individuals.

Eight distal metacarpal portions are included in the gender study (Block 1 N=1, Block 2 N=1, Block 3 N=6). In this sample four are right distal metacarpals and four are left distal metacarpals. The measurements recorded for each specimen are shown in Table 10.13.

Table 10.13 Distal Metacarpal Measurements

Cat. No.	Side	Measurements (cm) D	E	F	I	J
16812	L	6.15	3.02	3.21	3.33	3.51
24512	R	6.85	3.20	3.18	-	3.67
23632	L	6.89	3.39	3.28	3.67	3.48
23301	R	6.61	3.23	3.06	3.68	3.51
23633	R	6.22	3.08	2.99	3.55	3.49
21924	L	7.47	3.67	3.90	3.74	4.01
22427	L	7.49	3.72	3.88	3.91	4.12
23642	R	7.02	3.50	3.26	3.36	3.36

The majority of distal metacarpals in the sample are complete and all five measurements can be taken; however, the depth of the medial sagittal cannot be measured on one specimen (#24512). The distal metacarpal equation values are given in Table 10.14.

The analysis of distal metacarpals divides the sample into one group of three adult males and a second of three adult females. Two specimens (#16182 and #24512) are indeterminate or borderline cases. The distal measurements for the one complete metacarpal (#23642) identified this specimen as a female. However, the difference of the equations for the distal measurements is small, only slightly in favor of a female designation; if it had been found as a separate distal metacarpal portion it would be classified as indeterminate. Analysis of the proximal portion of this element assigned it to the adult female and sub-adult group.

Table 10.14 Distal Metacarpal Gender Analysis

Cat. No.	Side	Equation No.	Male	Female	Difference	Gender
16812	L	1	356.48	356.71	0.24	Indt.
24512	R	2	252.79	252.41	0.38	Indt.
23632	L	1	376.89	375.52	1.37	Male
23301	R	1	365.51	367.79	2.28	Female
23633	R	1	349.14	352.95	3.81	Female
21924	L	1	486.58	471.01	15.57	Male
22427	L	1	502.90	486.68	16.22	Male
23642	R	1	358.16	358.43	0.27	Female
Male=3 Female=3 Indt.=2						

No proximal or distal femur portions from Bushfield West are suitable for gender analysis. This is unfortunate since the femur gender equations, when applied to the sample of known sexes, appear to produce accurate gender identifications. The lack of femur specimens suitable for analysis lends support to Walde's (n.d: 30) statement that "in archaeological samples there is a strong tendency for both ends of this element to be destroyed by either taphonomic or cultural processes and few are usually available for analysis".

The fourth long bone portion for which there are no suitable specimens is the proximal tibia. However, thirteen distal tibia portions are suitable for analysis (Block 1 N=4, Block 2 N=8, Block 3 N=1). The sample consists of seven right distal tibiae and six left distal tibiae. The distal tibia measurements are presented in Table 10.15.

Table 10.15 Distal Tibia Measurements

Cat. No.	Side	Measurements (cm)		
		H	I	L
17580	L	6.74	5.03	4.87
15693	R	6.97	5.17	4.73
16829	R	7.27	4.97	5.13
N/A	R	6.83	4.89	5.07
28171	L	6.96	4.96	4.89
18348	R	6.76	4.76	4.91
18266	L	7.51	5.52	5.33
27415	L	7.48	5.18	5.59
24971	R	7.29	5.46	5.13
33161	L	6.68	4.84	4.84
32862	R	6.55	4.79	4.80
32162	L	7.23	5.38	5.24
20644	R	7.68	5.74	5.45

The two distal tibia equations developed by Walde (n.d: 32) have two variables each. Three variables are measurable on all of the distal tibia specimens and the equations use various combinations of these variables. The analysis was run with both equations as a test of the reliability of the results. Table 10.16 shows the values and results of the distal equations.

Table 10.16 Distal Tibia Gender Analysis

Cat. No.	Side	Equation No.	Male	Female	Difference	Gender
17580	L	1	415.48	419.82	4.34	Female
17580	L	2	316.86	321.34	4.47	Female
15693	R	1	414.19	418.52	4.34	Female
15693	R	2	340.16	341.96	1.79	Female
16829	R	1	475.23	472.71	2.52	Male
16829	R	2	355.36	354.38	0.98	Male
N/A	R	1	442.40	443.75	1.34	Female
N/A	R	2	318.25	322.04	3.79	Female
28171	L	1	430.81	433.34	2.53	Female
28171	L	2	331.05	33.35	2.30	Female
18348	R	1	420.98	424.71	3.73	Female
18348	R	2	307.68	312.46	4.77	Female
18266	L	1	511.14	504.54	6.60	Male
18266	L	2	395.72	391.18	4.54	Male
27415	L	1	537.34	527.90	9.44	Male
27415	L	2	377.52	374.05	3.47	Male
24971	R	1	476.43	473.76	2.67	Male
24971	R	2	376.36	374.25	2.11	Male
33161	L	1	408.65	409.94	1.29	Female
33161	L	2	304.69	310.15	5.46	Female
32862	R	1	396.56	403.61	7.06	Female
32862	R	2	292.68	299.60	6.92	Female
32162	L	1	484.68	481.15	3.53	Male
32162	L	2	386.43	367.23	19.20	Male
20644	R	1	534.25	525.02	9.23	Male
20644	R	2	417.57	410.83	6.73	Male
Male=6						
Female=7						

Since both equations assigned each specimen to the same gender, the results of the distal tibia gender analysis appear to be quit reliable . The ratio of males to females produced by the analysis is six males or 46% to seven females or 54%.

Nine proximal metatarsal portions (Block 1 N=3, Block 2 N=0, Block 3 N=6) are included in the analysis. The sample consists of six right specimens and only three left specimens. There is only one equation used in the analysis of the proximal metatarsal and it requires two measurements: greatest breadth and greatest depth. The proximal metatarsal measurements are shown in Table 10.17.

The same cautionary advice given for proximal metacarpal specimens concerning the lack of a separate proximal epiphysis and the difficulty in identifying mature

Table 10.17 Proximal Metatarsal Measurements

Cat. No.	Side	Measurements (cm) A	B
16673	R	5.56	5.73
16834	R	4.92	4.72
14952	L	6.09	5.82
20181	L	4.88	5.10
23640	R	5.10	5.23
23651	R	5.76	5.85
23355	R	5.49	6.22
23303	R	4.96	4.89
23822	L	5.19	5.28

specimens also applies to proximal metatarsal specimens. The results of the proximal metatarsal equation are presented in Table 10.18.

Table 10.18 Proximal Metatarsal Gender Analysis

Cat. No.	Side	Equation No.	Male	Female	Difference	Gender
16673	R	1	324.33	320.84	3.49	Male
16834	R	1	224.25	230.29	6.04	Female
14952	L	1	350.41	341.75	8.66	Male
20181	L	1	251.72	256.74	5.02	Female
23640	R	1	269.59	272.13	2.54	Female
23651	R	1	340.72	334.97	5.75	Male
23355	R	1	359.08	354.45	4.63	Male
23303	R	1	238.64	243.69	5.05	Female
23822	L	1	276.66	278.20	1.53	Female
Male=4						
Female=5						

The results of the gender analysis of the proximal metatarsal specimens shows an almost even split between males (N=4) and females (N=5). None of the specimens are borderline and even using the old 1.6 rejection rule only one of the specimens would be dropped from the analysis.

Eight (Block 1 N=2, Block 2 N=0, Block 3 N=6) distal metatarsal portions comprise the final group of long bone portions to be analyzed. The sample is evenly divided between right and left distal metatarsal specimens. Five measurements are recorded for each specimen (Table 10.19).

Equation four, which requires four of the five measurements, is used in the gender analysis of distal metatarsal specimens. Although the success rate of this equation in correctly identifying specimens of known sexes is not any higher than those of equations one or three it does employ one more variable than the other two equations. The results of the distal metatarsal gender analysis are presented in Table 10.20.

Table 10.19 Distal Metatarsal Measurements

Cat. No.	Side	Measurements (cm) D	E	F	I	J
15147	R	6.91	2.93	2.77	3.82	3.63
14952	L	6.91	3.25	3.22	4.00	3.86
21927	R	5.92	3.08	2.80	3.47	3.31
21928	L	7.22	3.77	3.35	4.27	4.01
23923	L	6.68	3.38	3.17	3.94	3.77
22428	L	5.58	2.83	2.59	3.59	3.39
23182	R	6.32	3.10	3.02	3.96	3.79
23636	R	5.89	3.02	2.85	3.45	3.29

10.20 Distal Metatarsal Gender Analysis

Cat. No.	Side	Equation No.	Male	Female	Difference	Gender
15147	R	2	385.64	386.55	0.91	Female
14952	L	2	451.28	441.40	9.88	Male
21927	R	2	338.11	337.69	0.42	Male
21928	L	2	500.68	484.84	15.84	Male
23923	L	2	438.27	428.70	9.57	Male
22428	L	2	336.50	341.50	4.99	Female
23182	R	2	427.72	422.60	5.12	Male
23636	R	2	338.69	337.12	1.57	Male
Male=6						
Female=2						

The distal metatarsals show a much higher ratio of adult males to adult females. Specimen #21927 shows a small difference, in favor of a male designation, between the values of the male and female equations. If the 1.6 elimination rule was employed this specimen as well as one female specimen (#15147) would be dropped from the analysis. One complete metatarsal (#14952) was recovered from Block 1, both the proximal and the distal metatarsal equations assigned this element to the male category.

10.4.1 Discussion and Summary

Specimens used in the gender determination of bison post-cranial skeletal elements include the following: distal humeri, proximal and distal radii, proximal and distal metacarpals, distal tibiae, and proximal and distal metatarsals. The distal tibiae and proximal radii contain the largest number of analyzed specimens, 13 in each category. The smallest analyzed group is the distal radii, which contains only two specimens. No proximal humerus specimens, proximal or distal femur specimens, or proximal tibia specimens were recovered in sufficiently complete condition to allow the necessary measurements to be taken.

Although Walde (n.d) identifies the categories to which distal humeri, proximal radii, and distal tibiae are assigned as male and female, these portions fuse before their opposite end counterparts. Therefore, even though the recovered portion is fused there is still a chance that it is representative of an immature animal. To allow for the different rates of fusion of proximal and distal epiphyses and to err on the side of caution, perhaps the results of the gender analysis should be referred to as groupings of either adult male bison or adult female and sub-adult bison. At the very least we should be aware of the potential bias of classifying immature males as females.

The distal humerus, distal metatarsal, and distal radius gender analysis results show that these samples are dominated by males with ratios of 7:4; 3:1; and 2:0 or 64%, 75%, and 100% respectively. However, it is noted that the distal radius sample is extremely small. The proximal tibia and proximal radius samples, which contain the largest number of identified specimens, as well as the proximal metatarsal sample show an almost even split between adult males and females and/or sub-adults. The proximal metacarpal sample is dominated by female/sub-adult individuals by a ratio of 6:3, while the distal metacarpal sample is quite variable with as many indeterminate specimens as there are males (N=3 for each) along with slightly fewer females (N=2). Table 10.21 summarizes the results of the post-cranial skeletal element gender analysis.

Table 10.21 Summary of Bison Post-Cranial Skeletal Element Gender Analysis

Element	Male	Female/Sub-Adult	Indeterminate
Dist. Humerus	7	4	0
Prox. Radius	6	7	0
Distal Radius	2	0	0
Prox. Metacarpal	3	6	0
Dist. Metacarpal	3	2	3
Distal Tibia	6	7	0
Prox. Metatarsal	4	5	0
Dist. Metatarsal	6	2	0

The results of the post-cranial skeletal element gender analysis are somewhat variable: some samples are dominated by males, others show an even distribution of males and females and/or sub-adults, and a few are mostly female and/or sub-adult individuals. If indeterminate results are eliminated from the analysis and simply the highest value is used to determine the grouping to which the specimen belongs, this would add three female specimens and one male specimen to the results. Overall, the sample of bison long bones indicates that the assemblage is evenly divided between bulls and a grouping of females and sub-adults. Table 10.22 is a summary of the bison post-cranial specimens by grouping, side, and site %MNI.

Table 10.22 Summary of Bison Post-Cranial Skeletal Element Gender Frequencies by MNI

Element	Male left	Male right	Female left	Female right	Site MNI	%Male	%Fem./Sub-
Dist. Hum.	4	3	1	3	9	44%	33%
Prox. Rad.	3	3	3	3	12	25%	25%
Dist. Rad.	1	1	0	0	9	11%	0%
Prox. Metac.	2	1	4	2	11	18%	36%
Dist. Metac.	3	0	0	2	6	50%	33%
Dist. Tibia	3	3	3	4	13	23%	31%
Prox. Metata.	1	3	2	3	11	27%	27%
Dist. Metata.	3	3	1	1	6	50%	17%

At least 4 males (indicated by the distal humerus) and 4 females (indicated by the proximal metacarpal and distal tibia) are represented within the site sample of at least 19 animals (based on the radial carpal MNI value). When the gender frequencies of each block are examined there is also an even division between males and females (Block 1 - 2 males and 2 females, Block 2 - 2 males and 2 females, Block 3 - 3 males and 3 females). Even though both left and right specimens are included, the sample size is still extremely small. As a result, the analysis of bison long bones from Bushfield West provides only a tenuous indication of the gender profile.

10.5 Carpals and Tarsals

Bison carpals and tarsals from Bushfield West are analyzed in an attempt to distinguish groupings which represent mature males and nursery herds consisting of females and immature males and females (sub-adults). The method used to sex carpals and tarsals was devised by Morlan (1991). The technique consists of taking a series of measurements for each carpal and tarsal. Pairs of measurements for each element are plotted against each other on a scattergram in an attempt to identify a clear separation between males and females. The specific measurements and means of orienting the elements while taking these measurements are given in Morlan (1991). Consultations with Dr. Morlan also helped to clarify some of the means in which the measurements were to be taken. In particular, the depth measurement for the fused 2nd/3rd carpal is not taken as indicated on Morlan's diagram (Morlan 1991: 218). Instead it is taken from the posterior to anterior margins with the carpal being oriented as shown in the diagram.

Only carpals and tarsals judged by their degree of ossification to be mature are included in the analysis. The calcaneus has an epiphysis which fuses in the 5th year in males and during the 6th year in females (Empel and Roskosz cited in Dyck and Morlan

1995: 580). The fused central/4th tarsal fuses sometime between three weeks and four months (Koch 1932, 1935 cited in Duffield 1973: 133). The remaining carpals and tarsals have single centers of ossification which fuse at an early stage in their development. Therefore, Morlan (1991: 215) cautions that it may be difficult to distinguish immature elements from mature elements. Two calcanei were determined to be immature on the basis of unfused epiphyses and are excluded from the analysis. Seven carpals (two radial carpals, one ulnar carpal, one internal carpal, one fused 2nd/3rd carpal, two unciform carpals) and four tarsals (one astragalus, one fused central/4th tarsal, and two fused 2nd/3rd tarsals) are also identified as immature and are dropped from the analysis. Classification of these elements as immature is based on a combination of three factors: small size, extreme porosity of the cortical bone, and light weight of the element. Two additional elements, an ulnar carpal and an unciform carpal, are also excluded from analysis since accurate measurements cannot be obtained due to the presence of pathologies.

A total of 66 carpals (Block 1 N=16, Block 2 N=12, and Block 3 N=38), 40 tarsals (Block 1 N=6, Block 2 N=5, and Block 3 N=29) and 18 lateral malleoli (Block 1 N=6, Block 2 N=10, and Block 3 N=2) form the sample of measurable elements. Measured carpals consist of 17 radial carpals, 12 ulnar carpals, seven accessory carpals, 10 internal carpals, nine fused 2nd/3rd carpals, and 12 unciform carpals. Tarsals that were measured include the following: 13 astragali, eight calcanei, 10 fused central and 4th tarsals, and nine fused 2nd/3rd tarsals.

Measurements were checked for accuracy by taking each measurement twice; if the two measurements were not within 0.5 mm of each other a third measurement was recorded and an average of the three measurements is used in the analysis. All of the carpal measurements and the majority of the tarsal measurements were made using a sliding dial caliper. However, the arms of this instrument are not long enough to allow accurate lateral and medial depth measurements of the astragalus and occasionally the scale is not long enough to measure calcaneus length. In these cases a GPM sliding caliper with long arms was used.

10.5.1 Gender Analysis of Carpals

Only two carpals—the radial and ulnar—show clear bimodal distributions when measurements are plotted against each other in a scatterplot format. The remaining carpals (the internal, fused 2nd/3rd, unciform, and accessory) show a continuum of plotted points that are difficult to interpret. However, based on associations with articular unit elements that do show clear bimodal separations, the results of the scatterplots can be differentiated into possible male and female and/or sub-adult associations.

Seventeen radial carpals are included in the gender analysis sample. Four of the specimens (#15315, #15671, #16066, and #29214) are components of various articular units. Three measurements are taken on each of the radial carpals. The measurements are shown in Table 10.23.

Table 10.23 Radial Carpal Measurements (cm)

Cat. No.	Side	Length	Width	Depth
14860	L	3.13	2.98	5.37
15315*	L	3.11	2.68	4.36
15671*	L	3.11	2.91	4.61
16066*	L	3.17	2.84	4.69
27043	L	3.65	3.22	5.43
28167	L	3.34	3.27	5.28
29214*	L	3.17	2.89	5.26
23573	L	3.02	2.71	4.26
23577	L	3.22	2.67	4.68
23695	L	2.89	2.63	4.60
20858	L	3.16	2.57	4.37
20436	L	3.17	3.00	5.36
23613	L	3.36	3.03	4.99
21914	R	2.97	2.64	4.36
23291	L	3.22	2.65	4.45
23289	L	3.46	3.26	5.36
21690	L	3.41	3.06	5.06

Note: catalogue number followed by * indicates that element is part of an articular unit.

Bivariate plots of depth versus length and depth versus width for radial carpal measurements result in groupings of adult males and females and/or sub-adults. Both plots show that the sample is comprised of eight adult males and nine females and/or sub-adults. Three of the articular unit specimens (#15315, #15571, and #16066) are assigned to the female and/or sub-adult group and one specimen (#29214) is assigned to the adult male group. The results of the bivariate plot of radial carpal depth versus length measurements is presented in Figure 10.6.

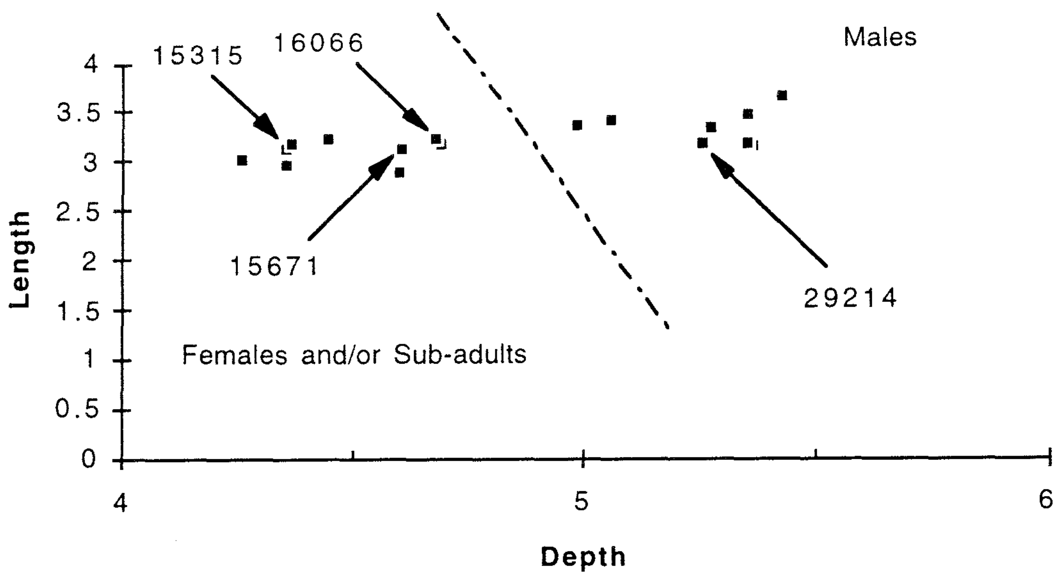

Figure 10.6 Radial carpal depth versus length.

Twelve ulnar carpals recovered from Bushfield West are considered to be mature elements and are sufficiently complete to permit the necessary measurements to be taken for gender determination. All four of the recommended measurements are recorded for the sample of ulnar carpals. The measurements are listed in Table 10.24.

Table 10.24 Ulnar Carpal Measurements (cm)

Cat. No.	Side	Length a	Length b	Width	Depth
16605	L	3.47	4.29	2.87	4.26
15331*	L	3.31	3.71	2.60	3.60
16063*	L	3.25	3.92	2.52	3.77
25243	L	3.80	4.57	2.92	4.54
33270	L	3.58	4.61	2.92	4.26
29912	L	3.70	4.23	2.99	4.11
23519	L	3.72	4.21	2.95	4.32
23030	L	3.27	3.73	2.44	3.59
23565	L	3.15	3.82	2.64	3.81
23562	R	3.13	3.61	2.36	3.69
21982	L	3.32	4.17	2.73	3.80
21663	L	3.42	4.49	2.88	3.96

Note: catalogue number followed by * indicates that element is part of an articular unit.

The bivariate plot of posterior length against width provides the best separation of adult males from adult females and/or sub-adults. The plot shows that the sample of ulnar carpals divides into two groups, one consisting of seven adult males and the second consisting of five females and/or sub-adults (Figure 10.7). Specimens #15331 and #16063 which were found to articulate with other carpals and/or metacarpals fall within the female group.

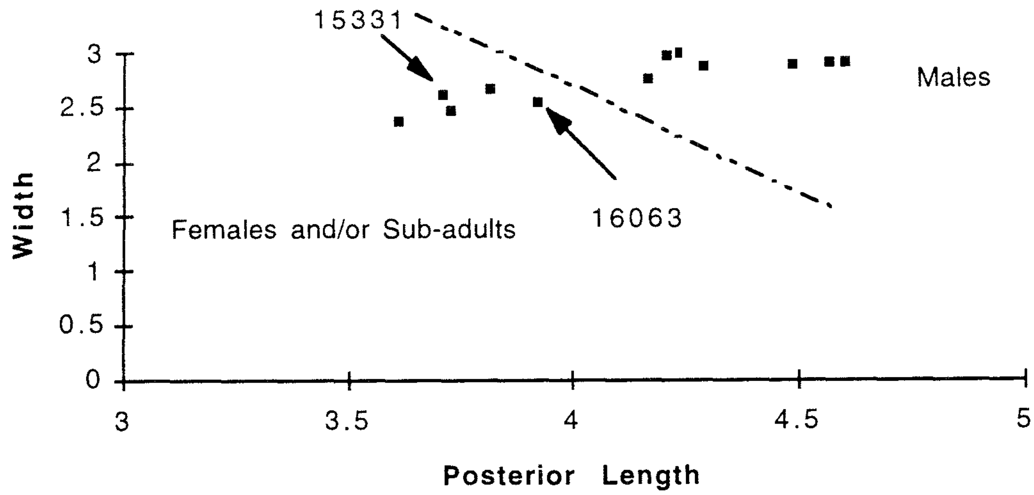

Figure 10.7 Ulnar carpals posterior length versus width.

The sample of internal carpals includes 10 mature elements. Three element measurements are recorded: length, width, and depth. This sample contains four specimens—#15314, #15674, #16065, and #29212—that are included in articular units. The measurements recorded for all of the internal carpals are shown in Table 10.25.

Table 10.25 Internal Carpal Measurements (cm)

Cat. No.	Side	Length	Width	Depth
15314*	L	2.93	3.36	4.27
15674*	L	2.80	3.18	-
16065*	L	2.75	3.36	4.21
18231	L	2.95	3.60	5.01
24443	L	3.29	3.95	4.91
29212*	L	2.73	3.55	4.68
23687	R	3.05	3.04	-
23537	L	2.82	3.23	4.28
20011	R	3.11	3.55	4.39
23585	L	2.67	3.27	4.00

Note: catalogue number followed by * indicates that element is part of an articular unit.

The scatterplot of length versus depth measurements produces the best results (Figure 10.8). The distributions of points appears to represent a continuous range of element sizes until the positions of the articular unit specimens are taken into account. Specimens #15314 articulates with radial (#15315) and ulnar (#15331) carpals which have both been identified as female and/or sub-adults. Specimen #29212 articulates with a radial carpal (#29214) that has also been identified as female and/or sub-adult. Specimens #15674 and #16065 each articulate with proximal metacarpal portions (#15669 and #16146) which have been assigned as female and/or sub-adults using Walde's bison post-cranial gender analysis method. The positions of these four specimens can be used as a guide in deciding where the division should be between possible groupings of males and females and/or sub-adults. This procedure results in the identification of three males and five females and/or sub-adults.

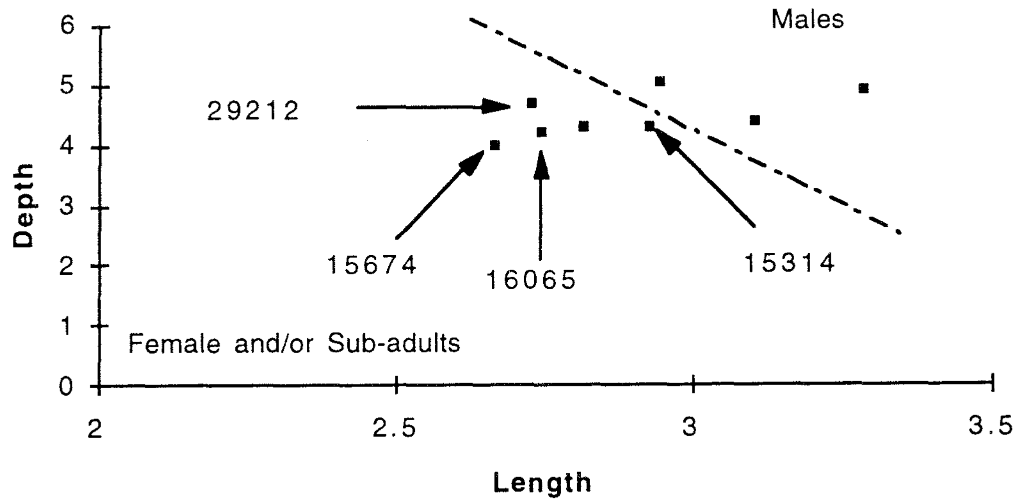

Figure 10.8 Internal carpals length versus depth.

The sample of fused 2nd/3rd carpals consists of nine elements. Three measurements—length, width, and depth—are recorded for the fused 2nd/3rd carpals (Table 10.26). Three specimens (#15670, #16077, and #29213) are from articular units.

Table 10.26 Fused 2nd/3rd Carpal Measurements (cm)

Cat. No.	Side	Length	Width	Depth
15670*	L	2.34	3.98	4.34
16077*	L	2.33	3.94	3.66
34748	R	2.57	4.66	4.42
29213*	L	2.52	4.47	4.35
22112	L	2.36	3.94	3.59
23551	L	2.16	3.85	3.50
23331	L	2.47	4.25	4.09
20434	L	2.25	4.24	3.84
21664	L	2.37	4.38	3.95

Note: catalogue number followed by * indicates that element is part of an articular unit.

Plotting width versus depth results in a scatterplot distribution that can be interpreted as representing two groups, but only with the aid of other information (Figure 10.9). Specimens #15670, #16077, and #29213 are elements which are in articulation with other carpals that do exhibit clear bimodal clustering. All three specimens articulate with radial carpals that have been assigned to female and/or sub-adult groups. Therefore, the scatterplot of fused 2nd/3rd carpal measurements is interpreted as consisting of an adult male group represented by two elements and a female and/or sub-adult group that is comprised of seven elements.

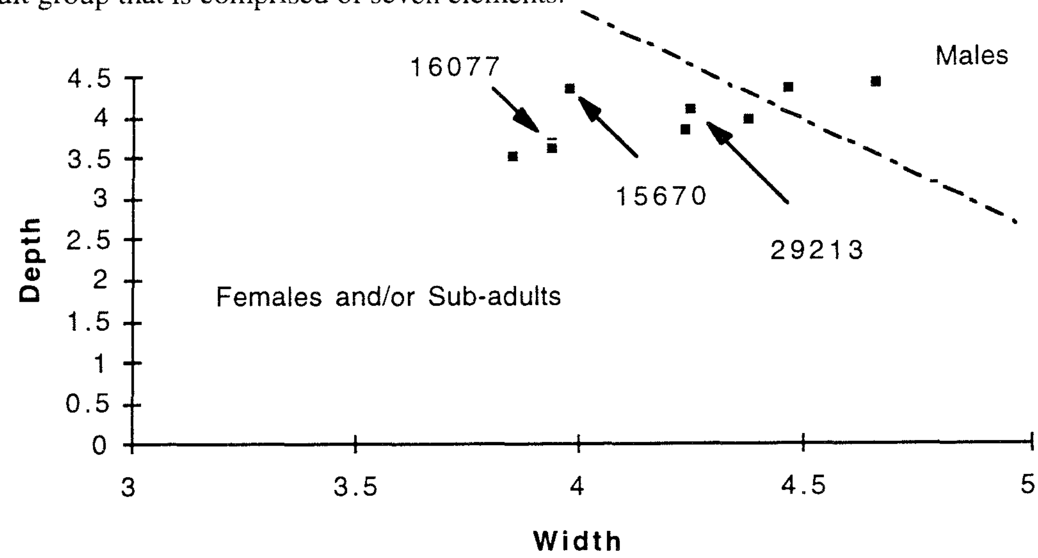

Figure 10.9 Fused 2nd/3rd carpals width versus depth.

The sample of unciform carpals consists of 12 mature elements and is one of the larger samples. Three of the specimens (#15672, #16067, and #29215) are from articular units. The measurements recorded include length, width, and depth (Table 10.27).

Table 10.27 Unciform Carpal Measurements (cm)

Cat. No.	Side	Length	Width	Depth
15675*	L	2.64	3.24	3.81
16067	L	2.45	3.06	3.36
29215*	L	2.94	3.33	3.87
20855	L	2.93	3.57	4.00
23563	R	2.59	3.06	3.42
23907	L	2.62	3.04	3.23
23596	R	2.82	3.16	3.90
21821	L	2.72	2.89	3.46
20437	L	2.74	3.11	3.38
21466	R	2.90	3.15	3.47
21662	L	2.83	3.24	3.62
23233	L	2.69	3.05	3.72

Note: catalogue number followed by * indicates that element is part of an articular unit.

The distribution of width versus depth measurements is not strongly bimodal; however, using the positions of specimens that are included in articular units a possible separation is suggested (Figure 10.10). Specimens #15672, #16067, and #29215 are all associated with articular units that include either radial or ulnar carpals or both that have been assigned to the female and/or sub-adult grouping. Using the positions of these specimens as an indication of how the points of the scatterplot could be grouped results in the identification of one male and 11 female and/or sub-adults.

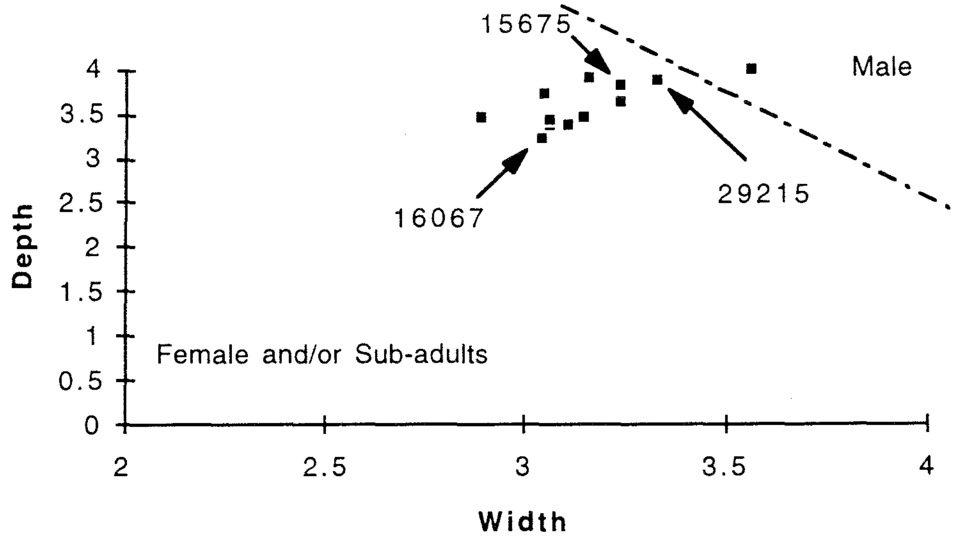

Figure 10.10 Unciform carpals width versus depth.

The accessory carpal sample contains the smallest number of specimens, seven. Length, width, and depth measurements are recorded in Table 10.28. One specimen, #15316, forms part of an articular unit.

Table 10.28 Accessory Carpal Measurements (cm)

Cat. No.	Side	Length	Width	Depth
15515	L	2.58	1.78	2.87
15316*	L	2.49	1.54	2.65
29978	R	2.67	1.64	3.26
23252	L	2.78	1.48	2.38
23288	L	2.04	1.49	2.41
23561	L	1.87	1.31	2.34
23590	L	2.29	1.66	2.77

Note: catalogue number followed by * indicates that element is part of an articular unit.

The scatterplot of length versus width measurements shows a continuum of points (Figure 10.11). Specimen #15316 articulates with an ulnar carpal that has been assigned to the female and/or sub-adult grouping. Using specimen #15316 as a marker that divides the two groupings results in assigning three specimens to the male group and four specimens to the female and/or sub-adult group.

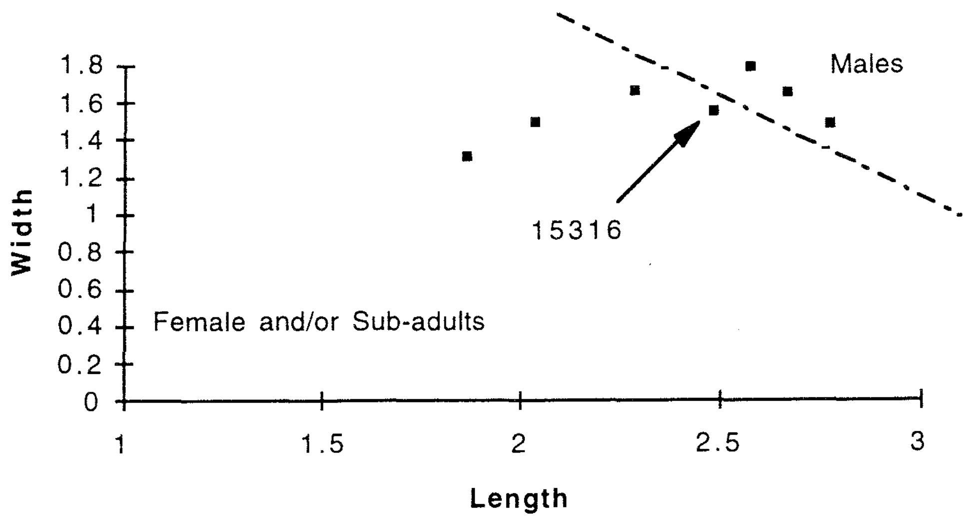

Figure 10.11 Accessory carpals length versus width.

10.5.2 Gender Analysis of Tarsals

Combinations of various measurements of all of the tarsals resulted in bimodal distributions of varying degrees. Analysis of the lateral malleoli is also included in this section.

The sample of fused central/4th tarsals consists of 10 elements. Three measurements: length, width, and depth were recorded and are presented in Table 10.29.

Table 10.29 Fused Central/4th Tarsal Measurements (cm)

Cat. No.	Side	Length	Width	Depth
16672*	R	5.91	6.57	6.27
24270	R	4.90	6.53	6.20
22408*	R	4.71	6.56	6.28
20182	R	4.56	6.07	5.85
21923	R	4.51	6.25	6.34
22437	L	4.10	5.58	5.65
23296	R	3.93	5.61	5.44
23649	R	-	6.05	5.69
23925	R	4.92	6.67	6.41
23359*	R	5.02	6.83	6.11

Note: catalogue number followed by * indicates that element is part of an articular unit.

Bivariate plots of width versus depth and width versus length result in clear bimodal distributions. The groupings consist of five males and four females and/or sub-adults. Specimens #16672, #22408, and #23359 are included in articular units consisting of either tarsals or proximal metatarsal portions. All three of the fused central/4th specimens from these articular units fall within the adult male group. Figure 10.12 shows the bivariate plot of width versus depth measurements.

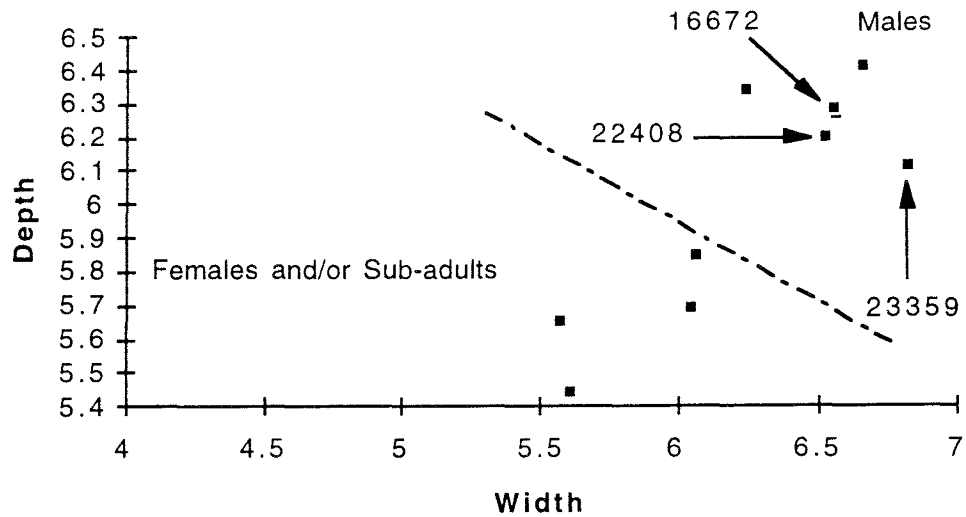

Figure 10.12 Fused central/4th tarsals width versus depth.

One of the smaller samples of tarsal elements consists of nine fused 2nd/3rd tarsals. The sample includes three specimens (#22410, #23357, and #23823) which are components of articular units. Three measurements: length, depth, and width, are taken on each of the fused 2nd/3rd tarsals (Table 10.30).

Table 10.30 Fused 2nd/3rd Tarsal Measurements (cm)

Cat. No.	Side	Length	Width	Depth
19504	L	1.15	2.17	3.82
22410*	R	1.33	2.81	4.29
23357*	R	1.35	2.66	4.32
23823*	L	1.11	2.43	4.08
20177	R	1.24	2.47	4.00
20552	L	1.28	2.72	4.43
23915	R	1.20	2.88	4.26
22130	L	1.44	3.07	4.41
23235	L	1.32	2.71	4.02

Note: catalogue number followed by * indicates that element is part of an articular unit.

A plot of width versus depth measurements results in a clear bimodal distribution consisting of five adult males and four females and/or sub-adults (Figure 10.13). As indicated previously, three of the specimens are from articular units. Specimen #23823 falls within the lower grouping (females and/or sub-adults). This specimen articulates with the proximal portion of a metatarsal (#23822) that was also identified as female using Walde's discriminant function analysis of bison post-cranial elements. Specimens #22410 and #23357 fall within the adult male grouping. Specimen #22410 is part of an articular unit that consists of an astragalus (#22409) and a fused central/4th tarsal

(#22408), both are identified as males. Specimen #23357 articulates with a fused central/4th tarsal (#23359) that is also identified as male.

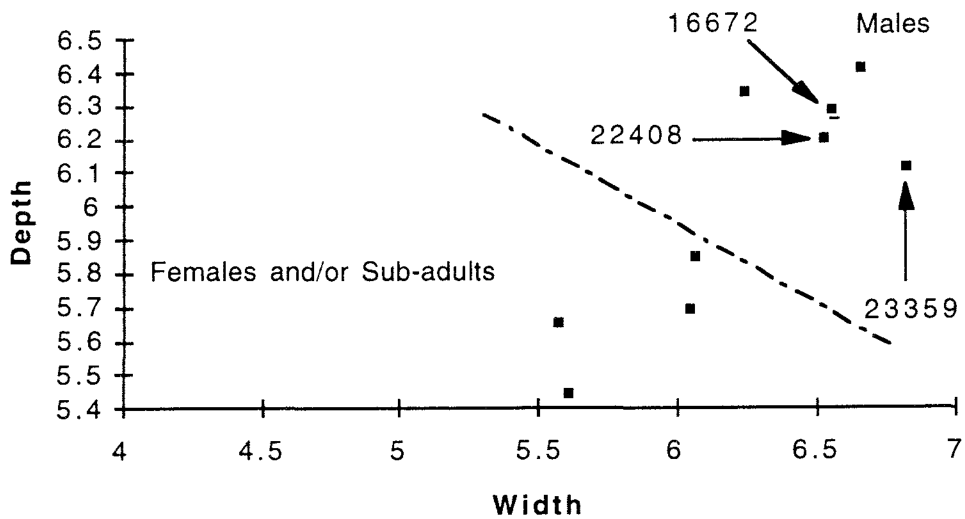

Figure 10.13 Fused 2nd/3rd tarsals width versus depth.

The sample of astragali thought to be suitable for gender analysis consists of 13 elements. A set of six measurements were taken on the astragalus specimens and are shown in Table 10.31.

Table 10.31 Astragalus Tarsal Measurements (cm)

Cat. No.	Side	L.Len.	M. Len.	P. Width	D. Width	L. Depth	M. Depth
15115	L	7.95	7.62	5.89	5.66	4.43	-
17766	R	7.58	6.97	5.20	5.27	4.83	4.12
365	L	7.35	6.89	5.01	4.81	4.00	3.99
6348	R	7.37	6.93	5.24	4.91	4.18	4.03
19139	R	7.68	7.29	5.30	5.32	4.42	4.37
24167	R	7.46	7.12	5.48	5.32	4.25	4.18
23358	R	8.03	7.71	5.61	5.55	4.52	4.65
23653	R	8.14	7.66	5.49	5.25	4.40	4.50
23645	R	7.12	6.69	4.73	4.78	3.99	3.65
23179	R	7.51	7.26	5.06	4.93	4.11	4.32
23928	R	7.47	7.21	5.47	5.27	4.04	4.38
23652	R	7.56	7.23	5.23	4.96	4.20	4.16
22409*	R	8.12	7.68	5.72	5.33	4.73	4.74

Note: catalogue number followed by * indicates that element is part of an articular unit.

Medial length plotted against distal width measurements produces a fairly clear separation of groups which can be interpreted as representing adult males and females and/or sub-adults (Figure 10.14). Four specimens are assigned to the adult male group and nine specimens are assigned to the female and/or sub-adult group. Specimen

#22409 which forms part of an articular unit falls within the male group. The fused central/4th tarsal (#22408) with which it articulates is also identified as a male.

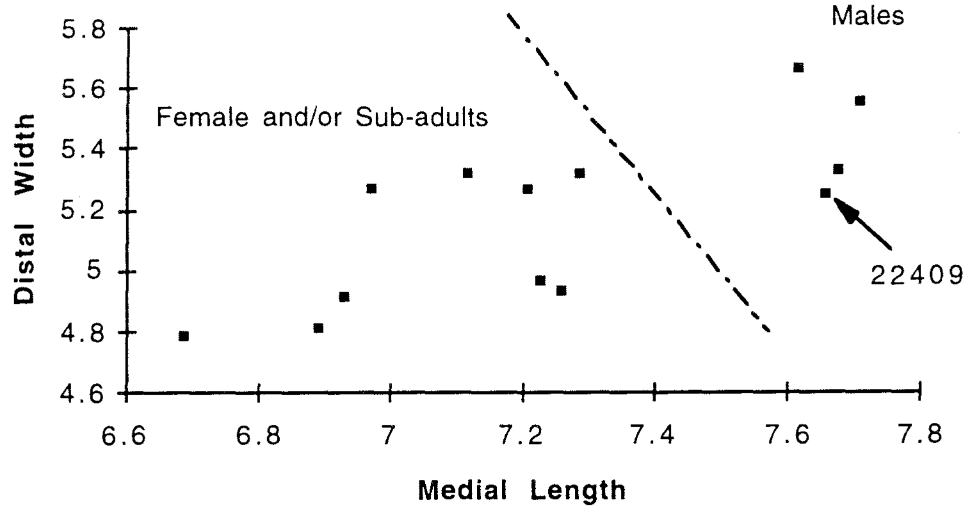

Figure 10.14 Astragalus medial length versus distal width.

The sample of mature calcanei consists of eight specimens. Morlan (1991) identifies seven possible measurements that can be taken on each calcaneus. However, five of the specimens from Bushfield West are incomplete and not all of the measurements can be recorded (Table 10.32).

