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It is entitled The Influences of Ecosystem Variability on Prehistoric Settlement: Testing Terrain-Based Locational Models for the Upper Basin, Northern Arizona

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THE INFLUENCES OF ECOSYSTEM VARIABILITY ON PREHISTORIC SETTLEMENT: TESTING TERRAIN-BASED LOCATIONAL MODELS FOR THE UPPER BASIN, NORTHERN ARIZONA

A thesis submitted to the

Division of Graduate Studies and Research
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by

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B.A., University of Cincinnati, 2001

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ABSTRACT

This thesis evaluates hypotheses concerning ancestral Puebloan (a.k.a. Anasazi) and Cohonina land-use of the Grand Canyon region. I examine the distribution of masonry ruins with respect to the Upper Basin's soil characteristics, climax vegetation species and economically important plants, and processes of erosion, to determine the extent to which these environmental factors influenced prehistoric settlement through time. In order to place masonry structures in time periods, a new ceramic chronology was developed using tree-ring verified dates for ceramics present in the Upper Basin. Occupational variability is assessed by determining artifact density, structure and room sizes, and rates of room construction through time. Conclusions concerning the land-use of the Upper Basin study area are drawn from archaeological data collected by the Upper Basin Archaeological Research Project (UBARP) and terrestrial ecosystem data supplied by the USDA Forest Service. I demonstrate that occupational intensity and duration in the Grand Canyon region were highly variable year-to-year, and thus many traditional environmental variables employed by settlement archaeologists are not effective in determining prehistoric land-use and settlement location in the Upper Basin.

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ACKNOWLEDGEMENTS

I would first like to express my gratitude to Dr. Alan Sullivan. He offered me the opportunity to be a part of the Upper Basin Archaeological Research Project (UBARP) and always made sure I had whatever was necessary to accomplish my goals. Without his generous support and advice throughout my undergraduate and graduate career this thesis and my education would not have been possible. I also thank Dr. Lynne Schepartz for serving on my committee. Her direction and insightful comments greatly improved the quality of this thesis. Finally, I would like to thank Danica Farnand and my parents, Mike and Mary, for their encouragement and support.

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CHAPTER 1:

INTRODUCTION

The Grand Canyon region has long been an arena for inquiry into the nature of the relationship between human behavior and the natural environment (Gummerman 1988). Frequently, researchers employ settlement-pattern and paleoenvironmental data to elucidate this relationship in the hopes of constructing overarching land-use models for the region (Dean 1988; Euler and Chandler 1978). These models depict prehistoric populations as being intimately tethered to elements in the natural environment, articulating, most notably, with distributions of arable land and water resources.

All too often, an oversimplified interpretation of ancestral Puebloans as an agriculturally-dependent people is made without considering other adaptive possibilities including the exploitive potential of their natural environment (Sullivan and Ruter in press). This restrictive agricultural view assumes that individuals are fixed in their environment, thereby imposing strict restraints on choices concerning livelihood opportunities. In the face of climatic and/or environmental fluctuation, inhabitants have one alternative to farming intensification - migration to a more agriculturally feasible locale.

Recently, Sullivan and his colleagues put forth a new model of Grand Canyon land-use (Sullivan et al. 2002). Derived from work in the Upper Basin, an area in the Kaibab National Forest between the Grand Canyon's South Rim and the Coconino Plateau, the "cross-canyon" model hypothesizes that inhabitants subsisted principally on wild resources and inhabited perennial structures in all but the late spring and summer months during some years. Depending on highly variable spring precipitation,

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populations may have temporarily abandoned their Upper Basin home to pursue agriculture on the North Rim and take advantage of the perennial waters of the Inner Canyon.

The local "elastic" environment is seen as highly modifiable in that resident populations can manipulate it by burning or intensifying hunting and gathering (Sullivan 1996). Instead of prehistoric Grand Canyon inhabitants being at constant risk in a volatile environment, they are well prepared to adapt to the ebb and flow of environmental and climatic fluctuations, feeling at home in their native land.

The goal of this thesis is to evaluate the "cross-canyon" land-use model with the most recent settlement pattern data from the Upper Basin. Several data requirements must be met in order to assess this model. First, I will describe the environmental variability of the Upper Basin and define different environmentally unique areas within the study area in terms of soil characteristics, climax vegetation species and economically important plant variability, and processes of erosion (Brewer et al. 1991).

Second, in order to control for settlement variability through time, I will develop a new ceramic chronology using the most up-to-date controlled surface archaeological data from 207 masonry ruins. I will assign prehistoric structures to one or more of five periods, spanning the 275 year occupation of the Upper Basin, based on when they were most likely to have been inhabited. Ware groups will be assigned to all structures according to culturally diagnostic assemblage components.

Third, occupational variability through time will be assessed. The objective of these analyses is to reveal preferential environmental characteristics. Fluctuations in land-use intensity will be assessed by calculating room construction rates, structure size

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variation, and variability in artifact density. I will explore these results and present hypotheses to account for the distributions of these archaeological phenomena. Finally, I will assess the "cross-canyon" land-use model in view of these new findings, and conclude that there is more evidence to support this model than the current Colorado Plateau-wide land-use models.

Organization

Following this introduction, Chapter 2 describes the methods used to collect the archaeological data for this thesis. Survey and artifact enumeration methods will be discussed along with the specifications of any technical equipment used. Post-field data processing, including differential correction, data entry, and archiving will also be covered.

Chapter 3 examines the environmental variation of the Upper Basin. Terrestrial ecosystem data manipulation and variable definitions will be discussed. The study area will be analyzed in terms of each variable's value and its extent throughout the landscape. Each terrestrial ecosystem unit will be described by the defining characteristics of its set of variable values.

Chapter 4 presents a new ceramic chronology for the Upper Basin. Tree-ring verified dates are assigned to ceramics present at masonry ruins. Three broad temporal periods are established and subdivided to create five occupational periods during the 275 years in which the Upper Basin was inhabited.

Chapter 5 discusses the occupational variation within the study area. Preferential environmental characteristics are traced through time. Occupational intensity is assessed

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by calculating room constructions rates, structures size, and artifact density variation for each occupational period.

Chapter 6, the conclusion of this thesis, presents a number of hypotheses to explain the variation documented in the previous chapters. The "cross-canyon" model will be assessed in terms of the new findings regarding environmental preferences and occupational intensity.

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CHAPTER 2:

METHODOLOGY

Survey Methods

The archaeological data used in the thesis were collected over a 14-year period (1989-2002) by the Upper Basin Archaeological Research Project (UBARP), located in northern Arizona between the South Rim of the Grand Canyon and the Coconino Rim (Fig. 2.1). The UBARP survey was initiated after the excavation of a late Pueblo II Anasazi structure, Site 17, produced evidence that disconfirmed many archaeologists' expectations that one- and two-room masonry structures in the Upper Basin were fieldhouses (Sullivan 1986). Rather, the relative lack of corn at the four-room site with a pottery manufacturing area suggested that there was considerably more variation with regard to land-use, settlement, and subsistence strategies in the Grand Canyon region, including the Upper Basin, than was initially proposed (e.g., Effland et al. 1981; Rice et al. 1980). Thus, the UBARP survey commenced with the goal of determining the land-use strategies employed in the Upper Basin while documenting the human impact on the forest's landscape.

