THE HARTLEY SITE (FaNp-19): INTERPRETING A TRANSITIONAL AVONLEA / OLD WOMEN'S FAUNAL ASSEMBLAGE

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ABSTRACT

The Hartley site (FaNp-19) is a Late Prehistoric multi-component habitation site containing a Mortlach and an Avonlea/Old Women's occupation. The faunal assemblage from the Avonlea/Old Women's occupation contains at least 22 species of vertebrates and at least four genera of invertebrates. These materials have been analyzed to establish the seasonality of the occupation as well as the palaeoenvironment and biogeography of the site area. Analyses of the faunal material helped to establish that the occupation was a single event. The occupation began in the late fall/early winter and continued through to the late winter/early spring. The environment of the region appears to have been similar to the modern environment although the site area itself may have been slightly damper.

Several factors, including the site positioning and the wide diversity of faunal species, may relate to the season of occupation. Faunal assemblages from sites such as Amisk, Long Creek, Lucky Strike, Tschetter, Lebret and Miniota in Saskatchewan and southern Manitoba show some similarities to the Hartley site remains. It is proposed that the procurement and settlement strategies in this region reflect the season of occupation. Sites with a winter seasonality are associated with areas of trees such as the Aspen Parkland or valley complexes and are often occupied for extended periods of time. These occupations may begin with a single large bison kill, but this may be followed through the winter by smaller attritional style kills. Sites which are occupied into the spring will exhibit a particularly diverse range of species.

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I dedicate this thesis to my grandfather T. Willis Clarke for introducing me to the wonders of the past and to Cathleen for being with me in my present and future.

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LIST OF ABBREVIATIONS

NISP	Number of Identified Specimens
MNE	Minimum Number of Elements
MNI	Minimum Number of Individuals
MAU	Minimum Animal Units
%MAU	Percent Minimum Animal Units
MGUI	Modified General Utility Index
(S)MAVGTP	Standardized, modified averaged total product utility model
Cat. #	Catalogue Number
dP	Deciduous premolar
P	Adult premolar
M	Adult Molar
IMMAT	Immature
F/I	Female/Immature
L	Left
R	Right
Eq.	Equation
DIF	Difference between two discriminant function equations.
L	Length
La	Anterior length
Ll	Lateral length
Lm	Medial length
Lt	Length of the talus facet on the calcaneus
Lc	Length of the fused central and fourth facet on the calcaneus
W	Width
Wp	Proximal width
Wd	Distal width
D	Depth
Dl	Lateral depth
Dm	Medial depth
sp.	A single unknown species
spp.	More than one unknown species
cf.	Taxa which "show an affinity towards"
B.P.	Before present
A.D.	*Anno Domini*
cal	calibrated
FCR	Fire-cracked Rock
N	North
E	East
r	Spearman's rho
p	Probability
N	Number of Ranks

CHAPTER 1

INTRODUCTION

1.1 Introduction of Thesis Problem

In the past few decades faunal analysis has become a prominent aspect of archaeology on the Northern Plains. The majority of the sites which have been investigated, however, are bison kill or processing sites. Kill sites are excellent data bases for bison studies due to their large sample size and the relative completeness of the elements present. However, these sites limit studies to the analysis of bison remains. Habitation sites often have more species represented but they often have limited sample sizes. There are, of course, exceptions such as the Amisk (Amundson 1986), Garrett (Morgan 1979), Long Creek (Wettlaufer 1960), McIntosh (Koch 1995) and Redtail (Ramsay 1994) sites. The analysis of these sites and others has revealed that although bison is the predominant animal represented in Northern Plains sites, other animal remains are often recovered as well. Smaller animals are often a significant part of the faunal assemblages at habitation sites and regularly occur in smaller numbers in bison kill and processing sites. Frequently, however, little attention is paid to these other taxa. These "non-bison, lesser or other" fauna are often simply mentioned in a small table after the analysis of the bison remains is complete. While bison may be the dominant species in the assemblage, the less abundant species are also very important in understanding the history of the occupation.

The Hartley site (FaNp-19) is a Late Prehistoric site located in central Saskatchewan (Figure 1.1), approximately one kilometre south of the city of

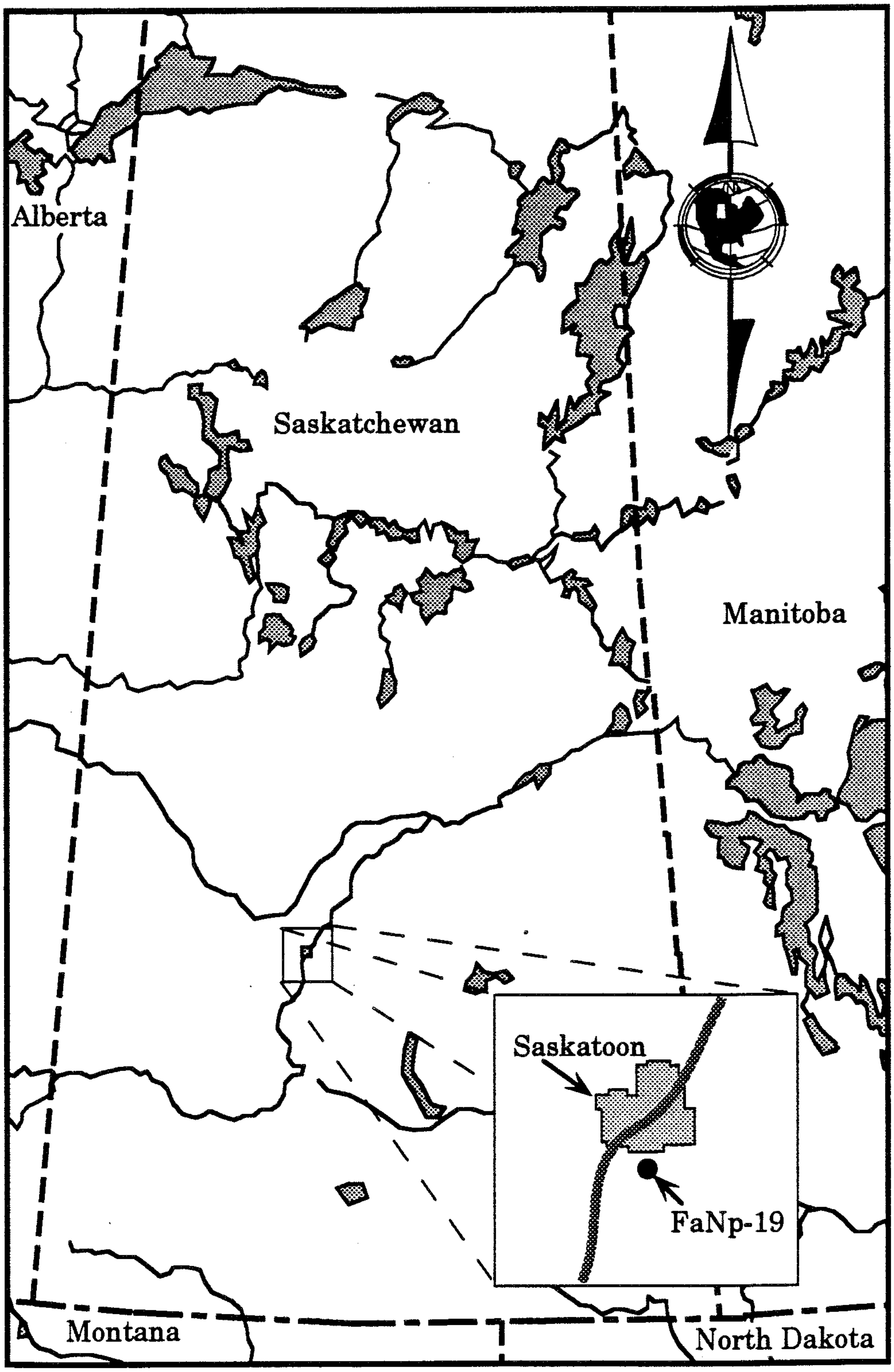

Figure 1.1 Map of Saskatchewan showing the location of the Hartley site (FaNp-19).

Saskatoon. The majority of the site has been disturbed by cultivation, but a few areas of intact deposits still remain in low lying areas and in two small groves of trees. The University of Saskatchewan, Department of Anthropology and Archaeology field school has conducted excavations at the site from 1988 through 1995. During the first three years (1988, 1989, 1990) at the site the students excavated a total of 49.5 m^2 within the intact area of occupation in the southern wooded depression. The artifact assemblage recovered in these excavations includes a wide variety of cultural materials and faunal remains. Cultural materials include ceramics and projectile points relating to the Avonlea and Old Women's cultural phases. Bifaces, scrapers and other lithic and bone tools are also found and it has been suggested that this was a habitation site (Meyer and Clarke 1991; Clarke and Meyer 1992). These artifacts are believed to relate to a single occupation event. The faunal remains are now known to include at least twenty-two different species of birds, fish, and mammals as well as at least one species of pelecypod (fresh water mussel) and three genera of gastropods (snails).

This thesis is a detailed analysis of the faunal material from the first three years of excavation at the Hartley site, carried out in order to establish: 1) that the material is from one occupation, 2) the season of occupation, 3) the importance of certain species in reconstructing the palaeoecology and biogeography of the region, and 4) that the site is a habitation area or base camp. It is hoped that this analysis will aid in the understanding of the procurement and settlement strategies utilized by the inhabitants of the Northern Plains prior to European contact.

This thesis will attempt to address these goals in four stages:

1) Identify the different taxa present at the site and determine the relationship of these taxa with one another. This will include determining if the

faunal remains are in fact related to the occupation or if they are intrusive in any way.

2) Determine the season of occupation at the site through a variety of techniques. This will include the analysis of several different taxa in order to establish the most accurate season of occupation possible.

3) Discuss the biogeography of some of the species present and discuss their importance to the understanding of the palaeoecology of the area.

4) Discuss the faunal remains which exhibit cultural modifications such as cut marks and polishing.

The site features within the 1988, 1989, and 1990 excavated area will then be discussed in relation to the distribution of the pottery, lithic tools and debitage, fire-cracked rock and burned and unburned faunal materials. The utility of the bison remains will be addressed using Emerson's (1990) standardized, modified averaged total products model. Site type distinction will be carried out through the application of a model such as the one proposed by Sivertsen (1980).

1.2 Overview of the Chapters

Chapter two is designed to give an overview of the biophysical environment of the region and the general site characteristics. First, a brief history of the work at the site is presented. The physiography of the region, the stratigraphy and burial conditions of the Hartley site assemblage are then discussed. The cultural affiliations present in the site are then introduced and the radiometric dates are presented. The climate, and the fauna and flora are addressed at the end of the chapter.

Chapter three outlines the methods and techniques utilized during the excavation and analysis of the Hartley site. It begins with a description of the field work carried out by the field school students. The students excavated 49.5 m^2 during the 1988, 1989 and 1990 field schools, the results of which will be used as the basic data in this thesis. A description of the methods used at the site is based primarily on information in the interim reports submitted to the Government of Saskatchewan, Heritage Branch (Meyer 1990; Meyer and Clarke 1991; Clarke and Meyer 1992) as well as field notes taken by the students and their supervisors. Due to the enormous amounts of lithic debitage, fire-cracked rock (FCR), ceramic, faunal and floral remains in the fine-screen samples only one unit has been analyzed as an example of the materials present. The latter samples are from a unit in the southern block of the excavation area where the faunal materials are the most concentrated and preservation is good. This section also outlines how the fine-screen samples were obtained and sorted. The computer cataloguing and artifact / ecofact identification procedures are also detailed in this chapter. Chapter three will also include the background information on the quantitative methods used in the thesis. The terminology of quantitative faunal analysis is defined and discussed.

Due to the large difference in the amount of literature on bison and non-bison remains the bison remains are analyzed in a separate chapter. Chapter four begins with a brief introduction to the faunal assemblage as a whole, then the remainder of the chapter is devoted entirely to the bison materials recovered from the site. The quantitative aspects of the bison remains are addressed for the specimens present. Seasonality of the Hartley site, based on the bison materials, is presented based on the foetal elements using discriminant function analysis equations (Walde n.d.a) and the analysis of the mandibles. Two separate methods of gender analyses are utilized to determine the herd composition. The carpals and tarsals are analyzed based on the procedures outlined by Morlan (1991). The second method analyzes the fused long bone epiphyses using the discriminant function analysis equations outlined by Walde (n.d.b).

Chapter five presents the systematic descriptions of the non-bison taxa present in the Hartley site faunal assemblage. The fish specimens were analyzed by Eric Simmonds, Winnipeg, Manitoba to identify the species present in the assemblage. Avifauna offer a number of means to establish the seasonality of the site. Migratory birds, including various species of waterfowl, are only present on the Northern Plains during specific times of the year and should not be present in assemblages during periods when they are in other parts of their range. The presence or absence of medullary bone in the long bones of some birds is also a seasonality indicator (Rick 1975). The use of rodent hibernation schedules as a seasonal indicator is also explored.

Chapter six will discuss the general diversity and distributions of faunal remains recovered from the Hartley site. Interpretations relating to the biogeography and palaeoenvironment of the site and the region will also be discussed.

Chapter seven addresses the intra-site variations in the Hartley site faunal assemblage. The distributions of lithic tools and debitage, pottery, fire-cracked rock and faunal materials are presented. These distributions are related to the archaeological features which are present within the excavated area of the site. The relative abundance of bison elements and their relation to Emerson's (1990) element utility indices are also discussed. The site type is confirmed through the application of Sivertsen's (1980) model of site type distinction. Chapter eight will begin with a brief comparison of the Hartley site to a few other Avonlea and Old Women's phase sites of the Northern Plains. This will be followed by the summary and conclusions.

CHAPTER 2.

SITE CHARACTERISTICS AND REGIONAL ENVIRONMENT

2.1 Site History

The Hartley site has been known since the 1930's and local amateur archaeologists collected artifacts through to the 1950's when limited excavations were carried out in the area by avocational archaeologist Ken Cronk (Meyer 1990). More recently, in 1987, three members of the Saskatoon Archaeological Society placed four small test holes in the eastern edge of the southern copse of trees. Three of these holes produced burned and unburned faunal remains and small amounts of debitage from a buried component (Meyer 1990). Later that year, Millenium Heritage Resource Consultants Limited conducted a reconnaissance of the area for Cairns Development Limited and suggested that more detailed work be carried out (Amundson and Kelly 1988). Systematic surface collection and subsurface auger testing of the area was conducted the next year (Amundson and Kelly 1988). This testing produced a considerable amount of faunal material, some debitage and pottery sherds, but no diagnostic artifacts. Two areas of intact occupation were identified. One of these was in a small grove of trees (Figure 2.1) and extended into parts of the surrounding field (Meyer and Clarke 1991). This was estimated by Millenium Consultants to consist of an approximately 2400m^2 area (Amundson and Kelly 1988:13). The second area was identified to the south east of the grove in a low lying area in the cultivated field. Other areas of intact occupation were later identified in the

Figure 2.1 View of the site area facing north with wooded areas with intact occupation visible on the left and background of the photograph.

groves of trees on the east side of Preston Avenue and in the aspen grove to the north.

The site has most recently become the focus of the University of Saskatchewan, Department of Anthropology and Archaeology field school from 1988 through 1995. A total of 100.5 units have now been excavated by the field school students in the southern grove of trees (Figure 2.2) and 11 units have been excavated in the northern aspen grove. These units have continued to produce cultural materials relating to the Avonlea and Old Women's phases. The Saskatoon Catholic School Board extended learning opportunities program was involved in limited excavations in the northern aspen grove in 1989 to 1991 (Clarke and Meyer 1993:10). These students opened up a total of six units which were finished by University field school

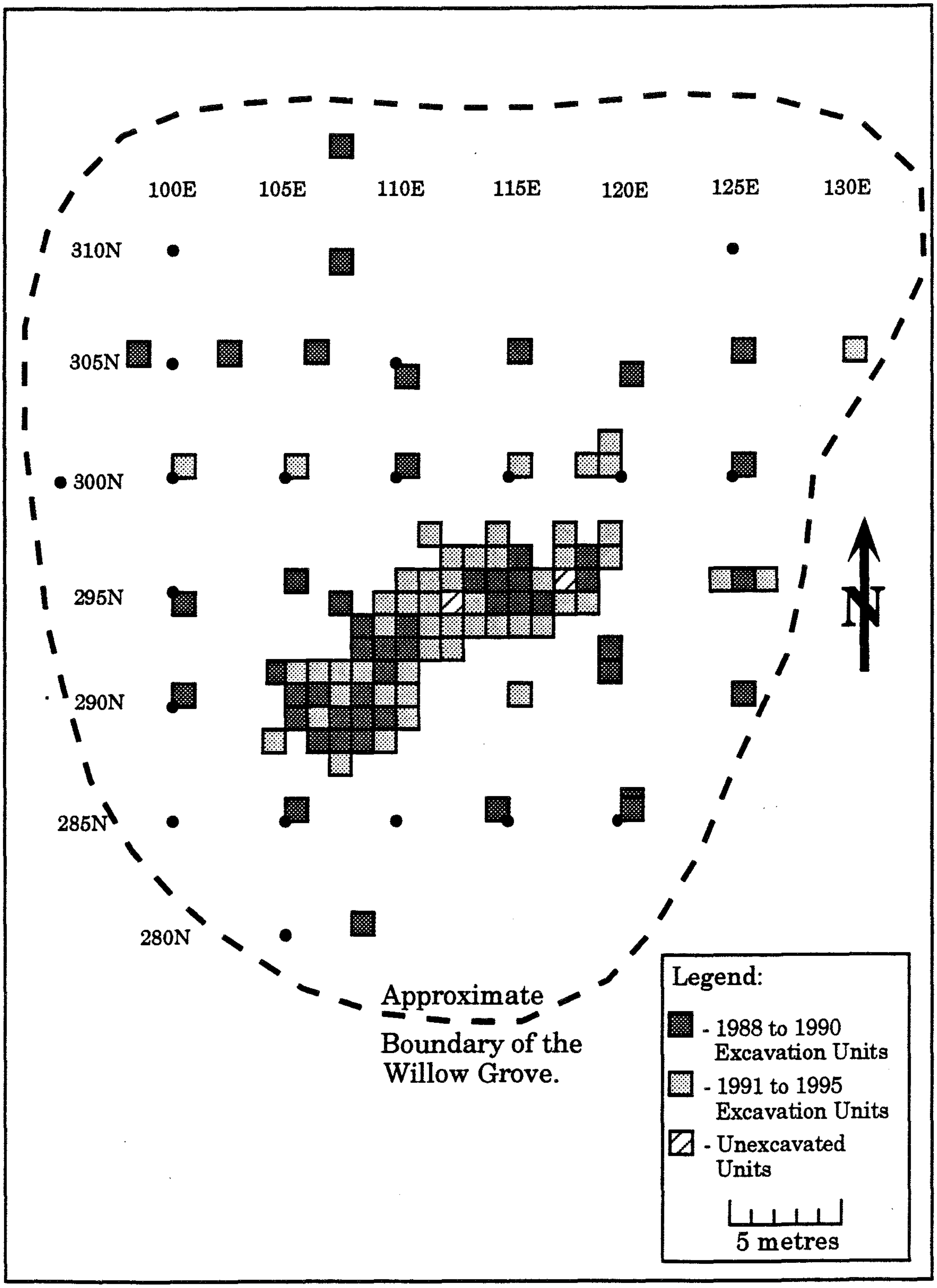

Figure 2.2 Map of the field school excavations showing the excavations from 1988 to 1995.

students in 1992 (Figure 2.3). Several other units were excavated by field school students in this area to determine the occupation in this part of the site. It was originally thought that the occupation in a northern grove of trees might relate to the kill or processing area associated with the occupation in the southern grove. Excavations of this area did not support this idea.

In 1989, a soil horizon was noted several centimetres below the occupation layer at the Hartley site. It was thought that there might be cultural remains in this paleosol and, therefore, one quadrant of every unit, since its discovery, has been excavated through this horizon. Artifacts, most notably fire-cracked rock and debitage, have been noted above, and occasionally in, this layer although these appear to be intrusive from the occupation above. Two enigmatic corner-notched points were recovered in 1992 from the lower part of the main occupation layer or just slightly below (Clarke and Meyer 1993:19). These points do not appear to be culturally associated with the main occupation, but are not stratigraphically associated with the lower paleosol either. Although this lower paleosol has been carefully monitored for any signs of cultural material, there has been no definite evidence found to confirm occupation in it. The presence of the two corner-notched projectile points and isolated scatters of debitage might suggest a very sparse occupation in this lower layer.

In conjunction with the 1992 field school a separate set of excavations were carried out in the cultivated field to the east and southeast of the southern grove of trees (Figure 2.3). These excavations were carried out to test the areas of intact occupation identified by Millenium Consultants in 1988 (Clarke and Meyer 1993:25). The materials recovered in this portion of the site, however, were not related to the Avonlea/Old Women's phase

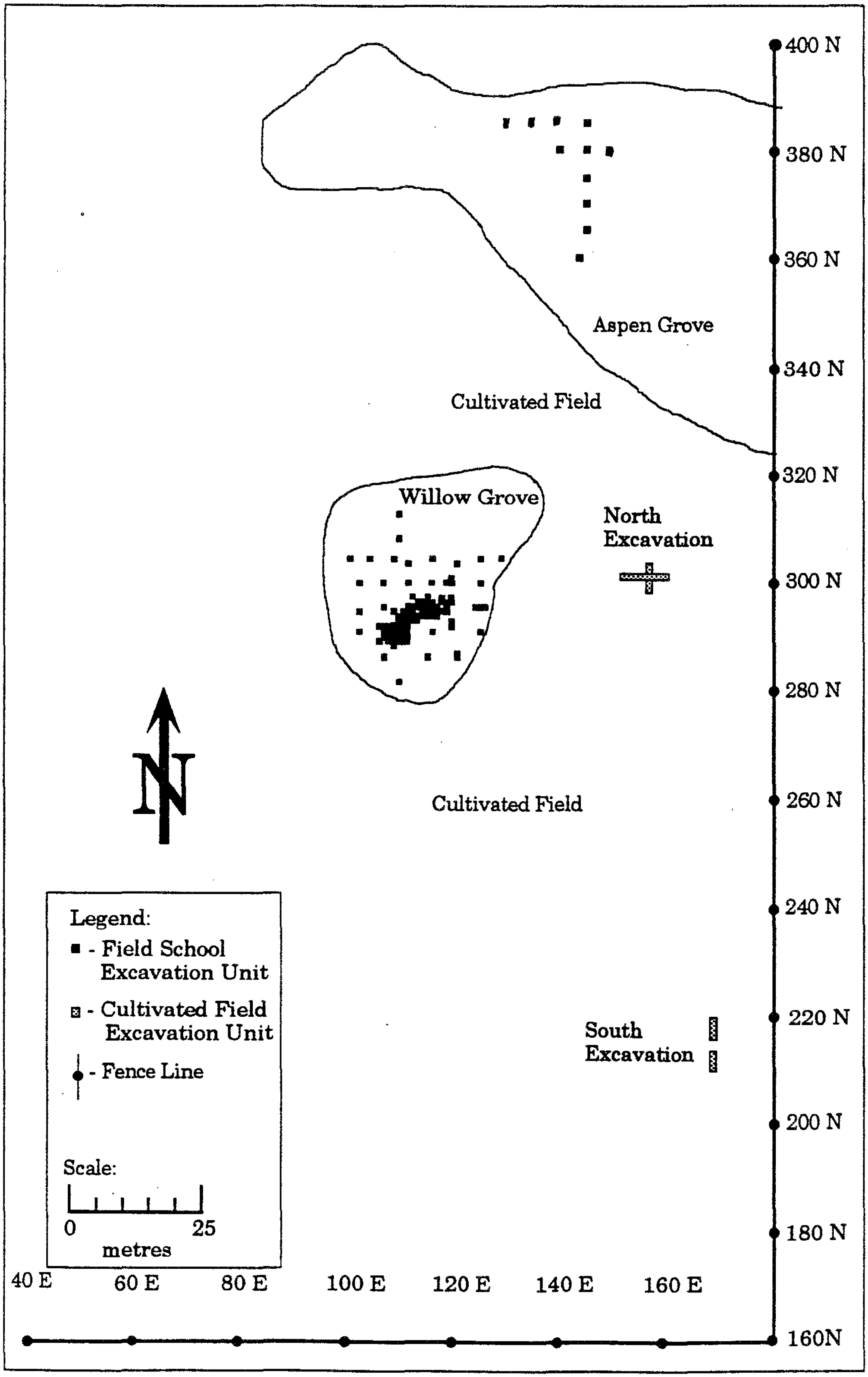

Figure 2.3: Map of the site area showing the location of the various excavation areas.

materials from the western portion of the site. The materials recovered relate to a more recent occupation of the area. Several Plains Side-notched projectile points and Mortlach pottery sherds have been recovered. Also recovered was one metal projectile point, as well as a fragment of sheet copper or brass. The recovery of these items shows that this occupation of the area was substantially later than the occupation on the west side of the site. For the most part the Old Women's/Avonlea occupation does not overlap with the Mortlach occupation (Figure 2.4). The Avonlea/Old Women's phase occupation is present in (and between) the two groves of trees, but was not positively identified in any of the excavations in the cultivated field or across the road to the east (Clarke and Meyer 1993). It appears that the Mortlach component of the Hartley site is concentrated in the eastern and southern portions of the site and the Avonlea/Old Women's component is concentrated in the north and west (Rollans and McKeand 1992).

Some Mortlach materials have been recovered from the excavations in the willow grove. These include a couple of Plains Side-notched projectile points and a limited number of Mortlach pottery sherds. Other items, such as a bifacially worked slot knife blade and a ground stone axe blade with raised ridges on each side of the central groove, are also more likely to be associated with Mortlach components than Avonlea or Old Women's phase sites (D. Meyer: personal communication). These materials are found in units throughout the excavated area in the grove but are not recovered in any significant concentrations. It is thought that these elements relate either to a extremely sparse part of the Mortlach occupation, which overlaps with the Avonlea/Old Women's occupation, or the material is intrusive in some way. There are no indications, from any of the field school units which have yielded Mortlach materials, that the faunal materials have been contaminated.

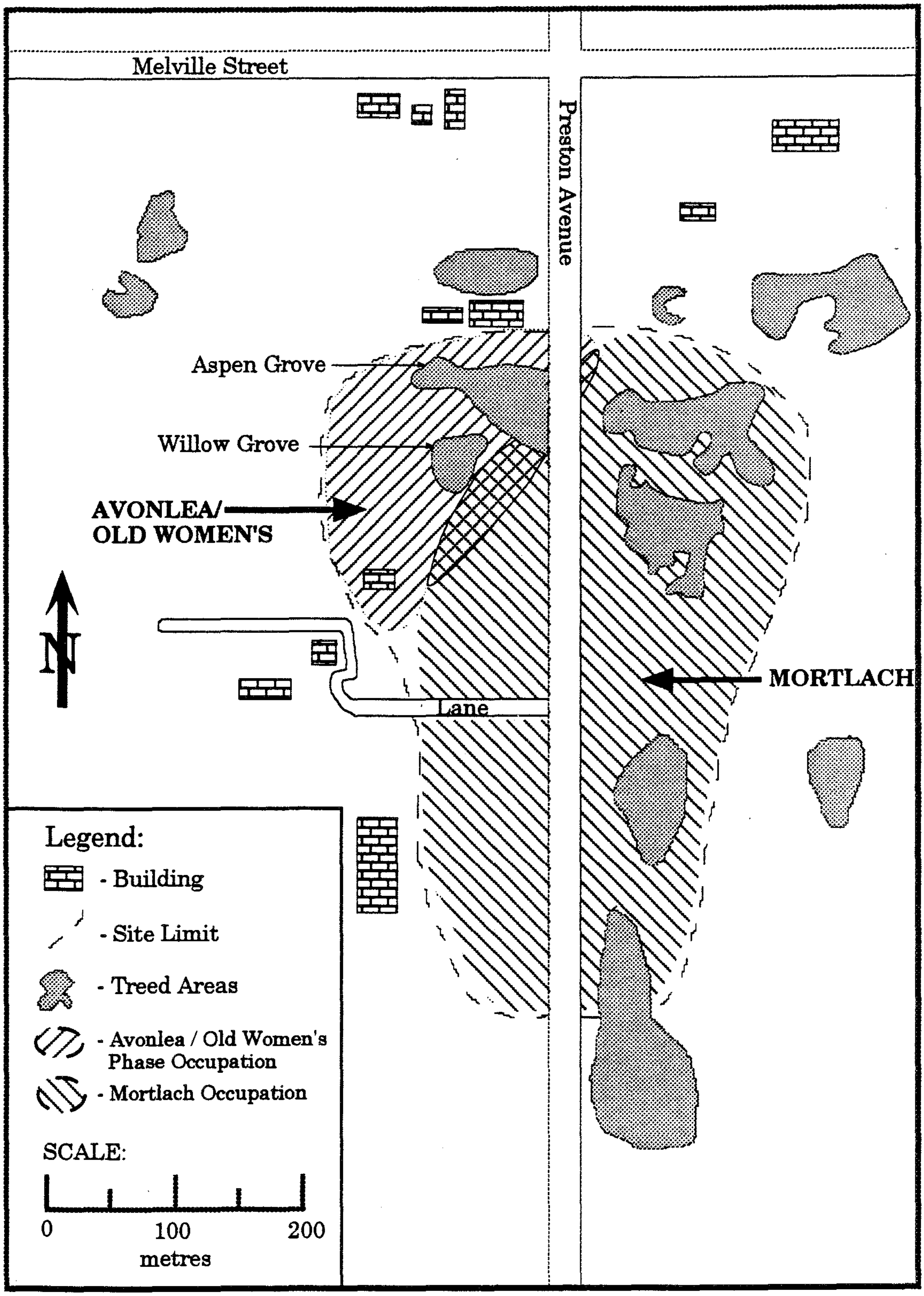

Figure 2.4: Map of the site area showing the approximate overlap of the Mortlach and Avonlea / Old Women's phase occupations.

2.2 Physiography

The Hartley site is located in the NE quarter of section 10, township 36, range 5, west of the third meridian. It is located in the Moose Woods Sand Hills area of the Saskatchewan Plains (Acton and Ellis 1978:3-4). The terrain of the area is typified by gently undulating wind-scoured sand plains and glacio-fluvial plains. Local relief is usually less than 3 metres in height. The elevation of the Moose Woods Sand Hills typically runs from approximately 520 metres on the high areas and 490 metres in the valley of the Saskatchewan River (Acton and Ellis 1978:6). The area has limited external drainage to the South Saskatchewan River. The dominant sediments of this area are Orthic Dark Brown sandy loams. The parent materials of the region are typically coarse to moderately coarse textured, weakly calcareous sands of glacio-fluvial and lacustrine origin (Acton and Ellis 1978). These sediments have been reworked by the wind during the Holocene and are part of the Dune Sand Association (Acton and Ellis 1978:64-65).

The South Saskatchewan River is the nearest major permanent water source. It is approximately five kilometres away from the site in a west northwesterly direction. Small permanent sloughs as well as temporary water sources are located within one or two kilometres of the site.

2.3 Site Stratigraphy and Burial Conditions

The predominant texture of the sediments at the Hartley site is sandy to sandy loam. The occupation layer (Figure 2.5), within the excavated area, is approximately 12 to 22 centimetres in thickness (Meyer 1990). The sediment has a sandy loam texture and is dark gray to black in colour. It is typically located at a depth of 5 to 12 centimetres below the surface in the central portions of the brushy area (Meyer 1990). The occupation layer in this portion of the excavation area lies directly below the active sod horizon. In the outer portions of the grove the top of the occupation layer is typically slightly deeper due to increased deposition of wind blown sediment from the surrounding field (Meyer 1990:12-13). This is especially true in the northwestern portion of the brushy depression. The sediment below the occupation layer is a yellow sand which varies in thickness.

The lower, buried soil horizon is located below the yellow sand and is often poorly defined and difficult to trace. It is grayish to grayish brown in colour, is typically located approximately 40 cm below the surface, and is 10 to 20 cm in thickness. One of the ongoing research questions at the Hartley site is to determine the nature of this lower horizon. A slightly lighter shade of sand, located directly below the lower soil horizon, is the deepest sediment in the stratigraphic profile. The sediments below this sand are not known.

The burial conditions at the Hartley site are slightly variable. The preservation of the faunal materials found in the occupation layer is very good, suggesting relatively rapid burial. The rate of bone deterioration is dependant on numerous external factors, but the condition of the bone suggests that it was not exposed to harsh elements for long periods of time. Conversely, faunal specimens that are found in the lower paleosol as well as in the sand above often have a distinctive weathered appearance that is uncharacteristic of the specimens found within the occupation layer. It is thought that the high water table in the area and the highly sandy matrix may differentially deteriorate faunal specimens which are moved out of the occupation layer. Two refitted ulna specimens have been noted during the cataloguing to exhibit this differential preservation. One specimen is very well preserved while the more deeply buried specimen shows a more pronounced degree of deterioration.

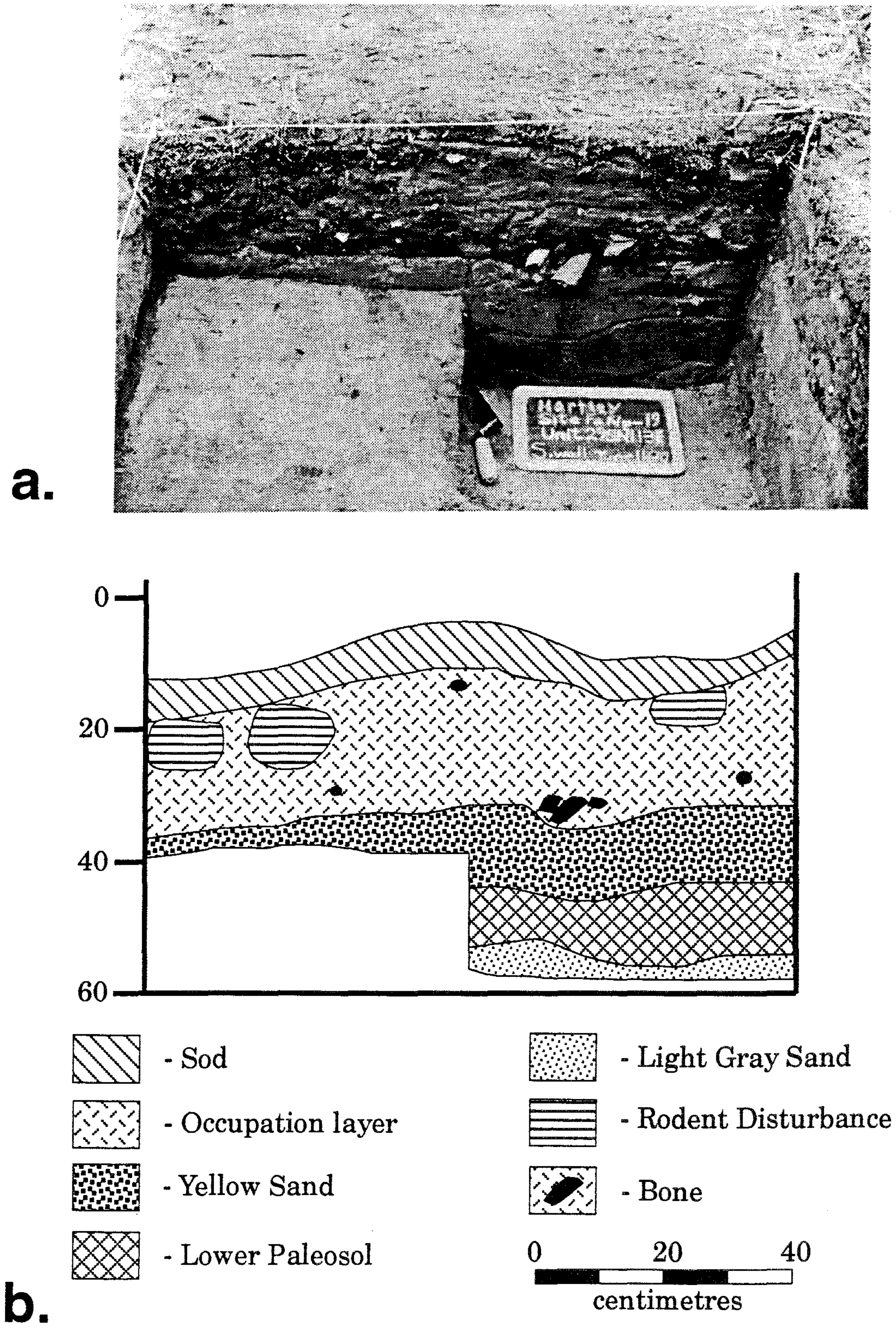

Figure 2.5 (a) Photograph of the stratigraphic profile of unit 295N 113E. (b) Stylized profile drawing of the south wall of unit 295N 113E.

2.5 Cultural Materials and Radiometric Dates

The initial three years of the field school excavations were focused in the southern grove of trees. The cultural materials present in this portion of the site come from one occupation layer which contains diagnostic materials from the Avonlea and Old Women's phases. Some intrusive Mortlach material is present in some of the units, but the amount of contamination to the faunal assemblage is thought to be negligible. The Avonlea and the Old Women's phase material appears to relate to one occupation event. There is no stratigraphic separation of these artifacts in any of the excavation units. The stratigraphic positions of the excavated material, including the faunal assemblage, shows no signs of a split in the occupation. This is further supported by the equal horizontal distributions of the projectile points and pottery sherds. Projectile points and pottery of both phases are distributed throughout the same portions of the site.

Several other sites in the Northern Plains also contain Avonlea/Old Women's phase materials in the same occupations. Some of these, such as Long Creek (Wettlaufer 1960), may be due to stratigraphic mixing or compressed stratigraphy (Morlan 1993:41). The Morkin site (Byrne 1973) and the Estuary Bison Pound (Adams 1977), may also contain mixed Avonlea/Old Women's phase materials in levels exhibiting compressed stratigraphy. Other sites which have "transitional" or "mixed" components include Gull Lake (Kehoe 1973), Bakken-Wright (Adams 1975), Amisk (Amundson 1986) and Sheep Camp (Cazakoff 1986). There are differing amounts of stratigraphic mixing and compressed stratigraphy at these sites which are difficult to establish in the literature.

One radiocarbon date of 1120 ± 60 B.P. (S-3382; bone), was acquired on a single bone sample from the Hartley site. The sample was an adult bison distal tibia which was taken from unit 290N 106E located in the main excavation block in the brushy depression. This radiocarbon date has been calibrated to cal A.D. 762-1013 (*p*=1.00), with a midpoint of A.D. 930, at 2 sigma using the University of Washington Quaternary Isotope Lab Radiocarbon Calibration Program, Rev. 2.0 (1987). One thermoluminescence date of A.D. 700 ± 360 (DUR 93TL170-1ASpfg; fired sediment) has also been obtained at the Hartley site. The sample was taken from a large hearth also in unit 290N 106E and was processed by the thermoluminescence laboratory at Durham University, England. The sample consisted of pieces of fired sediment collected from the subsoil directly below the hearth. The standard deviation for the thermoluminescence date is not as refined as the radiocarbon date, but the two appear to be similar in age.

2.5 Regional Climate

The climatic episode that coincides with the Hartley site occupation is the Neo-Atlantic (Wendland 1978). The Neo-Atlantic period ranges from 1260-850 B.P. and is the culmination of a warming trend that started in the preceding Scandic episode. The Neo-Atlantic episode is thought to have had similar amounts of rainfall as today. The episode was more moist than the preceding episode as well as the two episodes which followed (Semken and Falk 1987:200).

The current regional climate of the site area is classified as Dfb or Cold 'Forest' (moist) according to the Koeppen's modified classification (Chakravarti 1969:60). This classification also relates to all areas of Saskatchewan that are part of the mixed wood forest and the aspen parkland. It is characterized by cool summers and cold winters. The site area is on the border of the dry subhumid and a semiarid moisture regions of the province

(Richards and Fung 1969:52). The mean annual precipitation for the area is typically between 356 mm (14 inches) and 406 mm (16 inches) (Richards and Fung 1969:58). The mean daily temperatures for July range from 15.6°C (60°F) to 19°C (66°F). The mean daily temperatures range from -15.6°C (+4°F) to -20.6°C (-5°F) for the month of January (Chakravarti 1969:60).

2.6 Pre-agriculture Flora and Fauna

The flora of the site region is significantly different since the onset of agriculture and urbanization. The site is currently situated on the northern edge of the moist mixed grassland, which covers 11% of Saskatchewan (Padbury and Acton 1994). This region is closely correlated with semi-arid moisture conditions. It is intermediate between the true parkland to the north and the short grass prairie to the south. At the time of the occupation, the native plant community likely consisted of roughly the same dominant and sub-dominant species as today. The site region is characterized by plants adapted to sandy environments (Coupland and Rowe 1969). The region consists of large areas of common Spear Grass (*Stipa comata*) and Wheat Grass (*Agropyron dasystachyum*) with small patches of Aspen (*Populus tremuloides*). Other grasses, such as the Blue Grama Grass (*Bouteloua gracilis*) are common associates, especially in sandy loam soils (Coupland and Rowe 1969:74). Porcupine Grass is another common grass, in moist conditions. Rose (*Rosa* spp.), Creeping Juniper (*Juniperus horizontalis*), silverberry, dogwood (*Cornus* spp.), Western Snowberry (*Symphoricarpos vecidentalis*), Choke Cherry (*Prunus virginiana*) and Willow (*Salix bebbiana*) are some of the dominant shrubs found in the region (Coupland and Rowe 1969; Budd and Best 1969). Aspen and willows are typically found around sloughs and low lying areas (Padbury and Acton 1994). Many of these species are still present at the site and in nearby uncultivated areas (Meyer and Clarke 1991).

The diversity of the local fauna is also quite different with the onset of agriculture and increasing urbanization. The large fauna are the most conspicuously absent animals from the area. Animals such as bison, wolf, Elk, and Grizzly Bear are all absent from the modern fauna of the area. Other animals are more common in the area than in the past such as White-tailed Deer and Red Fox. Sources such as Seton (1905), Beck (1958), Maher (1969) and Banfield (1987) give geographic ranges of animals that occur, or formerly occured, in the site region. A more detailed analysis of the geographic ranges of some of these species is presented in chapter six.

Other ungulates such as Mule Deer and Pronghorn Antelope are also reported to have lived in the region. Carnivores are represented in the site area by the coyote, skunk, Red Fox, Swift Fox, Badger, Raccoon, Mountain Lion, River Otter and weasels. Some of these animals, such as the Swift Fox, are currently extirpated from the area. Others such as the River Otter and the Mountain Lion are found in low numbers. Leporids are very common in the site region as are several species of rodents. Rabbits and hares of the area include the Snowshoe Hare, the White-tailed Jackrabbit and the Nuttall's Cottontail. The Nuttall's Cottontail are currently found only in southern Saskatchewan although their range was much larger in the past. Rodents include several species of small mice and voles, the Least Chipmunks, ground squirrels, Red Squirrels, Northern Pocket Gophers, Muskrats and Beavers.

Avifauna include a wide variety of migratory and permanent residents. Of the 415 species which breed in Canada 242 have been reported in Saskatchewan (Gollop 1969:90). Species lists for the Saskatchewan region may be found in Gollop (1969), Belcher (1980), Adam et al. (1985) and

Godfrey (1986). Some of the more common birds in the area include the Meadow Lark, Eastern Kingbird, Yellowheaded Blackbird, Piping Plover and the Sharp-tailed Grouse (Padbury and Acton 1994). Herpetofauna are limited in the site area. Amphibians include salamanders and a few species of frogs and toads. Only a limited number of species of reptiles are present in the region, including the Red-sided and Plains Garter Snakes (Atton 1969:84).

2.7 Summary

The Hartley site is a late precontact/protohistoric site located in south-central Saskatchewan. The site has been known for several decades and has only recently been studied intensively. The site has two prolific occupations which are separated horizontally across the site area. A sparse, earlier occupation has been suggested to be present in the lower buried soil horizon (Clarke and Meyer 1993), although this now seems unlikely. One cultural component is relatively recent and has produced several Plains Side-notched projectile points and Mortlach pottery. This occupation has also produced two metal artifacts, a metal projectile point and a fragment of sheet copper or brass. The University of Saskatchewan archaeological field schools have concentrated their excavations on the earlier occupation. This occupation has produced one radiocarbon date of 1120 ± 60 B.P. which is calibrated at 2 sigma to cal A.D. 762-1013 (*p*=1.00), with a midpoint of A.D. 930 from a bone sample and one thermoluminescence date of A.D. 700 ± 360 based on fired sediment. Diagnostic materials from this occupation include projectile points and pottery from the Avonlea/Old Women's phases.

CHAPTER 3

RESEARCH METHODS

3.1 Field School Excavations and Laboratory Work

Due to the long term investigations at the Hartley site the field methodology was refined several times, as more about the site was learned. During the first season of excavation the Department of Anthropology and Archaeology field school students excavated each unit following the natural stratigraphy of the site. Each pair of students was responsible for the excavation of one 1x1 metre unit. The units at the site were laid out along a grid corresponding as closely as possible to the grid established in 1988 by Millenium Consultants. In 1988 the units were widely spread throughout the willow grove aligned with the five metre grid to determine the nature and extent of the intact occupation. Each unit was divided into four equal quadrants to maintain tight horizontal provenience. In order to maintain close vertical provenience natural stratigraphic layers that exceeded 10 centimetres in thickness were arbitrarily ended at 10 cm and a new level started. All large or potentially significant artifacts were planviewed and three dimensional provenience recorded as the distance north from the south wall of the unit, the distance east from the west wall and the depth below a datum placed in the southwest corner of the unit. Photographs were also taken of each completed level containing occupation materials prior to the removal of the artifacts (Figure 3.1).

Figure 3.1 Photograph of unit 290N 108E, level 6 prior to the drawing of the planview and the removal of the artifacts and ecofacts.

In 1989 it was decided that the natural levels were inappropriate for the students and to assure proper provenience was being maintained the units were excavated in 10 cm arbitrary levels. Each unit was again divided into quadrants and three point provenience was used to record the location of potentially significant artifacts. The following season, 1990, further refinements were made to the excavation techniques. The units were excavated in 5 cm arbitrary levels while maintaining the three point provenience and use of quadrants. For all three seasons of excavation, all of the soil from the units was passed through a 6 mm mesh to retrieve smaller artifacts that may have been missed during excavating. Fine screen samples were collected in 1990 from the northeast quadrant of each unit. These fine screen samples were passed through a window screen mesh (1.6 mm). The fine-screen samples from 1990 were dry screened though the 1.6 mm mesh in the field. This practice was abandoned in 1992 and replaced with the less abrasive methodology of water-screening the materials through the 1.6 mm mesh instead.

The students have also been responsible for the cleaning and initial cataloguing of the materials recovered from their units. They have hand washed the artifacts using small brushes and basins of water. Special care was taken with materials such as bison teeth and pottery. These materials were dry brushed or left uncleaned. Faunal species identifications and the identifications of lithic material types were completed with the aid of the departmental comparative collections.

3.2 Fine-Screen Analysis Procedures

In order to establish the differential recovery, between the coarse and fine-screen samples, and in hopes of identifying previously unrecognized species in the assemblage the fine screen samples from one unit were analyzed. The unit was selected based on its large sample size and the presence of small mammal and fish elements in the coarse sample from this unit. The fine screen sample was sorted into bone, tooth enamel, fire-cracked rock, lithic debitage, unidentifiable shell fragments, gastropod shells and identifiable faunal material. These materials were separated under low magnification using the facilities at Wanuskewin Heritage Park. The organic materials were also retained for further analysis of the seeds or insects. Hundreds of small pieces of micro-debitage, tooth enamel, pottery sherds, and fire-cracked rock fragments were identified in the sample. Thousands of burned and unburned fragments of faunal material were also present. Seventy-nine specimens were identified including one previously unrecognized species of vole, as well as a passeriform bird and two genera of gastropods.

3.3 Cataloguing Procedures

The identifications made by the students were later confirmed and in some instances, more precise identifications were made before creating the final catalogue of the site materials. The materials were computer catalogued using the MacADEM (Macintosh Archaeological Data Entry and Management Software) program created by T. Gibson of Western Heritage Services Inc. (1991). Funding was graciously made available through grants by the Saskatchewan Archaeological Society and the Presidents' office at the University of Saskatchewan. These funds were invaluable to the completion of this project.

The ongoing nature of the Hartley site excavations forced the situation where the units could not be catalogued in a sequential manner based on the unit designations. In order to maintain continuity in the catalogue, the units were catalogued in sequential order based on their unit designations of each excavation year. The 1988 units were catalogued first, starting with the northwestern most unit of that year. The sequence of the catalogue always proceeds to the next unit located immediately to the east. If no other units were located to the east, the next unit to be catalogued was the most northwestern unit of that year, that has not been catalogued.

The cataloguing of each unit proceeded from layer one to the bottom of the unit. Planviewed artifacts, which had three point provenience, were the first materials of each level to be catalogued. These artifacts were catalogued sequentially based on their planview numbers and their three point provenience maintained in the catalogue. The materials without three point provenience were catalogued according to their quadrant. The quadrants were catalogued in order for each level beginning with the northwest quadrant and proceeding clockwise to the southwest quadrant. The weight of each catalogue entry was entered into the program in decigrams. Materials were catalogued in a certain order in each level. Tools or possible tools, whether they were made of stone or bone, were catalogued first. These were followed by rim sherds, decorated neck sherds and decorated shoulder or body sherds. Individual, identifiable faunal materials were catalogued next. Other artifacts were catalogued as groups and given one catalogue number. These include undecorated potsherds with the same exterior finish, lithic flakes of the same material, lithic shatter of the same material, fire-cracked rock of the same material, long bone shaft fragments, unidentifiable cranial fragments, unidentifiable bone and enamel fragments. Burned and unburned faunal materials were divided and catalogued separately. The number of fragments in excessively large bags of fragments were estimated by counting and weighing a portion of the fragments and multiplying by the total weight.

3.4 Quantitative Analysis Background

Quantitative analyses are an important part of all faunal studies. They are not, however, without their problems. These problems range from discrepancies in terminology to statistical problems in their calculation (Lyman 1994). By surveying four major journals (*Journal of Archaeological Science, World Archaeology, Journal of Field Archaeology,* and *American Antiquity*) which regularly carry zooarchaeological studies Brewer (1992) notes that the study of quantitative analyses is still a major area of publication. In the ten year period between 1980 and 1989, 49 out of 97 articles relate to aspects of method and theory (Brewer 1992:229).

Several terms such as specimen and element are used repeatedly throughout this thesis and must be identified. Grayson (1984:16) follows Shotwell (1955, 1958) and states that "a *specimen* is a bone or tooth, or fragment thereof, from an archaeological or paleontological site, while an *element* is a single complete bone or tooth in the skeleton of an animal." (emphasis appears in the original). Lyman (1994) cites several other similar definitions although the terminology is often different. The term *element* is used in this thesis to refer to any complete bone or tooth from a given taxon. The term *specimen* is used to refer to any fraction of a bone or tooth that is identifiable to a given taxon. Another common term used in zooarchaeological studies is *fragment*. A fragment, as it is used here, follows the definition put forth by Brink and Dawe (1989:80). Fragments are fractions of elements that are not recognizable to any specific element but may be recognizable to a given class of elements, such as long bones. Fragment may also be used to describe element portions which are unrecognizable at any level beyond bone or tooth. If several fragments are reconstructed, however, they may be classified as a specimen or an element if they are found to represent an identifiable portion of, or the whole bone. The phrase *Hartley site faunal assemblage* also frequently appears in this thesis and is used to refer to the faunal material that was recovered during 1988, 1989, and 1990 University of Saskatchewan excavations.

Terms such as element and specimen are important in quantitative analyses for they are the basis of several measurements of taxonomic abundance. Lyman (1994) notes that two of the most basic measurements of taxonomic abundance are the Number of Identified Specimens (NISP) and the Minimum Number of Individuals (MNI). The NISP is the standard counting unit used and refers to all of the bones which have been identified to a specific element or class of elements, such as long bone fragments (Brink and Dawe 1989:81). They do not include bulk entries such as comminuted bone and tooth fragments. The MNI is the number of individual animals necessary to account for all of the identified specimens present in the assemblage (Grayson 1984). The MNI values calculated in this thesis take into account side and age (when possible) when determining the MNI values for a given element. The MNI for the radial carpal for example is fourteen based on the number of right elements present in the assemblage. The age of elements such as carpals and tarsals can not be accurately determined and is not taken into account. The age and side for specific long bones, such as humerii, are taken into account. The limitations of NISP and MNI are well documented (Binford 1978; Grayson 1984; Klein and Cruz-Uribe 1985; Brewer 1992; Lyman 1994) and do not warrant further discussion.