Table 10.32 Calcaneus Tarsal Measurements (cm)

Cat. No.	Side	Len.	P. Width	P. Depth	D. Width	D. Depth	Lt	Lc
16953	R	14.43	3.44	3.62	3.96	5.75	3.61	3.97
15114	L	-	-	4.33	-	-	3.84	-
24269	R	-	-	-	4.66	5.99	3.41	4.42
22435	R	14.41	3.67	3.85	4.71	5.69	3.65	4.10
23643	L	-	-	-	3.89	5.66	3.07	3.84
21459	L	-	-	-	-	6.17		4.44
23418	R	16.22	4.13	4.55	5.01	6.61	3.88	4.60
23924	R	15.49	4.29	4.43	4.83	6.05	3.57	4.50

Plotting the length of the fused central/4th tarsal articular facet against the length of the astragalus facet produces a separation of the calcaneus specimens into groups of probable males and females and/or sub-adults with three elements in each group (Figure 10.15). Plots of other calcaneus measurements did not produce bimodal distributions.

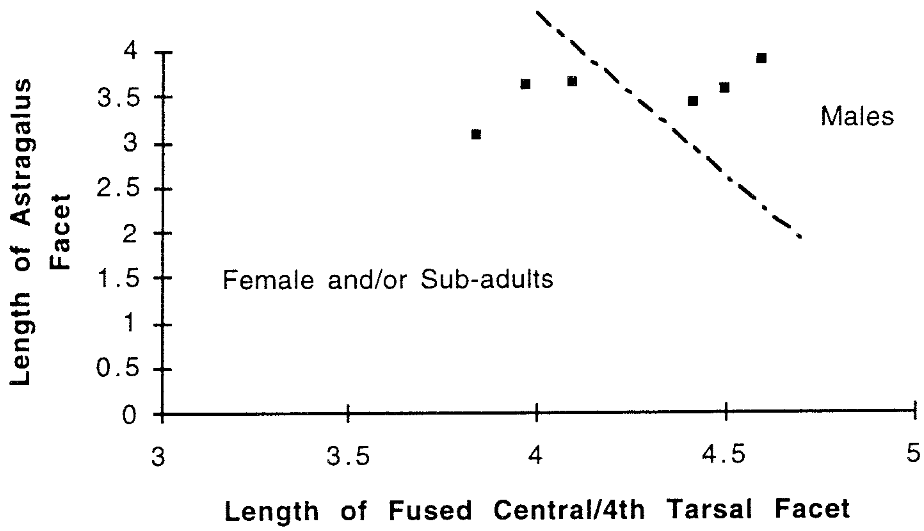

Figure 10.15 Calcaneus measurements of length of fused central/4th tarsal versus length of the astragalus facet.

The final group of bison elements to be examined consists of 18 lateral malleoli. Three measurements—length, width, and depth—are taken on each element (Table 10.33).

Table 10.33 Lateral Malleolus Measurements (cm)

Cat. No.	Side	Length	Width	Depth
17865	L	2.79	2.07	4.02
17669	L	3.06	2.15	4.58
15686	R	2.81	1.58	3.78
16860	R	3.09	1.88	3.77
17188	R	2.74	1.64	3.32
17912	L	2.71	1.76	3.46
18593	R	-	1.68	3.53
18260	L	2.86	1.97	4.11
35831	R	2.58	1.78	3.40
28168	L	-	1.77	3.60
32861	R	2.65	1.74	3.47
24239	R	3.02	2.14	4.10
33163*	R	2.67	1.71	3.54
27979	L	2.49	1.66	3.55
27414	L	3.18	2.16	4.28
29928	R	2.71	17.4	3.83
21807	R	2.75	1.90	3.65
20410	L	2.74	2.26	4.34

Note: catalogue number followed by * indicates that element is part of an articular unit.

Bivariate plots of various combinations of lateral malleolus measurements, including length versus depth which generally results in a good separation of males and females and/or sub-adults, produce a continuum of points which are difficult to interpret (Figure 10.16). A tenuous separation into two groups, one consisting of six adult males and the second consisting of 10 adult females and/or sub-adults, may be suggested by the plot.

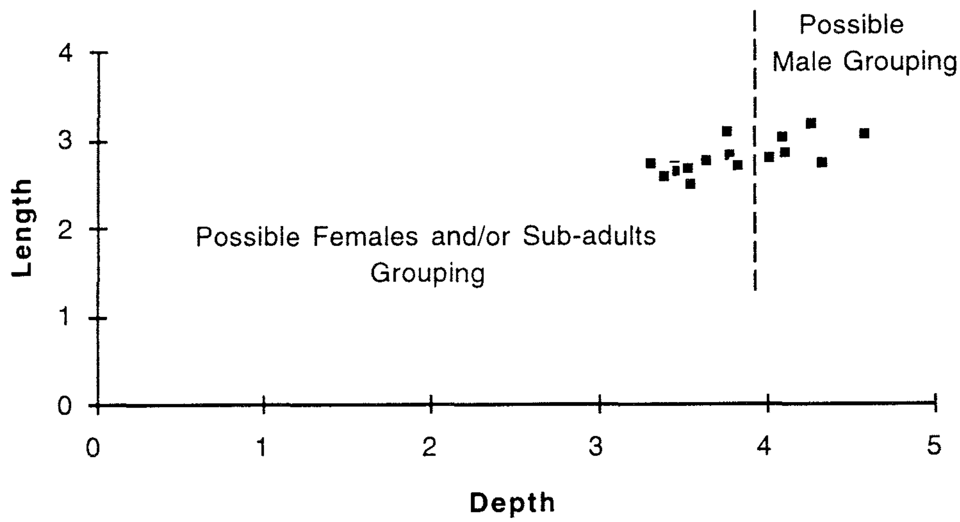

Figure 10.16 Lateral malleolus measurements length versus depth.

10.5.3 Discussion and Summary

Application of Morlan's carpal and tarsal gender analysis methods to carpals and tarsals recovered from Bushfield West was moderately successful. The small size of the samples requires that the results of the analysis be viewed with caution since some researchers suggest that the bimodal distributions are often a result of small sample size (Shortt 1993: 153). Bivariate plots of radial and ulnar carpal measurements do produce clear clusterings of specimens that can be interpreted as representing male and female and/or sub-adult groups. The radial carpal sample consists of 17 elements, while the sample of ulnar carpals consists of 12 elements; (coincidentally these are two of the largest samples used in the analysis). The radial carpal groupings are comprised of eight males and nine females and/or sub-adults. The ulnar carpals produced groups of seven males and five females. Analysis of the remaining carpals did not produce obvious bimodal distributions. However, the internal, fused 2nd/3rd, and unciform carpal samples each contained at least three elements which formed parts of articular units. The articular units are used to assign the sex of the associated carpals and to identify possible male and female and/or sub-adult groupings of bivariate plots of carpals in which clusters are not readily apparent.

The most encouraging aspect of the gender analysis is the consistency with which individual carpals from articular units are sexed and the agreement between carpals sexed using Morlan's method and metacarpals sexed using Walde's method. One articular unit consists of the following carpals—ulnar (#16063), internal (#16065), radial (#16066), unciform (#16067)—as well as a proximal metacarpal (#16146). The ulnar and radial carpals both fall within female and/or sub-adult groupings and the metacarpal is assigned to the female and/or sub-adult category using Walde's method. A second articular unit consists of an ulnar (#15331), radial (#15315), internal (#15314), and accessory (#15316) carpals. Both the ulnar and radial carpals are assigned to female and/or sub-adult groupings. A third articular unit includes the following: a radial (#15671), internal (#15674), fused 2nd/3rd (#15670), and unciform (#15675) carpals, as well as a proximal metacarpal portion (#15669). Using Morlan's method, the radial carpal falls within the female and/or sub-adult grouping and using Walde's method the metacarpal is considered to be indeterminate but the difference (0.3) favored assigning the specimen to the female and/or sub-adult category.

All of the tarsals showed clear bimodal distributions when various combinations of measurements are plotted. However, the sample of tarsal elements is quite small and this should be kept in mind when viewing the results of the analysis. Two tarsal articular units and two tarsal and metatarsal articular units are included in the analysis and the elements from these units are consistently assigned to the same gender. One tarsal articular unit includes a fused central/4th tarsal (#22408), astragalus (#22409), and a fused 2nd/3rd tarsal (#22410). All three tarsals fall within the male groupings of their respective bivariate plots. The second tarsal articular unit consists of a fused 2nd/3rd tarsal (#23357) and a fused central/4th tarsal (#23359). Both elements are assigned to male groupings. A third articular unit includes a fused central/4th tarsal (#16672) and the proximal portion of a metatarsal (#16673). Using Morlan's method the fused central/4th tarsal falls within the male grouping and using Walde's method the metatarsal is identified as male. The final articular unit is a fused 2nd/3rd tarsal (#23823) and a proximal metatarsal (#23822). The 2nd/3rd tarsal falls within the female and/or sub-adult cluster and the metatarsal is identified as female and/or sub-adult.

As was the case with the determination of long bone portion gender study, the analysis of carpals and tarsals shows varying results. Six of the carpals and the astragalus samples are dominated by females and/or sub-adults. Two of the tarsal samples have slightly more males than females and/or sub-adults. The sample of calcaneus specimens is evenly split between males and females and/or sub-adults. On average, results of the carpal and tarsal analysis indicate that there are more females and/or sub-adults (60%) represented in the sample than males (40%).

Table 10.34 summarizes the possible groupings that are interpreted from the scatterplots of Bushfield West carpals and tarsals.

Table 10.34 Summary of Bison Carpal and Tarsal Gender Analysis

Carpal	Male	Female/Sub-Adult	Total
Radial carpal	8	9	17
Ulnar carpal	7	5	12
Internal carpal	3	5	8
2nd/3rd carpal	2	7	9
Unciform carpal	1	11	12
Accessory carpal	3	4	7
Central/4th tarsal	5	4	9
2nd/3rd tarsal	5	4	9
Astragalus	4	9	13
Calcaneus	3	3	6
Total	41	61	102

CHAPTER 11

Butchering

11.1 Introduction

Once an animal is procured decisions concerning transportation and/or resource extraction must be made. The size of the carcass, distance from the base or habitation camp, and the number of people available to transport the resources are factors which enter into transport decisions (Yellen 1977: 280; Jarvenpa and Brumbach 1983: 174; Bunn, et al. 1988: 437; Bartram, et al. 1991: 101; O'Connell, et al. 1992: 332). Decisions made about whether to transport the carcass intact or in parts determines whether or not butchering processes begin at the site of procurement or at the site of final processing and consumption. Butchering is defined "as the human reduction and modification of an animal carcass into consumable parts" (Lyman 1987: 251-252). The sequence of actions involved in the procurement of animal resources are butchering processes and the marks or traces of these processes are interpreted as butchering patterns (ibid.: 294).

Originally, a butchering mark was identified on the basis of two criteria: patterning or the repeated occurrence of a mark in a specific location on a bone, and a function or a determined anatomical reason for the mark occurring in that location (e.g., severing muscle insertion points) (Guilday et al. 1962: 63). These criteria must be considered together when identifying butchering marks since agents other than humans can create marks that are patterned and it is often difficult to determine the function of such marks. Using the frequency of marks in determining patterns requires large samples of bones that demonstrate evidence of butchering marks. There are very few sites which yield samples that are sufficiently large enough to enable the researcher to identify butchering patterns based solely on the frequency of marks (Lyman 1987). Cut mark morphology was added as a third criteria in identification of butchering marks. Cut marks are described as being "V-shaped" or "U-shaped" in cross-section with occasional multiple fine parallel striations or barbs on the walls of the grooves (Lyman 1987: 295; Lyman 1994a: 297). However, researchers attempting to replicate cut marks have determined that cut mark morphology is affected by several factors—condition of the material being cut, the type of material being cut, cutting implement material, angle at which the force is applied, the amount of force applied, etc. The difficulties encountered in using the three criteria outlined above lead researchers to use ethnoarchaeological analogies to strengthen their interpretations of butchering processes and the functions associated with particular butchering marks.

11.2 Ethnoarchaeological Butchering Models

The most detailed ethnoarchaeological accounts of butchering techniques have been provided by Yellen's (1977) observations of the !Kung Bushman, Binford's (1978, 1981) documentation of the Nunamiut Eskimo, Binford and Bertram's (1977) study of the Navajo, and field work with the Hadza by O'Connell et. al (1988, 1992) and Bunn, et. al. (1988). Ethnoarchaeological accounts of butchering practices employed by groups inhabiting the boreal forest region are rare. Jarvenpa and Brumbach's (1983) description of an Athapaskan moose kill is one such rare account. Adrian Tanner (1979) focuses on the ritualistic treatment of animals killed by the Mistassini Cree, but provides limited information concerning the procedures involved in the transport and processing of animals.

In all of the cases cited above the participants are dealing with ungulates which weigh more than 100 kg. Therefore, the initial objective of butchering is to "divide the carcass into smaller, manageable, carrying size packages" (Yellen 1977: 280). Yellen's (1977: 281-284) account of how this is accomplished is summarized in this paragraph. The animal is skinned by slitting the hide along the ventral mid-line of the body from the neck to the mid-region between the hindlimbs, where it intersects slits made along the inner portions of both hindlimbs. Cuts are also made along the inner side of the forelimbs to the ventral slit. The hide is then skinned and peeled back from the legs and body on one side. The forelimb, including the scapula, is removed as a single unit by cutting between the scapula blade and the rib cage. The hindlimb is also removed as a single unit by severing the ligaments which connect the head of the femur with the acetabulum of the pelvis. The first five ribs are removed as a unit, they are snapped back toward the vertebral column and then chopped free. This leaves the rib heads still articulated with the vertebral column. The stomach and the internal organs are then removed. The skull is detached by chopping through the vertebral column between the second and third cervical vertebrae. This leaves the atlas and axis vertebrae still attached to the skull. The carcass is turned and the remaining forelimb, hindlimb, and first five ribs are removed as previously described. The back muscles are stripped from along either side of the vertebral column. The pelvis and sacrum are separated from the lumbar and caudal vertebrae. The remaining ribs which are attached to the sternum are separated from the vertebral column and the vertebral column is cut into segments. Finally, the horns are cut from the skull. Occasionally, the lower limbs are separated at the carpal/radius ulna joint and the tarsal/tibia joint and the phalanges are separated from the distal end of the metapodials.

O'Connell et. al. (1992: 324-325) show that Hadza hunter-gatherers follow butchering patterns similar to those outlined above. The lower limb elements are separated from the upper region by cutting through the distal radius ulna/carpal joints and the distal tibia/tarsal joints. The phalanges are then separated from the distal end of the metapodials. The remaining forelimb and hindlimb elements are separated from the carcass as articular units. The ribs are separated into units of three or four ribs each which are then snapped or chopped from the vertebral column leaving the rib heads articulated with the vertebrae. The sternum is separated from the rib cage and the vertebrae are dissected at the base of the cervical vertebrae and the top of the sacrum.

Variations in Hadza butchering procedures noted by Bunn et. al (1988) include detaching the phalanges and sesamoids from the metapodials and leaving them attached to the skin, removing one half of the pelvis and sacrum with the hindlimb, and leaving the tail vertebrae with the carcass rather than removing them with the hide. In most instances the scapula is removed with the forelimb by cutting from the ventral side between scapula and the rib cage. When the largest animals are butchered, the forelimb is first separated from the scapula and then the scapula is removed from the carcass. Utilization of the vertebral column varies according to several factors: in some instances it is divided into segments and transported back to the base camp and in others it is left at the kill site. The tongue is removed from the skull along with the neck meat. The skull is generally smashed and portions consumed at the kill site. How the skull is separated or if it is separated from the carcass is not mentioned. The remaining butchering procedures appear to be quite similar to those described by Yellen (1977).

Binford (1981: 51-54) describes five episodes of caribou butchering by Nunamiut Eskimos. The sequence of events is summarized in the following paragraph. The caribou is skinned by making circular cuts around the legs close to the distal end of the metapodial, then up the inner side of the leg. The second skinning incision consists of a slit on the ventral surface of the animal from the sternum, across the stomach to the point where it intersects with the skinning incisions made on the rear legs. After skinning is completed the contents of the abdomen are removed. The rear legs are removed as single units by making cuts into the acetabulum of the pelvis from the ventral surface. The front legs, including the scapula, are removed as single units by cutting between the scapula and rib cage from the ventral surface. Meat and sinew are removed from the back by making cuts along the entire length of the backbone on either side of the dorsal vertebral spines. The ribs are separated from the sternum and a cut is made between the second and third rib extending from the sternum to the vertebral column. The third to last ribs are then removed as a unit by snapping the rib cage backward towards the vertebrae. This results in the rib heads being left in articulation with the vertebrae. The sternum or brisket is removed as a single unit, as are the sacrum and pelvis which are cut from the lumbar vertebrae. Finally, the tongue is removed from the mandible.

Jarvenpa and Brumbach (1983: 177-178) give an account of the procedures followed by two Chipewyan adult males in the butchering of a moose. Skinning is accomplished by making a slit down the ventral surface or belly, then up the inner side of the legs. The skin is then peeled back from the carcass. The hind legs are removed as a unit by cutting the ligaments which attach the femoral head to the acetabulum of the pelvis. The fore legs and scapula are separated from the carcass as one piece. The remaining carcass is divided into six segments consisting of the following portions—the cervical vertebrae, the sternum, two rib sections, and the pelvis, sacrum and lumbar vertebrae.

The above ethnoarchaeological accounts of butchering practices demonstrate that various groups of hunter-gatherers follow similar procedures in butchering various species of large ungulates. The common denominator appears to be the skeletal model or basic anatomical structure of the animal involved. There is variability in the point at which the skull is severed from the vertebrae, the size of the vertebral and rib segments, and the order in which the limb elements are removed (front leg then rear leg or vice versa), as well as in the direction of skinning (beginning with front legs or with the rear legs). The forelimbs and hindlimbs may be subdivided into smaller parcels by removing the metapodials and phalanges. Occasionally the pelvis is separated from the sacrum and split longitudinally. The result is an ethnographically derived model of butchering procedures which has been used in the interpretation of butchering marks observed on large ungulate bones recovered from archaeological sites.

In the past, research has focused on documenting the procedures involved in the extraction of resources from large ungulates and comparable data concerning small mammals is usually limited to a few sentences. Researchers generally agree that small animals are transported to camp intact (Tanner 1979: 155; Bartram et. al. 1991: 101; Yellen 1991: 5). Therefore, initial butchering, processing, preparation, and consumption of small mammals usually occurs within one site. Yellen (1991) collected data concerning small mammal (3 - 21 kg in size) butchering and consumption as part of a long term study of the !Kung. The animal is skinned and the internal organs are extracted. The limbs are removed as four articular units by cutting through the joints (it is assumed that the scapula is removed with the forelimb elements). The forelimbs and hindlimbs are disarticulated by separating the individual elements at their joints. The ribs are chopped from the vertebral column and separated from the sternum. They are then subdivided into three or four smaller parcels. The vertebral section is then divided into smaller units one of which contains the pelvis and sacrum. These portions may be roasted or cooked. If they are cooked then the size of the unit must be small enough to fit into the cooking vessel (Yellen 1991: 10). Depending on the size of the animal, variation in butchering procedures occur in the number of portions the animal is divided into. The forelimbs of smaller animals are cooked as a unit rather than being disarticulated into individual elements. It appears as though the femur and tibia of the hindlimb are always separated. Occasionally, the ribs are separated at their articulations with the vertebrae resulting in fragmented vertebral spines but relatively complete ribs. The pelvis may be split into two halves.

Jarvenpa's (1980: 116-117) observations of Patuanak trappers shows that butchering processes undertaken in the preparation of small animal carcasses for cooking is minimal. The animal is skinned and eviscerated; however, the internal organs are often left inside the body cavity to be roasted or cooked with the meat. If the animal is small, such as a rabbit or muskrat, it is simply cut in half below the rib cage. Larger animals such as beavers require slightly more work. The head, legs, and tail are removed from the carcass and the rib cage is separated from the vertebral column.

11.3 Butchering Processes Interpreted From Archaeological Sites

The study of prehistoric butchering techniques originated in the 1950s with the work of Theodore White (1952, 1953, 1954, 1955, and 1956). White (1952) was interested in showing how the presence or absence of various skeletal elements could be used to infer butchering techniques and methods of food preparation. White (1954) also theorized that the presence or absence of particular elements was related to decisions concerning what skeletal portions are transported to the camp and what portions are left at the kill site. A third area of research conducted by White (1956) was the use of taxonomic abundance as an indication of species preference by cultural groups.

Subsequent researchers, particularly those dealing with bison remains recovered from kill sites and associated processing areas, used and expanded upon White's interpretations of butchering techniques (Kehoe 1967 and 1973; Frison 1970 and 1973;

Wheat 1979; Keyser and Murray 1979; Reher and Frison 1980; B. Kooyman 1981, and Clark and Wilson 1981). In each case the repeated occurrence of cut marks and/or chopping marks, and the similar locations of these marks, as well as elements found in articulation are inferred to represent stylized cultural patterns of bison dismemberment. The interpretations of butchering processes occurring at bison kill sites are similar to the stages involved in the butchering of large ungulates observed in ethnoarchaeological accounts, although the anatomical details concerning the removal of muscle masses and the disarticulation of elements is more specific.

At the Jurgen site, Wheat (1979: 62) identifies four types of cut marks and one fracturing blow mark which result from various butchering techniques. They include: 1) skinning marks on the carpals, tarsals, mandibles, and skull; 2) cut marks from severing the ligaments and muscles at the proximal and distal ends of leg bones; 3) cut marks which run parallel to the long axis of elements which are the result of stripping meat; 4) notches and grooves on articular elements which result from attempts to dismember the carcass. Circular depressions or crushed edges of bone observed in regions of muscle attachments are thought to result from hammerstone blows.

Binford (1981:113) noted only one major discrepancy between cut marks observed on caribou and sheep elements and those observed on large ungulate elements from northern plains archaeological sites. During the separation of the ribs from the vertebral column the ribs are snapped back and then severed from the tissue by cutting along the ventral surface of the break. This results in cut marks on the ventral surface of the ribs near the proximal end. These cut marks have not been noted in connection with bison processing in northern plains archaeological sites.

The main disagreement Binford (1981:142) has with the butchering model derived mainly by Frison (1970, 1973) and Wheat (1979), is in the use of heavy stone or bone tools as choppers. Binford (1981:144) contends that most of the elements which Frison described as having been butchered using a chopping technique are actually evidence of carnivore chewing. Binford presents a butchering model which employs cutting techniques rather than chopping techniques. However, chopping techniques may be used in specific situations such as in the breaking of frozen lower leg elements which have little muscle mass or in separation of the ribs from vertebrae.

11.4 Evidence of Butchering Processes From Bushfield West Fauna

The faunal material recovered from Bushfield West represent what Lyman (1994a: 300) calls the "final butchery consumption stage." Animals were transported either in portions or intact to the site where they underwent further dismemberment in preparation for cooking and consumption. All of the faunal material from Bushfield West was examined for evidence of butchering. This entailed recording cut mark location, orientation, and morphology, as well as noting bone fractures which may have resulted from disarticulation of the skeleton, and recording the occurrence of articulated skeletal elements.

11.4.1 Large Ungulates

As noted in a previous chapter, 60 faunal specimens recovered from Bushfield West exhibit cut marks. These marks are generally short, 5 - 15 mm in length, shallow, only 2 - 3 mm in depth, and are "U-shaped" to "V-shaped" in cross section. They occur as multiple cut marks (2 - 15 marks) which are parallel to each other and are usually oriented obliquely or perpendicular to the long axis of the bone. The majority of specimens (N=55) on which cut marks are evident are large ungulate remains: bison, elk, and unidentified ungulate. The various specimens from each taxon on which cut marks were identified have been discussed elsewhere. In this section all large ungulate specimens will be discussed together for following reasons: the sample of bones demonstrating cut marks is small (< 1% of the assemblage); ethnoarchaeological research indicates that animals of similar sizes are butchered in a similar manner; and the largest category of specimens exhibiting cut marks cannot be identified as to species. Large ungulate specimens which exhibit cut marks are presented in Table 11.1.

Table 11.1 NISP of Large Ungulate Remains with Cut Marks

Specimen		NISP	N cut	% cut
Cranium		661	1	0.2
Mandible		347	2	0.6
Hyoid		33	1	3.0
Atlas		11	0	0.0
Axis		11	0	0.0
Cervical		164	0	0.0
Thoracic		597	9	1.5
Lumbar		291	1	0.3
Sacrum		19	0	0.0
Caudal		20	0	0.0
Ribs		1618	24	1.5
Scapula		356	4	1.1
Humerus	-proximal	16	0	0.0
	-shaft	239	1	0.4
	-distal	78	0	0.0
Radius	-proximal	48	0	0.0
	-shaft	127	1	0.8
	-distal	50	0	0.0
Ulna	-proximal	67	0	0.0
	-shaft	82	0	0.0
	-distal	13	0	0.0

Table 11.1 (Continued)

Specimen		NISP	N cut	% cut
Carpals		94	0	0.0
5th metacarpal		7	0	0.0
Metacarpal	-proximal	22	0	0.0
	-shaft	22	0	0.0
	-distal	18	0	0.0
	-complete	1	0	0.0
Innominate		278	0	0.0
Femur	-proximal	62	0	0.0
	-shaft	183	2	1.1
	-distal	26	0	0.0
Patella		15	0	0.0
Tibia	-proximal	43	0	0.0
	-shaft	326	0	0.0
	-distal	55	1	1.8
Lateral malleolus		22	0	0.0
Tarsals		84	0	0.0
2nd metatarsal		4	0	0.0
Metatarsal	-proximal	21	0	0.0
	-shaft	49	0	0.0
	-distal	14	0	0.0
	-complete	1	0	0.0
Phalanges		325	0	0.0
Sesamoids		114	0	0.0
Long bone	-articular end	129	0	0.0
	-shaft	787	8	1.0
Metapodial	-proximal	2	0	0.0
	-shaft	18	0	0.0
	-distal	34	0	0.0
Totals		7604	55	13.5

Four cut marks occur on the edge and towards the base of the right occipital condyle, the only skull fragment on which cut marks were noted. The marks are short wide and shallow. Such marks may have resulted from the separation of the skull from the atlas as was noted by Frison (1973: 47) at the Wardell site where the paramastoid process was broken and then cuts were made between the atlas and the occipital condyles. A bison horn core (not listed in the Table 11.1) is cut at the base of the horn, in the area where the coronal process narrows as it comes off the frontal bone. Unless the horn core was to be fashioned into a utensil or tool the reason why it was severed from the skull is unclear. Access to the brain is generally accomplished by smashing the base of the cranium and enlarging the foramen magnum or by smashing the frontal bone between the horn cores (Frison 1970: 25; Murray and Keyser 1979: 208).

A left mandible fragment consisting of the condyle and partial coronoid process, and ascending ramus exhibits six short shallow cut marks on the lateral side of the condyle. These marks are parallel to each other and cover a small area (5 - 10 mm^2).

They are oriented perpendicular to the condyle and ascending ramus. The cut marks on the condyle may be associated with skinning or with the severing of ligaments in order to detach the mandible from the skull. A second mandible fragment consisting of the anterior portion of the horizontal ramus with socketed P3, P4, and M1 teeth and the diastema shows long (10-15 mm) shallow cut marks on the medial surface of the diastema. There are five widely spaced marks which are oriented obliquely to the long axis of the diastema. Cut marks on the medial side of the diastema may be associated with severing the mylohyoideus muscle to facilitate removal of the tongue (Frison 1970: 22).

Only two nearly complete mandibles were found at Bushfield West. The remaining specimens are mandible portions (N=352) including the following: coronoid processes (N=23), mandibular condyles (N=22), ascending rami (N=51), horizontal rami (N=114), horizontal rami with socketed teeth (N=21), alveoli (N=95), diastemi (N=19), and mandibular symphyses (N=7). The coronoid processes, condyles, and ascending ramus fragments may have resulted from the removal of the mandibles from the skull. This is often accomplished by smashing through the area where the mandible articulates with the skull (the temporal condyles of the skull and the coronoid process and condyle of the mandible). Such an impact would also succeed in fracturing the ascending ramus. The ventral portion of the horizontal ramus is often fractured to gain access to the pulp cavity below the teeth (Frison 1973: 47). Numerous horizontal ramus fragments were recovered from Bushfield West; however, it is difficult to say if the observed fragmentation is due to cultural or natural processes.

One left hyoid exhibits short sharp cut marks on the superior lateral edge of the greater wing. They consist of two groups of two distinct parallel marks which are "V-shaped" in cross section. Broken hyoids and cut marks on hyoids are associated with the removal of the tongue (Frison 1970: 22, Murray and Keyser 1979: 184). The recovery of only one nearly complete hyoid and 32 hyoid fragments lends support to this interpretation.

None of the 12 atlas vertebral fragments from Bushfield West exhibit cut marks. All of the specimens are heavily fragmented and consist of portions of the anterior and posterior articular areas (N=9), the arch and body (N=1), the wings (N=1), and epiphyses (N=1). Only nine axis vertebral specimens were found and they are also heavily fragmented. Axis portions include anterior and posterior articular surfaces (N=4), arch and body fragments (N=4), and transverse processes (N=1). The fragmented nature of the atlas and axis may be related to manner in which the skull was separated from the vertebrae by smashing through the first and second cervical vertebrae, a technique that was noted by Frison (1973: 47) at the Wardell site. However, it is also possible that the vertebrae were reduced to small fragments for the purposes of boiling and grease rendering.

The remaining third through seventh cervical vertebrae are also heavily fragmented. Only one nearly complete cervical vertebra was found. The other 163 specimens consist of vertebral portions including spinous processes (N=4), centrum fragments (N=20), arch fragments (N=36), transverse processes (N=14), pre-zygapophyses (N=50), post-zygapophyses (N=32), and epiphyses (N=8). None of these specimens exhibit cut marks associated with the removal of neck and forelimb muscles or with the disarticulation of the vertebral column into segments. Fragmentation of the articular surfaces and transverse processes may be related to butchering activities; however, it is more likely that they are the result of bone grease processing.

Nine unidentified ungulate thoracic vertebral fragments show evidence of cut marks. Cut marks occur on seven spinous process fragments, one arch fragment, and one post-zygapophysis fragment. All of the spinous process fragments have multiple shallow cut marks oriented either obliquely or perpendicular to the long axis of the spine. Three parallel cut marks were recorded on the arch of a thoracic vertebra between the post-zygapophysis and the spinous process. The remaining thoracic vertebral fragment has three shallow parallel cut marks on the lateral side of the post-zygapophysis. Cut marks situated on thoracic vertebral spinous processes are often associated with the removal of meat from along the backbone (Binford 1981: 111) Marks situated on the vertebral arch close to the pre-zygapophysis and post-zygapophysis may be related to separation of the vertebrae into manageable portions.

Only one thoracic vertebra is nearly complete, the remaining fragments (N=596) are quite small consisting of spinous processes (N=228), spinous process and arch (N=1), centrum fragments (N=46), arch fragments (N=55), transverse processes (N=27), pre-zygapophyses (N=81), post-zygapophyses (N=89), rib articulation facets (N=22), and epiphyses (N=47). There is no way to determine from these fragments which vertebrae are represented and how the vertebral column was divided into smaller segments. The dorsal spines or spinous processes of the thoracic vertebrae are often broken during the removal of the hump meat (in the case of bison) (Frison 1970: 20). The shoulder region is also one of the areas of choice meat cuts on a moose (Jarvenpa and Brumbach 1983: 178).

One nearly complete lumbar vertebra and 289 lumbar vertebral portions—arch and centrum fragment (N=1), spinous processes (N=11), centrum fragments (N=28), arch fragments (N=22), transverse processes (N=67), pre-zygapophyses (N=66), post-zygapophyses (N=74), and epiphyses (N=20)—are represented in the large ungulate faunal remains. Only one lumbar vertebral fragment exhibits cut marks: two groups of four shallow parallel marks are visible on the transverse process. The marks are each oriented obliquely to the long axis of the transverse process. These cut marks and fragmented transverse processes are usually associated with stripping longissimus and sublumbar muscles from the vertebral column (Keyser and Murray 1979: 212). The lower back and pelvic region is the second area of choice meat cuts on the moose (Jarvenpa and Brumbach 1983: 178). Fragmentation of the lumbar vertebrae may be related to the removal of meat or the division of the vertebral column into segments; however, it is likely that the comminuted nature of the bone is related to cooking and intensive grease rendering.

Very few sacral vertebral fragments (N=19) were recovered at Bushfield West. The majority of fragments are from the anterior portion of the sacrum: spinous processes (N=2), centrum fragments (N=7), wing fragments (N=2), transverse processes (N=3), pre-zygapophyses (N=2), and epiphyses (N=3). None of these fragments show evidence of cut marks and none of the sacrum fragments were found in association with innominate specimens. Therefore, the highly fragmented nature of the sacrum may be due to severing the sacral ligaments and the separation of the sacrum from the pelvis.

Two nearly complete caudal vertebrae and 18 caudal vertebral portions were identified in the assemblage. The caudal vertebrae consist of the following portions—spinous processes (N=2), spinous process and arch (N=1), centra (N=13), transverse process (N=1), and epiphysis (N=1). There are two possible explanations for the low numbers of caudal vertebrae found at the site. First, the tails from the various animals being processed may have been discarded when the animal was skinned. Second, as Brink and Dawe (1989: 106) suggest the tail and caudal vertebrae contained within the tail may remain attached to the hides which are carried away when the occupants leave the site.

The majority of cut marks observed on Bushfield West fauna occur on unidentified ungulate rib fragments (N=24). All except one rib fragment consists of a shaft or body portion. The exception is a fragment from the neck/body region of the rib. Nine of the rib shaft fragments have multiple shallow parallel cut marks on the dorsal surface of the rib body. The number of cut marks on these specimens ranges from two to five, positioned only a few millimeters apart. Four of the rib shaft fragments have multiple cut marks along the length of the rib body. One of these specimens exhibits 10 cut marks covering an area 2.5 cm in length. A second specimen consisting of a large portion of the rib shaft (10.0 - 20.0 cm) has 14 cut marks on the lateral surface extending over an area that is 4.0 cm in length. Seven of these cut marks are in close proximity to each other and several overlap. The remaining two rib shaft fragments have seven to eight cut marks extending over shorter areas of 1.5 - 2.0 cm in length. Two rib shaft specimens demonstrate groupings of multiple cut marks. One has two groups of multiple cut marks, one consisting of four marks and the other consisting of five marks. The second rib fragment has three groupings of two cut marks each plus one isolated mark. Seven of the ribs fragments show multiple cut marks on either the anterior or posterior edge of the shaft. In all cases four or five marks were recorded. The remaining two rib shaft fragments differ from the above in terms of mark morphology. Each specimen has two cut marks on either the anterior or posterior edge of the shaft. These marks are clearly deeper and wider, with "V-shaped" cross sections, than the majority of the cut marks noted on the other rib specimens. All of the cut marks are oriented either obliquely or perpendicular to the long axis of the rib shaft. Cut marks on the rib neck/body fragment may have resulted from cutting through tissue to detach the rib section once it had been snapped back towards the vertebral column (Binford 1981: 113). Cut marks on the rib shaft portions are possibly associated with meat filleting activities.

All of the 1618 rib specimens consist of rib portions: heads (N=52), head/necks (N=13), necks (N=61), neck/tubercles (N=6), tubercles (N=15), neck/body fragments (N=25), body fragments (N=1397), sternal ends (N=8), and costal cartilage (N=41). Fragmentation of ribs, particularly the proximal portions, may be an indication of butchering procedures in which the ribs are snapped from the vertebral column. The meat and tissue holding the ribs in place is then severed and the rib section is removed. However, the highly fragmented nature of the rib shafts is likely attributable to marrow consumption, weathering, and sediment compaction.

Four scapula fragments exhibit multiple shallow cut marks. Three short cut marks are visible on the caudal border of one scapula specimen. Similar marks are apparent on the lateral side of a scapula neck fragment. Two scapula blade fragments show multiple long shallow cut marks oriented longitudinally along the length of the blade; each blade fragment has seven to nine cut marks which are approximately 6.0 - 8.0 cm in length. Cut marks located in the region of the neck or glenoid cavity of the scapula are generally associated with dismemberment of the scapula from the humerus (Binford 1981: 121). Cut marks on the caudal or posterior border may have resulted from slicing through the muscle mass between the scapula and the rib cage during initial separation of the forelimb from the carcass. Longitudinal cut marks on the blade are associated with stripping meat from the infraspinous process of the scapula (ibid.: 98).

Two methods of separating the scapula from the humerus are suggested by Frison (1973: 39). The first entails chopping through the neck of the scapula just posterior to the articulation of the scapula and humerus. This would also result in fracturing the acromion process. The second method involves cutting through the muscles and ligaments in order to separate the glenoid fossa and humerus head. Removal of the supraspinatus and infraspinatus muscles results in fractures to the spine of the scapula. Five nearly complete scapulae and three complete glenoid fossae were found at Bushfield West, as well as several scapula fragments including glenoid fossa fragments (N=12), acromion process fragments (N=7), neck fragments (N=24), caudal borders (N=22), cranial borders (N=22), and blade fragments (N=176). The recovery of complete scapulae, as well as complete glenoid fossae and proximal scapula fragments indicates that both methods, smashing the neck of the scapula and cutting tissue and ligaments, were used to dismember the scapula and humerus.

Very few proximal humerus portions were found—head fragments (N=11), neck fragment (N=1), and major tuberosities (N=4). At the Wardell site butchering of the front leg included chopping or smashing the major and minor tuberosities to facilitate the removal of infraspinatus and supraspinatus muscles from their insertion points (Frison 1973: 40). However, the proximal portion of the humerus is also high in nutrients and is often crushed to facilitate grease processing. A second factor to consider is that the proximal humerus has a high percentage of cancellous bone, thus density-mediated destruction processes may be responsible for the high degree of fragmentation.

One unidentified ungulate distal posterior humerus shaft fragment exhibits multiple cut marks on the lateral edge of the lateral epicondyle. The eight marks are short shallow and oriented parallel to each other and transverse to the long axis of the epicondyle. Binford (1981: 124) interprets such marks as resulting from the disarticulation of humerus and ulna/radius joints which are stiff. The lateral epicondyle is also the point of origin of two extensor muscles; the carpi radialis and carpi ulnaris. Therefore, cut marks on the lateral epicondyle could be associated with severing these muscles. Since this region of the humerus is covered by very little meat these marks may also have resulted from skinning (Lyman 1994a: 307).

Multiple cut marks are apparent on an unidentified ungulate radius shaft fragment. The marks are oriented parallel to each other and are quite distinctive with "V-shaped" cross sections. Six of the cut marks are on the medial side of the radius shaft below the brachialis muscle attachment area. One cut mark is also on the medial edge but is situated on the posterior edge of the brachialis muscle attachment scar. These cut marks probably resulted from severing this large muscle mass.

The 162 ulnar portions recovered from Bushfield West are highly fragmented. The identified portions include olecranon processes (N=21), semi-lunar notches (N=18), trochlear notches (N=28), shafts (N=82), and styloid processes (N=13). Fracturing the olecranon process of the ulna serves two purposes: it results in the removal of the triceps muscle and it aids in the separation of the humerus and ulna/radius joint. According to Frison (1970: 14) it is also a "common practice to break the ulna loose from the radius by means of hammerstone blows directed from one side." This would result in fracturing of the ulnar articular surfaces; the semi-lunar notch, and trochlear notch; similar to what was observed at Bushfield West.

One nearly complete pelvis and 277 pelvic portions were identified in the large ungulate faunal assemblage. Except for the one nearly complete pelvis the remaining items are heavily fragmented. Several major muscles—the sublumbar and longissimus muscles which run longitudinally towards the vertebral column and ribs, and the biceps femoris, semitendinosus, and semimembranosus muscles which run down the hindlimb—are attached to the pelvis (Keyser and Murray 1979). Severing these muscles often results in fragmentation of the pelvis as was noted at Wardell, Glenrock, and Kremlin sites (Frison 1970: 14-16; Frison 1973: 42; Keyser and Murray 1979: 179).

Two unidentified ungulate right femur shaft fragments exhibit cut marks. One specimen is a lateral mid-shaft fragment with multiple shallow cut marks oriented obliquely to the long axis of the femur. Approximately 15 marks occur on the shaft with several occurring in close proximity to each other, often overlapping. These marks are possibly related to meat filleting. The second specimen is from the medial side of the femur just below the minor trochanter, multiple shallow parallel cut marks are visible on the muscle attachment line distal to the third trochanter. As many as eight separate cut marks can be seen on the shaft covering an area 20 mm in length. The latter cut marks are likely associated with the severing of muscles.

Two hundred and seventy-four femoral portions were recovered from Bushfield West. The femoral portions include heads (N=18), necks (N=15), major trochanters (N=3), minor trochanters (N=26), shafts (N=133), supracondyloid fossae (N=50), patellar grooves (N=8), and condyles (N=18). At the Glenrock site Frison (1970: 16) observed that the most common means of separating the femur from the pelvis is to sever the ligament attachments which frequently results in cut marks on the rim of the acetabulum; however, none of the acetabulum fragments from Bushfield West show evidence of this. The major trochanter is often damaged in the process of separating the gluteus medius muscle (Frison 1973: 42; Keyser and Murray 1979: 179). At the distal end of the femur the trochlea is frequently damaged when the patella is removed in order to strip the biceps femoris and vastus lateralis muscles (Keyser and Murray 1979: 178). At Bushfield West the distal portion of the femur is heavily fragmented possibly resulting from disarticulation of the hindlimb.

Chopping through the femur and tibia joint may result in damage to the distal condyles of the femur and the proximal condyles of the tibia. Forty-three proximal tibia condyle fragments are present in the assemblage. However, cut marks and chopping marks are not apparent on the proximal specimens and fragmentation may be the result of nutrient processing or density-mediated destruction rather than butchering.

Several short shallow cut marks are apparent on the posterior shaft of a distal portion of an elk tibia. The nine cut marks are less than 5 mm in length but are deep and "V-shaped" in cross section. They are oriented perpendicular to the long axis of the tibia. The location of these marks suggests that they are associated with either skinning or the disarticulation of the tarsals and the tibia.

Twenty large ungulate articular units were identified in the faunal assemblage associated with Bushfield West. The articular units are from either the radius/ulna joint or the lower regions of the forelimbs and hindlimbs. Three of the radius/ulnar articular units consist of proximal radius portions and ulnar trochlear and/or semi-lunar notch articular portions. The remaining radius/ulnar articular unit consists of unfused radius and ulna shaft fragments which articulate with each other. The majority of articular units are from the lower forelimb and hindlimb regions. The lower forelimb articular units include the following: five carpal articular units and one carpal and proximal metacarpal articular unit. The carpal articular units consist of two to five carpals each. The carpal/metacarpal articular unit consists of five carpals and the proximal portion of the metacarpal. The lower hindlimb articular units include the following: one distal tibia and tarsal, four tarsal and proximal metatarsal units, and three tarsal articular units. The tibia/tarsal articular unit consist of a distal tibia portion, astragalus, and calcaneus. The tarsal/metatarsal articular units consist of varying numbers of tarsals, one to four, and the proximal portion of the metatarsal. The tarsal articular units consist of two tarsals each. Two first and second phalanx articular units are also present in the faunal assemblage.

The articular units suggest that the lower regions of the forelimbs were separated by either cutting through the carpal and radius/ulnar joint or breaking the distal shaft of the radius and/or the proximal shaft of the metacarpal. Two complete distal radius portions, as well as 48 radius carpal articular surface fragments are represented in the assemblage. The lack of visible cut marks on the carpals and the fragmented nature of the distal radius indicates that the preferred method of removing the lower front leg was to break the distal shaft of the radius. However, fragmentation of the distal radius may also have resulted from marrow extraction and further processing of the cancellous bone for grease. Nine complete proximal metacarpal portions and 13 proximal articular metacarpal fragments occur in the sample. None of the proximal metacarpal specimens exhibits cut marks. It is likely that fragmentation of the metacarpal was a result of marrow extraction rather than a result of reducing the lower limb into smaller portions for cooking.

The lower hindlimb was disarticulated in a manner similar to that of the forelimb. The distal shaft of the tibia is broken and then the tarsal and proximal metatarsal joint is either cut or the proximal metatarsal shaft is fractured. Thirteen complete distal tibia portions and 42 tarsal and lateral malleolus tibia articular surface fragments are included in the collection of large ungulate specimens. None of the tarsals demonstrate evidence of cut marks and in only one case is there evidence of cut marks on the distal tibia. The nine complete proximal metatarsal portions and 12 proximal articular surface metatarsal fragments do not exhibit cut marks. The metatarsals are fractured towards the proximal end of the shaft to facilitate marrow extraction and the tarsals and occasionally distal tibiae or proximal metatarsals are discarded as articular units.

11.4.2 Medium-sized Mammals

The only medium-sized mammals that exhibit cut marks are felids and mustelids. A lynx mandible which consists of the anterior two-thirds of the mandible without socketed teeth, exhibits three short shallow parallel cut marks above the second nutrient foramen and below the P3 tooth socket. The cut marks are oriented perpendicular to the long axis of the mandible. Such marks are consistent with skinning, particularly since the head of an animal is the most difficult part to skin out (Jarvenpa 1980: 117).

The mustelid specimen that demonstrates evidence of cut marks is a left badger femur. Two shallow cut marks are situated on the lateral side of the posterior shaft, towards the proximal end of the shaft. The femur is not a complete element and both the proximal and distal portions are missing. The marks are oriented obliquely to the long axis of the shaft. They may be associated with stripping meat from the femur.