Since the excavation of Site 17, UBARP has intensively surveyed 16.4 square kilometers of Upper Basin terrain (Fig. 2.2) at least twice from two different directions by surveyors spaced no more than 10 meters apart (Figure 2.3). Because of this rigorous inspection -known as double-intensive survey- the presences and absence of the vast majority of surface archaeological phenomena within the study area are well known and highly documented.

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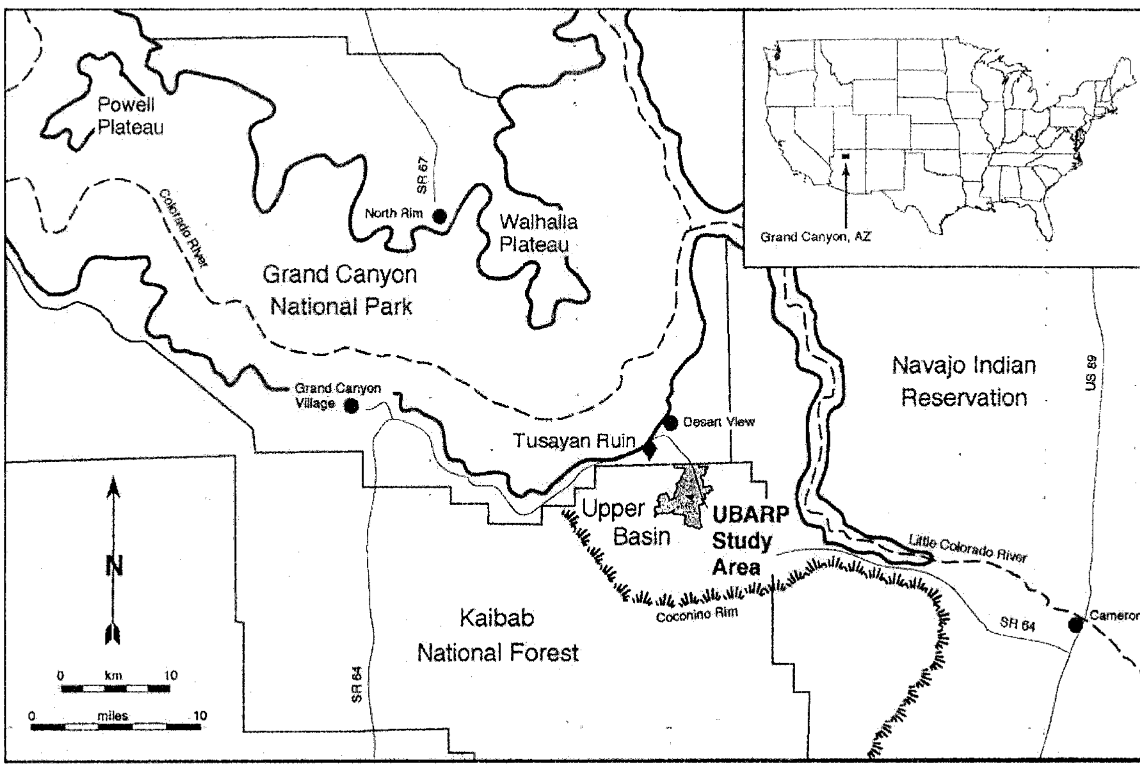

Figure 2.1. The eastern Grand Canyon region in northern Arizona.

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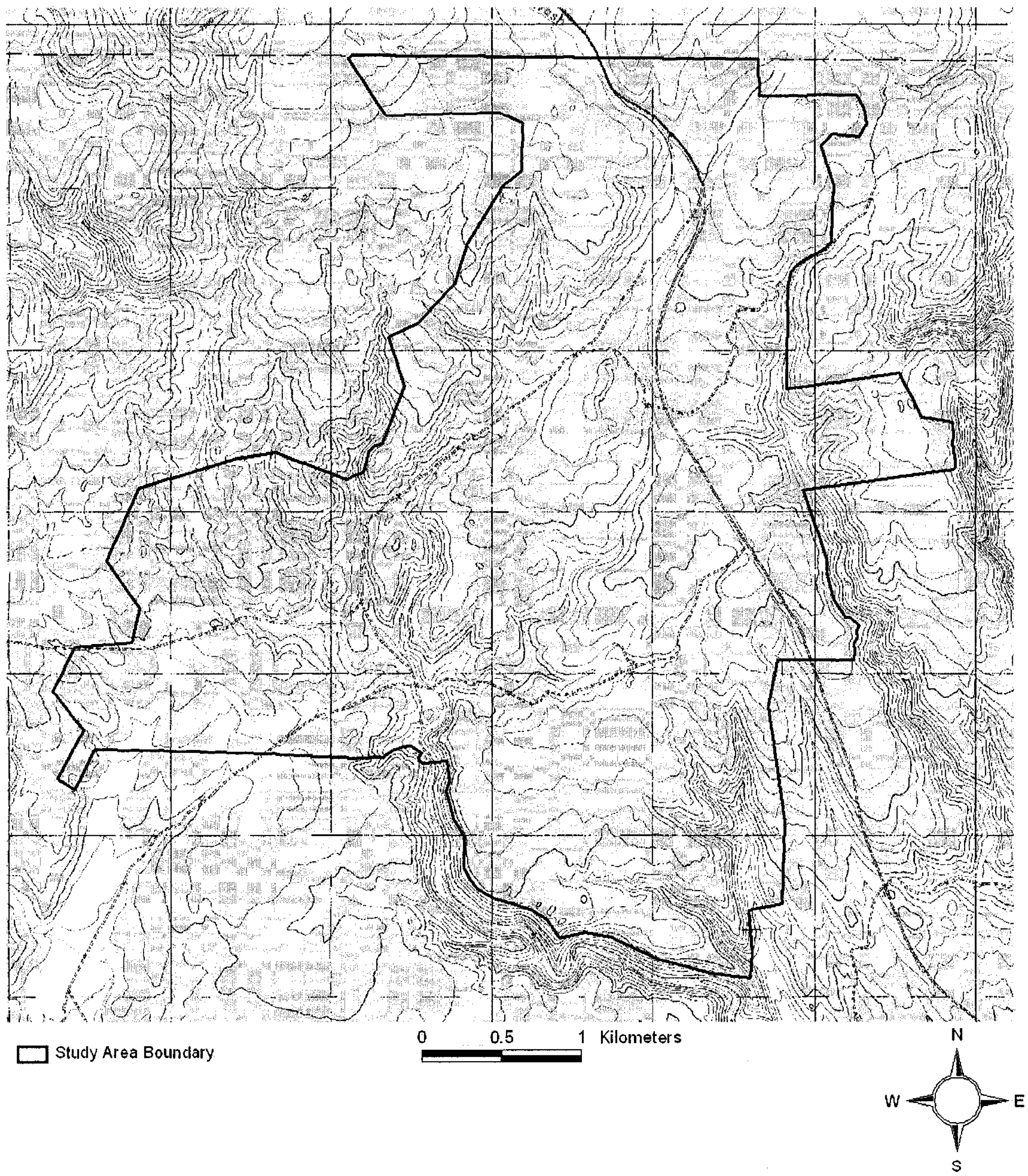

Figure 2.2. Upper Basin Archaeological Research Project study area as of 2002.