Other quantitative units used in this thesis include Minimum Numbers of Elements (MNE) and Minimum Animal Units (MAU). The MNE are "...the number of times an element (metacarpal) or a portion of an element (proximal metacarpal) occurs in the assemblage." (Brink and Dawe 1989:81). MNE values are determined in this thesis following the methodology outlined by Morlan (1994a). The definition of proximal and distal MNE values are determined by counting the number of specimens containing identifiable anatomical landmarks and zones. The MNE for the proximal metacarpal, for example, is identified by the most numerous of its two identifiable portions, the facet for the second and third carpal and the facet for the fourth carpal. The definition for MAU values have not changed much since Binford's (1978) original definition of the unit. The MAU is simply the MNE of a given element or portion of an element (i.e. proximal or distal end) divided by the number of times that element occurs in one complete skeleton. Unlike the MNI values the MAU does not take into account the side or age of the individual specimens.

3.5 Summary

Field methods at the Hartley site under went some fine tuning during the first few years of excavation. As the site stratigraphy and the extent of the occupation became clearer the units were excavated in more refined levels. The units excavated in the first three years at the site were excavated using three different methods. In 1988 the units were excavated following the natural stratigraphy of the site. Arbitrary levels of 10 cm were used in 1989 instead of the natural stratigraphy of the site. In 1990 the method was changed to arbitrary levels of five centimetres. Units in all three years were excavated in quadrants with the larger and more significant artifacts recorded *in situ*. Systematic and regular collection of fine-screened materials began in 1990. This material was collected from the northeast quadrant of each unit and dry screened through a 1.6 mm mesh at the site. The artifacts were cleaned and initially catalogued by the field school students and later re-organized and entered into a computer based cataloguing system. The quantitative terminology used in this analysis is based largely on the defining work of Lyman (1994), Grayson (1984), Brink and Dawe (1989), Binford (1978), Morlan (1994a) and Brewer (1992).

CHAPTER 4

ANALYSIS OF THE HARTLEY SITE BISON REMAINS

4.1 Introduction to the Hartley Site Faunal Assemblage

The Hartley site faunal assemblage is defined for the purpose of this thesis as the faunal material excavated during the University of Saskatchewan's Department of Anthropology and Archaeology field school during the 1988, 1989 and 1990 field seasons. Several subsequent seasons of excavation have since taken place at the site, but the recovered materials will not be used in these analyses.

A total of 193,064 fragments of faunal material are catalogued from the Hartley site assemblage (Table 4.1). These fragments have an overall weight of approximately 223.3 kilograms. Over fifty percent of the faunal assemblage is burned. The majority of the burned pieces are highly fragmented and represent only 23.4% of the total weight of the faunal assemblage. The unburned portion of the faunal assemblage is typically less fragmented and represents 76.6% of the faunal assemblage by weight. Almost 88% or 169,483 pieces of the faunal materials are unidentifiable fragments. These unidentifiable fragments weigh approximately 69.3 kilograms and comprise only 30.6% of the assemblage by weight. The total number of identified specimens (NISP) for all taxa present is 23,581 representing slightly more than 12% of the total assemblage. The identified specimens, however represent over 68% of the entire assemblage by weight (155 kg).

Table 4.1 Frequency and weight (grams) of burned and raw faunal materials.

Description	Total Frequency	Total Weight
Total Burned	99,791	52,168.9
Total Unburned	93,273	171,127.2
Total Faunal	193,064	223,296.1

At least 22 species of vertebrates and four genera of invertebrates are present in the Hartley site assemblage (Table 4.2). All faunal materials are identified to the most precise taxonomic level possible. Some specimens are too fragmentary to identify beyond the class level of taxonomic designation. The mammalian specimens which are not identifiable beyond the class level of distinction are divided into categories similar to those presented by Thomas (1969) and Grayson (1984). Animals are divided into 5 classes by their live body size (Thomas 1969:393, Grayson 1984:169). Rather than using the numerical designations suggested by Thomas (1969) the mammals are divided using qualitative terms. Mammals with a live weight of less than 100 grams are referred to as micro-mammals. Mammals weighing between 100 and 700 grams are referred to as small-mammals. Medium-mammals have a live weight between 700 and 5,000 grams. Large mammals exhibit a live weight between 5 and 25 kilograms. Very large mammals are mammals with a live weight greater than 25 kilograms. Avian specimens which are not identifiable beyond the class level are divided into small medium and large categories. These categories are more subjective than those used for the mammals. The small bird category includes any specimen that is approximately the size of a large song bird such as a robin or smaller. Medium birds include pigeon and duck sized birds and large birds include birds the size of large raptors or geese.

Over all, the faunal assemblage is very well preserved. This is reflected

Table 4.2 Hartley Site Fauna

Taxon	Common Name	NISP	%NISP	MNI	Wt. (g)
Mammalia					
Bison bison	Plains Bison	22,901	97.12	28	154,521
Canis lupus	Gray Wolf	3	0.01	1	10.2
Canis latrans	Coyote	7	0.03	1	4.4
Canis sp.	Canid	35	0.15	-	57.8
Vulpes vulpes	Red Fox	7	0.03	1	3.9
Vulpes velox	Swift Fox	33	0.14	3	27.4
Vulpes sp.	Fox	12	0.05	-	3.1
Taxidea taxus	American Badger	2	0.01	1	3.6
Lepus townsendii	White-tailed Jack Rabbit	8	0.03	1	4.9
Lepus americanus	Snowshoe Hare	9	0.04	2	3.7
Leporidae sp.	Rabbit/Hare	17	0.07	-	23.3
Spermophilus richardsonii	Richardson's Ground Squirrel	12	0.05	6	3.2
Spermophilus sp.	Ground Squirrel	40	0.17	-	4.7
Thomomys talpoides	Northern Pocket Gopher	4	0.02	2	0.7
Castor canadensis	American Beaver	5	0.02	2	3.6
Microtus pennsylvanicus	Meadow Vole	16	0.07	11	2.0
Microtus ochrogaster	Prairie Vole	3	0.01	2	0.4
Microtus sp.	Vole	2	0.01	-	0.3
Clethrionomys gapperi	Gapper's Red-backed Vole	11	0.05	1	1.1
	Micro-mammal	26	0.11	-	2.7
	Small-mammal	30	0.13	-	2.9
	Medium-mammal	20	0.08	-	7.2
Aves					
Anas crecca carolinensis	Green-winged Teal	45	0.19	1	4.3
Anas cf. *discors*	Blue-winged Teal	1	0.00	1	0.1
Bubo virginianus	Great Horned Owl	12	0.05	1	8.7
Tympanuchus phasianellus	Sharp-tailed Grouse	1	0.00	1	0.2
Bonasa umbellus	Ruffed Grouse	1	0.00	1	0.1
Tympanuchus sp.	Grouse	1	0.00	-	0.2
Meleagris gallopovo	Domestic turkey	105	0.45	4	246.0
Corvus corvidae	Common Raven	4	0.02	2	5.1
	Large bird	29	0.12	-	12.0
	Small bird	7	0.03	-	0.2
	Misc. bird	11	0.05	-	2.7

Table 4.2 Hartley Site Fauna (continued).

Taxon	Common Name	NISP	%NISP	MNI	Wt. (g)
Pisces					
Esox lucius	Northern Pike	19	0.08	2	2.0
Osteichthyes	Freshwater fish	13	0.06		1.6
Gastropoda					
Stagnicola spp.		17	0.06	17	0.9
Lymnaeidae sp.	Pond Snails	6	0.03	-	0.3
Vallonia sp.		86	0.36	86	0.5
Gyraulus sp.	Ramshorn Snail	1	0.00	1	0.1
Planospiral sp.	Snails	4	0.02	-	0.1
Pelecypoda					
Pelecypoda sp.	Pearly Mussels	15	0.06	-	3.2
TOTAL		23,581	100	179	154,981

in the recovery of highly porous foetal material as well as small fish, bird and invertebrate material. Some differential preservation is evident, however, on some of the large mammal specimens. It is likely that this is strongly related to vertical separation of specimens within the site. Specimens which are found within the main occupation layer are well preserved and show little evidence of natural destruction. Specimens which are found in the sandy layer below the main occupation often exhibit a higher degree of weathering. The lower elements tend to show signs of abrasion such as rounding of the edges of green bone fractures. Rootlet etching is the most common non-cultural damage present on any of the specimens. Cut marks, and the results of carnivore and rodent actions are also present on some specimens.

The majority of the large mammal specimens are highly processed and exhibit green bone breaks. Most specimens show little signs of weathering, and correspond roughly to early stage 1 based on the scale created by Behrensmeyer (1978:151). Some specimens show minor cracking on the long bones and mosaic cracking is evident on some of the articular surfaces and on the compact bones. A revised version of this classification scheme is presented by Todd et al. (1987). Seven stages are presented to describe the weathering of compact (carpals and tarsals) and cortical (long bones) elements. Stage zero of Behrensmeyer's scheme is essentially divided into two parts. The revised stage zero is used to designate fresh kills where the bones are still greasy and soft tissue is still present, and stage one is used to denote elements that are unweathered. All of the remaining stage descriptions are the same as in Behrensmeyer (1978) although the stage number is increased by one (Todd et al. 1987:64). The majority of the specimens from the Hartley site assemblage therefore correspond to stage one or two of this scheme.

The most diverse class of animals in the Hartley site assemblage are the mammals. Mammals make up 52% of the identified species with a total of fourteen identified species. Birds are the second most diverse class (7 species) making up approximately 22% of the assemblage. Gastropods comprise approximately 19% of the assemblage. It is unlikely that the gastropods are part of the cultural assemblage. They are reflections of the past natural environment. Fish and pelecypods make up 4% of the assemblage each. Almost 98% of the total identified specimens are bison. Due to this large disparity, the bison will be discussed independently. The remainder of the taxa are addressed in the following chapter.

4.2 Quantitative Analyses of Bison Remains

A total of 22,901 bison specimens are identified weighing over 154 kilograms. The NISP, MNE, MNI, MAU and % MAU for the complete and nearly complete bison specimens are presented in Table 4.3 and Figure 4.1. Only 4,288 specimens are complete or nearly complete. The remainder of the

Table 4.3 Hartley site bison counts for complete and nearly complete specimens.

Element	NISP	MNI	MNE	MAU	%MAU
Petrous	187	28	46	23.00	100.00
Mandible	67	11	15	7.50	32.61
Hyoid	3	1	2	1	4.35
Axis	2	2	2	2	8.70
Atlas	9	4	4	4	17.39
Cervical Vertebra (C2-C5)	90	4	16	3.2	13.91
Thoracic Vertebra	194	2	25	1.8	7.83
Lumbar Vertebra	77	3	14	2.8	12.17
Sacrum	20	1	1	1	4.35
Caudal Vertebra	34	2	21	1.4	6.09
Rib	1429	3	59	2.3	10.00
Sternum	7	1	1	1	4.35
Scapula	150	17	33	16.50	71.74
Proximal Humerus	16	6	12	6.00	26.09
Distal Humerus	62	23	42	21.00	91.30
Proximal Radius	50	19	33	16.50	71.74
Distal Radius	52	20	38	19.00	82.61
Ulna	137	14	24	12.00	52.17
Radial Carpal	24	14	22	11.00	47.83
Intermediate Carpal	44	20	34	17.00	73.91
Ulnar Carpal	38	20	28	14.00	60.87
Accessory Carpal	14	9	13	6.50	28.26
Carpal 2+3	38	16	24	12.00	52.17
Carpal 4	38	21	27	13.50	58.70
5th Metacarpal	14	9	13	6.50	28.26
Metacarpal	77	25	35	17.50	76.09
Innominate	96	11	22	11.00	47.83
Proximal Femur	35	13	25	12.50	54.35
Distal Femur	27	13	15	7.50	32.61
Patella	33	20	32	16.00	69.57
Proximal Tibia	37	5	10	5.00	21.74
Distal Tibia	68	17	28	14.00	60.87
Lateral Malleolous	30	17	28	14.00	60.87
Talus	53	26	40	20.00	86.96
Calcaneus	69	20	35	17.50	76.09
Tarsal C+4	43	19	31	15.50	67.39
Tarsal 1	31	17	29	14.50	63.04
Tarsal 2+3	30	15	26	13.00	56.52
2nd Metatarsal	12	7	12	6.00	26.09
Metatarsal	90	23	33	16.50	71.74
Medial Sesamoid	95	10	73	9.13	39.67
Lateral Sesamoid	70	7	49	6.13	26.63
Distal Sesamoid	72	7	51	6.38	27.72
Phalanx 1	236	13	103	12.88	55.98
Phalanx 2	193	14	106	13.25	57.61
Phalanx 3	95	9	72	9.00	39.13
Total	4288		1404		

Skeletal element	MNE	MAU	%MAU
Petrous	46	23.00	100
Distal Humerus	42	21.00	91.30
Talus	40	20.00	86.96
Distal Radius	38	19.00	82.61
Metacarpal	35	17.50	76.09
Calcaneus	35	17.50	76.09
Intermediate Carpal	34	17.00	73.91
Metatarsal	33	16.50	71.74
Proximal Radius	33	16.50	71.74
Scapula	33	16.50	71.74
Patella	32	16.00	69.57
Tarsal C+4	31	15.50	67.39
Tarsal 1	29	14.50	63.04
Ulnar Carpal	28	14.00	60.87
Lateral Malleolous	28	14.00	60.87
Distal Tibia	28	14.00	60.87
Carpal 4	27	13.50	58.70
Phalanx 2	106	13.25	57.61
Tarsal 2+3	26	13.00	56.52
Phalanx 1	103	12.88	55.98
Proximal Femur	25	12.50	54.35
Carpal 2+3	24	12.00	52.17
Ulna	24	12.00	52.17
Radial Carpal	22	11.00	47.83
Innominate	22	11.00	47.83
Medial Sesamoid	73	9.13	39.67
Phalanx 3	72	9.00	39.13
Distal Femur	15	7.50	32.61
Mandible	15	7.50	32.61
5th Metacarpal	13	6.50	28.26
Accessory Carpal	13	6.50	28.26
Distal Sesamoid	51	6.38	27.72
Lateral Sesamoid	49	6.13	26.63
2nd Metatarsal	12	6.00	26.09
Proximal Humerus	12	6.00	26.09
Proximal Tibia	10	5.00	21.74
Atlas	4	4.00	17.39
Cervical Vertebra	16	3.20	13.91
Lumbar Vertebra	14	2.80	12.17
Rib	59	2.30	10.00
Axis	2	2.00	8.70
Thoracic Vertebra	25	1.80	7.83
Caudal Vertebra	21	1.40	6.09
Sacrum	1	1.00	4.35
Sternum	1	1.00	4.35
Hyoid	2	1.00	4.35

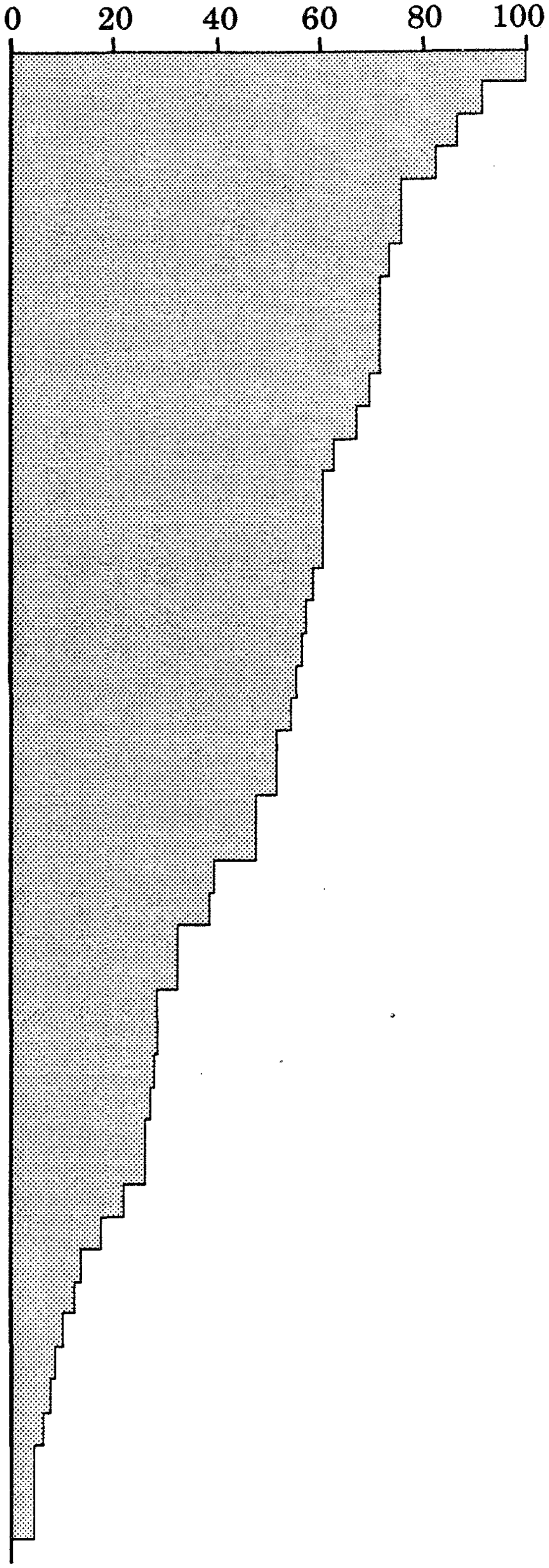

Figure 4.1 MNE, MAU and %MAU for the Hartley site bison elements.

specimens include miscellaneous long bone shaft, metapodial, skull, vertebrae and tooth fragments. The minimum number of individuals (MNI) for bison is 28 based on the number of identified petrous portions of the temporal bone. The minimum animal units (MAU) are derived by dividing the largest minimum number of elements (MNE) by the number of times the element occurs in the body. The MAU as derived from the petrous elements is 26. As is shown in Table 4.3 the remainder of the elements steadily decline in abundance. The axial elements are some of the least represented in the site. Only 4 percent of the expected sacral elements, sternabrae and hyoids are present in the assemblage. Recognizable (and countable) portions of vertebrae are also poorly represented in the assemblage. Limb elements such as the dense ends of the limb bones and the compact bones (carpals and tarsals) are present in large numbers. Long bones are highly processed and are almost never complete. Only two complete long bones are present in the assemblage, an immature radius and a left adult metacarpal. The remainder of the long bones are represented by fragmentary and complete ends as well as shaft fragments. Based on the %MAU's only 45.3% of the expected elements are present, or recognizable, within the assemblage. A more detailed examination of the distribution and representation of faunal elements will be presented in chapter 7.

4.3 Aging and Seasonality

4.3.1 Foetal Bison

The Hartley site faunal assemblage contains a large number of foetal remains (Table 4.4). All of the material appears to be from large ungulates, presumably bison. Foetal bone is easily recognizable due to its highly porous cortical bone. The bone is very fragile and is not always preserved.

Table 4.4 Foetal bison (?) elements

Portion	NISP	MNE	MNI	MAU
Skull	22			
Mandible	2			
Vertebra	99			
Rib	172			
Sternum	2			
Scapula	14	7	5	3.5
Humerus	12	8	5	4
Radius	10	8	5	4
Ulna	7	5	3	2.5
Innominate	11			
Femur	12	8		4
Tibia	13	10	7	5
Metapodial	42			
Phalanx	27			
Long Bone Fragments	102			
Miscellaneous	75			
TOTAL	622		7	

Foetal bison are often reported as seasonal indicators in archaeological reports (Landals et al. 1994; Wilson 1974; Frison, Wilson and Walker 1978; Walde n.d.a.). The precision of the defined season has been highly variable, though. Foetal remains are often used to suggest a wide seasonal window during which the site might have been occupied. If foetal bones are present, a site might have a seasonality ranging from late fall to early spring, depending on the age of the foetus. General restrictions may be placed on the season through qualitative descriptions of the bones. Small foetal elements suggest that the animal died early in the pregnancy and probably relates to an autumn occupation. Elements that are closer in size to those of a neonate animal likely belong to a later season of occupation. More precise descriptions of the seasonality need to be based on aspects such as quantitative measurements of the bones as well as better understanding of the growth rates of foetal bison.

Some underlying assumptions must be accepted before foetal remains may be used to determine the seasonality of a site. Modern bison are born in the spring, typically in the first two weeks of May (Rutberg 1984). Over 80% of the calves born in a given year are born during a brief calving pulse. Animals which are born too early or too late are less likely to survive. Climatic stresses to the newborn and energetic stresses to the cows are seen as the dominant forces which restrict the birthing schedule (Rutberg 1984:422). The period of conception must also be roughly the same time of year in the past as it is today. The growth of the foetus must also be understood.

The rutting period of modern bison tends to peak in mid-August (Banfield 1987; Rutberg 1984). The gestation period is typically 9-10 months long. The growth of appendicular and axial elements does not progress at the same rate at the same time. For instance, Wilson states that "In calves of *Bos taurus* the limb bones grow most intensively during the second half of uterine development, with comparatively slight intensity of axial bone growth. After birth this trend begins to reverse, the axial bones growing faster and the peripheral bones slower than before." (1974:146-147). Walde (n.d.a.) noted that growth of foetal elements is not linear. Growth appears to progress in periodic spurts separated by short periods of slower growth. The data regarding the episodic growth patterns need further analysis.

Some methodologies have been put forth to age foetal remains. Foetal remains were analyzed at the Casper site (Wilson 1974) in two ways. The maximum length as well as the minimum transverse and anterio-posterior diameters of the appendicular elements were measured. These measurements were then compared to measurements taken from comparative specimens of known age. The measurements taken by Wilson appear to show some correlation between size and age. A small cut was also made into the side of several bones to count the layers of periosteum. The periosteal tissue is stratified in foetal bone by thin cancellous interspaces (Wilson 1974:147). These strata were counted under low magnification and compared to a small control group to establish the age of the elements. This technique has subsequently been used at the Big Goose Creek (Frison 1992) and the River Bend sites (McKee 1985). McKee tested this methodology on sixteen archaeological and eighteen comparative femora. The results of his analyses were generally successful and the periosteal counts taken from the archaeological elements could be correlated to the ages of known femora. McKee also showed that the age groupings distinguished by the periosteal counts seemed to concur with the groups recognized by measurements of the diaphysis diameter.

An alternative method of determining seasonality has recently been put forth by Walde (n.d.a.) and is based on measurements of appendicular elements. Walde has presented a series of simple linear regression equations as an initial attempt to quantify the age of foetal elements. It is recognized that foetal growth does not necessarily progress in a linear fashion. The use of these equations is to be a cautious first step in determining more precise foetal ages based on metric analyses. Based on the initial tests of these equations, a linear approach appears to be acceptable for distinguishing age (Walde n.d.a.). The measurements used by Walde are the same three measurements that Wilson proposed for the Casper site material (1974). Two equations each have been created for the scapula, humerus, radius, metacarpal, femur, tibia and metatarsal. The first equation for each of the long bones uses the minimum anterior-posterior (cranio-caudal) diameter and the second uses the transverse (medio-lateral) diameter . The scapula equations use the thickness and height of the neck respectively. Walde does stress that "These equations are extremely provisional descriptions and will be subject to change as additional data from known bison foetal materials representing the entire range of gestation length become available." (n.d.a.:9). No equations were created for the length of the elements. The length should be recorded, but due to the fragile nature of these bones the length is rarely complete.

The foetal remains from the Hartley site were aged based on the linear regression equations suggested by Walde (n.d.a.). Seven foetal scapulae were complete enough to be measured for this analysis (Table 4.5).

Table 4.5 Metric data (cm) and age (gestation days) for foetal scapulae.

Cat #	Element	Side	Neck Height	Age	Neck Thickness	Age	Absolute Estimate Difference
1817	Scapula	R	0.79	155	0.38	143	12
2719	Scapula	R	1.66	220	0.82	220	0
3781	Scapula	R	1.6	215	0.83	222	7
6418	Scapula	R	1.75	226	0.82	220	6
7658	Scapula	L	0.5	134	0.23	117	17
12204	Scapula	L	1.11	179	0.59	180	1
13404	Scapula	R	1.82	231	0.89	233	2

Both left and right elements were used to maintain the largest sample size possible (Figure 4.2). The age based on neck height and the age based on neck thickness for each element is not always consistent. The larger elements appear to have better agreement than the smaller elements. The absolute difference ranged from zero days to 17 days. The largest differences occur in the two smallest elements. If the two ages for each element are averaged a range of 126 to 232 gestational days is represented by these specimens. This corresponds nicely to what would be expected judging by the

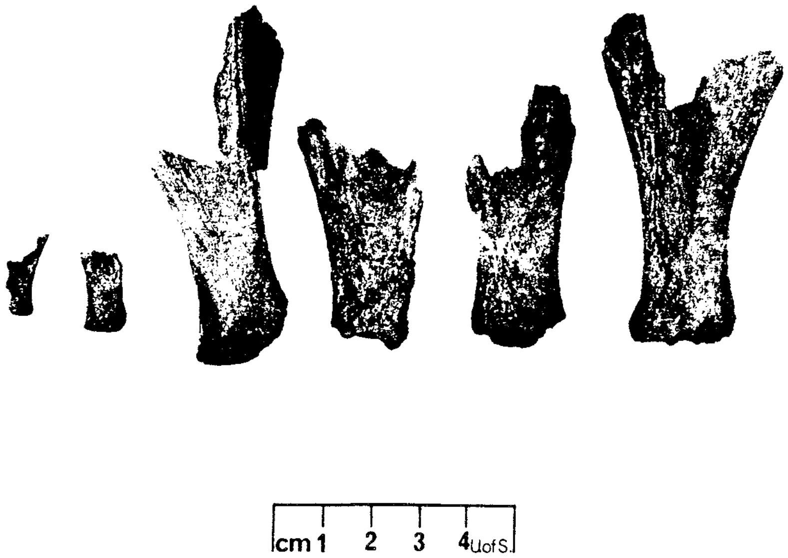

Figure 4.2 Foetal bison scapulae.

overall size of the elements. The ages of the smaller specimens may not be as accurate as those of the larger specimens.

Twenty-two foetal long bones were also measured (Table 4.6). The sample size for each element is small, so both left and right specimens were included in the sample. The absolute difference in the ages defined by the diaphysis diameters is for the most part small. Twelve of the twenty-two elements have differences of three days or less. Eight are within ten days and the remaining two are both less than fifteen days apart.

The size range of Hartley site foetal long bones is shown in Figures 4.3 to 4.5. The elements range in age from approximately 100 to 243 gestation days old. Thirty-nine days separate the two youngest elements and 17 days separate the two oldest. These outlying elements may represent animals which are due to atypical pregnancies and are not included in the discussions of seasonality. Assuming an average conception date of August 15, these elements represent animals killed from late December to late March.

Table 4.6 Metric data (cm) and age (gestation days) of foetal appendicular elements.

Cat #	Element	Side	Length	Cranio-Caudal Diameter	Age	Medio-Lateral Diameter	Age	Absolute Estimate Difference
6114	Humerus	R	34.8	0.78	143	0.7	144	1
11552	Humerus	R		1.23	195	1.18	202	7
12203	Humerus	R		1.1	180	1	180	0
13447	Humerus	L		1.63	242	1.52	243	1
4815	Radius	R	49.8	0.63	162	0.95	161	1
5527	Radius	L		0.73	178	1.04	172	6
5556	Radius	L		0.87	199	1.25	197	2
3193	Radius	R		0.79	187	1.18	189	2
11519	Radius	R		0.71	174	1.06	174	0
11853	Radius	R		1.04	224	1.41	216	8
8268	Femur			1.39	216	1.41	221	5
9227	Femur			0.58	146	0.62	143	3
5526	Tibia	L		1.11	194	1.34	198	4
9276	Tibia	L		0.38	95	0.49	104	9
9618	Tibia	L		1.33	224	1.57	224	0
10120	Tibia	R		1.26	214	1.48	214	0
11492	Tibia	L		1.17	202	1.4	205	3
11496	Tibia	L		1.3	220	1.5	216	4
13303	Tibia	L		0.66	133	0.85	144	11
3863	Metacarp		80.4	1.09	220	1.53	213	7
11839	Metatars			1.09	214	1.26	214	0
12019	Metatars			0.82	187	0.9	174	13

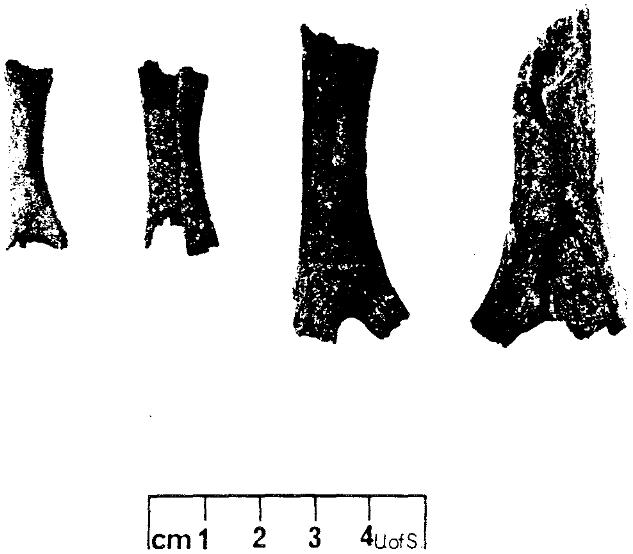

Figure 4.3 Foetal bison humeri.

Figure 4.4 Foetal bison radii.

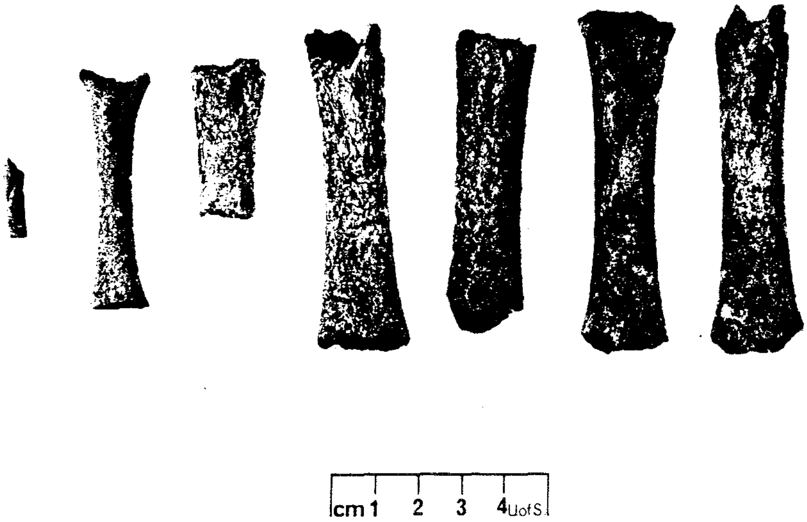

Figure 4.5 Foetal bison tibiae.

The two femora are similar to the sizes represented at the River Bend site (McKee 1985). The small femur from the Hartley site assemblage (#9927) is only slightly smaller than the elements from the smallest age grouping at the River Bend site. Based on metric analysis and periosteal strata counts the River Bend elements were suggested to represent animals of four or five prenatal months (McKee 1985:35). This is very close to the age of approximately 145 days (4.75 months) that was obtained using the equations proposed by Walde (n.d.a.). The larger Hartley site femur (#8268) is similar in size to the modern seven month foetus (UWA B0380) described by Walde (n.d.a.: Table four). The Hartley site femur was described as being 219 days old or just over 7 foetal months.

Other evidence for the diversity of foetal ages is the range of fusion seen in the elements which can not be measured. Metapodials begin to fuse together in the last two months of gestation (Wilson and Davis 1978:324). The majority of metapodials at the Hartley site are still separate halves and have not begun to fuse together. A significant number of vertebrae fragments were also recovered in the Hartley site assemblage. Walde noted the amount of fusion that had taken place in the vertebrae of the seven month old specimen (UWA B0380). The neural arch had begun to fuse to the centrum on some of the thoracic vertebrae and not on some others. Cervical vertebrae were still unfused and lumbar vertebrae were completely fused (Walde n.d.a.). None of the vertebrae identified from the Hartley site have begun to fuse suggesting an age slightly less than seven months. The majority of the appendicular elements (16) measured had average ages of 195 to 226 days. This would suggest that the majority of the foetal animals were killed in the month of March. These foetal elements appear to be from the oldest animals recovered from the site. The presence of smaller and differentially fused elements suggests that foetal animals were being collected from December through March.

4.3.2 Bison Tooth Eruption and Wear Schedules

The analysis of bison tooth eruption and wear patterns has proven to be a very important tool in determining the seasonality of archaeological sites (Frison and Reher 1970; Reher and Frison 1980; Reher 1973; Frison et al. 1976; Todd and Hofman 1987; Wilson 1980; Wilson 1988). The eruption schedule of deciduous and permanent teeth follows a regular pattern for the first five years, until the dentition is fully mature. The analyses of dentitions are similar to those described for foetal analyses. The time of conception for bison must be restricted to a short period of time which relates to a specific birthing period. This concise birthing period allows archaeologists to use the eruption schedules and wear patterns of bison teeth to establish the specific time of the year that the growth and wear of the teeth was stopped.

Several descriptions of wear patterns have been published based on large samples of bison mandibles and maxillae (Frison and Reher 1970; Reher and Frison 1980; Reher 1973; Frison et al. 1976; Todd and Hofman 1987; Wilson 1980; Wilson 1988). Through comparisons of the mandibular and maxillary teeth from large bison kill sites to modern bison of known ages archaeologists have been able to describe mandibular eruption and wear patterns for precise age groups. The primary descriptions used in the analysis of the Hartley site assemblage include the Wardell bison trap (Reher 1973), Glenrock buffalo kill (Frison and Reher 1970), Horner and Finley sites (Todd and Hofman 1987), the Hawken site (Frison et al. 1976), and the Henry Smith site (Wilson 1988).

All these analyses describe mandibular patterns for animals killed in the fall to winter seasons. They provide descriptions of age increments as follows: Wardell site (X.4 year increments), Glenrock (X.5 year increments), the Horner and Finley site (X.6 year increments), the Hawken (X.7 year increments) and the Henry Smith site (X.7 year increments).

The seasonality of the Hartley site dentition was inferred primarily from the qualitative aspects of mandibular eruption patterns and wear. Loose, individual teeth were assigned to age groups based on metaconid height measurements (Table 4.7). The Hartley site assemblage contained no maxillary portions with socketed teeth. A limited number of maxillary teeth were recovered which may represent associated tooth row portions, but they do not occur in sufficient numbers to be used in this analysis. Terminology for the description of the cusp patterns is based on the terminology suggested in Frison et al. (1976) and Frison and Reher (1980). The cusps of the molar teeth are labeled I to VIII beginning with the anterior buccal cusp as cusp I. The anterior lingual cusp is referred to as cusp II. The remainder of the cusps are labeled sequentially from anterior to posterior with the even numbered cusps located on the lingual side and the odd numbered cusps located on the buccal side. The buccal and lingual cusps of the hypoconulid of M3 are referred to as cusp IX and X respectively.

The metaconid is the anterior, lingual cusp (cusp II) of the mandibular molars. The metaconid height was measured from the root-enamel juncture to the top of the cusp. All unbroken molars, which had the base of the enamel exposed, were measured and plotted with respect to their height and their known age group. Metaconid heights were estimated on molars which had the tip of the cusp broken. Molars which did not belong to a known age group were placed in age groups based on their metaconid heights (Figure 4.6).

Table 4.7 Age groups and metaconid measurements for bison teeth.

Group	Age	Cat #	Side	Portion	Metaconid Height (mm)		
					M1	M2	M3
1	0.6	391/392	R	dp2-M1	54.5		
1	0.6	2664	L	dp2-M1	49.0		
1	0.6	7019	L	dp4-M2	53.9		
1	0.6	7496	L	dp2-M2	49.6		
1	0.6	12164	L	dp4			
				Mean	**51.8**		
2	1.6	83	R	dp4-M2	44.8		
2	1.6	247	L	P2-M3	43.4	64.4	
2	1.6	9708	R	M1	43.7		
				Mean	**44.0**	**64.4**	
3	2.6	9707	R	P2-M3	37.0	≈55.5	58.4
3	2.6	3920	R	M3			58.1
				Mean	**37.0**	**55.5**	**58.3**
4	3.6	3607†	R	P2-M3	38.0†	55.5†	
4	3.6	14072	L	M3			54.4
				Mean	•	•	**54.4**
6c	7.6-8.6	3063	L	M2-M3		35.4	
6c	7.6-8.6	188/190	L	P2-M3	13.5	33.8	48.2•
6c	7.6-8.6	9712	R	P3-M3	15.2	34.0	40.6
				Mean	**14.4**	**34.4**	**40.6**
6d	8.6-9.6	1844	L	M1-M3		≈18.0	
6d	8.6-9.6	1201/2	L	M1-M2	≈5.0	19.0	
				Mean	**5.0**	**18.5**	

† Pathologic specimens which have influenced metaconid heights.
≈ Estimated measurements.
• Questionable measurement (not used in any calculations).

No complete bison mandibles were recovered intact from the Hartley site assemblage. The bison mandibles present in the assemblage have all been broken during butchering or have been broken due to other taphonomic events. Most of the elements consist of several corpus fragments which contain a variety of premolars and / or molars. Only two complete buccal tooth rows could be reconstructed. The remainder of the mandible portions ranged in size from single socketed and unsocketed teeth to nearly complete tooth rows. The mandibles were often broken on the proximal end, in between or just after the molars. The distal or anterior ends of the mandibles were

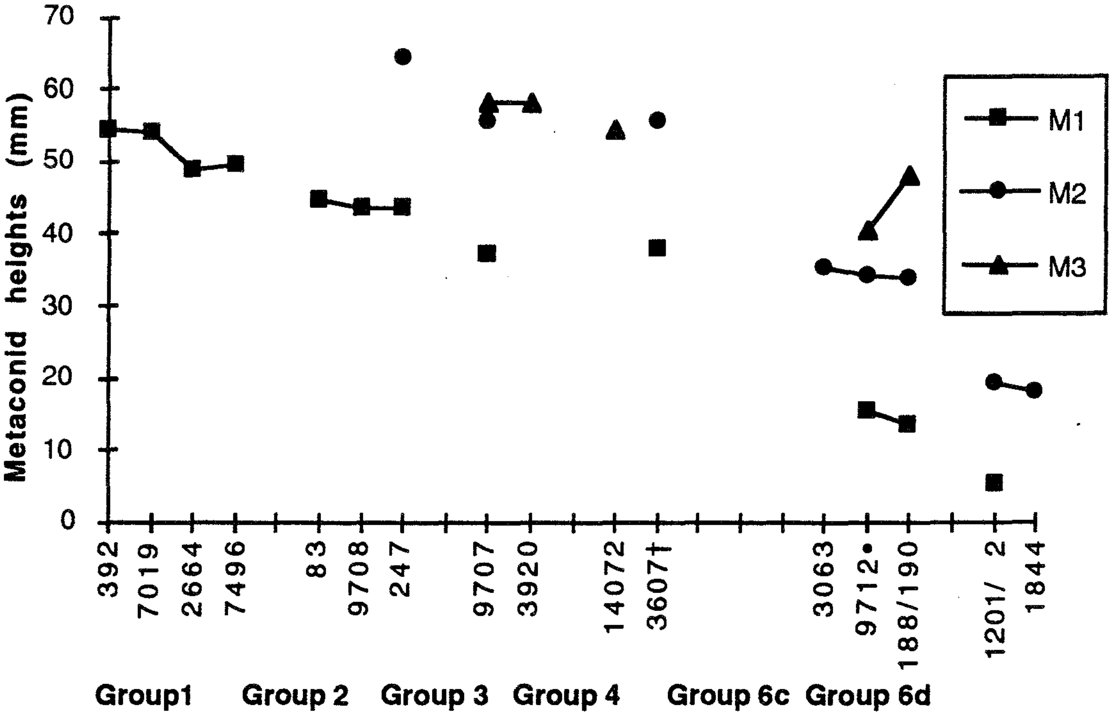

Figure 4.6 Regression of metaconid heights. († Pathologic specimen, • M3 shows abnormal wear.)

typically broken across the diastema. None of the mandible fragments retained incisor or canine teeth which were still socketed in their alveoli. This portion of the mandible was, therefore, not used to establish the seasonality.

All of the mandibles needed at least partial reconstruction before analysis could proceed. A total of thirteen fragmentary mandibles and tooth rows were analyzed in order to define the seasonality of the assemblage. Four unsocketed molars were also placed in age groups based on metaconid height measurements. It should be noted that a total of seventeen fragmentary mandibles is a small sample size. Subtle differences in the eruption and wear of individual mandibles are often expressed in larger sample sizes. Some minor variations have been also acknowledged during the analysis of the Hartley site assemblage. The differences seen in these dentitions are not greater than would be expected in a larger population. Limited comparisons between the elements found that two of the specimens (catalogue numbers 188 and 190) may be refitted to form a complete tooth row. These were analyzed as a single element. No positive matches between left and right mandibles could be identified. The total MNI for the sample is thirteen based on age and side. Despite the small sample size the eruption patterns and rates of attrition separate into age groups of X.6 year increments (Table 4.4).

Group 1 (0.6 years)

Group one consists of four mandibles (Rdp2-M1, Ldp2-M1, Ldp2-M2, and Ldp4-M2) and one socketed Ldp4. Slight to moderate wear is present on dp2 and dp3. The wear present on dp4 is complete on all cusps. The preexostylid on dp4 is never in wear and is well below the level of the occlusal surface. The postexostylid is not in wear on two of the specimens and exhibits slight wear or polished tips on two others. The postexostylid from the remaining dp4 may exhibit some wear but its tip has been broken which obscures part of its occlusal surface. The rootline for all of the deciduous premolars is still below the level of the alveoli. The first molar is present in three mandibles and is almost the same height as the occlusal surface of the premolars. The exostylid is not yet in wear on any of the specimens and slight to moderate wear is present on cusps I and II. Two mandibles had fragmentary M2 associated. These were not yet fully formed and only the first two cusps have erupted. No M3 teeth should be expected with any of the mandibles in this group due to their young age.

The wear patterns exhibited on these teeth all exhibit the same stage of wear as was found at the Horner, Finley (Todd and Hofman 1987) and Harder

(Morlan 1994b) sites. The M1 teeth at the Henry Smith site (Wilson 1988) and the Hawken site (Frison et al. 1976) exhibit wear on cusp III and IV which is not present on any of the Hartley site M1 specimens. The wear stages seen on the Hartley site sample are also slightly more advanced than those at Glenrock (X.5). Glenrock M1 are typified as being "...erupted but usually not to the level of the other teeth, M1 is unworn or slightly worn on the highest cusp" (Frison and Reher 1970).

Group 2 (1.6 years)

Group two is represented by two mandibles (LP2-M3 and Rdp4-M2). One RM1 is placed in age group two based on metaconid height measurements. P2, P3 and M3 can be seen forming under the deciduous teeth. P2 is beginning to erupt and P3 has almost pushed out dp3. The roots of dp4 are beginning to show above the alveoli. The preexostylid is not yet in wear on one specimen and is slightly polished on the other. The postexostylid is in wear and is joined to the rest of the tooth as a continuous loop. M1 is erupted to its full height and is in full wear. The exostylid on M1 is not yet in wear on either specimen. M2 has erupted and has wear on cusps I and II. Cusp III is slightly polished on one of the specimens. One rootless M3 was recovered with a mandible as a loose tooth and its eruption stage is unknown. Although the enamel at the top of the cusps appears to be fully formed the rest of the tooth is still very fragile. There is no wear or polish present on any of the cusps. This tooth is either unerupted or is just beginning to erupt out of the mandible.

Group 3 (2.6 years)

Group three is represented by the eruption patterns of one mandible (RP2-M3) and one loose RM3. There is little to no wear on P2 and P3. The dp4 has almost been pushed out and P4 is visible beneath it. M1 is in full wear with the exostylid worn and joined to the tooth in a continuous loop. All of the cusps on M2 are in complete wear. The exostylid on M2 is not yet in wear. M3 has moderate wear on cusps I and II. The loose M3 is polished or has very slight wear on cusps I and II.

Group 4 (3.6 years)

Group four is represented by one loose tooth (LM3). This tooth is placed in group four based on its metaconid height (Figure 4.2). One mandible (RP2-M2) is conditionally placed in age group 4 based on its wear patterns. The mandible has highly unusual wear. P2 shows slight wear. P3 is moderately to highly worn on all cusps. P4 is in full wear, but is wearing in a very unusual way. The tooth is compacted in between P3 and M1. The posterior edge of the tooth is almost 10 millimetres below the occlusal surface of M1. The metaconid has worn into a single loop of enamel which projects above the rest of the occlusal surface. An extra exostylid is also present on the buccal side of P4, M1 is well worn, and the exostylid is joined to the rest of the occlusal surface. M2 is also in full wear. The M2 exostylid is above the alveolus but is still well below the occlusal surface. Two examples of hypoplasia (demarcations of arrested tooth growth) are present on M2, 10-14 mm above the root line. This type of hypoplasia is often caused by winter stress on the growing animal (Wilson 1988). It is a result of protein deficiencies in the animal's diet restricting tooth formation. The location of this hypoplasia suggests stress in the winter of the first to the spring of the second year of life (Wilson 1988:218). Examples of hypoplasia were not observed on any other teeth in the Hartley site assemblage.

The metaconid heights for M1 and M2 are very close to those recorded for age group three (Figure 4.2). The difference in eruption and wear present on the teeth, however, does not support this association. Due to the pathologies recorded on these teeth it is more likely that the eruption schedule is correct and this mandible is older than age group three. It was not possible to precisely determine the age of this mandible, but based on the other mandibles' tight clustering it is probable that it is approximately 3.6 years of age.

Group 5 (4.6 years)

No elements were recorded for this age group.

Group 6

Group six represents animals which have a fully mature dental arcade (ages 5 and up). All of the teeth present in the mandible are fully erupted and in complete wear. Once the animal has reached this level of maturity, qualitative descriptions of the eruption patterns are no longer useful for dividing mandibles into precise age groups. Mandibles in this age group are based primarily on the descriptions of wear from the Horner and Finley sites (Todd and Hofman 1987). These age groups may not be as precise as those based on eruption patterns, but they have been refined using metaconid heights when available. At least two, possibly three, age groups are not represented in the sample.

Group 6a (5.6 years)

Group 6a is not represented by any specimens in the Hartley site assemblage.

Group 6b (6.6 years)

Group 6b is not represented by any specimens in the Hartley site assemblage.

Group 6c (7.6 - 8.6 years)

Group 6c is represented by three mandibles (LP2-M3, LM2-M3 and RP3-M3). All of the premolars exhibit well worn occlusal surfaces and have exposed root lines. M1 is well worn and the exostylid is joined to the main body of the tooth. The root line of M1 is also exposed. M2 is well worn with the exostylid joined to the main body of the tooth. The root line is not exposed on M2. M3 is in full wear and the hypoconulid is fully joined to cusps VII and VIII. The exostylid is worn to a small loop of enamel and is not joined to the main body of the tooth. All of the M1 and M2 metaconid heights are very similar on all of the specimens. M3 metaconid heights, however, are highly variable on the two measurable specimens in this age group (Figure 4.2). Although it can not be positively determined, specimen 9712 exhibits pronounced wear and is likely the tooth that is abnormal. A larger sample size is needed to be certain which of these teeth are abnormal in size.

The age of these animals as well as the season of death can not be precisely determined due to the small sample size and the fully mature dental arcade. An age of 7.6 - 8.6 is primarily inferred from the ages of the immature animals.

Group 6d (8.6 - 9.6 years)

Group 6d is represented by two mandibles (LM1-M3, LM1-M2). M1 and M2 are well worn and have the exostylid joined to the main body of the tooth. On M1, the roots are exposed and the postfossette is almost worn away. In one specimen the prefossette is completely worn away. The anterior cusps of M1 are becoming cupped. The second specimen is fragmentary, but it is probable that the prefossette is also worn away. M3 exostylid is in wear, but still unconnected to the remainder of the tooth. The roots of M3 are still well beneath the level of the alveolus. The exact age and season of death can not be determined for these specimens. The age range is inferred from the ages of the immature mandibles. The pronounced wear on these teeth suggests an animal of increasing age.

4.3.3 Discussion

The seasonality of the Hartley site based on the bison remains suggests that the site was continuously occupied from approximately December to late March. The analysis of the eruption patterns and attrition of the mandibular teeth suggest a seasonality based on X.6 year increments. The large number of foetal remains suggest that a significant number of adult female animals must have been procured. Metric and non-metric analyses of the foetal elements suggest a long occupation of the site ranging from approximately late December until late March. The majority of the foetal elements analyzed suggest that these animals were killed during the latter part of the occupation.

Based on the mandibular dentitions, six age groups are represented in the Hartley site assemblage. Animals range in age from 0.6 to approximately 9.6 years of age. Assuming that the animals present in the assemblage were born during the first two weeks of May, the season of death would have been in the very late autumn to early winter. The presence of foetal bison material corroborates that the Hartley site is a winter occupation.

The rate of dental attrition has been calculated for M1, M2 and M3. The small sample size and the large gap in usable measurements may potentially bias the results. M1 has an attrition rate of 5.9 mm/year, M2=6.6 mm/year and M3=3.5 mm/year. If combined, these produce an average rate of 5.3 mm/year. This is similar to other sites in the region such as the Harder site (5.8 mm/year) and the Henry Smith site which used an estimated attrition rate of 5 mm/year to determine most of its age groups.

The mortality profile based on the Hartley site mandibles is reflects an attritional, as opposed to a catastrophic profile (Figure 4.7). Attritional profiles are those which reflect the normal or natural deaths which occur in a population (Reher 1973). These profiles contain relatively large numbers of young and old animals and few middle aged animals. Catastrophic profiles reflect the living population (Reher 1973). These profiles are what should be present at large, natural or cultural, kill sites (Reher 1974:114). Young animals at archaeological kill sites, where catastrophic profiles should be

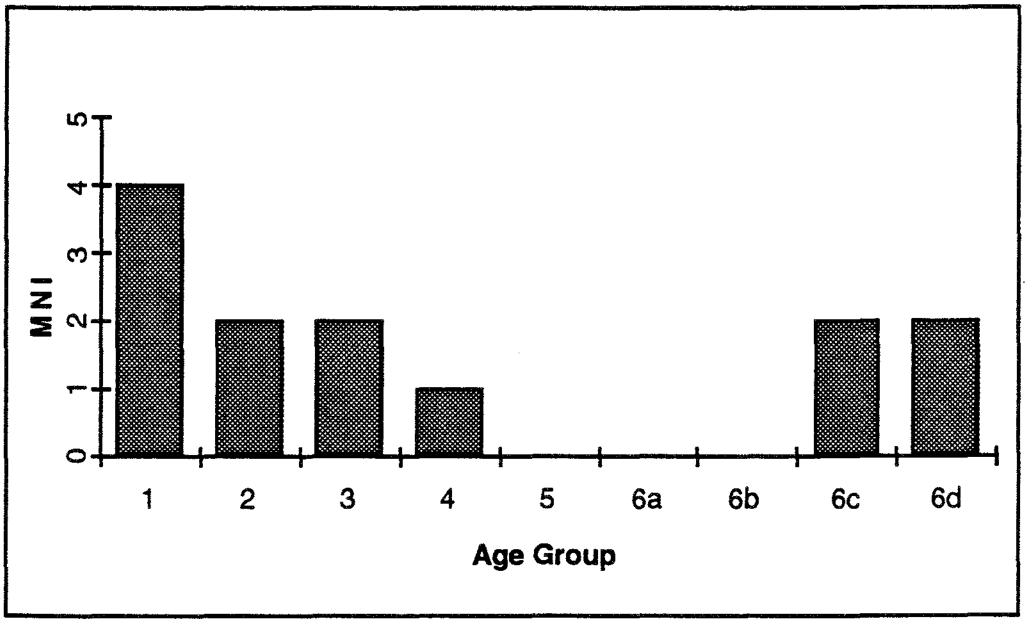

Figure 4.7 Mortality profile based on the bison mandibles.

seen, are typically under represented (Reher 1974:114). The mortality profile from the Hartley site assemblage, however, consists of a predominance of calves and long yearlings. Eight of the thirteen individuals represented are 0.6 to 2.6 years of age. Bison reach breeding age at 2 1/4 to 2 1/2 years old, but do not typically begin breeding until they are over three years of age (Frison and Reher 1980; Rutberg 1984). Eight out of 13 of the individuals are under three years of age and are unlikely to be part of the breeding stock. Only four animals have reached full maturity. The oldest animals represented in the Hartley site are approximately 8.6-9.6 years of age.