The most commonly occurring medium-sized animal at Bushfield West is the beaver; however, none of the beaver bones exhibits evidence of cut marks. In an examination of the food resources utilized by Cree-speaking Metis of Pinehouse in northern Saskatchewan, Tobias and Kay (1994: 211) list the whole weight value of beaver as 12.1 kg. Their information regarding beaver weights and edible portions is based on data obtained by the James Bay and northern Quebec native harvesting research committee. Banfield (1974: 158) lists the average weight of an adult beaver as 20 kg. In any case these weights indicate that a certain amount of butchering is required in the preparation of beaver carcasses for cooking and consumption. Roasting would require simple dismemberment of the carcass into manageable portions such as forelimbs, hindlimbs, rib halves, and removal of the head and tail. Cooking or boiling beaver remains in vessels would require more intensive disarticulation of the carcasses, down to individual elements and small vertebral and rib sections. Aside from removal of the skull and tail, lower portions of the forelimbs and hindlimbs (metapodials and phalanges) would likely be cut off prior to boiling. Beaver limb bones are heavy, dense, and possess small marrow cavities; therefore, marrow is not likely to be a primary resource. The small amount that is present may be extracted during cooking or consumption. Yellen (1990: 9-10) records that the !Kung fracture the shafts of porcupine elements with the meat still attached. This releases some of the marrow during cooking, while the remaining marrow is sucked out of the fractured bones during consumption.

Only 12.7% or 114 of the beaver axial specimens found at Bushfield West are complete or nearly complete elements and over half of these are isolated incisors and/or cheek teeth (N=68) (Table 11.2). One hundred and eleven or 13.7 % of the appendicular beaver remains are complete or nearly complete elements. The majority of these elements are from the lower regions of the forelimbs and hindlimbs: phalanges, tarsals, carpals, metacarpals, metatarsals, and patellae.

It is unclear from the available sample of beaver remains whether the appendicular elements were fragmented as a means of disarticulating the limbs into smaller segments which would fit in the cooking vessels or if they were fragmented in order to release marrow during cooking. Beaver carcasses may also have been roasted, in which case most of the fragmentation of elements would have occurred immediately prior to or during consumption.

There are no complete beaver skulls; however, there are several complete or nearly complete cranial portions (N=33). There are six nearly complete mandibles, which have either the coronoid process or mandibular condyle broken. All of these mandibles have varying numbers of socketed teeth. Separation of juvenile skulls into various cranial portions with visible sutures (N=37) is probably the result of natural decomposition of the tissues holding the elements together. Adult beaver skulls are robust and thick and fragmentation is more likely to be the result of deliberately smashing the skull either to dispatch the animal or to gain access to the brain during cooking and

Table 11.2 Complete or Nearly Complete Beaver Elements Compared to Beaver NISP

Specimen		NISP	N complete	% complete
Skull	-frontal	29	5	17.2
	-nasal	14	3	21.4
	-palatine	5	0	0.0
	-premaxilla	26	2	7.7
	-temporal	30	0	0.0
	-zygomatic	30	3	10.0
	-sphenoid	4	1	25.0
	-basisphenoid	2	1	50.0
	-parietal	19	1	5.3
	-interparietal	6	4	66.6
	-maxilla	29	0	0.0
	-maxilla/th	8	0	0.0
	-petrous	6	3	50.0
	-occipital	9	5	55.6
	-occipital condyle	12	3	25.0
	-auditory bulla	2	1	50.0
	-ext. aud.	1	1	100.0
	-jugular process	2	0	0.0
Mandible		63	6	9.5
Vertebra	-atlas	7	2	28.6
	-axis	5	0	0.0
	-cervical	5	1	20.0
	-thoracic	106	0	0.0
	-lumbar	57	6	10.5
	-sacrum	8	0	0.0
	-caudal	113	4	3.5
Rib		300	6	2.0
Sternum	-xiphoid	2	2	100.0
	-manubrium	1	1	100.0
Clavicle		11	2	18.2
Scapula		34	1	3.6
Humerus		81	1	1.2
Radius		49	0	0.0
Ulna		57	2	3.5
Carpals		17	14	82.4
Metacarpals		27	13	48.1
Innominate		67	1	1.5
Femur		71	2	2.8
Patella		7	2	28.6
Tibia		59	0	0.0
Fibula		53	0	0.0
Tarsals		53	30	56.6
Metatarsals		42	2	4.8
Metapodials		9	0	0.0
Phalanges		175	41	23.4

consumption. The fragmented nature of the mandibles may have resulted from extraction of incisors which were used as tool (chisels or gouges). The horizontal ramus would also contain a small amount of marrow.

Thirteen vertebrae are complete or nearly complete elements. The most common of these are lumbar vertebrae (N=6), followed by caudal vertebrae (N=4), atlas (N=2), and cervical vertebra (N=1). The remaining vertebral specimens are fragmented and consist of the following portions—spinous process, arch, and body (N=1), arch and body (N=1), arch (N=21), spinous processes (N=8), spinous process and arch (N=5), centra (N=110), transverse processes (N=30), odontoid process (N=1), wings (N=2), pre-zygapophyses (N=46), post-zygapophyses (N=15), and epiphyses (N=52). A large number of the centra (N=76) do not possess fused epiphyses, therefore, to a certain degree the incompleteness of the specimens is due to the immature condition of the vertebrae. In comparison to thoracic and lumbar vertebral specimens, cervical vertebrae appear to be under-represented in the sample. There are also 12 indeterminate vertebral specimens in the sample which could possibly increase the count of cervical vertebrae (not including the atlas and axis). None of the vertebrae were found in articulation; therefore, it is difficult to determine if or how the vertebral column was subdivided into smaller segments for cooking purposes. Fragmentation of the vertebrae may be associated with the removal of the ribs.

Only two complete and four nearly complete beaver ribs are represented in the sample. The remaining rib specimens consist of rib portions including head (N=15), head and neck (N=50), neck and tuberosity (N=14), neck (N=11), tuberosity (N=5), neck and body (N=15), body (N=179), and sternal ends (N=5). The large number of fragmented ribs seems to indicate that the ribs were separated from the vertebral column as part of the butchering processes; possibly by chopping through the proximal ends near their attachment with the vertebrae.

Beaver sternal elements are rare; only three specimens are identified in the sample. The distal ends of the ribs were likely separated from the sternum at some point in the preparation of the carcass. It is impossible to determine if the sternum was left attached to one of the rib sections or if it was removed as a separate portion. Various taphonomic processes may have completely destroyed the sternal elements or at least reduced them to unidentifiable bone fragments.

Only one complete scapula is represented in the sample. The remaining specimens consist of glenoid fossa and neck portions (N=12), acromion processes (N=10), blade fragments (N=5), spine fragments (N=4), cranial borders (N=1), and neck portions (N=1). The majority of scapulae are broken through the neck region, between the glenoid fossa and the blade. The acromion process is also frequently broken.

Of the 81 beaver humerus specimens recovered from Bushfield West only one is complete. The remaining items are fragmented humerus portions including shafts (N=30), heads (N=19), condyles (N=13), deltoid crests (N=6), epicondyles (N=5), major tuberosities (N=2), and condyles and distal shafts (N=5). The major tuberosities, most of the heads (N=17), and seven of the shafts are unfused. The most commonly observed position of fragmentation of the humerus occurs between the head and the deltoid crest. Breaks were also observed through the deltoid crest or just below it. At the distal end fragmentation commonly occurs just above or through the wide flaring epicondyles.

The radius specimens recovered are heavily fragmented and consist of the following portions: proximal articular surfaces (N=11), shafts (N=28), and distal carpal articular facets (N=10). Most of the distal articular facets are unfused (N=8), as are eight of the proximal articular facets and three of the shaft portions. The radius is broken at various positions along the shaft without any apparent patterning.

There are two complete ulnae represented in the sample, as well as 54 ulnar fragments. The fragments include shafts (N=23), olecranon processes (N=10), semilunar notches (N=8), trochlear notches (N=6), and styloid processes (N=7). The majority of styloid processes (N=5) are unfused, as are four olecranon processes, and five shafts. The majority of ulnae are broken towards the distal end of the shaft. Specimens that are fractured towards the proximal end are either broken through the semi-lunar notch or just below the trochlear notch.

Most of the 67 innominate specimens are highly fragmented, only one left innominate was found intact. The innominate portions include ilium fragments (N=21), acetabulum portions (N=21), ischium fragments (N=11), and pubis fragments (N=13). Such portions result from fragmentation of the innominate in three areas: through the ilium just posterior to the sacral articular surface, through the branch of the ischium anterior to where it flares, and through the narrow portion of the pubis shaft.

Two nearly complete femora and 69 femoral portions were identified in the assemblage of beaver fauna. Femoral portions include the following: heads (N=16), necks (N=1), major trochanters (N=15), minor trochanters (N=2), shafts (N=20), condyles (N=13), and trochlea (N=2). Several of the femoral portions are unfused: 10 heads, the neck fragment, 11 major trochanters, 11 shafts, and 11 condyles. The femur is broken at various positions along the shaft; at the proximal end through the neck and major trochanter, between the lesser trochanter and third trochanter, and distally just above the condyles.

Tibiae recovered from Bushfield West consist of three basic portions; proximal condyles (N=14), shafts (N=31), and distal tarsal articular surfaces (N=14). Several of these portions are unfused including proximal condyles (N=12), shafts (N=8), and distal articular surfaces (N=8). Tibia are broken towards the proximal end of the shaft through the tibial crest and towards the distal end of the shaft.

None of the fibulae was found as complete elements. Fifty-three fibula specimens consist of portions of proximal ends (N=6), shafts (N=33), and distal ends (N=14). As with other long bones several of the fibula portions are unfused including proximal articular surfaces (N=6), shafts (N=9), and distal articular surfaces (N=11). Fibulae are broken at various locations along the shaft without any apparent patterning.

Although very few metatarsals are complete a large percentage of the specimens are unfused epiphyses and shafts (47.6%). As stated previously, the majority of complete beaver elements are metacarpals, carpals, tarsals, and phalanges. This seems to indicate that the lower portions of the legs are separated from the limbs and discarded.

11.4.3 Small-sized Mammals

The most commonly occurring small mammal at Bushfield West represent the genus *Lepus*. This assemblage is dominated by snowshoe hare specimens (N=94). There are also a few white-tailed jackrabbit specimens (N=8) and leporid remains which cannot be identified to species (N=10). Snowshoe hares and white-tailed jackrabbits would have been procured for two reasons: first as a source of meat and second for their furs. Tobias and Kay (1994: 211) list the average weight of the snowshoe hare as 1.32 kg. Banfield (1974: 81) gives the average weight of the female as 1.55 kg, which is slightly more than the average weight of the male, 1.43 kg. The average weight of a white-tailed jackrabbit is 3.35 kg (Banfield 1974: 88). Cut marks are not apparent on any of the leporid specimens; however, they are fragmented. Twenty of the axial specimens (33.9%) are complete or nearly complete (Table 11.3). The majority of the complete or nearly complete axial elements are individual teeth (N=16). Forty-three of the 153 appendicular specimens (28.1%) are complete or nearly complete. Most of the complete elements are carpals, metacarpals, tarsals, metatarsals, and phalanges. The only complete long bones are two femora and one tibia.

Due to the delicate nature of the leporid skull it is not surprising that the cranial specimens are highly fragmented. Very few vertebrae and ribs are represented in the leporid fauna recovered from Bushfield West. It is impossible to determine if this is due to cultural processes, natural processes, or sampling techniques.

Table 11.3 Complete or Nearly Complete Leporid Elements Compared to NISP

Specimen		NISP	N complete	% complete
Skull	-temporal	2	0	0.0
	-zygomatic	4	0	0.0
	-palatine	1	1	100.0
	-maxilla	5	0	0.0
Mandible		4	0	0.0
Vertebra	-atlas	1	0	0.0
	-cervical	2	2	100.0
	-lumbar	5	1	20.0
Ribs		10	0	0.0
Scapula		1	0	0.0
Humerus		13	0	0.0
Radius		7	0	0.0
Ulna		4	0	0.0
Carpals		4	4	100.0
Metacarpals		7	3	42.9
Innominate		9	0	0.0
Femur		21	2	9.5
Tibia		20	1	5.0
Fibula		1	0	0.0
Tarsals		19	8	42.1
Metatarsals		12	8	66.7
Phalanges		24	10	41.7
Long bone	-shaft	2	0	0.0
Metapodials		9	0	0.0

The single scapula specimen is fractured through the neck and consists of the glenoid fossa. There are only two proximal humerus portions. One is an eroded head and the second is an unfused head. There are also two incomplete shaft fragments. The nine distal humerus portions are all fragmented in a similar manner, just above the olecranon fossa. Proximal portions of the radius were not recovered. The radius fragments represented in the sample consist of five shaft fragments and two distal shafts and carpal articular facets. The ulnar specimens are all proximal portions consisting of olecranon processes and trochlear notches. The three fragmented metacarpals are proximal portions. The carpals were recovered as complete elements. Fragmentation of the forelimb elements occurs close to the joints, near the proximal and distal ends. Such a pattern of fragmentation is consistent with attempts to disarticulate the forelimb into portions suitable for cooking by snapping the bones near their joints and then cutting through the connective tissue and ligaments.

The innominate is heavily fragmented and includes the following specimens: five acetabulum fragments, two ischiums, one ilium, and one acetabulum with branches of the ischium, ilium, and pubis. As mentioned previously, two of the complete leporid elements are femora. The remaining 19 femoral specimens consist of heads (N=9), shafts (N=8), and condyles (N=2). The majority of proximal femoral specimens are fractured either through the neck or just below the major trochanter. The shaft fragments are broken at various locations along the length of the shaft. The condyles are fractured transversely at the distal end of the shaft and longitudinally between the condyles. One complete tibia is present in the sample, as well as 19 tibia fragments. The tibia portions include two proximal condyle portions, one complete proximal end and partial shaft, six shaft fragments, three distal articular surfaces, and six complete distal ends and partial shafts. The tibia specimens are fractured at various positions along the shaft either between the mid-shaft and proximal end or mid-shaft and distal end. Three of the specimens are broken close to the proximal end and two are broken close to the distal end. Most of the metatarsals are complete; those that are not include one proximal portion, two shafts, and one distal portion. The pattern of fragmentation, especially for the innominates and femora is consistent with disarticulation of the skeleton by fracturing the elements rather than trying to cut between the joints.

Two snowshoe hare articular units were found at Bushfield West. One consists of the distal portion of a right tibia, as well as a calcaneus and astragalus. The second articular unit consists of four left metatarsals: 2nd, 3rd, 4th, and 5th. The majority of complete elements are from the lower regions of the forelimbs and hindlimbs and the recovery of the articular units suggests that the lower portions or feet were separated from the limbs and discarded.

11.4.4 Birds

Three resources are provided by birds: meat, feathers (which are used for fletching arrows and for decorative purposes), and bones (which can be fashioned into tools, whistles, or beads) (Gilbert 1981: 2-4). Three possible bird bone whistles—one made from a swan ulna, one from a large bird tibiotarsus, and one from a large bird long bone—were found at Bushfield West. A bird bone piercer or awl was also identified in the faunal sample from the site.

Eighty-one bird bones, or 14.6% of the bird fauna recovered from Bushfield West, are complete or nearly complete elements (Table 11.4). The majority of these are from the wings or the lower regions of the foot, tarsometatarsus and phalanges.

The remaining 474 bird specimens are fragmented and it is difficult to determine if the fractures are a result of cultural or natural processes. Parmalee (1977: 202) suggests that for medium-sized birds such as grouse it would not have been necessary to do much preparation for cooking other than removing their heads, feet, and feathers. However, for larger birds, such as sandhill cranes and Canada geese, it would have been necessary to reduce them into more manageable portions in order to fit them into cooking vessels. The cut marks observed on the three bird specimens provides some evidence of butchering at the site.

Table 11.4 Complete and Nearly Complete Bird Bones From Bushfield West by NISP

Taxon	Specimen	Number Complete
Medium waterfowl	1st phalanx (foot)	1
Large waterfowl	2nd phalanx (wing)	1
	indeter. phalanx	1
Swan	quadrate	1
	1st phalanx	1
Geese, unidentified	1st phalanx (foot)	1
	2nd phalanx (foot)	1
	scapholunar	1
Duck, unidentified	indeter. phalanx	1
Teal	carpometacarpus	1
Mallard	1st phalanx	2
	2nd phalanx	3
	scapholunar	1
Crane	furculum	1
Grouse, unidentified	premaxilla	1
	radius	2
	ulna	3
	carpometacarpus	15
	scapholunar	7
	cuneiform	4
	pollex	2
	1st phalanx (wing)	18
	2nd phalanx (wing)	1
	3rd digit (wing)	3
	tarsometatarsus	1
	1st phalanx (foot)	2
	2nd phalanx (foot)	3
	3rd phalanx (foot)	2

A single cut mark on the mallard tibiotarsus is located on the anterior portion of the shaft below the distal end of the fibular crest and above the mid-shaft region. The mark is deep, "V-shaped" in cross section and runs diagonally across the shaft. The swan carpometacarpus (two specimens that were refitted in the laboratory and thus represent a single element) exhibits three short deep "V-shaped" cut marks on the proximal end and the third is located in the mid-region of the metacarpal. The third cut is made at a sharp angle to the bone, slicing off some of the bone above the deepest line of impact.

11.5 Discussion of Butchering Techniques From Bushfield West Fauna

Only a small percentage of the large ungulate (bison, moose, and elk) remains from Bushfield West exhibit marks which can be directly attributed to butchering. Less than 1% of the assemblage or 55 specimens show evidence of cut marks and one specimen exhibits chopping marks. The majority of the cut marks occur on the axial elements, particularly the ribs. Nine appendicular elements demonstrate evidence of cut marks. The four cut marks noted on the scapula are situated on the neck, blade, and caudal border. Cut marks recorded on the humerus, radius, and femora are situated on the shafts. The cut marks observed on the tibia are located on the distal portion of the specimen. Wider and deeper chopping marks are visible on one humerus shaft. Binford (1981: 134) suggests that rather than representing filleting marks, cut marks located on long bone shafts are the result of scraping the bone to remove the periosteal tissue in preparation for marrow cracking.

Cut marks on axial specimens, fragmentation of appendicular elements, and the recovered articular units suggests that a combination of cutting and chopping or bone breakage was used to dismember the large ungulate carcasses. Since the faunal remains are highly fragmented and represent the final stage of processing it is impossible to determine the exact segments into which the vertebral column and ribs were separated. Several cut marks occur on the ribs in various locations. These locations appear to be more numerous than the three suggested by Binford (1981:113).

The method of separating the scapula and humerus is difficult to determine since very few proximal humerus portions were found and no cut marks are visible on the glenoid fossae. The lack of proximal humerus specimens may indicate that this area of the humerus was smashed in order to separate the two elements; however, the proximal humerus is also frequently selected for grease extraction. Disarticulation of the distal humerus, radius and ulna joint appears to have been accomplished by smashing or chopping through the olecranon process of the ulna from the side. This process may also have involved smashing the distal shaft of the humerus and the proximal shaft of the radius. Cut marks are not apparent on any of the carpals and very few distal radius portions were found. Several metacarpals are fractured towards the proximal end of the shaft. This pattern indicates that dismemberment is accomplished by smashing the distal and proximal shafts of the respective long bones.

The pattern of disarticulating the hindlimb appears similar to that described for the forelimb, a combination of cutting tissue and ligaments and fracturing selected elements. Cut marks were not observed on either the acetabulum specimens or femoral head fragments. However, fragments of the proximal end of the femur including the head, neck, major and minor trochanters were identified in the assemblage indicating that disarticulation could have been achieved by smashing the proximal end of the femur. However, it should be noted that complete proximal portions of the femur are rarely recovered from archaeological sites since they are frequently selected for bone grease processing and they are also susceptible to destruction by natural taphonomic processes. Similarly, intact distal femur portions and proximal tibia portions are lacking at Bushfield West. Femoral condyle and trochlear fragments are present, as are tibia medial and lateral condyles. However, it is difficult to determine if the fracturing of these element portions is due to cultural or natural processes. One distal tibia has cut marks which are attributed to either skinning, filleting, or disarticulation of the joint. None of the tarsals exhibit evidence of cut marks. Complete distal tibia portions fractured at the distal end of the shaft and complete proximal metatarsal portions fractured at the proximal end of the shaft are represented in the assemblage. This seems to indicate that the separation of the lower portion of the hindlimb was accomplished by smashing the distal tibia shaft and the proximal metatarsal shaft.

Medium-sized and small-sized animals such as beavers, snowshoe hares, and birds were apparently transported whole to the site where they underwent processing. Processing involved dismembering the carcasses into suitable portions and removal of the feet, or in the case of birds, the wing extremities and feet. Fracturing of the proximal and distal ends of the limb bones likely occurred as a result of carcass dismemberment, while fragmentation of the shafts may have taken place either prior to cooking or during consumption. The method of cooking, roasting as opposed to boiling, affects the degree to which the carcasses were processed. Boiling required that the carcass be divided into sections small enough to fit into the cooking vessels. If the carcasses were roasted dismemberment of the animal would have been minimal.

CHAPTER 12

Economic Utility of Bison

12.1 Introduction

Since the late 1980s, a major part of the analysis of archaeological assemblages entails the use of economic utility indices to interpret butchering and processing decisions made by people in extracting necessary food resources. Binford (1978) initiated this approach with his observations of Nunamiut hunting and butchering practices and the development of food utility models. Subsequent researchers have devised similar economic utility models for other taxa (see Lyman 1994a: Table 7.3). These models are based on the recognition that various parts of the animal anatomy differ in amounts and quality of food, and the assumption that this will result in certain decisions by people concerning how to exploit those resources. If such a relationship exits between food yield and processing decisions then, as Lyman (1992: 7) notes, "that relationship can be used as a powerful interpretive tool in archaeological contexts."

12.2 Binford's Economic Utility Indices

Interdependent with decisions concerning butchering, transportation, and processing animal carcasses are decisions regarding the economic utility of anatomical parts. "The butcher's interest is in which parts of the animal are best for the greatest variety of potential uses" (Binford 1978: 72). In order to assess the economic value of carcass portions Binford (1978) devised usable meat, bone marrow, and bone grease quantitative utility indices. Meat weights and the percentages of marrow fat and bone grease fat used in establishing the indices were derived from one adult male caribou, one adult female domestic sheep in poor condition, and one juvenile sheep.

The meat utility index (MUI) was constructed to determine the amount of usable meat associated with each anatomical part of caribou and sheep carcasses. As each butchering unit was removed from the carcass it was weighed. The units were then disarticulated into their representative components and each element with associated meat, tissue, and bone was again weighed. The meat was then removed from the bones which were weighed, thus obtaining an estimate of the amount of usable meat. Dry bone weights were obtained after the bones were cleaned and degreased. In the calculation of the MUI the gross weights of the animal, each anatomical part, and the dry bone weight were used to determine a standardized meat utility index (Binford 1978: 15-23).

Although the quantity and not the quality of meat was considered important in determining the MUI, both the quantity and quality of bone marrow were thought to be important when determining the economic utility of elements based on associated bone marrow. Binford (1978) hypothesized that the oleic acid or fatty acid with the lowest melting point (also known as white fat) was considered to be nutritionally superior to yellow fat. The percentage of oleic acid and marrow cavity volume were determined for each element. A third factor which entered into the equation was the efficiency or ease with which the marrow could be extracted from the bones. The marrow index (MI) devised by Binford (1978: 26) combines measurements of oleic acid, marrow cavity volume, and ease of marrow extraction.

In evaluating bone grease, quality is again considered to be an important factor and a distinction is made between white bone grease and yellow bone grease. White grease is found in the articular ends of long bones, while yellow grease is located in the mandible, vertebrae, and ribs. The grease index (GI) takes into consideration three factors: grease quality, bone density, and size of the bone or bone portion (ibid.: 32). The quality of bone grease is determined by the percentage of oleic acid. Bone density determines the ease with which bones are broken for grease rendering. The size or volume of the element is related to the quantity of available grease. The grease index was subsequently divided into two indices; one for white grease which applies to appendicular elements and the other for yellow grease which applies to axial elements.

Since the economic utility of an animal portion is determined by considering the values of all of the available resources simultaneously Binford (1978) created a general utility index (GUI) which combines the values derived for meat, marrow, and grease. The GUI was subsequently modified to account for the fact that carcasses are butchered into transportable parcels which consist of articulated units of elements rather than single elements. This often results in the transportation of elements which are of low economic utility simply because they are articulated with elements of high utility. Elements that are transported due to their anatomical position in a butchering unit and not because of their nutritional value are known as "riders" (ibid.: 74).

Graphic comparison of the abundance of skeletal elements recovered from various ethnoarchaeological sites, spring and fall kill-butchering sites and camp sites, with the standardized MGUI results in a series of utility curves that can be used to interpret transport and utilization decisions. The abundance of skeletal elements is determined by calculating the MAU value. The MAU value is standardized by dividing each of the MAU values by the maximum MAU value in the assemblage and multiplying by 100. Curves which represent the selection of large quantities of high and moderate utility elements and the discard of large numbers of low utility elements indicate "bulk" or "reverse utility strategy" decisions. This strategy is intended to maximize the quantity of butchering units removed from the site of the kill. Curves that indicate the selection of large frequencies of high utility parts and the discard of large numbers of moderate and low utility elements are interpreted as "gourmet" selection decisions. This strategy is thought to maximize the quality of parts removed from the site. A diagonal linear line indicates an unbiased selection strategy. According to this strategy, parts are removed in equal proportion to their determined economic utility (ibid.: 81). However, Lyman (1992: 8) cautions that different sites; kill-butchering sites as opposed to processing or habitation sites, will produce different curves which may be interpreted as reflecting different selection strategies rather than the same strategy seen at opposite stages of the process.

In the development of meat, marrow, and grease utility indices Binford (1978) notes, that in each instance, there are strong linear correlations between the indices for caribou and sheep. Therefore, it is suggested that the indices developed from data obtained during the study of caribou and sheep carcasses may also be applied to assemblages of other large ungulates in the size range of 50 to 250 lb. In light of this recommendation and due to the absence of equivalent information concerning meat, marrow, and grease percentages in bison carcasses, researchers have employed Binford's MGUI to interpret bison kill site assemblages (Speth 1983; Brink and Dawe 1989; Todd 1987).

12.3 Metcalfe and Jone's Economic Utility Indices

In a series of articles concerning the economic utility of body parts Metcalfe and Jones (1988) and Jones and Metcalfe (1988) evaluated Binford's utility indices. Metcalfe and Jones (1988: 486) agree that "the economic-utility indices provide archaeologists with a set of expectations about how different hunting and subsistence strategies should be reflected in the frequency of faunal elements in archaeological assemblages." However, they found the MUI, MI and consequently the MGUI indices to be unnecessarily complex. Metcalfe and Jones (1988) simplify the MUI index by using only the gross weight of the body part and the dry bone weight. Using the caribou data provided by Binford (1978), Metcalfe and Jones (1988: 489) demonstrate that similar economic utility rankings are produced by a simplified MUI formula and Binford's GUI. The simplified MUI formula is corrected for "riders" in the same manner as that used by Binford and the result is a economic utility index known as the food utility index (FUI) (ibid: 491). Metcalfe and Jones tested their FUI model against faunal remains recovered from Nunamiut kill-butchering sites and the results were found to be comparable to those produced by the MGUI model.

In deriving a simpler MI (marrow index) Jones and Metcalfe (1988: 416) consider only marrow cavity volume and the time required to extract the marrow. A strong linear correlation was noted when the marrow cavity volume is plotted against the %MAU represented by each element selected for processing. The correlation is not as strong when the percentage of oleic acid multiplied by the marrow cavity volume is plotted against the %MAU. Thus they concluded that the percentage of fatty acid was not an important factor in determining which bones would be selected for marrow processing (Jones and Metcalfe 1988: 419-420).

12.4 Brink and Dawe's Economic Utility Indices

Following Metcalfe and Jone's careful examination of Binford's utility indices and their suggestion that economic utility indices be developed for other animal species, Brink and Dawe (1989) devised a simplified grease index (GI) based on data obtained from bison elements. The sample from which the information was derived included three bison—a 5 year old male killed in November, a 3-5 year old male killed in April, and a 3.5 year old female killed in December (Brink and Dawe 1989: 125).

Once the long bones were cleaned of muscle, connective tissue, and fat they were divided into three segments consisting of the proximal articular end, the shaft portion, and the distal articular end. A hydraulic press was used to pulverize the bone segments. The amounts of fatty acids, dry bone, and moisture were measured for each bone portion. The fatty acids found within each sample were not separated into percentages of oleic acid and other acids as Binford had done. The size of the marrow cavities, as well as the weight of the marrow plug contained within the shafts were measured. The marrow plugs were homogenized and the percentage of total fatty acids contained within the marrow was determined for each sample (ibid.: 125-128).

Subsequently, Brink and Dawe (1989: 133-134) used the data from their bison study to derive a revised grease index. This index is a simplified version of Binford's and consists of the percentage of fatty acids multiplied by the bone volume, divided by 100. The revised grease index was tested on the bison faunal assemblage recovered from the processing area at Head-Smashed-In, as was Binford's GI. The result was a curvilinear correlation which exhibited a stronger relationship between the revised grease index and the frequency of element portions than did Binford's model (ibid.: 135).

A second index devised by Brink and Dawe (1989: 139-143) is the bone utility index (BUI). This index combines the bone marrow and bone grease values into a single index. The reasoning behind the development of such an index is that it is often difficult to distinguish between bone grease rendering and bone marrow extraction from the archaeological record. Complete shaft portions are rarely found at processing sites and shaft fragments are often difficult to identify as to skeletal element. The process of cracking bones to recover the marrow and smashing the articular ends for the rendering of grease is viewed as a continuum of the resource extraction process that cannot be divided into discrete activities (ibid.: 139). The BUI consists of multiplying the percentage of fatty acids by the bone portion volume and then dividing by 100. In determining the value of shaft portions the percentage of fatty acids in the bone tissue itself and the percentage of fatty acids contained in the marrow are added together (ibid.: 140).

12.5 Emerson's Economic Utility Indices

Emerson (1990) devised a series of body part utility models designed to rank the values of different bison carcass parts based on the amount of edible resources available. The models are based on quantitative data obtained from four bison—an adult 4 year old male killed in the spring, an adult 6-7 year old female killed in the spring, a juvenile 1.5 year old male killed in the fall, and an adult 16.5 year old female collected in the fall. It was noted that the older female was in poor nutritional condition due to abnormal dental wear and a deformed mandible (Emerson 1990: 86). The adult male killed in the spring was not fully mature which may result in lower product yields than a fully mature male (ibid.: 588). In order to construct the utility indices; various carcass components were analyzed including total meat and individual muscle weight, fat and other tissue weight, demuscled bone weight, bone marrow and bone grease weight, marrow cavity volume, dry bone weight, bone density and volume measurements (ibid.: 178).

The carcasses were skinned, eviscerated, the heads removed between the occipital condyles of the skull and the atlas, and then separated into right and left halves along the mid-line of the vertebral column. In analyzing the carcass components it was necessary to divide the halves into smaller units consisting of either single elements or sets of elements. For each unit the muscle was separated from the fat and fasciae and then weighed. Subcutaneous, intermuscular, and cavity fat were collected separate from muscle tissue to obtain a gross weight of the fat tissue for each carcass unit. Other tissue weight which included tendon, ligament, fasciae, and cartilage was also recorded for the carcass units. Each element or carcass unit was then stripped of meat, fat, ligaments, tendons and then weighed. This provided a demuscled bone weight that included cartilage, fresh bone, bone marrow, and bone grease.

In the collection of bone marrow data, Emerson divided the long bones into halves at the midpoint of the total length of the bone and designated the halves as either proximal or distal ends. In Brink and Dawe's (1989) study the proximal and distal ends of the long bone refer only to the articular ends. In one case, Emerson cracked the long bones from the left side of the older female with a hammer and anvil and the marrow was collected from the cavities and weighed. This latter procedure is closer to the method of marrow collection used by Brink and Dawe (1989).

The density and volume of each skeletal element was recorded as part of the study of bone grease production; however, as a direct measure of available bone grease, the elements were boiled and the grease was collected as the water cooled. Generally, elements were boiled whole, if they had not been halved during marrow collection, with holes drilled into the cancellous tissue of the articular ends to aid in the grease extraction process. The articular ends of the elements from the left side of the older female were crushed using a hammer and anvil prior to boiling to increase the amount of exposed surface area, thus facilitating the rendering of the bone grease. Dry bone weights were recorded after the bones were thoroughly degreased and dried. The percentage of moisture and fat was determined for homogenized samples of meat, marrow, and grease.

Emerson (1990: 215) notes that the distinction which archaeologists make between fat found in the medullary cavities of bone (bone marrow) and that found in the cancellous bone (bone grease) is one that is based on the processing methods used to recover the fat. Both bone marrow and bone grease are made up of fatty acids and they differ only in the composition of the fatty acids (percentages of oleic, stearic, myristic, and palmitic acids). Rather than stressing the percentage of oleic acid represented in the total fatty acids and thus the quality, Emerson (1990: 217) regards fat composition and how it is related to fat mobility and thus quantity to be the important factor; (fat mobility refers to the conversion of fat into energy under conditions of nutritional stress). Emerson (1990: 231-232) concluded that marrow fat of appendicular elements is more stable than that of axial elements.

Using the quantitative data obtained from this study Emerson devised 50 bison utility models (ibid.: 599-601). There are several important differences between the economic utility models developed by Emerson and those discussed previously. The standard of measure used by Emerson (1990: 606) in the construction of the majority of the models is caloric yield rather than product weight yield. Specific data concerning the economic utility of complete elements, as well as proximal and distal element portions are available. The models are based on quantity of products rather than quality and cost of resource extraction. Finally, three different types of utility models—single class, averaged, and mixed class—are produced which take into account age, sex, and condition of the assemblage being analyzed (ibid.: 615-617). Averaged models are those in which the data from the four bison are averaged to produce a general indication of economic utility. Single class models are based on the data of each individual bison and they are designed to evaluate assemblages dominated by either immature males, young adult males, adult females, or adult females in poor nutritional condition. Mixed class models combine the data from two classes of animals, e.g., young adult males and adult females.

12.6 Application of the General Utility Index to the Bushfield West Assemblage

Utility indices are applied to the assemblage of bison specimens recovered from Bushfield West in order to gain some insight into the processing decisions undertaken at the site. A minimum number of 19 bison are represented in the assemblage. The MNI estimate is based on the recovery of 19 left radial carpals. The bison material from Block 1, Block 2, and Block 3 are combined and examined as a single assemblage. All of the specimens are summarized by NISP, MNE, MNI, MAU, and %MAU counts in Table 12.1. The frequency of bison specimens as expressed by %MAU is the specified manner of quantifying assemblages when employing economic utility indices to interpret assemblage composition.

Emerson's (1990: Table 8.6) standardized modified averaged data total products model, (S)MAVGTP, is used as a measure of general economy utility. The reason for selecting the averaged data model is that the bison assemblage represented at Bushfield West is a mixture of adult males, adult females, and immature animals. Although a gender analysis of long bone portions and carpals and tarsals was undertaken the number of elements that could be assigned to a specific gender is low compared to the frequency of specimens represented at the site. Therefore, if mixed class and single class utility models are used, only a small portion of the assemblage can be included in the analysis. The total products model represents the caloric yield of all products associated with each carcass unit.

Table 12.1 Bushfield West Bison Assemblage

Element	NISP	MNE	MNI	MAU	%MAU
Skull:					
-petrous	9	7	4	3.50	33.33
-other	38	8	4	4.00	38.10
Mandible:					
-cor. process	15	9	7	4.50	42.86
-condyle	13	12	6	6.00	57.14
-asc. ramus	20	11	7	5.50	52.38
-diastema	14	13	8	6.50	61.90
Vertebrae:					
-axis	2	1	1	1.00	9.52
-cervical	1	1	1	0.14	1.33
-thoracic	5	2	1	0.14	1.33
Hyoid	8	5	3	2.50	23.81
Scapula:					
-glenoid	12	10	7	5.00	47.62
-other	3	1	1	0.50	4.76
Humerus:					
-proximal	2	2	2	1.00	9.52
-shaft	14	6	4	3.00	28.57
-distal	21	14	9	7.00	66.67
Radius:					
-proximal	31	21	12	10.50	100.00
-shaft	12	5	3	2.50	23.81
-distal	30	15	9	7.50	71.43
Ulna:					
-proximal	28	18	12	9.00	85.71
-shaft	11	4	3	2.00	19.05
-distal	13	12	10	6.00	57.14
Carpals:					
-radial	21	21	19	10.50	100.00
-internal	15	14	12	7.00	66.647
-ulnar	15	15	13	7.50	71.43
-fused 2nd/3rd	11	11	9	5.50	52.38
-unciform	17	17	13	8.50	80.95
-accessory	7	7	5	3.50	33.33
5th metac.	5	3	3	1.50	14.29
Metacarpal:					
-proximal	20	14	11	7.00	66.67
-shaft	8	4	3	2.00	19.05
-distal	12	11	6	5.50	52.38
Innominate:					
-acetabul.	24	12	6	6.00	57.14
-other	5	1	1	0.50	4.76
Femur:					
-proximal	3	2	1	1.00	9.52
-shaft	4	3	2	1.50	14.29
-distal	4	3	3	1.50	14.29
Patella	10	10	8	5.00	47.62
Tibia:					
-proximal	3	2	1	1.00	9.52

Table 12.1 (Continued)

Element	NISP	MNE	MNI	MAU	%MAU
-shaft	18	7	4	3.50	33.33
-distal	22	19	13	9.50	90.48
Lat. mall.	19	19	8	9.50	90.48
Tarsals:					
-calcaneus	17	15	8	7.50	71.43
-astragalus	16	16	12	8.00	76.19
-fused cen/4th	17	15	9	7.50	71.43
-fused 2nd/3rd	12	12	6	6.00	57.14
1st tarsal	6	6	2	3.00	28.57
2nd metat.	3	3	3	1.50	14.29
Metatarsal:					
-proximal	17	16	11	8.00	76.19
-shaft	17	4	3	2.00	19.05
-distal	9	9	6	4.50	42.86
1st phalanx	87	61	8	7.625	72.61
2nd phalanx	70	59	8	7.375	70.24
3rd phalanx	58	53	7	6.625	63.10
S. med. ses.	41	37	5	4.625	44.05
S. lat. ses.	31	30	4	3.75	35.71
Infer. ses.	24	20	3	2.5	23.81

Although utility values for vertebrae and ribs are provided they are not used in the analysis since very few of these specimens can be identified as bison. Emerson (1990: 172) considers the skull (without the brain), mandible (minus the tongue), and the hyoid to be a single carcass unit, therefore, separate utility values are not presented for the mandible and the cranium. The radius and ulna are also identified as a one carcass unit, as are all of the carpals, all of the tarsals, and the sacrum and pelvis. In calculating the frequency of elements represented in the Bushfield West assemblage the mandibles, cranium, each of the carpals and tarsals, the sacrum and innominate are counted as separate elements or specimens. NISP, MNE, MNI, MAU, and %MAU values are determined independently for each specimen. For the (S)MAVGPT model, the element associated with the highest %MAU value is used to represent carcass units which consist of more than one element; i e., mandible, radius, radial carpal, and astragalus. As is the case for the majority of vertebrae, the sacrum is highly fragmented and cannot be identified as to species. It is not used in the analysis; however, the economic utility value for the sacrum/innominate carcass unit is used in association with the %MAU value of the innominate. Utility values for the long bones are presented for proximal and distal portions which, as explained previously, consist of the long bone divided at the mid-point and each half designated as either the proximal or distal portion. The analysis is therefore run using the %MAU of long bone proximal and distal ends and not shaft segments. Emerson provides utility values for anterior phalanges and posterior phalanges, but does not differentiate between 1st, 2nd, and 3rd phalanges. In the quantification of the Bushfield West bison assemblage specific counts are provided for 1st, 2nd, and 3rd phalanges; however, no attempt was made to differentiate between anterior and posterior phalanges. Therefore, phalanges are not included in the economic utility analysis. The %MAU of Bushfield West bison specimens and the (S)MAVGTP values are presented in Table 12.2.

Table 12.2 Bushfield West Bison %MAU and Associated (S)MAVGTP Values

Element	%MAU	%MAU Rank	(S)MAVGTP Value	(S)MAVGTP Rank
Mandible	61.90	9.0	14.20	8.0
Scapula	47.62	6.0	31.60	12.5
Hum. P.	9.52	2.0	31.60	12.5
Hum. D.	66.67	10.5	25.10	10.0
Rad. P.	100.00	16.5	16.50	9.0
Rad. D	71.43	12.0	12.10	6.0
R. Carpal	100.00	16.5	6.60	4.0
Metac. P.	66.67	10.5	3.90	2.0
Metac. D.	52.38	7.0	2.60	1.0
Pelvis	57.14	8.0	54.70	15.0
Fem. P.	9.52	2.0	69.40	16.5
Fem. D.	14.29	4.0	69.40	16.5
Tib. P.	9.52	2.0	40.80	14.0
Tib. D.	90.48	15.0	25.50	11.0
Astragalus	76.19	13.5	13.60	7.0
Metat. P.	76.19	13.5	7.50	5.0
Metat. D	42.86	5.0	4.50	3.0

The graph of (S)MAVGTP economic utility values plotted against the %MAU for bison mandibles and appendicular specimens is shown in Figure 12.1. The frequencies of bison specimens and the corresponding utility values are negatively correlated (using Spearman's Correlation Coefficient $r=-0.48$, $P<0.05$, >0.01; $N=17$). The graph demonstrates that the relationship is a reverse utility curve or is indicative of a bulk processing strategy in which specimens of lower economic value were recovered in greater proportions than specimens of higher economic value. While the relationship is not considered perfect, because of the large number of specimens concentrated in the upper left and middle area of the graph, it does show that specimens were processed to obtain the maximum resource yield. Specimens ranked as having the highest total product yield—the proximal and distal femoral portions—were the least commonly recovered. Specimens possessing lower total product yield—radial carpal, proximal radius, proximal metatarsal, astragalus, etc.—were found in increasingly greater numbers. In comparison to other specimens of similar economic value, the pelvis appears to be over-represented and the proximal humerus appears to be under-represented. Radial carpals and proximal radii were the most commonly recovered specimens yet there is a large difference in their total product yields indicating that fewer proximal radii should be found. While examining the relationship between total product yield and the frequency of recovered specimens it should be kept in mind that there are other agents that are capable of creating patterns similar to those interpreted to be the result of humans extracting the greatest amount of food value from animal carcasses (Brink and Dawe 1989: 130).

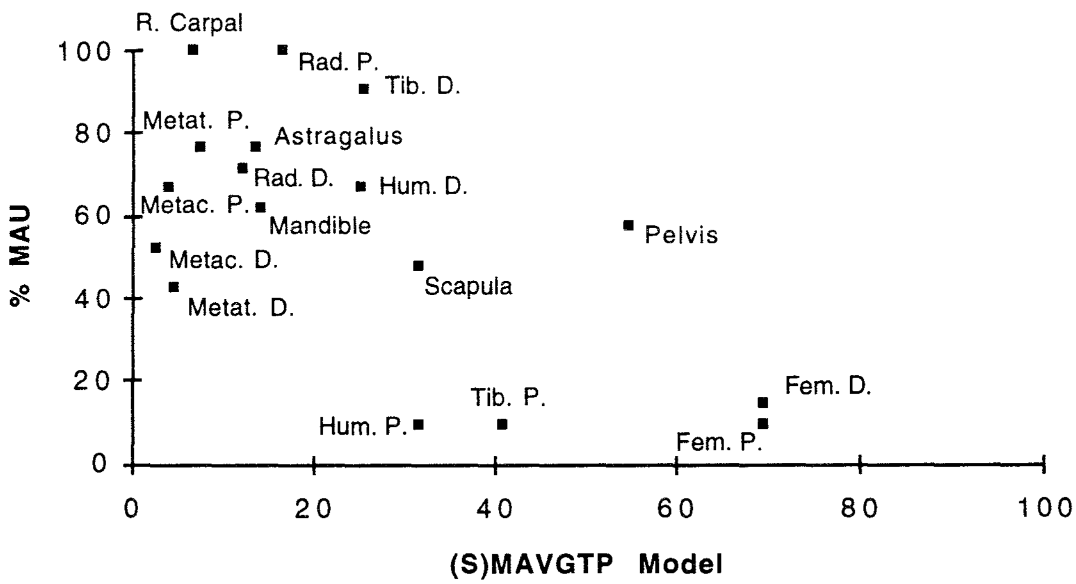

Figure 12.1 (S)MAVGTP Economic utility values plotted against %MAU.

12.7 Bone Marrow and Bone Grease Analyses

Speth (1983: 144) emphasized the importance of fat as a food resource and suggested that "fat levels in an animal were of more than incidental importance" often playing an important role in the selection decisions made by hunters and gatherers with respect to herd, animal, and carcass portions. The fatty acids within bone marrow and bone grease are a major source of food energy providing over twice as many calories per gram than either protein or carbohydrates. Essential fat-soluble vitamins A, D, E, and K are also found within fat, and bone marrow is suggested to be a major source of vitamin C (ibid.: 148-149). A diet consisting of only lean meat leads to nutritional stress and eventually a condition termed "protein poisoning". One other important aspect of a diet that consists mostly of protein is the amount of energy needed to metabolize protein as compared to fat or carbohydrates (ibid.: 153).