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Figure 2.3. Intensive survey in the Upper Basin.

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Lithic and ceramic artifacts observed during survey are recorded on transect forms. When architecture, features, or clusters of artifacts are observed, a Mapping Unit (MU) is established. The "MU" is employed as the unit of observation, rather than the conventional "site" taxon, because it is common to find a protohistoric feature (e.g., a Cerbat encampment) intruded into a prehistoric masonry room block, both of which were subsequently overlain by a historic brush structure (Sullivan et al. 2002). The MU concept allows for each of these phenomena to be recorded separately, without inferring associations in the field. Three mapping units would be assigned for the previous example.

At the centroid of each MU, a GPS reading is taken that records the UTM coordinates of the MU (Fig. 2.4). In order to acquire precise proveniences for each MU, Trimble GeoExplorer IIIs are employed on survey, capable of providing accurate locations within 5 m if the differential correction procedure is followed properly. Differential correction involves a technique for reducing navigation message ephemeris and satellite clock errors in GPS-derived positions by using additional data from a reference GPS base station receiver at a known position. In conjunction with the UTM coordinates, other various observations are made dependent on the archaeological phenomena encountered, including rubble mound dimensions and number of rooms for each masonry ruin (Appendix A).

An artifact-enumeration unit (AEU) is also established at each masonry ruin to record artifact density and assemblage diversity data (Fig. 2.5). AEUs provide a way to acquire a representative sample of the structure's artifact assemblage while controlling for site size. All artifacts are pin flagged in and around the masonry room block. A 5 m

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diameter circle is inscribed around the densest location of artifacts, usually in front of the room block (Fig. 2.6). Great care is taken to avoid areas where erosional or depositional processes are clearly affecting artifact density and variety. Artifacts are then identified and counts for each type are recorded on AEU forms (Appendix B).

Finally, terrain and landform are described and recorded and black and white photographs are taken of the structure and environmental setting. As of the 2002 field season, 207 masonry ruins have been recorded in the aforementioned fashion. These archaeological data constitute the bulk of the dataset for this thesis.

Figure 2.4. Recording UTM coordinates at a fire-cracked-rock pile with a GPS rover.

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Figure 2.5. Masonry ruin rubble mound.

Figure 2.6. Data collection at an artifact enumeration unit at a masonry ruin.

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Post-Survey Methods

At the end of each field day, the UTM coordinates collected for that day are differentially corrected. This procedure involves downloading the corresponding base station data for each UTM position. Base station data are provided by a number of regional USDA Forest Service offices, for example Prescott, AZ, and Cedar City, UT. The base station files contain positions of a known point recorded constantly for every hour of the day. The difference between the known point location and the recorded point location allows for error calculation (Trimble 2002). This error calculation is then applied to the positions recorded by the hand-held units resulting in a more accurate position, usually within 5 m.

The corrected GPS recorded locations and data dictionary informaton are imported into the UBARP Access database using Trimble's Pathfinder Office software. The Access database allows for the new survey data to be appended to the existing survey dataset. The updated survey data is then integrated into the existing UBARP GIS[1].

In contrast to the automated GPS and GIS procedures, the data recorded on AEU forms are entered into an AEU Access database manually. From UBARP Access, data tables can be created and imported into SPSS for statistical analysis. Eventually, this step will become obsolete as data collection procedures are developed to record AEU information digitally through palm devices (e.g., Trimble GeoExplorer CE, Trimble Pathfinder Pocket & palm-top computer).

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CHAPTER 3:

ENVIRONMENTAL VARIATION

The Upper Basin is a downfaulted block of the Coconino Plateau that is approximately 363 km^2 in area (Babenroth and Strahler 1945; Barnes 1987; Huntoon 1990). Elevation varies between 1,860 m in Lee Canyon to 2,256 m at Desert View. In the north, the basin is densely covered with pinyon-juniper woodland with intermittent patches of grass and sage. To the south, the woodland thins to scattered juniper and eventually to sagebrush and grasslands. Paleoecological evidence (Cole 1990) suggests that this vegetation pattern developed well before the earliest evidence of humans in the region (2000 B.C.) and continued until historic times with the exception of the effects of burning (Sullivan 1996).

Terrestrial Ecosystem Variables

Ecosystem data from the *Terrestrial Ecosystem Survey of the Kaibab National Forest* (TES) (Brewer et al. 1991) were used to determine the range of variation in the natural environment of the Upper Basin. A terrestrial ecosystem is defined by the interaction among three major components: soil, water, and vegetation (Brewer et al. 1991). TES environmental data for the Upper Basin study area were obtained from the USDA Forest Service in the form of an ArcInfo file. Contained within this file were the polygons of the terrestrial ecosystems of the entire Kaibab Ranger District. For this analysis, the Kaibab Ranger District coverage was clipped in order to produce a file that contained only the TES information contained within the UBARP study area. Therefore,

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a shape file containing borders of each ecosystem (Fig. 3.1) and corresponding TES data were used to determine the TES unit composition of the UBARP study area.

Not all data contained in the USDAFS TES study were found to be useful because many of the variables pertained to contemporary management concerns or their values were the result of modern management practices, e.g., *roadfill suitability, off-road vehicle trail potential*. Therefore, an appropriate subset of 10 variables for each ecosystem's dataset was selected: *soil taxa*, *soil phase*, *climax vegetation class*, *soil loss potential*, *natural soil loss*, *vegetal ground cover*, *potential productivity of herbaceous and woody plants*, *potential productivity of forage/food plants*, *potential productivity of fuel wood*, *topsoil suitability*, and *susceptibility to erosion*.

The soil taxon is defined for each unit by one of three nominal values: (1) *fluventic ustochrepts*, (2) *lithic ustochrepts*, or (3) *typic haplustalfs*. If a TES unit contained multiple soil taxa, then the taxon with the most area was chosen to represent the TES unit because there is no differentiation between soil taxa within the TES polygons. Fluventic ustochrepts soils are an Inceptisols (i.e., soil with weakly developed horizons) subgroup that have a mesic soil temperature and a ustic (dry) moisture regime with either 0.2 percent or more organic carbon at a depth of 125 cm below the mineral surface, or an irregular decrease in organic carbon content from a depth of 25 cm to a depth of 125 cm, or to a lithic or paralithic contact if shallower, and are of a slope less than 25 percent (Soil Survey Staff 1997; Troeh et al. 1993). Lithic ustochrepts soils are a subgroup of Inceptisols (soils with weakly developed horizons) that have a mesic soil temperature and a ustic (dry) moisture regime with a lithic contact