The attritional profile may be due to a number of different factors. The profile may be a factor of the small sample size or a bias in the sampling technique. It may also be the result of preferential retrieval from a catastrophic kill site. Higher numbers of younger animals may have been removed from the kill site due to their smaller, more portable size (Reher 1974). The high frequency of young animals could also be due to selective hunting practices at several single animal or small scale kills, or it may be due to any combination of these possibilities.

Therefore, the bison remains suggest that bison were being hunted more or less continuosly throughout the winter months. Over the course of the winter, several small scale or single kills were undertaken. One larger scale kill event may have taken place in the early winter, although this is speculative. No mandibles were identified which exhibited eruption and wear patterns attributed to a late winter or early spring season of death. This may simply relate to the small sample size or to a lack of retrieval of mandibles to the site. Without the presence of the foetal remains it would have been difficult to establish the length of the occupation.

4.4 Gender Analysis

Sexual dimorphism in bison makes it possible to determine the gender of the animal based on the size of its elements. Adult bulls are larger and more robust and grow to be 600-860 kg in size. Cows are smaller and typically grow to be 350-550 kg in size (Rutberg 1984). Caution must be exercised because immature males do overlap in size with mature females (Morlan 1991; Speth 1983; Walde n.d.b.). Several techniques for distinguishing gender of bison populations have been suggested. Some of these techniques are based on the analysis of cranial elements (Frison et al. 1976) and mandible depths (Reher 1970 and 1973). Others have focused on post-cranial elements such as metapodials (Bedord 1978; Peterson and Hughes 1980), phalanges (Roberts 1982; Ziemens 1982), long bones (Speth 1983; Todd 1987; Walde n.d.b.), and carpals and tarsals (Morlan 1991).

The gender dynamics of the Hartley site bison assemblage are based on the analysis of the long bones and the carpals and tarsals. To distinguish absolutely between male and female animals the element must reach maturity. Full maturity of long bones is defined for this analysis as the complete fusion of the entire element, although this definition may be problematic when the elements are heavily processed as they are in the Hartley site assemblage. The proximal and distal epiphyses of long bones do not fuse at the same time. Several years may separate when the two (or more) portions become completely fused to the diaphysis. For example, the proximal radius is completely fused to the diaphysis at age two (Empel, W. and T. Roskosz 1963:270, as cited in Dyck and Morlan 1995:567). The distal end of the radius, however, does not fuse until age five for bulls and age six for cows. It is not until this point that the radius becomes mature. Therefore, a fully fused proximal radius does not necessarily come from a mature element.

The same problem arises in the analysis of carpals and tarsals and other elements with only one centre of ossification. It is not possible to distinguish between immature and mature elements. For the purpose of this analysis, results of the gender analyses are divided into male and female/immature groups unless it can be shown that the element is fully mature.

The long bone analyses follow the discriminant function analysis technique proposed by Walde (n.d.b.). Carpal and tarsal analyses use the bivariate plot technique proposed by Morlan (1991) .

4.4.1 Long Bone Analysis

The long bones present in the Hartley site assemblage display varying degrees of fragmentation. Most long bones exhibit spiral fractures on the diaphysis, presumably due to butchering for marrow extraction. Due to the fragmentary nature of the bones, methods of analyses which require complete bones (or complete ends of bones) could not be used. One methodology has been proposed specifically for fragmentary specimens. Walde (n.d.b.) has developed a set of discriminant function analyses in order to distinguish the gender of fragmentary bison long bones. He has produced several equations for the proximal and distal ends of six limb elements (humerus, radius, metacarpal, femur, tibia and metatarsal). Each set of equations has been tested on a data base of laboratory specimens of known gender. The equations are presented in the general form:

$$Gx=C_1x_1\underline{V} + C_2x_2\underline{V} + \ldots + C_nx_n\underline{V} + K \qquad (4.1)$$

where Gx is the classification score for group x (e.g., male or female), C is a classification coefficient, K is a constant, and $\underline{V}$ is a variable (Walde n.d.b.). The measurements used in the equations ($\underline{V}$) are the same as those presented by Speth (1983). Walde uses the measurements from Speth unchanged because of their suitability to this form of analysis. Some of the original measurements which are difficult to replicate were omitted (Walde n.d.b.). Two separate equations (G_{male} and G_{female}) are run for each element to create a male and a female group. The mathematical difference between these groups establishes the gender of the element. For the purpose of this analysis the female group was always subtracted from the male group in order to maintain consistency. The male category is then represented by the positive values and the female category is represented by negative values.

In the original presentation of these equations an arbitrary acceptance value of 1.6 was imposed (Walde 1985). Any values under 1.6 were ignored due to a low probability of success. Through further testing Walde has determined that the 1.6 acceptance rule eliminates correctly assigned individuals more often than it eliminates incorrectly assigned individuals (Walde n.d.b.). Furthermore correctly assigned male elements are eliminated more often using this rule than correctly identified female elements. This results in an unnecessary bias towards female dominated assemblages (Walde n.d.b.). The 1.6 acceptance level is therefore not used in this analysis. Some values, however, that are extremely low have been discounted as indeterminate due to their low probability of being correct.

Measurements were taken on the fused proximal and/or distal ends of all the acceptable long bones. No unfused specimens were included in this sample. Specimens which were too fragmentary or too weathered were not included in this analysis. There were no measurable specimens for the proximal humerus, femur or the proximal tibia. Measurements were taken as described by Speth (1983:171-191). The measurements were taken using calipers to the nearest 0.1 mm.

Forelimb

Distal Humerus (Table 4.8):

The distal humerus is a denser portion of the bone and several usable portions are present in the assemblage. Twenty four specimens were complete enough to be used in this analysis (Table 4.8). Fifteen are rights and nine are left.

Sixteen (67%) of these specimens were identified as being female/immature and seven (29%) were identified as males. The gender of one specimen (catalogue number 6151) could not be determined. The difference between the equation results was only 0.166. This difference is too small to accurately determine the gender of the element.

Table 4.8 Distal humerus gender measurements.

Cat. #	Side	I*	J*	K*	M*	N*	O*	Male Eq.	Female Eq.	•DIF.	Sex	◊Eq.
657	R	7.96	4.81	7.61	7.41	3.2	3.8	223.95	233.93	-9.98	F/I	8
696	R	7.82	5.4	8.14	7.1	3.6	4.09	236.82	244.09	-7.27	F/I	8
1752	R	8.3	5.2	8.15	7.51	3.85	4.2	268.59	270.25	-1.66	F/I	8
3291	R		4.7					86.178	92.361	-6.18	F/I	7
3581	R		5.09					105.89	109.11	-3.22	F/I	7
5400	L					3.75	4.28	164.82	166.54	-1.72	F/I	4
5505	R	8.01	5.21	8.29	7.64	3.72	4.11	259.0	262.64	-3.61	F/I	8
5993	L	8.13	4.91		7.62			96.79	101.38	-4.59	F/I	7
6019	L		5.22	8.41				167.82	170.01	-2.19	F/I	6
6048	R	8.82	5.41	8.61	8.4	4.03	4.53	304.96	301.11	3.85	M	8
6151	L		5.51	8.72				183.32	183.2	0.166	?	6
6995	R	9.7	5.81	10.01	9.7	4.35	5.28	384.84	368.25	16.59	M	8
7004	R		5.73	8.91				193.35	191.71	1.636	M	6
7138	L	9.11	6.01		8.95			152.4	148.63	3.76	M	7
7605	R					3.75	4.1	163.38	165.83	-2.44	F/I	4
9693	L		4.67		7.1			84.660	91.072	-6.41	F/I	7
10504	R	7.9	4.95		7.62			98.813	103.10	-4.29	F/I	7
11020	L	8.31	5.91	9.56	8.7			221.29	216.65	4.639	M	3
11204	R		5.8					141.78	139.6	2.166	M	7
11848	R		5.74					138.74	137.03	1.71	M	7
12143	L		5.65	8.59				180.14	180.80	-0.66	F/I	6
12166	R	7.69	5.3	7.82	7.08	3.47	3.96	219.47	229.69	-10.2	F/I	8
12683	L	7.92	5.3	8.32	7.6	3.65	4.35	249.88	254.11	-4.23	F/I	8
13298	R	7.9	5		7.15			101.3	105.25	-3.91	F/I	7

* Measurements as presented in Speth (1983). • Absolute difference between the male and female equations. ◊ Abbreviation for equation.

Dyck and Morlan (1995) note that there is confusion in the literature regarding the rates of fusion for the proximal and distal humerus. It is accepted that the distal end is the first end to become fully fused. The year in which the different epiphyses fuse, however, is variable (Duffield 1973; Empel and Roskosz 1963:372, as cited in Dyck and Morlan 1995). All of the humeri measured have fully fused distal epiphyses, but they can not be referred to as mature elements. While it may be assumed that the gender of the animals present in the male category is correct, the animals placed in the female category may include some individuals that are not fully mature. This group is referred to as female/immature.

Walde (n.d.b.) has observed that smaller distal humeri are often split between the lateral and medial condyles as a result of marrow extraction. The smaller humeri are more likely to be female and may bias the male/female ratio if they are not analyzed. Nine fragmentary specimens in the assemblage exhibited fractures which appear to be related to this type of butchering. Six of these specimens were female and three were male. This type of processing does not affect the male / female ratio.

Proximal Radius (Table 4.9):

Thirteen fused proximal radii were complete enough to enter into Walde's formulae (Table 4.9). Seven of the specimens are lefts and six are rights. All of the proximal radii were placed in the female/immature category. The proximal epiphysis of the radius is the first epiphysis to fully fuse to the diaphysis. The distal end does not fuse until much later at approximately age five for bulls and age six for cows (Duffield 1973; Empel and Roskosz 1963:270, as cited in Dyck and Morlan 1995). The proximal radius is not necessarily representative of a mature element.

Table 4.9 Proximal radius gender measurements

Cat. #	Side	A	B	C	D	Male	F / I	DIF.	Sex	Eq.
860	L	8.48		2.8		200.41	212.13	-11.72	F/I	4
2728	R	8.76	4.71	2.6	5.18	344.44	356.55	-12.11	F/I	1
2800	R	8.66	4.37		4.44	243.46	255.61	-12.14	F/I	3
3025	R	8.65	4.62	2.62	5.15	334.4	347.06	-12.66	F/I	1
5566	R	8.61	4.72	2.77	5.22	349.65	358.3	-8.653	F/I	1
5991	R	8.52	4.81	2.75	4.89	341.74	352.28	-10.54	F/I	1
6001	L		4.9	2.97	5.48	384.57	386.69	-2.12	F/I	2
6366	L	8.41		2.6	5.2	182.44	198.99	-16.55	F/I	4
11287	L	8.9	4.42	2.92	4.9	314.37	325.27	-10.9	F/I	1
11414	L	8.58	4.47	2.65	4.9	309.69	324.8	-15.1	F/I	1
11830	L	8.98	4.93		5.01	316.85	318.19	-1.333	F/I	3
12876	L	8.71	4.53	2.82	4.82	316.67	328.89	-12.22	F/I	1
12880	R	8.96		2.73	4.91	212.18	224.24	-12.06	F/I	4

Distal Radius (Table 4.10):

Twelve fused distal radii were also analyzed (Table 4.10). Eight are rights and four are lefts.

Table 4.10 Distal radius gender measurements

Cat. #	Side	G	H	I	J	K	Male	Female	DIF.	Sex	Eq.
200	L	8.53	4.73	4.73	1.75	3.16	244	246.35	-2.35	F	1
704	L	7.75	4.4	4.46	1.37	3.05	207.19	215.45	-8.26	F	1
2715	R		4.1	4.32	1.62	2.81	134.97	144.5	-9.52	F	3
3047	R	7.76	4.34	4.5	1.52	2.92	205.73	215.51	-9.78	F	1
3448	R	8.11	4.02	4.56	1.68	2.81	218.93	226.58	-7.66	F	1
4119	L		4.05	4.31	1.58	3.04	132.77	138.92	-6.15	F	3
5376	R	7.8	4.63	4.37	1.58	2.92	200.89	211.91	-11	F	1
6117	R	8.4	4.62	4.51	1.58	3.16	232.61	235.83	-3.22	F	1
6441	L	8.11	4.18	4.65	1.57	3.07	225.84	230.05	-4.21	F	1
7005	R		3.89	4.11	1.52	2.68	117.78	130.33	-12.6	F	3
10137	R	7.92	4.13	4.21	1.67	2.77	196.07	206.69	-10.6	F	1
13905	R	8.3	4.68	4.53	1.62	2.89	228.13	236.42	-8.28	F	1

All of these specimens are also placed in the female category. No complete radii appear in these calculations. It is likely that some of the proximal and distal specimens are from the same element.

Proximal Metacarpal (Table 4.11):

The proximal metacarpal does not have a true epiphysis and does not change substantially with age. Twenty-one specimens were measured, fifteen rights and six lefts. Sixteen (76%) of the proximal metacarpals were placed in the female/immature category. Three (14%) of the specimens were placed in the male category and two (10%) were indeterminate.

Table 4.11 Proximal metacarpal gender measurements

Cat. #	Side	A	B	M	F	DIF.	Sex	Eq.
373+	L	6.83	4.03	275.3	276.3	-0.94	M*	1
591	R	6.61	3.91	256.6	260	-3.43	F/I	1
661	L	6.67	4.09	271.2	273.1	-1.85	F/I	1
3044	R		4.01	221.6	222.9	-1.29	F/I	3
3059	R	6.42	4.06	256.8	260.8	-4.03	F/I	1
3624	R		3.91	209.4	212.2	-2.81	F/I	3
4516	R	6.12		187.6	195.9	-8.23	F/I	2
6336	L	7.21		272.5	269.2	3.298	M	2
6360	R	6.25		197.7	204.6	-6.86	F/I	2
7015	R	6.6		225	228.1	-3.15	F/I	2
7026	R	6.1	3.85	227.2	235	-7.85	F/I	1
7469	R	6.64	4.01	264.5	267.1	-2.58	F/I	1
9999	L	6.31		202.4	208.6	-6.22	F/I	2
10404	L	6.49	3.99	255.7	259.6	-3.89	F/I	1
11108	R		3.81	197.3	201.6	-4.32	F/I	3
12681	R	6.32	3.61	222.6	230.2	-7.56	F/I	1
12702	R	7.01	4.09	288.2	287.4	0.853	M	1
12875	R	6.95	4.09	285.2	284.8	0.376	?	1
13131	L		3.77	192.4	197.3	-4.93	F/I	3
13798	R	6.38	4.01	251.5	256.2	-4.65	F/I	1
13978	R	6.89		247.6	247.7	-0.09	?	2

$^{+}$ Complete element.

* Gender was changed due to conflicting distal measurements.

Distal Metacarpal (Table 4.12):

The distal epiphysis is the final end of the bone to fuse and is the mark of a mature element. Fourteen mature distal metacarpals were measured. Eight were rights and six were lefts. Eight of the specimens were classified as female. Four were classified as males and two were indeterminate.

Table 4.12 Distal metacarpal gender measurements

Cat. #	Side	D	E	F	I	J	M	F	DIF.	Sex	Eq
373+	L	6.57	3.31	3.09	3.71	3.81	405	404.8	0.201	M	1
705	R	6.61	3.42	3.19	3.71	3.51	370.48	370.29	0.187	?	1
740	R	6.5	3.26	3.05			227.98	230.38	-2.41	F	3
3523	R	6.7	3.81	3.63	3.78	3.62	404.86	395.92	8.946	M	1
4518	R	6.7	3.67	2.91	3.6	3.31	331.38	337.41	-6.03	F	1
10622	R	6.5	3.29	3	3.59	3.51	358.49	361.9	-3.42	F	1
10667	R	6.5	3.2	3.01	3.7	3.5	359.82	362.98	-3.16	F	1
10819	L	7.23	3.7	3.5	4	3.8	439.83	431.96	7.863	M	1
11863	L	6.29	3.22	3.02	3.51	3.37	335.07	339.09	-4.02	F	1
12135	L	6.52	3.39	3.07	3.7	3.51	363.11	365.03	-1.92	F	1
12551	L	6.64	3.52	3.13	3.79	3.6	381.04	381.16	-0.12	?	1
12559	L	6.82	3.5	3.22	4.11	3.91	434.88	431.02	3.859	M	1
13023	R	6.43	3.3	2.91	3.64	3.45	345.76	350.99	-5.23	F	1
13827	R	6.46	3.41	3.11		3.46	231.59	232.67	-1.08	F	3

+ Complete element.

One complete metacarpal (catalogue number 373) was analyzed. The proximal end was categorized as female/immature. The calculations on the distal end produced a very low positive value. Both of these values are relatively weak indicators of the element's gender. Walde also noticed some cases where young males were incorrectly classified using the proximal end and correctly classified using the distal end (Walde n.d.b.). This problem is most apparent among males of about three years of age. It is presumed that the conflicting results for the Hartley site element are indicative of an immature male which has not yet reached full size.

Distal Tibia (Table 4.13):

The distal epiphysis of the tibia is the first to fuse. It fuses to the diaphysis in the middle of the fourth year. The proximal end fuses a year and a half later at the end of the fifth year (Duffield 1973). Sixteen distal tibiae are present, eleven of which are rights and five are lefts. Ten (63%) were classified as female/immature, five (31%) were classified as males and one (6%) was indeterminate.

Table 4.13 Distal tibia gender measurements

Cat. #	Side	H	I	J	M	F	DIF.	Sex	Eq.
388	R	7.05	5.03	5.1	458.8	458.2	0.59	M	1
469	R	7.5	5.38	5.17	493.3	488.7	4.65	M	1
565	L	7.1		4.98	448.9	449.4	-0.5	F	1
658	L	6.94		5.02	443.6	444.8	-1.1	F/I	1
5210	L	6.95	4.86	5.24	467.9	466.4	1.52	M	1
5988	R	6.95	4.91	4.8	420.5	424.2	-3.7	F/I	1
6118	R	6.76	4.96	4.94	424.2	427.6	-3.4	F/I	1
9728	R	6.71		4.84	410.5	415.4	-4.9	F/I	1
10069	R	6.8	5.07	4.94	426.6	429.7	-3.1	F/I	1
10071	R	6.92	4.93	5.01	441.3	442.7	-1.4	F/I	1
10655	L	6.61	4.92	4.8	400.2	406.2	-6.1	F/I	1
10660	L	7.51	5.4	5.36	514.4	507.4	6.95	M	1
10675	R	6.5	4.88	4.8	393.6	400.4	-6.9	F	1
11293	R	6.81	4.99	5.01	434.7	436.9	-2.2	F/I	1
11302	R	6.95	5.02	5.1	452.8	453	-0.1	?	1
12749	R	7.12	5.19	5.2	473.8	471.5	2.27	M	1

Proximal Metatarsal (Table 4.14):

The proximal metatarsal, like the proximal metacarpal, does not have an epiphysis. It is not possible to distinguish immature males and adult females (Walde n.d.b.). Walde also notes that the butchering of metatarsals occasionally splits the proximal metatarsal into caudal and cranial portions. This splitting occurs most frequently on the smaller elements which are presumably the female and immature. The larger, more robust bones do not typically split in this way. This destruction of smaller elements may inflate the relative number of males in a given sample.

Twenty-two proximal metatarsals were measured. Fifteen are lefts and seven are rights. Eleven (50%) specimens were categorized as female/immature. Eight (36%) specimens were classified as males and three (14%) were indeterminate.

Table 4.14 Proximal metatarsal gender measurements

Cat. #	Side	A	B	M	F	DIF.	Sex	Eq.
250	R	5.38	5.35	288.9	288.4	0.459	?	1
374	R	4.66	4.86	225.5	233.4	-7.9	F/I	1
465	R	5.79	5.24	295.4	291.6	3.805	M	1
1731^{+}	L	5.94	5.35	309.2	303.6	5.576	M	1
1738	R	4.99	4.73	227.6	232.9	-5.36	F/I	1
2530	L	5.79	5.9	345.6	339.4	6.207	M	1
2823	L	4.6	4.5	195.9	205.7	-9.76	F/I	1
2961	L	5.4	5.4	293.4	292.6	0.824	M	1
3043	L	6.23	6.08	375.3	364.4	10.88	M	1
3522	L	5.32	5.1	267.7	268.7	-1	F/I	1
3664	L	4.91	4.77	227.7	233.6	-5.95	F/I	1
4109	R	5.37	5.02	263.4	264.2	-0.83	F/I	1
5642	L	5.1	4.91	245.2	248.9	-3.7	F/I	1
7459	L	5.36	5.3	284.4	284.3	0.094	?	1
7857	L	5.3	5.27	279.9	280.5	-0.56	F/I	1
8005	L	5.63	5.32	295.7	293	2.634	M	1
10630	R	5.26	5.04	260.9	262.7	-1.77	F/I	1
10692	R	4.91	4.88	236.1	241.6	-5.55	F/I	1
11125	L	5.09	4.92	245.6	249.4	-3.76	F/I	1
11205	L	5.91	5.61	327.9	321.6	6.248	M	1
13948	L	5.41	5.22	280.1	279.8	0.26	?	1
13997	L	5.61	5.41	301.8	299	2.779	M	1

Distal metatarsal (Table 4.15):

The distal end of the metatarsal fuses to the diaphysis at the end of the fourth year (Duffield 1973). Eighteen distal metatarsals were measured including eleven lefts and seven rights. Twelve (67%) were classified as females, four (22%) as males and two (11%) as indeterminate.

The distal metatarsal measurements show a high percentage (67%) of females. The proximal measurements tend to reflect a much lower presence of females (50%). It is likely that the distal sample is the more accurate representation. The high degree of processing at the Hartley site is likely to have removed a portion of the proximal metatarsals from the measurable sample.

Table 4.15 Distal metatarsal gender measurements

Cat. #	Side	D	E	F	I	J	Male	Female	DIF.	Sex	Eq.
659	L	5.92	2.92	2.7	3.81	3.54	308.752	311.236	-2.48	F	1
1731+	L	6.75	3.38	3.13	4.03	3.81	409.469	400.345	9.12	M	1
1854	R	5.92	2.91	2.7	3.78	3.54	308.471	311.002	-2.53	F	1
2166	L	5.68	2.79	2.6	3.6	3.39	281.264	286.759	-5.49	F	1
5531	R	5.65	2.8	2.54	3.51	3.31	275.54	281.937	-6.40	F	1
6472	L	5.92	2.97	2.7	3.62	3.3	310.157	312.408	-2.25	F	1
7164	L	6.02	3	2.8	3.7	2.99	324.648	324.961	-0.31	?	1
8378	L	5.87	2.92	2.71	3.61	3.4	305.751	308.315	-2.56	F	1
10704	L	6	2.91	2.85	3.78	3.61	323.848	323.985	-0.14	?	1
10848	L	6.19	3.2	2.91	3.56	3.4	349.646	346.79	2.86	M	1
11114	L	5.9	2.81	2.77	3.64	2.99	308.665	310.792	-2.13	F	1
11299	L	6.21	3.07	2.92		3.22	348.085	345.611	2.47	M	1
11871	L	5.85	2.9	2.57	3.51	3.21	294.815	299.47	-4.66	F	1
12310	R	5.97	2.82	2.79	3.62	3.42	315.314	316.818	-1.51	F	1
12323	R	5.79	2.75	2.69	3.66	3.53	293.878	297.854	-3.98	F	1
12676	R	5.89	2.91	2.72		3.33	307.562	309.95	-2.39	F	1
12838	R	6.3	3	2.99	3.89	3.8	357.126	353.633	3.493	M	1
13405	R	5.6	2.8	2.65	3.66	3.4	278.91	284.021	-5.11	F	1

4.4.2 Discussion

The gender analyses of the Hartley site assemblage long bones show that the dominant category is female/immature (Table 4.16). A total of 140 long bone portions were analyzed. The proportion of females/immatures ranges from fifty percent for the proximal metatarsals to 100 percent of the distal radii. Males range from zero percent for the distal radii sample to 36 percent for the proximal metatarsals. Indeterminate specimens make up zero percent of the distal radii to 14 percent for the proximal metatarsals. Seventy percent of the total number of long bones were classified as female/immature. Twenty-two percent were classified as males and eight percent were indeterminate.

Walde notes (n.d.b.) that the female/immature distal humeri and the proximal metatarsals are often broken as a result of marrow extraction. This preferential breakage may inflate the ratio of male specimens in a given assemblage. This is probably a factor in the high numbers of males in both the distal humerus and the proximal metatarsal groups at the Hartley site.

Table 4.16 Long bone gender results

Portion	Male		•Female		◊Indet.	
	N	%	N	%	N	%
Distal Humerus	7	29	16	67	1	4
Proximal Radius	0	0	13	100	0	0
Distal Radius	0	0	12	100	0	0
Proximal Metacarpal	3	14	16	76	2	10
Distal Metacarpal	4	29	8	57	2	14
Distal Tibia	5	31	10	63	1	6
Proximal Metatarsal	8	36	11	50	3	14
Distal Metatarsal	4	22	12	67	2	11
Total	31	22	98	70	11	8

• Female / Immature. ◊Indeterminate.

It should be restated that this sample has a small inherent bias with respect to the maturity of the elements studied. Some of the specimen groups (i.e. distal radius and the distal metapodials) contained all mature elements. The other groups of specimens may or may not have contained some elements that were not fully mature. The elimination of some of the 'almost mature' elements has reduced the number of elements that would have been placed in the female/immature category.

4.4.3 Carpal and Tarsal Measurements

The use of carpals and tarsals to distinguish gender has largely been ignored in the past. Some work has been conducted on the calcaneus (Haspel and Frison 1987) and the talus (Ziemens and Ziemens 1974). The other carpals and tarsals have been overlooked due to their uniform appearance despite their age. The calcaneus is the only carpal or tarsal that has a true epiphysis that does not fuse in the first few months of life. All of the other elements grow rapidly from one centre of ossification or fuse very quickly. Morlan (1991) described measurements for all of the carpals and tarsals (as well as the lateral malleolus) which may be used in a bivariate analysis to establish gender. These measurements have been shown to produce bimodal distributions separating the adult males from the females and the immatures (Morlan 1991; Zurburg 1991).

The large number of carpals and tarsals in the Hartley site assemblage make it well suited to this type of analysis. Approximately 250 elements were complete enough to be measured. All measurements were recorded with calipers to the nearest 0.1 millimetres (Appendix A, Tables A1.1-A1.10). Measurements were estimated on some specimens if there was minor weathering or shovel damage at the measurement point. Some individual measurements were recorded for fragmentary specimens. Highly weathered specimens were not included in the sample if the measurements could not be accurately estimated. Terminology used to identify carpals and tarsals is often confusing. The combinations of human anatomy and zoological terms used for these elements is often hard to follow. The names of the different elements and the measurements used in this analysis follow Morlan (1991).

Carpals

Radial Carpal

The radial carpal lies at the proximal medial location of the forelimb. Nineteen complete and partial radial carpals were measured (Table A1.1, Appendix A). Length (L), width (W) and depth (D) were recorded on all of the complete specimens. Some specimens were fragmented and only provided one or two of the measurements. Seventeen elements produced length and depth measurements. When plotted these measurements exhibit a large cluster of fourteen female/immature elements and a smaller loose assortment of males

(Figure 4.8). Graphs of length versus width as well as width versus depth produced similar distributions.

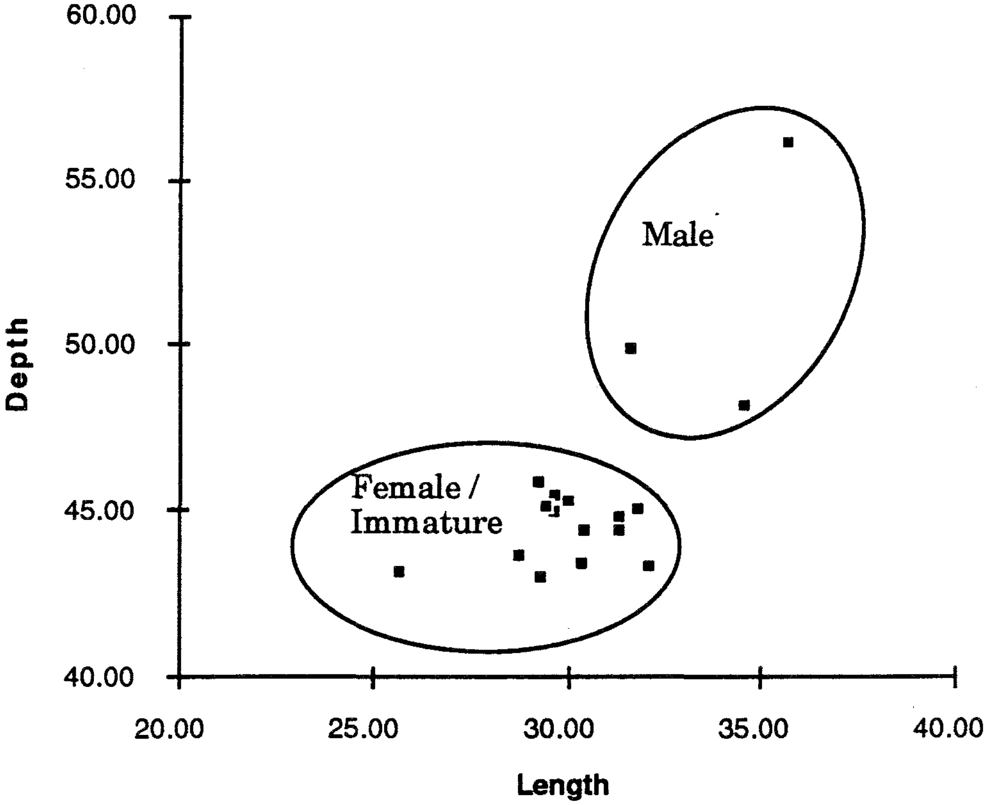

Figure 4.8 Bivariate plot of radial carpal measurements.

Intermediate Carpal

The intermediate carpal articulates with the lateral surface of the radial carpal and is the central carpal of the proximal row. Twenty one intermediate carpals were measured for width (W) and depth (D) (Table A1.2, Appendix A). Length was not recorded on any of these specimens. When width is plotted against depth two elements stand out as male and nineteen are classified as female/immature (Figure 4.9).

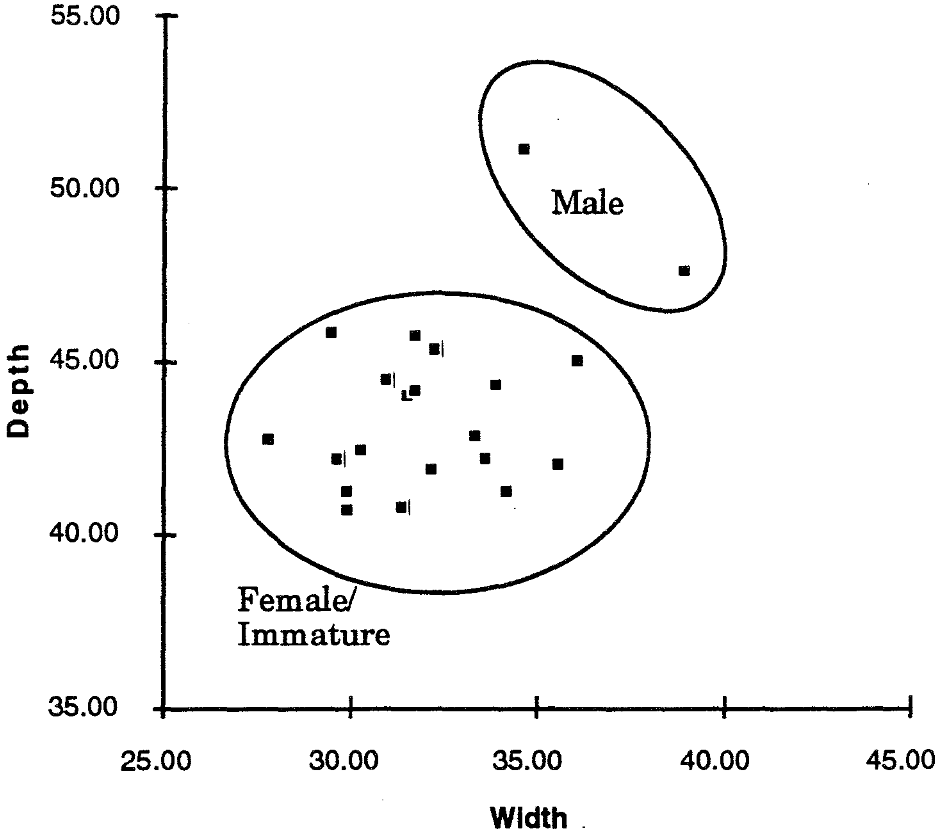

Figure 4.9 Bivariate plot of intermediate carpal measurements.

Ulnar Carpal

The ulnar carpal lies in the lateral position of the proximal row of carpals. Anterior length (La), proximal length (Lp) and depth (D) measurements were recorded for these elements. Width was found to be difficult to replicate and often obstructed by weathering and, therefore, was not recorded. Nineteen elements were suitable for producing anterior length and depth measurements (Table A1.3, Appendix A). The distribution of these elements shows that thirteen are female/immature and six are male (Figure 4.10).

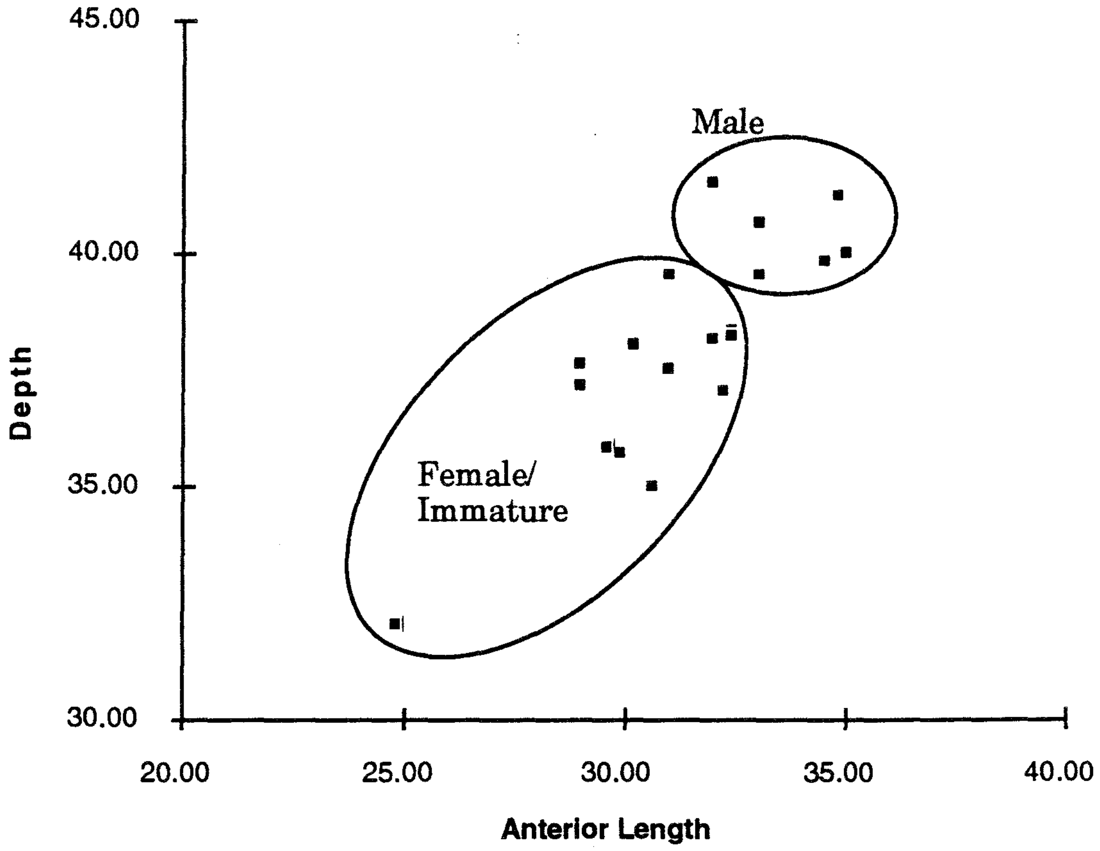

Figure 4.10 Bivariate plot of ulnar carpal measurements.

Fused Second and Third Carpal

The fused second and third carpal is the medial carpal of the distal row. Nineteen were measured for width and depth (Table A1.4, Appendix A). Length was difficult to replicate and was not recorded for these specimens. The bivariate plot of width versus depth separates into groups with thirteen female/immature animals and six males (Figure 4.11).

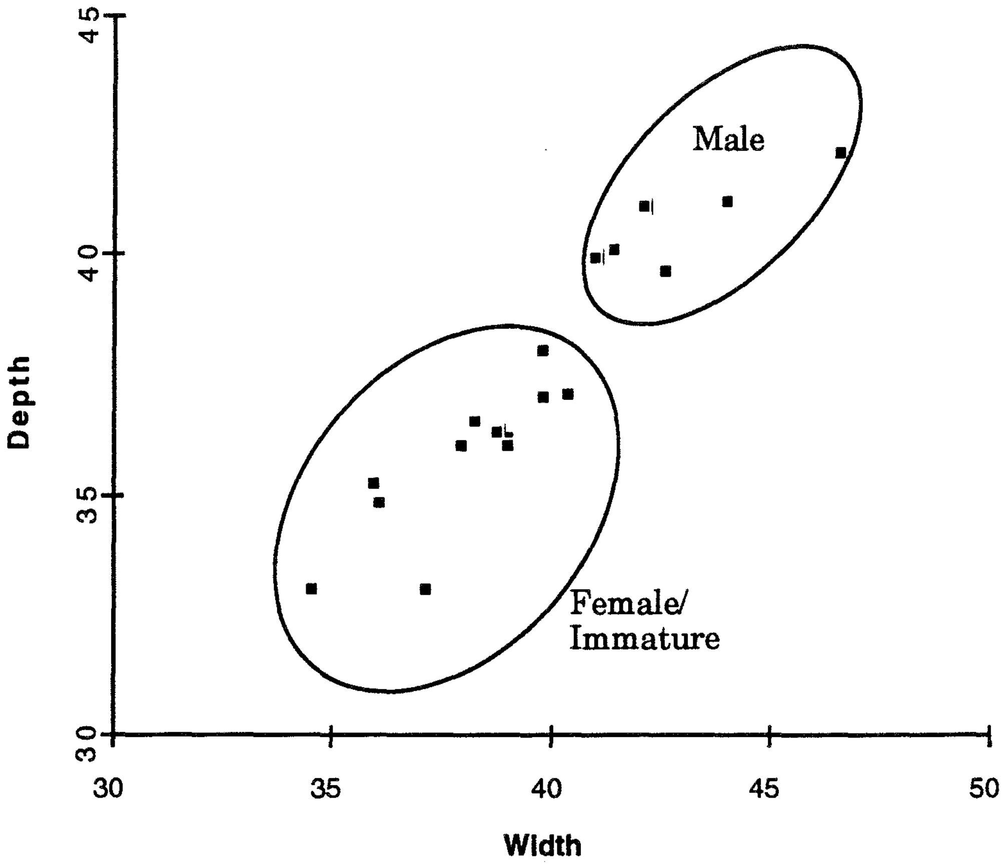

Figure 4.11 Bivariate plot of fused second and third carpal measurements.

Fourth Carpal

The fourth carpal is the lateral carpal of the distal row. Length, width and depth measurements were recorded (Table A1.5, Appendix A). Seventeen elements were plotted in a graph of width versus depth (Figure 4.12). The bivariate plots for the fourth carpal show a large loose group of sixteen female/immature animals and one male.

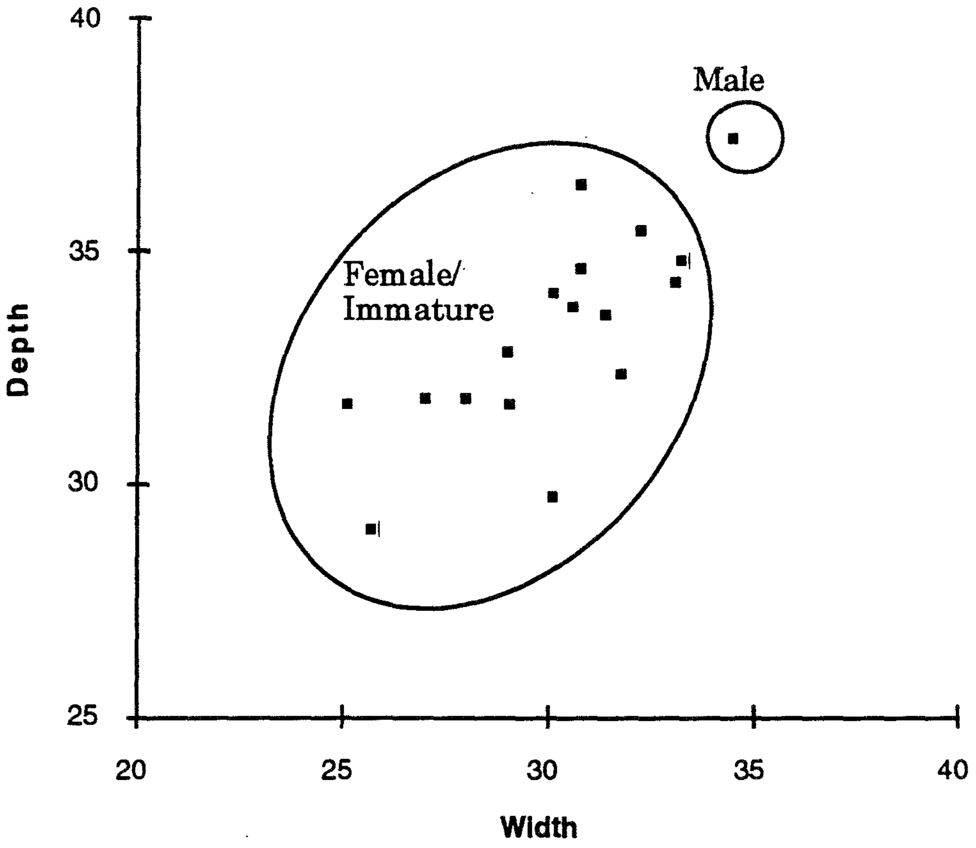

Figure 4.12 Bivariate plot of fourth carpal measurements.

Accessory Carpal

No measurements for the accessory carpal were recorded.

Tarsals

Talus

The talus is the medial carpal of the proximal row. The talus is one of the largest tarsals and has two measurements in each of the three dimensions (Morlan 1991). Lateral length (Ll), medial length (Lm), proximal width (Wp), distal width (Wd), lateral depth (Dl), and medial depth (Dm) were recorded on all of the usable specimens (Table A1.6, Appendix A). Different combinations of these measurements were then plotted with varying degrees of success. Medial length versus proximal width provided reasonably good separation (Figure 4.13). Plots of lateral length versus proximal width and medial length versus medial depth also showed similar bimodal distributions. Other combinations tended to show little or no clustering.

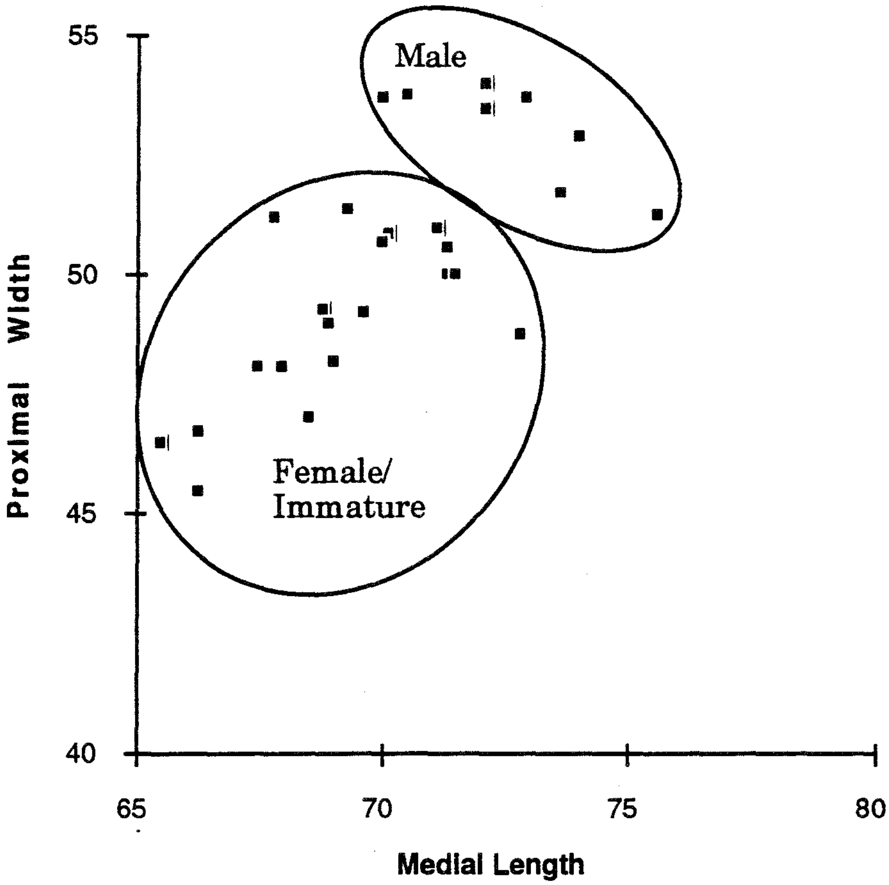

Figure 4.13 Bivariate plot of talus measurements.

Calcaneus

The calcanei in the Hartley site assemblage are highly fragmentary. Measurements recorded include the length (L), proximal width (Wp), proximal depth (Dp), distal width (Wd), distal depth (Dd), length of the talus facet (Lt) and the length of the fused central and fourth tarsal facet (Lc) (Table A1.7, Appendix A). Although a total of thirty-five elements are present in the assemblage, less than half of these could be plotted at one time. The most definite separation was achieved by plotting distal width versus distal depth (Figure 4.14). Of these sixteen specimens ten clustered in the female/ immature range and six appear to be males. Both mature and immature specimens were plotted due to the small number of fused specimens.

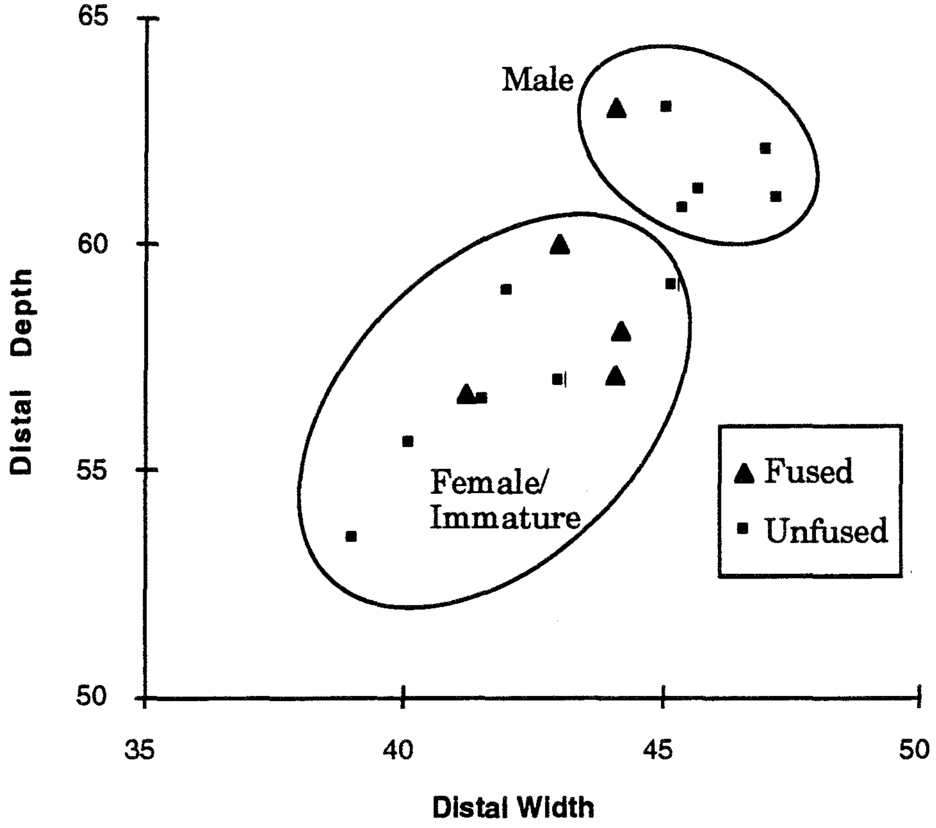

Figure 4.14 Bivariate plot of calcaneus measurements.

Fused Second and Third Tarsal

The fused second and third tarsal had a total of twenty elements that could be plotted as width versus depth (Table A1.8, Appendix A). Length was not recorded for any of these specimens. The division between the two groups is the strongest out of all of the elements analyzed. The female/immature cluster contained seventeen elements and the male cluster contained three elements (Figure 4.15).

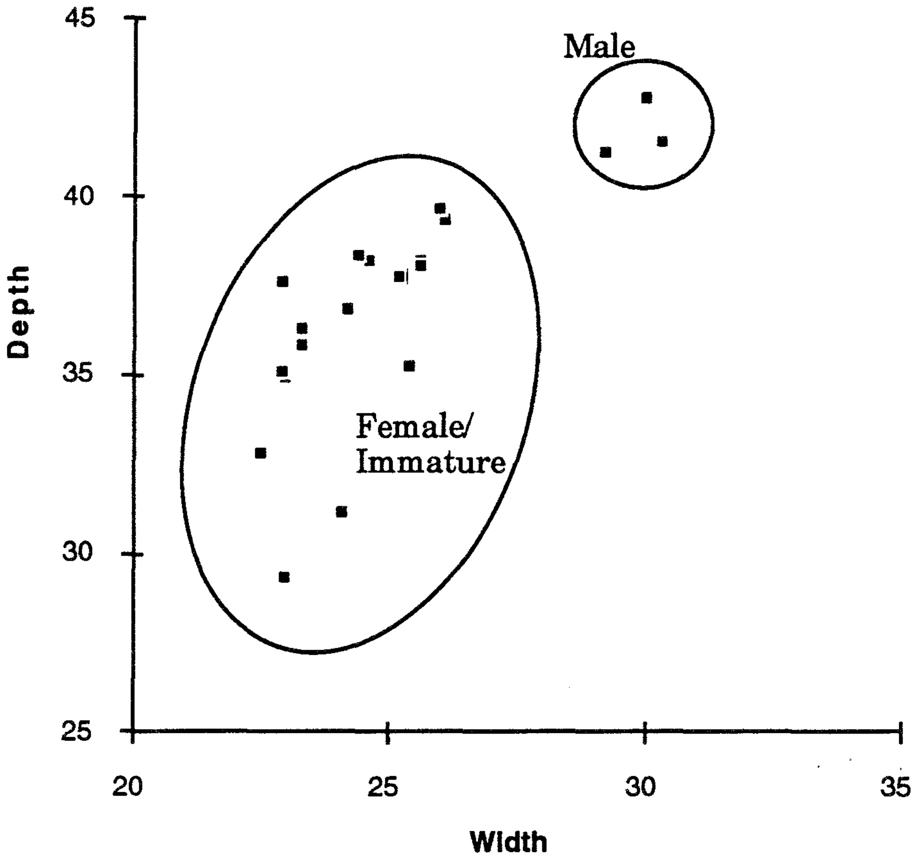

Figure 4.15 Bivariate plot of fused second and third tarsal measurements.

Fused Central and Fourth Tarsal

Width and depth were recorded on twenty four elements (Table A1.9, Appendix A). Width alone was recorded on one other specimen. Length was not recorded on any of the specimens. A fairly tight cluster of seventeen females/immature is present when width versus depth is plotted (Figure 4.16). The male group is less cohesive and contains seven elements.