Emerson's (1990: Appendix C, Table 17) standardized modified averaged grease fat model (abbreviated as (S)MAVGGRE), as well as Brink and Dawe's (1989: Table 20) revised grease index are employed to determine if specific bison elements represented at Bushfield West were being selected for grease rendering. The major differences between Emerson's model and Brink and Dawe's revised index are in sample composition, the method used to determine proximal and distal element portions, and the unit of measurement by which product yield is expressed. Emerson's sample consists of four bison of varying age, sex, and nutritional condition. Brink and Dawe's sample consists of three bison: two males and one female of varying ages and presumably nutritional condition since they were killed at different times of the year. In a comparison of the marrow fat content between the two samples Emerson (1990: 324) notes that the marrow fat values from her sample are lower than those reported by Brink and Dawe. She attributes the differences to either normal population variability or a greater degree of nutritional stress in the four bison selected for her study. The method of defining proximal and distal portions is significantly different in that Emerson (1990: 183) includes portions of the shaft in her divisions, while Brink and Dawe (1989: 125) include only the articular ends. Emerson's models of carcass unit utility are based upon measures of caloric yield while Brink and Dawe's index is based upon a measure of weight per volume yield. Emerson's yield values are standardized, whereas Brink and Dawe's are not.

Table 12.3 presents the %MAU of Bushfield West appendicular elements and Emerson's associated (S)MAVGGRE values. The (S)MAVGGRE includes the caloric yields of both yellow and white grease. Grease index values are not provided for the skull or mandible; therefore, they are dropped from the study.

Figure 12.2 shows the (S)MAVGGRE values plotted against the %MAU of bison appendicular specimens. The frequency of recovered bison specimens and the grease values exhibit a strong negative correlation (using Spearman's Correlation Coefficient $r=-0.88$, $P<0.01$; $N=16$) indicating an unbiased strategy of resource extraction in which elements were selected for processing in relative proportions to their grease index values. Graphically, the spread of points suggests that there are several specimens that are either over or under-represented at the site. Four specimens—the distal femur, proximal femur, proximal humerus, and proximal tibia—are associated with high grease yields and were rarely recovered at Bushfield West suggesting that they may have been selected specifically for grease rendering. Although the pelvis has a high grease index value it appears to have been only moderately selected for grease processing. The remaining specimens are grouped together in the central area of the graph.

Table 12.3 Bushfield West Bison %MAU and Associated (S)MAVGGRE Values

Element	%MAU	%MAU Rank	(S)MAVGGRE Value	(S)MAVGGRE Rank
Scapula	47.62	6.0	43.60	6.0
Hum. P.	9.52	2.0	71.80	13.0
Hum. D.	66.67	9.5	58.50	11.0
Rad. P.	100.00	15.5	51.90	9.0
Rad. D	71.43	11.0	48.50	7.0
R. Carpal	100.00	15.5	38.20	4.0
Metac. P.	66.67	9.5	33.00	2.0
Metac. D.	52.38	7.0	30.40	1.0
Pelvis	57.14	8.0	97.60	14.0
Fem. P.	9.52	2.0	100.00	15.5
Fem. D.	14.29	4.0	100.00	15.5
Tib. P.	9.52	2.0	71.70	12.0
Tib. D.	90.48	14.0	56.90	10.0
Astragalus	76.19	12.5	49.60	8.0
Metat. P.	76.19	12.5	38.90	5.0
Metat. D	42.86	5.0	33.50	3.0

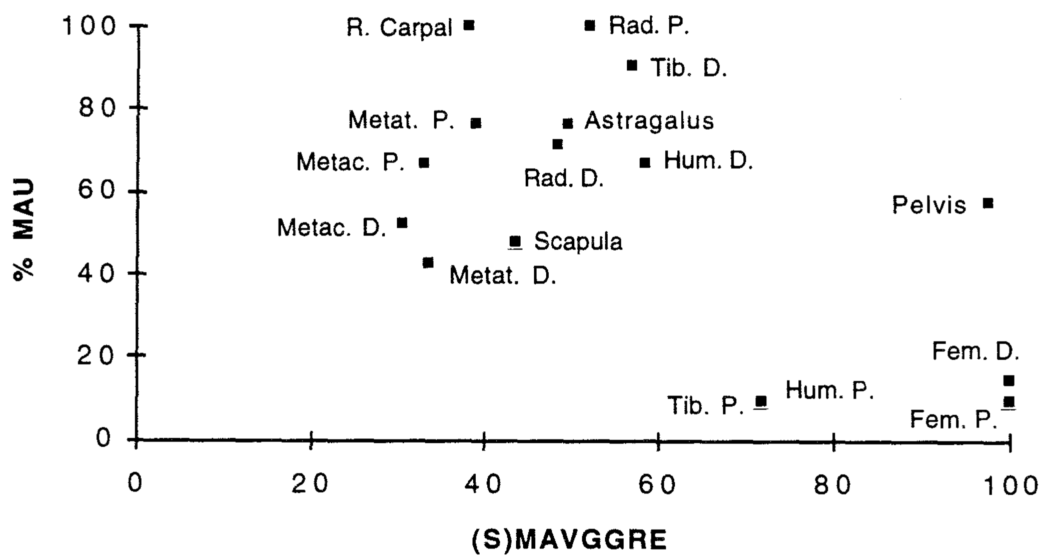

Figure 12.2 (S)MAVGGRE economic values versus %MAU.
*Note the proximal tibia and proximal humerus are represented by the same point on the graph.

The second assessment of the bison specimens recovered at Bushfield West regarding grease processing activities uses Brink and Dawe's revised grease index. The frequency of bison specimens is again expressed as %MAU. Grease index values are only provided for appendicular long bones; therefore, the scapula, pelvis, radial carpal, and astragalus are dropped from the analysis (Table 12.4).

Table 12.4 Bushfield West Bison %MAU and Revised Grease Index Values

Element	%MAU	%MAU Rank	Grease Index Value	Grease Index Rank
Hum. P.	9.52	2.0	241.48	1.0
Hum. D.	66.67	7.5	64.12	5.0
Rad. P.	100.00	12.0	42.71	7.0
Rad. D	71.43	9.0	49.73	6.0
Metac. P.	66.67	7.5	6.76	12.0
Metac. D.	52.38	6.0	14.58	9.0
Fem. P.	9.52	2.0	112.41	3.0
Fem. D.	14.29	4.0	186.30	2.0
Tib. P.	9.52	2.0	96.82	4.0
Tib. D.	90.48	11.0	12.22	10.0
Metat. P.	76.19	10.0	7.44	11.0
Metat. D	42.86	5.0	20.07	8.0

Figure 12.3 shows the relationship between the frequency of long bone proximal and distal portions and the revised grease index. Graphically, the relationship is a reverse utility curve in which the specimens that have high grease indices were rarely found while those with low grease indices were found in increasingly greater numbers. A negative correlation that is significant at the 0.05 level exists between the %MAU and the revised grease index (using Spearman's Correlation Coefficient $r=-0.69$, $P<0.05$; $N=12$). Using Brink and Dawe's revised grease index there is a close fit between the expected frequency of specimens with the largest quantity of grease and the frequency at which these specimens were actually recovered from the site. The proximal humerus, distal femur, proximal femur, and proximal tibia contain the highest grease reserves and were rarely found at the site. The proximal metacarpal, proximal metatarsal, and distal tibia possess the lowest grease yields and were the most commonly recovered specimens. The proximal radius, distal radius, and distal humerus appear to be over-represented at the site. However, Brink and Dawe (1989: 135-136) again caution that the reverse utility curve depicted in the graph of the revised grease index versus %MAU can also be created by other agents and it "is not proof of a causal relationship."

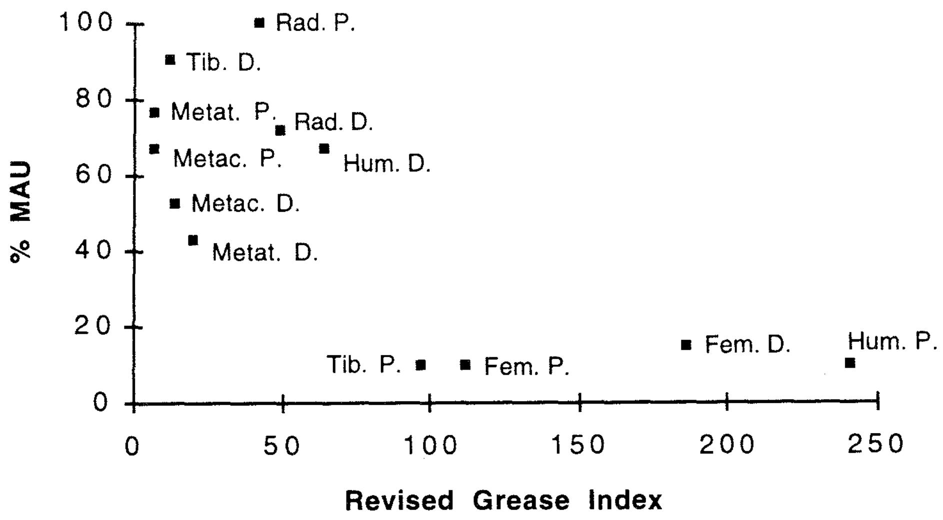

Figure 12.3 Revised grease index versus %MAU of long bone proximal and distal portions.

The differences in the relationship between %MAU and grease yield as shown in the two models may be due to differences in model construction. Emerson (1990: 608-615) compared the rank order of carcass units in caloric yield to the rank order in weight yield and did not note any significant changes in unit values. Therefore, the unit used to measure grease yield does not appear to account for the differences shown in the graphs. The differences in the composition of the samples from which the data was obtained to construct the models may be a factor in the differing results. The sample that Brink and Dawe used may be a more accurate reflection of the population—with respect to age, gender, and nutritional condition—from which the bison at Bushfield West were selected.

Possible explanations suggested by Emerson (1990: 669-670) for deviations from the expected pattern as a result of the application of a model to an assemblage include the following: (1) inappropriate selection of model type (e.g., if an averaged model is used to assess an assemblage dominated by males); (2) differences between carcass units identified in the model and those determined by butchering processes at the site; (3) differences between predicted and actual transportation and processing decisions; (4) insufficient data to detect differences in the treatment of animals based on age and sex; and (5) inappropriate application of specific models with regard to the specific product upon which extraction efforts are focused. Unfortunately, it is impossible to assess the validity of most of these explanations for the failure of a model to accurately predict the recovery of elements at a site. Density-mediated destruction of certain elements is also another factor which may affect the shape of the utility curves.

The bison assemblage at Bushfield West can also be assessed using utility indices to determine if marrow extraction was an important activity. Emerson (1990: Appendix C, Table 12) designed her marrow utility index, (S)MAVGMAR, to be comparable to Binford's marrow index (MI) by separating the marrow content of long bones into proximal and distal halves. However, using %MAU based upon proximal and distal ends of elements in the assessment of marrow processing activities may not be an accurate representation of the frequency of elements that were actually selected for their marrow content. In reviewing Binford's marrow index, Brink and Dawe (1989: 137) comment that "it is highly unlikely that any hunter would crack open a long bone, remove the marrow from one half and throw the other half away." They also argue that the frequency with which the articular ends of long bones are recovered at a site does not necessarily indicate which elements were selected for marrow processing. A more accurate measure of marrow extraction would be provided by the percentage of complete shafts as opposed to fractured shafts (Brink and Dawe 1989: 138). As was the case for the processing area at Head-Smashed-In, very few complete shafts are present in the assemblage from Bushfield West. This seems to indicate that they were either smashed as part of the grease rendering process, elements were selected for marrow content with little regard for the yield provided by each element, or that factors other than those mentioned contribute to the destruction of element shaft portions. Brink and Dawe (1989: 139) could not devise a way to quantify elements that may have been selected for marrow processing so they did not develop a separate marrow index for bison.

Emerson's (S)MAVGMAR values and the %MAU for Bushfield West bison specimens are presented in Table 12.5.

Table 12.5 Bushfield West Bison %MAU and Associated (S)MAVGMAR Values

Element	%MAU	%MAU Rank	(S)MAVGMAR Value	(S)MAVGMAR Rank
Scapula	47.62	6.0	36.90	6.0
Hum. P.	9.52	2.0	71.50	12.0
Hum. D.	66.67	9.5	69.20	11.0
Rad. P.	100.00	15.5	68.00	10.0
Rad. D	71.43	11.0	50.30	8.0
R. Carpal	100.00	15.5	36.20	5.0
Metac. P.	66.67	9.5	29.20	4.0
Metac. D.	52.38	7.0	18.20	2.0
Pelvis	57.14	8.0	10.20	1.0
Fem. P.	9.52	2.0	97.20	14.0

Table 12.5 (Continued) Element	%MAU	%MAU Rank	(S)MAVGMAR Value	(S)MAVGMAR Rank
Fem. D.	14.29	4.0	98.20	15.0
Tib. P.	9.52	2.0	100.00	16.0
Tib. D.	90.48	14.0	84.50	13.0
Astragalus	76.19	12.5	55.20	9.0
Metat. P.	76.19	12.5	40.60	7.0
Metat. D	42.86	5.0	25.20	3.0

Figure 12.4 shows the relationship between the (S)MAVGMAR values and the %MAU of bison specimens from Bushfield West. Three specimens associated with high marrow index values—proximal tibia, proximal femur, and the distal femur—were the least frequently recovered specimens. However, the remaining specimens are spread over the central upper portion of the graph showing no apparent relationship between the frequency with which they were recovered at the site and their assigned marrow index values. Using the Spearman's rank order correlation coefficient there is no significant correlation between %MAU and the (S)MAVGMAR model (r= 0.03, N=16).

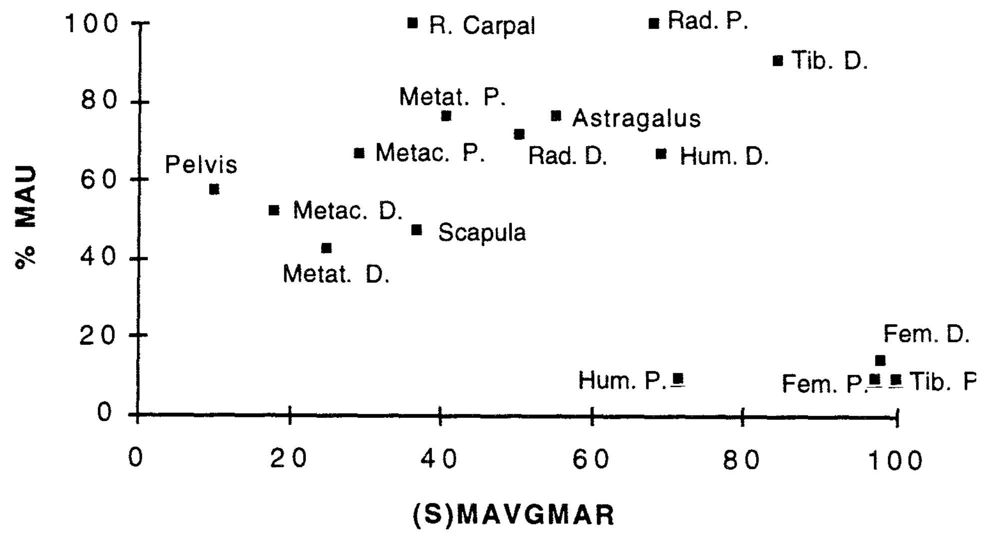

Figure 12.4 (S)MAVGMAR economic utility values versus %MAU

Although Brink and Dawe (1989: 140-143) did not develop a revised bone marrow index they did present data and values for a bone utility index (BUI). This index combines the product values of bone grease and bone marrow associated with each proximal, shaft, and distal long bone portion. The index values for the articular portions are the same as those presented in the revised grease index model showing that the marrow data for the articular ends of long bones does not alter the index values. The shaft marrow data incorporates the percentages of fats found in the bone tissue and the percentages of fat in the marrow removed from the shaft cavity. Following Brink and Dawe's reasoning that marrow processing and grease rendering represent a continuous activity which cannot be shown as separate stages in the archaeological record, their bone utility index (BUI) is applied to the Bushfield West bison assemblage. The %MAU of proximal, shaft, and distal long bone portions, as well as the associated fatty acid index values are presented in Table 12.6.

Table 12.6 Bushfield West Bison %MAU and Associated BUI Values

Element	%MAU	%MAU Rank	Index Value	Index Rank
Hum. P.	9.52	2.0	241.48	18.0
Hum. S.	28.57	9.0	110.80	13.0
Hum. D.	66.67	13.5	64.12	10.0
Rad. P.	100.00	18.0	42.71	8.0
Rad. S.	23.81	8.0	82.71	11.0
Rad. D	71.43	15.0	49.73	9.0
Metac. P.	66.67	13.5	6.76	1.0
Metac. S.	14.29	5.5	19.07	5.0
Metac. D.	52.38	12.0	14.58	4.0
Fem. P.	9.52	2.0	112.41	14.0
Fem. S.	14.29	5.5	142.43	16.0
Fem. D.	14.29	5.5	186.30	17.0
Tib. P.	9.52	2.0	96.82	12.0
Tib. S.	33.33	10.0	122.11	15.0
Tib. D.	90.48	17.0	12.22	3.0
Metat. P.	76.19	16.0	7.44	2.0
Metat. S.	14.29	5.5	34.92	7.0
Metat. D	42.86	11.0	20.07	6.0

Figure 12.5 shows the relationship between the %MAU and the BUI to be a reverse utility curve. Specimens having a high combined yield of marrow and grease were rarely found, while those with lower values were found in increasingly greater numbers. Outliers from the curve appear to be metacarpal and metatarsal shafts which are under-represented and the distal humerus, distal radius, and proximal radius which are over-represented. Brink and Dawe's bone utility index correlates significantly and negatively with the frequency of long bone portions recovered from Bushfield West using the Spearman's Correlation Coefficient ($r=-0.64$, $P<0.01$, $N=18$). The predicted recovery of element portions based on the bone utility index closely matches the actual frequency of specimens found at the site.

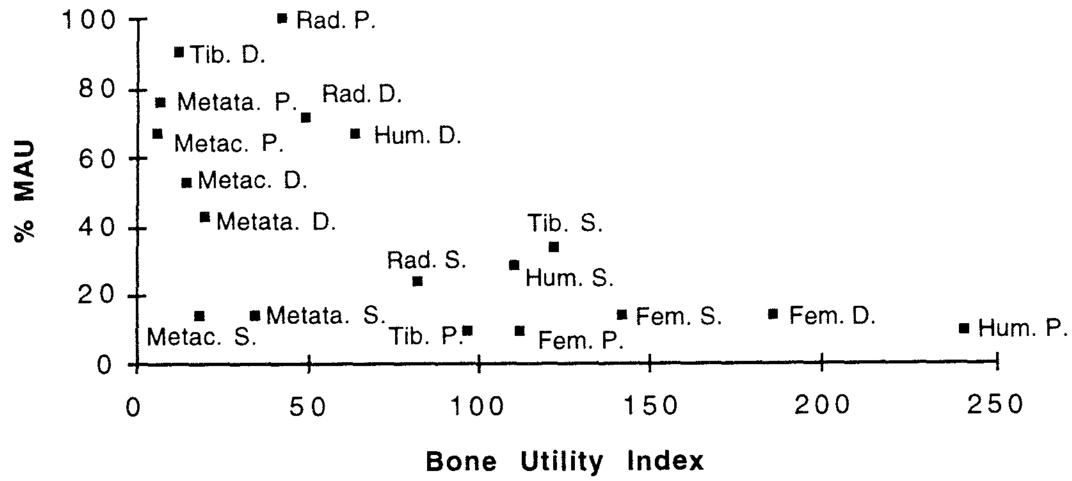

Figure 12.5 Bone utility index economic values versus %MAU.

12.8 Discussion and Summary of Utility Indices

A bulk recovery strategy is suggested for the appendicular specimens when the (S)MAVGTP model is applied to the Bushfield West bison data. Specimens associated with high total product yields were rarely recovered, while specimens of low total product yield were recovered in much higher frequencies. This is particularly true of the proximal and distal femur portions, the proximal tibia, and the proximal humerus which have low %MAU counts and high total product values. However, the innominate and scapula are over-represented according to their index values. The %MAU is based on the recovery of acetabulum portions rather than the ilium, ischium, or pubis. If the %MAU had been based on the other portions the %MAU value would drop from 57.14 to 4.76 bringing the innominate in line with other elements of high total product yield. The scapula has relatively low grease and marrow yields but relatively high meat yields; therefore, its value may be overestimated if the focus is on the recovery of the greatest quantity of all resources. The cluster of low utility elements in the upper left corner of the (S)MAVGTP model graph rather than a smooth curve does suggest that there are other problems with the fit of the model to the assemblage.

Models with a narrower focus than the total products model are used to determine if the extraction of specific resources—marrow, grease, or both—were undertaken at the site. When Emerson's (S)MAVGGRE model was applied to the assemblage this resulted in a distribution similar to that of the (S)MAVGTP model. In general, all of the specimens are associated with higher yield values using the grease index model than the total products model. This results in the specimens being distributed between the 30 to

100 range along the grease scale as opposed to the 0 to 70 range on the total product scale. Also the group of low value specimens is not as tightly clustered. The relationship between the %MAU and the grease yields is one in which specimens associated with high yields were being selected for grease rendering, resulting in their destruction and removal from the assemblage. Specimens associated with lower grease yields were less frequently selected and were thus more commonly recovered at the site.

Brink and Dawe's revised grease index is also used to assess the bison assemblage from Bushfield West. The revised grease index fits closely with the frequency of recovered specimens resulting in a reverse utility curve. The proximal humerus, distal femur, proximal femur, and proximal tibia were specifically selected for grease processing and were, therefore, rarely recovered at the site. The remaining lower index specimens were found in rapidly increasing frequencies. Three outliers—the proximal radius, distal radius, and distal humerus—appear to be over-represented.

Emerson's (S)MAVGMAR model is used to assess the extent to which elements were selected for marrow processing. The result of plotting %MAU against the (S)MAVGMAR values are two loosely associated clusters. Rarely recovered specimens are again the proximal and distal femur portions, the proximal tibia, and the proximal humerus. This suggests that they may have been selected for bone marrow extraction based on their corresponding high marrow yields. The remaining specimens are scattered in the upper central area of the graph. Using the Spearman's Correlation Coefficient it was determined that a significant correlation does not exist between the %MAU and the (S)MAVGMAR values. The problem with this model may reside in the construction of the model, since the marrow values are based on proximal and distal portions rather than the shaft segments, as well as demonstrating that the %MAU based on proximal and distal portions may not accurately reflect the frequency of elements selected for marrow processing.

The application of Brink and Dawe's bone utility index (BUI) to the %MAU demonstrates a close fit between the frequency with which specimens were recovered and their associated index values. A bulk selection strategy is suggested by the recovery of higher percentages of specimens that are assigned low utility marrow and grease values and a low rate of recovery of specimens assigned high utility marrow and grease values. The proximal radius, distal radius, distal humerus, and possibly the tibia shaft appear to be over-represented, while the metacarpal and metatarsal shafts are under-represented. The low number of identified metapodial shaft portions as compared to tibia and humerus shafts may be due to the fact that the tibia and humerus shafts possess a greater number of distinguishing landmarks which aid in their identification.

In general, a much stronger relationship exists between Brink and Dawe's revised grease index and bone utility index and the Bushfield West assemblage than was achieved using Emerson's (S)MAVGTP, (S)MAVGGRE, and (S)MAVGMAR models. This may be due to the differences in the bison samples from which the data used to construct the models was obtained. It may also be a result of the manner in which the models were constructed. It is suggested that the bison population represented at Bushfield West more closely reflects the bison sample from which Brink and Dawe obtained their data with regard to age, sex, and nutritional condition. Also, the means of determining anatomical frequency of specimens (particularly the articular ends of long bones) represented at Bushfield West corresponds closely with the methods used by Brink and Dawe at Head-Smashed-In.

12.9 Structural Density of Bison Bones and Survivorship

Lyman (1994a: 235) cautions that skeletal part frequencies which are attributed to transport and processing decisions may often be a result of differential skeletal preservation or survivorship. Research has focused on the identification of the taphonomic processes which destroy bones—carnivore consumption, fracturing and crushing of bones by humans to obtain marrow and grease, trampling by humans and animals, fluvial transport, weathering, and sediment loading—and the physical properties of bone which mediate these effects—bone porosity, morphology, size and mineral density (Shipman 1981: 21; Lyman 1982: 43-71; Kreutzer 1992: 271). Initial research concentrated on the relationship between bone mineral density and survivorship. However, Shipman (1981: 23-24) contends that what was being measured as "bone density" (the ratio of weight to volume) was actually "bone composition" (the ratio of spongy bone to compact bone). In defining bone density Lyman (1982: 76-77) distinguishes between "true density" and "bulk density". True density is a ratio of weight to the volume of solid bone that excludes the volume of the pore spaces. Bulk density is a ratio of weight to the volume of solid bone plus pore space volume.

Lyman (1982: 86) measured the bone density of the skeletons of 13 deer, three domestic sheep, and one (partial) pronghorn antelope. Measurements of bone mineral densities were taken at one or more scan sites for each element (ibid: 93-94). The locations of the scan sites were chosen for the following reasons: intra-element structural variation; ease of identifying scan site position to ensure comparable scan site locations on similar elements of different individuals; suspected or known differences determined by previous studies; and obvious discrepancies between the frequencies of various skeletal elements recovered at archaeological and paleontological sites (ibid.: 92). The property that Lyman intended to measure was bulk density (expressed as g/cm^3); therefore, it was necessary to include scan site thickness, as well as area, in the equation used to calculate bone density. It is assumed that bulk density rather than true density provides a more accurate prediction of survivorship since it takes into account pore space and surface area. The greater the porosity of a bone, the larger the surface area per unit volume that is exposed to the mechanical and chemical effects of attrition (ibid.: 122). The model devised by Lyman hypothesizes that the bulk density of bones mediates the effects of most taphonomic processes. The model was tested using data from paleontological, archaeological, and ethnoarchaeological contexts resulting in accurate predictions of the relationship between the bulk density of bones and the frequency of bones represented in each situation.

Researchers have applied Lyman's bone density model to archaeological assemblages in order to assess the frequency of skeletal elements recovered. Generally, this has involved the application of deer bone density data to assemblages which consist of artiodactyl remains that are not deer. Kreutzer (1992: 272-274) disagrees with the assumption that bone density data obtained from small cervids is appropriate for the investigation of assemblages consisting of other taxa, specifically bison because of differences in the skeletal structure. Structural differences attributed to increased body size include an increase in the ratio of element thickness to element length, straighter bone shafts, and a more vertically oriented pelvis. There are also fundamental differences in the means of locomotion or gait due to leg length and body mass which result in structural dissimilarities. Smaller cervids that are structurally designed for speed and agility must withstand greater forces that are applied to the lower limb bones and joints. There are also obvious differences in body proportions, with bison having massive skulls, large thoracic humps, and heavy forequarters. This results in differences in the structure of elements in the neck region of bison and deer.

Kreutzer (1992: 275-277) collected bone density data for 12 modern bison skeletons using scan site locations as defined by Lyman. Linear density (true density) and volume density (bulk density) measurements were derived in a manner similar to that of Lyman. One main difference is that Kreutzer (1992: 283) took several thickness or dimension measurements at each scan site and plotted the calculated areas on graph paper in determining volume density rather than using a maximum bone thickness measurement. This may result in more accurate measurements of volume densities.

As pointed out by Kreutzer (1992: 283), there is a major weakness in the manner in which volume density is measured by both herself and Lyman (1982). To account for the size of the marrow cavities of the long bone shafts, so that the dimension of the marrow cavity could be subtracted from the volume density measurement, would require the sectioning of the element so that the volume of the marrow cavity could be measured directly. However, this was not possible with the specimens that were used, resulting in volume density measurements that are consistently under-estimated.

Kreutzer (1992: 289-290) applied both deer bone density data and bison bone density data models to archaeological assemblages consisting of bison skeletal remains and noted that they produced contrasting results. This underlines the importance of concordance between models and data if valid interpretations are to be achieved.

In the analysis of bone structural density, MNE frequencies are converted to % survivorship. The reason for this is that the focus of the study is not on "how many bones there are, but on how many survived from the original carcasses, and a mammalian carcass has different MNE frequencies of different skeletal elements" (Lyman 1994a: 251). Lyman points out that the % survivorship value is the same as the %MAU value. It should also be noted that the structural density values are considered to represent points along an ordinal scale since they are derived from the average values of several individuals. These individuals are of different ages, sexes, and presumably nutritional status (ibid.: 252).

The relationship between the frequencies of bison skeletal elements recovered from Bushfield West and volume density is examined using %MAU for element portions and bone volume density data as measured by Kreutzer (1992: Table 2). The %MAU values and volume density values for each element are presented in Table 12.7. The selection of scan site and the corresponding volume density value is based on the portion that is used to determine MNE values. The MNE value of the scapula is based on the frequency of glenoid fossae and the closest corresponding scan site is SP1, just proximal to the glenoid fossa through the neck. The MNE value of the innominate is based on the occurrence of the acetabulum; therefore, the scan site selected for the innominate is AC1. Three scan sites are used for the long bones: one is representative of the proximal portion, the second for the shaft, and the third corresponds to the distal portion. For smaller bones including the carpals, tarsals, and phalanges which are generally recovered as complete elements, scan sites which transect the medial areas of the elements are used. The patella is not included in the study since Kreutzer (1992) does not provide scan site volume density data for this element.

Table 12.7 Bushfield West Bison %MAU and Volume Density

Element	%MAU	%MAU Rank	Volume Density	Volume Density Rank	Scan Site
Mand.	61.90	18.0	0.61	30.0	DN2
Hyoid	23.81	8.5	0.36	8.0	HYOID
Scapula	47.62	13.0	0.50	22.5	SP1
Hum. P.	9.52	2.0	0.24	1.0	HU1
Hum. S.	28.57	10.0	0.45	15.5	HU3
Hum. D.	66.67	21.0	0.38	9.0	HU5
Rad. P.	100.00	35.5	0.48	19.0	RA1
Rad. S.	23.81	8.5	0.62	31.0	RA3
Rad. D	71.43	25.5	0.35	6.5	RA5
Ulna P.	85.71	32.0	0.34	5.0	UL1
R. Carpal	100.00	35.5	0.42	12.0	SCAPHO
Int. C.	66.67	21.0	0.35	6.5	LUNAR
Ul. C.	71.43	25.5	0.43	13.0	CUNEIF
2nd/3rd C.	52.38	14.5	0.52	24.5	TRAPMAG
Un. C.	80.95	31.0	0.44	14.0	UNCIF
Metac. P.	66.67	21.0	0.59	29.0	MC1
Metac. S.	14.29	5.5	0.69	33.0	MC3
Metac. D.	52.38	14.5	0.53	26.5	MC6
Pelvis	57.14	16.5	0.53	26.5	AC1
Fem. P.	9.52	2.0	0.31	3.0	FE1
Fem. S.	14.29	5.5	0.45	15.5	FE4
Fem. D.	14.29	5.5	0.26	2.0	FE6
Tibia P.	9.52	2.0	0.41	10.5	TI1
Tibia S.	33.33	11.0	0.76	35.0	TI3
Tibia D.	90.48	33.5	0.41	10.5	TI5
Lat. mall.	90.48	33.5	0.56	28.0	LATMAL
Cal.	71.43	25.5	0.49	21.0	CA3
Astragalus	76.19	29.5	0.72	34.0	AS1
Cen./4th T.	71.43	25.5	0.77	36.0	NC3
2nd/3rd T.	57.14	16.5	0.50	22.5	2&3 CP
Metat. P.	76.19	29.5	0.52	24.5	MR1
Metat. S.	14.29	5.5	0.67	32.0	MR3
Metat. D	42.86	12.0	0.48	19.0	MR6
1st Phal.	72.62	28.0	0.48	19.0	P13
2nd Phal.	70.24	23.0	0.46	17.0	P23
3rd Phal.	63.10	19.0	0.32	4.0	P31

Figure 12.6 shows the volume density of the selected scan sites for each specimen plotted against the %MAU values. The majority of the points are clustered in the central area of the graph, as well as along the X axis. There are also a few points located on the right hand side of the graph. The plot does not reveal any apparent relationship between %MAU and volume density.

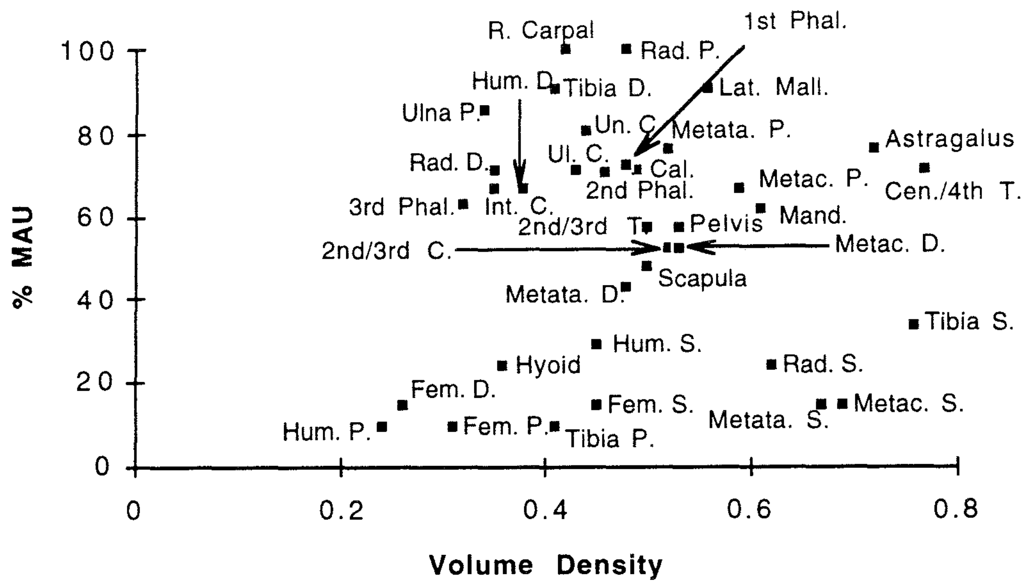

Figure 12.6 Volume density versus %MAU.

The %MAU for each specimen are compared statistically to the corresponding volume densities using Spearman's Correlation Coefficient and a significant correlation is not apparent (r=0.06, p>0.05, N=36). The assemblage is also separated into groupings of forelimb and hindlimb specimens in order to determine if bone mineral density plays a significant role in the frequencies with which each group of elements were recovered at the site. For the forelimb which consists of the scapula down to and including the metacarpal there is a negative correlation (r=-0.36, p>0.05, N=16). For the hindlimb, which consists of the innominate down to and including the metatarsal there is a positive correlation (r=0.41, p>0.05, N=15). It should be noted that in each instance neither of the correlations are significant at the 0.05 level. Therefore, the Bushfield West bison assemblage does not appear to be the result of density-mediated destruction.

The statistical correlation between %MAU and (S)MAVGTP is significant and negatively correlated, while the statistical correlation between %MAU and volume density is insignificant; therefore, the Bushfield West bison remains represents (according to Lyman's classification system) a Class 2 reverse utility assemblage (Lyman 1994a: 264). Grayson (1989: 647) notes that reverse utility curves produced by the human transport of skeletal parts are characterized by a combination of correlations just described. However, Bushfield West is a habitation site **to** which skeletal parts were transported not a kill/butchering site **from** which skeletal parts were transported. Therefore, the bison bone frequencies recovered at Bushfield West are more accurately described as resulting from human utilization. This interpretation is strengthened when the strongly significant correlations between %MAU and the revised grease index and between %MAU and the BUI are also taken into consideration. To state that weathering, carnivore consumption, and sediment compaction have not altered the bison specimens recovered at Bushfield West would be inaccurate since traces of such taphonomic processes have been recorded on a certain percentage of the assemblage. However, the results of the economic utility and volume density analyzes indicate that the natural taphonomic processes did not alter the bones to such a degree as to obscure the evidence of cultural modifications.

CHAPTER 13

Summary and Conclusions

13.1 Introduction

Bushfield West is a late precontact habitation site situated on a lower terrace of the Saskatchewan River near Nipawin in east central Saskatchewan. Four radiocarbon dates for the site provide an averaged date of 422.7 ± 40.0 rcybp (cal 529 [503] 335 BP) (Morlan 1993: 31). The distinctive ceramics, small side-notched projectile points, end scrapers, drills, adze blades, bone harpoons, bone whistles, shell beads, and pendants indicate that the site remains were produced by the ancestors of historic Cree groups (Gibson 1993: 100).

Between 1981 and 1984 a total of 624 square metres of the site were excavated. The main research objective associated with the excavation of Bushfield West was to expose large areas of the site's intact occupation in order to identify intra-site settlement patterns (Gibson 1994: 7). This was accomplished by employing a block excavation method in which extensive contiguous areas of the site were uncovered, photo-mapped. At Bushfield West 18 blocks varying in size from 4 m^2 to 234 m^2 were excavated; the largest excavation areas included Block 1 (95.5 m^2), Block 2 (234 m^2), and Block 3 (200 m^2).

The soil matrix from the excavation blocks was sifted through 6 mm screening mesh. A small portion of the matrix was water screened through 2 mm window screen mesh to recover microdebitage and microfauna. The excavation of the three largest block areas resulted in the retrieval of a substantial amount of faunal material; 108,135 specimens weighing 170.5 kg. The assemblage was subsequently subdivided into an unidentifiable component (93,545 fragments, 42.5 kg) and an identifiable component (14,590 specimens, 128.0 kg). The material recovered from the 6 mm screening process which was identifiable as to skeletal element and/or taxon is the focus of this thesis. A number of taxa are represented in the assemblage of identifiable material including at least 21 species of mammals, 10 species of birds, 11 species of fish, and one species of frog.

13.2 Interpretations of Bushfield West Fauna

Bison, beaver, fish, and grouse remains along with a few canid and leporid specimens are consistently found in each excavation block. Striped skunk is represented in Block 1 but not in Block 2 or Block 3. Bear was found in Blocks 1 and 3; however, not in Block 2. Lynx remains were recovered in Blocks 2 and 3 but not in Block 1. Marten is represented only in Block 2 and badger was found only in Block 3. Sauger and goldeye, found in Block 1, and goldeye, flathead chub, and burbot, recovered from Block 3, are rare occurrences represented by one or two specimens each. The remaining fish species (sturgeon, walleye, northern pike, white sucker, longnose sucker, silver redhorse, and shorthead redhorse) commonly occur in all three excavation blocks. The loon and one species of hawk, each represented by single elements, were found in Block 1. Three owl specimens were recovered from Block 2 but not elsewhere. Crane specimens were found in Blocks 2 and 3 but not Block 1. Grouse, waterfowl, and perching birds were commonly found in all three excavation blocks.

Analysis of the distribution of faunal material recovered from the three excavation blocks indicates that various activities were occurring throughout the site during its occupation. Within Block 1 heavy concentrations of a variety of faunal material are associated with a nuclear surface hearth located in the northwest corner of the block. Faunal material representing various species including a large number of beaver, bird and fish, as well as large ungulates was recovered from the hearth and the area surrounding it. The size of bone fragments found in association with the hearth ranged from 2-6 mm up to 100-200 mm. Some of the larger elements found in the area included three bison carpal articular units. Concentrations of debris were also found in areas 2 to 3 metres away from the hearth indicating that a certain amount of maintenance of the area surrounding the hearth had taken place.

Four smaller hearth features were uncovered in Block 1 and a variety of taxa were found in association with each hearth. One area of interest is associated with a small hearth on the north side of the block. A heavy concentration of large ungulate long bone articular portions was found immediately north of the hearth suggesting that bone grease rendering occurred in this area. The faunal assemblages associated with the remaining hearths appear to be quite similar to each other; generally dominated by large ungulate remains followed by beaver and then substantially smaller percentages of leporid, fish, and bird remains.

The faunal assemblage associated with a rock pit feature located on the east side of the block appears to have a slightly different composition than the assemblages identified with the hearth features. The faunal material consists primarily of beaver and a few bird and fish remains with very few large ungulate remains.

There are other areas of heavy concentrations of faunal material in Block 1 that are not associated with any visible features. The processing of large ungulate elements may have occurred in these areas or they may represent areas in which material was intentionally disposed of.

Fourteen hearths and two rock pit features were found in Block 2 and a wide variety of fauna is associated with each feature. A certain amount of spacial separation of the faunal material is apparent in one area on the west side of Block 2. This area is characterized by multiple features: a cluster of two hearths and one rock pit. Ungulate vertebral fragments were found either within or adjacent to one of the hearths and the rock pit. Beaver remains were found within the second hearth. Fish remains were located primarily to the west of the features; bison and unidentified ungulate axial and appendicular specimens were situated south and west of the hearth; and beaver and grouse were found in an area south of the hearth. There is also a certain degree of size sorting of the faunal material. The smaller debris was found within and around the features, while the larger debris was situated farther away to the north, south, and west of the features. This indicates that the area was probably used for an extended period of time and that a certain amount of maintenance was required, involving the collection and removal of larger pieces of bone.

The central area of Block 2 contained four hearths, three of which were found in close proximity to each other. Fish, beaver and snowshoe hare remains were found in association with two of the hearths indicating that they had been cooked, consumed and discarded in this area. A few large ungulate remains were found adjacent to the features; however, the majority of them were found in an arc surrounding the hearths on the east, south, west, and northwest, with a clear area to the northeast possibly indicating that the features were contained within a structure and that the larger debris had accumulated along the edges of the structure.

Two areas of Block 2; one in the northeast corner and the other in the southeast corner; are characterized by lower percentages of ungulate remains (38%-39%) and an almost equal percentage of fish (36%-39%) along with a significant number of bird and beaver specimens. The first area contains two hearths which are situated less than one metre apart. The area in the southeast corner of the block contains a large hearth consisting of ash, charcoal, and fire-reddened soil. Several grouse specimens and numerous fish bones were found within this hearth. An area on the east side of Block 2 situated between these two contains a heavy concentration of ungulate forelimb and hindlimb articular portions in association with a small hearth suggesting that marrow and grease extraction occurred here.

Two hearths and three elongated ice scours were found in Block 3. A large oval hearth consisting of ash and fire-reddened soil was situated in the central area of the block. Several ungulate axial and appendicular remains were found surrounding the large hearth while, beaver cranial and appendicular remains were concentrated within the hearth. Grouse specimens were found north of the hearth and a heavy concentration of walleye remains representing at least seven individuals was encountered just northwest of the hearth.

The second hearth located in the southeast corner of the block is considerably smaller. The faunal assemblage associated with the hearth in the southeast corner of the block consists mainly of ungulate and beaver remains with a few bird and fish remains. The beaver remains were recovered from within the boundaries of the hearth.

The ice scours located on the northern edge of the block contained numerous large ungulate remains, beaver and geese specimens, and sturgeon scutes. Gibson (1994: 168) speculates that these natural depressions were used as refuse disposal areas. The variety of species and elements found in the depressions, as well as the fact that several of the specimens are burned or calcined seems to support this hypothesis.

A large number of bison cranial and appendicular specimens, as well as beaver axial elements were found in the northeast corner of Block 3. No features were associated with the faunal material.

Reconstruction of the taphonomic histories of the vertebrate fauna recovered from Bushfield West indicate that a wide array of processes, both natural and cultural, were involved. Root erosion or root etching is the most frequently observed taphonomic modification of fauna recovered from Bushfield West, affecting 5% (705 specimens) of the identifiable fauna. Root erosion is especially common on large ungulate remains. Various stages of weathering have modified 2% of the identifiable fauna assemblage. The large-sized mammals demonstrate evidence of early stages of weathering (Stages 1 and 2), while medium-sized mammals exhibit slightly more advanced stages (Stages 2 and 3). Only four bird specimens and one fish bone show evidence of weathering. Several forms of carnivore modifications—pitting, punctures, scoring, furrowing, chipping, and evidence of digestion—were observed on large mammal remains. Element portions containing high percentages of cancellous bone (proximal or distal portions of long bones, innominates, and phalanges), as well as long bone shaft portions show evidence of carnivore modifications. The majority of burned bones are from large ungulates, followed by beavers, canids, and fish bones. Most of the calcined items are beaver bones, followed by large ungulates, and fish specimens. Cut marks are recorded on 60 of the identifiable specimens recovered from Bushfield West (< 1% of the sample). Almost all of the cut marks occur on large ungulate bones. Cut, polished, and drilled bone fragments consist of large mammal, bird, and canid remains. Most of the specimens reflect the initial stages of tool production; therefore, it is still possible to identify the skeletal element that was selected for tool manufacturing.

Cut mark locations on the large ungulate specimens and fragmentation patterns observed on the recovered elements demonstrate that a combination of cutting ligaments and soft tissue, as well as smashing bones at muscle insertion points was used to dismember large ungulate butchering units. Six articular units from the lower forelimb region and eight articular units from the lower hindlimb region of large ungulates were recovered from Bushfield West. These articular units indicate that the lower forelimbs and hindlimbs were disarticulated in a similar manner consisting of smashing the distal shaft of either the radius or tibia and the proximal shaft region of the metacarpal or metatarsal. Since cut marks are not apparent on any of the carpals or tarsals it is believed that separation of the lower limb elements was not achieved by cutting through the ligaments which hold the carpal and tarsal units together. None of the beaver remains exhibits cut marks; however, the sample is highly fragmented. Beaver elements may have been fragmented in order to separate the limbs into smaller segments which would fit in cooking vessels or to release marrow during cooking and/or consumption. The majority of complete beaver elements are from the lower region of the legs—metacarpals, carpals, tarsals, and phalanges—indicating that they were separated from the upper limbs and discarded. A similar pattern of fracturing long bones near the proximal and distal ends in order to separate the elements was also observed with the snowshoe hare remains. The majority of complete elements are also from the lower regions of the forelimbs and hindlimbs suggesting that the feet were separated from the legs and discarded. Cut marks and fragmentation of bird specimens are interpreted as evidence of butchering and processing activities.