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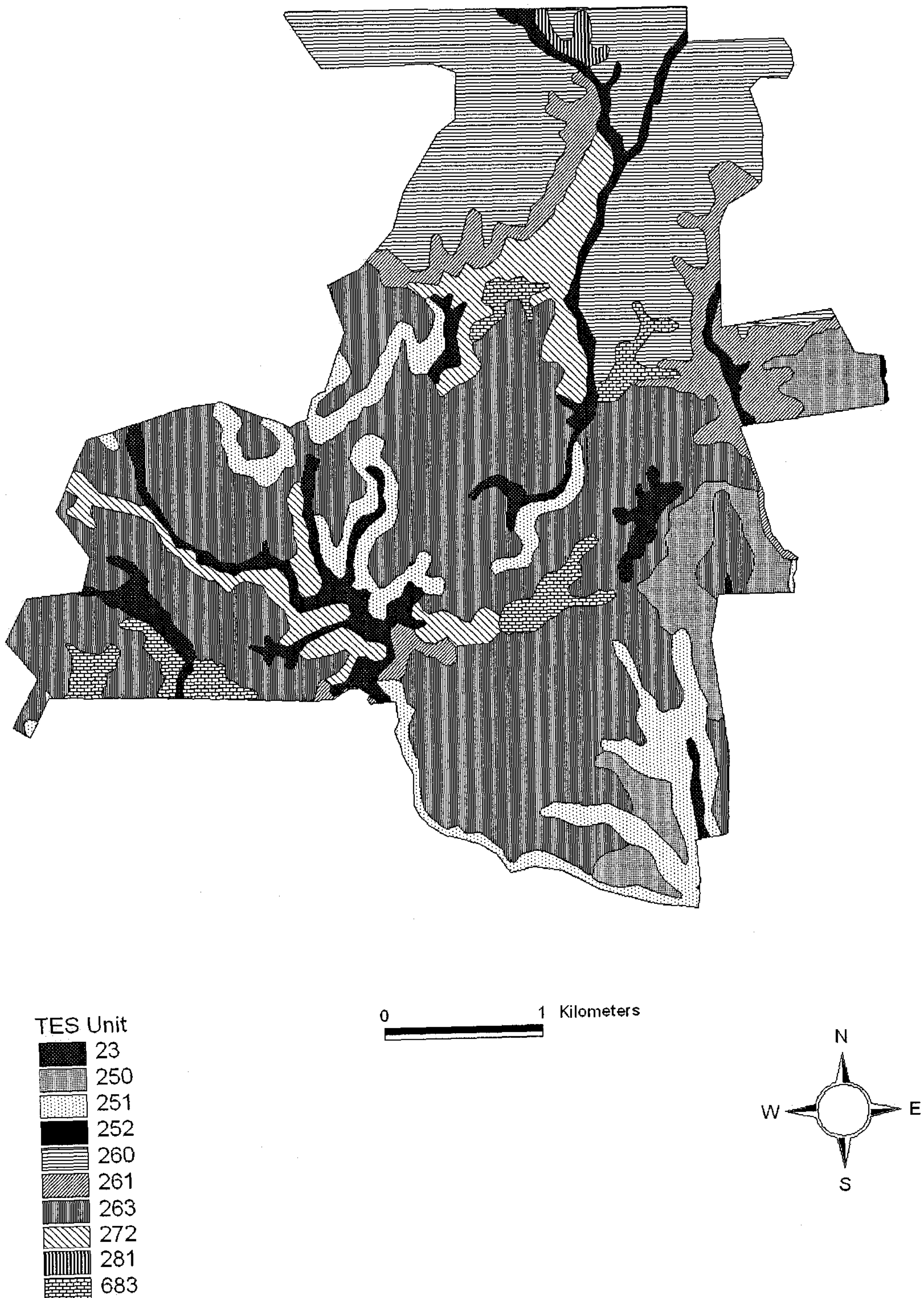

Figure 3.1. Terrestrial ecosystem survey units of the Upper Basin study area.

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within 50 cm of the mineral soil surface (Soil Survey Staff 1997; Waters 1992). Typic haplustalfs are an Alfisols (fertile soil) subgroup that have a ustic (dry) moisture regime and are considered "typical" haplustalfs (Soil Survey Staff 1997; Troeh and Thompson 1993). Lithic ustochrepts dominate the study area, comprising over 14 km^2 of the 16.4 km^2 (Figure 3.2).

The soil phase designation reflects differences in soil/environmental features and describes the texture of the soil (Fig. 3.3) (Brewer et al. 1991). Soil phase is defined by one of six nominal values: (1) *deep loam*, (2) *gravelly loam*, (3) *very gravelly loam*, (4) *gravelly, fine sandy loam*, (5) *very gravelly, fine sandy loam*, and (6) *very cobbly, very fine sandy loam*. More than 12 km^2 of the study area is categorized as either Soil Phase 3, very gravelly loam, or Soil Phase 4, gravelly, fine sandy loam (Fig. 3.4).

Vegetation class consists of climax species based on the land's potential for vegetation development (Brewer et al. 1991). Climax species groups are defined by one of six nominal values: (1) *Artemisia tridentata, Bouteloua gracilis, Pinus edulis*, (2) *Pinus edulis, Juniperous osteosperma, Artemisia tridentata, Stipa comata*, (3) *Pinus edulis, Quercus gambelii, Artemisia tridentata, Stipa comata*, (4) *Pinus edulis, Juniperous osteosperma, Quercus gambelii, Artemisia tridentata*, (5) *Pinus edulis, Juniperous osteosperma, Artemisia tridentata*, and (6) *Artemisia tridentata, Stipa comata, Agropyron cristatum, Quercus gambelii*. Not surprisingly, Classes 2 and 3 comprise more than 13 km^2 of the study area, with Classes 1, 4, and 6 accounting for roughly 1 km^2 each (Fig. 3.5).

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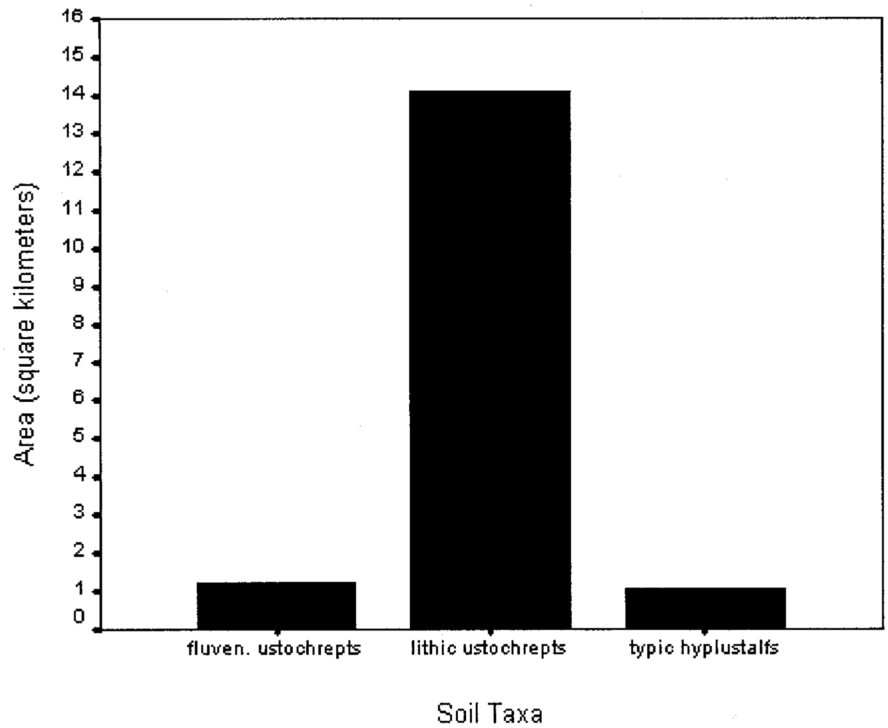

Figure 3.2. Distribution of soil taxa by area.