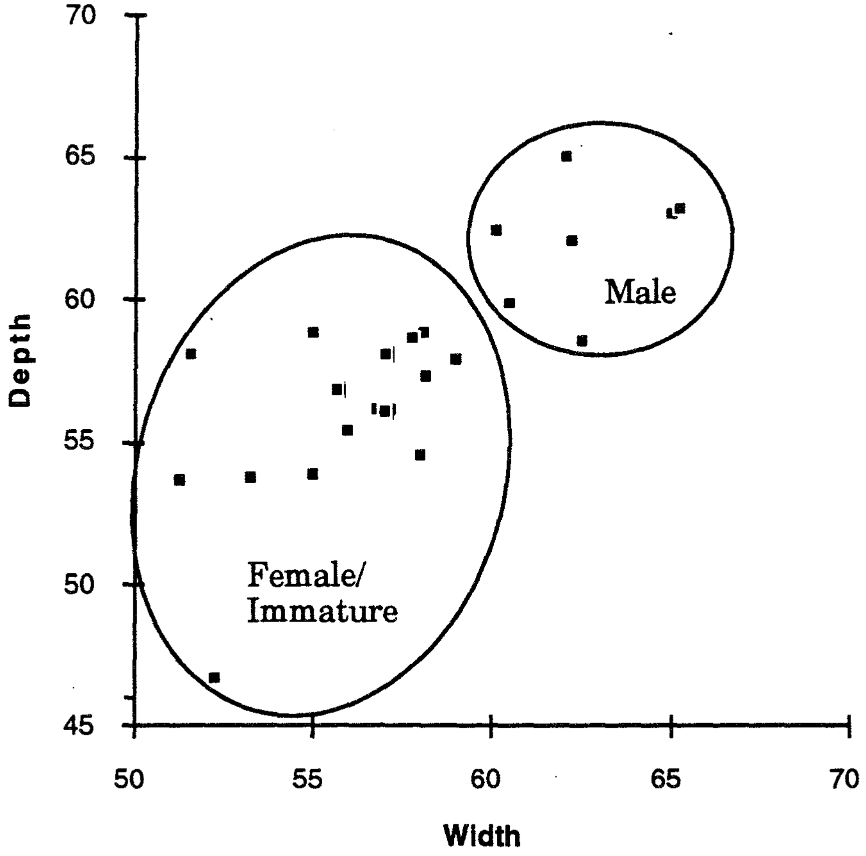

Figure 4.16 Bivariate plot of fused central and fourth tarsal measurements.

Lateral Malleolus

The lateral malleolus lies proximal and lateral to the true tarsals. Although it is not a true tarsal it is typically considered part of the tarsal assembly. The length and depth of the lateral malleolus were recorded (Table A1.10, Appendix A). Eighteen elements were plotted as length versus depth with good results (Figure 4.17). Width was not recorded on any of these specimens.

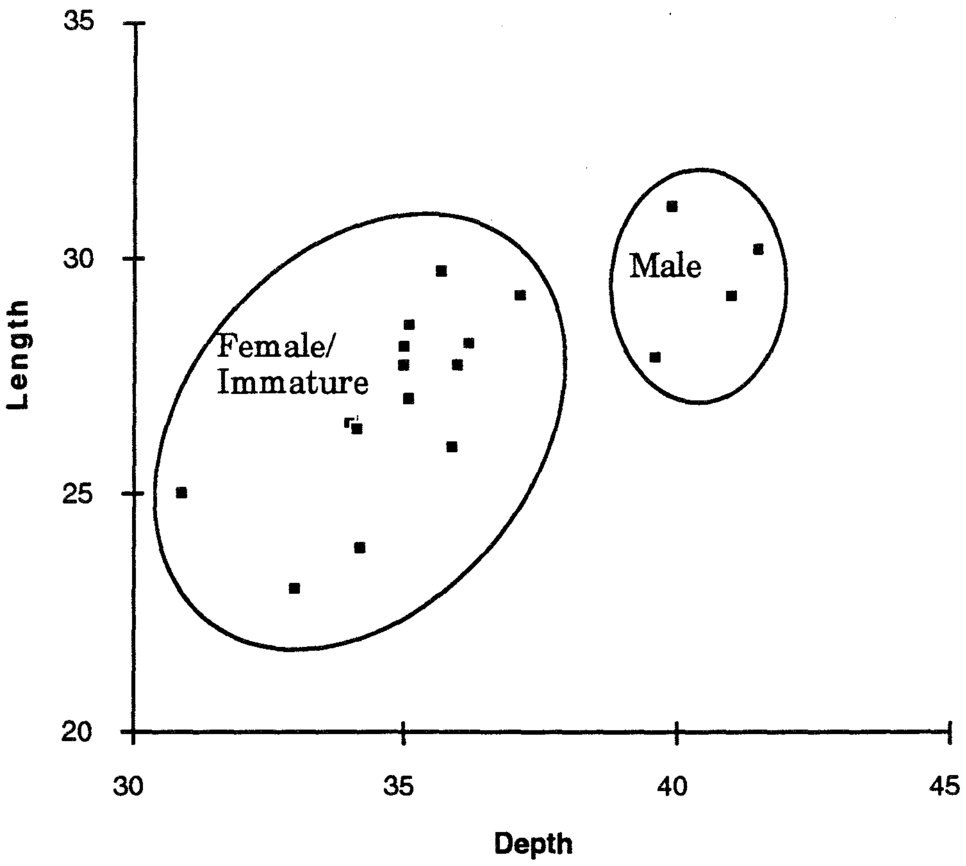

Figure 4.17 Bivariate plot of lateral malleolus measurements.

4.5 Summary

The bivariate graphs of carpal and tarsal measurements varied widely in their clarity. The separation between male and female/immature animals was often difficult to establish due to the small sample size and the large number of immature animals in the assemblage. Measurements that provided clear bivariate groups for Morlan (1991) did not always work as well with this sample. Trial and error plotting of different variables was sometimes needed to establish clearly bimodal distributions. The separation between some groups (i.e. carpal 4) were clarified using the two comparative adult male elements from Morlan (1991) as a guide to check the size of the Hartley site specimens.

The ratio of female/immature to male elements ranged from 63%:37% for the calcaneus to a 94%:6% ratio for the fourth carpal (Table 4.17).

Table 4.17 Carpal and tarsal gender measurements and results.

Element	Meas.	Total	F/ I N	F/I %	Male N	Male %
Radial Carpal	L/D	17	14	82	3	18
Intermediate Carpal	W/D	21	19	91	2	9
Ulnar Carpal	La/D	19	13	68	6	32
Fused 2/3 Carpal	W/D	19	13	68	6	32
Fourth Carpal	W/D	17	16	94	1	6
Talus	Lm/Wp	27	19	70	8	30
Calcaneus	Dd/Wd	16	10	63	6	37
Fused C/4 Tarsal	W/D	24	17	71	7	29
Fused 2/3 Tarsal	W/D	20	17	85	3	15
Lateral Malleolus	D/L	18	14	78	4	22
TOTAL		198	152	77%	46	23%

The carpal and tarsal gender ratios are quite similar to those obtained on the long bones. Approximately 77% of the carpals and tarsals are classified as female/immature and 70% of the long bones were assigned to the female/immature group. The difference between the two analyses is probably due to the removal of the immature elements from the long bone analysis. The Hartley site bison assemblage is comprised of approximately 75% females and immature animals and 25% males.

Over all the bison elements in the Hartley site assemblage reflect the procurement and processing of animals associated with nursery herds. Based on the analyses of the mandibles, long bones, carpals and tarsals the majority of the animals in the assemblage are either female or immature with only a few male individuals present. The high frequency of foetal elements also suggests that a large number of female animals were being selected by the hunters. The presence of a few mature or nearly mature males in a nursery herd is not unlikely although their numbers would be few. Immature males likely represent a large portion of the males identified. The division of the population into small male herds and somewhat larger nursery herds is well documented for the winter months (Berger and Cunningham 1994:75).

CHAPTER 5.

HARTLEY SITE NON-BISON FAUNAL ASSEMBLAGE

5.1 Introduction

The Hartley site faunal assemblage contains a wide variety of vertebrate and invertebrate species. These species represent animals that are both cultural as well as natural parts of the assemblage. The following systematic descriptions of these taxa follows the presentation by Walker (1987) and Walker (1992). The taxonomic nomenclature, geographic range and habitat are presented for each species. These categories are based primarily on the modern ranges described by Banfield (1987) for the mammals and Godfrey (1986) for the birds. The taxonomic nomenclature, geographic ranges and habitats of the gastropods and the pelecypods are based on Clarke (1981), Clarke (1973) and La Rocque (1968). The fish material was identified and analyzed by Eric Simmonds. Seasonality of the avian long bones is based on methods presented by Rick (1975) and migration chronology of waterfowl (Bellrose 1976). Seasonality is also estimated based on the chronology of hibernating rodents (Koch 1995). Hibernation schedules are based on Banfield (1987).

5.2 Systematic Descriptions of Non-Bison Fauna

Morlan (1994c) suggests several bone modification factors to record in order to establish whether or not rodent elements are part of an archaeological assemblage. These factors include:

1. completeness or portion of skeletal element;
2. fracture state (fresh, dry, recent, or not applicable);
3. tooth marks (type and location);
4. digestion (pitting, thinning, adhering fecal material);
5. cut marks (and/or trampling marks);
6. burning (charring and calcining);
7. weathering (split lines, exfoliation; Behrensmeyers [1978] stages);
8. rootlet etching (superficial, moderate, heavy);
9. other relatively rare modifications such as distinctive staining, polishing, rounding, pathology, etc. (Morlan 1994c:137).

These criteria not only provide "...a reasonable framework for interpreting rodent bones in archaeological sites." (Morlan 1994c:139) they provide a reasonable framework for interpreting all small vertebrates in archaeological sites. Therefore, this framework is used in this thesis to establish the association (or lack of association) for all of the vertebrates in the Hartley site assemblage not just the rodents.

Several abbreviations are used in the systematic descriptions. They are as follows: NISP "number of identified specimens", MNE "Minimum Number of Elements", MNI "Minimum Number of Individuals", sp. refers to an unknown species (singular), cf. refers to taxa which "show an affinity towards", misc. "miscellaneous", and indeter. "indeterminate".

Class Osteichthyes, Order Salmoniformes, Family Esocidae, *Esox lucius* [Northern Pike].

Geographic range of species: The Northern Pike is the only species of the genus *Esox* that is found in North America, Eurasia and Siberia (Berra 1981:38). They are found throughout Canada except western and central British Columbia.

Habitat: Northern Pike inhabit small lakes, shallow regions of large lakes which have heavy vegetation, marshes and some rivers (Lee et al.

1980:133). They have the greatest tolerance of all *Esox* species to cold environments.

Material: Thirty-two fish specimens are present in the assemblage. Nineteen specimens were analyzed by Eric Simmonds and determined to be *Esox lucius*. At least two individuals are represented by two basioccipitals.

Discussion: Esox lucius grow to be 500 to 700 mm in length although lengths as large as 1.33 metres have been recorded (Lee et al. 1980:133). The average weight is typically between 1.13 to 1.36 kg (2.5 and 3.0 pounds) for an adult, although weights of over 22.68 kg (50 pounds) have been recorded (Eddy and Underhill 1974:200). They spawn in the spring while the water is typically between 4° and 11°C. The spawning usually takes place under the ice (Lee et al. 1980:133). The Hartley site individuals appear to be quite small. None of the specimens show any evidence of burning or butchering. The specimens are stained the same colour as the other faunal specimens in the assemblage. No evidence of carnivore or other predator modification is visible on any of the specimens.

Class Osteichthyes, [Fish sp.].

Material: Twenty-one specimens could not be identified beyond the class level of taxonomic designation.

Discussion: Due to the low numbers of fish specimens in the Hartley assemblage it is likely that these specimens are also *E. lucius*. This is only speculation, however, and can not be confirmed. No cultural modifications were observed on any of these specimens. Rootlet etching was observed on a few specimens although the small size might make etching on these specimens less common than on larger specimens.

Class Aves, Order Anseriformes, Family Anatidae, *Anas crecca carolinensis* [Green-winged Teal].

Geographic range of species: The Green-winged Teal is North America's smallest duck and breeds throughout Canada south of the northern tree line (Godfrey 1986:83-84). They return to the United States each year for the winter.

Habitat: Green-winged Teals are surface feeding ducks. They typically inhabit freshwater ponds, marshes, shallow edges of lakes. Teals have been noticed to spend time in shallow salt and brackish water and shores during migration and winter. They nest on the ground in an area which has some grass or shrubbery for cover, typically near a source of fresh water.

Material: A total of 45 specimens were identified from one Green-winged Teal (Table 5.1). All of the elements appear to be from one individual.

Table 5.1 Green-winged Teal NISP / MNE / MNI.

Element	**NISP**	**MNE**	**MNI**
Skull	12	1	1
Mandible	2	2	1
Cervical Vertebra	13	13	1
Thoracic Vertebra	4	4	1
Synsacrum	3	1	1
Rib	2	2	1
Scapula	2	2	1
Humerus	1	1	1
Carpometacarpus	2	2	1
Pelvis	2	2	1
Femur	1	1	1
Phalanx	1	1	1
Total	45	32	1

Discussion: These specimens are from the northwest quadrant of unit 292N 119E. Several of the elements, such as the vertebrae, were still articulated and others were only slightly separated when they were recovered.

They were concentrated within the main occupation level at a depth of 16-20 cm. The texture and colouration of the bones suggests that they are part of the assemblage. None of the elements show any signs of cut marks, burning, or canid modification. Southward migration begins in early September and may continue until freeze up in mid-November to mid-December on the Northern Plains (Bellrose 1976:222). Green-winged Teals are one of the first ducks to return in the spring. They begin to return to Canada as early as the first week of April (Bellrose 1976). Green-winged Teals have an average weight of 0.68 to 0.71 pounds (Bellrose 1976).

Class Aves, Order Anseriformes, Family Anatidae, *Anas* cf. *discors* [Blue-winged Teal].

Material: This category contains one individual that is represented by one left distal scapula.

Discussion: This specimen is slightly larger than the scapulae of the Green-winged Teal recovered from the Hartley site assemblage, as well as the individual in the comparative collection at the University of Saskatchewan. It is, however, roughly the same size as the Blue-winged Teal specimen in the Unversity of Saskatchewan's collection. It is suggested, therefore, that this scapula is from a Blue-winged Teal (*Anas discors*) which is slightly larger than the green-winged variety. Blue-winged Teals have an average weight of 0.83 to 1.02 pounds (Bellrose 1976:275). This identification is tentative due to the lack of elements and the closeness in size between the two species. It is presumed that this specimen is in fact larger because it is a different species and not because of sexual dimorphism. The Blue-winged Teal migrates out of Saskatchewan at a slightly different time than the Green-winged Teal. They depart on their southern migration from early September to November. They do not return until late April to mid-May (Bellrose 1976:280). Bellrose (1976:277) lists the Blue-winged Teal as the most abundant breeding duck on the Northern Plains and parklands.

Class Aves, Order Galliformes, Family Phasianidae, Subfamily Tetraoninae, *Tympanuchus phasianellus* [Sharp-tailed Grouse]

Geographic range of species: Present year round from Alaska and the Yukon through the boreal areas of northern Canada to east-central Québec and onto the plains. The southern range of the Sharp-tailed Grouse is in eastern Oregon and through to northern Michigan (Godfrey 1986:163).

Habitat: Sharp-tailed Grouse are found in a wide variety of environments ranging from the grassland to open areas within coniferous forests.

Material: One left proximal tarsometatarsus was recovered from the assemblage representing one individual.

Discussion: The tarsometatarsus has no evidence of cut marks or burning. It is weathered in a similar manner as the other elements in the assemblage. Rootlet etching is moderate and it is stained similar to the rest of the assemblage. Sharp-tailed Grouse are present year round and may be hunted at any time of the year. No medullary bone is present in this small specimen.

Class Aves, Order Galliformes, Family Phasianidae, Subfamily Tetraoninae, *Bonasa umbellus* [Ruffed Grouse].

Geographic range of species: Ruffed Grouse are permanent residents in the forests from Alaska to Québec and from the northern treeline of the boreal forest to northern California and northeastern Virginia in the south (Godfrey 1986:160-161).

Habitat: The preferred habitat of the Ruffed Grouse includes second growth deciduous and mixed woodland, wood edges and openings as well as alder and willow-bordered valleys. They do not frequently inhabit large areas of old growth forests, but may use coniferous areas for shelter.

Material: One right proximal tibiotarsus, representing one individual, is identified in the assemblage.

Discussion: The texture and colour of the bone is slightly lighter than the rest of the assemblage. The specimen was recovered from the first excavation level, 0-10 cm below the surface. No cut marks or burning are present on this specimen. It is likely that this bone is not part of the cultural assemblage. This bone may represent an animal recently killed by a carnivore or hunter. There was no evidence of carnivore modification observed on the bone. How the bone became part of the overall faunal assemblage can not be determined at this time.

Class Aves, Order Galliformes, Family Phasianidae, Subfamily Tetraoninae, sp. [Grouse].

Material: One distal right tibiotarsus is present.

Discussion: The specimen is heavily stained and exhibits moderate rootlet etching. The break appears to be a fresh bone break. The specimen shows no evidence of cut marks or burning. This specimen is from a unit over five metres away from the previously discussed Sharp-tailed Grouse specimen and likely represents a separate individual and possibly a separate species.

Class Aves, Order Galliformes, Family Phasianidae, Subfamily Meleagridinae, *Meleagris gallopavo* [Domestic Turkey].

Geographic range of species: Due to the domestication of this species, these animals are now found worldwide. Wild Turkeys are originally found in the eastern and central United States and southern Ontario (Godfrey 1986).

Habitat: There is no true habitat of Domesticated Turkeys. Wild Turkeys live in wooded regions of mature forest.

Material: A total of eighty-seven specimens were identified representing at least two individuals (Table 5.2).

Table 5.2 Domesticated Turkey NISP / MNE / MNI.

Element	NISP	MNE	MNI
Cervical	8	7	1
Thoracic	2	2	1
Lumbar	6	6	1
Synsacrum	1	1	1
Sternum	2	1	1
Pelvis	3	2	2
Femur	2	2	1
Tibiotarsus	2	2	1
Fibula	1	1	1
Tarsometatarsus	6	4	2
Scapula	1	1	1
Coracoid	1	1	1
Humerus	7	2	1
Radius	0	0	0
Ulna	3	1	1
Carpometacarpus	3	2	2
Ulnar Carpal	2	2	1
Scapholunar Carpal	1	1	1
First Phalanx (forelimb)	3	2	2
Phalanx	31	31	2
Rib	2	2	1
TOTAL	87		

Discussion: These elements are not part of the cultural assemblage. Wild Turkeys were never present in Saskatchewan, although there have been some recent attempts to introduce them into the Cypress Hills (Godfrey

1986). Domesticated Turkey on the other hand, were raised on the Sommerfeld farm for a number of years. These elements are all recovered from the upper layers of the site, well above the rest of the assemblage. These elements probably became incorporated in the assemblage when manure from the barns was dumped in the area. Alternatively, some animals may have been killed by carnivores and taken to the wooded area for consumption.

Class Aves, Order Strigiformes, Family Strigidae, *Bubo virginianus* [Great Horned Owl].

Geographic range of species: North and South America. Canadian range includes everywhere south of the arctic tundra-boreal forest border (Godfrey 1986:310).

Habitat: Great Horned Owls inhabit deciduous and coniferous wooded areas that range from very dense forests to isolated bluffs. Great Horned Owls may also inhabit wooded ravines and coulees.

Material: Twelve articulated and semiarticulated hindlimb elements were recovered from unit 295N 118E. These include one right tibotarsus, one right tarsometatarsus and ten complete phalanges.

Discussion: All of the elements were recovered from the upper eleven cm of the site. The freshness and the near articulation of these elements suggest that they are not part of the cultural assemblage. It is not known how these elements became part of the faunal assemblage at the Hartley site.

Class Aves, Order Passeriformes, Family Corvidae, *Corvus corax* [Common Raven].

Geographic range of species: The Common Raven is found in the both the New and Old World. They are found throughout boreal and arctic regions of Canada and the United States (Godfrey 1986:396-397).

Habitat: Ravens typically inhabit mountainous, rugged hill country, sea coasts as well as arctic and forested environments.

Material: Four specimens were identified as Raven representing three distinct elements. One distal ulna specimen and one midshaft refit as one element. The two right distal ulnae have most of their diaphyses and the right carpometacarpus is also almost complete. One ulna shows some build up of sclerotic bone along the diaphysis suggesting that the bird suffered some trauma to its wing from which it recovered.

Discussion: The presence of Raven elements at the Hartley site is interesting. The Raven is not presently seen this far south of the boreal forest. Ravens were, however, present in the region in the past. The Raven was closely associated with the movements of the bison and declined in numbers with the decimation of the bison herds. The elements are all stained and show moderate rootlet etching. The breaks appear to be fresh bone breaks. No burning or cut marks are present on any of the elements. One distal ulna has a hole of unknown origin through the anterio-posterior aspect of the bone. The puncture is approximately 4 mm in diameter on one side and approximately 2 mm on the opposing side. The edges of the hole are not polished and appear to be have been made when the bone was not fresh. It is possible that the hole is due to severe root or insect burrowing.

Class Aves, Order Passeriformes [Small Bird]

Material: Eight specimens are identified as small bird bones. These include one skull, one complete humerus, one proximal humerus, one distal ulna, one phalanx and three long bone shaft fragments.

Discussion: These small bird bones include two specimens worthy of further discussion. The complete left humerus is the same size as a medium sized song bird. It is slightly stained and is superficially rootlet etched. There are no cut marks, burning or evidence of canid modification. It is slightly smaller than the two Robin specimens in the University of Saskatchewan faunal collection. The distal ulna is burned and is also smaller than the American Robin specimens in the University of Saskatchewan faunal collection. It is not known if these two elements represent one or two individuals. Based primarily on the freshness of the bones, the other specimens are not considered to be part of the Avonlea/Old Women's occupation. It was not possible to determine how these specimens became part of the natural faunal assemblage, although this is likely related to predation.

Class Aves [Large Bird]

Material: A total of twenty-nine specimens were identified as large bird. Two individuals are represented in this category based on two left distal humerii. One ulna fragment, one carpometacarpus, one femur, one phalanx and three miscellaneous vertebrae fragments are the only other complete or nearly complete specimens. The other specimens include eight long bone shaft fragments and eleven unidentifiable fragments.

Discussion: The surface texture and colouration of these bones suggest that most of them are not part of the Avonlea/Old Women's phase assemblage. The texture and colouration of most of these specimens suggests that they are Domestic Turkey bones although this can not be stated with any degree of certainty.

Class Aves [Miscellaneous Bird]

Material: Eleven specimens could be identified only to the class designation of Aves. These include 2 miscellaneous vertebrae fragments, 2 rib fragments, 2 complete phalanges, 3 long bone shaft fragments and two unidentifiable fragments.

Discussion: The texture and colouration of these specimens suggests that they are all more recent than the Avonlea/Old Women's phase assemblage. Two specimens of egg shells are also present. These are from the upper levels and are probably related to recent birds nesting in the area. Nests of magpies and several smaller species have been observed in the trees during the field work at the site. Alternatively, these shells may be related to predation from domestic birds at the farmyard.

Class Mammalia, Order Lagomorpha, Family Leporidae, *Lepus townsendii* [White-tailed Jack Rabbit].

Geographic range of species: The White-tailed Jack Rabbit is found in the northern Great Plains (Banfield 1987:88-90).

Habitat: The White-tailed Jack Rabbit inhabits areas of short-grass prairie. They seldom enter thickly wooded areas unless seeking shelter. Small shrubs and willow thickets are often used for cover. Jack rabbits are active year round and are primarily nocturnal. Jack rabbits do not burrow although they may seek temporary refuge in Badger burrows (Banfield 1987).

Material: The White-tailed Jack Rabbit is represented by eight specimens. These include one first sacral vertebra, one right radius fragment, one left acetabulum, one right distal femur, one left immature and one right adult proximal tibia, one left talus and one left fourth tarsal. These eight elements are from at least two individuals, based on the ages of the two proximal tibiae.

Discussion: All of the specimens show signs of rootlet etching. The sacrum, radius and the femur are burned. The other specimens are typically stained. The broken edges of the right proximal tibia indicate fresh bone breaks. None of the items have any cut marks or canid modifications. Hockett (1991) presents several criteria to distinguish between modification of leporid bones by humans and raptors. Some important human signatures include: 1) tibia diaphysis cylinders which may include cut marks or burning; 2) many small burned fragments; 3) cut marks; 4) high frequencies of adults; and 5) presence of artifacts indicative of a base or field camp (Hockett 1991:674). Raptor-deposited leporid elements obviously lack clearly cultural modifications such as burning, cut marks and associated artifacts. They also tend to leave few tibia cylinders behind. Raptors also produce single or multiple puncture marks which appear on one side of the bone only. These are made by the powerful beak and talons of the bird. Shearing damage to the greater trochanter of the femur is often present as is pellet matter which will stick to the bones. Raptors also tend to leave a higher percentage of forelimb rather than hindlimb elements behind. Clearly the jack rabbit elements present at the Hartley site reflect human rather than raptor deposition.

Class Mammalia, Order Lagomorpha, Family Leporidae, *Lepus americanus* [Snowshoe Hare].

Geographic range of species: The distribution of the Snowshoe Hare encompasses most of Canada. They are found from Alaska to Nova Scotia and from the boreal forest-tundra boundary to the northern United States (Banfield 1987:80-84).

Habitat: The Snowshoe Hare does not show a strong preference for any specific type of habitat. They may be found in deciduous and coniferous forests, swamps, and riverside thickets. In the prairies they tend to inhabit aspen copses. These hares are crespuscular and nocturnal by nature and do not hibernate. Snowshoe Hares depend on an intricate knowledge of the runways and areas of cover in their home range to escape predators and do not burrow (Banfield 1987:80-84).

Material: Nine specimens are identified as Snowshoe Hare. One left scapula, three distal humerii (two left and one right), one right proximal radius, one left proximal ulna, one complete right ilium and acetabulum, one left distal femur and one left proximal tibia. These specimens indicate at least two Snowshoe Hares are present in the Hartley site assemblage.

Discussion: The bones exhibit staining typical of the assemblage and are etched by rootlets. Three specimens are burned. These include one left distal humerus, one right humerus and one proximal ulna. The fragmentation and the burning of the forelimb elements suggests that the Snowshoe Hare elements are present due to human and not raptor deposition (Hockett 1991).

Class Mammalia, Order Lagomorpha, Family Leporidae, Leporid sp. [Rabbit / Hare].

Material: A total of seventeen specimens could not be identified beyond the genus level. These include two skull frgments, one complete immature left mandible, one right mandible fragment, one left lower molar, two rib fragments, one right distal humerus, one left proximal radius, one left ulnar carpal, one left ischium, one right proximal femur, one right proximal tibia, one right calcaneus, one right talus and two phalanges.

Discussion: The immature mandible is not stained and shows no sign of rootlet etching. The texture of the bone appears to be slightly different than the bones in the assemblage. It was recovered from the upper ten centimetres of the excavation unit and is probably not part of the cultural assemblage. The remainder of the specimens are stained and rootlet etched as is typical of the other elements in the assemblage. Eight of the specimens are burned. These include both phalanges, the radius, the ulnar carpal, the tibia, the calcaneus, one rib body and the right mandible fragment. One of the phalanges is extremely calcined. The high percentage of burned elements confirms that these elements are present due to human depostion (Hockett 1991). The presence of large numbers of burned carpals, tarsals and phalanges may suggest how these animals were being cooked. Morlan (1994c:138) has proposed the burned incisors and phalanges (with no burning of other elements) of a Richardson's Ground Squirrel recovered from the Tipperary Creek site are due to the animal being cooked whole. In situations such as this, burning would occur only on portions of the body such as the muzzle and the feet where the bones are not protected by flesh.

Class Mammalia, Order Rodentia, Family Sciuridae, *Spermophilus richardsonii* [Richardson's Ground Squirrel].

Geographic range of species: The Richardson's Ground Squirrel is ubiquitous throughout the central plains of North America.

Habitat: The habitat preferred by the Richardson's Ground Squirrel is one of open prairie with rolling hills of gravelly or sandy soil. They tend to avoid wet lands. These rodents live in small colonies and are very tolerant of other species of rodents in their home range. Richardson's Ground Squirrels hibernate for approximately seven months of the year (Banfield 1987:115). They enter their burrows in the middle to the end of August and reemerge during the second half of March. Early mild weather will, however, bring them out earlier.

Material: A total of four cranial and eight mandibular specimens are present in the Hartley site assemblage. These specimens represent at least three skulls and eight mandibles from a minimum of six individuals.

Discussion: One left mandible has a very distinct lack of staining. This element was recovered from the upper eleven centimetres of the site and was not culturally introduced into the faunal assemblage. The remainder of the specimens all exhibit staining and rootlet etching similar to the rest of the assemblage. None of the specimens exhibits burning, cut marks or evidence of canid modification. The lack of post cranial remains is due to the inability to identify species based on fragmentary post cranial elements. There is no evidence of digestion or gnawing on any of the specimens.

Class Mammalia, Order Rodentia, Family Sciuridae, *Spermophilus* sp? [Ground Squirrel].

Material: A total of thirty-six specimens could only be identified to the genus level (Table 5.3). The majority of these elements are post cranial specimens which are not diagnostic beyond the level of genus. Five cranial specimens include one burned edentulous mandible fragment, one right and one left nearly complete mandible which are missing the second and third molars, one upper tooth and one highly fragmented maxilla.

Table 5.3 *Spermophilus* sp. NISP / MNE

Element	NISP	MNE
Skull	2	2
Mandible	3	3
Upper Tooth	4	4
Lower Tooth	1	1
Atlas	1	1
Axis	1	1
Lumbar Vertebra	8	8
Scapula	2	2
Humerus	5	5
Radius	1	1
Ulna	1	1
Pelvis	3	2
Femur	6	5
Fourth Tarsal	2	2
Total	40	39

Discussion: Several of the ground squirrel specimens are intrusive. A group of ten specimens are associated and represent one individual that died in its burrow or was left there by a predator. It was recovered at a depth of approximately twenty-one centimetres. The specimens include a badly fragmented maxilla, two nearly complete immature mandibles, one vertebral fragment, one complete scapula, one nearly complete humerus, one radius, one ulna, one acetabulum and one nearly complete femur. All of the elements are immature and are not stained like the rest of the assemblage. There is little or no sign of rootlet etching. All of the breaks in the bones appear to be recent and on dry bone. It is possible that this individual excavated a poor hibernaculum and died during its first winter. There is no doubt, no matter what the cause of death, that this individual is intrusive to the cultural assemblage. Three other specimens (one left proximal femur, one right distal femur and one right scapula) are also intrusive. These specimens show no signs of rootlet etching and are not stained. They were all recovered from separate areas of the site and are not likely part of the same individual.

The other twenty-one specimens are all stained and have the same texture as the other elements in the assemblage. Elements which are fractured were broken while the bone was fresh. There are no signs of carnivore action on any of these specimens. Eleven specimens are burned. Three upper teeth, one lower incisor, two fourth tarsals, one innominate, one left distal humerus, one right humerus, one right proximal femur and one right edentulous mandible are all moderately to heavily burned. Six elements are part of the fine-screen assemblage, all of which are burned. These include all four unsocketed teeth and the two tarsals.

Class Mammalia, Order Rodentia, Family Geomyidae, *Thomomys talpoides* [Northern Pocket Gopher].

Geographic range of species: The range of the Northern Pocket Gopher is the central plains and western mountain regions of North America. They are common throughout the plains of the Prairie Provinces and in the mountain valleys of British Columbia (Banfield 1987:147-150).

Habitat: The Northern Pocket Gopher prefers deep, heavy, moist soil in a grassland environment. They often dig new burrows near sloughs, poplar bluffs and river banks in the summer when the higher ground dries out. These are true fossorial animals and do not leave their burrows for extended periods of time except at night. Northern Pocket Gophers are solitary animals and do not tolerate other animals in their burrows except during the mating season.

Material: Three mandible fragments and one partial cranium are identified as Northern Pocket Gopher. A minimum of two individuals are represented by two right mandibles.

Discussion: The cranium and one mandible are heavily stained and moderately etched by rootlets. The other two mandibles are burned. These mandibles were recovered from the same excavation quadrant and likely represent one individual. There is no evidence of carnivore modification on either of the pocket gopher specimens.

Class Mammalia, Order Rodentia, Family Castoridae, *Castor canadensis* [American Beaver].

Geographic range of species: Beavers inhabit practically all of North America from Mexico to Alaska (Banfield 1987:158-162).

Habitat: Slow moving streams, lakes rivers and marshes are typical Beaver habitat. They tend to prefer forested regions but they can live where only shrub willows, alders or water plants provide food.

Material: Five lower incisor specimens are the only elements identified as Beaver in the Hartley assemblage. Two of these specimens are refitted to establish an MNE of 4 and an MNI of 2.

Discussion: The Beaver incisors are stained in areas of exposed dentine. Minor rootlet etching is also present on some areas of dentine.

Beavers enjoy areas of permanent water deep enough to build their lodges. The closest area large enough to support a group of Beavers would be the South Saskatchewan River.

Class Mammalia, Order Rodentia, Family Cricetidae, *Clethrionomys gapperi* [Gapper's Red-Backed Vole].

Geographic range of species: The Gapper's Red-backed Vole is distributed throughout northern North America from British Columbia to Labrador and from Great Slave Lake to the southern Rocky Mountains and the Great Smoky Mountains (Banfield 1987:182).

Habitat: The preferred environment of the Gapper's Red-backed Vole is in areas of coniferous forest with plenty of cover such as rotten logs, stumps and brush (Banfield 1987:181). Hardwood forests are also acceptable. Water is another important aspect of their environment. These voles are typically found in close proximity to springs, brooks and bogs. They typically inhabit aspen groves and the shrubby vegetation along coulees in the prairies. The Gapper's Red-backed Vole is primarily a solitary animal, but home ranges will often overlap with others. They do not construct runways of their own and use ones constructed by other animals such as the Meadow Vole and the Bog Lemming. They are active year round and do not hibernate.

Material: Seven upper molars (four right and three left), one complete mandible and two lower left molars were recovered from the fine-screen sample. These specimens represent at least two individuals based on upper right molars.

Discussion: All of the specimens are stained. There are no obvious signs of rootlet etching. This is not surprising however due to the size of the specimens. No red-backed vole elements are present in the assemblage outside of the fine-screen sample. There are no signs of digestion or tooth marks on any of the specimens.

Class Mammalia, Order Rodentia, Family Cricetidae, *Microtus ochrogaster* [Prairie Vole].

Geographic range of species: The Prairie Vole is geographically restricted to the Great Plains (Banfield 1987:207).

Habitat: Prairie Voles occupy dry grassland environments. They do not inhabit open regions and require dense grass or brush for cover. The Prairie Vole will not enter wooded areas and tend to leave the damper areas for the Meadow Vole. They are predominantly nocturnal by nature but may be seen during the day. These rodents are active all year round and do not hibernate during the winter. They are social animals and live in small colonies of up to nine individuals. They excavate their own burrows which are typically two to four inches below the ground surface.

Material: A total of two crania and one left mandible are identified as Prairie Vole. These specimens represent at least two individuals.

Discussion: One cranium and the mandible are both heavily stained and represent portions of the assemblage. The third specimen, a second cranium, is not stained and is probably not part of the Avonlea/Old Women's assemblage. It is not known how this cranium entered into the assemblage. There is no evidence of digestion or carnivore tooth marks on any of the specimens.

Class Mammalia, Order Rodentia, Family Cricetidae, *Microtus pennsylvanicus* [Meadow Vole].

Geographic range of species: The range of the Meadow Vole extends from the Atlantic to the Pacific and from Alaska to Georgia (Banfield 1987:210).

Habitat: Meadow Voles prefer wet meadows with an abundance of grasses, sedges or mosses for cover. They will inhabit just about any relatively open area avoiding only deep forested areas and high, dry grasslands. They are primarily terrestrial and live in extensive colonies. They construct elaborate pathways through the dense grasses for runways. The Meadow Vole is active year round and does not hibernate.

Material: A total of sixteen specimens are identified as Meadow Vole. These include eleven complete or nearly complete crania, one loose upper molar and four mandibles. The MNI for the Meadow Vole is eleven based on the number of crania.

Discussion: Two crania and two mandibles are not stained and appear to be more recent than the rest of the assemblage. These specimens may have entered into the assemblage a number of different ways although predation by raptors or other carnivores is most likely. The remainder of the specimens are all heavily stained and have the appearance of the rest of the assemblage. Only cranial elements are present in the sample due to the lack of diagnostic post cranial elements. One isolated left upper molar is burned. This tooth is part of the fine-screen sample. There is no evidence of carnivore modification on any of the specimens.

Class Mammalia, Order Rodentia. *Microtus* sp.

Material: Two partial crania from at least two individuals could only be identified to the genus level of designation.

Discussion: Both crania consist of the premaxilla and nasal areas of the skull. Both contain the incisors and at least one first molar. The specimens are both stained and unburned. There is no evidence of carnivore modification on either specimen.

Class Mammalia, Order Carnivora, Family Canidae, *Canis lupus* [Gray Wolf].

Geographic range of species: The wolf was originally distributed throughout the whole of North America except for small areas in coastal California and the southwestern states (Banfield 1987:289-294).

Habitat: Wolves show very little preference for any particular environment and occupy many types of habitats.

Material: The material includes one right radial carpal, one left metacarpal and one complete right talus.

Discussion: It is extremely difficult to distinguish specific large canids based on postcranial remains (Walker and Frison 1982, Morey 1992, Walker 1992:99). Wolves, domesticated canids and coyotes form an almost continuous gradiant of size and robustness. The elements described here as wolf are identified purely on the basis of qualitative size comparisons. All of the elements are of equal size or larger than the large male comparative specimen in the University of Saskatchewan collection.

All three elements are moderately rootlet etched. The radial carpal is moderately burned and recently broken. The metacarpal and the talus are stained and show little signs of other weathering. These elements are placed in

Behrensmeyer's stage zero to stage one (1978:151). There are no cut marks or canid modifications present on any of the elements.

Class Mammalia, Order Carnivora, Family Canidae, *Canis latrans* [Coyote].

Geographic range of species: The geographic range of coyotes originally spanned western North America from central Mexico to the central Prairie Provinces (Banfield 1987:286-289).

Habitat: The coyote inhabits a wide variety of environments including alpine tundra, boreal forests, aspen parklands and short-grass steppes. Coyotes seem to prefer hilly terrain with groves of poplars and brushy stream banks.

Material: The coyote specimens include one left petrous portion of the temporal bone, one right fourth carpal, one left accessory carpal, one right ulnar carpal, two right and one left metacarpals and one left talus. The two right metacarpal specimens refit together into one single element. A minimum of seven elements from at least one individual are represented by these specimens.

Discussion: The coyote elements are again assigned to species entirely based on size. All of the elements are within the size range of the animals represented in the University of Saskatchewan comparative collection. All of the specimens are moderately root etched and several show signs of burning. The petrous, and the three metacarpal specimens all shows signs of light burning. The ulnar and the fourth carpal are both heavily burned, but not calcined. The accessory carpal and the talus are stained but not burned.

Class Mammalia, Order Carnivora, Family Canidae, *Canis* sp.

Material: Thirty-five specimens are not identifiable beyond the genus level of designation (Table 5.4). These specimens represent at least twenty-eight elements and one individual.

Table 5.4 Canid sp. NISP / MNE / MNI.

Element	Side	NISP	MNE	MNI
Maxilla	-	1	1	1
Upper Tooth	-	1	1	1
Thoracic Vertebra	Axial	1	1	1
Caudal Vertebra	Axial	1	1	1
Misc. Vertebra	Axial	1	1	1
Rib	-	4	2	1
Humerus	Left	1	1	1
Radius	-	1	1	1
Ulna	Right	1	1	1
First Carpal	Right	1	1	1
Second Carpal	Right	1	1	1
Fifth Metacarpal	-	3	2	1
Fourth Tarsal	Left	1	1	1
Phalanx	-	8	7	1
Metapodial	-	7	4	1
Sesamoid	-	2	2	1

Discussion: These specimens are best described as being medium-sized canid. They are all elements which are above the average size of a coyote and below that of the wolf. It is probable that some of these elements represent a domesticated dog, although this can not be stated with certainty. Positively identified domesticated canid are known to be present in the Hartley site from subsequent excavations (Clarke and Meyer 1993:24). One burned, fragmented mandible was identified during the 1992 field season.

All of the specimens are rootlet etched. Twenty specimens are moderately to heavily burned. The burned specimens include the distal ulna, the tooth fragment, three rib fragments, the first and second carpals, the distal metacarpal, the fourth tarsal, five phalanges, three metapodials and both sesamoids. The unburned specimens are all stained like other elements in the site. The humerus is nearly complete, missing only the proximal end. There are no cut marks present on any of the specimens. Some pitting is present on the proximal end of the humerus shaft and on one of the phalanges. The presence of pitting suggests some carnivore modification has taken place. Several distinct cut marks are present on the distal ulna.

Class Mammalia, Order Carnivora, Family Canidae, *Vulpes vulpes* [Red Fox].

Geographic range of species: The Red Fox is found all across North America. They are found from the arctic tundra to the southern United States and from Labrador to the coast of British Columbia (Banfield 1987:298-301). The Red Fox is found throughout Saskatchewan, but is rare in the southwestern portion of the province.

Habitat: The Red Fox prefers semi-open country and is seldom found in densely forested areas.

Material: Red Fox is represented by seven specimens. All of the materials identified are axial elements including one right immature mandible fragment, one immature lower tooth, two cervical and three lumbar vertebrae. These specimens represent at least six distinct elements and one individual.

Discussion: One lumbar vertebra centrum is slightly burned. The mandible is fragmentary and contains the first molar. The large second molar, recovered separately, is still unerupted and is not fully developed. The breaks on the bone appear to have been made while the bone was dry. All of the specimens show moderate rootlet etching and are stained.

Class Mammalia, Order Carnivora, Family Canidae, *Vulpes velox* [Swift fox].

Geographic range of species: The Swift Fox was originally found in the arid plains from Texas to southern Canada (Banfield 1987:301-304). The Swift Fox has been eradicated from most of its original range and was extirpated in Canada until recently (Carbyn and Killaby 1989).

Habitat: Swift Foxes inhabit areas of arid short grass prairie and shrubby deserts.

Material: Thirty-three Swift Fox specimens are identified in the Hartley assemblage (Table 5.5). These specimens represent twenty-four elements from at least three individuals. The MNI of three is based on two right nearly complete mandibles and one fragmentary right mandible.

Discussion: The colour and texture of the unburned specimens match the rest of the assemblage. All specimens are moderately etched by rootlets. One mandible is almost fully complete, missing only the portion bearing the incisors and the canine. The second mandible is a complete corpus portion of the element from the canine to the third molar. The third mandible is a fragmentary specimen, the alveolus area around the fourth premolar and the

Table 5.5 *Vulpes velox* NISP / MNE / MNI

Element	NISP	MNE	MNI
Mandible/Lower Tooth	5	3	3
Thoracic Vertebrae	5	5	1
Lumbar Vertebrae	2	2	1
Humerus	2	2	2
Radius	1	1	1
Radial Carpal	2	2	2
Ilium	2	1	1
Tibia	4	3	2
Metatarsal	7	5	1
Phalanx	3	1	1
TOTAL	33	25	

second molar. The two teeth were recovered separately. No cut marks are present on the mandibles. The vertebrae specimens include five complete thoracic vertebrae and two lumbar centrums. One of the lumbar vertebrae is heavily burned. The ilium is complete as is the acetabulum. The acetabulum is broken, but the break appears to be recent. One tibia is an almost complete right element, missing only the distal epiphysis. The other three are fragmentary. These include two left proximal ends and one right distal end with a small portion of the diaphysis. One proximal and one distal specimen are burned. The distal specimen being slightly calcined. Two left radial carpals are present, one is burned. The two distal humerii are both burned. One specimen is left and the other is right. The right distal radius is also burned. Metatarsals two through five were found in association with three first phalanges. All of the elements are heavily stained but no cutmarks or evidence of canid modification is present. All of the Swift Fox appendicular elements are fully fused and the teeth are erupted and in full wear suggesting that the three individuals are fully mature animals.

Class Mammalia, Order Carnivora, Family Canidae, *Vulpes* sp.

Material: Fourteen specimens could only be identified to the genus level. These include one cervical centrum, four thoracic vertebrae, one partial lumbar vertebra, three indeterminate vertebrae, one right proximal ulna and two edentulous mandible fragments.

Discussion: Four of the vertebrae specimens are burned. All of the specimens are etched by rootlets and the unburned specimens are stained in a manner consistent with the rest of the assemblage.

Class Mammalia, Order Carnivora, Family Mustelidae, *Taxidea taxus* [Badger].

Geographic range of species: The geographic range of the badger stretches from the centre of the Prairie Provinces to central Mexico in central and western North America (Banfield 1987:335-337).

Habitat: Badgers inhabit open grasslands and the aspen parklands.

Material: One right almost complete tibia and one left burned third carpal.

Discussion: Both elements show no evidence of cutmarks or canid modification. Rootlet etching is moderately present on both specimens.

Class Mammalia, Medium Mammal.

Material: These twenty specimens could only be identified to the class level of taxonomic designation. These include two cervical vertebrae fragments, two thoracic vertebra fragments, six indeterminate vertebrae fragments, six rib bodies, one right proximal femur, three phalanges.

Discussion: These specimens are grouped as medium mammals based strictly on their size. All of the specimens are part of the assemblage based on their colour and degree of rootlet etching. Six specimens are burned. The femur, one rib body and three vertebrae fragments are moderately burned and one vertebra fragment is calcined. There are no cut marks, tooth marks or evidence of digestion present. The breaks in the bone appear to have happened while the bone was fresh. Medium mammals include all animals with a live body weight of 700 to 5,000 grams, as adapted from Thomas (1969:393). These would include rabbits, hares and small fox-sized animals

Class Mammalia, Small Mammal.

Material: Thirty-one specimens are classified as small mammal. These include five skull fragments, one cervical, four thoracic, four lumbar and three indeterminate vertebral fragments, one rib body, two left distal humerii, one proximal ulna, one ulnar carpal, one innominate fragment, one right femur diaphysis, two metapodial fragments and four phalanges.

Discussion: Small mammals are animals which have a live body weight between 100 and 700 grams, such as squirrels (Thomas 1969:393). One immature femur diaphysis is not stained and is thought to be intrusive. The remainder of the specimens are all accepted as part of the assemblage. Eight specimens are burned. These include one partial cranium, the ulnar carpal, one of the metapodials, one cervical, one thoracic, two lumbar and one indeterminate vertebral centrum. The remainder of the small mammals are stained and do not show any signs of cultural or carnivore modification. Two phalanges, the metapodials, the ulna, the rib, the innominate and the ulnar carpal are all part of the fine-screen sample.

Class Mammalia, Micro-Mammal.

Material: Forty-one specimens are classified as micro-mammals. Three partial crania, one edentulous mandible, six miscellaneous teeth, one cervical, three miscellaneous vertebrae fragments, one sacrum, one caudal vertebra, two humerii, two ulnae, five femora, four tibiae, one patella and eleven phalanges.

Discussion: Micro-mammals are animals that have a live body weight less than 100 grams. This includes all of the vole, mouse and least-weasel-sized animals (Thomas 1969:393). Only eight of the forty-one specimens are part of the regular screen sample. These include two skulls, one mandible, two miscellaneous teeth, one tibia, the sacrum and one vertebra. One of these skulls is not stained and is presumed to be intrusive. The remaining seven are stained and are part of the assemblage. The material from the fine-screen sample is dominated by elements that were not recovered by the six millimetre screens. Eleven of the specimens are burned including three teeth, one vertebra fragment, two ulnae, three femora and two tibiae. None of the micro-mammal specimens show any signs of cut marks, tooth marks or digestion.

Phylum Mollusca, Class Pelecypoda, Family Unionidae, Freshwater Mussels [Pearly Mussels].

Geographic range: Pearly mussels are found worldwide but are primarily found in the northern hemisphere (Clarke 1981:253). As a group they are found throughout Canada. They are found from the Arctic through the American border and from the east to the west coasts. Individual species are, of course, more restricted in their range.

Habitat: These bivalved molluscs inhabit a wide variety of habitats. They may be found in an assortment of permanent water sources. Fresh water mussels inhabit both standing water as well as flowing water sources.

Material: Fifteen bivalve shell specimens are present in the assemblage. The number of individuals represented is not known.

Discussion: There were no signs of cultural modification observed on any of the specimens. No diagnostic features are present on these specimens that would aid in the identification of specific taxonomic designations. The determination of individual species is dependant on features such as the hinge apparatus (Dr. A. Aitken: personal communication). These specimens are classified as pearly mussels based on their size and the geographic location of the site. The original shells (and therefore the entire animal) must have been relatively large. Several fragments are 20 mm or greater in size and show no diagnostic features, suggesting that the original shell was considerably larger. These large bivalves need a sizable, permanent water source in which to live. The closest source of bivalves of this size is the South Saskatchewan River.

Phylum Mollusca, Class Gastropoda, Family Lymnaeidae, *Stagnicola* spp. [Pond Snails].

Geographic range: The genus *Stagnicola* is present throughout Canada. Several species inhabit the Plains region including the *S. caperata*, *S. catascopium catascopium*, *S. elodes*, and the *S. reflexa* (Clarke 1981).

Habitat: The genus *Stagnicola* occupies a wide range of habitats. The range of habitat is even quite diverse within individual species. The *Stagnicola* common to this area occupy all kinds of aquatic environments. Some species of *Stagnicola* are commonly abundant in aquatic areas of thick vegetation and muddy sediments (Clarke 1981:142). Typical habitats include everything from zones of temporary water such as shallow pools, vernal ponds or spring flooded margins of permanent water sources to large permanent lakes, rivers and swamps (Clarke 1981).

Material: A total of seventeen individuals are identified as *Stagnicola* spp. The shells are the largest in the assemblage, some specimens approaching 18 mm in height.

Discussion: The shells are lymnaeaform (spiral), dextral and in good condition. The aperture is some what ovate and the height is usually at least half the height of the shell. The outer lip of the aperture is slightly thickened and has a brownish-purple tinge when light passes through it. The inner lip is thick and is expanded but does not enclose the umbilicus. The spire shape is conical and quite elongated in some specimens. The shape of the shell does not approach the extreme elongation of *S. reflexa* in any of the specimens. The nuclear whorls are reddish-brown in colour in approximately half of the specimens and are always rounded with little or no sculpturing present. Fine striate growth lines are visible on the remainder of the whorls. The final whorl or body whorl is slightly expanded.

The genus *Stagnicola* is highly adapted to wet environments. The presence of these gastropods suggest that at least temporary standing water was present at the site in the past.

Phylum Mollusca, Class Gastropoda, Family Lymnaeidae, Lymnaeidae sp. [Pond Snails].

Geographic range of species: Lymnaeaform gastropods are found worldwide. They are found in Canada from Labrador to British Columbia and from the Great Lakes to Victoria Island (Clarke 1981:130-149)

Habitat: These gastropods are commonly referred to as pond snails. They are aquatic to semi-aquatic animals occuring in a wide variety of habitats. Pond snails inhabit areas ranging from cold arctic lakes to the Great Lakes and are found in standing and flowing waters. Most species tend to occupy small, shallow standing bodies of permanent or temporary water. Some species are strictly aquatic while others may venture out of the water.

Material: Six fragmented shells are present that can not be identified beyond the family level. The aperture is damaged or missing on these specimens making further identification difficult.

Discussion: Pond snails are a diverse family and inhabit a wide variety of wetland environments. These specimens do not serve to enhance our knowledge of the site.

Phylum Mollusca, Class Gastropoda, Family Planorbidae, *Gyraulus* sp. [Ramshorn Snail].

Geographic range: The Canadian range of distribution of the genus *Gyraulus* is highly diverse (Clarke 1981:176-183). They are present thoughout Canada except for the high Arctic.

Habitat: As may be expected, with a wide geographic range comes a wide range of habitats. (Clarke 1981). This genus is found in all types of permanent and temporary water sources.

Material: One individual is represented by one nearly complete shell.

Discussion: The shell of this individual is small (>4mm) and is missing the lip of the aperture. The shell is dextral, quite delicate and planorbid (flat spire). The aperture is oval and appears to lack any thickening of the lip. The umbilical is quite flat and all whorls are visible in both the apical and the umbilical views. Fine spiral lines are visible on all but the nuclear whorls.

Phylum Mollusca, Class Gastropoda, Family Vallonidae, *Vallonia* sp. [Terrestrial Snail].

Geographic range: The geographic range of the genus *Vallonia* is quite widespread. It ranges throughout North America, from central Ontario and Alberta in the north to New Mexico and California in the south. It ranges from California east through Texas in the west (La Rocque 1970; Evanoff 1987; Wu and Jones 1989).

Habitat: The habitat of the genus *Vallonia* is also quite diverse. They are often associated with shady or treed areas. Wu and Jones suggest that this genus is very climatically tolerant and is abundant in short-turfed grasslands, stone walls, garbage dumps and to a lesser degree woodlands (1989:198-199). Others show the habitat of the genus to include everything from prairie to montane regions (Elias and Nelson 1989; La Rocque 1970). The genus inhabits a variety of environments ranging from purely terrestrial to living in stream edges (La Rocque 1970:756-765). Some species are reported to be common among small prairie groves of trees (La Rocque 1970) and in aspen groves in higher altitudes (Evanoff 1987:449).