Multiple lines of evidence indicate that Bushfield West was occupied in the spring (April, May). Several of the bird species found at Bushfield West are common spring and fall migrants to the Nipawin region and for some this area is also within their breeding ranges. The majority of fish species identified in the fauna are spring spawners. It is at this time of the year that fish congregate in large numbers in shallow waters and are easily captured. The two species of fish that are not spring spawners are represented in the assemblage by only one specimen each. The recovery of foetal/newborn unidentified ungulate remains, as well as juvenile beaver and red fox also suggest a spring occupation.

The occurrence of medullary bone in grouse specimens is one of the strongest indicators that the site was occupied during the spring. Medullary bone is produced by females during the breeding season as a source of calcium for the building of egg shells. The breeding season for grouse is usually from the end of April to the beginning of May; however, the time of breeding and nesting can vary by as much as two weeks (Bergrund and Gratson 1988: 510-511). Taking this into account, as well as the following—clutch size, the length of time prior to laying in which the bird begins to produce medullary bone, and the period of time that it takes for the medullary bone to be completely resorbed—a time frame of mid-April to the end of May is suggested by the presence of medullary bone. The recovery of hundreds of eggshell fragments from the occupation paleosol also indicates that the site was occupied in the spring.

A comparison of the eruption schedules and wear patterns of bison mandibles and isolated lower molar metaconid heights recovered from Bushfield West with the eruption schedules and wear patterns described by Wilson (1980) for bison from the Garnsey site, demonstrates that they were killed in the spring, late April or May. The age profile shows that the animals are between 0.2 years and 11.0 years and is interpreted as being the result of attritional predation rather than a single catastrophic kill episode.

Two different methods were used to establish the gender profile of bison represented at Bushfield West. The first involved a step-wise discriminant function analysis of proximal and distal long bone portions. This study indicates that the bison assemblage at Bushfield West is comprised of approximately 50% adult males and 50% adult females. The second involved the use of bimodality in measurements of carpals and tarsals which is interpreted as representing two groups: one consisting of adult males and the other consisting of adult females and/or sub-adults. Results of the gender analysis of carpals and tarsals shows that the bison sample represented at Bushfield West consists of 40% males and 60% females and/or sub-adults. The most notable aspect of the gender analysis of the carpals and tarsals is the consistency with which elements from an articular unit are assigned to the same sex. The articular units also demonstrated complete agreement between carpals and tarsals sexed using Morlan's method and conjoining long bone portions sexed using Walde's method.

Economic utility indices were used in conjunction with the frequencies of bison elements recovered from Bushfield West to interpret the processing and utilization decisions made by the inhabitants of the site. Emerson's standardized modified averaged data total products model, (S)MAVGTP, is used as a measure of general economy utility. When plotted against the frequency of bison specimens the relationship is expressed as a reverse utility curve indicating a bulk processing strategy in which specimens of lower economic value were recovered in greater proportions than specimens of higher economic value. Emerson's (S)MAVGGRE model and Brink and Dawe's revised grease index were compared to the frequency of long bone proximal and distal portions. A much stronger correlation was achieved using Brink and Dawe's revised grease index than Emerson's (S)MAVGGRE model. The relationship expressed using Brink and Dawe's revised grease index is a reverse utility curve which demonstrates a close fit between the frequency of specimens recovered at the site and what one would expect to be recovered if specimens yielding the largest quantity of grease were selected specifically for that resource. A reverse utility curve is also shown in a comparison of Brink and Dawe's bone utility index and the frequency of long bone portions (proximal, shaft, and distal) recovered at the site. The relationships between Brink and Dawe's revised grease index, as well as their bone utility index and the frequency of element portions recovered indicates that elements were being selected for the extraction of specific resources—marrow and grease. A comparison of the frequency of carpals, tarsals and long bone portions with volume density data does not result in a significant correlation suggesting that survivorship in the assemblage is not density-mediated.

The faunal assemblage at Bushfield West is clearly dominated by bison with a minimum of 19 animals represented in the assemblage. A combination of aging and gender analysis data indicates that the bison at Bushfield West represents several procurement events. Modern herd composition varies depending on the time of the year, with the percentage of males being as high as 44% during the rut and generally dropping to 17% at other times of the year (Wilson 1980: 117). Therefore, it is unlikely that a single herd consisting of 40-50% males and 50-60% females would be encountered in the spring. A more likely interpretation is the procurement of small numbers of cows and calves or young males, as well as solitary bulls. The high percentage of males represented at Bushfield West may indicate that they were selectively hunted due to their higher fat content.

Although bison represent an important part of the subsistence economy of the people inhabiting Bushfield West they do not represent the sole food resource. The faunal assemblage is diverse and represents the exploitation of a wide variety of mammal, bird, and fish species. Two other species of large ungulates—moose and elk—are present in the assemblage. Moose generally occur as solitary animals or in pairs consisting of a female with a calf. Elk are usually found in small herds of females and calves and groups of males. The large number of beaver recovered at the site demonstrates that they were also an important part of the subsistence economy. Other mammals of lesser importance include muskrat, snowshoe hare, canids, bear, lynx, and red squirrel. Several species of migratory waterfowl, as well as grouse and cranes are represented in the sample. A substantial number of fish appear to have been taken during their spring spawning runs. In summary, the major attraction of this site to precontact people during the spring of the year was the availability of a wide variety of food resources.

Bushfield West was one of the most significant heritage resources documented during the Nipawin Hydroelectric Project. It is also one of the few extensively excavated single component habitation sites located in the southern boreal forest which is characterized by good stratigraphic control, a large artifact assemblage, and adequate preservation of faunal remains. In an attempt to identify intra-site settlement activities and lifeways the ceramic vessels, stone tools, features, and their distributions have been examined in meticulous detail by Gibson (1994). The analysis of the faunal assemblage recovered at Bushfield West contributes valuable data to the overall interpretation of the day to day activities taking place at the site.

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APPENDIX A

Common and Scientific Names of Fauna in the Nipawin Area

Table 1 Common and Scientific Names of Mammals of Potential Economic Importance to Prehistoric Peoples in the Nipawin Area

Common Name	Scientific Name
Bison	*Bison bison bison*
Moose	*Alces alces*
Elk	*Cervus canadensis*
Woodland caribou	*Rangifer tarandus*
Mule deer	*Odocoileus hemionus*
White-tailed deer	*Odocoileus virginianus*
Black bear	*Ursus americanus*
Domestic dog	*Canis familiaris*
Gray wolf	*Canis lupus*
Coyote	*Canis latrans*
Red fox	*Vulpes vulpes*
Cougar	*Felis concolor*
Lynx	*Lynx canadensis*
Mink	*Mustela vison*
Fisher	*Martes pennanti*
Marten	*Martes americana*
Short-tailed weasel	*Mustela erminea*
Long-tailed weasel	*Mustela frenata*
Least weasel	*Mustela nivalis*
Badger	*Taxidea taxus*
Raccoon	*Procyon lotor*
Porcupine	*Erethizon dorsatum*
Striped skunk	*Mephitis mephitis*
Woodchuck	*Marmota monax*
Beaver	*Castor canadensis*
Muskrat	*Ondatra zibethicus*
River otter	*Lutra canadensis*
Snowshoe hare	*Lepus americanus*
White-tailed jackrabbit	*Lepus townsendii*

Table 2 Small Rodents and Micro-rodents Occurring in the Nipawin Area

Common Name	Scientific Name
Least chipmunk	*Eutamias minimus*
Red squirrel	*Tamiasciurus hudsonicus*
Flying squirrel	*Glaucomys sabrinus*
Richardson's ground squirrel	*Spermophilus richardsonii*
Thirteen-lined ground squirrel	*Spermophilus tridecemlineatus*
Franklin's ground squirrel	*Spermophilus franklinii*
Northern pocket gopher	*Thomomys talpoides*
Deer mouse	*Peromyscus maniculatus*
Gapper's red-backed vole	*Clethrionomys gapperi*
Northern bog lemming	*Synaptomys borealis*
Heather vole	*Phenacomys intermedius*
Meadow vole	*Microtus pennsylvanicus*
Meadow jumping mouse	*Zapus hudsonius*
Western jumping mouse	*Zapus princeps*
Masked shrew	*Sorex cinereus*
Water shrew	*Sorex palustris*
Arctic shrew	*Sorex arcticus*
Pigmy shrew	*Microsorex hoyi*
Short-tailed shrew	*Blarina brevicauda*

Table 3 Common and Scientific Names of Birds Occurring in the Nipawin Area

Common Name	Scientific Name
Canada goose	*Branta canadensis*
White fronted goose,	*Anser albifrons*
Snow goose	*Chen hyperborea*
Ross' goose	*Chen rossii*
Tundra swan	*Cygnus columbianus*
Trumpter swan	*Cygnus buccinator*
Mallard	*Anas platyrhynchos*
American black duck	*Anas rubripes*
Common goldeneye	*Bucephala clangula*
Common merganser	*Mergus merganser*
Hooded merganser	*Lophodytes cucullatus*
Gadwall	*Anas strepera*
Northern pintail	*Anas acuta*
American wigeon	*Anas americana*
Blue-winged teal	*Anas discors*
Green-winged teal	*Anas crecca*
Northern shoveller	*Anas clypeata*
Redhead	*Aythya americana*
Lesser scaup	*Aythya affinis*
Canvasback	*Aythya valisineria*
American coot	*Fulica americana*
Bufflehead	*Bucephala albeola*
Common loon	*Gavia immer*
Horned grebe	*Podiceps auritus*
Western grebe	*Aechmophorus occidentalis*
Red-necked grebe	*Podiceps grisegena*
Cormorant	*Phalacrocoracidae*
White pelican	*Pelecanus erythrorhynchos*
Great blue heron	*Ardea herodias*
Belted kingfisher	*Megaceryle alcyon*
Cliff swallow	*Petrochelidon pyrrhonota*
Bank swallow	*Riparia riparia*
Spotted sandpiper	*Actitis macularia*
Solitary sandpiper	*Tringa solitaria*
Lesser yellowlegs	*Tringa flavipes*
Piping plover	*Charadrius melodus*
Killdeer	*Charadrius vociferus*
Ring-billed gull	*Larus delawarensis*
Franklin's gull	*Larus pipixcan*
Bonaparte's gull	*Larus philadlphia*
California gull	*Larus californicus*
Common tern	*Sterna hirundo*
Forster's tern	*Sterna forsteri*
Caspian tern	*Sterna caspia*
Black tern	*Sterna niger*
Spruce grouse	*Canachites canadensis*
Ruffed grouse	*Bonasa umbellus*
Sharp-tailed grouse	*Pedioecetes phasianellus*
Gray partridge	*Perdix perdix*
Willow ptarmigan	*Lagopus lagopus*

Table 3 (continued)

Common Name	Scientific Name
Sandhill crane	*Grus canadensis*
Whooping crane	*Grus americana*
Turkey vulture	*Cathartes aura*
Red-tailed hawk	*Buteo jamaicensis*
American kestrel	*Falco sparverius*
Sharp-shinned hawk	*Accipiter striatus*
Cooper's hawk	*Accipiter cooperii*
Prairie falcon	*Falco mexicanus*
Peregrine falcon	*Falco peregrinus*
Merlin	*Falco columbarius*
Golden eagle	*Aquila chrysaetos*
Bald eagle	*Haliaeetus leucocephalus*
Osprey	*Pandion haliaetus*
Great horned owl	*Bubo virginianus*
Long-eared owl	*Asio otus*
Saw-whet owl	*Aegolius acadicus*
Short-eared owl	*Asio flammeus*
Northern hawk owl	*Surnia ulula*
Boreal owl	*Aegolius funereus*

Table 4 Common and Scientific Names of Fish Occurring in the Saskatchewan River Near Nipawin Area

Common Name	Scientific Name
Lake trout	*Salvelinus namaycush*
Lake whitefish	*Coregonus clupeaformis*
Sturgeon	*Acipenser fulvescens*
Goldeye	*Hiodon alosoides*
Burbot	*Lota lota*
Cisco	*Coregonus artedii*
Northern pike	*Esox lucius*
Walleye	*Stizostedion vitreum*
Carp	*Cyprinus carpio*
Yellow perch	*Perca flavescens*
Sauger	*Stizostedion canadensis*
Longnose sucker	*Catostomus catostomus*
White sucker	*Catostostomus commersoni*
Shorthead redhorse	*Moxostoma macrolepidotum*
Silver redhorse	*Moxostoma anisurum*
Quillback sucker	*Carpiodes cyprinus*
Emerald shiner	*Notropis atherinoides*
River shiner	*Notropis blennius*
Spottail shiner	*Notropis Pimephales promelas*
Spoonhead sculpin	*Cottus ricei*
Brook stickleback	*Culaea inconstans*