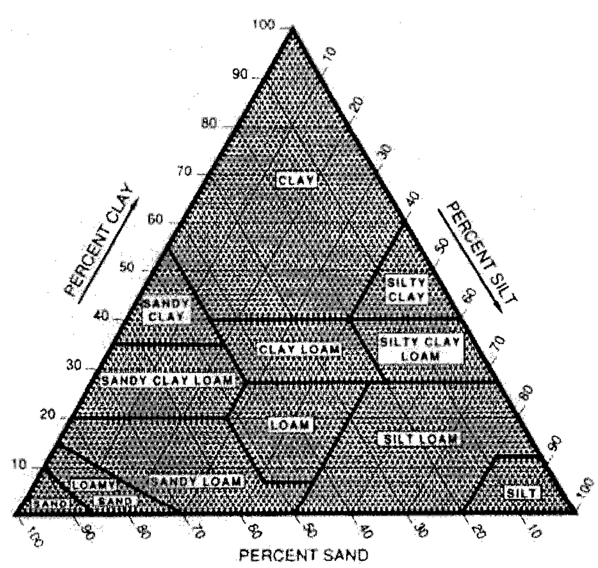

Figure 3.3. Soil textural triangle. Drawing modified from *Keys to Soil Taxonomy* (Soil Survey Staff 1997).

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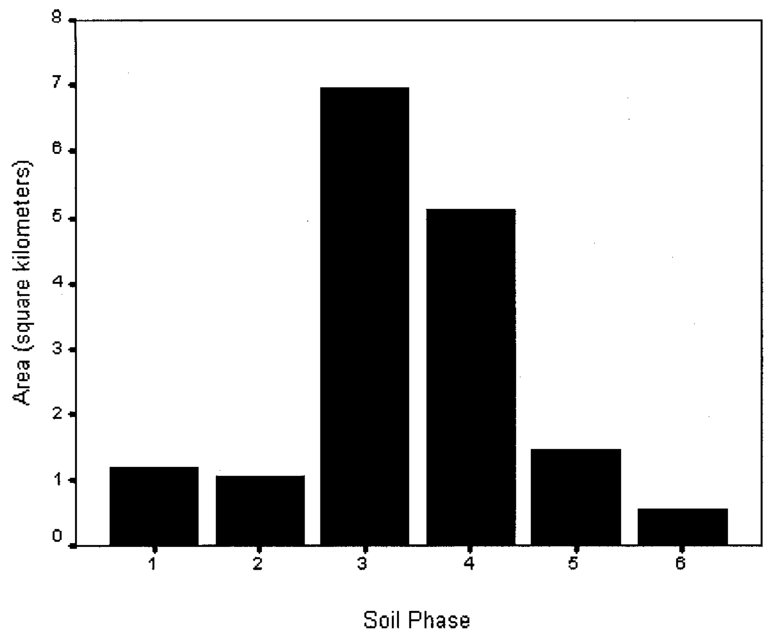

Figure 3.4. Distribution of soil phase by size (area).

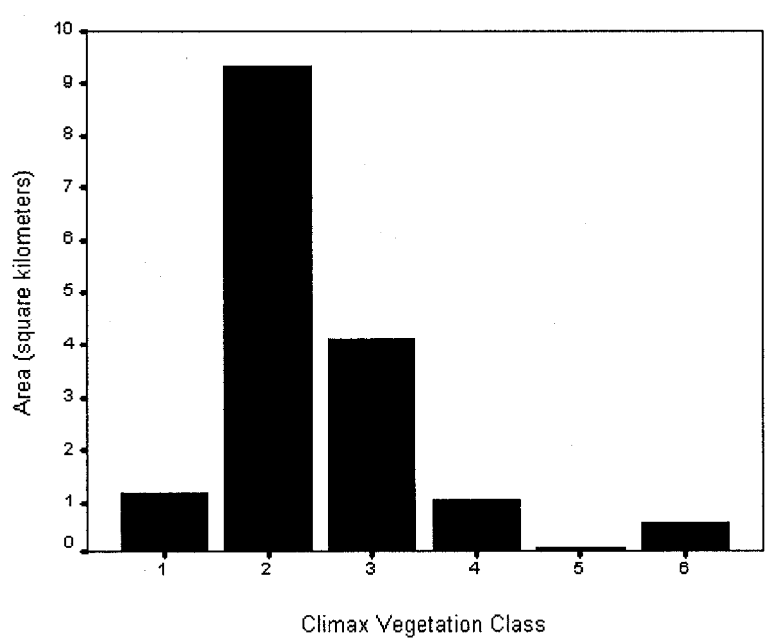

Figure 3.5. Distribution of climax vegetation class by size (area).

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Soil loss potential is the estimated rate of annual soil loss if all current vegetation were removed (Brewer et al. 1991). The far majority of the Upper Basin study area (11 km^2) is categorized at 5-6.6 percent annual loss while nearly one-third (5 km^2) of the study area varies from approximately 10 percent to 40 percent annual loss (Fig. 3.6).

Natural soil loss is the estimated rate of annual soil loss if the unit reaches its climax vegetation class (Brewer et al. 1991). Annual loss varies far less, relative to potential soil loss, with all units falling under 6 percent (Fig. 3.7).

Natural vegetal ground cover measures vegetation and litter coverage associated with the conditions of the unit's climax category (Brewer et al. 1991). Interestingly, the Upper Basin study area is dominated by two distinct classes of cover, units with 40 percent ground cover, an area of nearly 7 km^2, and units with 65 percent cover, accounting for more than 5 km^2 (Fig. 3.8).

Herbaceous and woody plant growth is measured in pounds per acre of total annual yield of all plants from the soil surface to a height of 4.5 feet (Brewer et al. 1991). While nearly half, or over 7 km^2 of the study area yields 725 pounds per acre, the remaining 9 km^2 vary widely in yields, from 425 to 750 pounds per acre (Fig. 3.9).

Forage and food plant maximum is measured in pounds per acre of total annual yield of food plants, assuming the removal of undesirable plants (juniper) (Brewer et al. 1991). Nearly 7 km^2 of the study area would yield 975 pounds per acre, while over 4 km^2 would yield 1300 pounds per acre. The remaining 5 km^2 of the study area varies widely between 525 and 1600 pounds per acre (Fig. 3.10).