Material: Eighty-six complete or nearly complete shells may be identified as separate individuals. Some researchers have classified six of the formerly recognized species as one broad species, *Vallonia costata* (Wu and Jones 1989:199), while other researchers recognize several distinct species of *Vallonia* (Elias and Nelson 1989; Evanoff 1987; Hibbard and Taylor 1960; La Rocque 1970).

Discussion: These specimens are quite minute averaging slightly less than 4 mm in height. The shells are all dextral. The spire is slightly elevated and the umbilical is wide and concave. All of the whorls are visible in both the apical and the umbilical views. The whorls expand slowly and steadily from the nuclear whorls. The sutures are depressed and relatively strong sculpturing is present on all but the nuclear whorls, which are smooth. The aperture is rounded and displays a prominent lip. A slight callous is present on the inner lip.

Phylum Mollusca, Class Gastropoda, Family cf. Vallonidae

Material: Four partial shells could not be identified beyond the level of class. The shapes and sizes of the shells are, however, highly reminiscent of the Vallonidae shells.

Discussion: The highly fragmented nature of these shells does not allow any further observations.

5.2.1 Discussion

The Hartley site faunal assemblage contains a minimum of twenty-two species of vertebrates and four genera of invertebrates. The diversity of the assemblage is in part due to the recovery of the fine-screen sample. Sixty-eight percent of the gastropods are part of the fine-screen sample. The fine-screen sample increased the number of vole species by one (*Clethrionomys gapperi*). It also greatly increased the number of small and micro-mammal post-cranial elements recovered in previously identified taxa. Shaffer (1992a) discusses the large number of mouse and vole bones that are lost through large meshed screens. The crania, innominates and sacral elements are the only elements recovered with any regularity from 6 mm screens (1992a:131). Shaffer (1992a) found that the recovery of bones from mammals with a live weight of 71-340 grams is also poor when using a 6 mm screen. The only elements to be consistantly recovered in test screenings are the pelves, scapulae, femora, humeri, skulls and mandibles (Shaffer 1992a:131). By using a large mesh Shaffer argues that a recognizable fraction of the assemblage will be lost. The recovery of large numbers of smaller elements in the Hartley site fine-screen sample seems to reflect this bias. Although these elements are often not identifiable to a specific level they are still important to the proper understanding of the assemblage as a whole. It is important to analyze all available elements in order to determine the association these small animals have with the site (Morlan 1994c, Shaffer 1992a, 1992b and Hockett 1991).

Through the identification of specific bone modification criteria (Morlan 1994c) some of the specimens from the Hartley site assemblage are found to relate to more recent events at the site. These specimens do not significantly alter the interpretation of the Hartley site assemblage although they decrease the number of elements present in some species. Three avian species are also removed entirely from the list of animals present in the cultural assemblage. The elimination of one of these species, the Domestic Turkey (*Meleagris gallapovo*), is not a surprise. The Domestic Turkey is a relatively recent arrival to the Northern Plains and should not be expected in a precontact site. The other species that are eliminated are the Ruffed Grouse (*Bonasa umbellus*) and the Great Horned Owl (*Bubo virginianus*). These species are native to the area, but the texture and condition of the bones indicates that they do not belong with the remainder of the Avonlea/Old Women's phase fauna. It is not possible to determine the exact factors that introduced these specimens into the site, although predation by other animals is probably one of the main reasons.

Several reasons may be put forth to explain the diversity of animals present in the culturally introduced portion of the Hartley site fauna. These animals may have cultural significance, they may be procured for their pelts (or plumage), they may be procured for dietary reasons, or they may serve a number of these purposes. Ten species and seven less specific taxa categories of vertebrates contain elements that are burned. Only five (*Vulpes vulpes*, *Castor canadensis*, *Spermophilus richardsonii*, *Microtus ochrogaster*, *Microtus* sp. and *Clethrionomys gapperi*) of the twenty-two categories of mammals have no burned specimens. These categories contain only a few (typically cranial) specimens which represent a few individuals. Larger, less specific categories such as *Vulpes* sp., medium mammal, *Spermophilus* sp., small mammal and micro-mammal all contain a significant amount of burned material. It is likely that most or all of these mammals are dietary items. This is further substantiated by the high proportion of green bone fractures. Cut marks are not typically found on small and micro-mammals (Morlan

1994c, Shaffer 1992b) and are not as useful in determining the function of these animals. Some animals possibly served dual purposes. Fur bearing animals such as the canids and the rabbits might have been skinned prior to consumption, although there is no direct evidence for this.

Only one out of the eight culturally introduced categories of avifauna contains burned specimens. No cut marks are present on any of the avian specimens. These taxa are probably dietary although no direct evidence is present. Fractures suggest that most of these elements were broken while the bone was fresh. No carnivore modifications are present. It is also possible that the teal spp. and the Ravens were procured for their plumage. Again, there is no direct evidence to support or deny this hypothesis. The fish remains also show no direct evidence of carnivore modification, cut marks or burning. It is assumed however that these specimens do represent a dietary portion of the assemblage. The meat of the pelecypods are also edible. The shells may have also been kept and modified as decorations. However, no cutmarks or cultural modifications are present on these specimens.

5.3 Aging and Seasonality

5.3.1 Aves

Under certain circumstances avian long bones may be used in the establishment of the seasonality of a site. Rick (1975:183-190) presents a methodology to determine the season of occupation based on the presence of medullary bone in avian long bones. Such bone accumulates in the medullary cavity of avian long bones during the breeding period. This boney growth occurs only in females and is used as a calcium supplement for the production of egg shells. The medullary bone is developed for only three to four weeks during the ovulating season (Gilbert, Martin and Savage 1985:11). This short time span allows the archaeologist to establish a reasonably refined seasonality if medullary bone is present.

There are some disadvantages in using medullary bone as a seasonal indicator. No assumptions may be made if medullary bone is not present. A lack of medullary bone may simply mean that the specimen is a male or is a non-breeding female (Rick 1975:188). The limited time frame of the medullary bone limits its chance of being present in any given sample. If the first set of eggs is lost some birds may re-nest, altering the time frame of the breeding season (Rick 1975:189). Medullary bone is also difficult to detect in small birds.

The Hartley site avian elements (that are part of the cultural assemblage) were inspected to see if they contained medullary bone. Rick (1975:184) notes that all elements in the body store an amount of medullary bone, but it is most visible in the femur, tibiotarsus and the ulna. These elements are large with open medullary cavities. Several elements could not be checked, such as the femora of the Green-winged Teal, because they are complete elements. No medullary bone was seen in any of the elements.

The presence of migratory waterfowl such as the Green-winged Teal (*Anas crecca carolinensis*) and the possible Blue-winged Teal (*Anas* cf. *discors*) also provides an approximate range of seasonality. The Green-winged Teal begins its autumn migration in early September. Some late individuals may remain in the parkland / northern grassland region until the water begins to freeze in mid-November to mid-December (Bellrose 1976:222). These birds are also one of the first ducks to return in the spring, returning to the Northern Plains as early as the first week of April (Bellrose 1976). The Blue-winged Teal begins its southward migration in early September. The last individuals are on their way by November. They do not begin to return until late April to mid-May (Bellrose 1976:280).

Caution must be taken when using these migration patterns to imply seasonality. First, the sample size is extremely small. Second, the onset of migration is highly dependant on the weather. Small numbers of Green-winged Teals may stay on the northern grasslands into mid-December if the weather permits (Bellrose 1976). Thirdly, teals (as well as Ravens) have distinctively coloured feathers and may have been procured for their wing and tail feathers at an earlier point in time. In an analysis of the Cheyenne ornithology, Moore notes that "(b)rightly marked ducks, such as male mallards, redheads, and especially teal, are said by some to be painted and aggressive 'warrior birds'. This does not imply, however, that they are not edible." (1986:187). If these elements do represent animals that were procured during the site occupation, a seasonality of late April / early May to early November would be suggested. The material may also relate to the Mortlach occupation and not relate to this assemblage. Based on the texture, colour and location of the elements this is extremely unlikely.

5.3.2 Rodents

Rough estimates of seasonality may be based on the presence of rodents that hibernate through the winter (Koch 1995:48). These estimates are best used in conjunction with the presence and absence of other taxa which are unavailable during part of the year. Although several genera of rodents are present in the Hartley site assemblage only one hibernates during the winter. The genus *Spermophilus* hibernates for approximately six to seven months of the year depending on the species. Three species of ground squirrels *S. richardsonii*, *S. franklinii* and *S. tridecemlineatus* occupy the

Northern Plains (Banfield 1987). Richardson's Ground Squirrels enter their burrows in the middle to the end of August and reemerge during the second half of March. Early mild weather will however bring them out earlier. Thirteen-lined Ground Squirrels enter hibernation in late September and reemerge in early April (Banfield 1987:123). Franklin's Ground Squirrels enter hibernation in late August to early September and reappear in mid April (Banfield 1987:125).

Richardson's Ground Squirrels are the only species to be positively identified in the Hartley site assemblage. A minimum of six individuals are present in the assemblage based on mandible counts. More individuals may be present if the animals in the *Spermophilus* sp. category represent separate individuals but this can not be confirmed. It is not improbable, however, that the other species are also present. Based on their hibernation schedule none of these rodents would be available during the period of late September to mid /late March. The presence of a relatively large number of Richardson's Ground Squirrels in the assemblage suggests a seasonality of mid March to mid / late August. If other species are present the site could have been occupied from mid March to late September.

5.3.3 Discussion

Based on the avifauna and the rodents the seasonality of the Hartley site assemblage suggests a slightly different time frame than the bison analyses. Medullary bone is not present in any of the avian long bones. Due to the nature of the methodology this does not confirm or eliminate any season of the year during which the site could be occupied. Migration patterns of the waterfowl are also not as helpful as initially anticipated. Both individuals have highly colourful wings and may not have been procured during the occupation at the site. The rodent hibernation schedules overlap slightly with the seasonality of the bison spring foetal remains. None of the bison seasonality analyses indicate that the site was occupied earlier than November which is far too late in the season for any of the ground squirrels. The presence of Northern Pike in the assemblage also supports the hypothesis that the occupation of the site extended into the early spring. Northern Pike are early spring spawners and would have been readily available at that time. Unfortunately, however, no definite seasonality has been established for the fish remains which could support or deny this.

5.4 Summary

The Hartley site faunal assemblage contains a minimum of twenty-two species of vertebrates and four genera of invertebrates. The majority of the species are associated with the Avonlea / Old Women's phase occupation of the site. A few of the specimens of some species as well as all of the specimens from other species are not associated with the occupation. These specimens include small mammals which have died due to predation, poorly excavated hibernacula or other natural causes. Three avian species including the Domestic Turkey (*Meleagris gallapovo*), the Ruffed Grouse (*Bonasa umbellus*) and the Great Horned Owl (*Bubo virginianus*) are also not part of the Avonlea / Old Women's phase occupation. The Domestic Turkey is not indigenous to the Northern Plains and relate to the operation of the Sommerfelds' turkey farm. The other species that are eliminated based on the the texture and condition of the bones. It is not possible to determine the exactly how these specimens became part of the assemblage into the site, although predation by other animals is probably one of the main reasons.

Analyses of the avifauna and some of the rodents at the site it appears that the Hartley site was continuously occupied into the early spring. None of the avian bones which could be analyzed showed any signs of medullary bone. Unfortunately this does not confirm or eliminate any season of the year during which the site could be occupied. Waterfowl migration patterns could not show a definite seasonality either, although they did overlap slightly with the other the previously established seasonality. The rodent hibernation schedules overlap slightly with the seasonality of the bison spring foetal remains. The presence of Northern Pike in the assemblage also supports an early spring seasonality as they spawn in the early spring. Unfortunately, however, no definite seasonality has been established for the fish remains.

CHAPTER 6.

PALAEOECOLOGICAL IMPLICATIONS OF THE FAUNAL ASSEMBLAGE

6.1 Considerations for Regional Biogeography

Biogeographical interpretations are an important aspect of what may be learned from zooarchaeological assemblages. The reconstruction of the regional and site environment are only possible, however, if the actual specimens are properly identified. Graham and Semken (1987:3) note that proper identification of microtine dentitions is crucial to the reconstruction of past environments. Several species of microtine rodents and gastropods are almost indistinguishable based on skeletal elements or shells alone. Specific designations often rely on the colour of the pelt (mammals) or the nature of the periostracum and soft parts (gastropods). The microtine dentitions present at the Hartley site are identifiable to the species level of taxonomic designation. The gastropods are, however, only identifiable to the level of genus. This less precise level of designation limits the interpretations which can be reached based on these specimens. Biogeographic reconstructions also rely on the relative contemporaneity of the identified species. Environmental reconstructions are not valid if the species identified are not associated.

One means of gaining some insight into the palaeoecology of the region is through the determination of an area of sympatry. Sympatric species are species which coexist in a given geographic region (Smith, R. 1986:45). According to Graham and Semken (1987:7) "(t)he geographic region in which the modern fauna ranges of all or most taxa overlap defines the area of sympatry for that local fauna." The area of sympatry is determined by plotting the geographic range of each species present in the archaeological assemblage on a regional map. The area containing the maximum number of species is referred to as the area of sympatry. A harmonious area of sympatry is one in which all of the species co-occur in a given area. A disharmonious area is one in which the species do not co-occur in a given region. If the area is harmonious it is suggested that the past and present environments are roughly analogous to one another. Disharmonious areas suggest that there is no analog for the past environmental setting.

Graham and Semken (1987:8) outline five basic assumptions or requirements that are important in the determination of an area of sympatry. First, the identification of elements must be to a species level of designation. Second, the ecological and physiographical tolerances of a species have not changed dramatically. This is not expected to be problematic in relatively recent sites like the Hartley site. Third, the modern distributions of animals must be accurately known and if any changes are present they should be due to environmental factors and not human intervention. Fourth, differences in published range maps may affect the boundaries of the area of sympatry. Fifth, the boundaries are often determined by a few species and the ecological and physiological factors may be unduly weighted by these species. Variations may also be due to vegetation patterns, interspecific competition or predation and disease.

All of the species present in the Hartley site faunal assemblage are (or were) present in the overall fauna of the region. Some animals such as bison and Swift Fox are no longer present in the immediate geographical area. These absences are due explicitly to human intervention and not because of environmental change. The removal of these animals should be addressed prior to the definition of the area of sympatry. Other species such as the wolf and the Raven are also absent from modern range distributions and must also be discussed before the area of sympatry for the Hartley site assemblage is determined.

6.1.1 *Vulpes velox* (Swift Fox)

The Swift Fox is North America's smallest wild canid (Egoscue 1979). It is significantly smaller than the Red Fox, with a total length, including the tail, of only 600-875 mm. The winter coat is long and dense, having a dark buffy grey upper portion, orange tan sides, legs, lower portion and tail and a white or buff coloured belly. In the summer the coat becomes shorter, harsher and more of a reddish colour (Banfield 1987). Typical Swift Fox habitat consists of areas of short to medium length prairie grasses, and the foxes are primarily nocturnal hunters that prey on rabbits, rodents, birds and insects (Nowak 1991).

The Swift Fox's original range, extended well into central Alberta and Saskatchewan (Seton 1905; Hall and Kelson 1959; Chapman and Feldhamer 1982). Up until the early 1980's the Swift Fox was considered extinct or "extirpated" in Canada (COSEWIC 1978). These animals were almost completely wiped out in the early part of this century due to trapping and other campaigns to try to reduce coyote populations. However, a few still remained in the Northern Plains states and in 1983 an effort was begun to reintroduce these animals into their Canadian habitat. Over 250 animals have now been released south of the Cypress hills in both Saskatchewan and Alberta (Nowak 1991). The Hartley site lies within the northern boundary of the historic distribution. The larger northern range is also substantiated by the archaeological record. Swift Fox elements are present in several

Saskatchewan archaeological sites including sites, along the Souris River (Peggy McKeand: personal communication), the Oxbow Dam site (Nero and McCorquodale 1958), and the Bracken Cairn (Walker 1982). Swift Fox elements are present in Alberta at sites along the Belly River, DhPj-11 and DhPj-31 (Quigg 1974), at the Cactus Flower site (Brumley 1975) and the Larson site (Milne 1988). More southerly examples of Swift Fox distribution may be found in Semken and Falk (1987). They analyzed 95 faunal reports from sites that contained at least eleven species of animals throughout Nebraska, Iowa and the Dakotas. Forty-eight of these sites contain Swift Fox material. Other sites in the United states include the Hulme (Bozell 1991) and McIntosh (Koch 1995) sites in Nebraska.

6.1.2 *Bison bison bison* (Plains Bison)

The Plains Bison (*Bison bison bison*) is another species that due to human intervention no longer roams the Northern Plains. The total population of bison, including the Wood Bison (*B. bison athabascae*), is reported to have reached as high as 70 million throughout North America prior to the arrival of the Europeans. The Plains Bison was effectively extirpated in Canada by 1885 (Gates, Chowns and Reynolds 1992:139). The bison were hunted almost to the point of extinction with only a few Woods and Plains Bison remaining in small isolated pockets. By 1889 approximately 1,000 animals or less existed in North America (Jones et al. 1983:336; Banfield 1987:406).

The original geographic range of these two sub-species spanned North America. Bison could be found from Alaska and the southern and western Northwest Territories down the Rocky Mountains into Oregon and to the Gulf of Mexico. The eastern limits of these animals was along the Appalachian

Mountains and isolated parts of the Atlantic coast (Jones et al. 1983:336). This geographic range was occupied by two separate sub-species. *B. b. bison* occupied the grassland environments and *B. b. athabascae* inhabited the more forested regions (McDonald 1981; Frison 1992; Gates, Chowns and Reynolds 1992).

6.1.3 *Canis lupus* (Gray Wolf)

The wolf was once common throughout North America (Binford 1981; Frison 1992; Nowak 1991). Several sub-species of wolf are differentiated in North America, largely based on geographic distribution. One sub-species *Canis lupus nubilis* was common on the plains and was highly associated with the bison (Berger and Cunningham 1994). These wolves were often referred to as Buffalo Wolves and followed the herds, often at very close quarters. It is not possible to differentiate between the Buffalo Wolf and the Timber Wolf based on skeletal elements, but based on the geographic location of the Hartley site, it is likely that these animals may be considered Buffalo Wolves. Barsness (1985:17) states that they often "... hung about watching for signs of weakness amongst the old, or for glimpses of the strayed calf, yet they often ran through the herds unmolested and played about the waterholes as if they too were herd members." Jones et al. (1983:255) state that "(b)y nearly all reports, wolves once were abundant throughout the Northern Great Plains, both on the prairie (where they followed herds of bison) and in forested areas (where they preyed mostly on deer)." Banfield (1987:295) notes that "(t)he 'buffalo' wolf that formerly followed the herds of buffalo across the great plains of southern Manitoba and Saskatchewan..." is now possibly extinct.

The wolf populations on the plains were dealt a serious blow with the depletion of the bison (Jones et al. 1983:255). Ranchers and trappers continued to kill the remaining wolves. Carcasses were laced with poison and wolves were shot and trapped for sport and profit. Rezendes (1993:210) states that "In northern Montana alone, between 1883 and 1918, 80,000 wolves were poisoned, shot, or trapped under a state bounty system." People in other parts of the Northern Plains were also quickly eradicating their wolf populations. "In 1934 the last wolf was killed in the Black Hills region of South Dakota (Jones et al. 1983:255). Other remaining populations of this subspecies did not last much longer.

The presence of the "Buffalo" Wolf is also well documented archaeologically. Wolves are well represented at archaeological sites all across the Northern Plains. Wolf elements have been recovered from several Saskatoon area sites including the Hartley site, the Norby site (Zurburg 1991), the Gowen sites (Walker 1992) and the Redtail site (Ramsay 1994). Wolf elements are also present in numerous other archaeological sites throughout the Canadian and American Plains (Frison 1992).

6.1.4 *Corvus corax* (Raven)

The Raven (*Corvus corax*) is present throughout North America although its numbers are greatly reduced on the plains from what they once were. In the past, Ravens on the plains were closely associated with the movements of the bison herds. Their relative absence on the plains today may also be closely tied to the absence of the bison. Bent (1964:202) reports that Ravens were not as abundant in Oklahoma as they were "in the days of the buffalo". With the disappearance of the buffalo the Ravens also decreased in numbers. Ravens were killed by eating poisoned bait put out by people to kill the wolves. Many were also killed by eating the dead wolves as well. As carrion feeders they would have been omnipresent at bison kill sites, especially those of significant size. Heinrich (1989) also discusses the depletion of Ravens as well as the increase in the number of crows. The Ravens' main food source, the bison, was eliminated on the plains causing the number of Ravens to decrease. The crows on the other hand actually benefited from the increase in agriculture as it increased their food supply (Heinrich 1989:29)

Heinrich (1989:27) also discusses an ethnographic account pertaining to Ravens, wolves and bison as presented by James R. Mead (1989), in his book *Hunting and Trading on the Great Plains:1859-1875.* When hunting wolves the Kaw (Kansas) Indians would kill a few bison and leave them unguarded for one night. Just prior to sunset on the second night the bison would be laced with strychnine to kill the wolves that would come to feed on the carcasses. "The reason we put out our baits after sunset was on account of thousands of ravens that seemed to live with the buffalo, and which were confined exclusively to country occupied by them." (Mead 1986:73 as cited in Heinrich 1989:27). Ravens were essentially eradicated from the Northern Plains at the same time as the wolf and the bison.

6.1.5 Discussion

To determine the area of sympatry for the Hartley site faunal assemblage, geographical ranges from Banfield (1987) and Godfrey (1987) are analyzed in order to determine areas of overlap. Animals such as the Swift Fox are typically found in areas of short to medium length prairie grasses. Other animals such as the red-backed vole and the Snowshoe Hare tend to inhabit more wooded areas such as aspen copses. Green-winged Teals are also common parkland and Northern Plains inhabitants. In general, the Hartley site vertebrate fauna reflects a parkland or mixed grassland/woodland environment.

The current regional distributions of some animals no longer cover this geographical area. This is due to recent human intervention, predominantly the depletion of the large bison herds. The regional geography of these animals has been revised to their pre-agriculture extents to show that no extra-limital species are present in the Hartley site assemblage. These revised distributions all overlap in parkland types of environments. This overlap suggests that at the time of the site occupation the general ecology of the region was similar to the present environment. However, the size of the overlap is quite large due to the lack of refinement in the general distribution maps. A large area of sympatry suggests that the area is not a precise indication of the past environment due to the variability within that area. A harmonious association between the faunal assemblage and the modern environment suggests that the environmental conditions at the time of the occupation were roughly analogous to the modern conditions (Graham and Semken 1987:7).

The Hartley site faunal assemblage is not a complete representation of the fauna that were present in the area while the site was occupied. Several animals which may be expected at a site are absent from the Hartley site faunal assemblage. These include several species of ungulates which would have provided relatively large amounts of meat. Only two species of ungulates have been identified at the Hartley site. The most abundant species is bison although one fragmented portion of an Elk antler is also present in the 1992 excavation material. Because Elk antlers are shed annually, it is possible that no other portion of the animal was ever at the site. Several other species of ungulates would have been present in the region while the site was occupied including Mule Deer, Moose and possibly Pronghorn. The absence of these animals from the assemblage may be explained in a number of ways. Bison are the dominant herbivore in the area and increases in their numbers in a given area may force out other ungulates (Morgan 1980: 151). The people at the site may have selectively hunted bison and ignored the other animals or the other ungulates may have been processed away from the main camp or processed more completely than the bison elements.

6.2 Site Specific Palaeoenvironmental Reconstruction

Several micro-mammals and gastropods are very good indicators of palaeoenvironmental settings. These species have several characteristics which make them useful in determining the past environment. They all have relatively short life spans which ensures that the environment did not change significantly during the animals' lives. They are also restricted in the size of their home range. The small size of the micro-mammals also implies that people would not travel large distances to procure them. The gastropods are likely to be a purely biological segment of the faunal assemblage. Some forms of terrestrial snails may have a home range that is less than a couple of hundred metres in diameter (Barber 1988:14). It is therefore relatively safe to use these animals in reconstructing the palaeoenvironment of the site area.

The use of these animals to reconstruct the palaeoecology is not without its short comings. The determination of the species composition of the assemblage is based on many of the same assumptions as those found in determining the area of sympatry (Graham and Semken 1987:9). The small sample size from the assemblage also limits discussion of relative frequencies.

6.2.1 Microtine Rodents

At least three species of microtine rodents are present in the Hartley site faunal assemblage: *Clethrionomys gapperi*, *Microtus pennsylvanicus* and *Microtus ochrogaster*. Based on a MNI of eleven, *M. pennsylvanicus* is the most common species. *C. gapperi* is represented by two individuals and *M. ochrogaster* is represented by one individual. These species may be found in the same types of environments, but typically at the exclusion of the other species. Overlaps in the home ranges of these species are only noted on occasion (Merritt 1981; Reich 1981; Stalling 1990). It should not be assumed that these animals were deposited within their home range at the time of death. It is probable that at least some of these individuals were introduced to the assemblage from outside of their natural habitat. Human or animal predators may have transported these small animals to the site area. It is unlikely, however, that the animals were transported too far out of their native environment.

The Meadow Vole (*M. pennsylvanicus*) tends to live in large loose colonies but will attack strange voles of any species. They will especially defend a home range of 7 square yards around their nest. Females are typically more territorial than males. Wet meadows with an abundance of grasses, sedges or mosses for cover are their preferred habitat. They will inhabit just about any relatively open area avoiding only deep forested areas and high, dry grasslands. They live mainly above ground and construct runways through the grass for cover. The Meadow Vole builds its nest under an old log or occasionally in a burrow. The burrows are usually abandoned burrows of other animals but a Meadow Vole occasionally will excavate a burrow of its own. The ground in typical Meadow Vole habitat is usually too wet for burrowing (Jones et al. 1983:223). This species has a home range of

0.08 to 0.23 acres depending on the habitat and season. The home ranges tend to be the smallest in the winter when the ground is covered with snow and largest during the breeding season in the fall. The density may be 15-45 animals per acre in old, field habitat while the density may reach 45-150 animals per acre in marsh habitat. Population peaks, which can occur every three to four years, may reach 400 animals per acre. The maximum life span in the wild is approximately 17 months (Banfield 1987).

The Prairie Vole (*M. ochrogaster*) is a social animal and lives in small colonies. These colonies may be family based and include as many as nine animals in the winter. The Prairie Vole is more fossorial than the Meadow Vole and spends the summers primarily above ground and the winters underground. They can excavate their own tunnels but also reuse abandoned tunnels of other animals. Males average about 143 mm in length and 43 grams. Females are slightly larger averaging 150 mm in length and 45 grams in weight. Population density varies with the season and the habitat from 25.2 to 145.8 animals per acre. The average home range is between 0.24 and 0.02 acres.

The Gapper's Red-backed Vole (*C. gapperi*) is a solitary animal during the summer and lives in small family groups in the winter. The average length is roughly 129 mm and it usually weighs approximately 13.6 g. They typically inhabit forested or shrubby regions. Although they are primarily terrestrial, they are known to climb trees. They do not make their own runways and use the runways of Bog Lemmings and Meadow Voles. They often use the cover of logs, brush, stumps and other large objects that they can dart under while going from place to place. They may use abandoned burrows if they are present. The home range may be as large as 3.56 acres in the summer. The outer limits of the range may overlap with other red-backed voles. Winter ranges are again much smaller and are approximately 0.35 acres in size. These ranges are primarily tunnels radiating out from the nest, under the snow cover. Population densities vary from 0.17 to 4.42 per acre.

These three species of voles are all common in the present local environment. The Meadow Vole is the most abundant species in the Hartley site assemblage, although as stated before, the sample size is very small. *M. pennsylvanicus* is reported to be dominant over *M. ochrogaster* when their individual ranges overlap. If *M. pennsylvanicus* moves into territory occupied by *M. ochrogaster* it will move into the moister areas with higher denser, vegetation (Stalling 1990:4). *M. ochrogaster* will then be forced into the drier less vegetated regions of the area. *M. pennsylvanicus* and *C. gapperi* tend to live in exclusion of one another as well (Merritt 1981:5; Reich 1981:4). Relatively strong evidence is presented by Hnatiuk (1967) that *C. gapperi* and *M. pennsylvanicus* are found in the same areas in the Saskatoon region.

> In conclusion it seems that in this part of their range *M. pennsylvanicus* and *C. gapperi* display a minimum amount of interspecific rivalry because of the availability of diversified habitat. Habitat preference, thus specialization, is indicated by *C. gapperi*, by the fact that it occurs in low numbers in, or is absent from, some habitats. (Hnatiuk 1967:138)

M. ochrogaster and *C. gapperi* are also rarely seen sharing home ranges. The exclusion between these two species, however, is likely environmental. *C. gapperi* occupies a wooded or brushy habitat and *M. ochrogaster* lives in the drier grasses.

The local environment suggested by the presence of these microtine rodents is very similar to the present site environment, or the environment as it would have been prior to agriculture. It is suggested that large areas of open grasslands were present with tall, dense grasses and moist soil, which were occupied by Meadow Voles. If the ratio of *M. pennsylvanicus* to the other species is accurate it would suggest that the Meadow Vole occupied the dominant habitat. Drier areas of grassland would have been occupied by *M. ochrogaster*. Treed or brushy areas such as those found in the deeper depressions at the site would have been occupied by *C. gapperi*. The environment may have been slightly wetter although this is difficult to state for certain. *C. gapperi* has a very high water requirement and needs at least small amounts of standing moisture and therefore will select microenvironments that meet this need (Jones et al. 1983:212; Merritt 1981:3).

6.2.2 Gastropods

Due to my lack of familiarity with the materials the gastropods present at the site could not identified as precisely as the vertebrates. The genus is the most precise level of designation described. Although some of the genera described are variable in their habitats they are still useful indicators of what the general environment would have been like in the past. Three genera of gastropods are present in the assemblage, representing at least four species. The first genera are lymnaeaform, characterized by high conical spires and large apertures. One genus, *Stagnicola*, is represented by seventeen individuals. Members of this genera are commonly referred to as pond snails. Four species of *Stagnicola* are commonly found throughout the Canadian plains in temporary and permanent water sources. These include the *Stagnicola caperata*, *S. catascopium catascopium*, *S. elodes* and the *S. reflexa* (Clarke 1981:130). They tend to occupy a wide range of habitats. Most species occupy everything from temporary water sources such as shallow pools and vernal ponds to large lakes and rivers. The remaining species only occur in large permanent lakes and rivers. They are all typically aquatic, although they are able to tolerate some dry conditions.

One single specimen is a member of the Planorbidae family or the Ramshorn snails. This specimen belongs to the genus *Gyraulus*. Three species of *Gyraulus* occupy the Canadian plains, *G. circumstriatus, G. parvus* and *G. deflectus*. These species are occupants of temporary or permanent water bodies (Clarke 1981:176-180). This individual is a part of the fine-screen sample.

The third genus is the most abundant at the site. Eighty-six individuals are identified as belonging to the family Vallonidae, genus *Vallonia*. Several distinct species are recognized for this genus by some authors (La Rocque 1970; Elias and Nelson 1989) while others lump them together as one (Wu and Jones 1989). The individuals present in the Hartley site assemblage are very minute, less than 4 millimetres in width. They have planospiral shells and are terrestrial in nature. Wooded environments in and under the leaf litter or under rough rocks in gravelly sediments are typical habitats of this genus (Wu and Jones 1989:198). All of these individuals are part of the fine-screen sample. Due to their small size it is not possible to determine if their abundance is due to the sampling technique or whether they are more abundant throughout the site. Several of the lymnaeaform specimens are part of the coarse-screen sample which has inflated their relative abundance and distribution. Very few of the larger lymnaeaform gastropods are present in the fine-screen sample with respect to the *Vallonia*. The low frequency of lymnaeaform specimens in this fine-screen sample may suggest that the relative abundance of the *Vallonia* is correct.

The lymnaeaform and the planorbid gastropods both suggest that a wetter environment was present in the past. These genera require at least temporary bodies of water. The apparent abundance of *Vallonia* is likely a reflection of the sampling technique The presence of this genus suggests that the area was similar to today's environment with copses of trees being present.

6.2.3 Summary

Based on the species composition of both microtine rodents and gastropods, it appears that the site environment during the occupation was similar, although moister than the environment at the current time. The hypothesis that the local environment was slightly wetter is further supported by the larger, regional palaeoclimatic trends. The cultural affiliation and the radiometric dates place the site within the Neo-Atlantic period (Wendland 1978). The Neo-Atlantic period is typified as having similar amounts of rainfall as today and being more moist than the episode preceding (Scandic) and the two (Pacific and Neo-Boreal) following it (Semken and Falk 1987:200).

CHAPTER 7.

INTRA-SITE ANALYSIS OF THE HARTLEY SITE FAUNAL ASSEMBLAGE

7.1 Introduction

The faunal specimens, as well as the lithic and ceramic assemblages, were distributed unevenly across the excavated area. Concentrations of materials are discernable throughout the excavated area. The majority of the faunal elements present in the assemblage are fragmented, potentially biasing distribution maps based on numbers of specimens. The assemblage was mapped by weight in order to reduce the biasing effect. The distributions of fire-cracked rock and ceramics were also mapped by weight to reduce the effect of fragmentation. The distribution and relative abundance were examined in order to determine the site function.

There are few culturally modified bones at the site. Less than one percent of the specimens show indications of cultural modification. These modifications range from simple cut marks to finely made cut and polished bone items. Comparisons to other sites of similar ages and seasonalities are also presented.

7.2 Culturally Modified Bone

Several faunal specimens show evidence of cultural modification. One broken bone "pin" is now 55.5 mm in length and averages 5.2 mm in diameter (Figure 7.1). This pin has one broken end, the other being polished to a flat, blunt edge. Two complete series of six incised lines, running perpendicular to

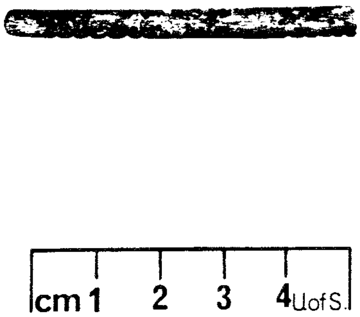

Figure 7.1 Incised bone pin

the length of the pin, are present on alternating sides. A third series of incisions is started near the broken end of the pin but is broken at the sixth line of the series. The pin has a slight curvature which may be related to the curvature of the bone it is carved from. Over all, the pin is very precisely made. It is made from a large ungulate long bone diaphysis (based on the size and density of the bone). The function of this modified bone is unknown. A similar pin has been recovered at the Miniota site, in southwestern Manitoba (Landals et al. 1994:227-230). The Miniota site specimen is complete and measures 229 mm in length. The function of this pin is also unknown, although Landals suggests several possibilities including use as a hair pin, a gaming piece or a pin used in weaving textiles (Landals et al. 1994:227-230).

Other bone tools present at the Hartley site are more difficult to interpret. In 1992 one antler fragment, possibly Elk (*Cervus elaphus*), was uncovered which may be a part of a tool kit. The specimen is in poor condition and is highly fragmented. No other Elk or cervid elements have been identified in the faunal assemblage.

Other culturally modified pieces include a few small polished bone fragments and specimens which exhibit slight signs of possible wear. The most common type of modification is cut marks. Approximately two hundred specimens exhibit cut marks. These range from small unidentifiable fragments to complete or nearly complete elements. The majority of these elements are bison. No cut marks are present on any fish, bird, micro-mammals or small mammals. Considering the large number of faunal specimens present in the assemblage the occurrence of cut marks is relatively low. Cut marks are primarily located across ribs, vertebral portions and areas of long bones suggestive of hide removal and primary butchering (Binford 1981). It is possible that the low numbers of cut marks may relate to a winter occupation. Morlan (1994b:773) suggested that a high number of impact scars and low number of cut marks may relate to the dismemberment of frozen carcasses.

7.3 Intra-site Analysis

The excavation area contained several features including at least two large hearths. These features appear to be significant in relation to the distribution of artifacts and faunal specimens within the excavation area. Only a very low percentage (less than one percent) of the bone exhibits evidence of carnivore modification. This low fraction, however, does confirm that carnivores were present at the site and can not be ignored or entirely discounted in the spatial patterning of the assemblage.

7.3.1 Characteristics of Site Features and Artifacts

Several hearth features were noted in the first three years of excavations (Figure 7.2). One large hearth was located in the northwestern

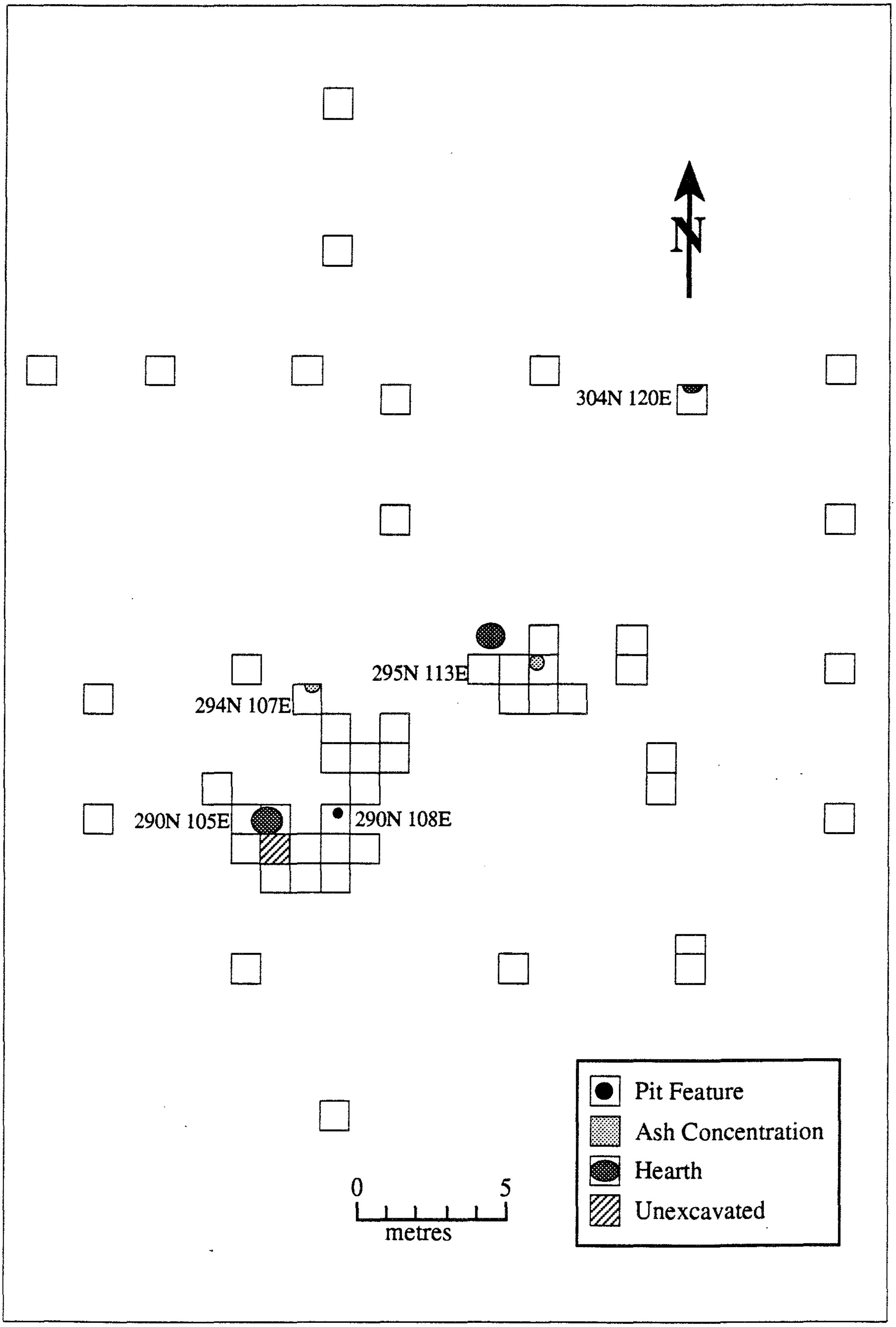

Figure 7.2 Distribution of features throughout the excavation area.

portion of the large contiguous block of units, in units 290N 105E and 290N 106E. This hearth was over one metre in diameter and was associated with ash and charcoal. The hearth area had an abundance of red oxidation and fired sediment suggesting a long exposure to intense heat. The oxidized sediment was over 30 cm thick in some areas. The hearth was highly disturbed by rodent burrowing and small amounts of oxidized sediment had been pushed into all of the surrounding units although little vertical displacement was apparent.

A similar hearth was fully identified during later excavations approximately 10 to 12 m to the north east (Figure 7.2). This second large hearth (units 295N 113E, 296N 113E and 296N 114E) was partially uncovered during the 1990 field season when a small portion was identified in the north wall of unit 295N 113E. This hearth also exhibited signs of intense heat including fired sediment and extensive oxidation of the sediments below. At least one smaller hearth was present in the units excavated in the first three seasons. It was located in the northern half of unit 304N 120E (Figure 7.2), approximately 12 to 15 m northeast of the second large hearth. The oxidized area was approximately 37 cm in diameter at the widest point and was approximately 10 cm deep. The hearth contained small amounts of ash and charcoal as well as some burned and calcined bone fragments. This hearth was also concave at the base and relatively shallow.

Two small ash concentrations are also present in the units excavated during the initial three years field work (Figure 7.2). One ash concentration is located in the northeast quadrant of unit 294N 107E. This concentration is approximately 6 cm in thickness and 38 cm in diameter. The overall dimensions are poorly defined although it appears to have a shallow, dish-shaped lower boundary. A few small flecks of charcoal were observed in the ash during excavation. The second concentration is located in the northwest quadrant of unit 295N 115E. It is not as thick, only three to four cm deep, but is approximately 45 cm in diameter. It is likely that this ash is associated with the large hearth immediately to the west.

One possible pit feature was identified in 1990. It was located almost in the exact centre of unit 290N 108E. The pit was irregular in size, approximately 25 cm in diameter and 15 cm deep. Several fragments of foetal bones were associated with the feature including, several ribs, a tibia and several other specimens. The feature also contained the body fragment of an Avonlea projectile point, lithic debitage and several fragments of unidentifiable bone. The feature was first noticed near the bottom of the main concentration of the occupation layer. The pit began to take shape and still contained an abundance of artifacts in level eight (40 cm below surface) even though the main concentration of faunal elements and artifacts became scarce by level 7. Several large rodent disturbances were present in this area of the unit and the so-called pit feature probably represents an infilled hibernaculum. The large number of small faunal specimens and small pieces of lithics were probably moved along with the sediment during the animal's excavations.

Several large concentrations of fire-cracked rock were present in the excavation area (Figure 7.3). Only one unit, 309N 108E, was void of all cultural material. Over 4700 fragments, weighing 29.9 kg, of fire-cracked rocks were distributed throughout the excavation area. One heavy concentration was east of the southern hearth and a second concentration is present to the southeast of the central hearth. Few fragments of fire-cracked rock were present in the peripheral units of the excavation area. The fire-cracked rock recovered from the Hartley site was predominantly granitic.

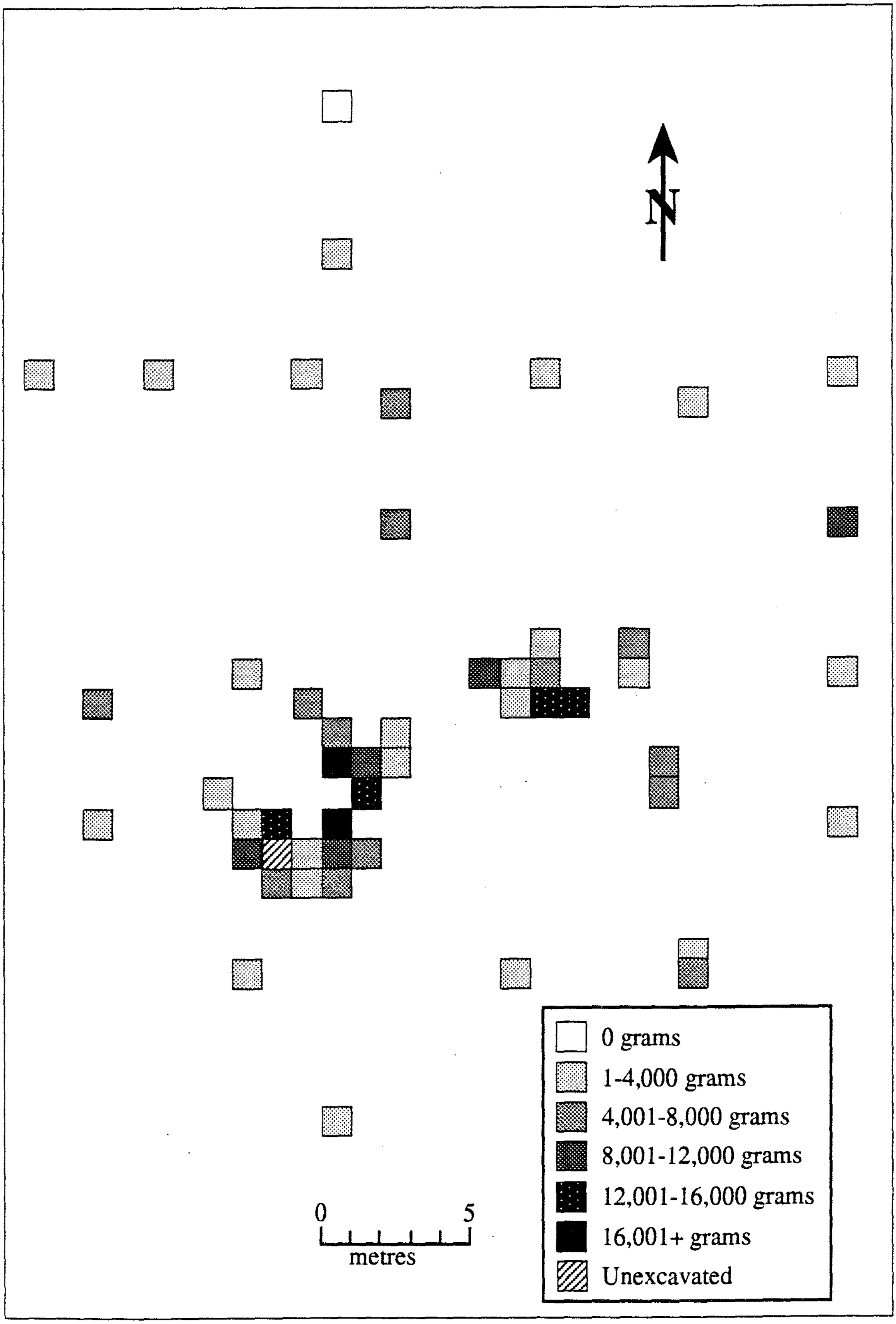

Figure 7.3 Map of the excavation area showing the distribution of fire-cracked rock by weight.

Other igneous and metamorphic rocks were also present in smaller quantities. No stone boiling pits or rock-lined hearths have been identified at the Hartley site. Fire-cracked rock is essentially absent from any of the hearths at the site. The rocks are typically very friable and crumble when handled. This high degree of degradation suggests that the rocks were subjected to long and / or repeated heating.

The pottery is also widely distributed throughout the excavation area (Figure 7.4). One large area of concentration is apparent adjacent to the central hearth. Over 400 sherds, weighing over 500 g, are present in both unit 295N 114E and 294N 115E. Over 300 g of pottery are present in both 294N 100 E and 304N 110E. These sherds include both body and indeterminate sherds as well as several neck and rim sherds. A significant number of the sherds in this area are part of a large, conical Avonlea vessel. The distribution of other neck, rim and shoulder sherds are presented in Figure 7.5. Pottery is poorly represented around the large southern hearth in general and rim, neck and shoulder sherds are conspicuously absent.

Lithic tools comprise a wide variety of complete and fragmentary tool forms. These include 62 projectile points, 3 choppers, 38 miscellaneous bifaces, 60 retouched flakes, 1 spokeshave, 43 endscrapers, 5 sidescrapers, 2 awl/gravers and 9 miscellaneous unifaces. Projectile points are found throughout the excavation area (Figure 7.6). Several units contain four or more points. These units are primarily located near the large southern and central hearths. Other lithic tools are closely associated with the large central and southern hearths (Figure 7.7). Other areas of high concentration are seen in unit 304N 110E, 295N 105E and 290N 100E.

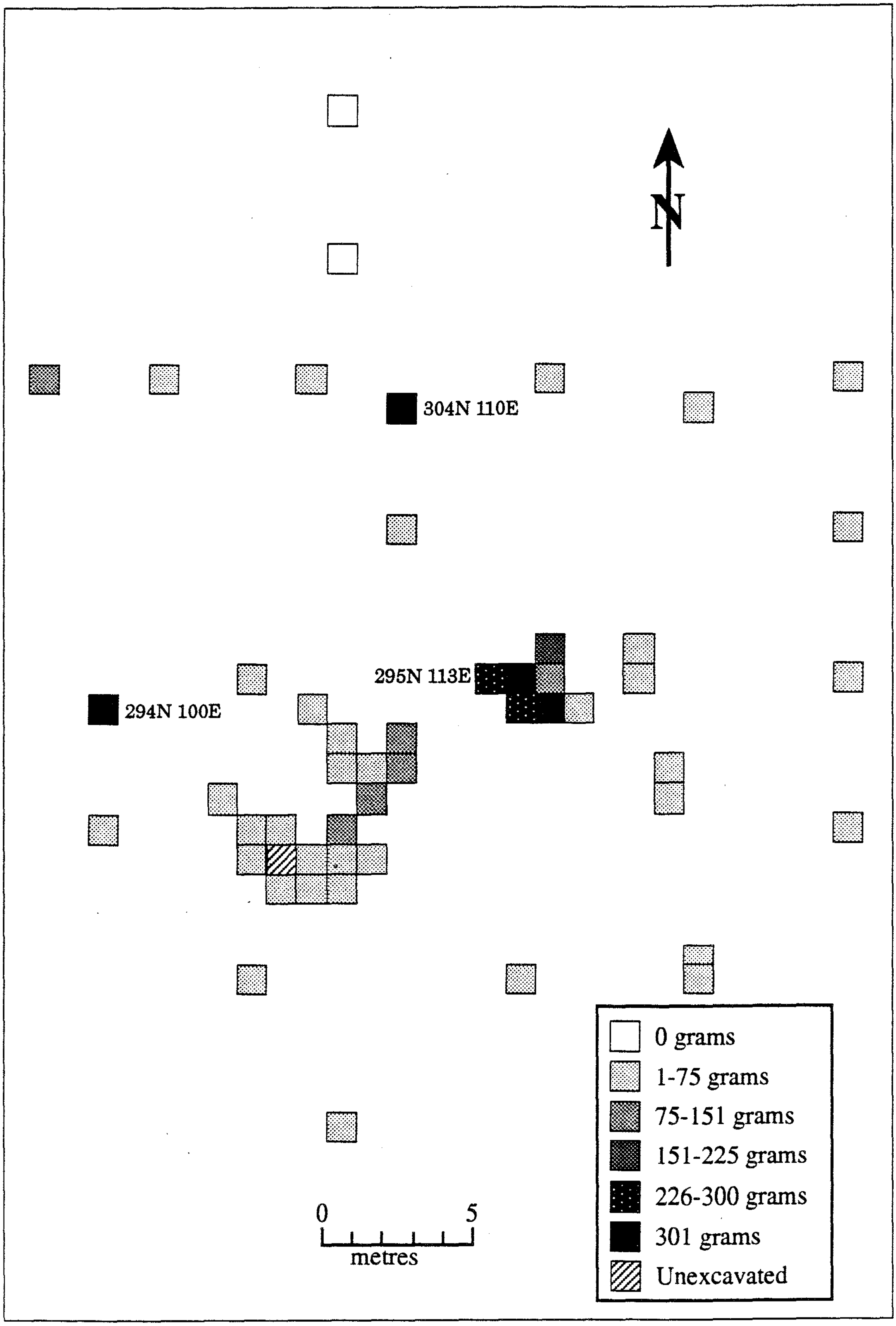

Figure 7.4 Map of excavation area showing the distribution of pottery sherds by weight.