APPENDIX B

Bushfield West - Block 1 NISP Distributions

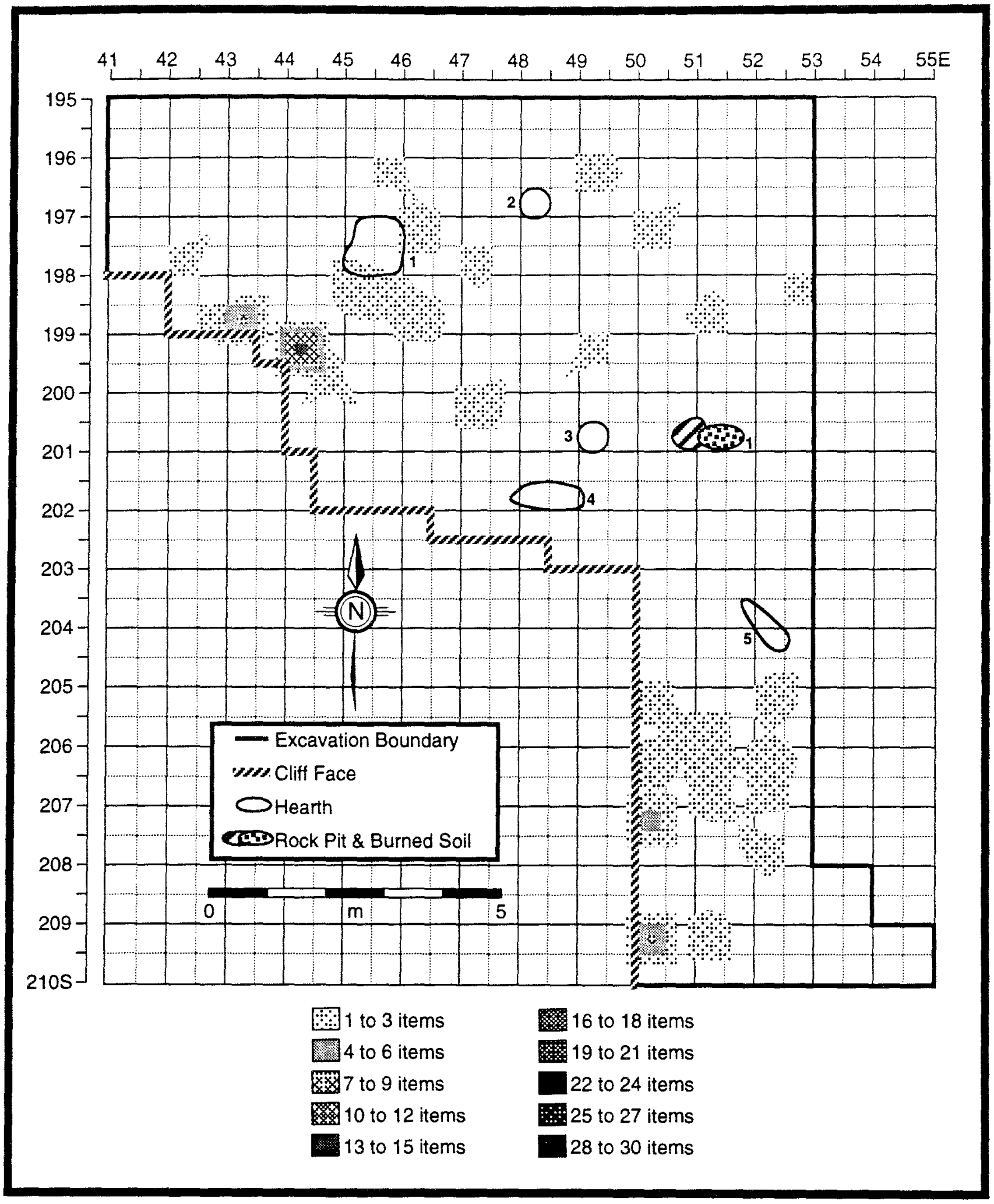

Figure 1 Block 1 – Unidentified Ungulate Cranial NISP Distribution

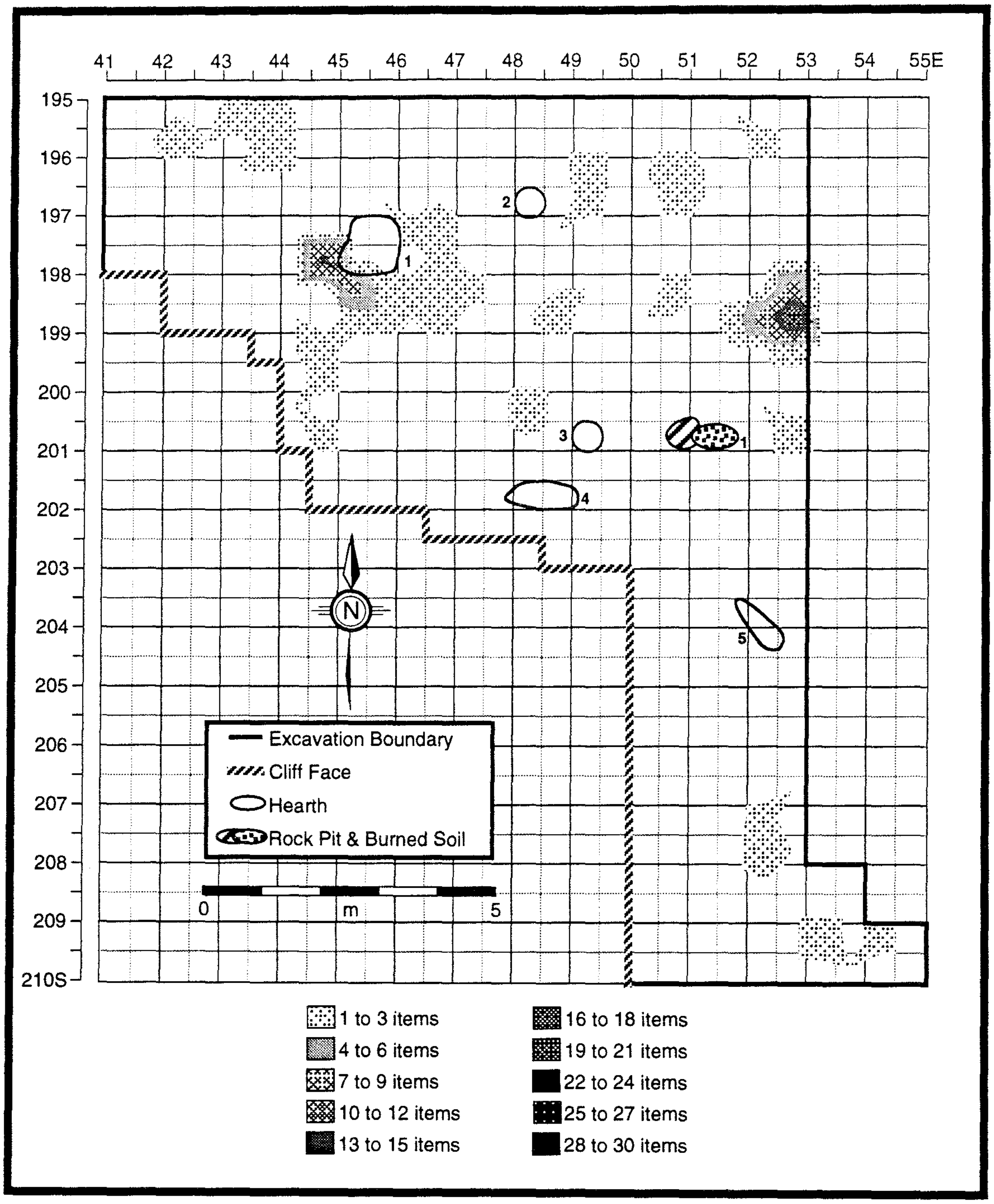

Figure 2 Block 1 – Unidentified Ungulate Vertebrae NISP Distribution

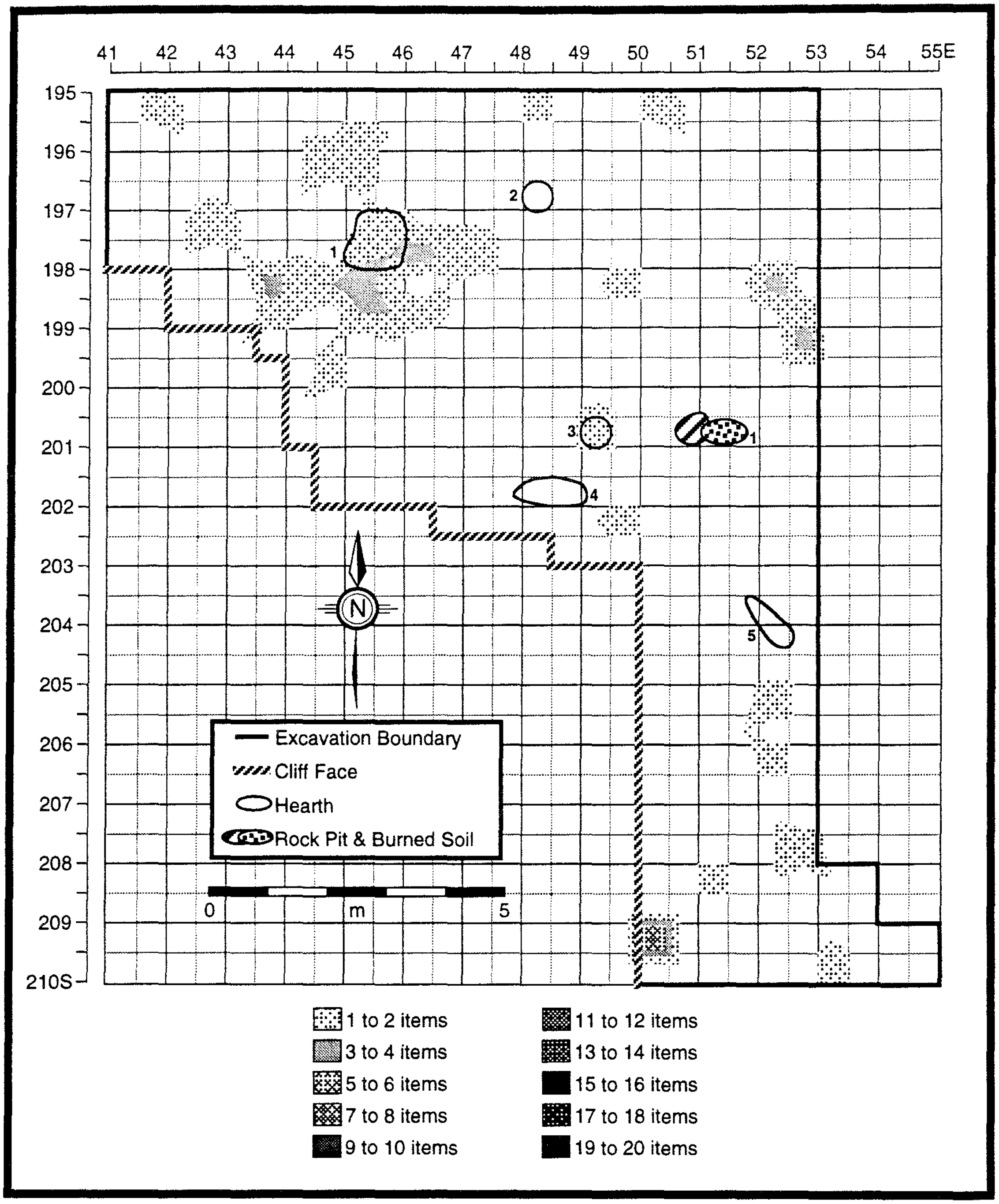

Figure 3 Block 1 – Unidentified Ungulate Rib NISP Distribution

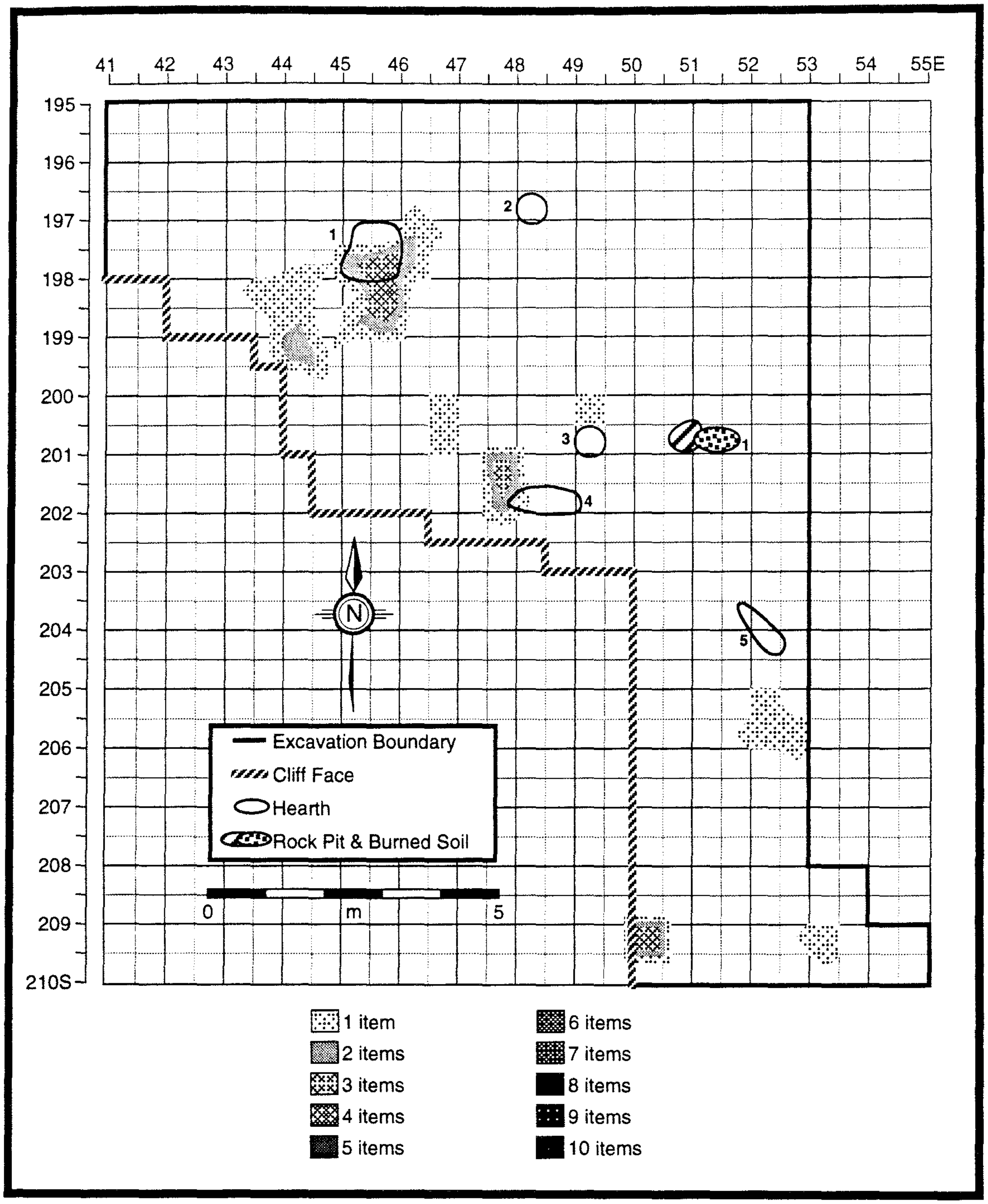

Figure 4 Block 1 – Unidentified Ungulate Forelimb NISP Distribution

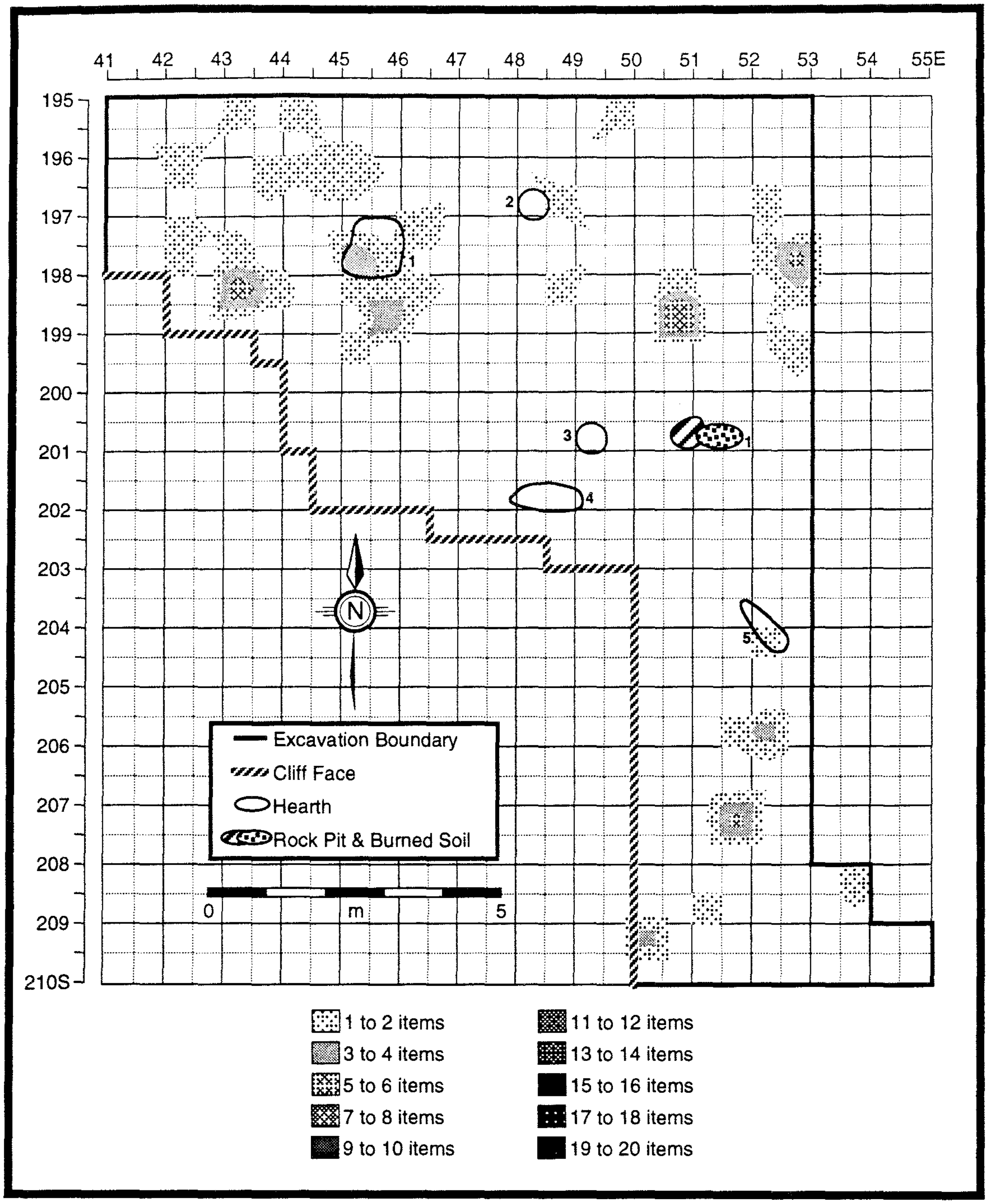

Figure 5 Block 1 – Unidentified Ungulate Hindlimb NISP Distribution

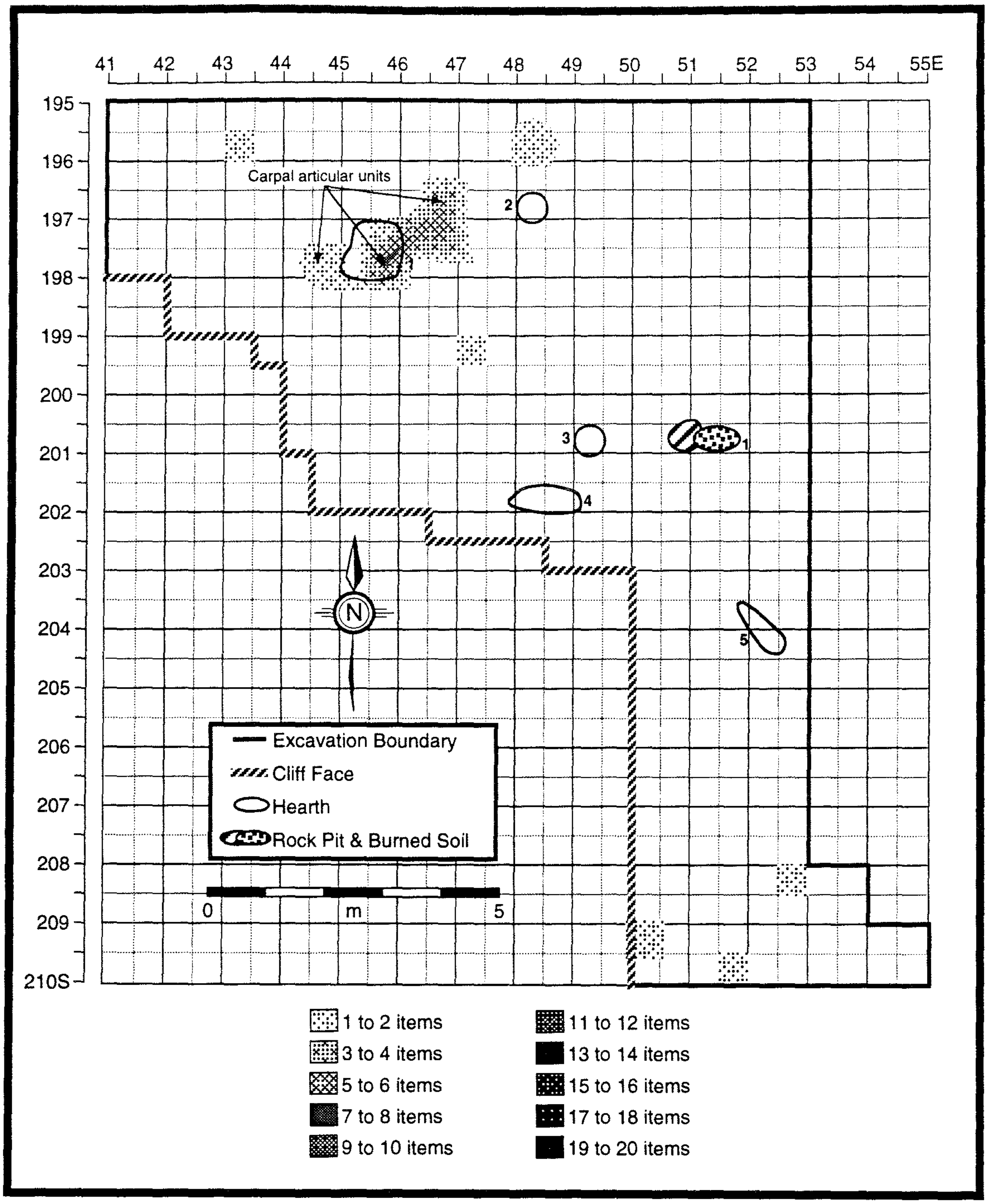

Figure 6 Block 1 – Bison Forelimb NISP Distribution

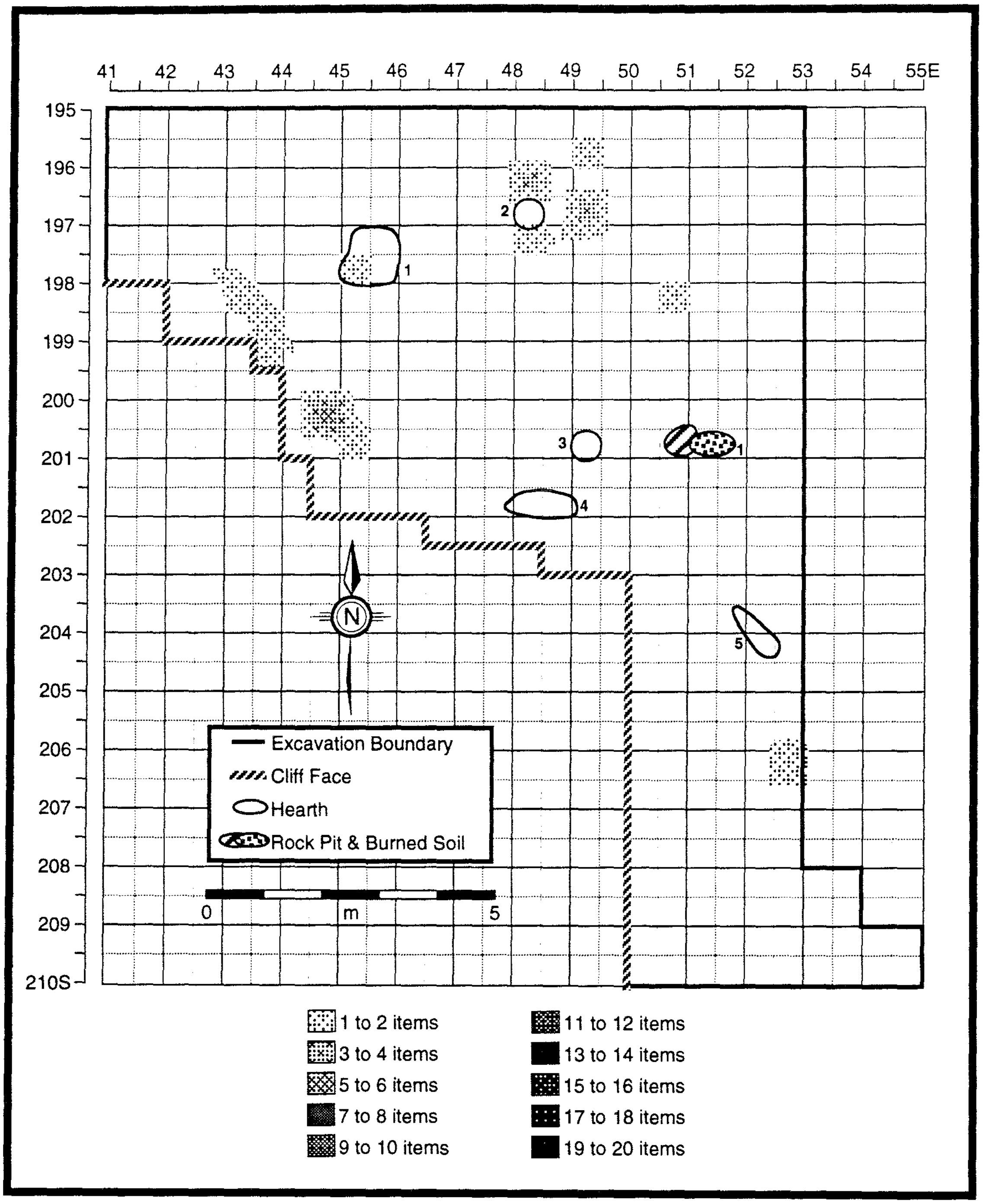

Figure 7 Block 1 – Bison Hindlimb NISP Distribution

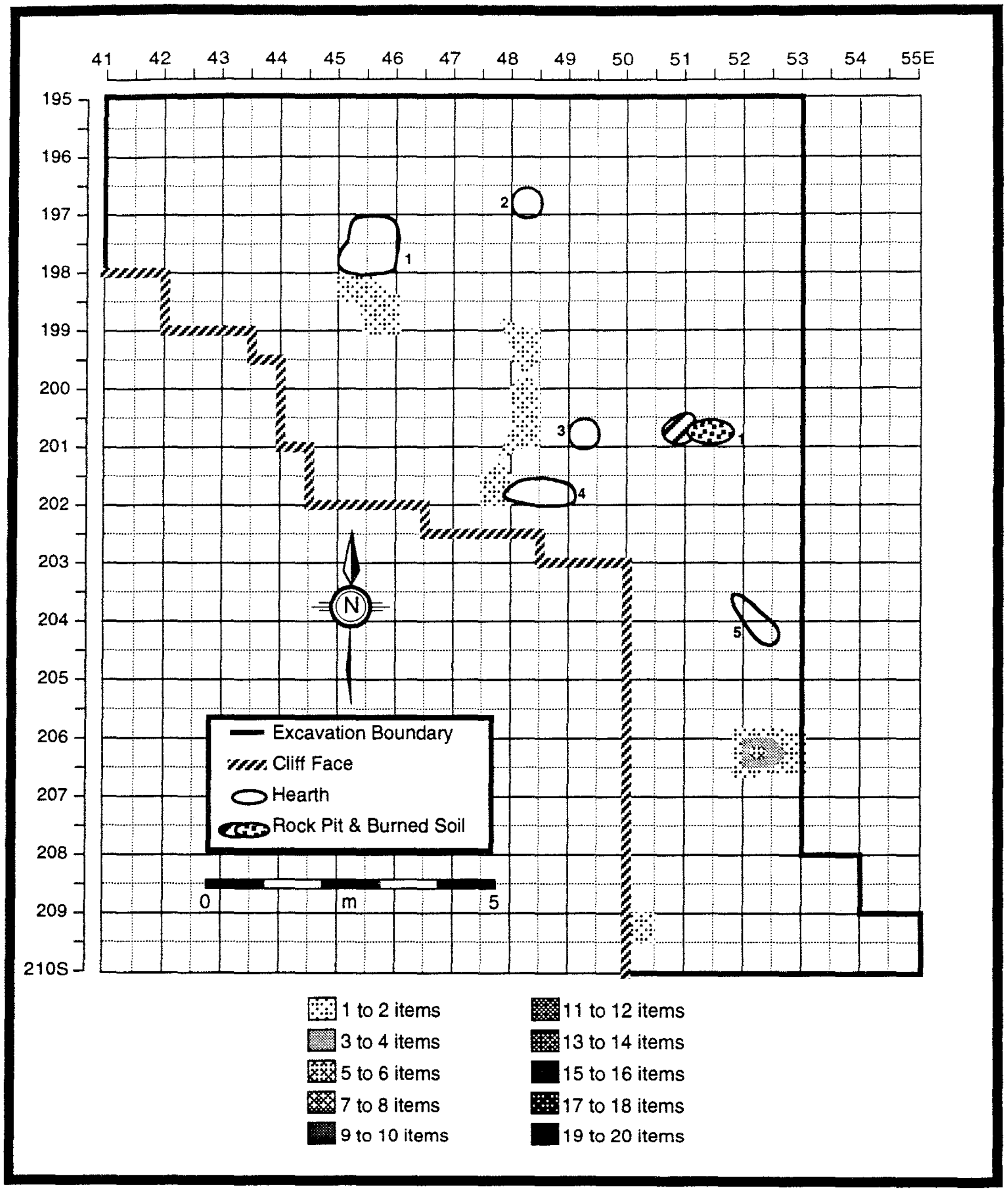

Figure 8 Block 1 – Elk NISP Distribution

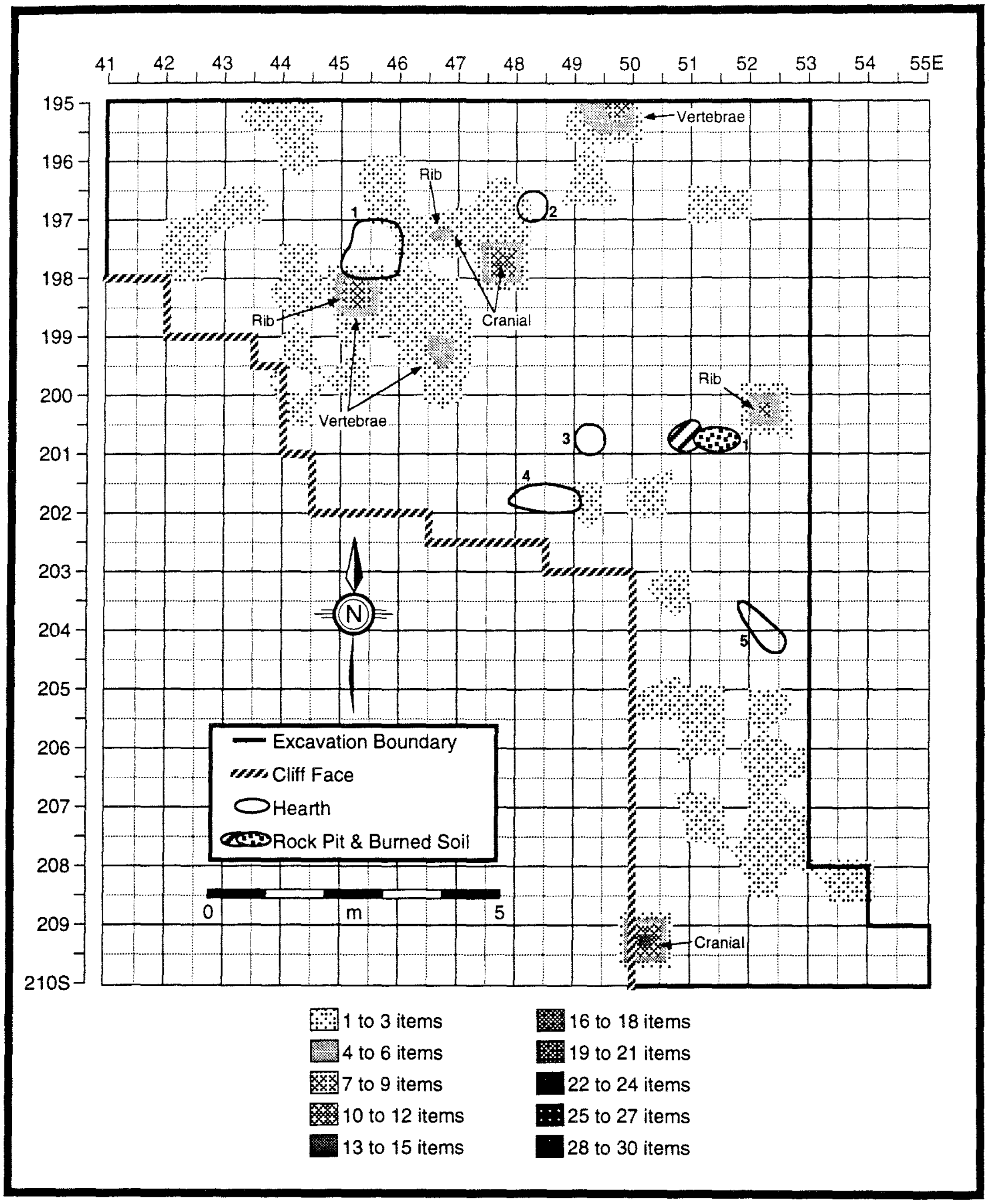

Figure 9 Block 1 – Beaver Axial NISP Distribution

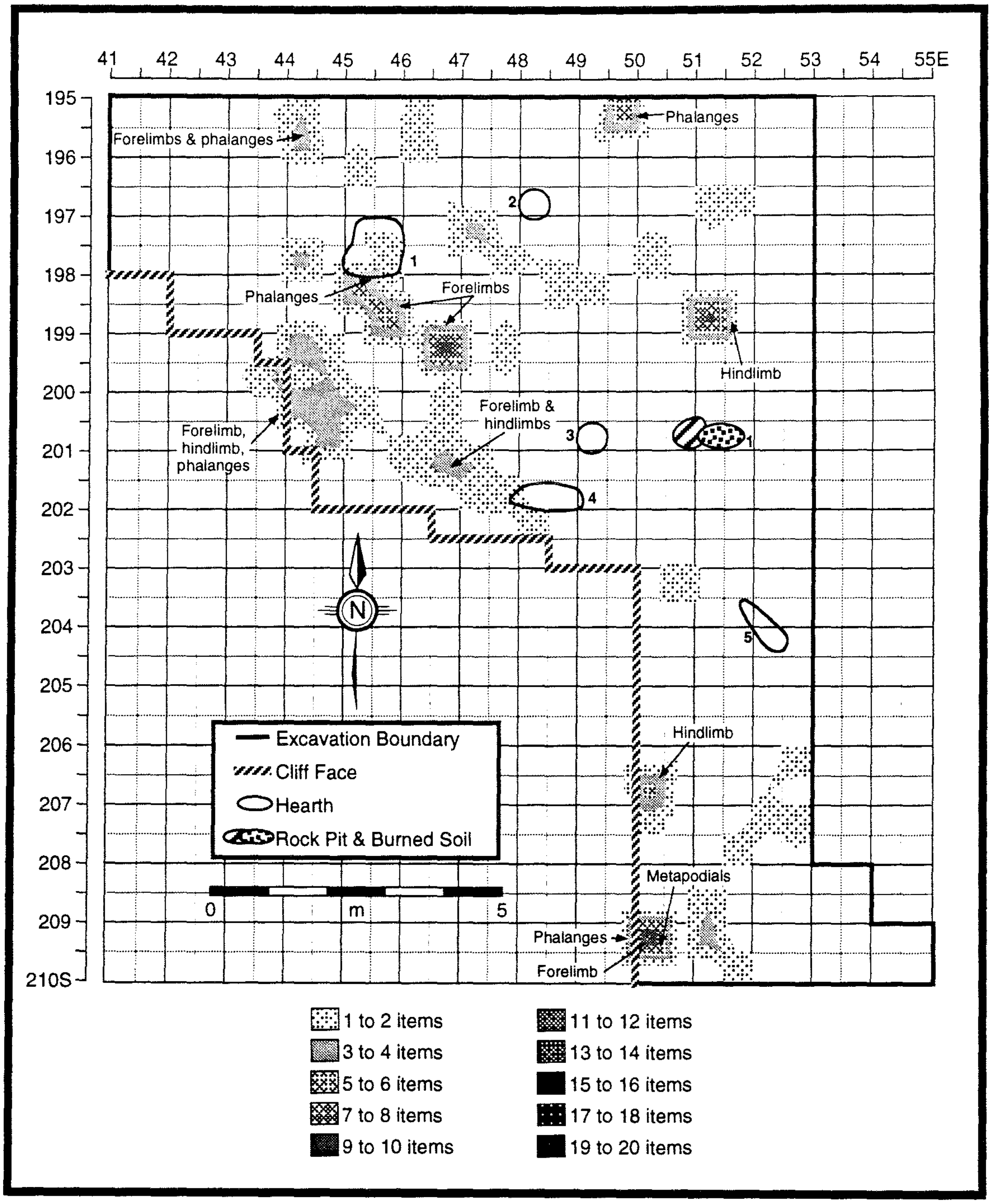

Figure 10 Block 1 – Beaver Appendicular NISP Distribution

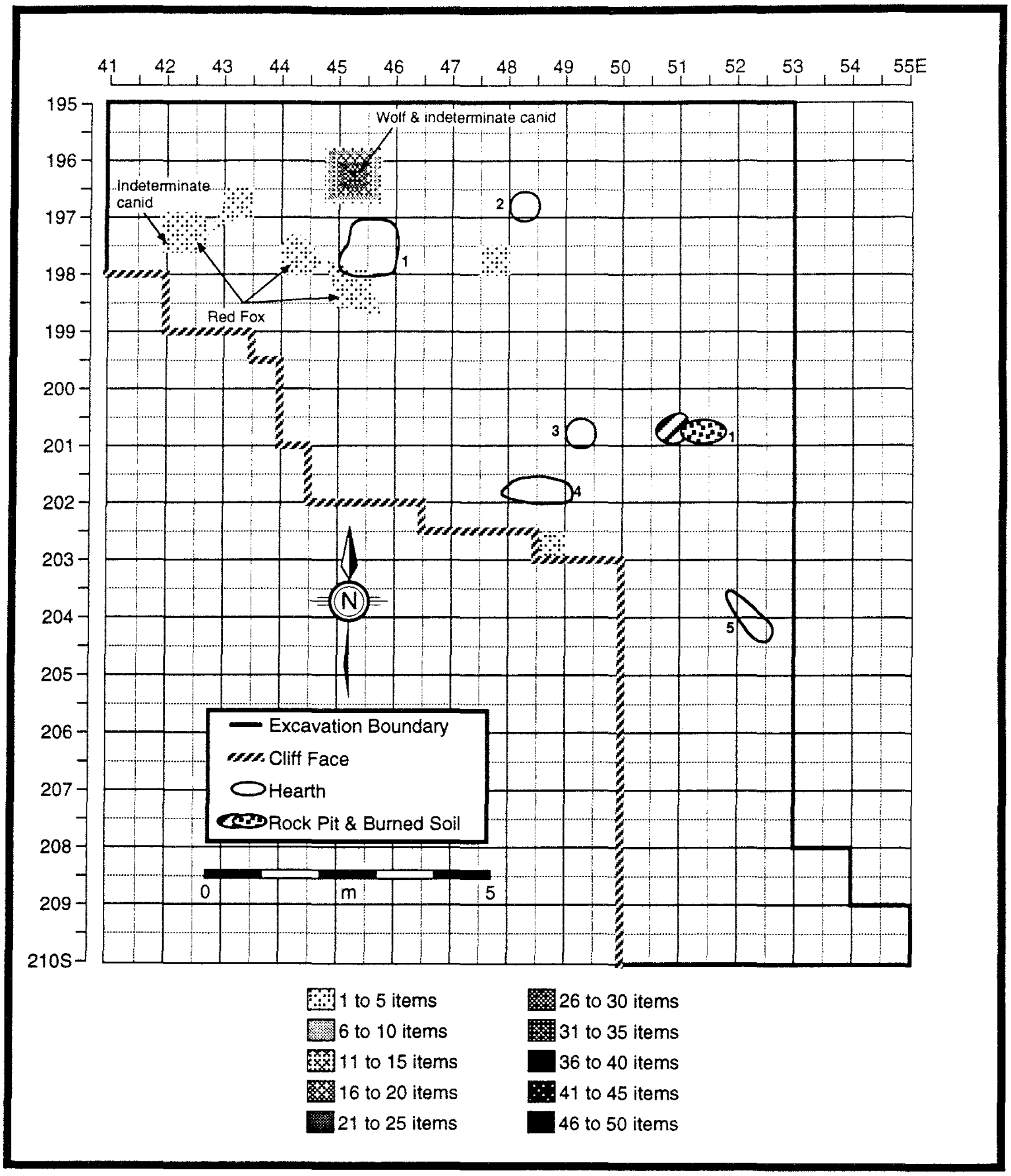

Figure 11 Block 1 – Canid NISP Distribution

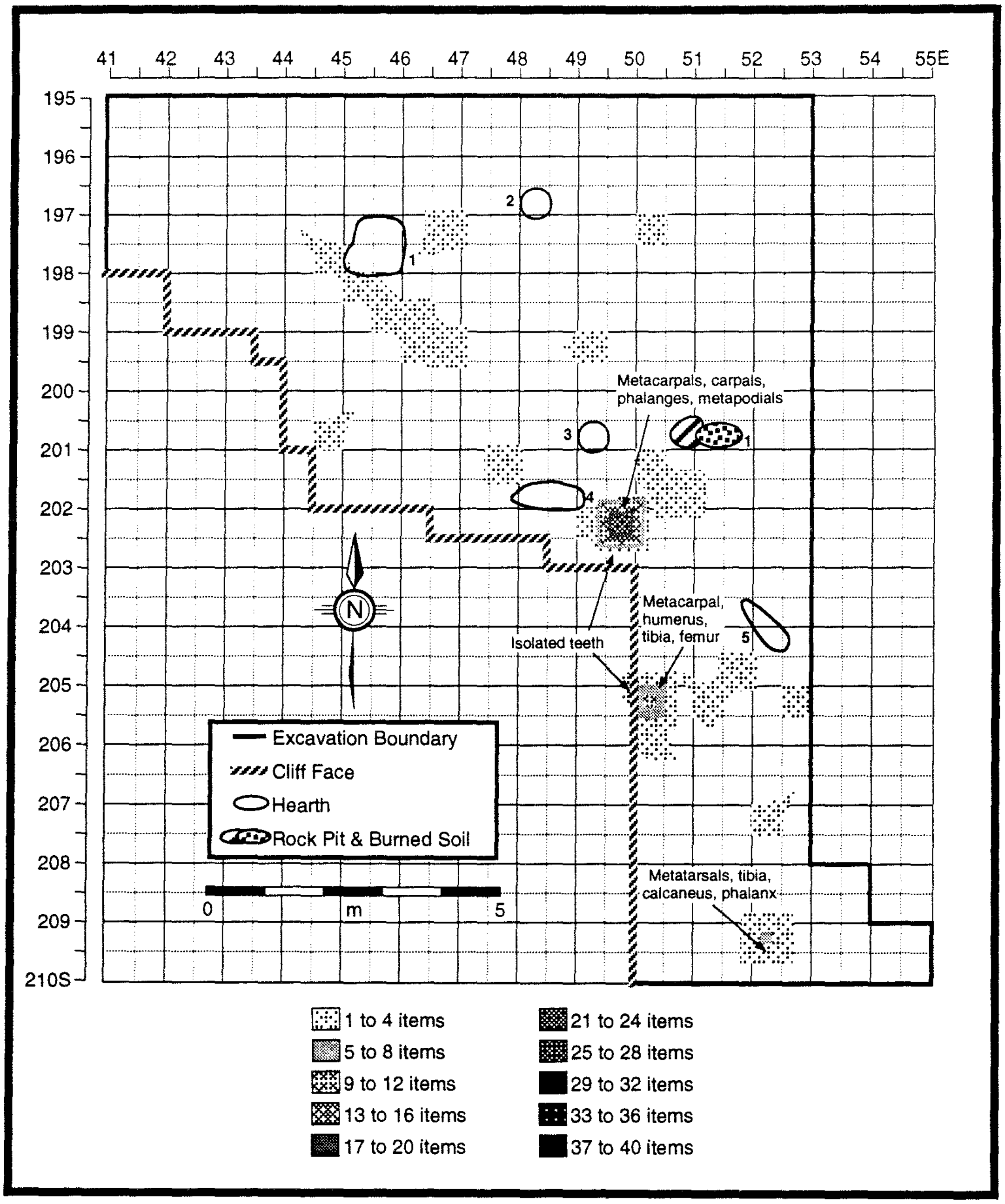

Figure 12 Block 1 – Snowshoe Hare NISP Distribution

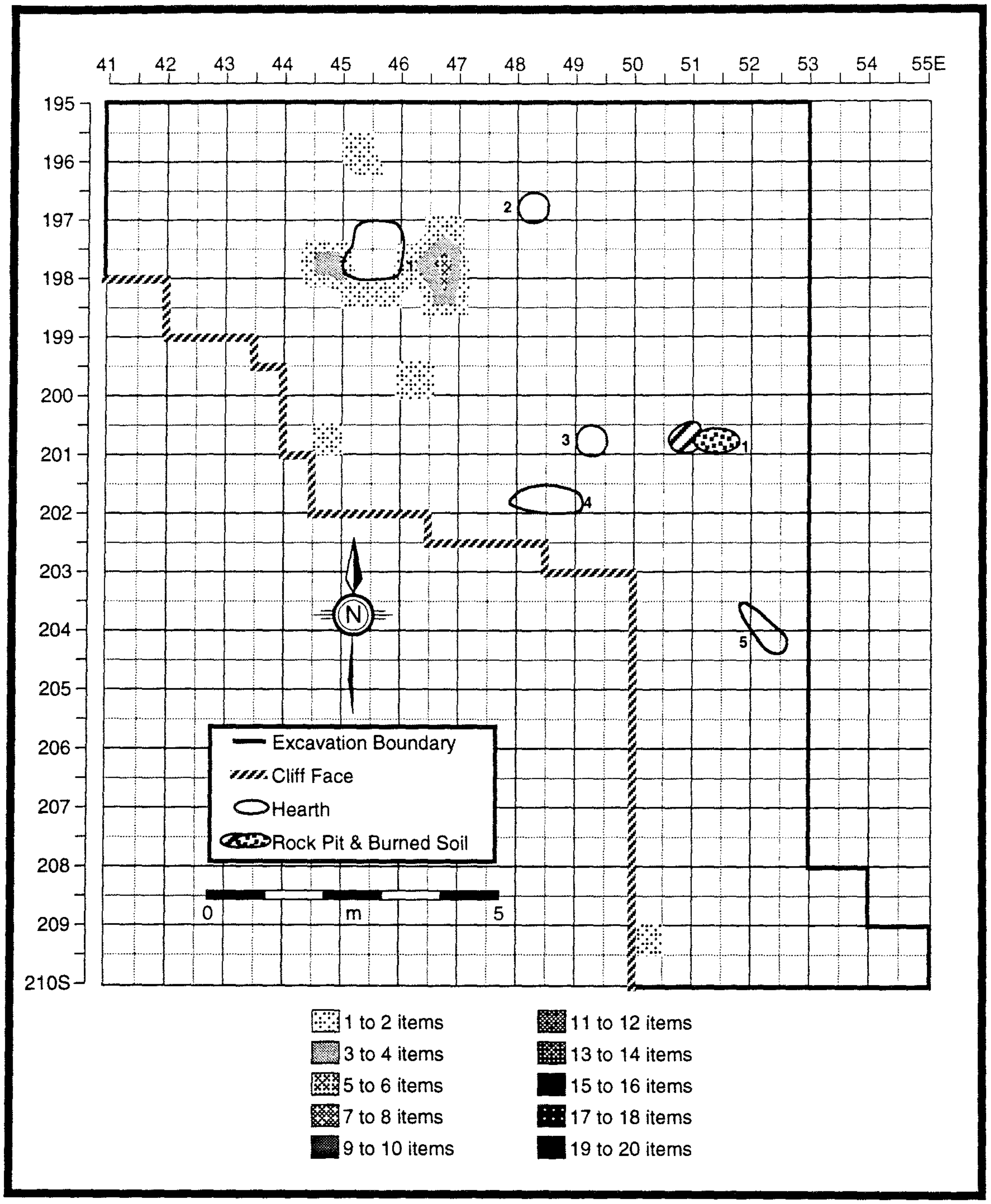

Figure 13 Block 1 – Grouse NISP Distribution

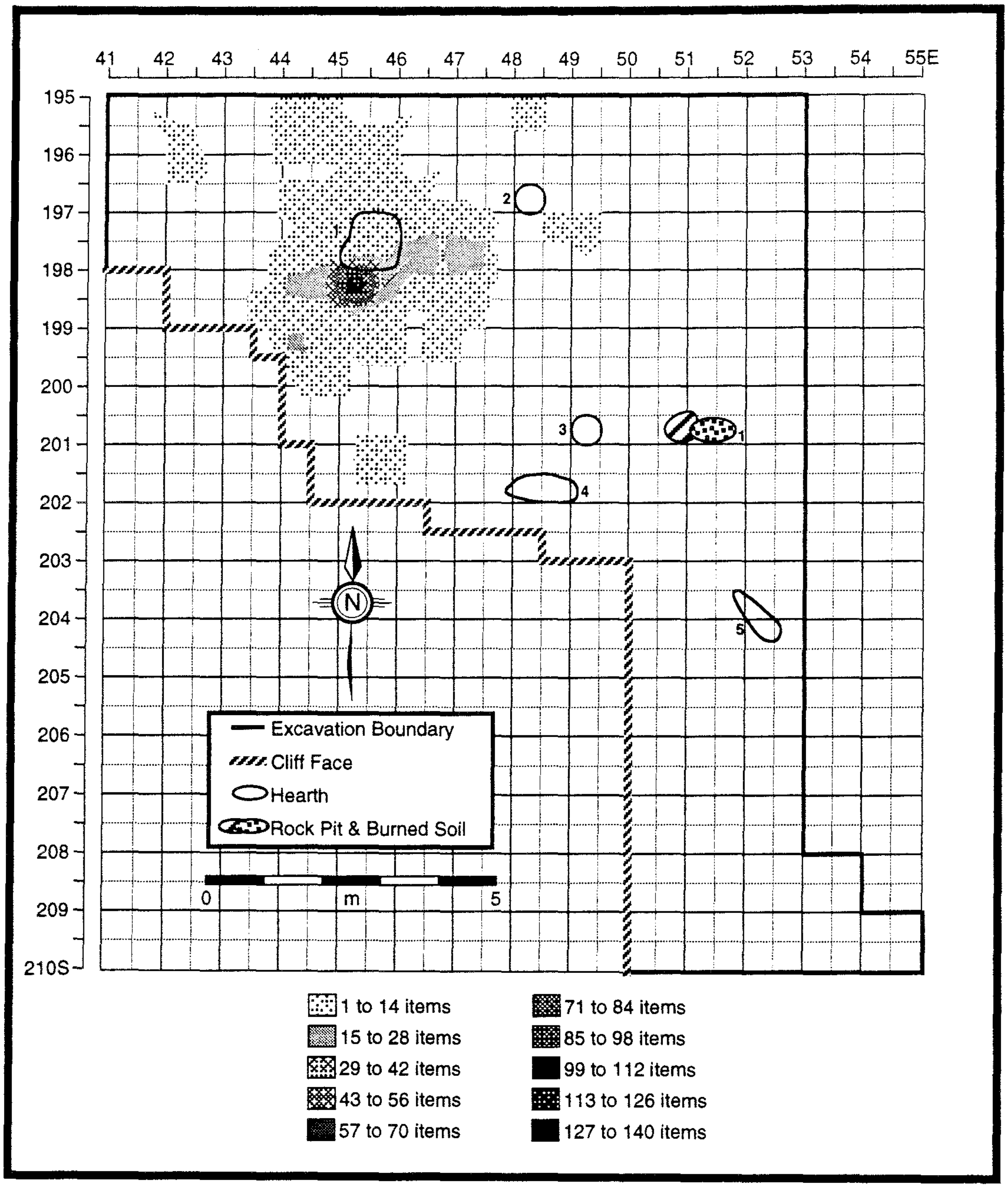

Figure 14 Block 1 – Unidentified Fish NISP Distribution

APPENDIX C

Bushfield West - Block 2 NISP Distributions