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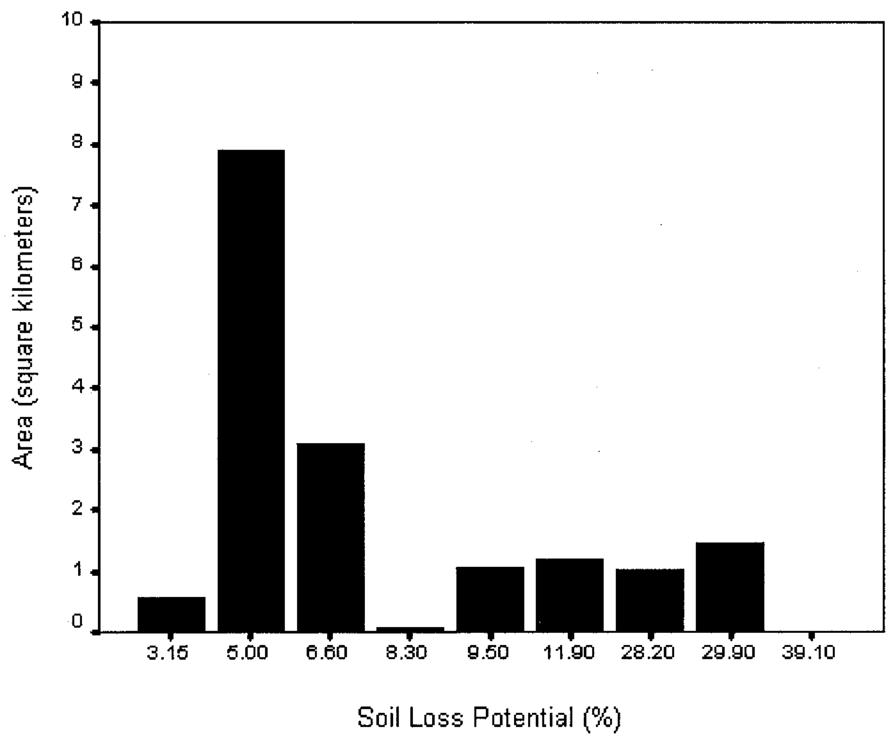

Figure 3.6. Distribution of soil loss potential by size (area).

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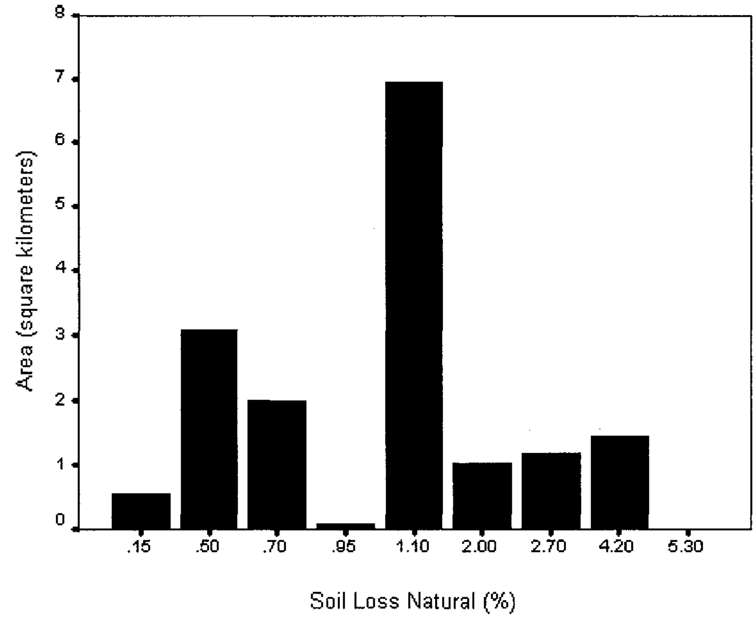

Figure 3.7. Distribution of natural soil loss by size (area).

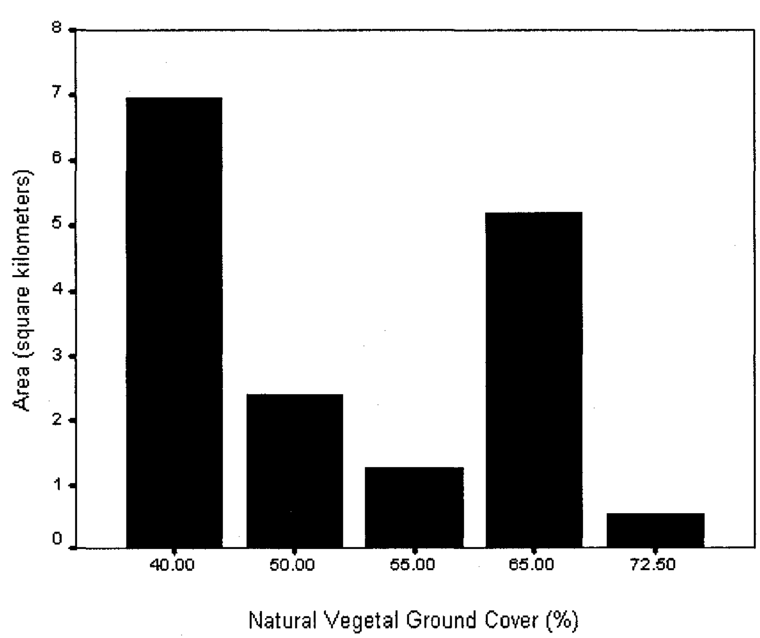

Figure 3.8. Distribution of vegetal ground cover by size (area).

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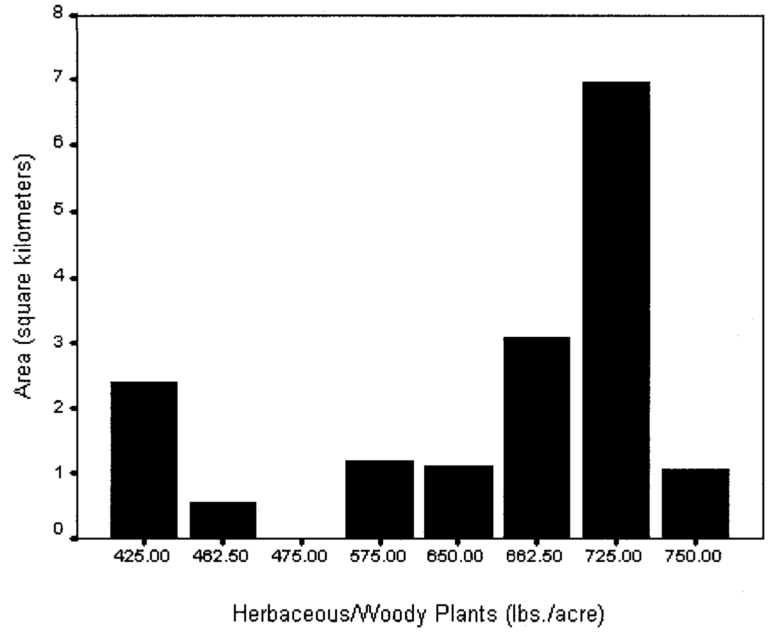

Figure 3.9. Distribution of herbaceous and woody plant mass by size (area).