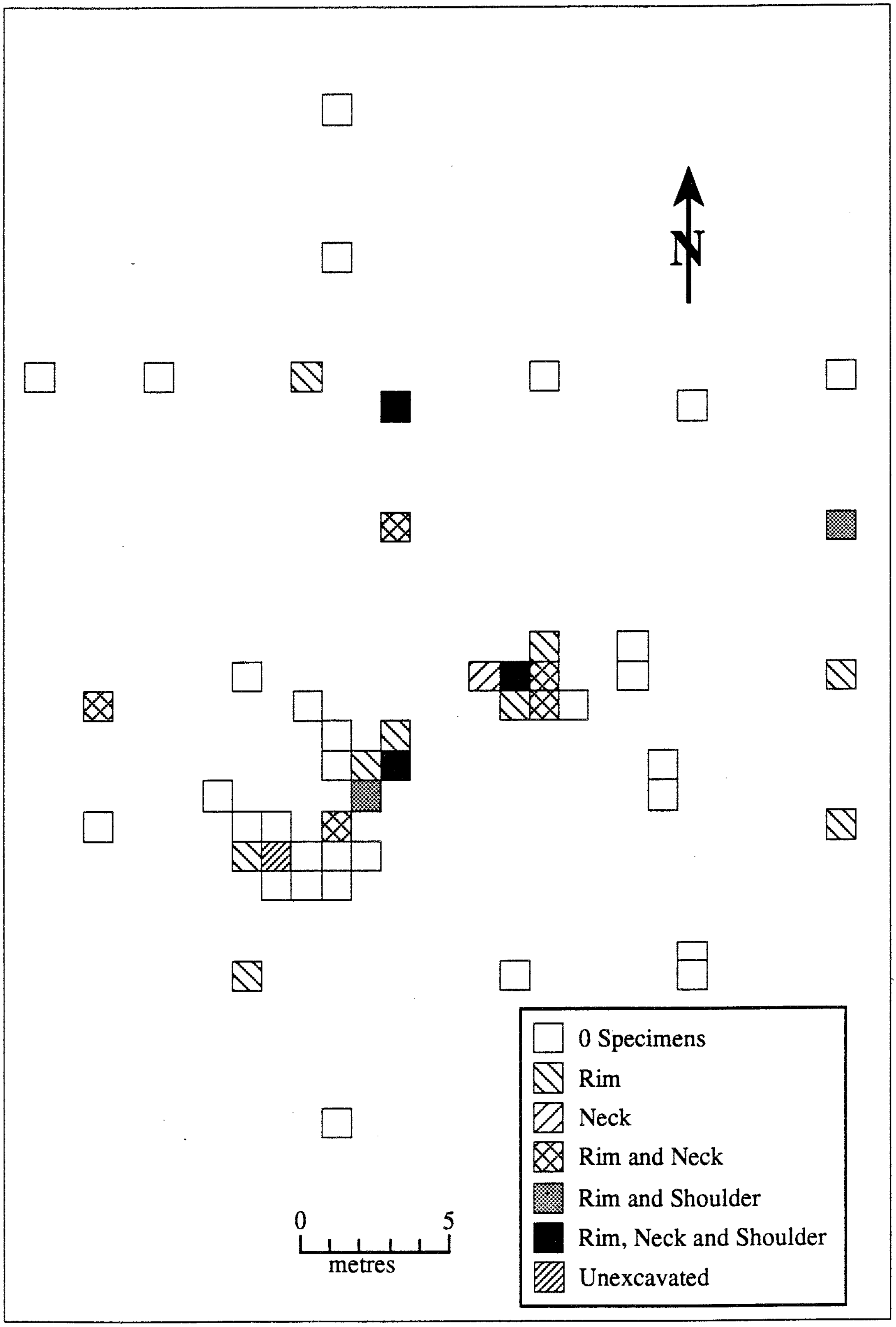

Figure 7.5 Map of the excavtion area showing the distribution of rim, neck and shoulder sherds.

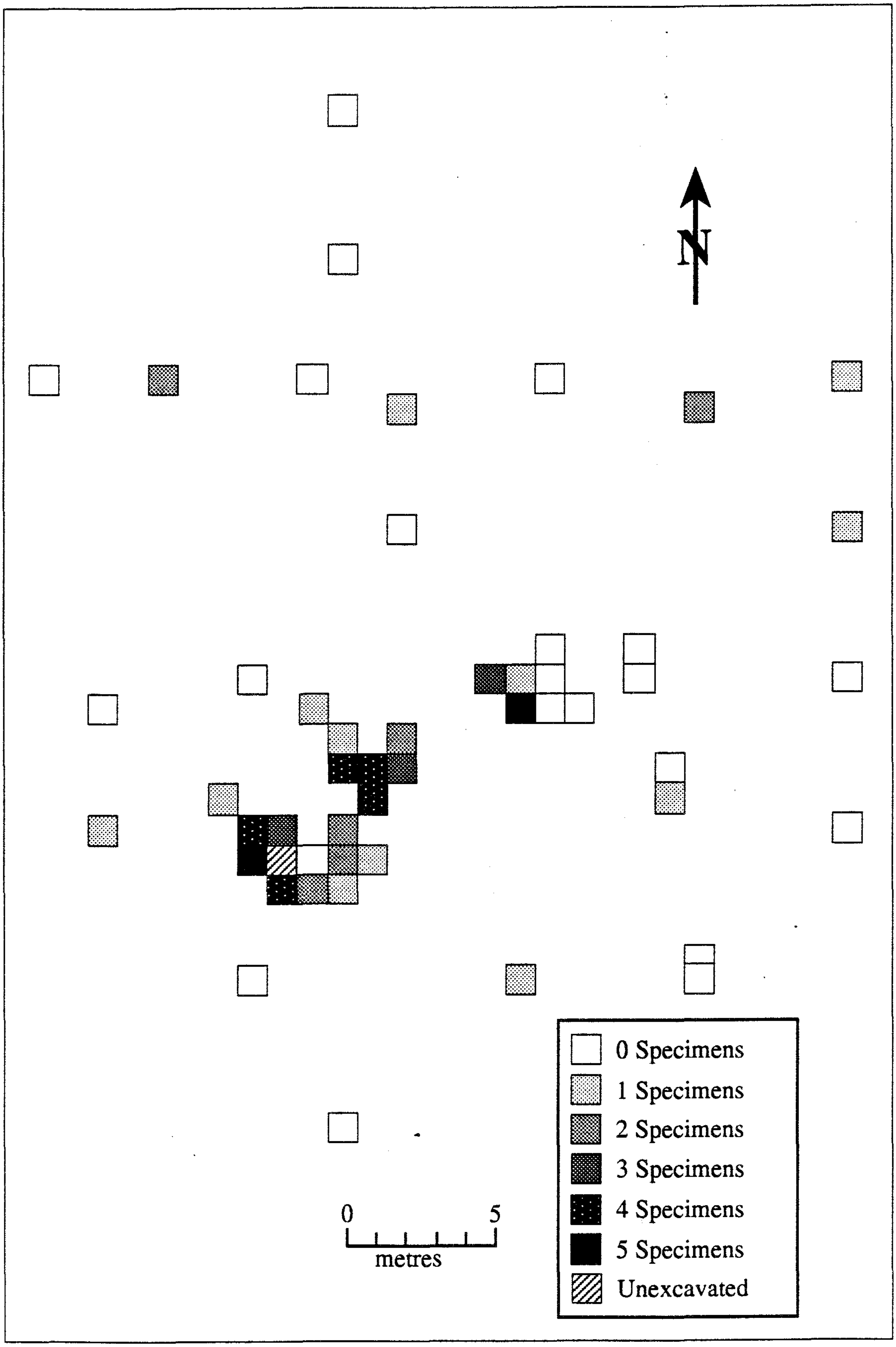

Figure 7.6 Map of the excavation area showing the distribution of projectile points.

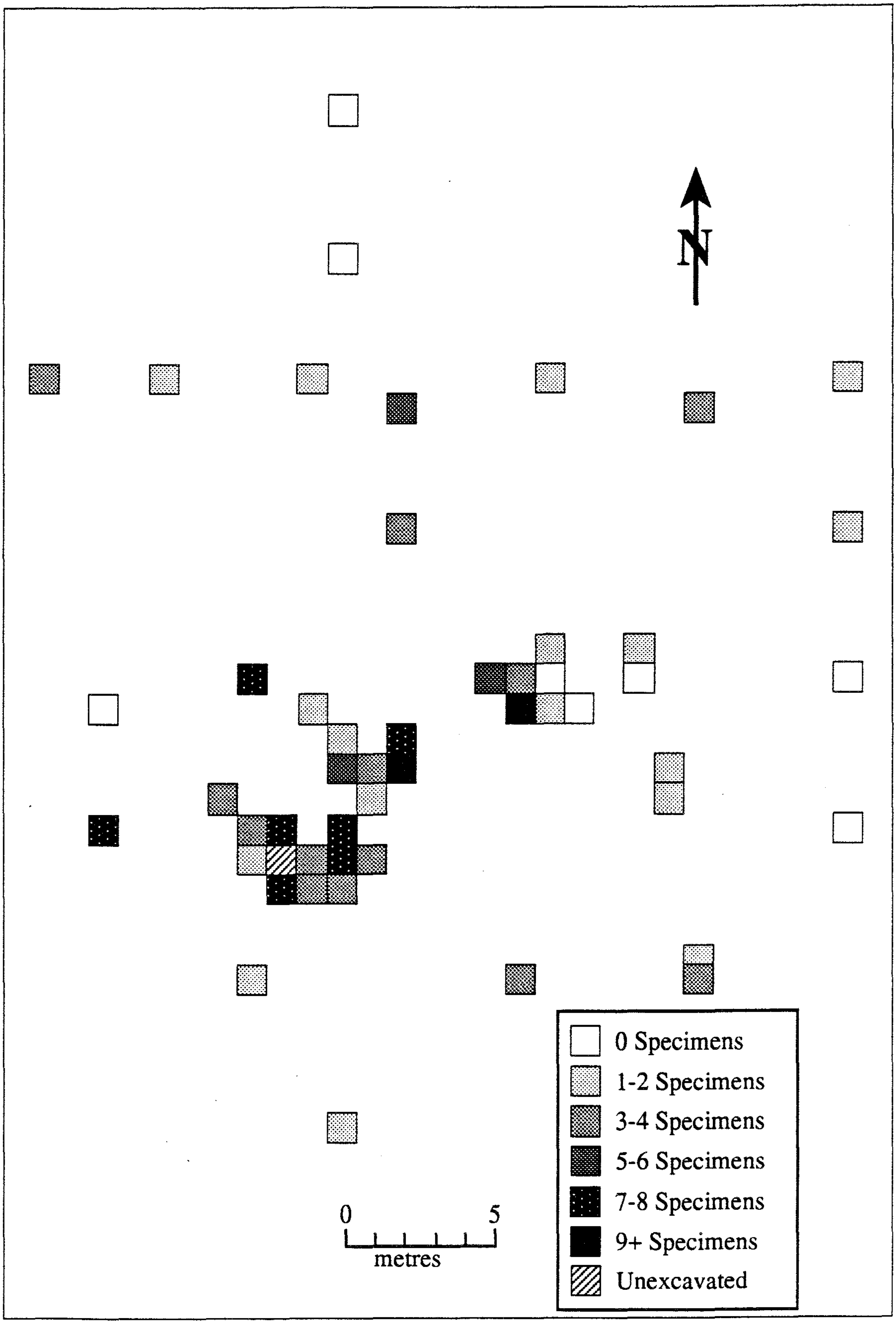

Figure 7.7 Map of the excavation area showing the distribution of lithic tools (excluding projectile points).

Lithic debitage is also wide spread and abundant in the excavation area. The most abundant lithic material (Table 7.1) represented in the flakes and shatter is Swan River chert (1449 pieces) making up 46% of the material. Silicified peat is the second most common lithic material type (1088 pieces) representing 34% of the flakes and shatter.

Table 7.1 Lithic material types for flakes and shatter.

Material	Number	Weight
Swan River chert	1449	1203.1
Silicified peat	1088	756
Miscellaneous Chert	155	75.5
Knife River flint	136	45
Fused Shale	90	76
Quartzite	51	62.8
Basalt	50	106.1
Miscellaneous Chalcedony	41	10.2
Quartz	34	24.7
Silicified Wood	32	24.2
Miscellaneous lithics	19	262.5
Siltstone	11	2.5
Rocky Mountain Quartzite	9	25.3
	3165	2673.9

A total of 18 cores, 39 bipolar cores/pièces esquillées and 3165 flakes and pieces of shatter are present in the assemblage. Cores and pièces esquillées are distributed throughout the excavated area and tend to be composed of the same general lithic material types as the flakes and shatter (Figure 7.8 and 7.9). There are relatively few cores and pièces esquillées present in the peripheral units. Most of these artifacts are closely related to the two main hearths. Lithic flakes and shatter are also associated with the hearth areas although other areas of concentration are present (Figure 7.10). Unit 304N 110E has a large concentration of flakes and shatter which is not

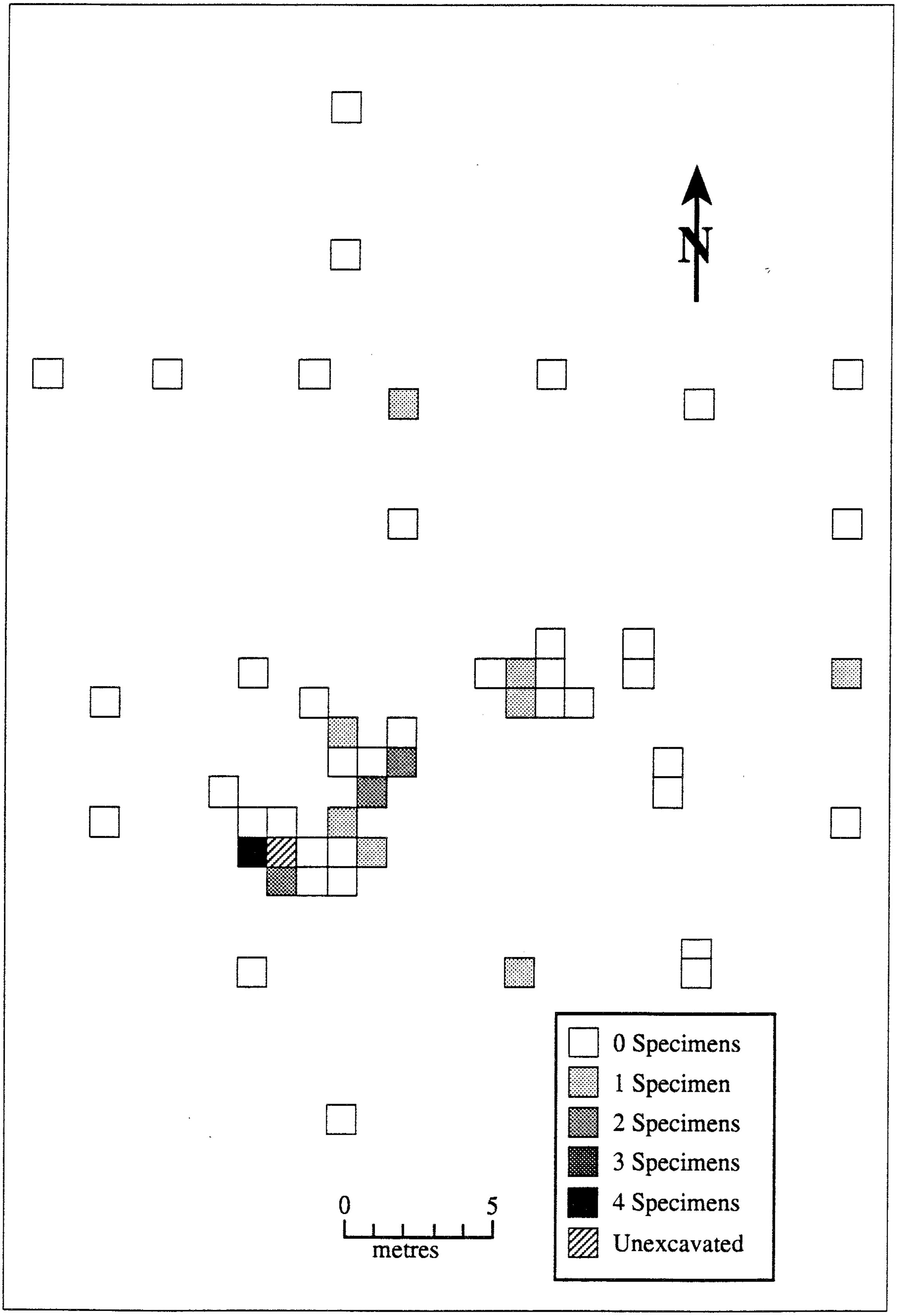

Figure 7.8 Map of the excavation area showing the distribution of cores (excluding bipolar cores / pièces esquillées).

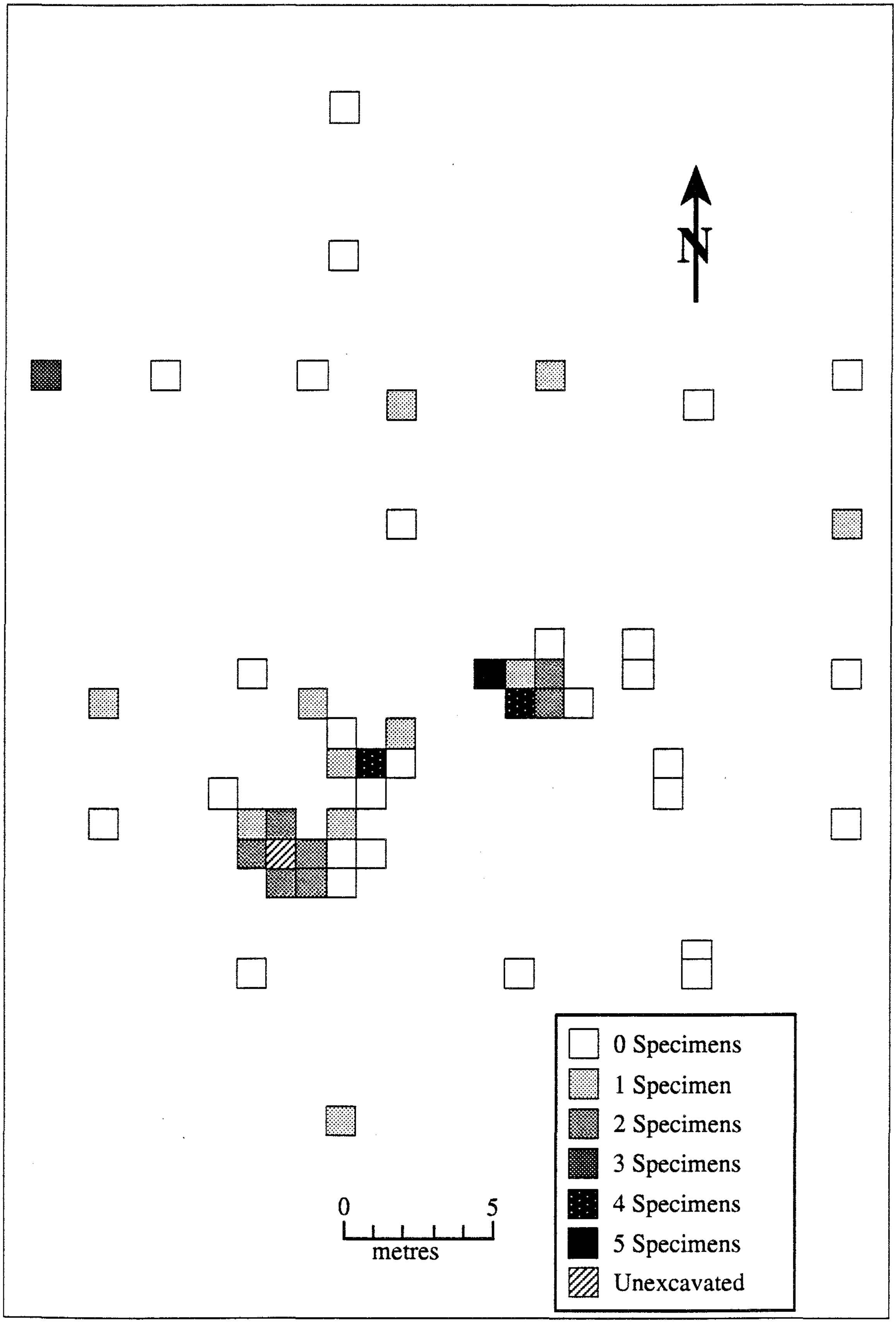

Figure 7.9 Map of the excavation area showing the distribution of bipolar cores / pièces esquillées.

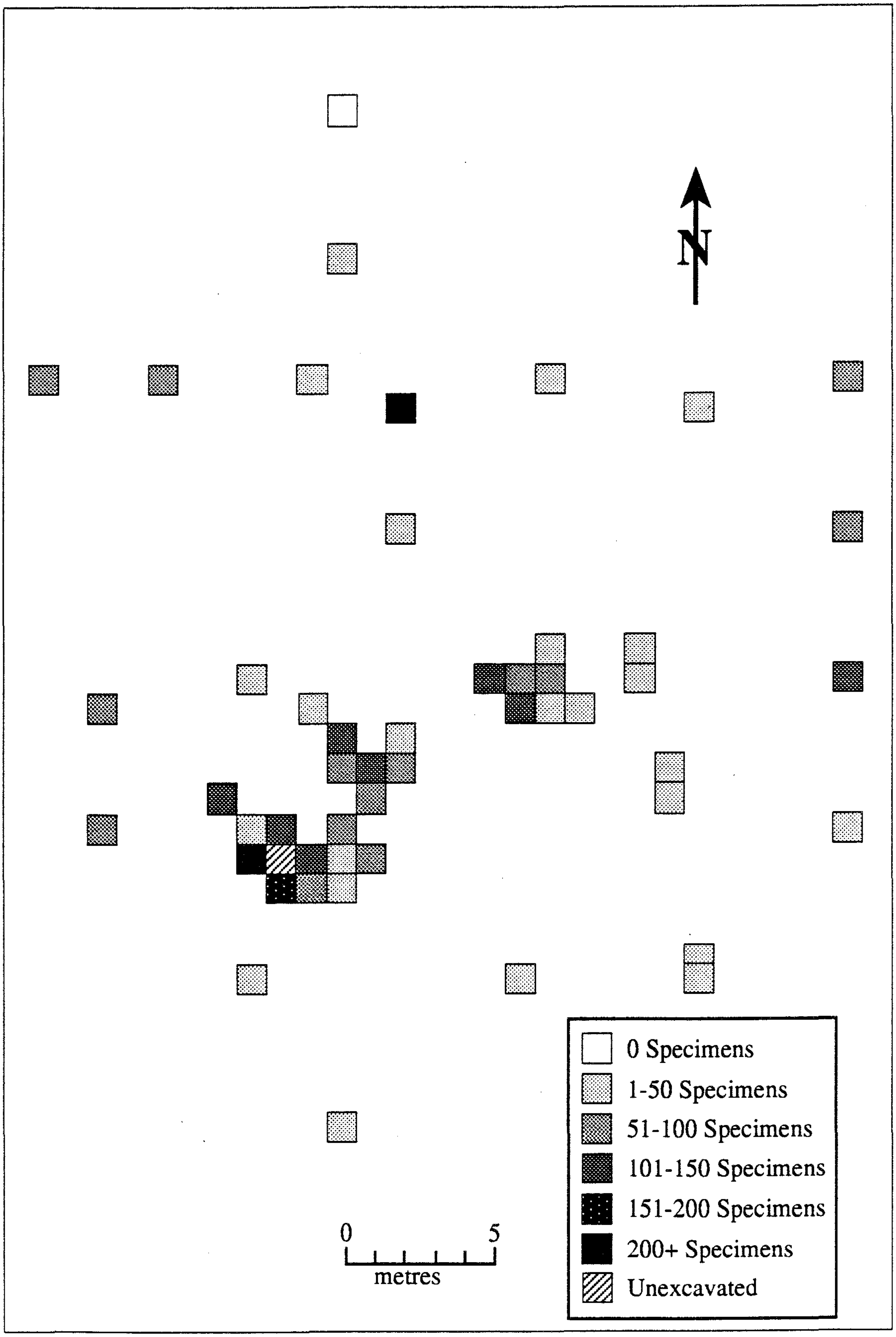

Figure 7.10 Map of the excavation area showing the distribution of flakes and shatter.

associated with any known features although one may be nearby but is yet to be excavated. This northern portion of the excavation area is otherwise quite low in other artifacts and faunal specimens.

7.3.2 Distribution of Faunal Specimens

The faunal remains tend to be clustered to the south and the east of the hearth areas. Expressed graphically (Figure 7.11), the entire faunal assemblage is most concentrated to the south and east of the large hearth in the southern part of the excavation area. A slightly lower concentration is clustered next to the other two hearths. Little difference is visible in the distribution of burned and unburned specimens (Figure 7.12 and 7.13). The distribution of these are generally associated with the two hearths in the central and southern areas of the excavation area. The distribution of the faunal assemblage is essentially a reflection of the bison remains. The size difference between bison and the other fauna at the site as well as the dominance in relative abundance makes the distribution of faunal remains overly biased towards bison.

Bison are found throughout the site and are present in all units which contained cultural materials (Figures 7.14 and 7.15). Based on frequency counts, the density of bison specimens is greatest in the southern portion of the excavation area, to the south and east of the hearth. A second, less dense concentration is located east of the central hearth. These two areas of concentration are also reflected in the weight distribution of bison specimens (Figure 7.15). In contrast, unit 300N 125E contains relatively few specimens although the weight is quite high. These specimens may reflect a third minor area of concentration south and east of the third hearth in which relatively complete elements are present.

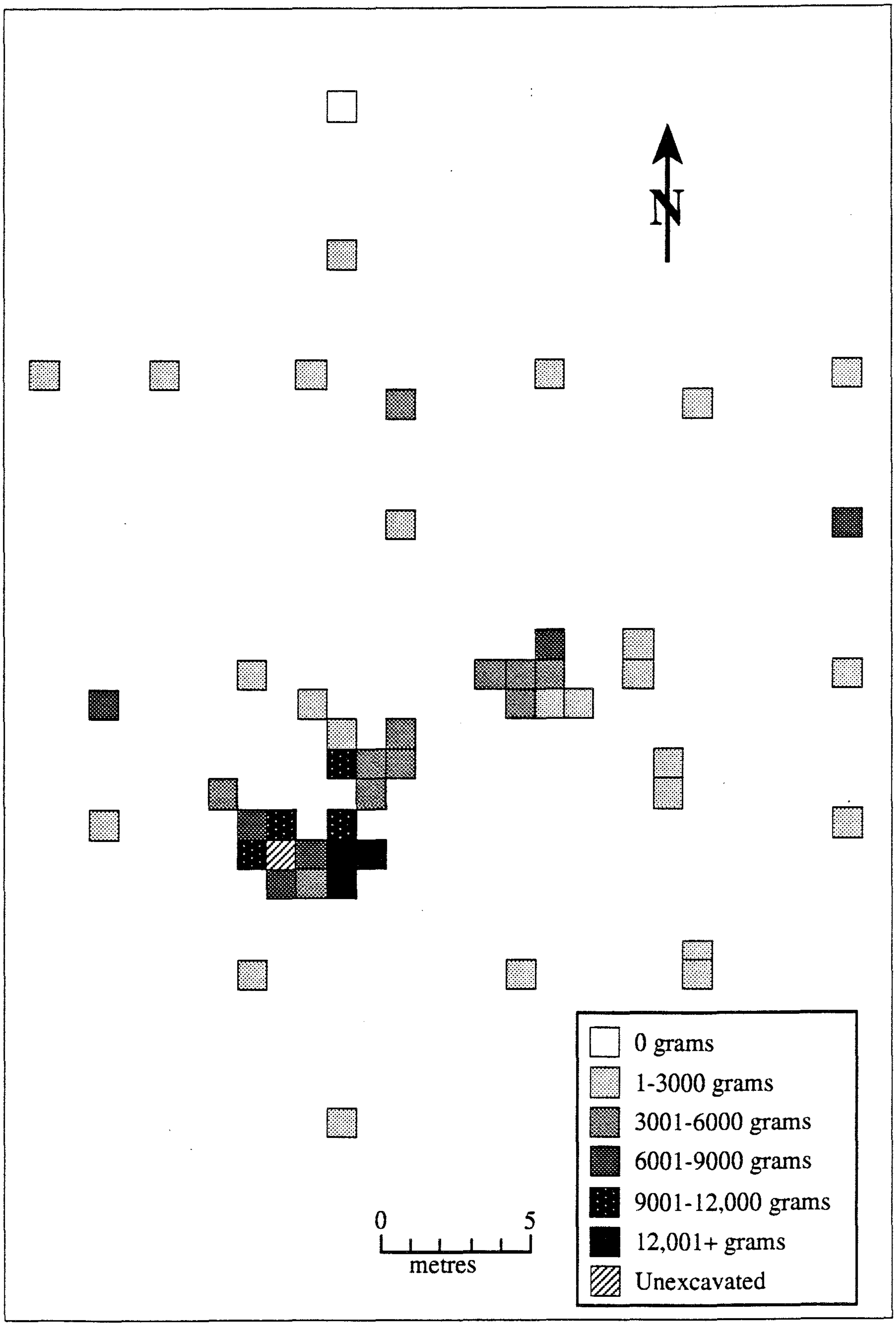

Figure 7.11 Map of the excavation area showing the distribution of the total faunal assemblage by weight.

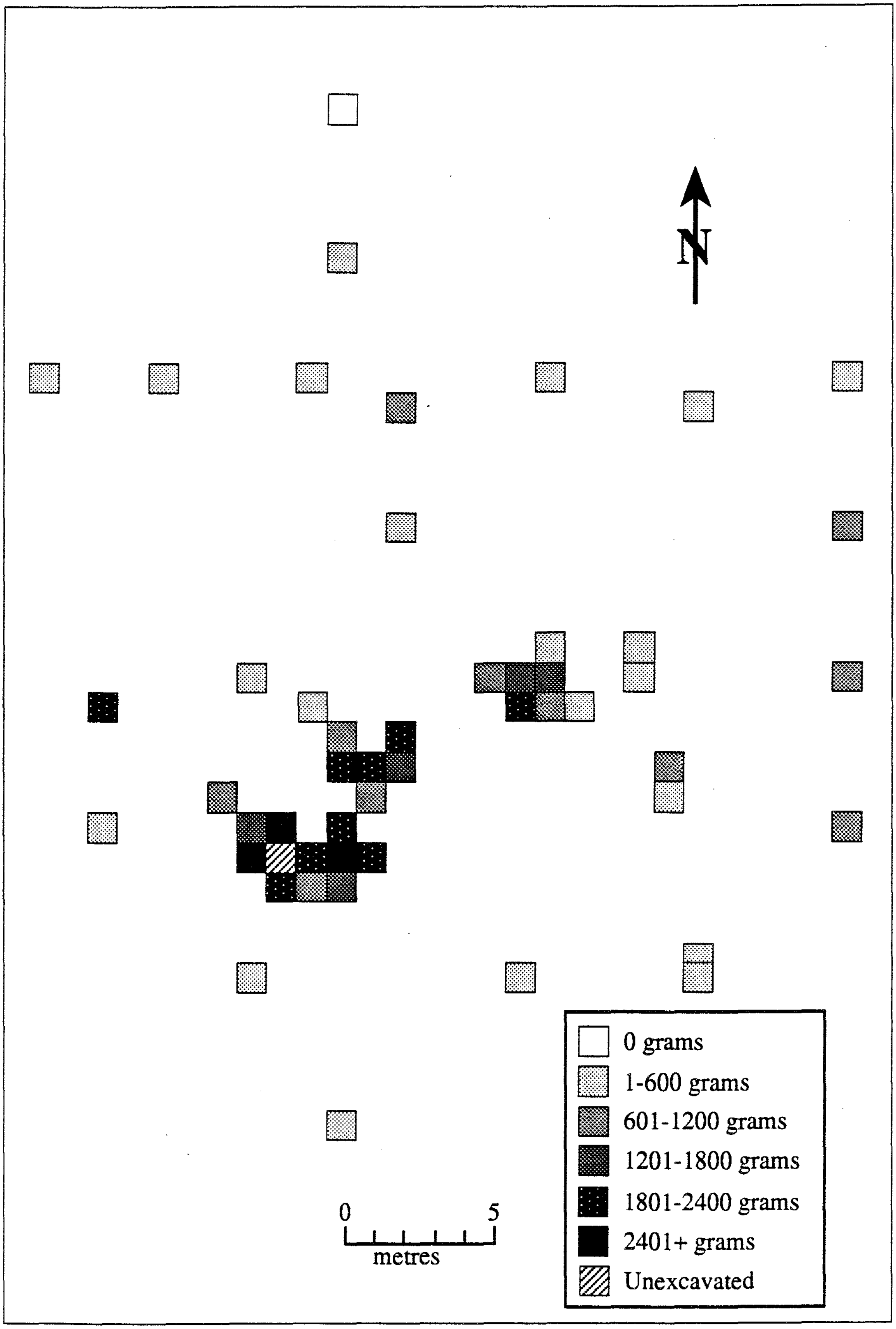

Figure 7.12 Map of the excavation area showing the distribution of burned faunal portions by weight.

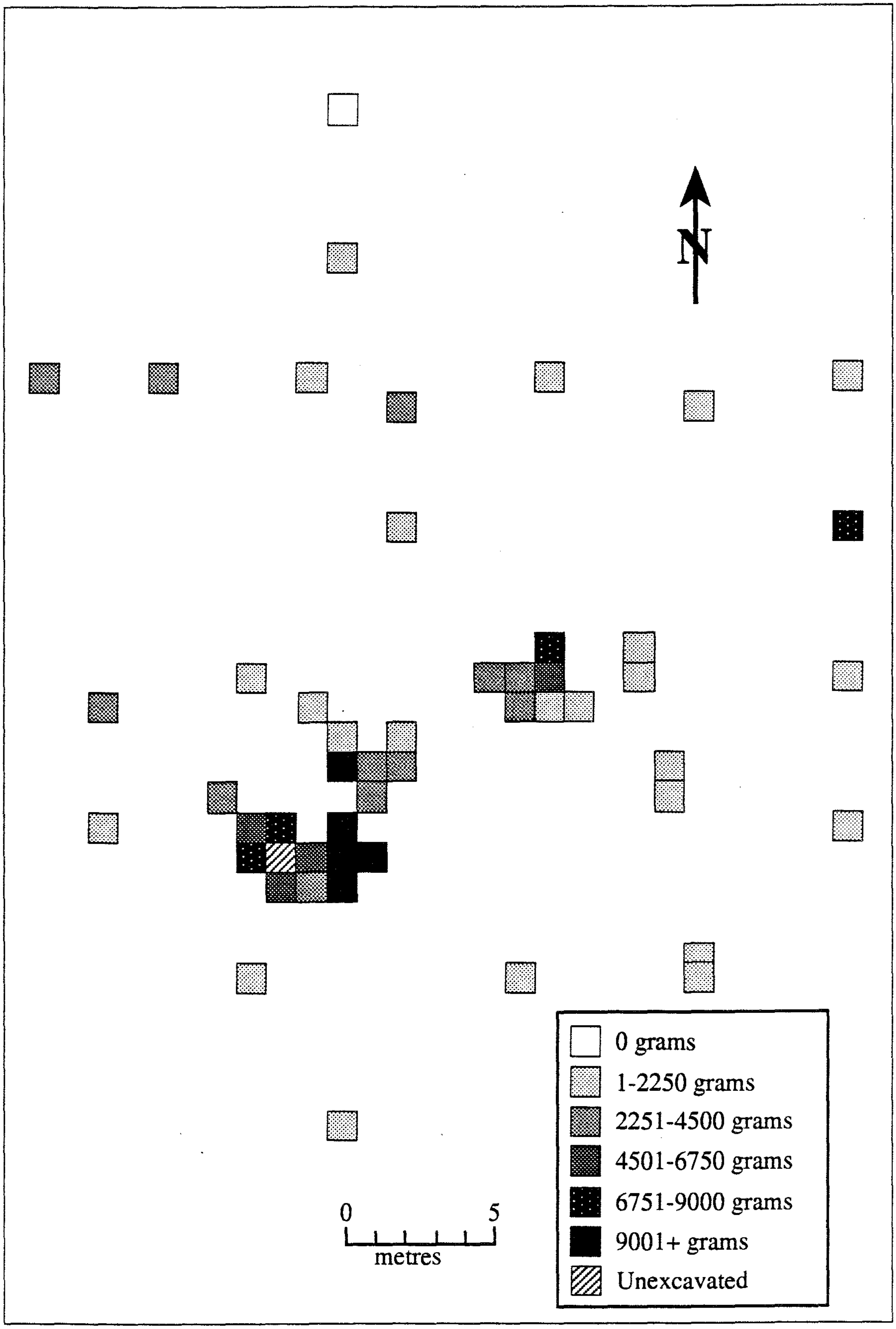

Figure 7.13 Map of the excavation area showing the distribution of unburned faunal portions by weight.

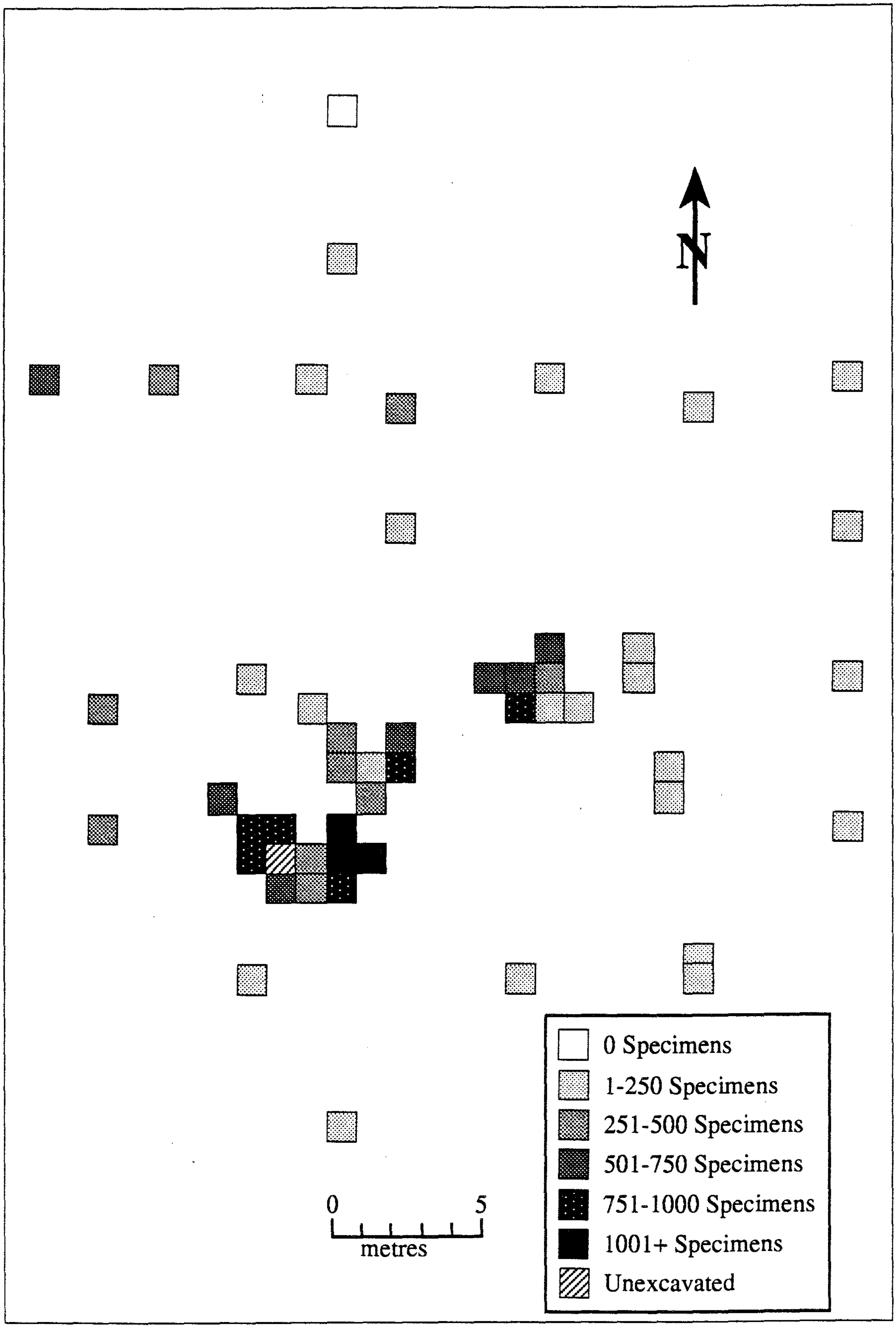

Figure 7.14 Map of the excavation area showing the distribution of bison specimens by frequency.

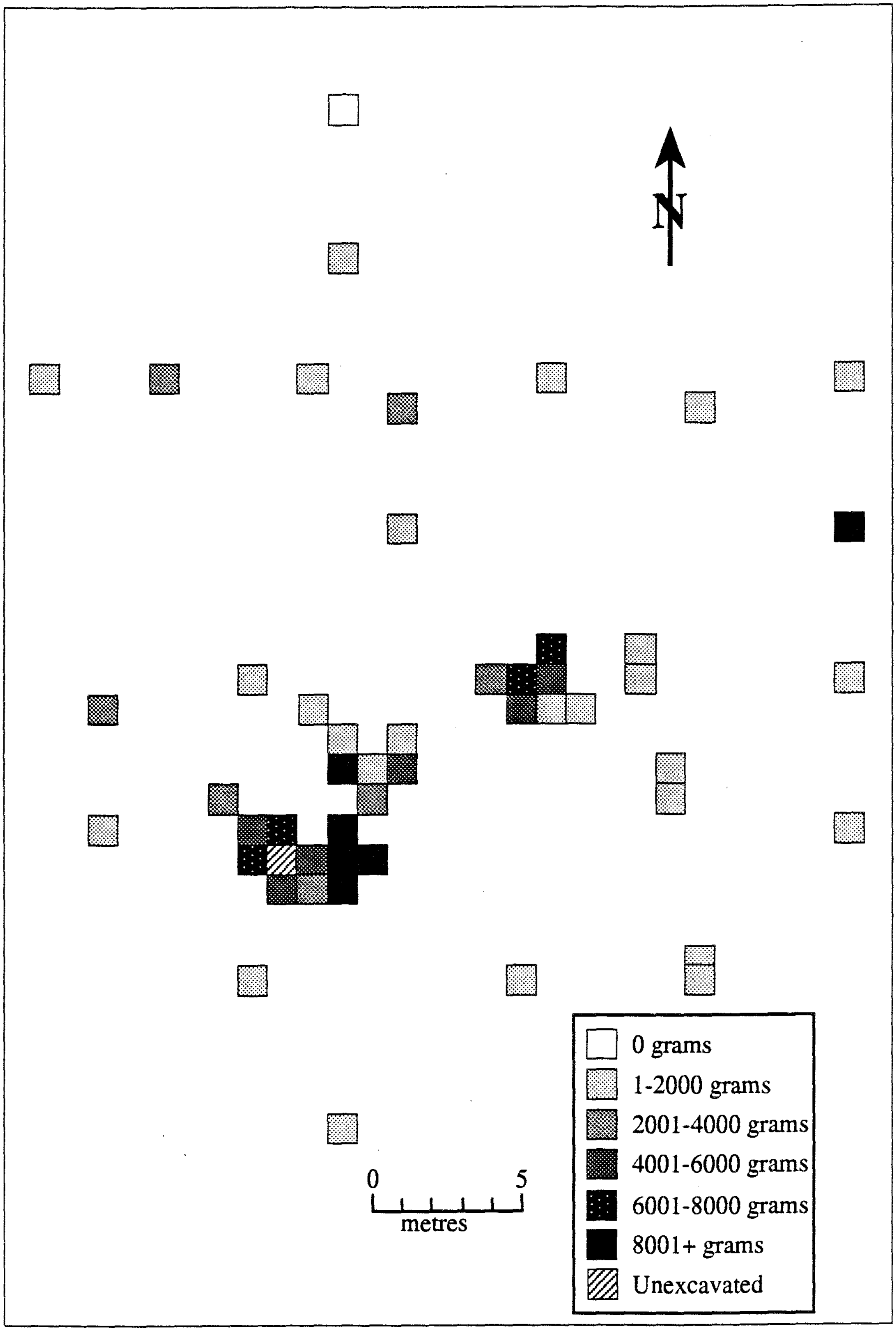

Figure 7.15 Map of the excavation area showing the distribution of bison specimens by weight.

Axial elements (Figure 7.16) are also widely distributed throughout the excavation area. The area south and east of the southern hearth again contains the densest concentration of material. Articulated and near articulated elements are present in the areas adjacent to the southern and central hearths. A partial series of articulated cervical and thoracic vertebrae are present in unit 288N 106E. The few thoracic vertebrae present still have rib heads in articulation. It appears that the ribs were broken just below the tubercle rather than being separated from the vertebrae by disarticulation. Very few ribs at the site have much of the body below the tubercle. Large portions of rib bodies are present, but these are rarely complete with a head and tubercle. A small series of three articulated lumbar vertebrae is present in unit 300N 125E. The long vertebral processes are broken off close to the body of the vertebra. This is interpreted as a relic of butchering as well. Several other small sections of articulated or nearly articulated vertebrae have been encountered in units after 1990. These articulated units are present in units close to the two main hearths.

Appendicular specimens are also concentrated around the southern hearth (Figures 7.17 and 7.18). A high weight value is present in units 300N 125E and 292N 108E due to a high proportion of complete or nearly complete appendicular elements. There appears to be little difference in the distribution of forelimb and hindlimb elements (Figure 7.17 and 7.18). Articulated appendicular units are also present in the assemblage. These units typically consist of articulated or near articulated phalanges and other elements of low value. One articulated distal humerus and proximal radius/ulna was located southeast of the southern hearth in unit 289N 108E. The opposing ends of the long bones are broken off just below the articulated epiphyses, presumably for

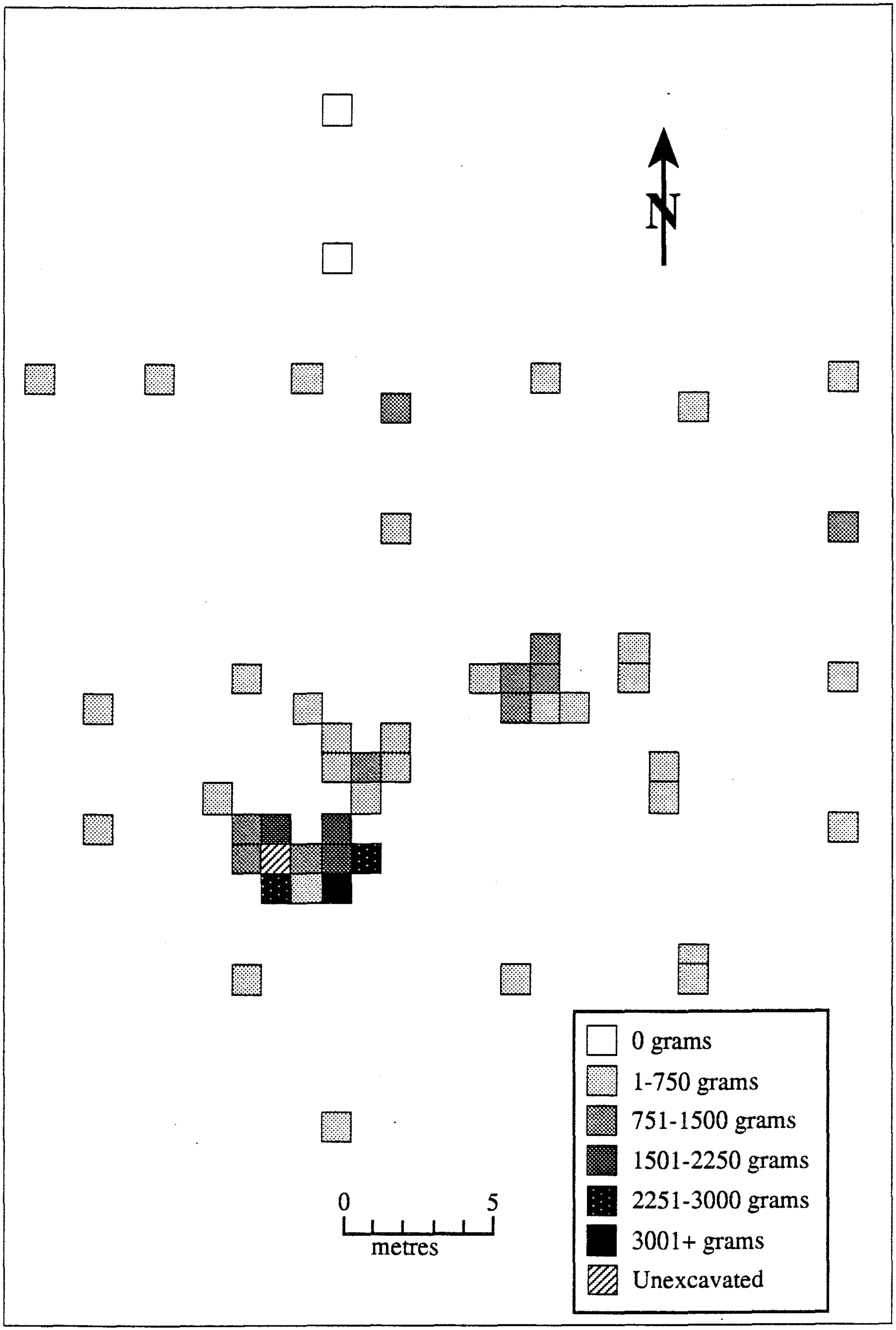

Figure 7.16 Map of the excavation area showing the distribution of bison axial specimens by weight.

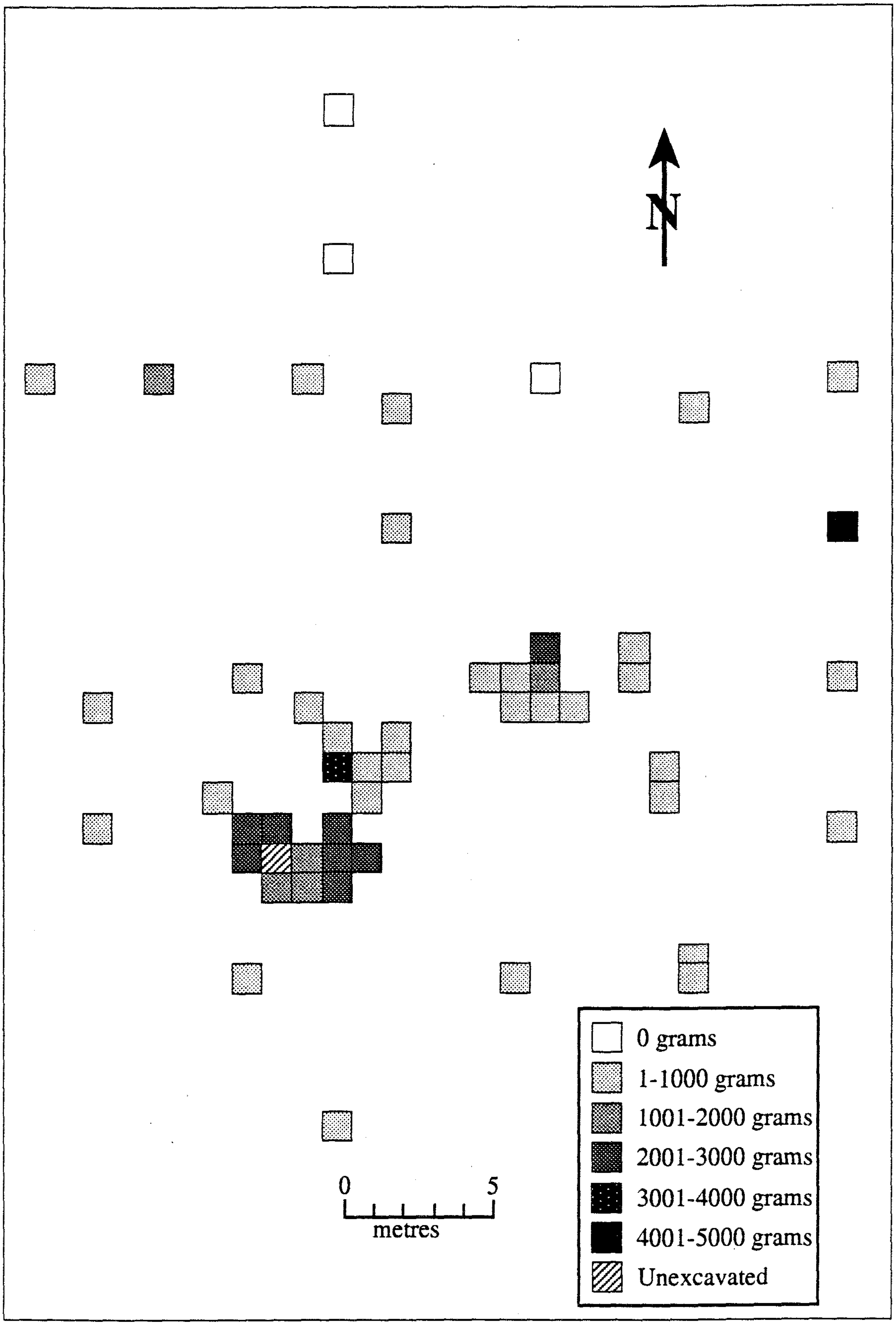

Figure 7.17 Map of the excavation area showing the distribution of bison forelimb elements by weight.