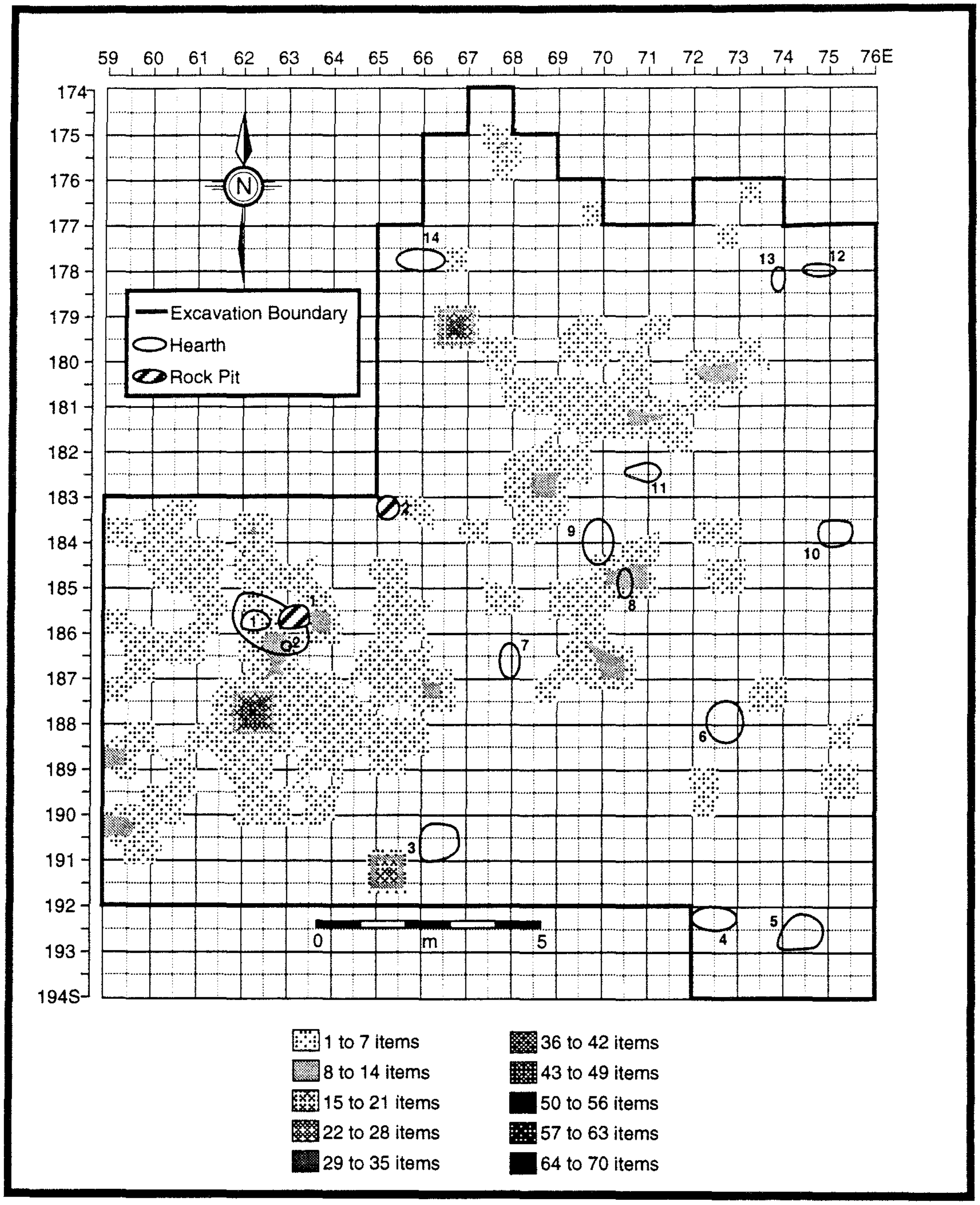

Figure 1 Block 2 – Unidentified Ungulate Cranial NISP Distribution

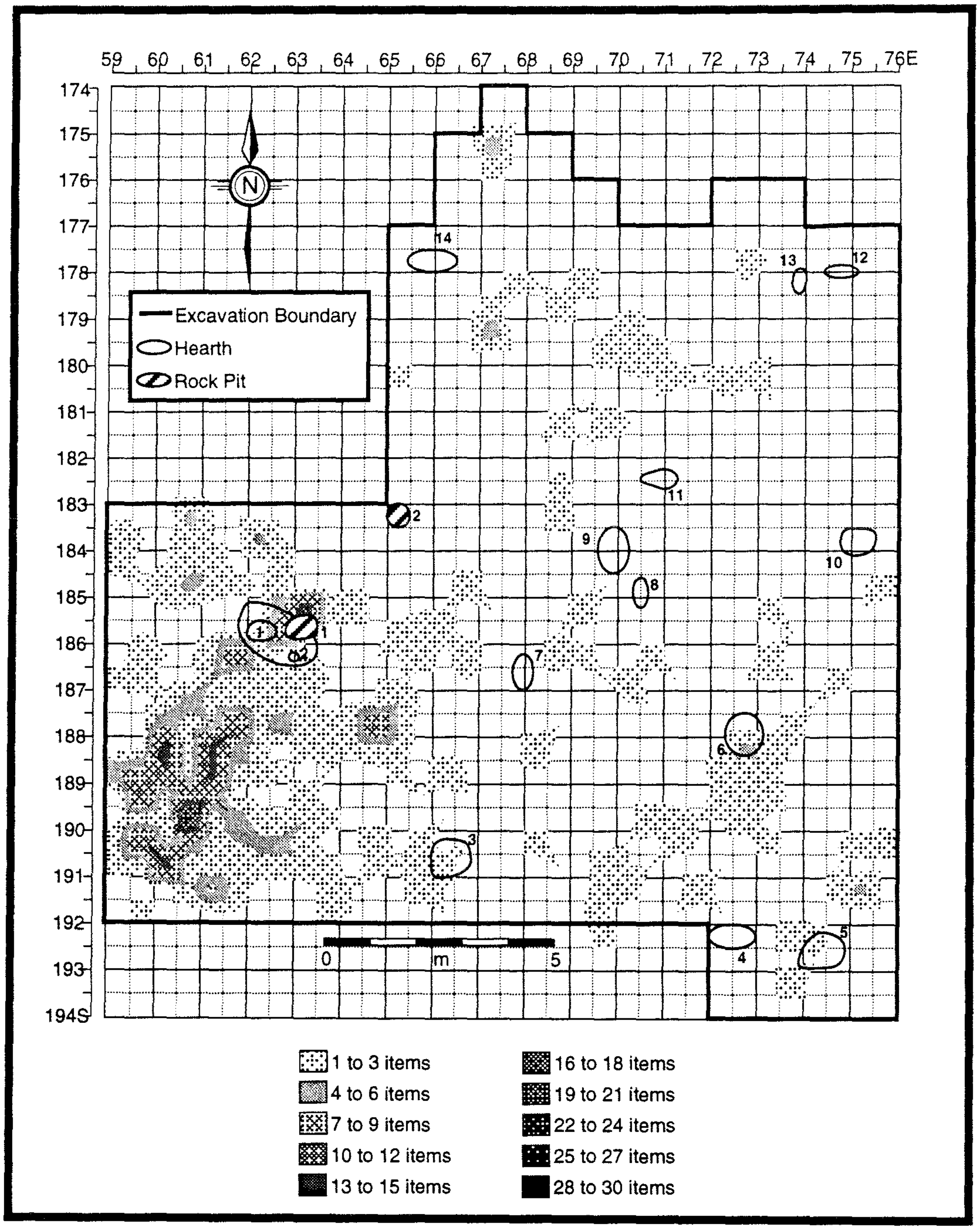

Figure 2 Block 2 – Unidentified Ungulate Vertebrae NISP Distribution

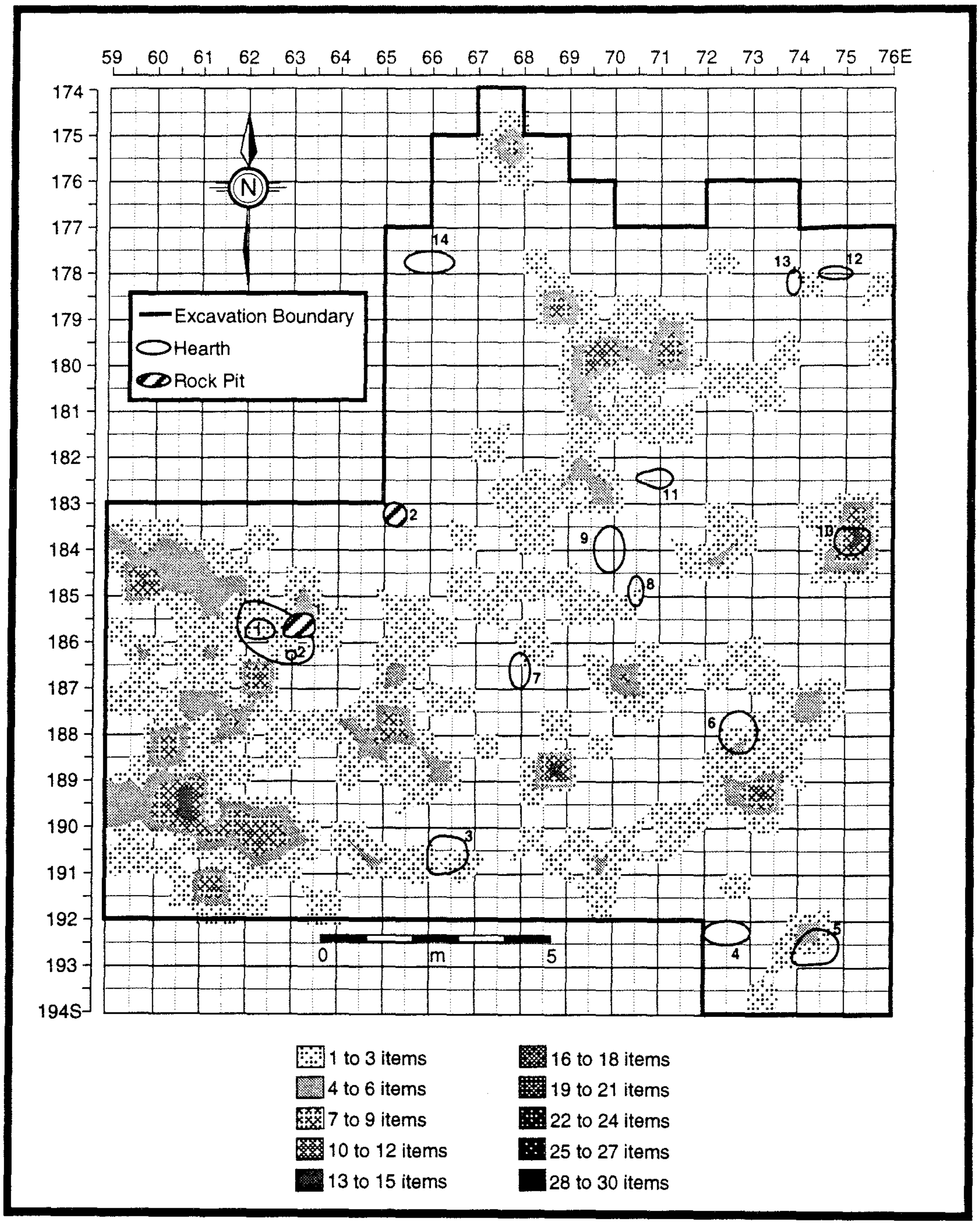

Figure 3 Block 2 – Unidentified Ungulate Rib NISP Distribution

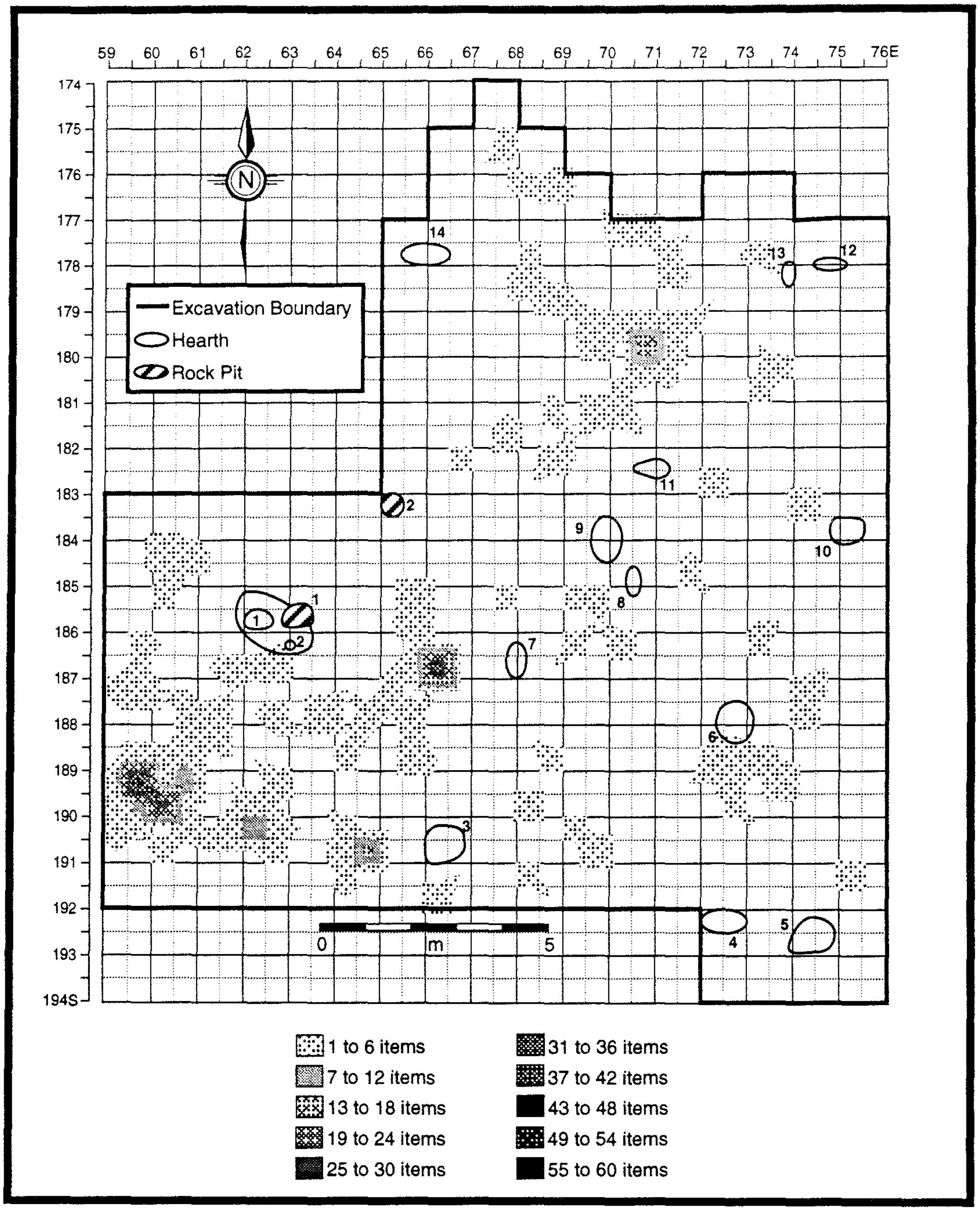

Figure 4 Block 2 – Unidentified Ungulate Forelimb NISP Distribution

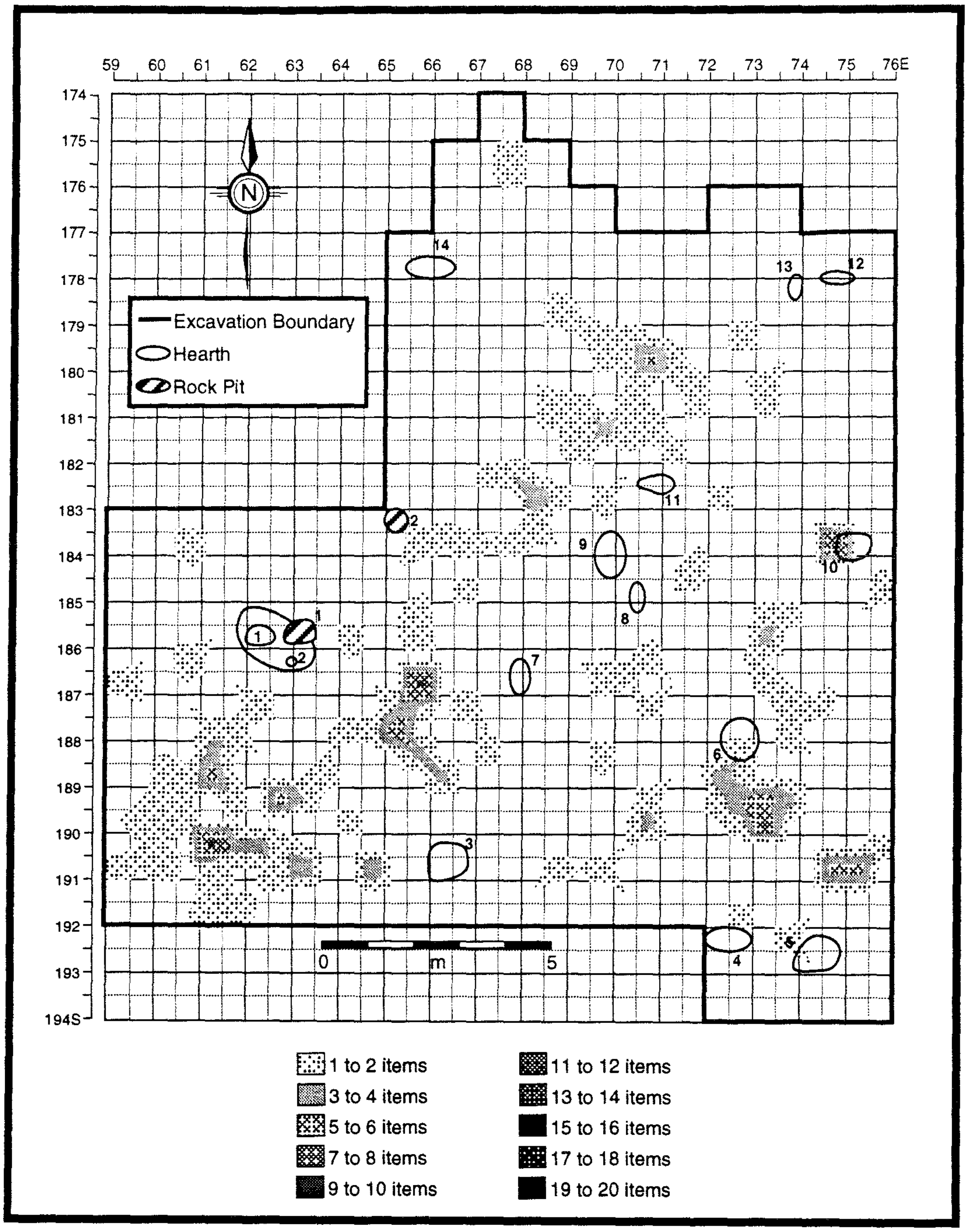

Figure 5 Block 2 – Unidentified Ungulate Hindlimb NISP Distribution

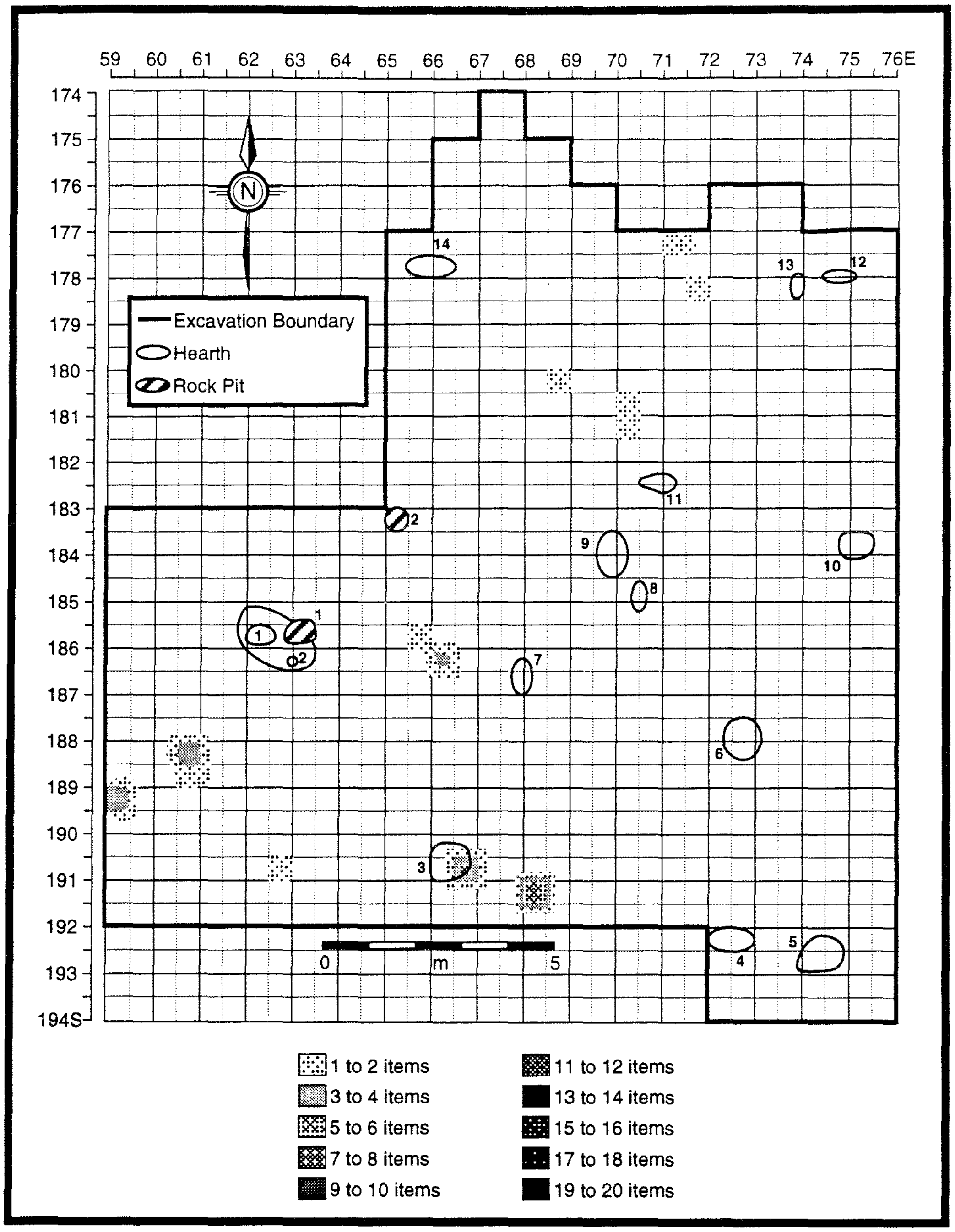

Figure 6 Block 2 – Bison Forelimb NISP Distribution

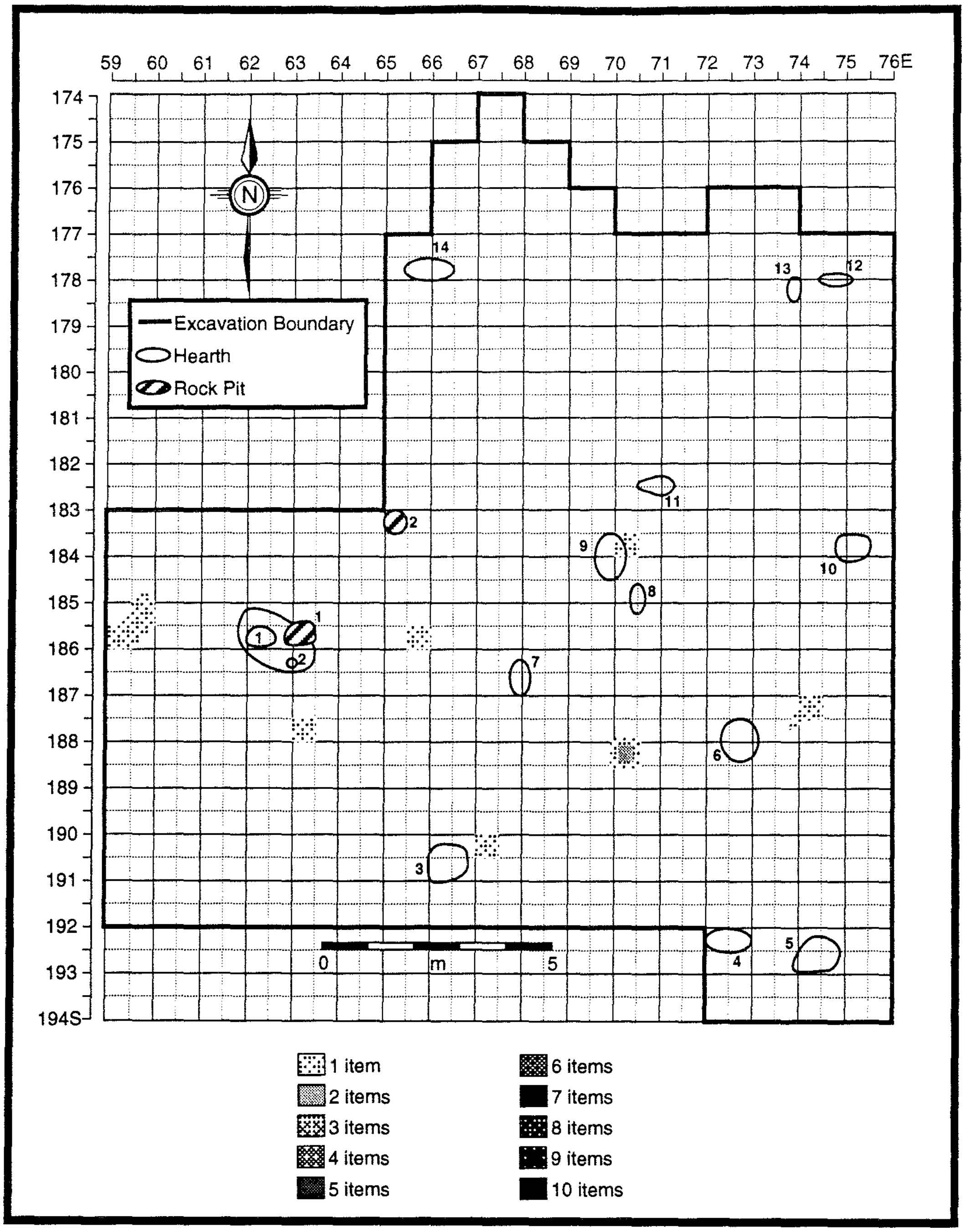

Figure 7 Block 2 – Bison Hindlimb NISP Distribution

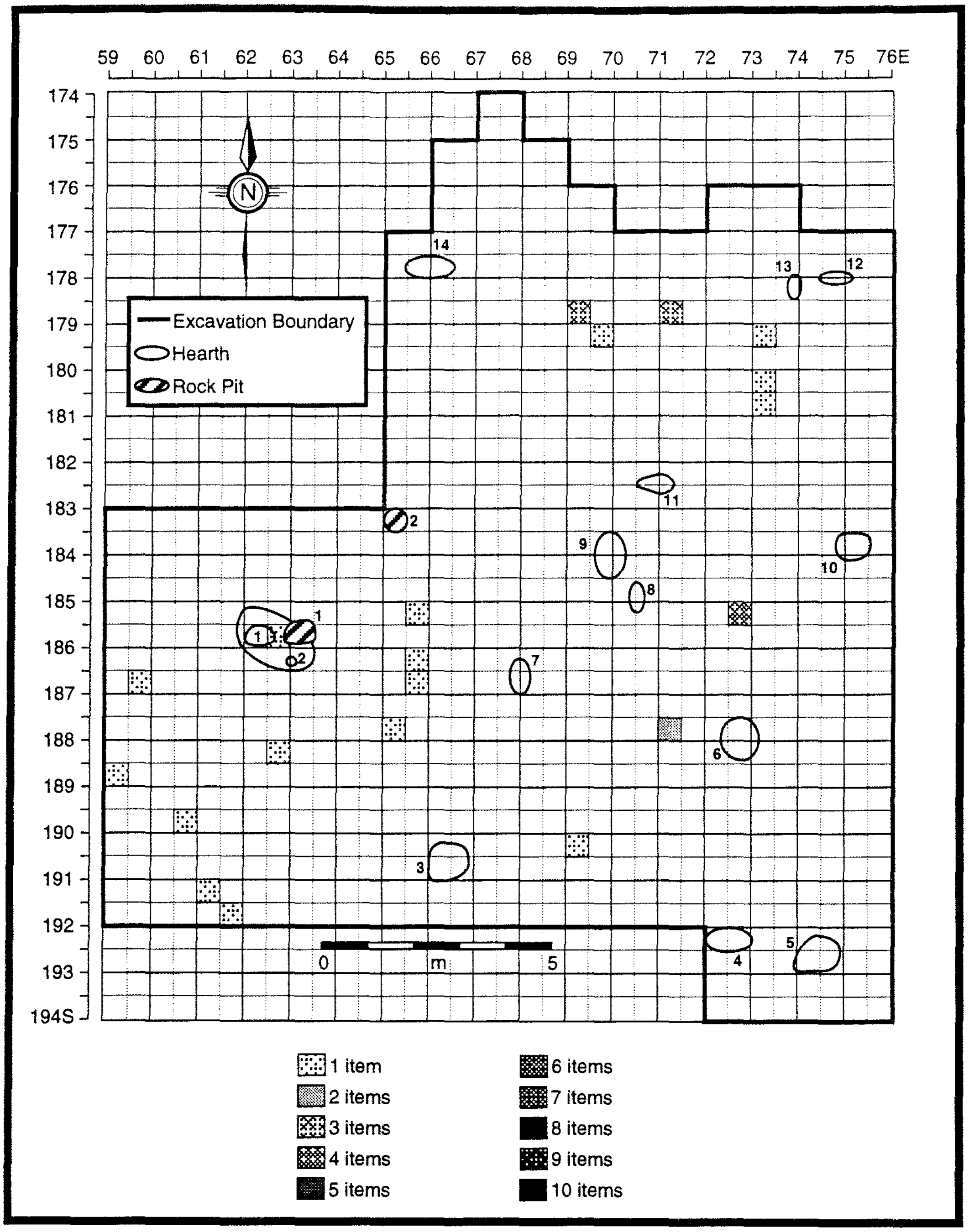

Figure 8 Block 2 – Moose NISP Distribution

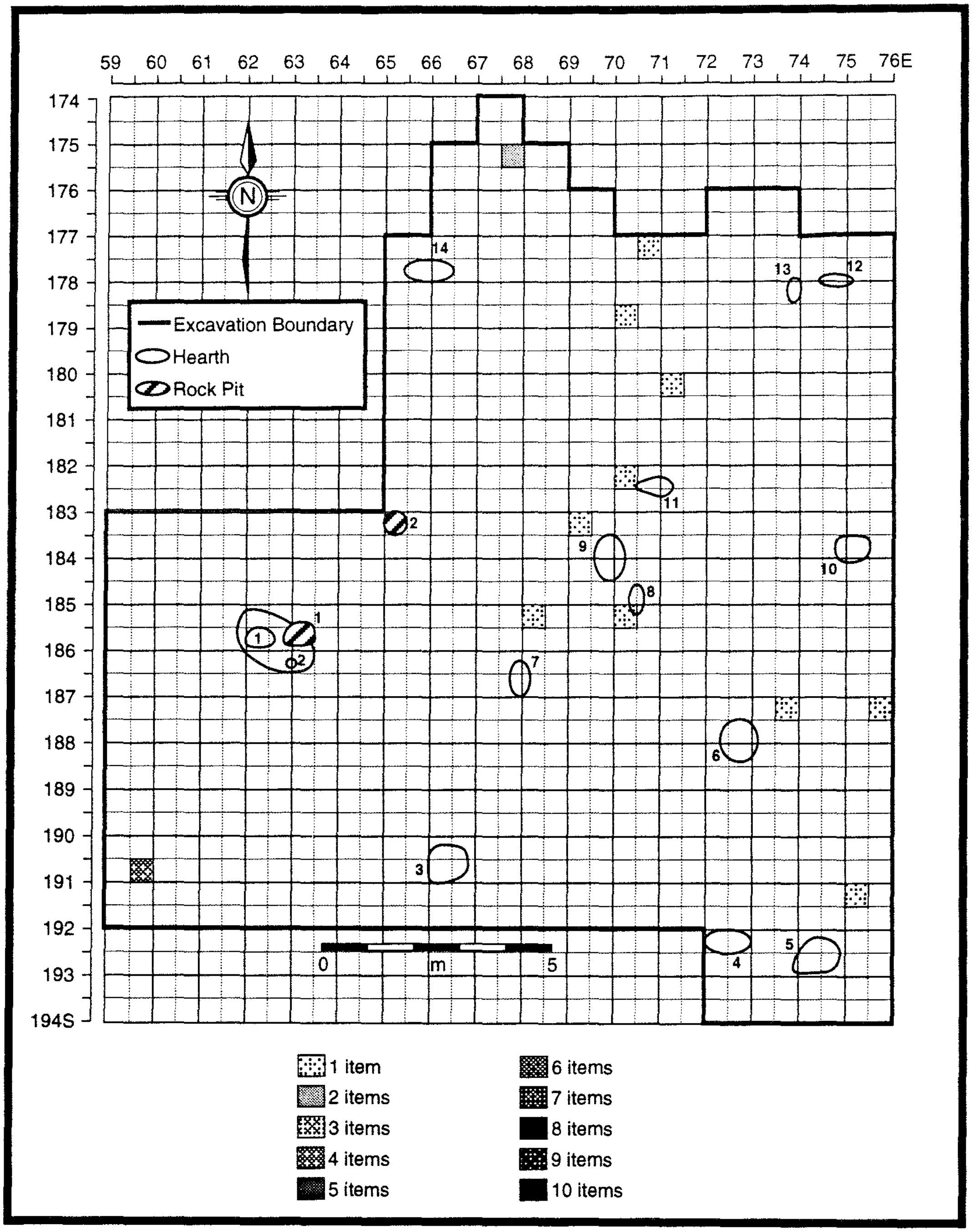

Figure 9 Block 2 – Elk NISP Distribution

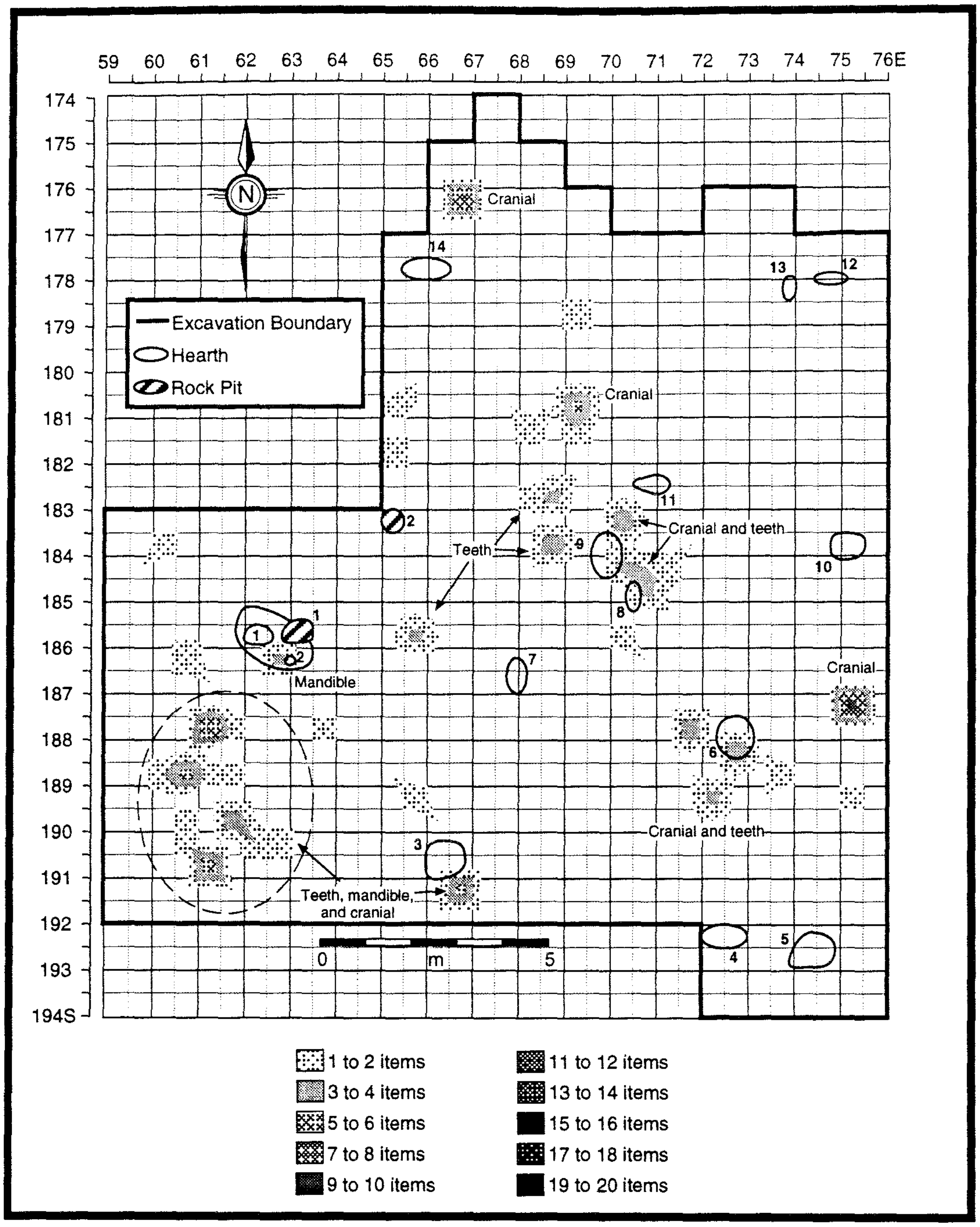

Figure 10 Block 2 – Beaver Cranial NISP Distribution

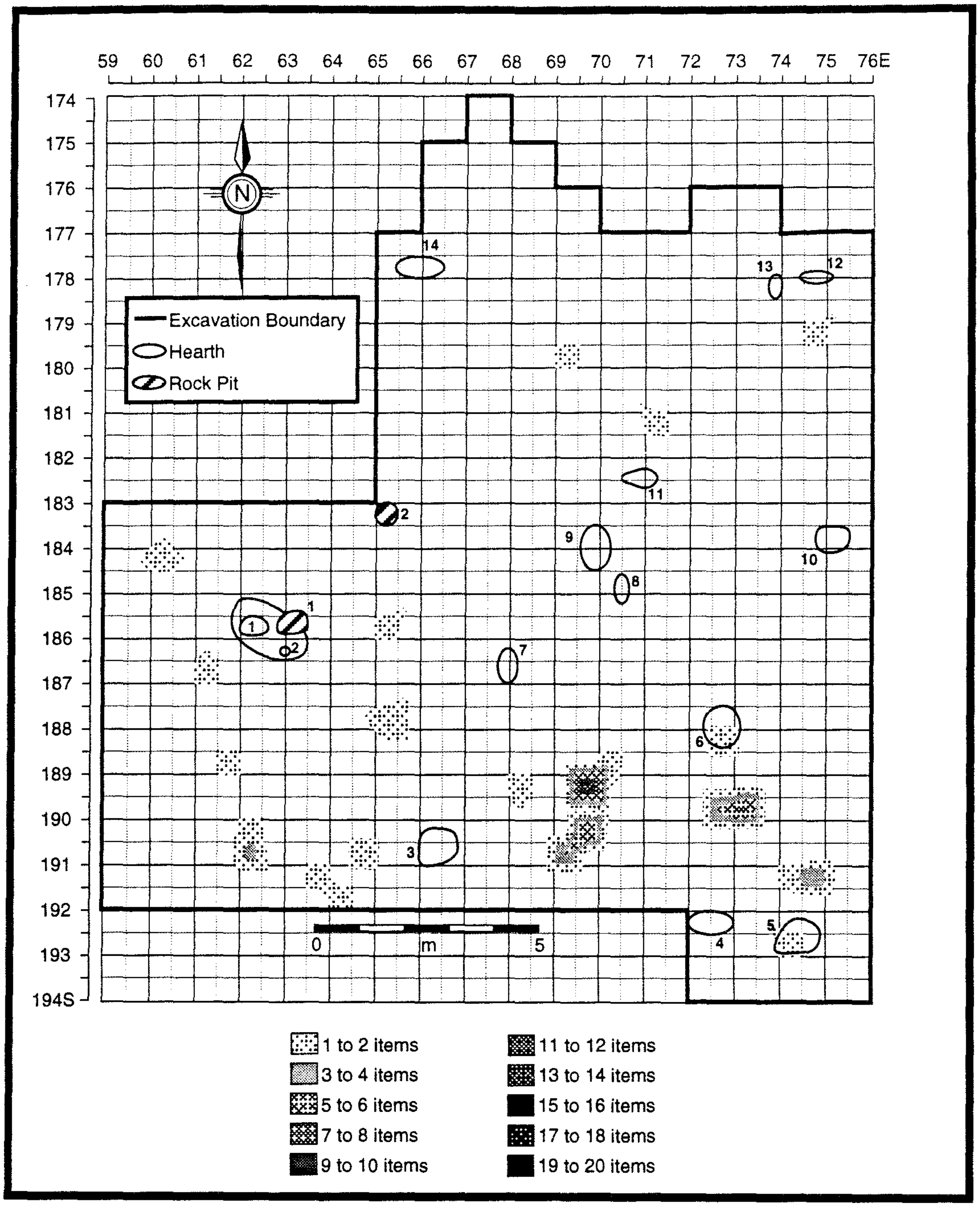

Figure 11 Block 2 – Beaver Vertebrae NISP Distribution

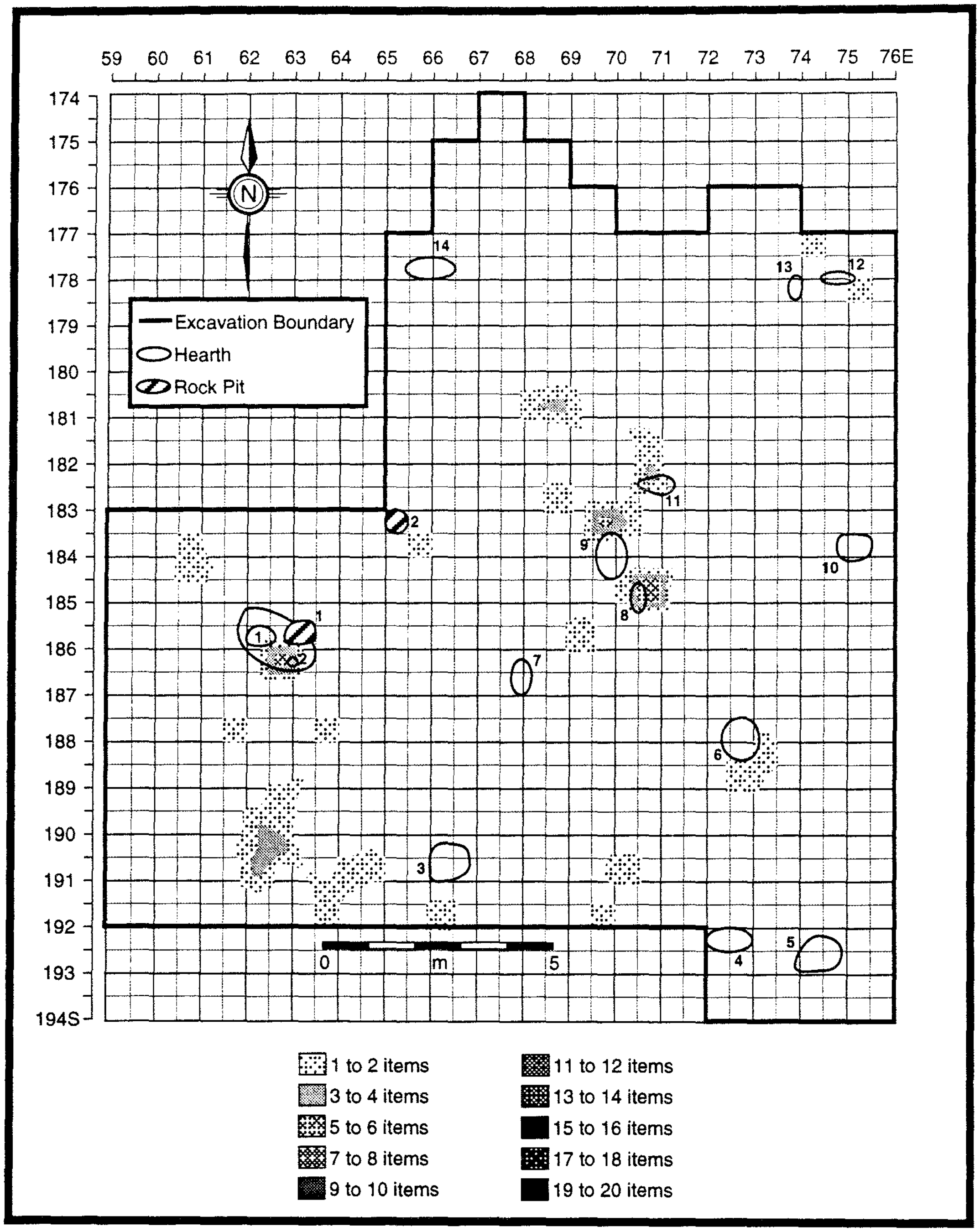

Figure 12 Block 2 – Beaver Rib NISP Distribution

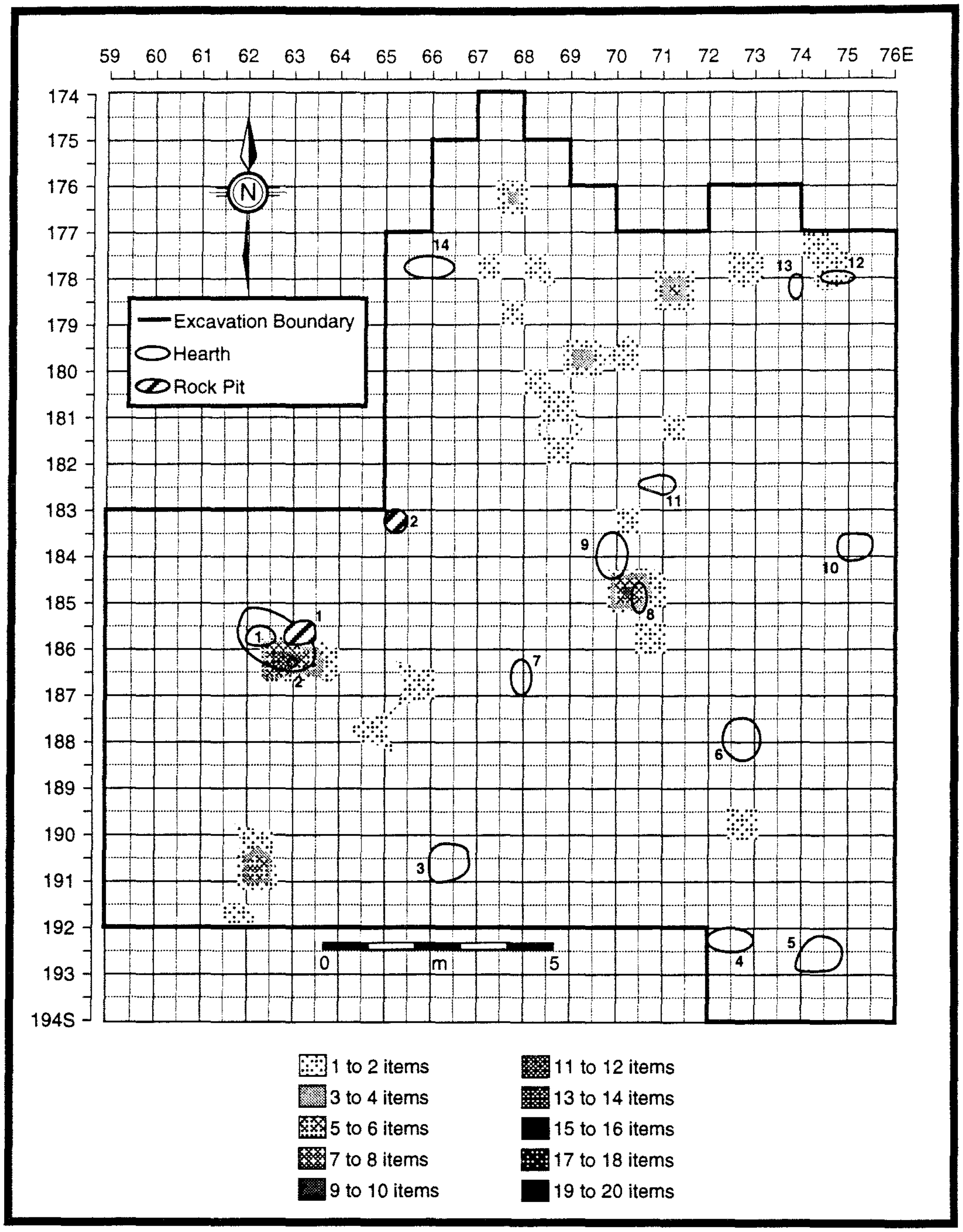

Figure 13 Block 2 – Beaver Forelimb NISP Distribution

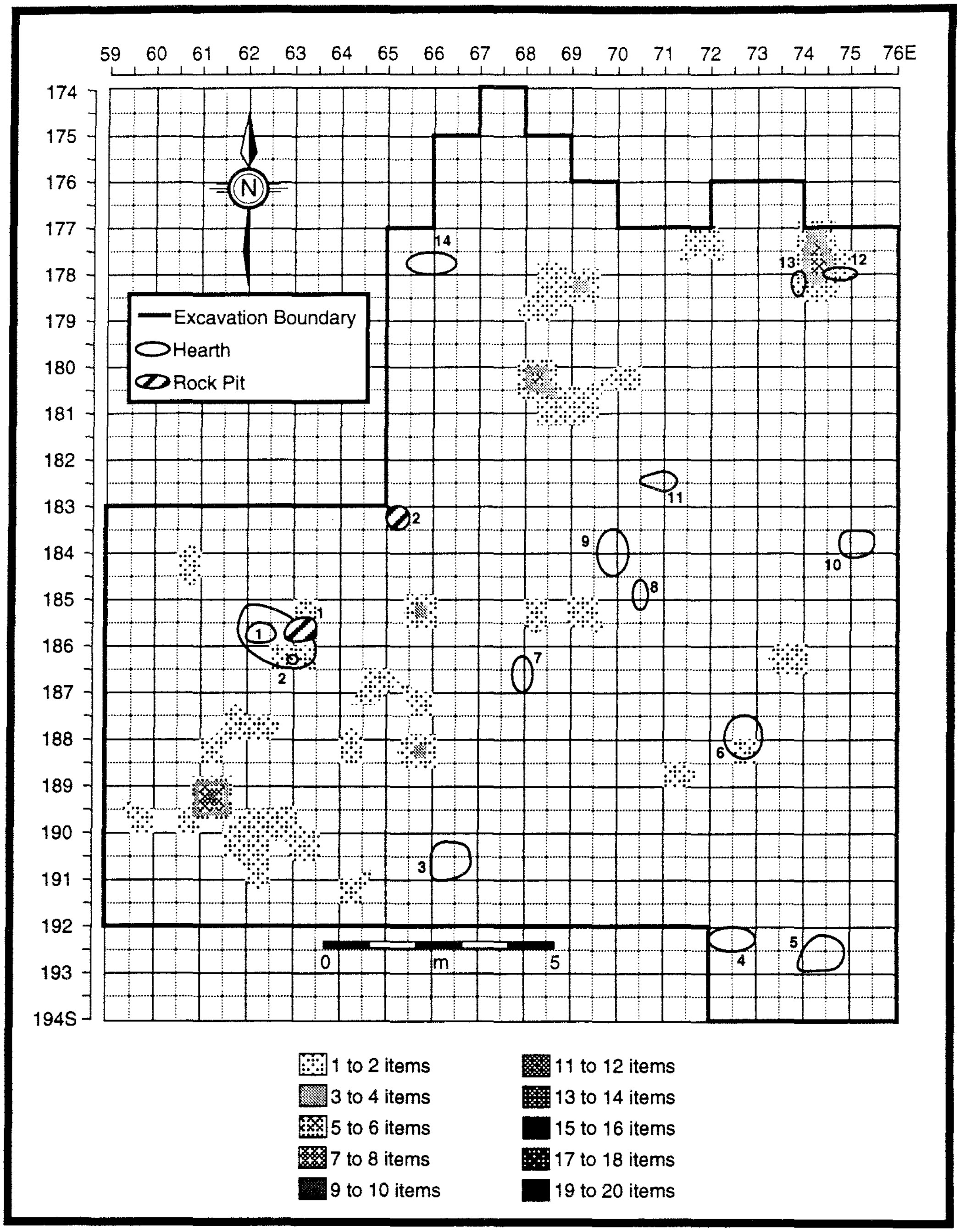

Figure 14 Block 2 – Beaver Hindlimb NISP Distribution

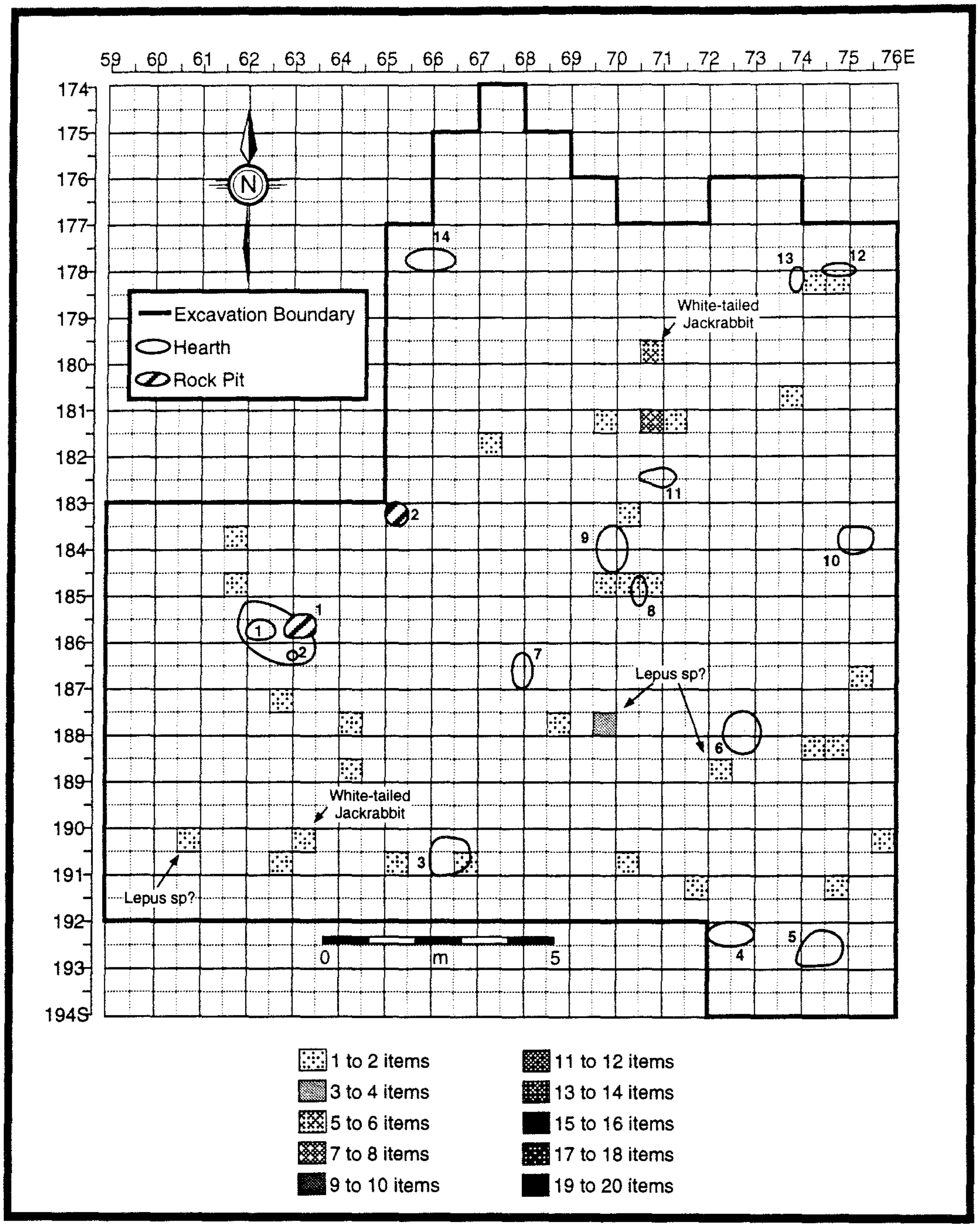

Figure 15 Block 2 – Snowshoe Hare, White-tailed Jackrabbit, and *Lepus* sp. NISP Distribution