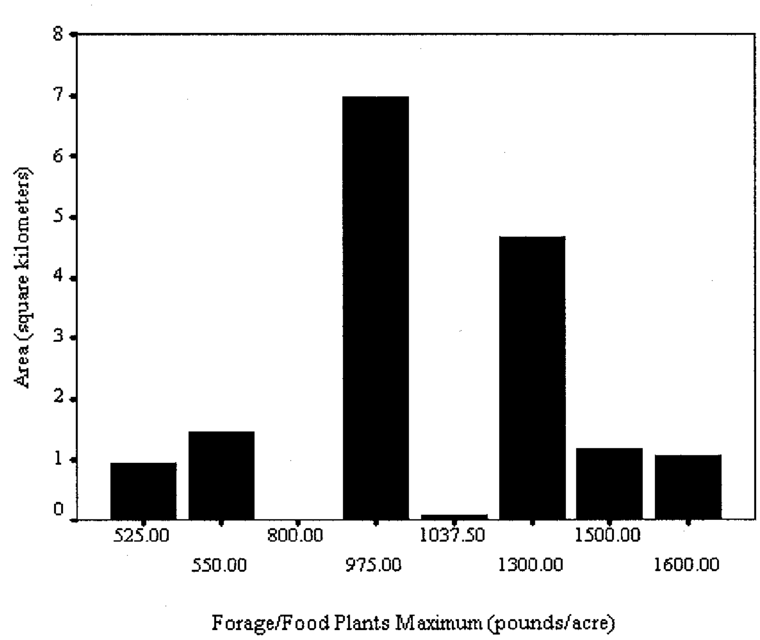

Figure 3.10. Distribution of food plant mass by size (area).

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The fuel wood measurement is expressed in cords of wood per acre. Nearly 7 km^2 of the study area would yield five cords per acre while the remaining 9 km^2 vary in yields from 0 to 14 cords per acre (Fig. 3.11).

Topsoil suitability is determined by the suitability of the top 100 cm of soil to maintain vegetation (Brewer et al. 1991). This variable is defined by one of two ordinal values: (1) *poor* or (2) *fair*. The majority of the study area, over 15 km^2, is categorized as poorly suited for use as topsoil (Fig. 3.12).

Erosion risk is determined by the relative susceptibility to erosion upon the removal of all current vegetation (Brewer et al. 1991). This variable is defined by one of three ordinal values: (1) *slight*, (2) *moderate*, or (3) *severe*. The greater part of the study area (11 km^2) is at a moderate risk to erosion, while the remaining 5.5 km^2 is nearly evenly split between a slight and a severe risk (Fig. 3.13).

Terrestrial Ecosystems of the Upper Basin

Ten TES units define the environmental variation in the Upper Basin study area. Two TES Units, 260 and 263, account for more than 60 percent of the study area (Table 3.1). Several attempts were made to group similar TES units with Ward's method cluster analyses (Everitt et al. 2001), but there were few to no similarities among the clustered groups. Because of the large amount of variation among TES units, grouping any units would eliminate many potentially important environmental differences; therefore, they were not combined. Individual descriptions of each TES unit can be found in Appendix C.

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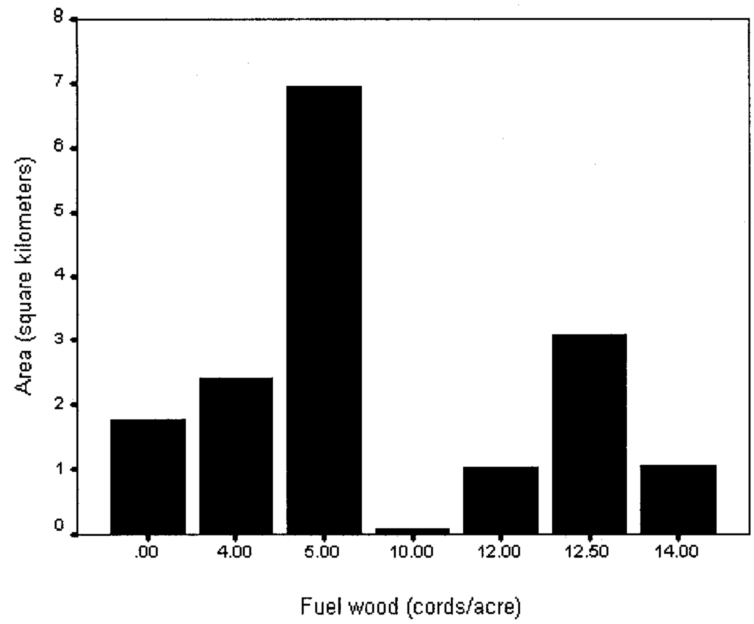

Figure 3.11. Distribution of fuel wood mass by size (area).

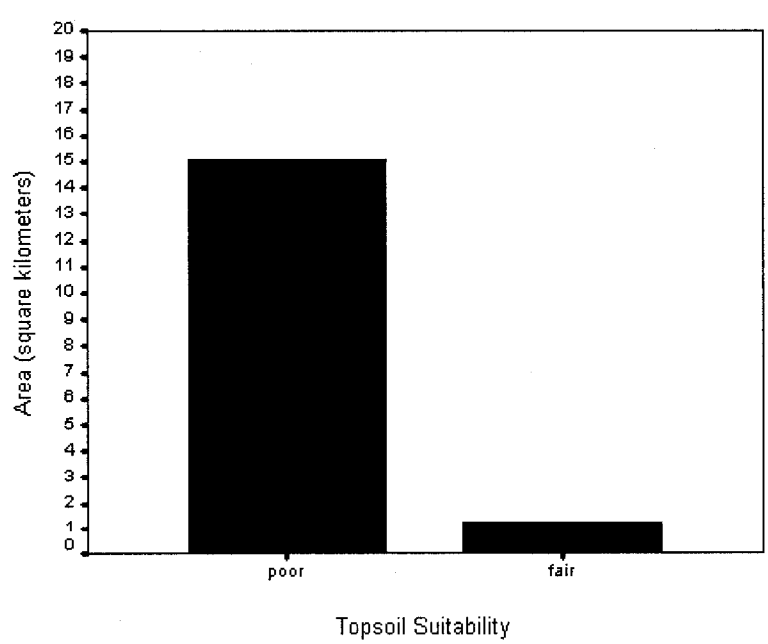

Figure 3.12. Distribution of topsoil suitability by size (area).

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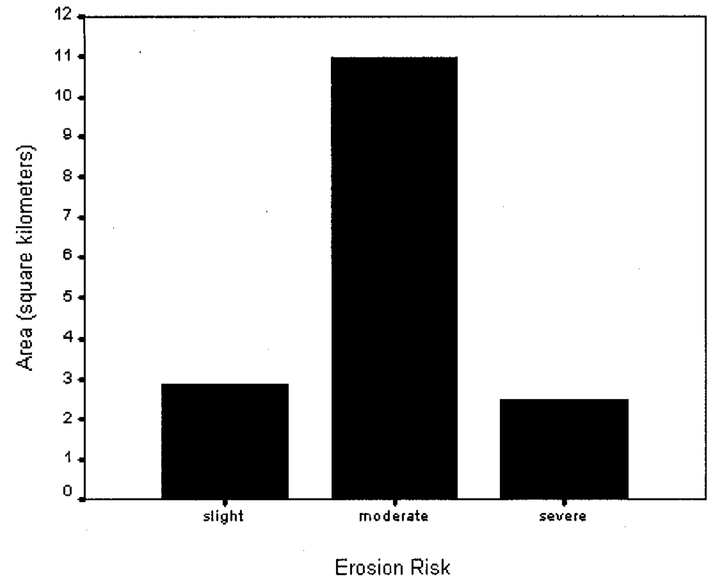

Figure 3.13. Distribution of erosion risk by size (area).