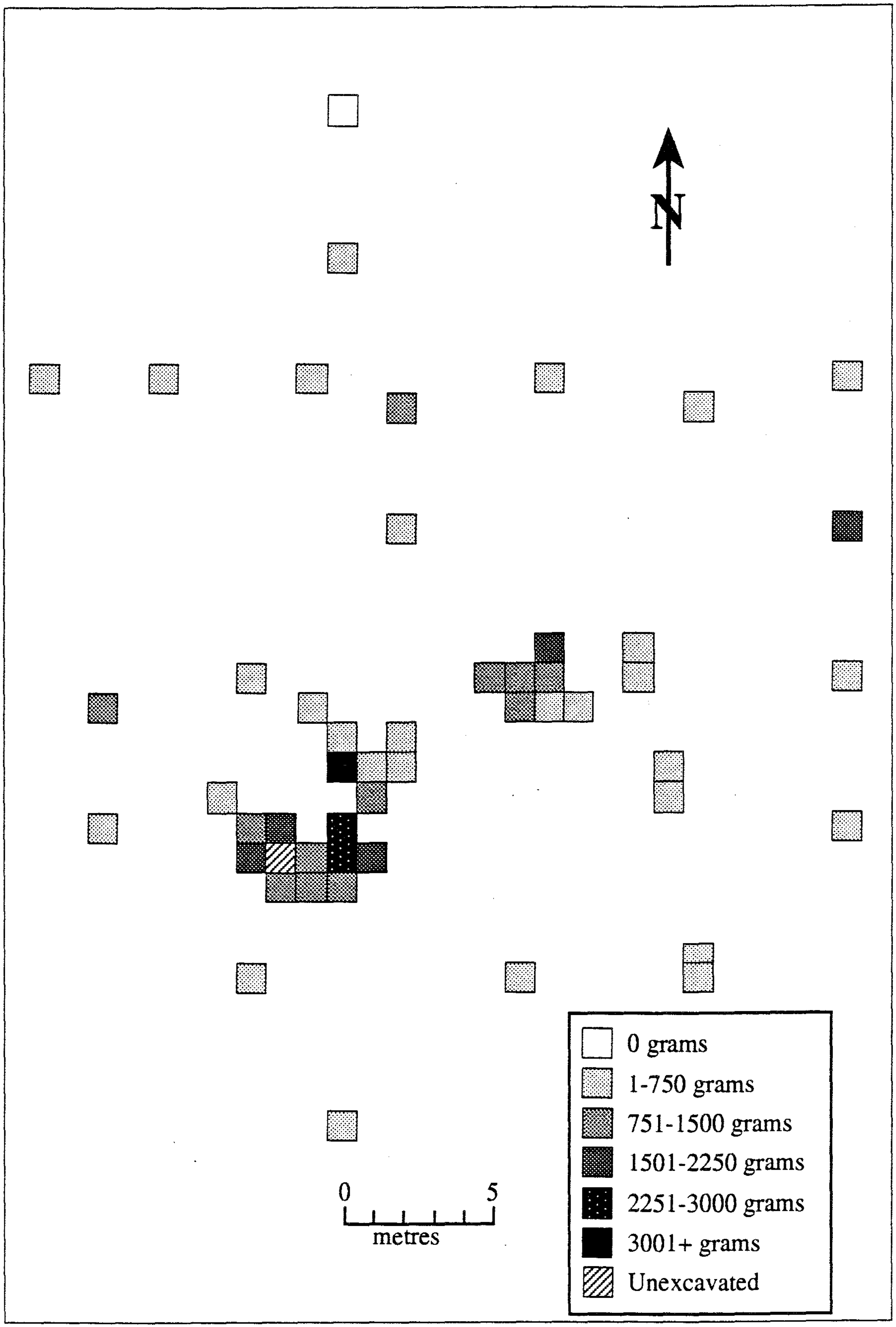

Figure 7.18 Map of the excavation area showing the distribution of bison hindlimb specimens by weight.

marrow extraction. One left adult pathologic calcaneus is present in unit 288N 108E (Figure 7.19). The tuber calcis is badly damaged and has healed in a large disfigured knob of sclerotic bone. The animal was likely lame due to this injury. It is not possible to determine the nature of this injury for certain, but it may be due to a wolf attack. Wolves occasionally attack large game by grabbing the Achilles' tendon (Banfield 1987). Foetal elements are concentrated primarily in the southern portion of the excavation area although a lesser concentration is present adjacent to the central hearth (Figure 7.20).

Figure 7.19 Pathologic bison calcaneus.

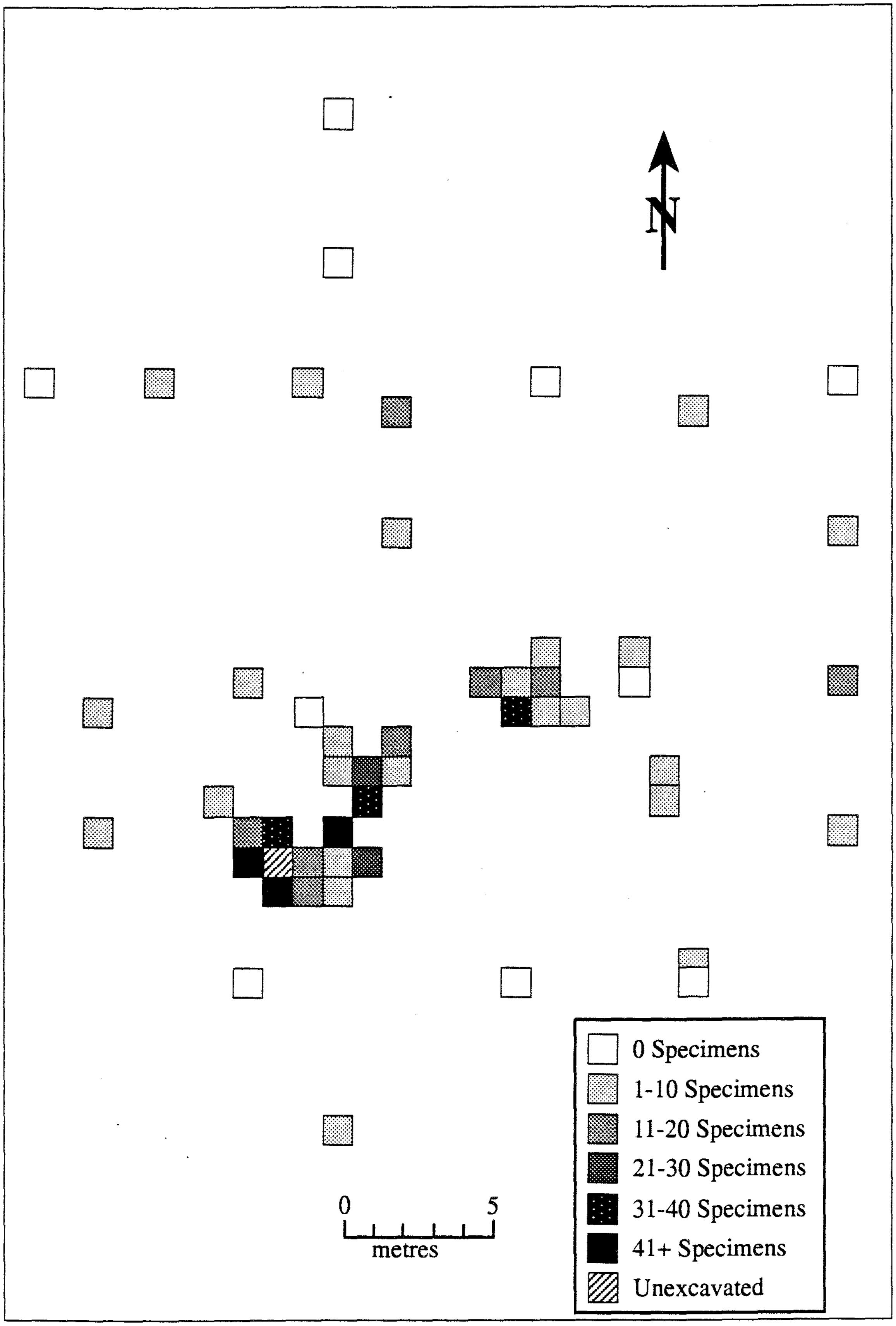

Figure 7.20 Map of the excavation area showing the distribution of foetal bison specimens.

The other fauna are also distributed throughout the entire excavation area. Bird specimens are distributed widely throughout the area (Figure 7.21). Thirty-five specimens are present in unit 292N 119E. These specimens are all from one Green-winged Teal (*Anas crecca carolinensis*) individual. Other small concentration areas are found adjacent to the central and southern hearths. The rabbit specimens are also concentrated around the two central hearths (Figure 7.22). A few specimens are also distributed in the northern and eastern units. The small number of leporid specimens present in the assemblage precludes any detailed discussions of the distribution of these specimens. *Vulpes* elements are quite concentrated in their distribution (Figure 7.23). Most of the elements are located in units adjacent to the southern hearth in the large faunal midden. No specimens are present in the northern units and very few are located in any of the peripheral units. Larger canids are most concentrated in the units adjacent to the central hearth (Figure 7.24). Smaller numbers of specimens are loosely spread throughout the excavation area. The two Badger (*Taxidea taxus*) elements are separated by over ten metres. One is a part of the material in unit 290N 105E and the other is from unit 294N 114E. Other unidentifiable medium mammals are distributed throughout the site (Figure 7.25). The majority are again concentrated near the hearths.

Small mammals, including the ground squirrels and the pocket gopher elements, are found throughout the excavated area (Figure 7.26). There is a slight concentration of specimens near the southern and central hearths. Interpretation of the distribution of small and micro-fauna is tentative based on the recovery rates of 6 mm mesh screening. A large number of specimens are present in unit 290N 109E. The concentration of specimens in this unit reflects the collection of a fine screen sample. The recovery of forty-seven

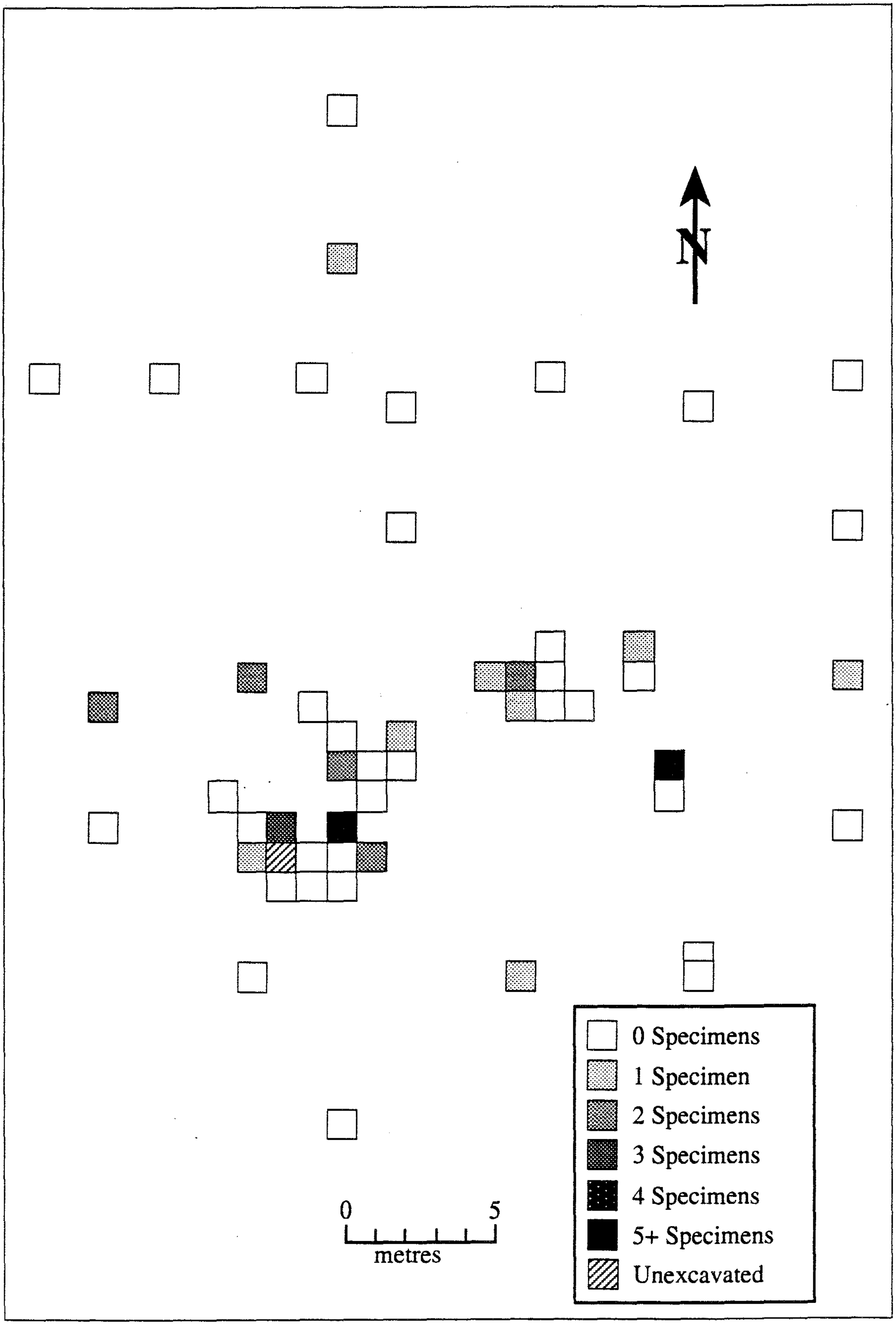

Figure 7.21 Map of the excavation area showing the distribution of avian specimens.

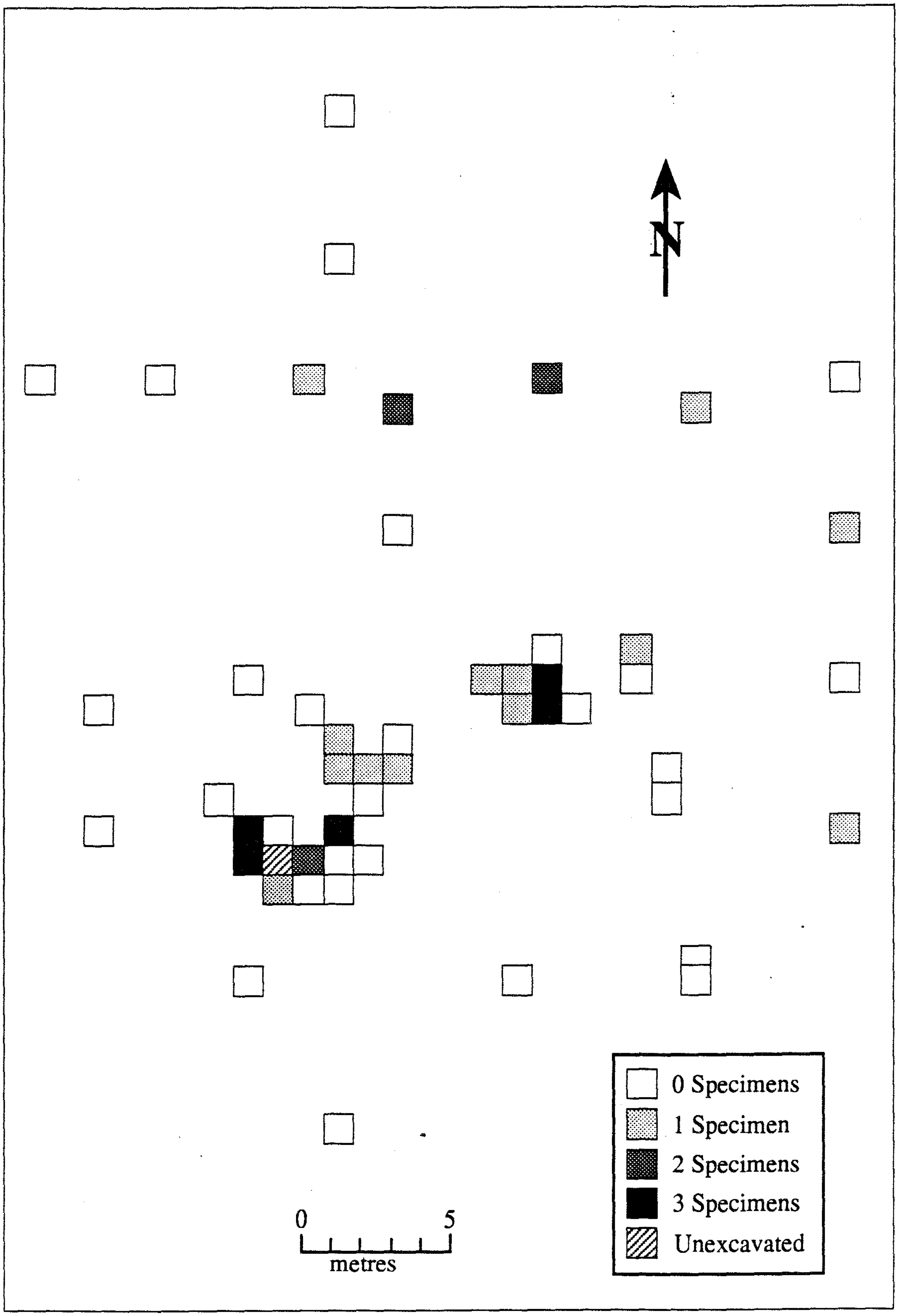

Figure 7.22 Map of the excavation area showing the distribution of the leporid specimens.

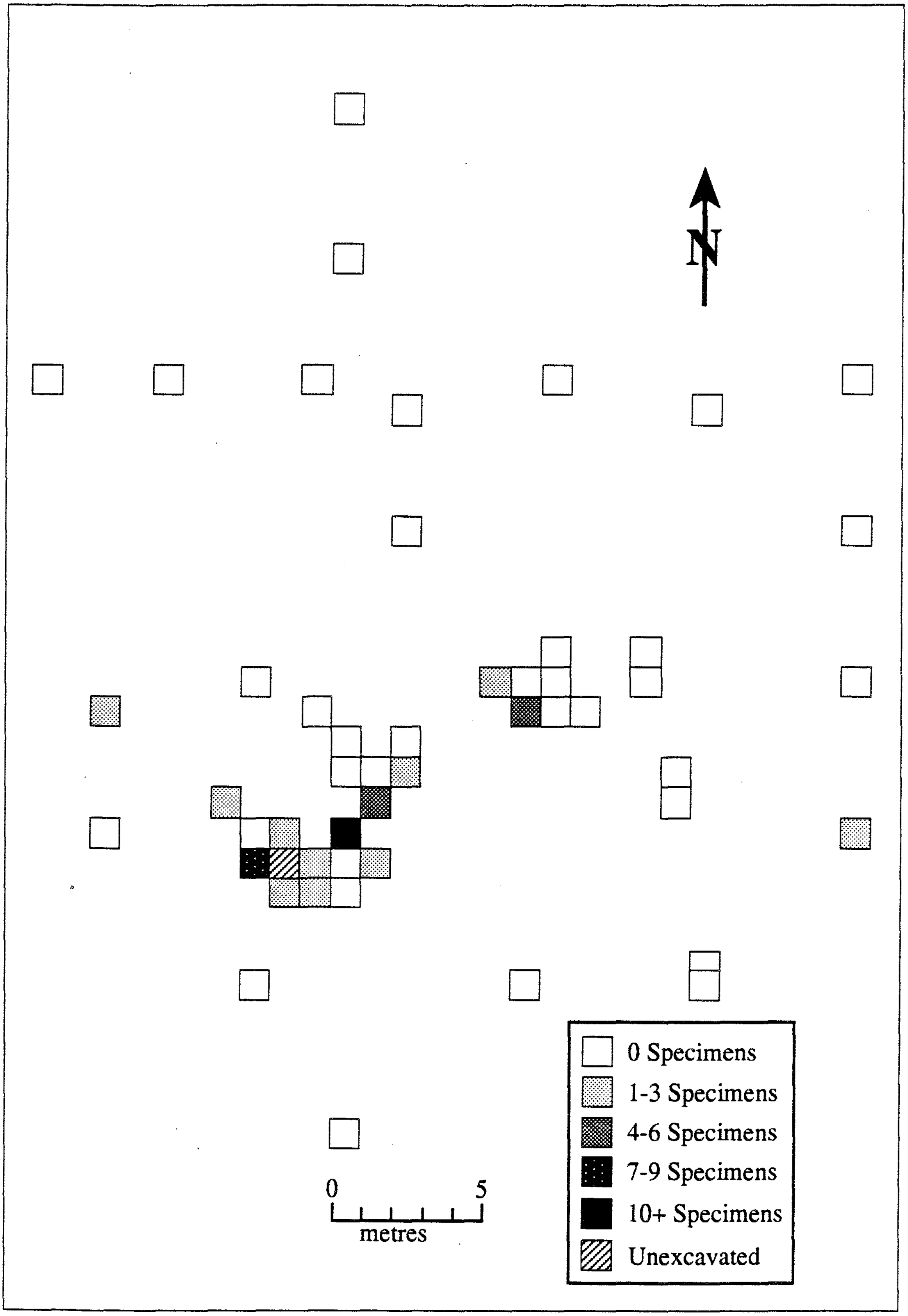

Figure 7.23 Map of the excavation area showing the distribution of fox specimens.

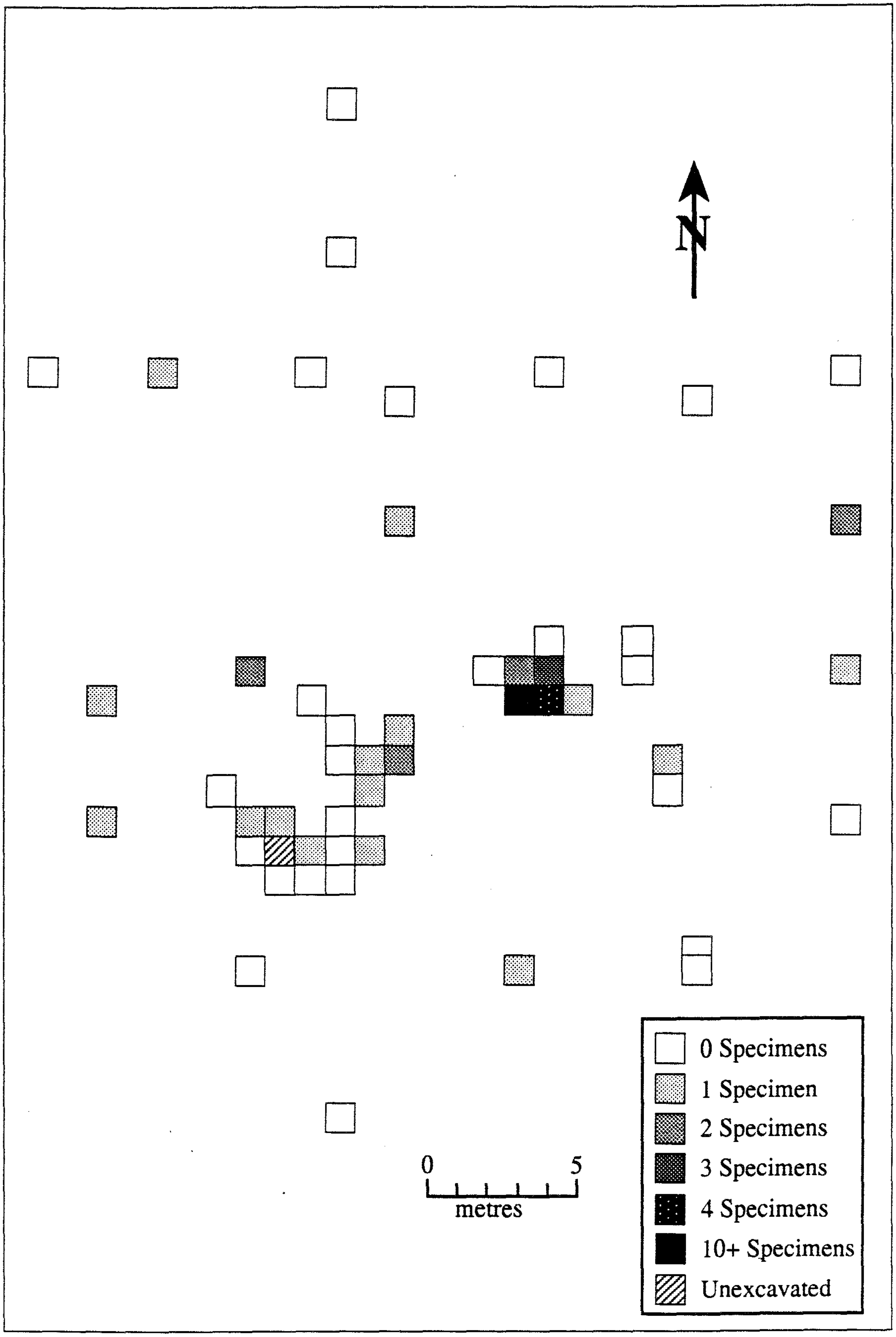

Figure 7.24 Map of the excavtion area showing the frequency of canid specimens.

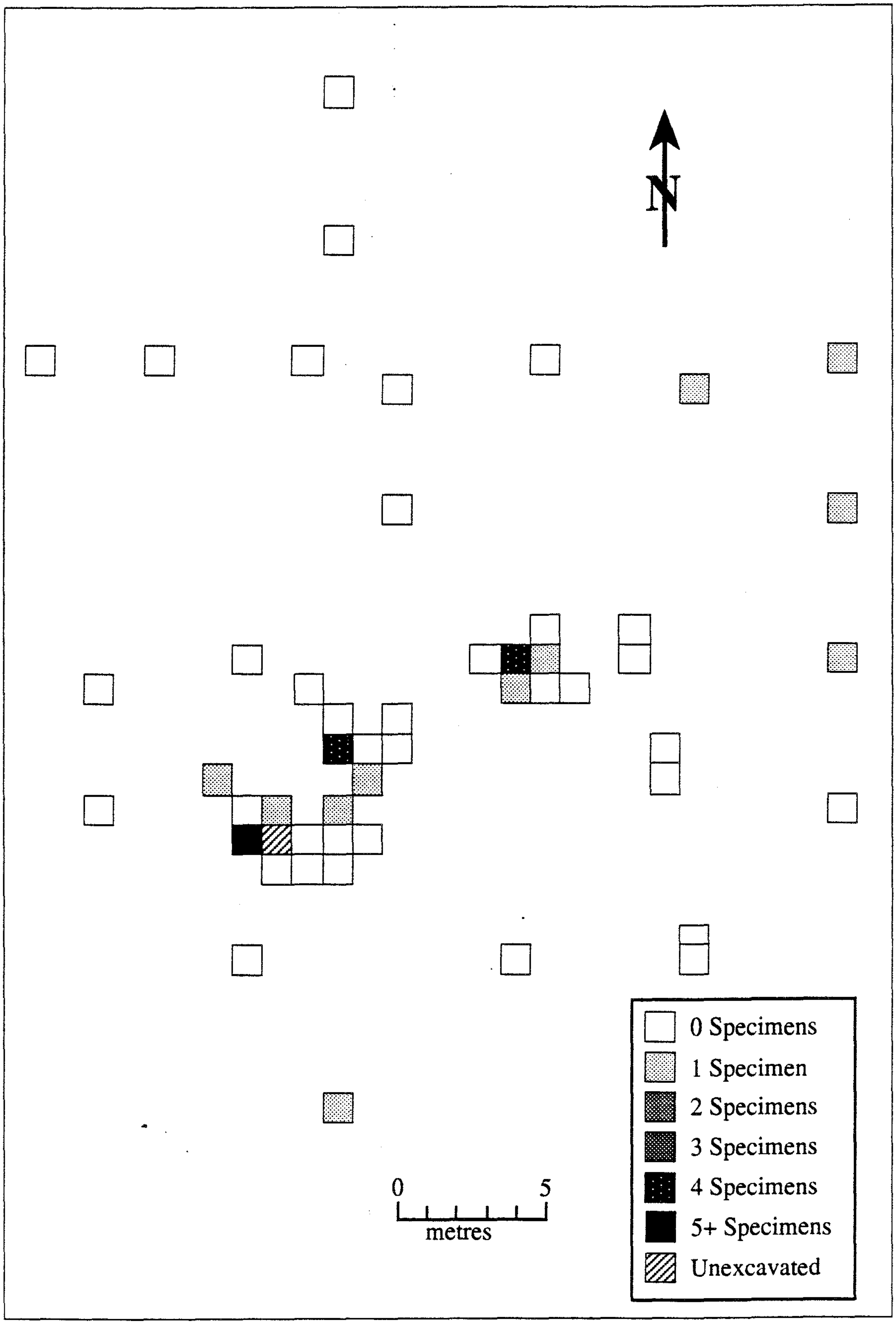

Figure 7.25 Map of the excavation area showing the distribution of the medium mammal specimens.

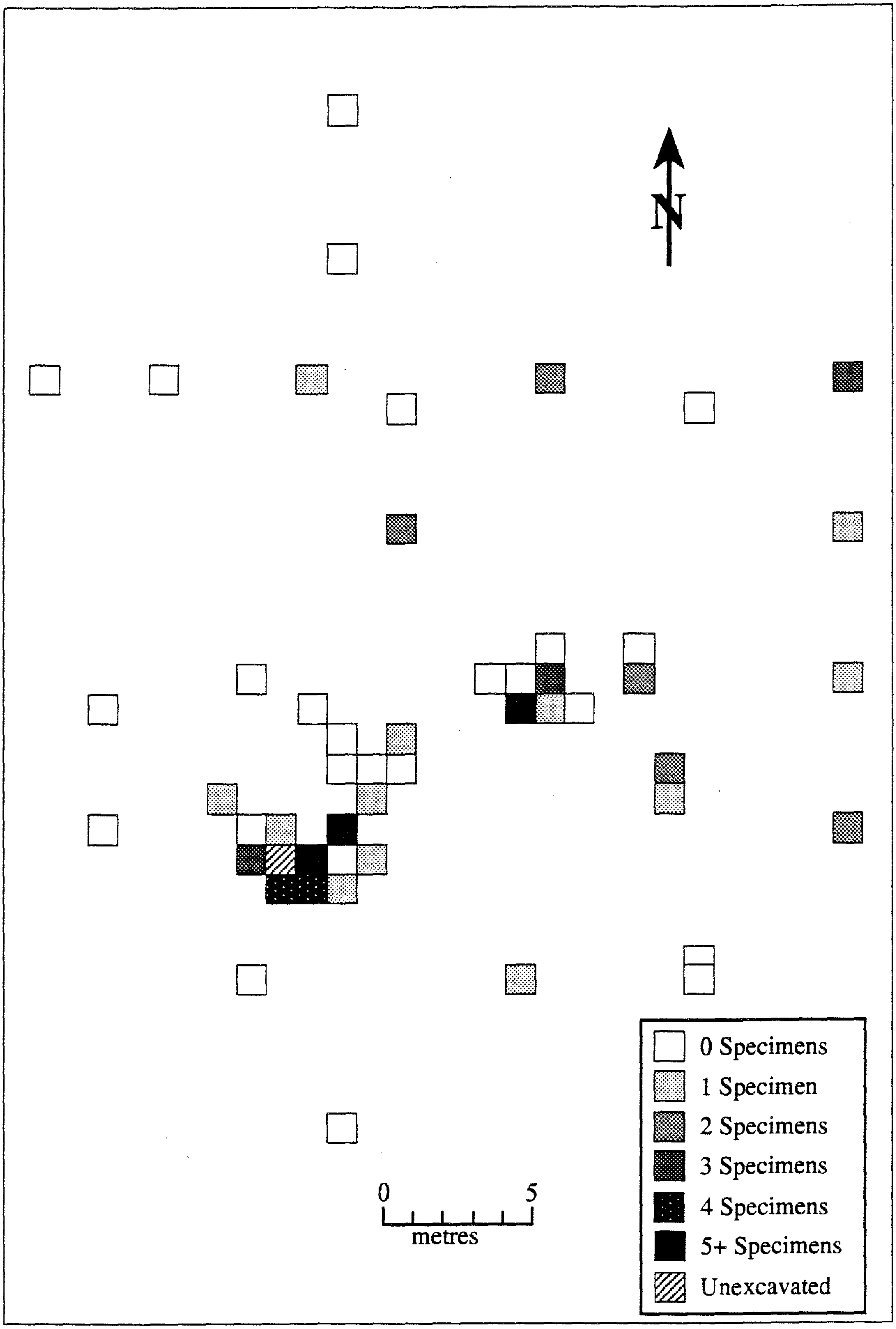

Figure 7.26 Map of the excavation area showing the distribution of small mammal specimens.

micro-mammal specimens from unit 290N 109E also reflects fine screen recovery (Figure 7.27). The other identified specimens are located across the excavation area. One area of concentration appears to be to the east of the central hearth. The high density of small and micro-mammal specimens from unit 290N 109E is a strong indication of the abundance of faunal materials that are missed using regular 6 mm meshed screens. The higher recovery rates of a smaller mesh size would significantly alter the distribution patterns of the smaller fauna at the site. Shaffer (1992:135) argues that differential recovery rates between large and fine meshed screens are not simply biased, but are biased in a predictable manner. The recovery of large elements such as crania, innominates and sacra does not account for the taphonomic path of those elements. Crania, especially those of micro-mammals, are extremely fragile and are not necessarily the element that has the best chance of survival. The recovery of several *C. gapperi* teeth in the fine screen sample is an excellent example of the importance of fine screen samples. As there are no other diagnostic elements of *C. gapperi* present in the faunal assemblage, this species would have gone unnoticed if the fine screen sample had not been taken.

The fine screen sample also increased the recovery of gastropods and fish elements in the assemblage. The small sample size and the large percentage that is part of the fine screen sample makes it difficult to discuss the distribution of these elements. The fish elements are primarily limited to the area adjacent to the southern and central hearth (Figure 7.28). Two specimens are located in unit 300N 100E. The invertebrates are also very difficult to discuss. The gastropods are present in five units (Figure 7.29). Seventy-four percent of the individuals are part of the fine screen sample. Another eighteen percent of the individuals are part of the regular sample of

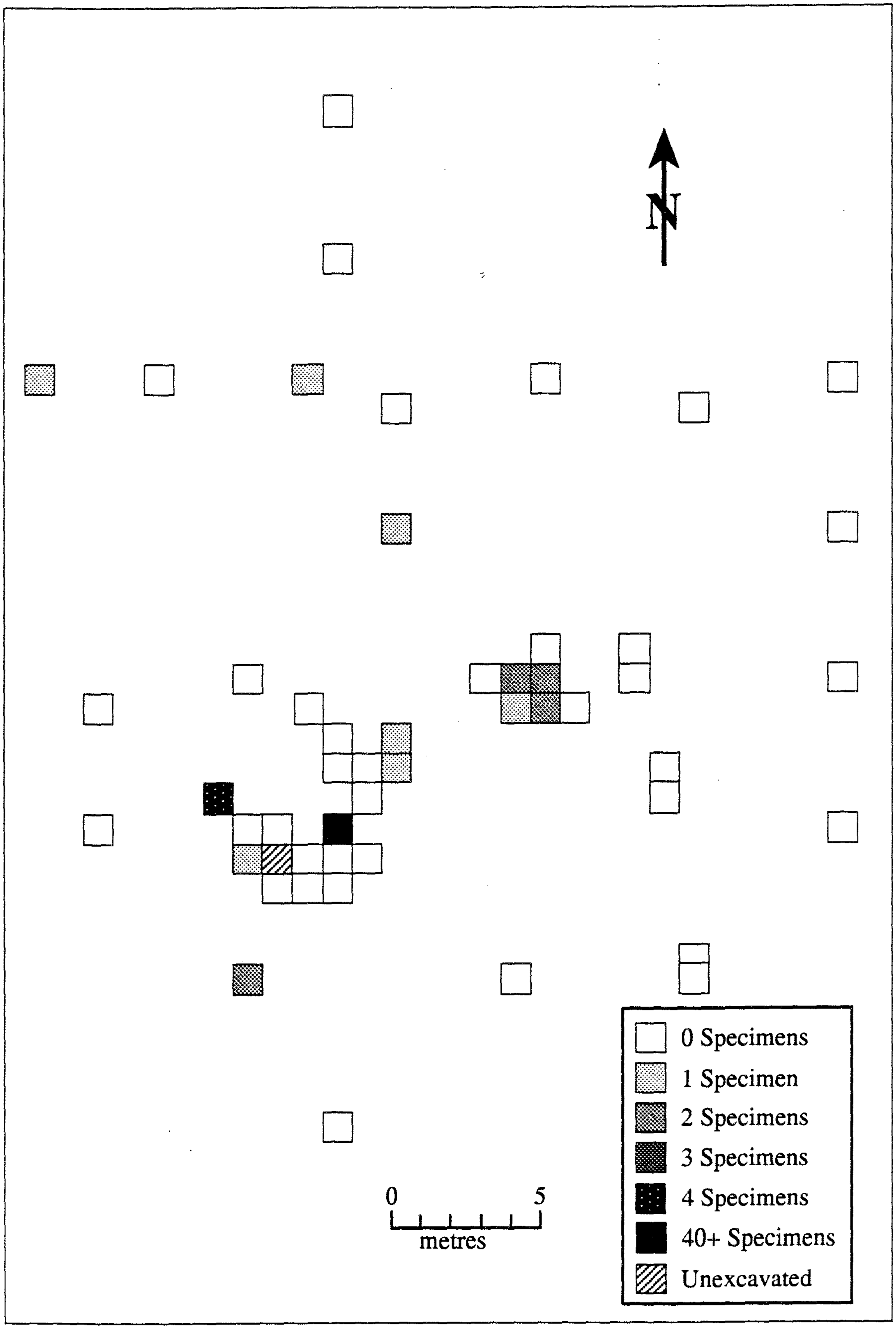

Figure 7.27 Map of the excavation area showing the distribution of micro-mammal specimens.

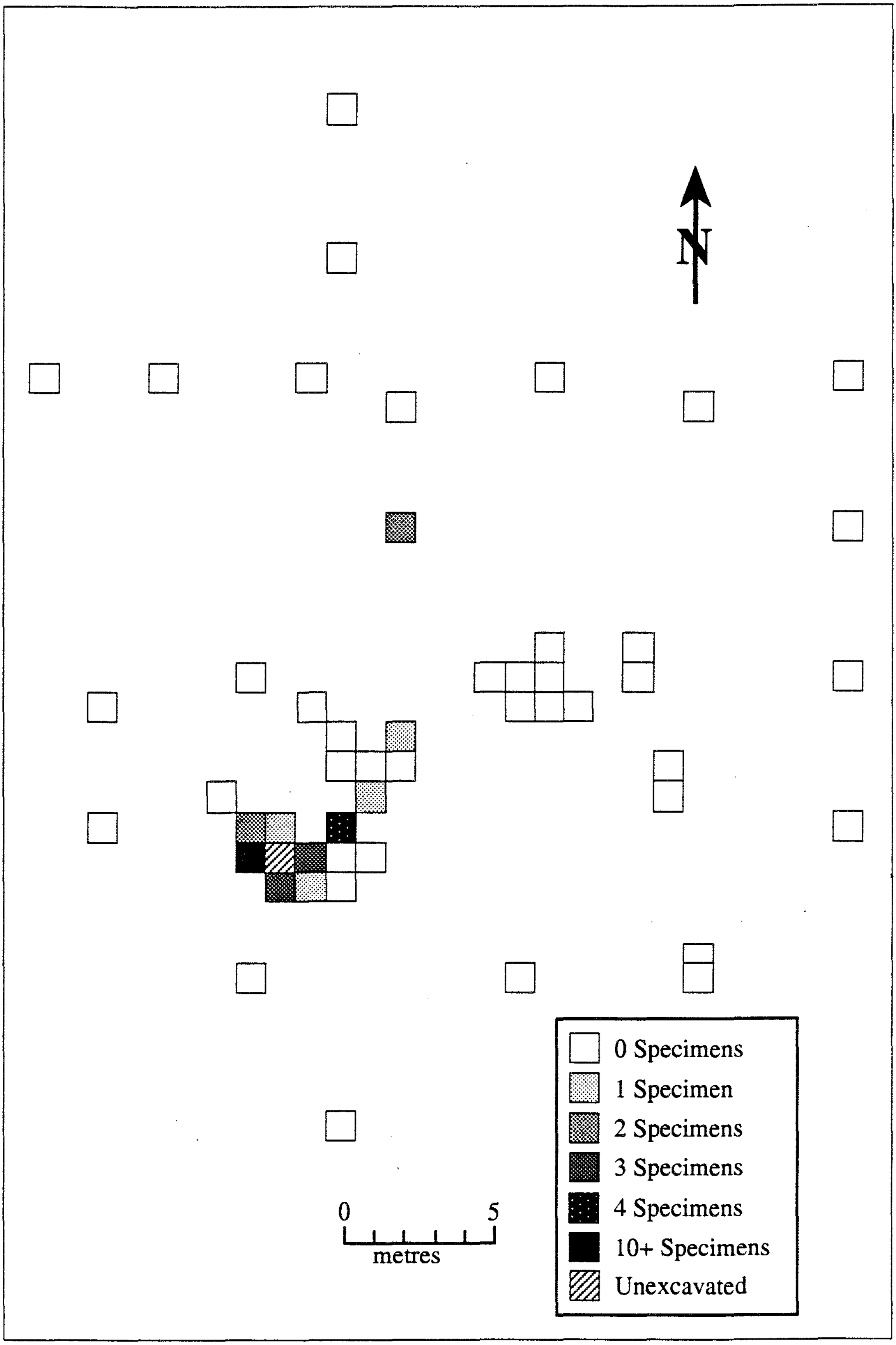

Figure 7.28 Map of the excavation area showing the distribution of fish specimens.

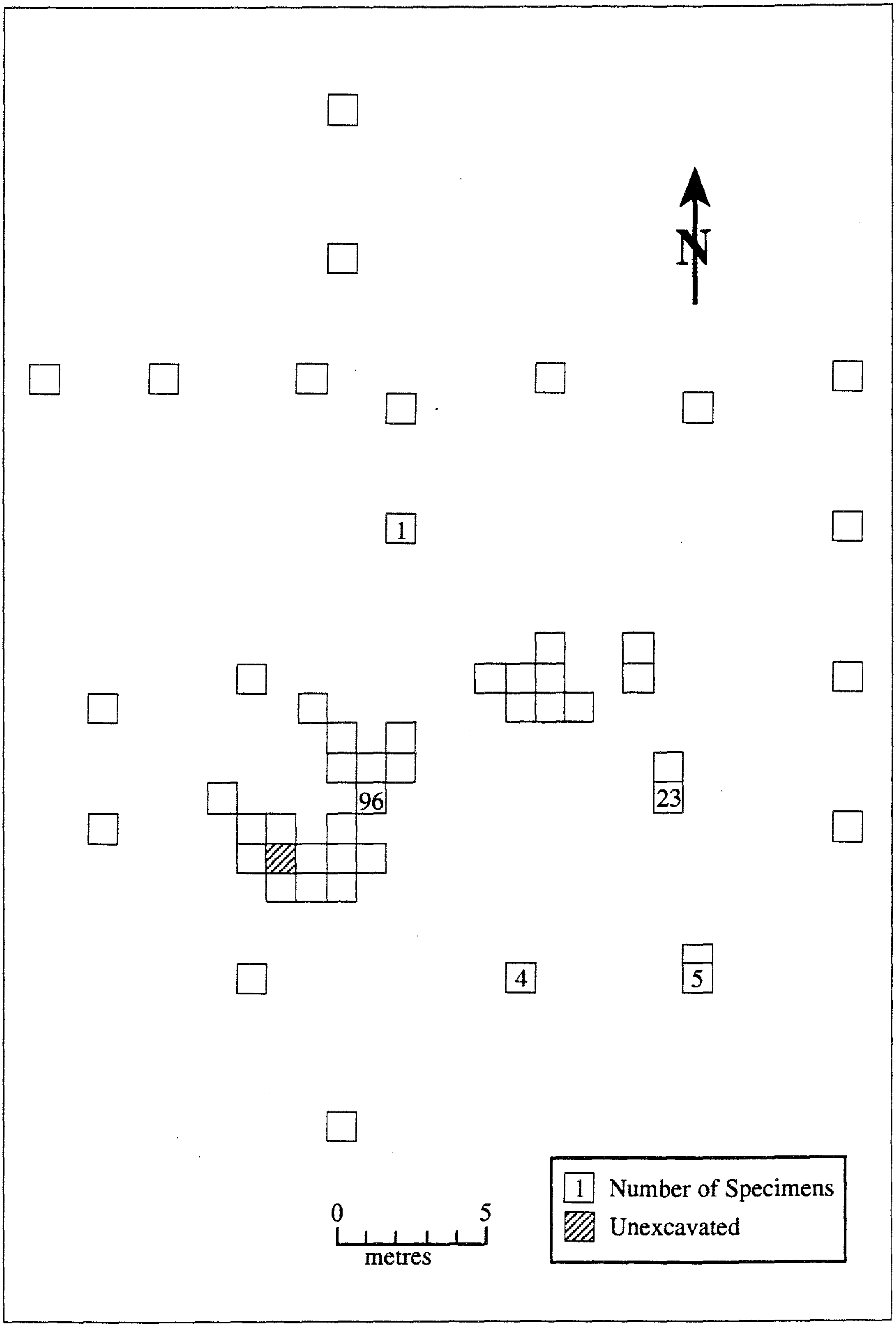

Figure 7.29 Map of the excavation area showing the distribution of gastropods.

unit 291N 119E. The mussel shells are widely distributed across the excavation area (Figure 7.30). There is no strong indication of spatial patterning.

7.3.3 Presence / Absence of Specimens

The presence and absence of skeletal material in an archaeological assemblage is a complex issue. The presence of large vertebrate remains (such as bison) is typically assumed to be due to the cultural introduction of the elements into the site. This may be especially true for habitation sites. The absence of elements from an assemblage, however, may be due to a large number of cultural and natural factors.

The premise behind analyzing the presence and absence of skeletal elements is that there is a cultural reason (or reasons) as to why some elements are deserted at a kill site while others are taken away for further processing. It is assumed that elements of low economic utility are left at the kill site, relatively unprocessed, while items of high utility are removed from the kill and further processed at a secondary or tertiary location (Binford 1978; Brink and Dawe 1989; Emerson 1990; Lyman 1992).

The relative abundance of bison skeletal elements is often expressed as a utility index. Several indices have been created including Binford's (1978) original MGUI (Modified General Utility Index), Brink and Dawe's Grease Index (1989) as well as several others (see Lyman (1992) for an overview of utility indices). A lengthy debate has been under way since Binford proposed the use of a MGUI. It is becoming apparent that the presence of a reverse utility curve can no longer be assumed to be evidence of purely cultural transport of the elements (Grayson 1984, 1989; Kreutzer 1992; Brink and Dawe 1989; Lyman 1992; Morlan 1994b). Several other factors must also be

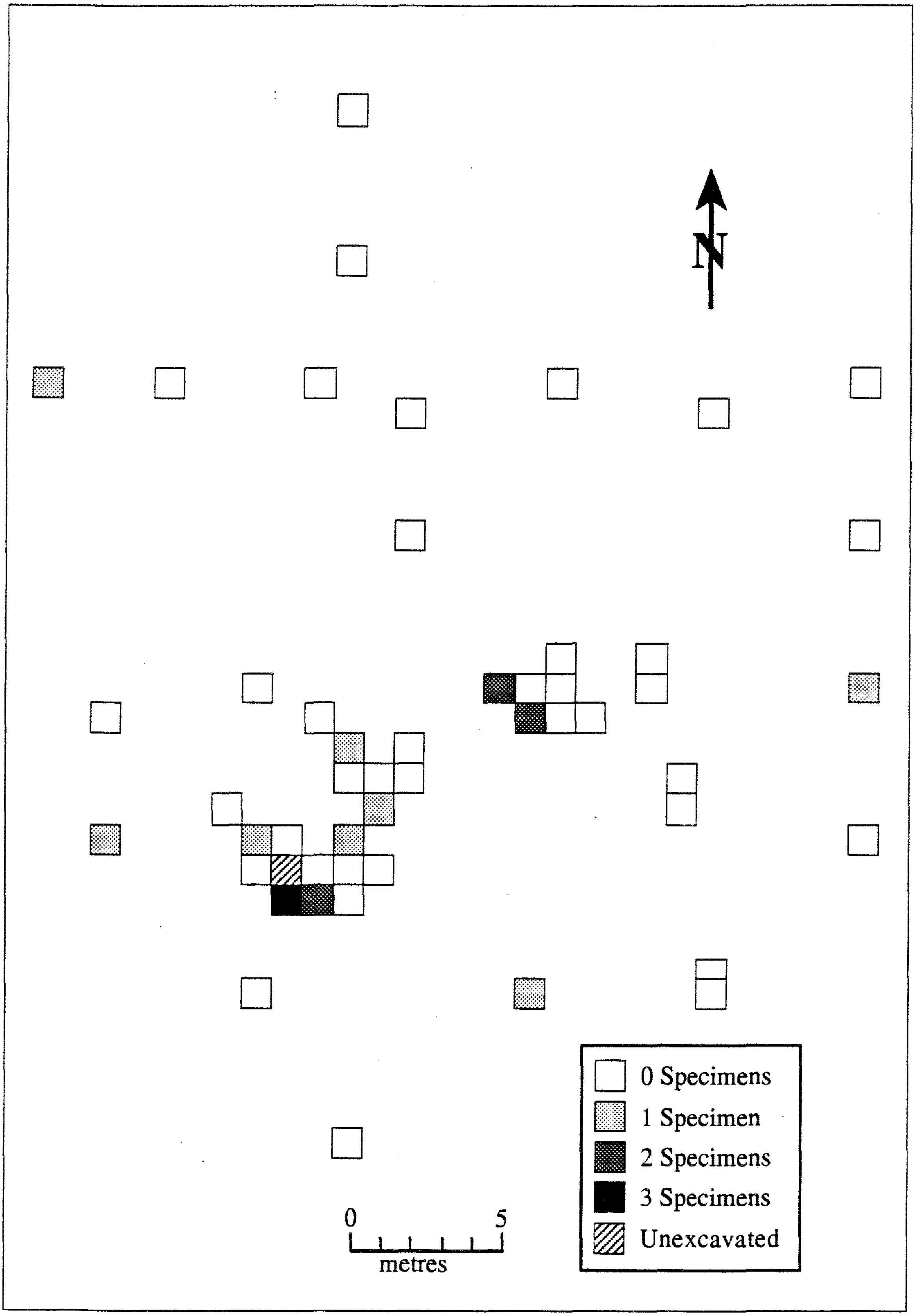

Figure 7.30 Map of the excavation area showing the distribution of mussel shell fragments.

taken into account when interpreting relative abundance. These factors include both cultural and natural destruction of faunal elements that are within a site.

Emerson (1990) devised several utility indices based on four bison of varying gender, age and nutritional condition. Included is an index which Emerson (1990:623) calls the standardized, modified averaged total products model, (S)MAVGTP. This utility index is a culmination of the indices created for each of the individual bison of varying ages, gender and nutritional states. By averaging these sets of data Emerson creates an index to be used on assemblages of mixed age and gender (1990:655). It is likely that this type of index is also the most suitable to be used in assemblages of mixed seasonality as well. When plotted against %MAU values for the bison specimens in the Hartley assemblage a reverse utility curve is apparent (Table 7.2 and Figure 7.31).