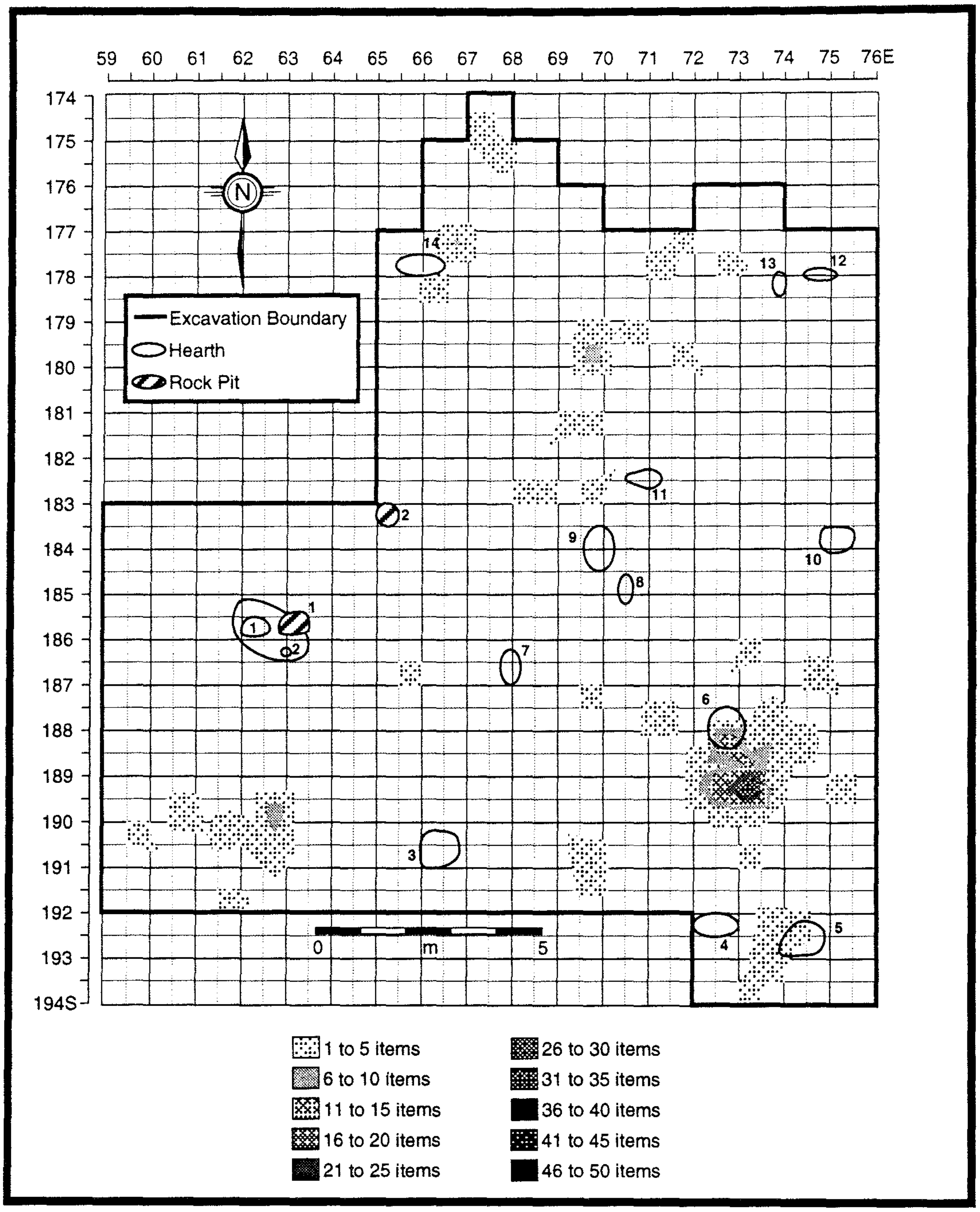

Figure 16 Block 2 – Aves NISP Distribution

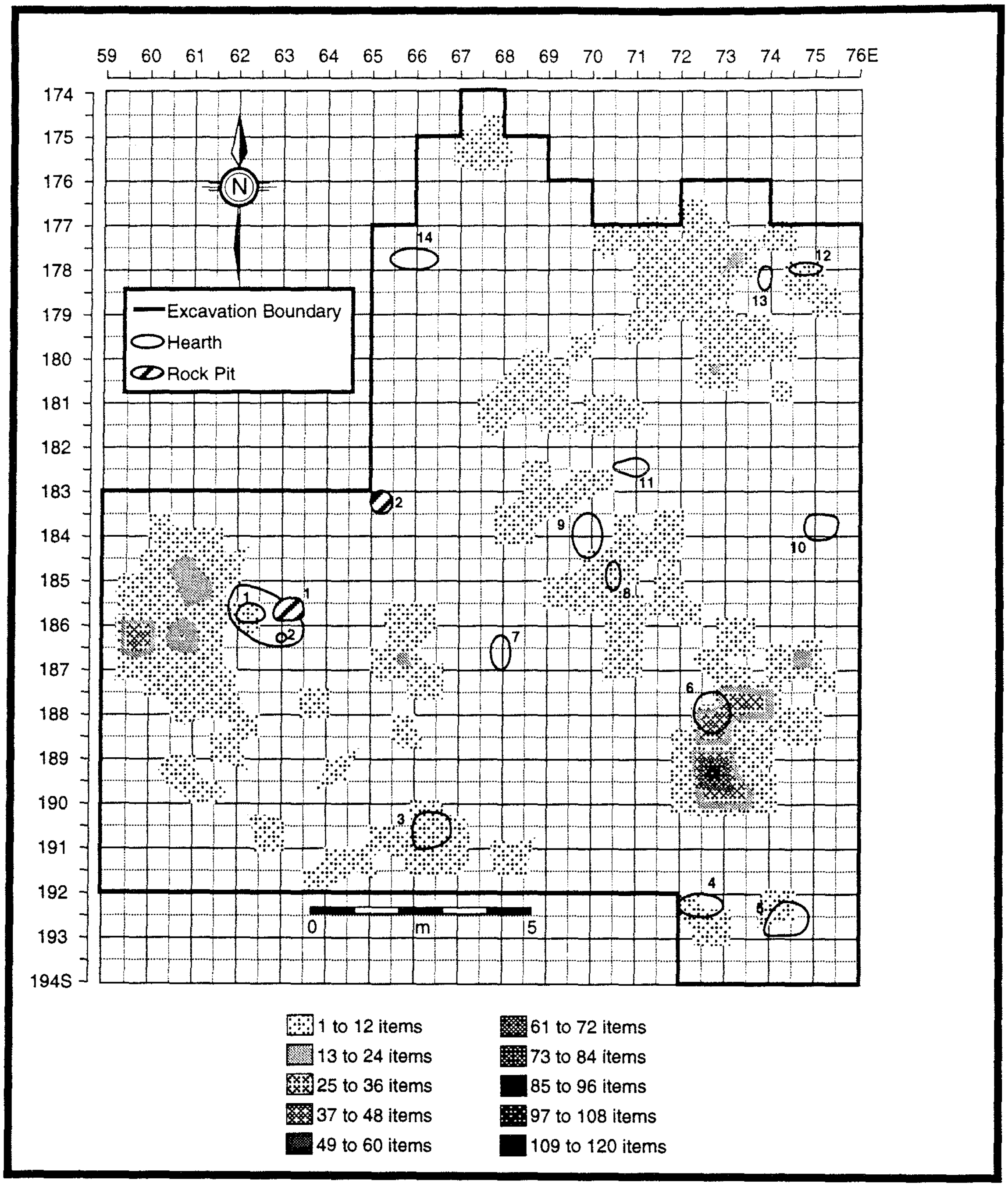

Figure 17 Block 2 – Osteichthyes NISP Distribution

APPENDIX D

Bushfield West - Block 3 NISP Distributions

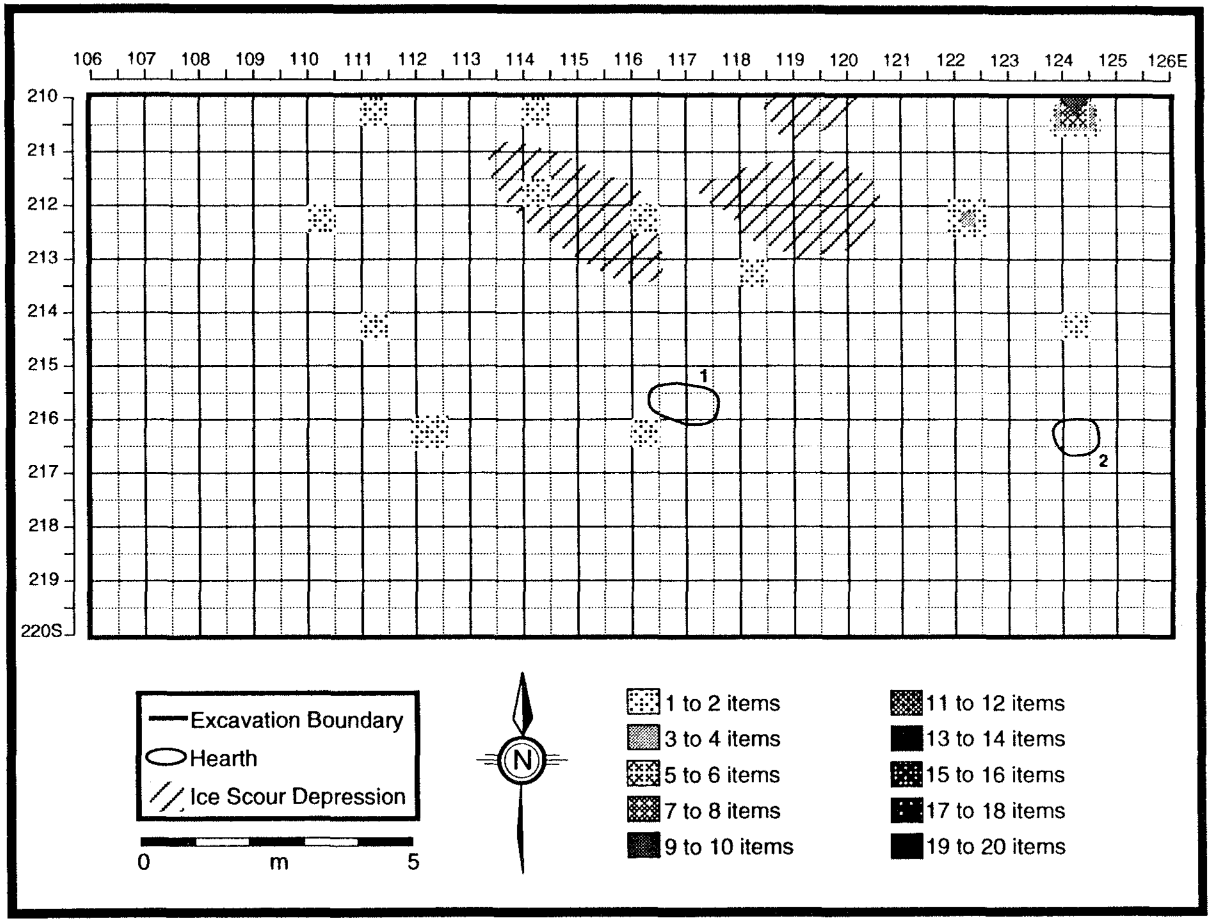

Figure 1 Block 3 – Bison Cranium NISP Distribution

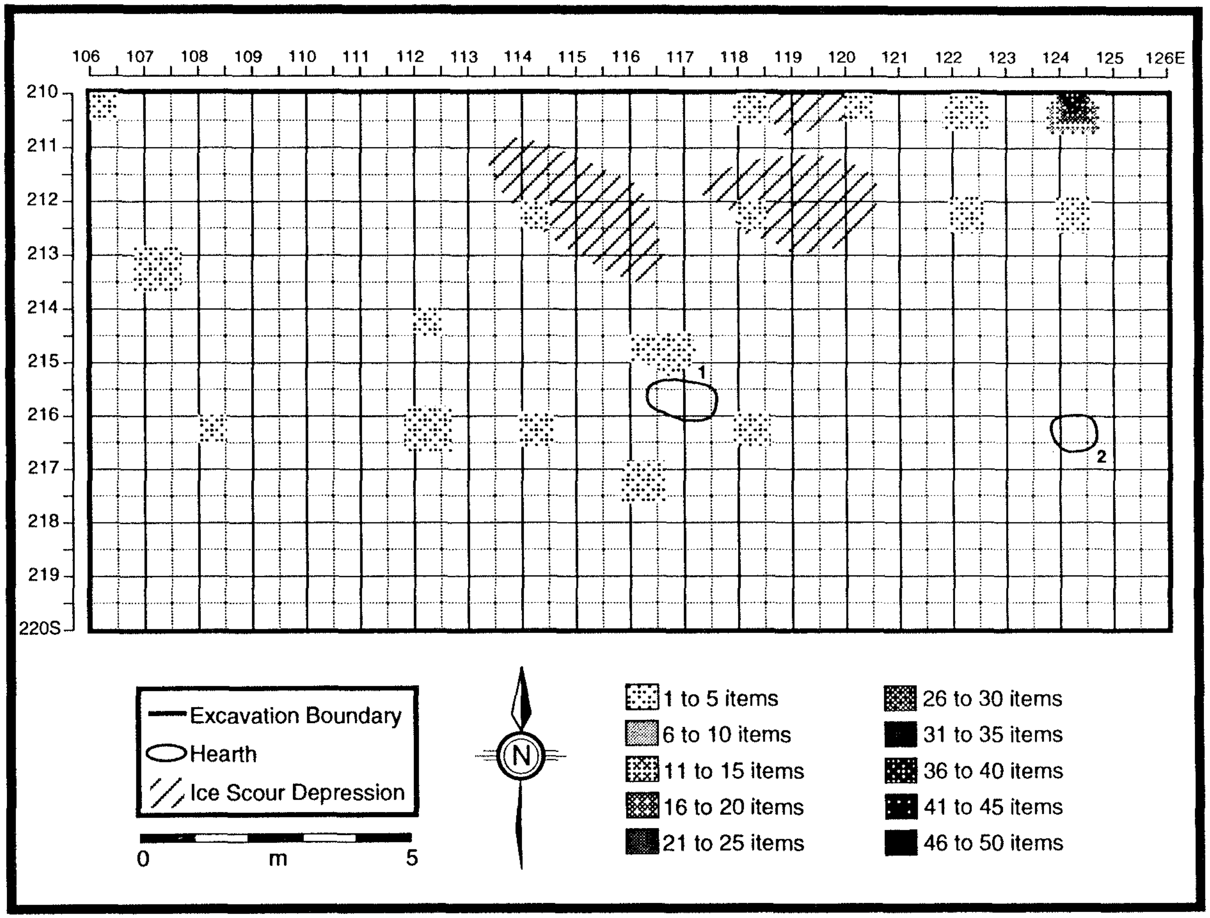

Figure 2 Block 3 – Bison Forelimb NISP Distribution

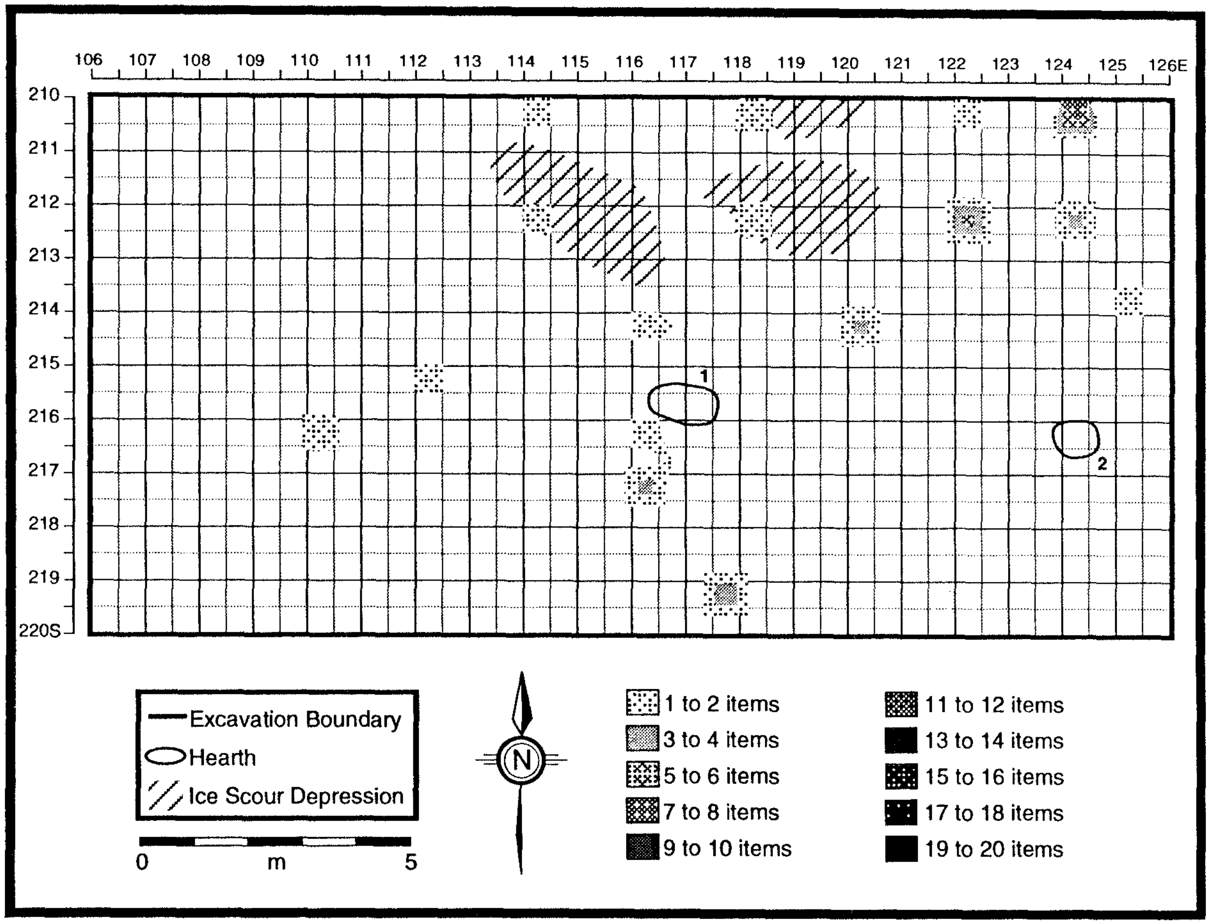

Figure 3 Block 3 – Bison Hindlimb NISP Distribution

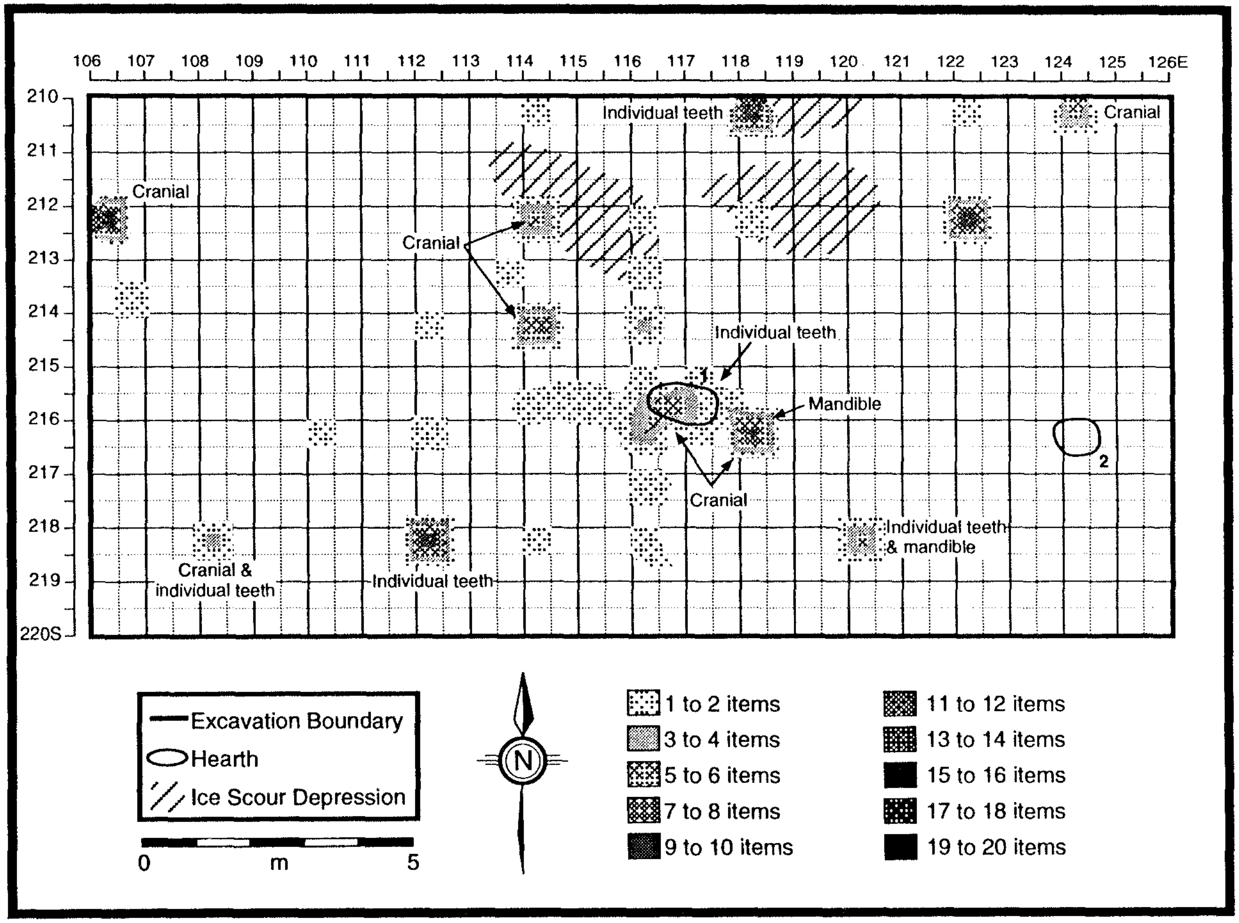

Figure 4 Block 3 – Beaver Cranial NISP Distribution

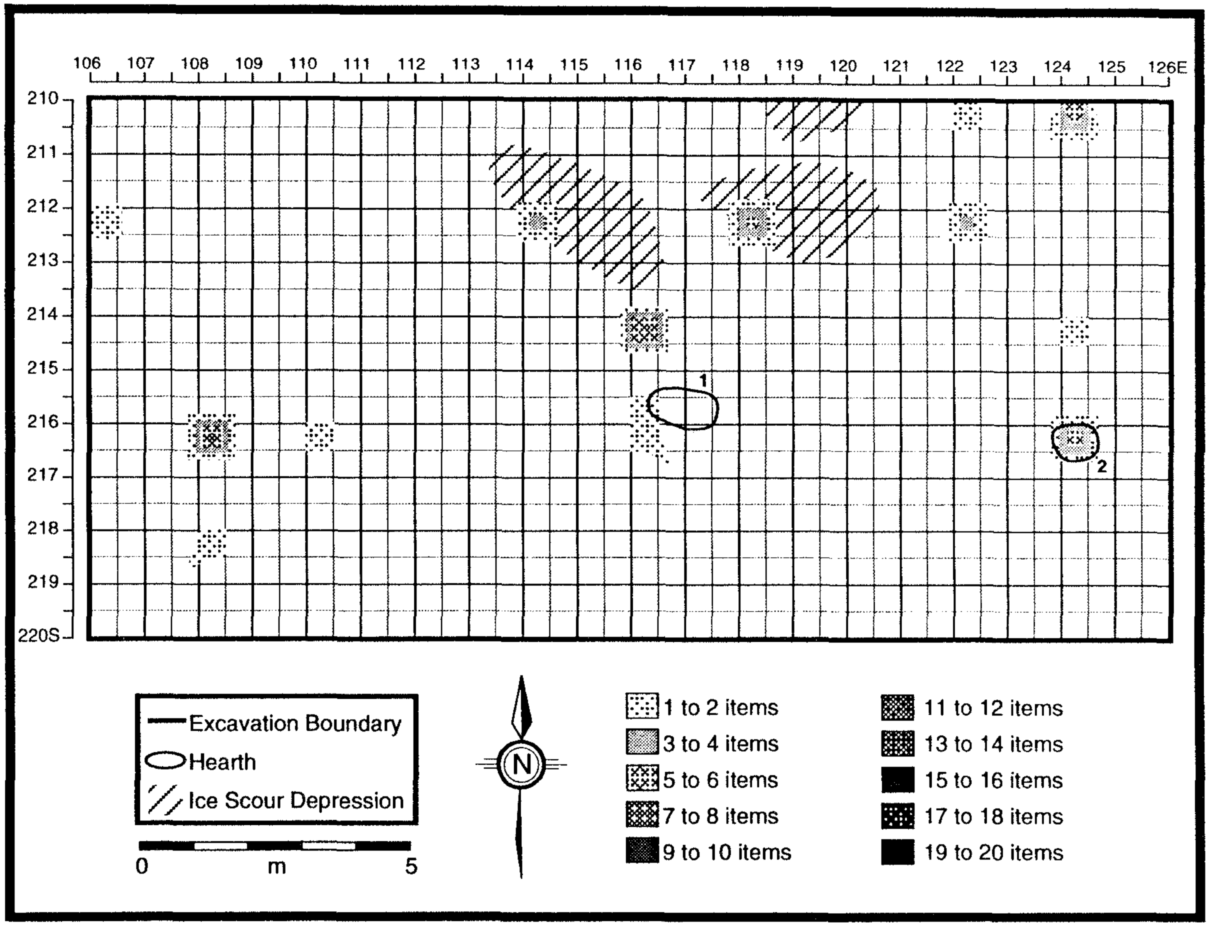

Figure 5 Block 3 – Beaver Vertebrae NISP Distribution

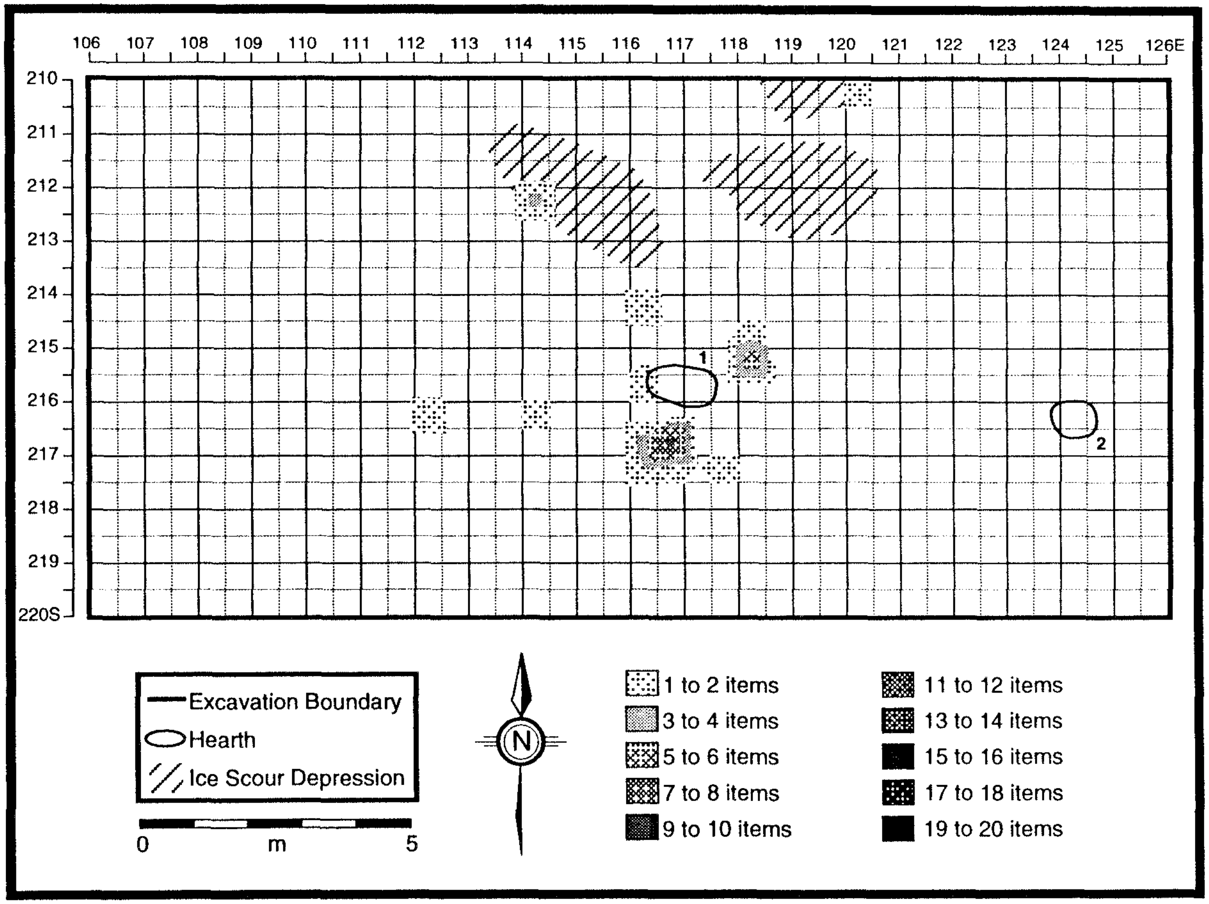

Figure 6 Block 3 – Beaver Rib NISP Distribution

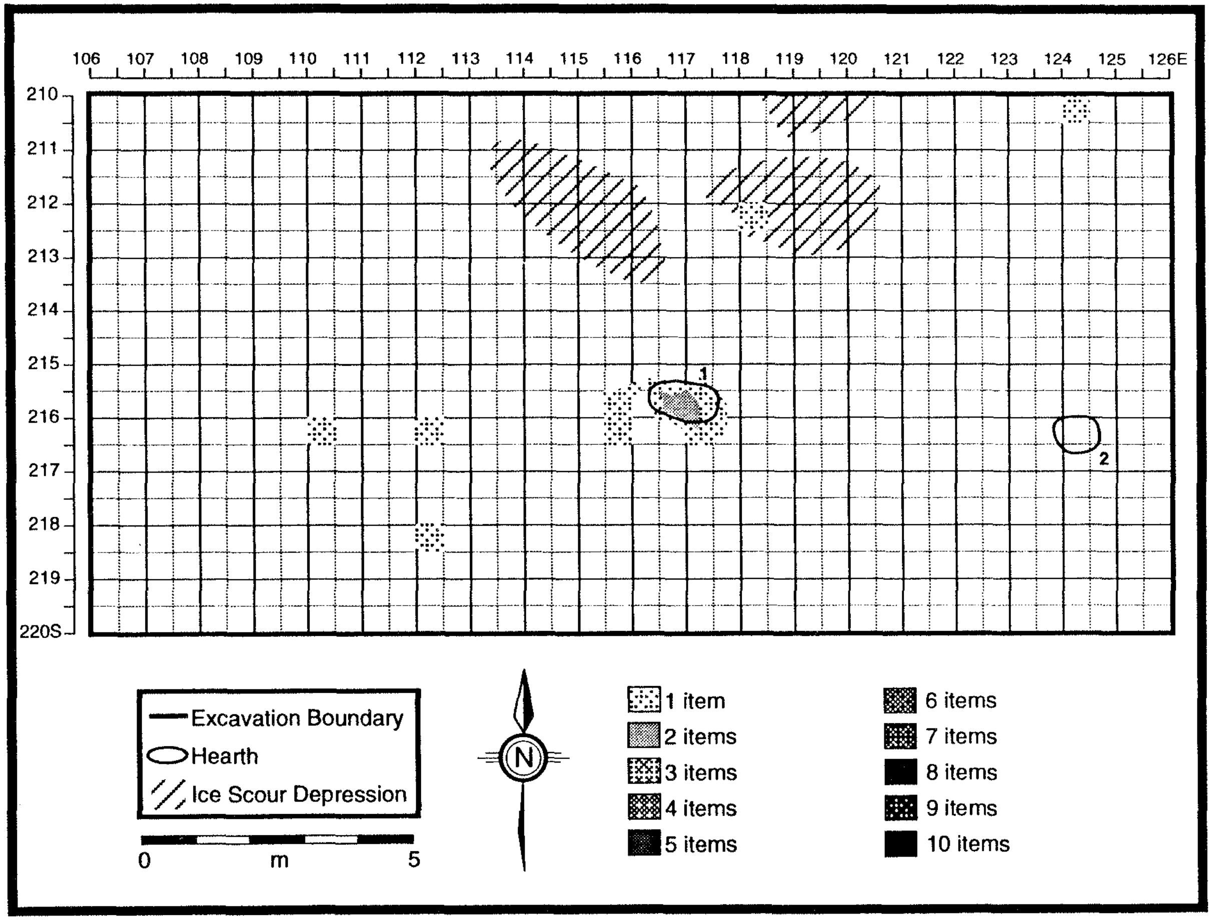

Figure 7 Block 3 – Beaver Forelimb NISP Distribution

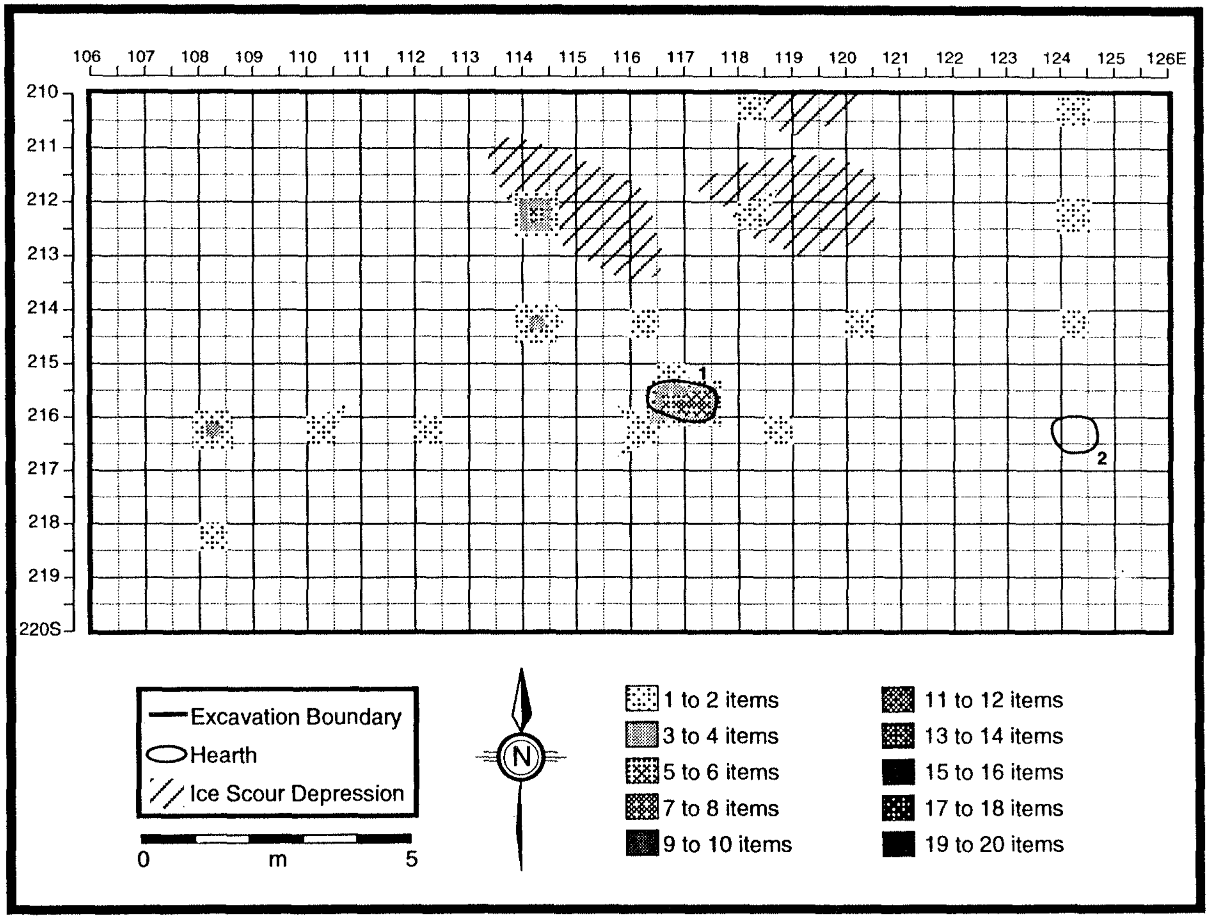

Figure 8 Block 3 – Beaver Hindlimb NISP Distribution

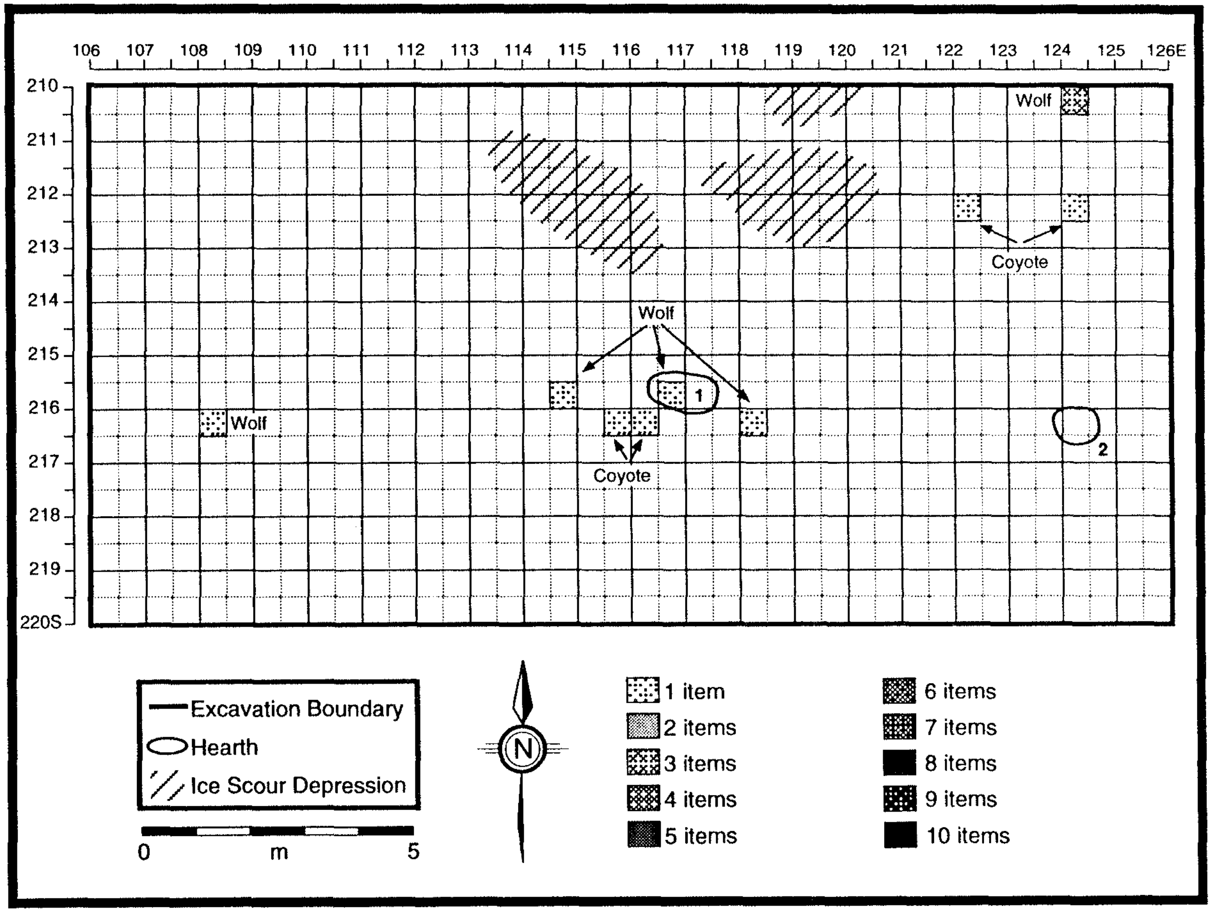

Figure 9 Block 3 – Canid NISP Distribution

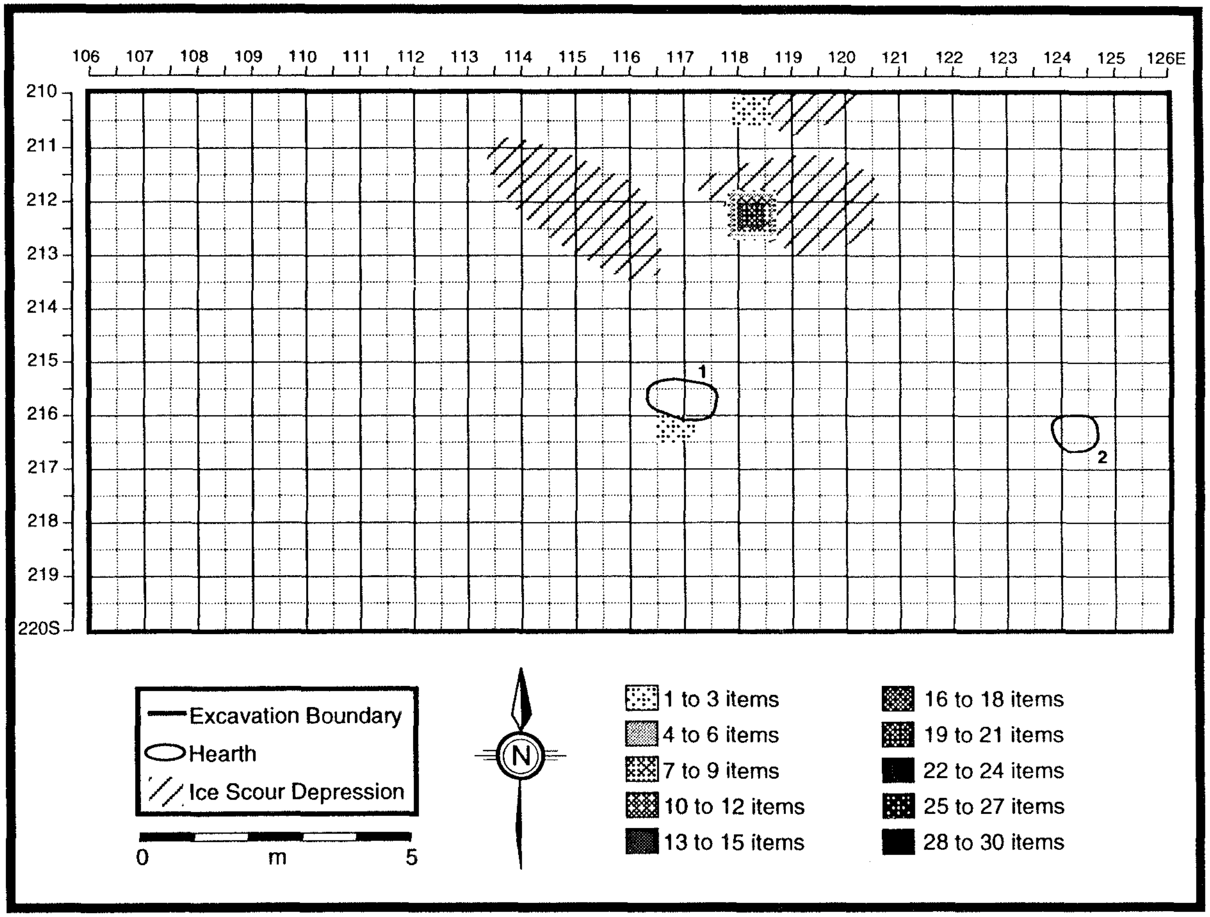

Figure 10 Block 3 – Geese NISP Distribution

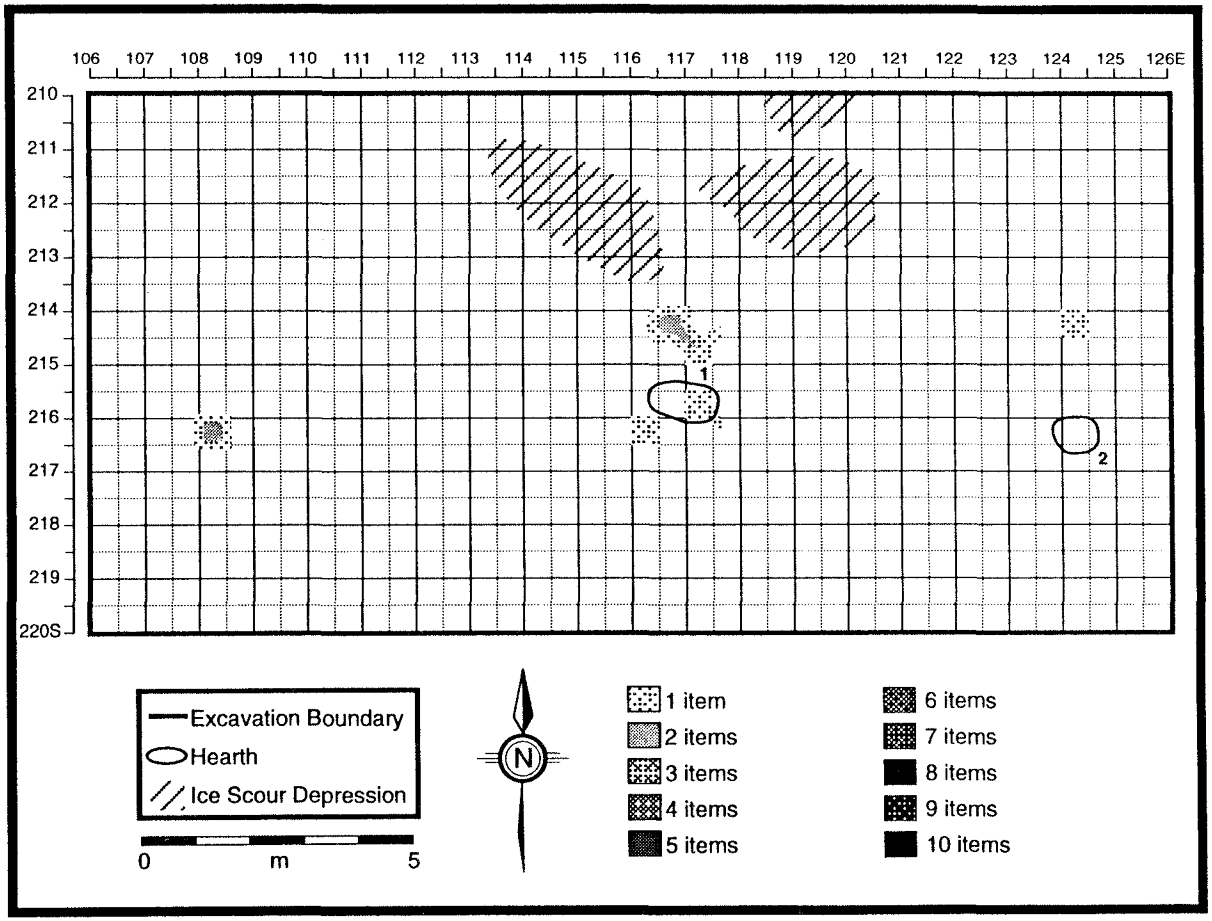

Figure 11 Block 3 – Gamebird NISP Distribution

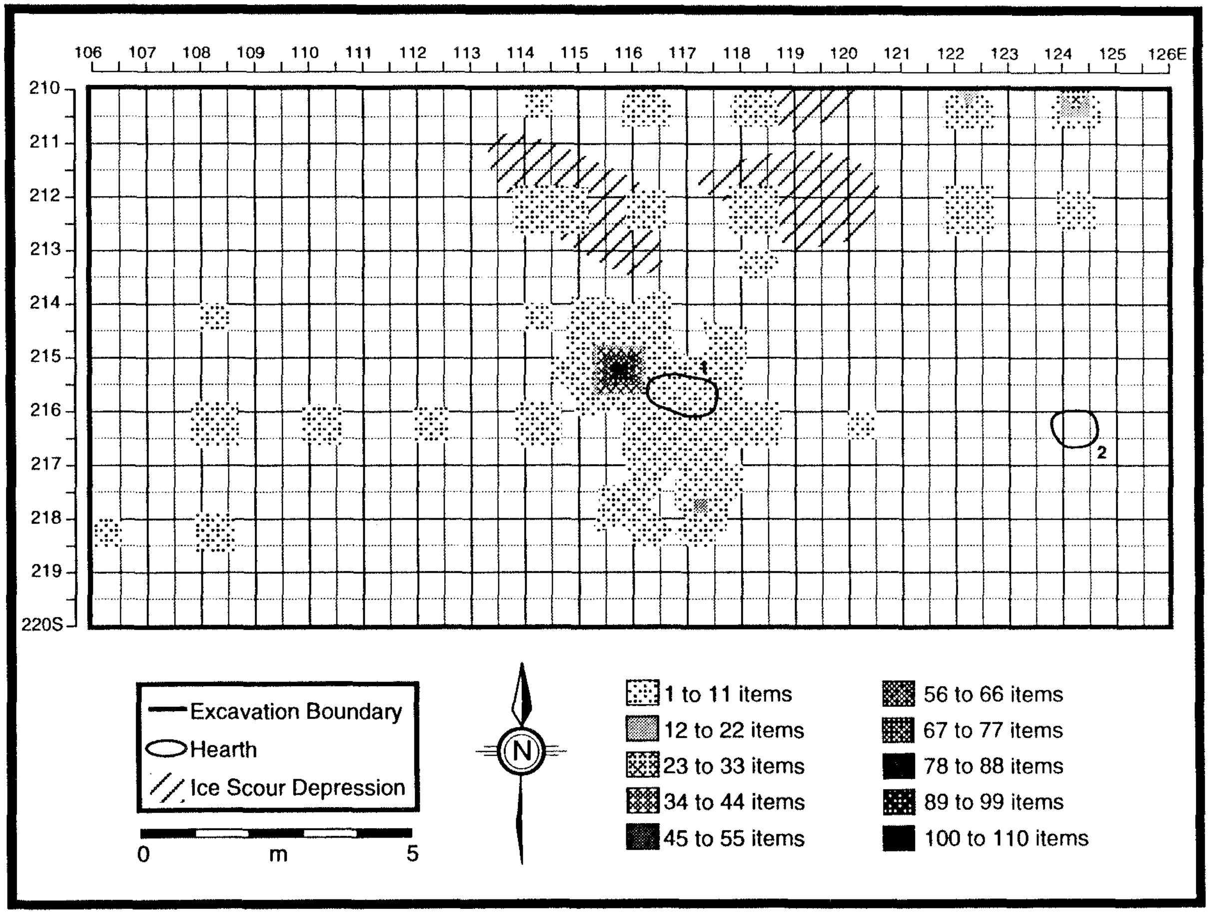

Figure 12 Block 3 – Osteichthyes NISP Distribution

APPENDIX E

Bison Teeth Measurements

Table 1 Lower dp4 Measurements

Cat. No.	Alveolar len.	Greatest wid.	G. Len. WF	Ex.Mid. C. Height
16656	20.1	23.73	23.73	14.1
27401	24.4	28.8	28.7	17.2
19038	23.9	27.9	27.7	11.4

*Alveolar len., alveolar length; Greatest wid., greatest width; G. Len. WF, greatest length of wear facet; Ex.Mid. C. Height, external mid crown height. Greatest width for dp4 is measured at the base of the anterior crescent.

Table 2 Lower M1 Measurements

Cat. No.	Meta.	len.	wid. at base	wid. at wear	exo. height	exo. wear
26851	31.6	27.2	19.1	15.6	20.6	-
24378	24.0	25.4	19.0	16.9	29.8	-
25057	39.0	28.0	17.6	13.8	34.3	-
19226	39.7	29.0	17.5	14.7	34.5	-
34366	48.5	31.2	18.8	13.2	40.2	-
25518	20.9	25.1	19.4	17.9	19.2	-
27151	37.3	31.6	20.7	17.3	29.1	-
24458	9.6	27.7	18.5	16.7	12.5	-
25239	21.2	25.1	19.2	16.4	17.4	-
31251	31.8	26.91	18.9	15.0	29.1	-
24460	7.1	19.4	13.1	14.4	3.0	-
27757	36.5	31.4	20.8	17.0	30.2	-
20438	51.3	32.7	20.4	13.2	42.4	6.3
20015	33.75	26.0	15.8	13.5	30.4	-

*Meta., metaconid height; len., M1 length; wid. at base, width at base; wid. at wear, width at wear; exo height, exostylid height; exo wear, exostylid wear.

Table 3 Lower M2 Measurements

Cat. No.	Meta.	len.	wid. at base	wid. at wear	exo height	exo wear
25642	-	34.57	19.3	13.8	44.7	20.0
31939	71.7	38.7	20.9	13.4	51.2	8.1
31250	50.4	32.6	20.8	15.2	42.4	4.7
23729	-	39.4	-	11.9	-	11.5
23730	-	-	-	-	-	4.6

*Meta., metaconid height; len., M2 length; wid. at base, width at base; wid. at wear, width at wear; exo height, exostylid height; exo wear, exostylid wear.

Table 4 Lower M3 Measurements

Cat. No.	Meta	len.	wid. at base	wid. at wear	exo height	exo wear
28216	-	43.5	18.8	14.3	27.9	-
33110	-	44.5	16.5	11.2	-	18.2
29417/ 29423	-	44	17.3	15.3	-	4.1
25643	63.3	39.4	15.9	10.9	24.2	29.2
24070	42.4	43.4	18.0	16.3	28.3	-
24071	42.5	42.8	-	15.8	-	-

*Meta., metaconid height; len., M3 length; wid. at base, width at base; wid. at wear, width at wear; exo height, exostylid height; exo wear, exostylid wear.

Table 5 Upper dp4 Measurements

Cat No.	Alveolar len.	Greatest wid.	G Len WF	End height
16656	19.9	19.9	26.6	14.4
25031	21.8	21.1	26.3	13.5
27400	24.9	25.5	32.5	13.7
19003	23.6	24.0	30.5	10.68
23584	24.1	22.4	-	13.8

*Alveolar len., alveolar length; Greatest wid., greatest width; G. Len. WF, greatest length of wear facet; End height, endostyle height. Greatest width for dp4 is measured at the base of the anterior crescent.

Table 6 Upper M1 Measurements

Cat. No.	Par.	A. len	A. wid	C. len.	C. wid.	Endo. hght.	Endo.wear
17548/ 17563	22.4	23.5	25.4	21.0	19.8	20.5	-
16656	51.7	29.3	18.0	31.0	15.9	32.5	13.8
25137	42.0	25.3	24.6	30.0	18.6	1.5	34.0
24567	35.9	23.4	27.5	30.3	19.3	33.5	-
23644	21.4	22.7	27.4	26.4	26.5	13.1	-
20442	36.0	29.3	27.2	21.7	31.6	33.5	-
23880	40.4	28.4	27.7	32.4	22.3	38.23	-
23879	25.2	22.1	26.3	22.1	25.7	23.6	-
23608	38.4	32.8	30.2	32.9	24.7	34.6	-
23617	54.5	32.2	19.7	35.7	18.5	33.2	11.3

*Par., paracone height; A. len, alveolar length; A. wid, alveolar width; C. len., crown length; C. wid., crown width; Endo. hght., endostyle height; Endo. wear, endostyle wear.

Table 7 Upper M2 Measurements

Cat. No.	Para.	A. len	A. wid.	C. len.	C. wid.	Endo hght.	Endo wear
17548/ 17563	29.8	28.9	24.2	31.3	21.1	-	-
17566/ 17595	38.7	32.9	26.5	35.1	24.1	32.6	-
27399	-	32.5	21.8	36.2	21.4	38.8	15.4
24622	49.1	31.3	25.8	33.6	24.2	29.1	-
24566	52.3	32.8	24.6	34.5	22.5	30.3	10.2
19039	-	31.7	23.3	36.6	19.6	31.1	16.0
22738	-	31.0	26.0	32.1	21.9	-	-
23617	54.5	32.2	19.7	35.7	18.5	33.2	11.3
23598	39.2	33.4	29.6	35.3	23.8	39.2	33.2

*Par., paracone height; A. len, alveolar length; A. width, alveolar width; C. len., crown length; C. wid., crown width; Endo. hght., endostyle height; Endo. wear, endostyle wear.

Table 8 Upper M3 Measurements

Cat. No.	Para.	A. len	A. wid.	C. len.	C. wid.	Endo hght.	Endo wear
17584/ 17563	37.9	31.8	25.2	33.6	21.1	27.5	-
17678	61.6	30.5	24.5	29.7	18.0	31.3	18.6
24180	26.8	32.1	26.5	32.5	28.5	24.0	-
34011	-	31.7	26.8	32.8	23.7	27.1	2.8
30106	-	31.7	26.5		21.4	29.3	1.5
20446	-	32.0	23.0	32.4	23.0	-	-
23881	50.6	30.8	26.8	31.8	20.3	34.9	2.6
19627	63.9	31.6	22.4	34.9	19.0	41.8	13.5
22737	48.5	30.6	20.1	30.5	21.6	34.6	-

*Par., paracone height; A. len, alveolar length; A. width, alveolar width; C. len., crown length; C. wid., crown width; Endo. hght., endostyle height; Endo. wear, endostyle wear.