The reverse utility curve is supported by a significant and negative correlation between the %MAU and the (S)MAVGTP ($r = -0.34$, $p<0.05$, N=25). The %MAU are also positively and significantly correlated with volume density ($r=0.336$, $p=0.05$, N=37) as defined by (Kreutzer 1992). These correlations do not explain what agents are responsible for the destruction of the elements. Some of the elements at the site are extensively processed. Elements processed for marrow and grease extraction are often fragmented to the point of being unrecognizable in the archaeological context. Elements may also be absent from assemblage counts due to non-cultural taphonomic agents. Density-mediated destruction of skeletal elements has been suggested as one of the primary factors accounting for the absence of skeletal elements (Grayson 1989; Lyman 1992). Carnivore gnawing, fluvial transport as well as cultural processing are only a few of the density-mediated agents

Table 7.2 Bison elements (abbreviations are as they appear in Figure 7.31) and Emerson's (1990) standardized, modified averaged total product model data.

Portion	MAU	%MAU	(S)MAVGTP
Skull, without tongue (SKULL)	23.00	100.00	14.2
Atlas (ATL)	4	17.39	6.4
Axis (AXI)	2	8.70	7.8
Cervical Vertebrae, C3-C7 (CER)	3.2	13.91	56.6
Thoracic Vertebrae (THO)	1.8	7.83	84.7
Lumbar Vertebrae (LUM)	2.8	12.17	82.9
Innominate/Sacrum (INN)	11.00	47.83	54.7
Caudal Vertebrae (CAU)	1.4	6.09	1.5
Ribs (RIB)	2.3	10.00	100
Sternum (STE)	1	4.35	52.9
Scapula (SCP)	16.50	71.74	31.6
Proximal Humerus (HUMp)	6.00	26.09	31.6
Distal Humerus (HUMd)	21.00	91.30	25.1
Proximal Radius (RADp)	16.50	71.74	16.5
Distal Radius (RADd)	19.00	82.61	12.1
Proximal Metacarpal (MCp)	17.50	76.09	3.9
Distal Metacarpal (MCd)	9.50	41.30	2.6
Carpal, Intermediate (CARP)	17.00	73.91	6.6
Proximal Femur (FEMp)	12.50	54.35	69.4
Distal Femur (FEMd)	7.50	32.61	69.4
Proximal Tibia (TIBp)	5.00	21.74	40.8
Distal Tibia (TIBd)	14.00	60.87	25.5
Proximal Metatarsal (MTp)	16.50	71.74	7.50
Distal Metatarsal (MTd)	14.50	63.04	4.50
Tarsal, Talus (TARS)	20.00	86.96	13.6

MAU:(S)MAVGTP, $r = -0.3438$, $p < 0.05$, N=25. (Ebden 1988).

that may eliminate specimens from an archaeological assemblage (Binford 1981; Grayson 1989; Lyman 1992).

Evidence of cultural processing at the Hartley site is abundant. Large numbers of impact scars and fragmented long bone diaphyses are present throughout the site. Carnivore tooth marks are also present on some faunal specimens. These occur on a very low percentage of the specimens. Tooth marks, however, are not necessarily going to be present on all elements.

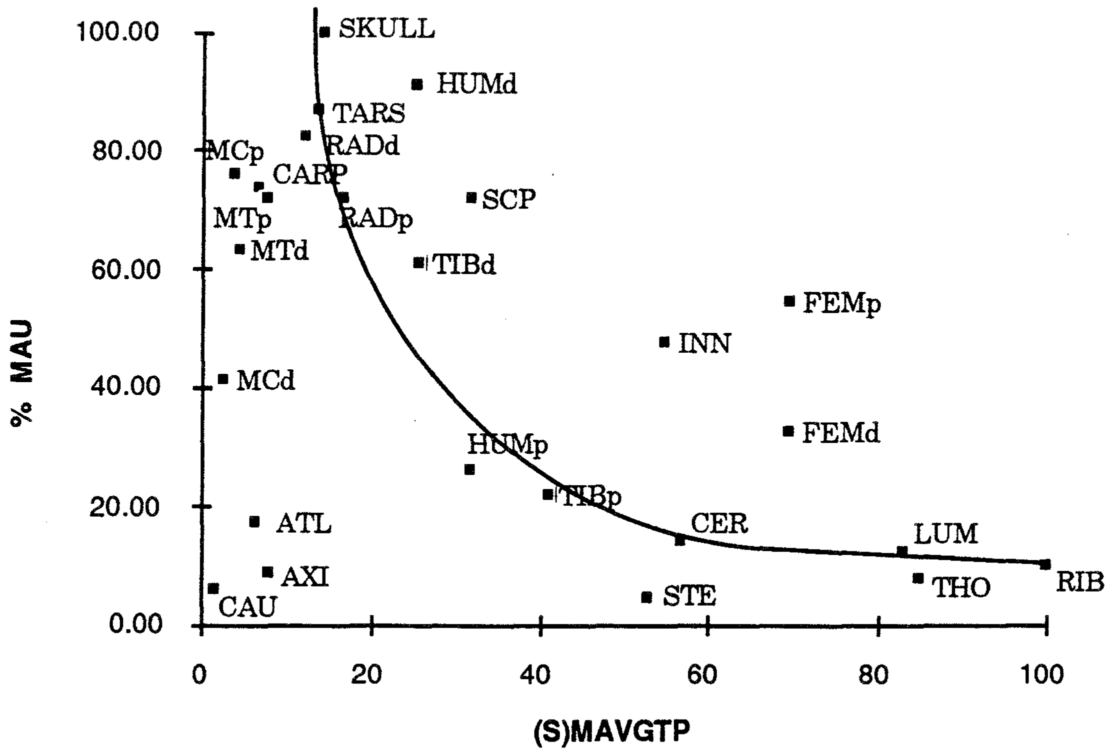

Figure 7.31 Emerson's (1990: Table 8.6 page 624) standardized, modified averaged total products model versus % MAU. Reverse utility curve visually fitted.

Frozen elements, for example, may not be scored and punctured at the same rate as warm, fresh bones. Tooth marks of large carnivores would also be difficult to identify on the bones of small and micro-mammals. These animals, as well as foetal bison elements, are likely to be consumed whole. Evidence of the elements passing through the gastro-intestinal tract of the animal is needed to establish the consumption of these smaller elements. No evidence of digestion is present on any of the specimens in the assemblage, suggesting that the digestion of these elements was either complete or not prevalent at the site. It is not known for certain if carnivores played a significant role in the relative frequencies of specimens in the assemblage. The low number of tooth marks, the high number of foetal and small and micro fauna suggests that carnivores were not a primary factor in the creation of the current presence/absence ratio in the assemblage. It is most probable that the resulting reverse utility curve is due to transport as well as cultural, and to a lesser degree, non-cultural destructive forces.

7.4 Site Type Determination

7.4.1 Sivertsen's Model of Site Distinction

In an effort to better qualify the determination of archaeological site types Sivertsen (1980) devised a model to determine site function based on the presence and absence of features, artifacts and ecofacts and their interrelationships to site activity areas. Building on ethnoarchaeological work conducted by Binford (1978) and Yellen (1977), Sivertsen's model proposes that certain archaeological indicators should reflect past site activities. These activities may be evident in the spatial patterning of artifacts at the site or they may be simply reflected in the relative frequencies or presence and absence of artifacts (1980:427). The model was originally devised to be used in differentiating PaleoIndian kill, butchering, processing and camp sites. The model is thought to be general enough to be applied effectively to a more recent site. In the model ten sets of criteria are analyzed:

1) density of bone remains;
2) articulation of bone remains, ranging from articulated to semiarticulated to disarticulated;
3) dispersal of bone remains, ranging from concentrated to dispersed;
4) fragmentation of bone remains, ranging from whole to completely fragmentary;
5) density and dispersal of the lithic material;
6) numbers and diversity of various functional types of stone tool remains, for example: scraping tools; serrated and notched tools, chopping tools, massive bashing tools, boring tools, gouging tools etc.;
7) amount of waste or debitage present, ranging from none to large amounts of waste flakes and debris;
8) range of different species at a site;
9) range of nearby environmental zones;

10) variations in topography. (Sivertsen 1980:427).

These ten criteria are then divided into 37 categories. Each category may be answered with a simple presence or absence.

With few exceptions, the Hartley site corresponds closely to the criteria established for a camp, multiple activity or terminal processing loci (Sivertsen 1980:430). Criteria from the Hartley site that match those given by Sivertsen as relating to camp sites include dispersed, fragmented bone remains, a wide diversity of faunal species, large numbers of animals represented, but few bones from each one, many kinds and numbers of tools, indicating diverse activities, evidence of tool manufacture (i.e. cores, manufacturing flakes, early stages of finished tools), relatively high proportions of debitage, relatively higher proportions of stone material in comparison to bone remains, hearths and charred bones, and dense, dispersed occupation debris (1980:430). One category not referred to by Sivertsen that is often associated with camp sites, is an abundance of pottery sherds.

Some discrepancies are also present in the Hartley site assemblage with regards to the model for camp sites. The Hartley site does not have blades present in the assemblage. This is likely a failure of the model to integrate later time periods on the North American Plains, in which blades are rare in any type of site. The Hartley site also has a number of articulated vertebral sections as well as articulated limb elements. These are seen as reflections of processing/butchering practices and are not typical of habitation sites. Sivertsen admits that this is a potentially problematic attribute, especially in sites where processing is taking place at the habitation site (1980). The ratio of lithics to bone in the Hartley site assemblage may not be as high as one might expect at a long term habitation site. The ratio of stone to bone is much higher than would be expected at a kill site yet it may not be as high as some other habitation sites. The presence of articulated skeletal elements and the low lithic to bone ratio may be due to the seasonality of the site rather than the site function. The seasonality of different site activities is not addressed in the current model.

7.5 Summary

The intra-site analysis strongly establishes the Hartley site as a long term, multiple activity occupation site. Sivertsen's model (1980) of site type designation shows a strong correlation between the artifacts, features and site location of the Hartley site with what would expected to be present in the archaeological representation of a habitation site. However, the presence of articulated skeletal specimens is not typically expected at a camp site by Sivertsen's model. The presence of several sets of articulated vertebrae as well as a few articulated limb specimens may be due to the differences in activities at PaleoIndian camp sites and more recent sites. These specimens may also be a reflection the long term, winter occupation of the Hartley site. Unfortunately, the assemblage contains few culturally modified bones. One polished bone pin is present as well as a few elements displaying less distinct wear and polish. Cut marks are also relatively uncommon. Some cut marks were undoubtedly destroyed by the processing of the elements and other taphonomic agents. The low frequency of cut marks may partially reflect the method of disarticulation used. Smashing the attachment points of the elements may reduce the number of cut marks that should be expected on the elements.

The distribution of artifacts and ecofacts is closely associated with the large hearths located in the central and southern portions of the excavation area. A large, dense scatter of fragmented and articulated elements is present south and east of the southern hearth. This area had the highest concentrations of most artifact categories with the exception of pottery sherds. The densest concentration of pottery sherds is located adjacent to the central hearth. A large number of faunal remains, lithic tools and debitage are also associated with this hearth feature. A third, partially exposed, hearth is present in the northeast portion of the excavation area. This feature appears to be associated with a slight increase in the number of artifacts and faunal remains, but only a few units have been excavated in the area making definite discussions difficult. The bison elements are shown to exhibit a reverse utility curve when plotted against Emerson's (S)MAVGTP model (1990). Several factors are suggested to be at least partially responsible for the presence and absence of these elements. The primary factor is due to human transportation and processing, while others such as carnivore ravaging and other attritional factors are responsible to a lesser degree.

CHAPTER 8

SUMMARY AND CONCLUSIONS

8.1 Introduction

The Aspen Parkland, as well as the wooded valleys of the adjacent Northern Plains, are reputed to have been wintering grounds for Plains Bison (Morgan 1980; Epp 1988; Nicholson 1988). Morgan (1980) suggested that the bison herds situated in southern Saskatchewan migrated to the north and east for the winter. Bison spent the winter months in the Aspen Parkland and other regions where shelter and appropriate vegetation were available, such as river valleys and areas of Mesic Mixed Prairie (Morgan 1980:155). The bison arrived on the wintering grounds shortly after the first snow and remained until the spring thaw. This winter range would have been very attractive to the bison for a number of reasons. The region has a larger and more reliable system of permanent water sources. By the end of the summer many of the water sources on the Xeric Mixed Prairie have dried out. The winter range also maintains a supply of green grasses longer than the Xeric Prairies to the south (Morgan 1980:153). Bison converged during the late fall and early winter and spent the winter in suitable areas in large herds (Morgan 1980:158). The bison dispersed in the spring and spent the summer months on the Xeric Mixed Prairie in small herds.

Some researchers have opposed this theory stating that bison movements were simply random and should not be referred to as migrations (Hanson 1984). Others (Epp 1988; Nicholson 1988) have suggested that neither model is completely correct and that bison display a dual dispersion foraging strategy. Epp (1988) compares bison to African Wildebeest and suggests that some small herds of bison stayed in one place throughout the year while other herds migrated between summer and winter ranges. The sedentary herds of bison remained in areas of the summer range which had anomalous, wooded, and/or topographically distinct regions such as river valleys, ranges of hills or sand hills (Epp 1988:314). Morgan (1980) and Epp (1988) do agree that those animals which moved to a winter territory migrated into regions with specific environmental features such as the Aspen Parkland.

For the purpose of this thesis it is not necessary to determine if bison are truly migratory or not. It is important to note, however, that the bison populations in the region appear to be sedentary and in large numbers during the winter months. If bison are a fully migratory species, as Morgan (1980) suggests, bison would be most abundant in the Aspen Parkland, the Mesic Mixed Prairie and valley complex regions. If bison employ a dual dispersion foraging strategy, they would still be in greater abundance in sheltered regions than on the true grasslands. If bison are not migratory at all, there would be an equal chance of finding a herd anywhere in their range, including the northern extremes of the grasslands and the Aspen Parkland.

Several authors have suggested that human occupation of the Aspen Parkland also increased in the winter. Seasonal movements of people on the Northern Plains and the adjacent Aspen Parklands have been discussed by several authors including Morgan (1980), Epp (1988), Nicholson (1988), Smith and Walker (1988) and Meyer and Epp (1990). It is generally accepted that the people of the Northern Plains followed the movement of the bison herds into the Aspen Parkland and other wooded regions in the late fall. It is unlikely that the people directly followed the herds to a specific area. It is more probable that the people moved into an area which held a dense population of animals, after the bison had become more sedentary. The congregation of the bison in this region allowed the people to establish long term, winter campsites (Morgan 1979:182). The large numbers of bison present in the area allowed the people to successfully operate large communal kills such as the Tschetter site (Prentice 1983), during the late autumn and winter. The abundance of animals would also allow for opportunity for selective procurement of individual animals or small groups of animals. The Aspen Parkland also supports a much wider variety of plant and animal species than the plains region (Nicholson 1988). Saskatoon berries, Choke Cherries, rose hips, as well as several other fruits, nuts and berries all begin to ripen in the fall. The large numbers of these plants would, therefore, present the people in the parkland and other wooded areas with a valuable resource that would not be readily available on the grasslands, except in small isolated areas. This increase in human occupation of the region lasted throughout the winter and into the spring.

Smith (1986) and Smith and Walker (1988) suggest that the people stayed in the wintering areas for a period of time, even after the bison had returned to the grasslands. The wide diversity of the parkland ecosystem including the return of the migratory waterfowl and availability of terrestrial and aquatic animals sustained the people prior to the move back out on to the grasslands. Meyer and Epp (1990) note that the parkland need not be interpreted as a true ecological zone as it was primarily occupied as an extension of the grasslands. Smith and Walker (1988) note that fishing is associated with spring and to a lesser degree fall activities in this region. During the late spring or early summer the majority of the people began to move back out onto the grasslands. The summer months were spent on the grasslands involved with the summer bison hunt (Smith and Walker 1988:88). The movement of a large percentage of the population out of the Aspen Parklands and other wintering areas would also decrease the size and number of camps in the region. Evidence of this inflated winter occupation of this region should be apparent in the archaeological record.

The Hartley site is one of a growing number of Late Prehistoric sites that have been investigated along the boundary of the Northern Plains and adjacent Aspen Parkland. Definite seasonalities are not available for many of the sites in this region making conclusions about the ratio of summer to winter sites unobtainable. Sites such as Miniota (Landals et al. 1994), Amisk (Amundson 1988), Lebret (Smith, B. 1986; Smith and Walker 1988), Lucky Strike (Wilson 1984), and Tschetter (Prentice 1983), however, do show some general trends in Late Prehistoric faunal assemblages.

8.2 Inter-site Comparisons

The Tschetter site (FbNr-1) is an Old Women's phase bison pound located in the Aspen Parkland west of Saskatoon (Prentice 1983). Based on age and sex composition of the bison as well as environmental factors Prentice (1983:36) suggests that the Tschetter site is a winter site (November to January). Three bone collagen radiocarbon dates are available for this site, 1005 ± 75 B.P. (S-669), 920 ± 45 B.P. (S-1631) and 1020 ± 100 B.P. (S-2225) which have been averaged as 952.5 ± 36.0 B.P. (Morlan 1992:69). The lithic and ceramic assemblages are similar to those at the Hartley site, although the frequencies of artifacts are not at all comparable (Meyer and Clarke 1991). As would be expected at a kill site, bison is the dominant animal represented. Several species of carnivores are also present including wolf, domesticated dog, badger and striped skunk. Leporids, Richardson's Ground Squirrels, mice and/or voles and birds are also represented (Walker 1978).

The Amisk site (FbNp-17) is a multi-component habitation site located north of Saskatoon in Wanuskewin Heritage Park (Amundson 1986). The site is situated in the valley of a tributary creek of the South Saskatchewan River. Seven cultural layers are present at the site which range from Plains Side-notched materials in the upper layer to Oxbow materials in the lowest cultural layer. Layer one is a compression of at least two, maybe three occupations. Plains Side-notched, Prairie Side-notched and Avonlea materials were recovered from this one layer. It is not known if these materials relate to three distinct occupations or if the Avonlea and Old Women's material are part of one single occupation. Amundson (1986:58-59) reports three dates for this layer, two bone collagen dates of 480 ± 65 B.P. (S-2531), A.D. 1470 and 635 ± 85 B.P. (S-2770), A.D. 1315 and one date taken on charcoal 905 ± 155 (S-2537), A.D. 1045. No seasonality is available for this layer although the presence of small amounts of *Canis* sp., Pronghorn, bird, fish, ground squirrel elements as well as clam shell fragments suggests that this occupation was not a true winter occupation. It is possible, however, that the occupation occurred in the early spring or late fall. The bison remains are the most common specimens present in the layer and are highly comminuted. The high concentrations of very fragmentary bone in this level suggests a significant amount of grease or marrow extraction was occurring in these occupations.

The Lèbret site (EeMw-26) is a multi-component habitation site which includes Avonlea materials (Smith and Walker 1988). The site is located in the Qu'Appelle Valley at the narrows between Katepwa and Mission lakes, south of Lebret. Although the animal remains include bison, deer, Snowshoe Hare, River Otter, Beaver, and duck the most interesting part of the assemblage is the large number of fish. Five species of fish are present at what may have been a fish weir location. The Avonlea assemblages (as well as several others) are represent occupations which took place in the spring, based on the timing of fish spawning runs. One of the Avonlea assemblages has been radiocarbon dated to 1260 ± 115 B.P. (S-2691; bone collagen).

The Roussell site (FbNs-2) is located northwest of Saskatoon in a shallow, stabilized sand dune depression (Dyck 1972). The site contains an Avonlea component which produced a significant amount of bison remains from limited test excavations. No features were found at the site, although burned bone was recognized in several areas. Vertebral segments are the most abundant skeletal elements. Several thoracic vertebrae are recorded as articulated in one test unit. The long bones appear to be disarticulated and broken, presumably for marrow and / or grease extraction (Dyck 1972). Most of the vertebral elements are missing the processes and the ribs are typically broken just below the head. The minimum number of individuals in the excavations is three. One radiocarbon date of 1185 ± 70 (S-670; bone) was obtained (Dyck 1983:111). The seasonality of this component is unknown.

The Lucky Strike site (FdNm-16) is an Old Women's phase site located approximately 18 km east of Rosthern and 2.3 km from the South Saskatchewan River in the Aspen Parkland of central Saskatchewan (Wilson 1984). Two separate areas at the site (approximately 80 metres apart) have been excavated. The site is a campsite which shows signs of a relatively long term occupation (Wilson 1984:24). This occupation is suggested to be a summer or fall occupation based on the site location. Two radiocarbon dates are available for the site, 1020 ± 90 B.P. (S-2281; bone) or A.D. 930 ± 90 and 875 ± 95 (S-2280; bone) or A.D. 1075 ± 95 (Wilson 1984:24). The faunal assemblage is not as prolific as the Hartley site assemblage, but does contain several different taxa. The assemblage contains predominantly bison although deer, canid, bird and rabbit are also represented (Wilson 1984:16). Evidence of marrow extraction is present although the bones do not appear to have been rendered for grease extraction. Features at the site include two hearths which have extensively oxidized the soil below suggesting a very hot, long term fire. One of these hearths measures over 2 m by 1 m in size. The majority of the artifacts from the site are associated with these hearths. It is suggested that the hearths may relate to pottery making although there is little evidence for this. If these hearths are not for firing clay it is possible that the seasonality is incorrect.

The Long Creek site (DgMr-1) is a multi-component habitation site located in the valley of Long Creek, approximately 13 km south of Estevan. The site is situated in a wooded valley on the northern edge of the Great Plains (Wettlaufer 1960). The site may represent a winter occupation, based on the location, although the wide diversity of fauna would have been attractive throughout the year (Wettlaufer 1960:4). One Avonlea level at the site again has a moderate variety of faunal species including bison, large canid, Swift Fox, coyote, domesticated dog, fish and invertebrates. Beavers, rabbits, rodents, Striped Skunks, deer, waterfowl and frogs are also present at the site in other levels (McCorquodale 1960:88).

The site that is most comparable to the Hartley site, is the Miniota site. This site (EaMg-12) is located in the Aspen Parkland, on a terrace of the Assiniboine River in southwestern Manitoba. The site contains a number of similar faunal and artifactual remains as are seen at the Hartley site. Fifty-eight square metres of excavation revealed that the site is an Avonlea habitation. It contains lithic, ceramic and faunal remains which are concentrated in a midden to the southeast of a large hearth. Two radiocarbon dates are available for the Miniota site. The first is a charcoal date of 1340 ± 90 B.P. (Beta-58908), calibrated to A.D. 565 to 880, at the 95% confidence level. The second date is taken on bone collagen (corrected for ^{13}C content) and is slightly more recent, 970 ± 90 B.P. (Beta-58907), or A.D. 885 to 1245 at the 95% confidence level based on Klein et al. (1982) calibration tables. Due to the disagreement between these two dates Landals et al. (1994:56) calculate that the occupation occurred between A.D. 665 and 1015 with a mid-point of A.D. 840

A diverse array of faunal species is also present in the assemblage. Bison or large ungulates are, of course, well represented in the recoveries. Cutmarks, found on 63 "elements", are most commonly present on thoracic vertebrae and ribs (Landals et al. 1994:181-184). The majority of the specimens at the Miniota site are heavily fragmented and exhibit green bone breaks. All of the measurable long bone ends (13 distal humeri and distal tibiae) are described as females (Landals et al. 1994:186-7). Seasonality of the site is based on an extremely limited number of mandibles. Three mandibles are suggested to relate to a X.6 year kill event. This is the same seasonality as the Hartley site mandibles. The bison remains also include an amazing number of foetal specimens (N=2693) which are quite diverse in their overall size (Landals et al. 1994:189). Foetal elements range in size and age from extremely small elements categorized as three month term to large elements that are nearly full term (Landals et al. 1994:196). Most of the aged foetal elements are classified as being procured in the months of March and April. The range of size and age of these foetal elements is larger and more complete than at the Hartley site. The minimum number of foetuses outnumbers the MNI of adult/immature bison by a ratio greater than 3:1 (Landals et al. 1994:189).

Other mammals represented at the site include deer, canids, Beaver, rabbit, Muskrat, fox and mouse and/or vole. Deer/small ungulates are represented by only a small number of specimens. The canids are well represented in the site, including individuals identified as large, medium and small canids. Beaver are the most abundant of the smaller "fur-bearers" (Landals et al. 1994:204). Other mammals are represented by only a few elements.

Fish remains are abundant (746 specimens) and are represented by scales as well as bones. Fish are the second most common category after the bison or large ungulates (Landals et al. 1994:204). Several different species are present including Northern Pike, Walleye, Burbot, sucker and catfish. A minimum of 17 fish from five species are represented in the assemblage (Landals et al. 1994:207). The avifauna at the Miniota site are represented by 70 identified specimens. These include hawk, grouse, crow and one much larger bird. Mollusc specimens found at the site include 52 shell fragments and four complete shells. The shells are identified as *Lampsilis radiata seleqoidea* (Landals et al. 1994:208).

Aquatic specimens are more abundant at the Miniota site than at the Hartley site. This may be an due to a longer occupation of the Miniota site into the spring months when these species are more readily available. Both sites show extensive utilization of the diversity of the fauna of the region. Bison or large ungulates are the most prevalent category at both sites. Both sites also have large numbers of foetal elements, the majority of which are from late in the occupation. However, the Miniota site has far more foetal elements than the Hartley site. The presence of these elements suggests that bison were being selectively harvested for the foetuses especially during the months of March and April. This type of selective procurement was noted by

Peter Fidler in his journal entry of February 4, 1793, while in what is now southern Alberta (Fidler 1990:73).

In sum, the Hartley site is one of a number of sites in the Northern Plains / Aspen Parklands which have a wide diversity of faunal remains in potential winter and spring occupations. The list of sites presented here is far from complete, but they do suggest some trends in Late Prehistoric occupations of this region. Sites such as Tschetter provide evidence for the use of late fall and winter bison pounds which were positioned in the parklands. The habitation sites often show signs of lengthy occupations including large amounts of faunal material and well used hearths. Some of these sites, such as Long Creek and Amisk contain aquatic and migratory species which may be associated with spring or autumn occupations. Other sites such as Lucky Strike and Roussell have little or no aquatic or migratory fauna and may be associated with any seasonality. The Hartley and Miniota sites provide the strongest evidence of extensive, long term winter habitations. These sites may also indicate an increase in the selective hunting of pregnant female bison in the late winter or early spring. The Miniota site has an abundance of foetal remains, which date to approximately March or April. There are full term and nearly full term individuals present at the site as well, but these are less common. The wide range of foetal ages indicates that small scale attritional kills also took place throughout the winter. The Miniota site also has an abundance of fish remains (as well as other aquatic fauna) whereas the Hartley site has but a few. The Miniota site is situated right on the banks of the Assiniboine River suggesting that fish would have been more readily available than at the Hartley site. The Hartley site does not appear to have been occupied as late into the spring as the Miniota site which may also influence the relative abundance of aquatic fauna.

8.3 Review and Discussion

The Hartley site is a multi-component habitation site located in the Moose Woods Sand Hills in central Saskatchewan. The site is situated just south of the city of Saskatoon, near the boundary of the Northern Plains and the Aspen Parkland. The site contains at least two occupational areas which, on the whole, are separated horizontally across the site area. The most recent occupation includes Mortlach pottery and Plains Side-notched points as well as a few metal artifacts. This occupation is predominantly confined to the eastern and southern portions of the site.

The other occupation at the site is an Avonlea/Old Women's phase component. This occupation has been the focus of University of Saskatchewan, Department of Anthropology and Archaeology field schools from 1988 to 1995. It is primarily located in the western and northern portions of the site, although some overlap with the Mortlach material is present in the central portion of the site. Two dates are available on the material from the Avonlea/Old Women's phase occupation. One radiocarbon date on bone is 1120 ± 60 B.P. (S-3382; bone) is calibrated to A.D. 762-1013 (p=1.00) at the 95% confidence level with a mid-point of A.D. 930 The calibrated date is calculated using the University of Washington Calibration Program (1987). The second date, a thermoluminescence date, is based on fired sediment samples from the same unit as the bone sample. This date is within the range of the radiocarbon date, at A.D. 700 ± 360 (DUR 93TL170-1ASpfg), although the standard deviation is quite large.

The Avonlea/Old Women's phase faunal assemblage, from the first three years of field school excavations, was analyzed in this thesis in order to establish: 1) the season of occupation; 2) the importance of certain species in reconstructing the palaeoecology and biogeography of the region and 3) the type of occupation. It was hoped that this information would aid in the understanding of the procurement and settlement strategies utilized by the inhabitants of the Northern Plains prior to European contact.

At least twenty-two species of vertebrates and four genera of invertebrates are present in the faunal assemblage at the Hartley site. These include a wide variety of mammals and birds as well as at least one species of fish. The invertebrates include three genera of gastropods and at least one genus of mussel. The most abundant class of animals is the mammals. Fourteen (52%) of the identified species are mammals. At least seven species of birds are also present in the assemblage. Three genera of gastropods and one genus of mussel are also identified. Bison is, however, the most dominant species present in the assemblage. A total of 22,901 bison specimens are identified, weighing over 154 kilograms.

The seasonality of the Hartley site faunal assemblage was calculated using several independent methods. The determination of the seasonality was based in part on the analysis of the bison mandibular dentitions. A MNI of thirteen was calculated based on the age and side of the mandible portions. The mandibles ranged in age from 0.6 to 9.6 years of age. Eight of the 13 mandibles analyzed were 2.6 years of age or less. The remainder of the animals comprise two groups of fully mature dentitions. It was not possible to determine their precise ages, but based on the amount of wear and the metaconid heights, these animals are best described as 7.6-8.6 and 8.6-9.6 years of age. It was not possible to determine if the small variations in wear patterns present on the teeth is due to individual wear, slight differences in age or variations in the diet. The mortality profile, although based on a small sample, is indicative of an attritional kill scenario. This would suggest that the animals were hunted in small groups or single animal kill events rather than in one large communal kill. The profile, however, may be biased due to the small sample size.

The foetal bison remains were also studied in order to determine their seasonality. The foetal elements ranged greatly in size, suggesting a broad range of foetal ages. The scapulae and long bones were measured in order to establish a quantitative seasonality. The foetal elements reflect a continuous progression of ages from approximately three gestational months of age to about eight gestational months of age. An average conception date has been assumed as August 15 for this study. The entire rutting season for bison is in the late summer to early autumn. This date was used only as a guide, as the true conception date in many cases was undoubtedly slightly earlier or later in the year. The foetal elements represent animals which were procured from late fall/early winter through to late winter/early spring.

The seasonality is also supported by a high proportion of female and immature bison. Analyses of the long bones and the carpals and tarsals show a definite predominance of females and immature animals. Gender analyses of the long bone epiphyses classified 70% of the measurable specimens as female/immature, 22% as male and 8% as indeterminate. Only mature elements were measured in this study, which may inflate the number of male specimens.

Analyses of the carpals and tarsals also indicated a high proportion of female/immature animals. Approximately 77% of the carpals and tarsals have been classified as female/immature. The difference between the two methods probably relates to the systematic exclusion of the immature elements from the long bone analysis. The high proportion of the female/immature elements seems to suggest that the Hartley site fauna has an abundance of animals typically associated with nursery herds, as would be expected during the months outside of the rut.

The seasonality was also addressed based on the analyses of other species in the assemblage. All of the avifauna specimens were examined for medullary bone (Rick 1975). The presence of medullary bone indicates that the bird was an ovulating female, thus linking it directly to the breeding season of that taxon. The lack of the medullary bone, however, does not indicate or eliminate any season of the year. Unfortunately, no specimens in the Hartley site assemblage were found to contain medullary bone. The presence of two migratory waterfowl may suggest a milder season of occupation. The Green-winged and the Blue-winged Teals are common breeders on the Northern Plains and the Aspen Parkland. If these specimens were acquired during the occupation of the Hartley site they would suggest a seasonality of late April to early November, due to their winter migration out of the region (Bellrose 1976). On the other hand, it is possible that these elements were not obtained while the site was being occupied. These animals have very distinct markings on their feathers and may have been obtained at an earlier time and brought into the site.

The presence of rodents that hibernate also suggests a milder season of occupation at the site. These animals, such as the Richardson's Ground Squirrel, and possibly Franklin's Ground Squirrel and Thirteen-lined Ground Squirrel, are only readily available between mid/late March to August or September. The spring portion of the schedule overlaps slightly with the seasonality of the foetal bison remains. These animals may have been procured during the latter portion of the occupation, during the early spring. At least two Northern Pike were also recovered from the assemblage. The Northern Pike is a spring spawner and was often caught in the spring (Smith,

B. 1986). It is likely that these individuals further support an early spring collection.

The geographic distributions and habitat requirements for the fauna represented in the Hartley site suggest that the environment was similar to the present environment. Species such as Swift Fox, Meadow Vole and Badger provide evidence that large areas of open grassland were present in the region. Other taxa such as Gapper's Red-backed Vole and Snowshoe Hare indicate that areas of shrubby or wooded cover were also present. Several animals, which no longer exist in the area, such as bison, wolf, Swift Fox and Raven, were present when the site was occupied. No extra-limital ranges for species were recorded for any of the taxa in the assemblage. The site area itself appears to have been slightly wetter than at the present time. The presence of Gapper's Red-backed Voles and lymnaeaform gastropods indicates that at least temporary bodies of standing water were nearby.

Culturally-modified bone appears to be relatively scarce (except for large numbers of broken fragments). Bone tools and cutmarks account for less than one percent of the specimens identified. Breaking bones at the muscle attachment points appears to have been the preferred method of disarticulation. Complete bison elements are rare. Vertebral processes and rib heads were typically broken off during butchering. Long bones were typically broken along the shaft for marrow extraction. Observations on the distribution of different artifact classes and faunal specimens show distinct concentrations within the excavated area. These concentrations appear to be in close proximity to two large hearths. The largest concentration of faunal specimens and lithic artifacts was found to the southeast of the large southern hearth. The largest concentration of pottery, however, appears to be associated with the large central hearth. Sivertsen's (1980) model of site activity recognition suggests that the site was a long term habitation site. The presence of a few articulated skeletal elements and the low ratio of lithic debitage to bone are two factors which disagree with Sivertsen's model (1980). These factors may be related to the winter occupation of the site.

The analysis of the faunal assemblage has also given a strong indication that this material is part of a single occupation. The specimens associated with the Avonlea/Old Women's occupation are taphonomically consistent. These specimens typically display a similar stage of weathering, although some variation is present within different portions of the site. The faunal material is well preserved and does not exhibit signs of weathering indicative of long exposure of the material prior to burial. The faunal material may have been buried relatively quickly or protected from the elements by dense vegetation. The well defined seasonality of the occupation, as interpreted from the faunal remains, also helps establish that the assemblage is part of a single, long term occupation.

Intra-site and inter-site comparisons have provided some interesting information about regional subsistence and settlement patterns. The Hartley site and the Miniota sites are presented as examples of long term habitation sites which are situated in bison wintering areas. These sites contain large numbers of highly bison specimens as well as a broad range of foetal bison elements. Migratory waterfowl and aquatic species such as fish also provide evidence that the sites were inhabited into the spring when these animals became available. The faunal material at other sites such as Lucky Strike, Roussell, Long Creek and Amisk has not been analyzed to determine a definite seasonality although the lack of foetal material may suggest that these sites are not middle or late winter occupations. The presence of aquatic species in some of the sites, such as Long Creek and Amisk, may reflect spring or late fall sites based on the seasonal round model presented by Smith (1986). Definite seasonalities need to be established, using widely accepted methods, for these occupations before these hypotheses can be confirmed.

8.4 Conclusions

The Hartley site is a good example of an Avonlea/Old Women's phase site in the mixed grasslands near the boundary of the grasslands and the Aspen Parklands. The faunal material as well as the site stratigraphy and the distribution of the diagnostic artifacts indicates that this assemblage is one occupation. The specimens in the faunal assemblage tend to display a similar stage of weathering, although some variation is present within different portions of the site. The faunal material is well preserved suggesting that the material was buried relatively quickly. The well defined seasonality of the occupation also helps establish that the faunal assemblage is part of a single, long term occupation.

In accordance with Sivertsen's model of site utility, several factors suggest that the site is a long term habitation site. These include the large amount (as compared to kill or processing sites) of pottery sherds and, to a lesser degree, lithic debitage. The large amounts of highly processed and burned bone as well as the large number of species present are also factors which suggest that the site is a habitation site. This is further supported by the presence and absence of certain bison elements of variable economic utility.

The local environment was similar to the modern environment with large expanses of prairie grasses and isolated groves of shrubs and aspen. It is not possible to determine if the site area itself was wooded at the time of occupation although the seasonality of the site suggests that wood for fires and shelter would have been a definite necessity. Based on the microtine rodents and the gastropod environmental requirements it is probable that the site area was slightly wetter than at the present time. The water table is still quite high in the area and may have only lowered since the onset of intensive agriculture.

The Hartley site faunal assemblage is one of a very few sites in the region for which a definite seasonality has been established. The site was occupied for a period of several months. The occupation appears to have begun in the late autumn/early winter and continued through to the late winter/early spring. The dominant source of meat was provided by bison. It appears that the bison were hunted in several small kills of a few animals or single animal kills which occurred quite close together in time. One larger, initial bison kill may have occurred at the beginning of the occupation. This would have resulted in a large amount of bison meat that could have been cached for the upcoming winter months. Several of the canids may also have been procured at this time. The range of foetal element ages is the strongest evidence for the procurement of a small number of bison over a period of several months. The majority of the foetal elements are from the late winter. This pattern is also seen at the Miniota site (Landals et al. 1994) and may reflect a selective procurement of pregnant cows during this time of year. Evidence of the site being occupied into the spring includes the presence of Northern Pike, ground squirrels and migratory waterfowl. Based on the relative rarity of aquatic fauna and lack of term or near term foetal elements, it is unlikely that the Hartley site was occupied much beyond spring breakup. The Miniota site and the Lebret site show the predominance of aquatic fauna in Avonlea sites which are occupied later into the spring.

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Appendix A

Bison Carpal and Tarsal Measurements

Table A1.1 Radial carpal gender data

Cat. Num.	Side	Portion	Length	Width	Depth	Sex
723	Right	Complete	31.35	29.60	44.35	•F
725	Left	Complete	31.85	24.15	45.05	F
761	Right	Complete	29.70	28.85	45.40	F
2059	Right	Complete	35.65	33.45	56.10	◊M
2414	Left	Complete	25.70	26.15	43.10	F
3115	Right	Complete	30.40	-	43.35	F
4603	Right	Complete	30.00	28.15	45.25	F
5197	Left	Midshaft	34.00	-	-	
6125	Right	Complete	31.65	27.70	49.85	M
7041	Right	Complete	30.45	27.75	44.40	F
9993	Right	Complete	31.35	29.50	44.80	F
10669	Left	Complete	29.70	27.90	44.90	F
10833	Right	Complete	29.35	27.75	42.95	F
10885	Right	Complete	29.00	-	-	
10918	Left	Complete	28.75	26.75	43.65	F
11759	Right	Complete	29.25	25.55	45.85	F
12878	Right	Complete	29.50	26.80	45.10	F
13830	Left	Complete	32.10	26.35	43.30	F
13929	Left	Complete	34.55	30.70	48.15	M

• Female / Immature. ◊ Male.

Table A1.2 Intermediate carpal gender data

Cat. Num.	Side	Portion	Length	Width	Depth	Sex
561	Right	Complete	30.40	31.55	44.00	•F
991	Left	Complete	28.75	30.90	44.45	F
1075	Right	Complete	26.75	30.25	42.45	F
1330	Right	Complete	27.25		44.00	
1420	Left	Proximal	25.80	30.70		
2089	Left	Complete	28.70	34.65	51.10	◊M
3057	Right	Complete	30.45	31.75	45.70	F
3077	Left	Complete	26.70	33.65	42.15	F
3370	Right	Midshaft	27.85	31.60		
3513	Left	Complete	26.85	32.15	41.90	F
4362	Left	Complete	28.20			
4530	Right	Complete	32.25	35.55	42.00	F
5190	Left	Complete	28.45	29.60	42.20	F
6677	Right	Proximal	26.20	29.10		
6999	Left	Complete	29.65	33.95	44.30	F
7042	Right	Complete		32.25	45.30	F
7860	Right	Midshaft		34.20	41.25	F
10542	Right	Complete		29.95	41.25	F
10825	Right	Complete		36.10	45.00	F
10844	Right	Complete		27.80	42.70	F
11273	Left	Complete		29.90	40.70	F
12163	Right	Complete		38.90	47.60	M
12560	Left	Complete		33.35	42.80	F
12709	Right	Complete		31.75	44.10	F
12841	Left	Complete		29.90		
12879	Right	Complete		31.35	40.75	F
13829	Right	Complete		29.50	45.75	F

• Female / Immature. ◊ Male.

Table A1.3 Ulnar carpal gender data

Cat. Num.	Side	Portion	¤anter. L	‡post. L.	Depth	Sex
801	Left	Complete	32.20	39.90	37.00	•F
1419	Left	Complete	* 33	37.00	39.50	◊M
3078	Right	Complete	32.40	38.20	38.30	F
3472	Right	Complete	32.00	40.00	41.50	M
3507	Right	Complete	33.00	39.50	40.60	M
4592	Right	Complete	32.40	* 38.7	38.20	F
5034	Right	Proximal	* 29.8			
6020	Right	Complete	31.00	36.70	37.50	F
7069	Left	Complete	31.00	37.50	39.50	F
7177	Right	Complete	31.10			
10919	Right	Complete	29.90	37.30	35.70	F
11242	Right	Complete	34.80	38.90	41.20	M
12686	Right	Complete	29.00	* 36.5	37.10	F
12691	Right	Complete	32.00	40.10	38.10	F
13017	Left	Complete	24.80	31.10	32.00	F
13179	Right	Proximal		34.20		
13183	Left	Complete	35.00	* 41	40.00	M
13186	Left	Complete			* 38	
13466	Right	Complete	29.60	36.00	35.80	F
13467	Right	Complete	30.60	38.00	35.00	F
13746	Left	Complete	29.00	36.90	37.60	F
13920	Left	Complete	34.50	42.80	39.80	M
13960	Right	Complete	30.20	40.10	38.00	F
14066	Left	Proximal		35.40		
14129	Right	Midshaft	33.00			

• Female / Immature. ◊ Male. * Estimated measurements on weathered specimens. ¤ Anterior length. ‡ Posterior length.

Table A1.4 Fused second and third carpal data

Cat #	Side	Portion	Width	Depth	Sex
706	Right	Complete	41	39.9	◊M
2954	Right	Complete	39	36	•F
3079	Right	Complete	39.8	* 38	F
3105	Right	Complete	36	35.2	F
4132	Right	Complete	39.8	37	F
4361	Left	Complete	38.3	36.5	F
5201	Left	Complete	41.4	40.1	M
5368	Left	Complete	* 40.4	* 37.1	F
5999	Right	Complete	46.6	42.1	M
7377	Right	Complete	* 38	* 36	F
8554	Left	Midshaft	42.6	* 39.6	M
9920	Right	Midshaft	34.6	* 33	F
10535	Right	Complete	37.2	33	F
10686	Right	Complete	39	36.2	F
10836	Left	Complete	38.8	36.3	F
10923	Right	Complete	39	36	F
12320	Left	Complete	44	41.1	M
12865	Right	Complete	36.1	34.8	F
13027	Left	Complete	42.1	41	M

• Female / Immature. ◊ Male. * Estimated measurements on weathered specimens.

Table A1.5 Fourth carpal gender data

Cat Num	Side	Portion	Length	Width	Depth	Sex
582	Right	Complete	27.5	32.2	35.4	•F
2498	Left	Complete	28.2	33.2	34.8	F
3080	Right	Complete		30.1	34.1	F
3098	Right	Proximal	25.2	31.1		
3662	Right	Proximal	28.2	30.8	34.6	F
4803	Left	Complete	24.1	25.7	29	F
7055	Right	Complete	25.2	27	31.8	F
7158	Right	Complete	26.7	33.1	34.3	F
8614	Right	Complete	26	31.8	32.3	F
8686	Right	Midshaft	25.5	28.2		
10638	Left	Midshaft	30			
10821	Left	Complete	28.5	34.5	37.4	◊M
10840	Right	Complete	26.2	30.6	33.8	F
10843	Right	Complete	25.6	29.1	31.7	F
12526	Right	Complete	24.9	30.8	36.4	F
12953	Left	Complete	23.7	25.1	31.7	F
13912	Left	Complete			32.1	
13941	Right	Complete	29.4	30.1	29.7	F
13965	Right	Complete	25.8	31.2		
13970	Right	Complete		28	31.8	F
13979	Right	Complete	25.8	29	32.8	F
14008	Right	Complete	28.6	31.4	33.6	F

• Female / Immature. ◊ Male.

Table A1.6 Talus gender data

Cat #	Side	L l	L m	W p	W d	D l	D m	Sex
87	Left	75.2	72.4	48.8	48.8	41.3	42.7	•F
198	Left	79.5	75.6	51.3	47.2	44.1	42	◊M
470	Right	77.2	72.9	53.7	53.5	42.2	44.1	M
3468	Left	77.3	74	52.9	51.9	43.1	42.1	M
4137	Left						46.1	
4344	Left	71.2	68.8	49.3	47.2	39.1	39.1	F
5396	Left	74	66.3	46.7	45.8	40.8	38.1	F
5501	Right	72.3	66.3	45.5	46	40	34.6	F
5545	Right	78	72.1	53.5	50.8	43.1	40.2	M
5638	Right	78	71.1	51	50.6	42.5	40.1	F
6018	Left				52	44.2		
6333	Left	72	68.9	49	50	40.6	40	F
6343	Left	71.9	65.5	46.5	45.5	40.5	37.5	F
7027	Right				48	41		
7031	Left	75	69.6	49.2	49.2	42.5	39	F
7045	Left				48.4			
7060	Right		69	48.2			40	F
7125	Left	74	67.8	51.2	48.2	40	39.5	F
7154	Left	77.2	71.3	50	47.1	42.9	38.1	F
7457	Left	72.6	67.5	48.1	47	39.9	39.1	F
7855	Right	78.1	73.6	51.7	50.5	42.7	42.1	M
7865	Right		71.3	50.6			40.8	F
9928	Left	77	72.1	54	48	41.1	41.1	M
10682	Left	72	68.5	47	46	39.1		F
10687	Right	73	68	48.1	46.6	40.1	39.1	F
10928	Left	75	70.1	50.9	48.5	40.6	39.2	F
11861	Right	76.1	70.5	53.8	51.5	43.2	38.1	M
12697	Right	73.2	69.3	51.4	49.7	40.7	41	F
13034	Left	77	70	53.7	49	40	39.6	M
13981	Left	72.1	71.5	50	47.8	40.2		F
14001	Left	73.8	70	50.7	47	42.4		F

• Female / Immature. ◊ Male. Ll:Length lateral. Lm:Length medial. Wd:Width distal. Wp:Width proximal. Dl:Depth lateral. Dm:Depth medial.

Table A1.7 Calcaneous gender data

Cat #	Side	Age	L	Wp	Dp	Wd	Dd	Lt	Lc	Sex
249	Right	UF	145.6			41.5	56.6	34.1	36	•F
375	Right	UF		32.7	38.2					
452	Right	UF			48					
468	Right	UF	155			47	62.1	35.7	41.2	◊M
593	Right	?				43	57	35.1	40.2	F
679	Left	F	143	38	39.1	44.1	57.1	32.1	37.2	F
1034	Right	UF						32		
1133	In Sid	UF		34.2	40.2					
1658	Right	UF				*43.2		33.2		
1733	Left	?					58.6	32.1	38	
2912	Right	UF		35	41					
2950	Left	UF				*44.2	58.1	33.1	38	F
3034	Right	?					60.4	*34.2	39.5	
3035	Right	UF	151.1	37	41.2	45.4	60.8	36.1	*39	M
3439	Left	F	*139		*37			*32		
3446	Left	?				40.2		30.5		
3855	Right	F		37.1	38					
4139	Left	UF	124	*31.1	*31.2	39	53.5	*31.8	*37.5	F
4510	Left	UF				40.1	55.6	32	38.1	F
4606	Left	UF					51.9	*33.1	*33.2	
4629	Left	F	141.1		36	41.2	56.7	35	38.2	F
4631	Left	UF				45.7	61.2	33	43	M
6353	Right	UF				*40.1		27.6		
6456	Left	F	*145							
7135	Left	UF		34.1	33.1					
7869	Right	UF		35	40					
7997	Right	UF	152			45.2	59.1	33	41.1	F
9724	Right	?					59.1	*34.2	*39	
10665	Right	UF				40.5		33		
10694	Right	?							36.8	
11252	Left	F	150.1		37	*41.1		*31.2		
11303	Right	UF				42	59	35.1	39.8	F
12312	Left	F	144.7	37.2	38	43	60	34	38.8	F
12674	Right	UF		33	39.1					
12687	Right	F	151.1	38.1	41	44.1	63	36	41	M
12746	Left	UF				45.1	63	33.9	39	M
13726	Left	F		40.1	*39.8			*32.2		
13766	Left	UF		41.2	44					
13987	Left	?							34.8	
14086	Left	UF	158.2			47.2	61	32.8	44	M

• Female / Immature. ◊ Male. * Estimated measurements on weathered specimens. L:Length. Wp:Width proximal. Dp:Depth proximal. Wd:Width distal. Dd:Depth distal. Lt:Length talus facet. Lc:Length central and fourth tarsal facet.

Table A1.8 Fused second and third tarsal gender data

Cat Num	Side	Portion	Width	Depth	Sex
405	Right	Complete	23	34.9	•F
467	Right	Complete	29.2	41.2	◊M
1168	Left	Complete	30.3	41.5	M
1259	Right	Complete	25.6	38.2	F
1260	Left	Complete	24.1	31.1	F
1620	Left	Complete	25.4	35.2	F
1636	Left	Complete	24.6	38.2	F
2106	Right	Complete	30	42.7	M
2911	Left	Complete	24.2	36.8	F
3064	Right	Proximal	23.3	35.8	F
4386	Left	Complete	22.9	37.6	F
5507	Left	Complete	24.4	38.3	F
5644	Left	Complete	25.2	37.7	F
6340	Left	Complete	25.6	38	F
7859	Left	Complete	26.1	39.3	F
10760	Right	Complete	23.3	36.3	F
12046	Left	Complete	22.5	32.8	F
12861	Right	Complete	26	39.6	F
13902	Right	Complete	* 22.9	* 35.1	F
14127	Right	Complete	23	29.3	F

• Female / Immature. ◊ Male. * Estimated measurements on weathered specimens.

Table A1.9 Fused central and fourth tarsal gender data

Cat Num	Side	Portion	Width	Depth	Sex
255	Left	Complete	62.5	* 58.5	◊M
258	Right	Complete	60.5	59.8	M
466	Right	Complete	65	63	M
800	Left	Complete	59	57.8	•F
2171	Right	Complete	57.2	56.1	F
2716	Left	Complete	51.3	53.6	F
3017	Right	Complete	* 51.6	58	F
3018	Right	Complete	* 53.5		
4136	Left	Complete	53.3	53.7	F
4342	Left	Complete	55.7	56.8	F
4523	Left	Complete	55	53.8	F
6004	Left	Complete	58.1	58.8	F
6121	Left	Complete	* 56.8	56.1	F
6133	Left	Complete	62.1	65	M
6339	Left	Complete	60.1	62.4	M
7130	Left	Complete	* 57	* 58	F
7139	Right	Complete	* 57	* 56	F
7861	Right	Complete	62.2	62	M
10685	Left	Complete	55	58.8	F
10691	Right	Complete	56	55.3	F
11285	Right	Complete	58.2	57.2	F
11289	Left	Complete	65.2	63	M
12714	Left	Complete	58	54.5	F
13418	Right	Complete	57.8	58.6	F
14096	Left	Complete	* 52.3	46.7	F

• Female / Immature. ◊ Male. * Estimated measurements on weathered specimens.

Table A1.10 Lateral malleolus gender data

Cat Num	Side	Portion	Length	Depth	Sex
472	Right	Complete	27.9	39.6	◊M
708	Right	Complete	26.5	34	•F
716	Left	Complete	28.1	35	F
856	Left	Complete	26	35.9	F
1221	Right	Complete	27.7	35	F
1331	Right	Proximal	23	33	F
1371	Right	Complete	30.2	41.5	M
2178	Left	Complete	29.2	41	M
2826	Left	Complete	25	30.9	F
3066	Right	Proximal		33	
4899	Right	Complete	31.1	39.9	M
5989	Right	Complete	29.2	37.1	F
6173	Right	Complete	28.6	35.1	F
6354	Right	Midshaft	35.7		
6727	Right	Complete	26.5	34.1	F
7155	Left	Complete	29.7	35.7	F
10081	Right	Complete	26.7		
10820	Left	Complete	28.2	36.2	F
11288	Left	Complete	23.9	34.2	F
11910	Right	Complete	27.7	36	F
12734	Right	Complete	27	35.1	F

• Female / Immature. ◊ Male.