Table 3.1. Extent of terrestrial ecosystem survey (TES) units in the study area.

TES Unit	Area (km^2)	Percent of Study Area
23	1.19	7.28
250	.94	5.76
251	1.46	8.91
252	.01	.04
260	3.09	18.86
261	1.03	6.28
263	6.95	42.50
272	1.06	6.49
281	.08	.46
683	.56	3.42
TOTAL	16.37	100.00

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The ten attributes defining each TES unit can be grouped into three categories, (i) soil characteristics, (ii) climax vegetation and economically important plants, and (iii) erosional processes. These three categories are traditionally used in predicting archaeological site location (Kohler 1988; Gumerman 1988; Dean 1988). Attributes associated with soil characteristics are *soil taxa* and *soil phase*. Attributes associated with climax vegetation and economically important plants are *climax vegetation class*, *vegetal ground cover*, *potential productivity of herbaceous and woody plants*, *potential productivity of forage/food plants*, and *potential productivity of fuel wood*. Attributes associated with erosional processes are *soil loss potential*, *natural soil loss*, and *susceptibility to erosion*. The influence that these variables have on structure location in the Upper Basin will be evaluated in Chapter 5.

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CHAPTER 4:

CHRONOLOGY & CULTURAL AFFILIATION

A ceramic chronology was developed to trace occupational variability through time. Using a combination of Colton's (1955, 1956, 1958), Breternitz's (1966), and Sullivan et al.'s (1995) analyses, date ranges (Fig. 4.1) were established for all ceramic types that have been observed in the study area (Appendix D).

Occupational Ranges

Each mapping unit was assigned an occupational date range based on its ceramic assemblage composition (Appendix E). Date ranges were assigned to mapping units using the earliest and latest possible dates that would include all ceramics present in the artifact assemblage. This range is not intended to reflect the entire occupation span of the mapping unit. Rather, the mapping unit was occupied at some point within the date range. A mapping unit was considered to have multiple occupational components only if the assemblage contained ceramics that did not have overlapping dates, i.e., Kana-a Black-on-White and Citadel Polychrome (Fig. 4.1). Because ceramics do appear earlier and later than the assigned date range (see Breternitz's Indigenous and Trade Dates in Appendix E), the occurrence of a small quantity (n<3) of sherds in the ceramic assemblage was not sufficient to place a mapping unit into a specific time range (Liss 1992). Therefore, ceramic types represented by sherds totaling two or less were disregarded in this analysis.

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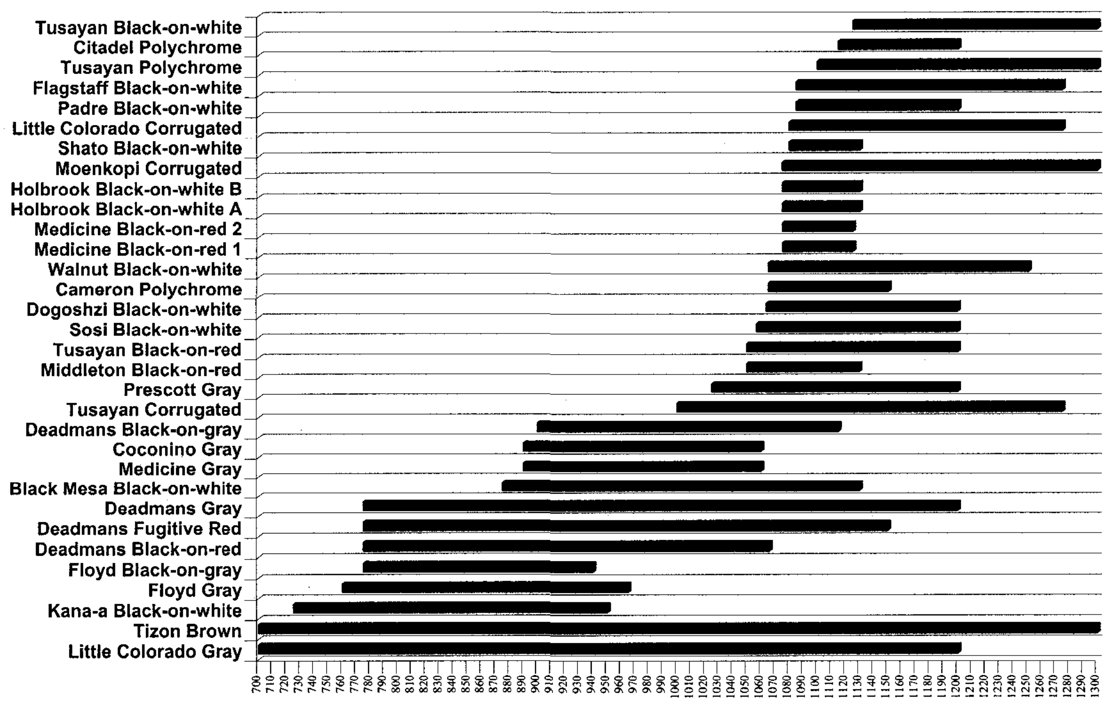

Figure 4.1. Ceramic date ranges.

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Broad Temporal Periods

Although this method was successful in dating some mapping units to within a 20 year span, most mapping units' occupational ranges spanned 100-150 years. In order to make more precise temporal inferences, a finer resolution is needed. Some of the most well-dated mapping units, having relatively short occupation spans defined by a variety of diagnostic ceramics, were used to bracket the occupation span of the study area. MU 306 is the earliest well-dated MU in the study area with an occupational range beginning at AD 875. MU 229.1 is the latest well-dated MU in the study area with an occupational range ending at AD 1150. These two mapping units were used to establish the occupation span of the study area, as AD 875-1150. This time frame was then divided into three broad temporal groups, each of which contained a number of well-dated mapping units dating only to within the single group. Group 1 (AD 875-AD 1000) contained seven well-dated mapping units, Group 2 (AD 1000-1070) contained 11 well-dated mapping units, and Group 3 (AD 1070-1150) contained 35 well-dated mapping units.

Ratios of San Francisco Mountain Gray Ware (SFMGW) to Tusayan Gray Ware (TGW), undecorated to decorated sherd frequencies, and uncorrugated to corrugated sherd frequencies are known to decrease through time because more TGW vessels, ceramic types with painted decorative styles covering greater portions of vessels, and vessels with corrugations extending further down from the vessel neck were all being produced at later dates (Beals et al. 1945; Rice et al. 1980; Sherman 1994). These characteristics of the well-dated mapping units were used to define the threshold values of each ratio for each temporal group (Table 4.1). The ratio threshold values were then

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used to assign mapping units with large occupational ranges to one or more of the broad temporal periods (Fig. 4.2).

Table 4.1. Threshold percentages for each broad temporal period.

Ratio	Period 1 AD 875-1000	Period 2 AD 1000-1070	Period 3 AD 1070 - 1150
Percentage of SFMGW	>48	<56	<58
Percentage of undecorated ceramics	>76	<90	<96
Percentage of uncorrugated ceramics	>91	<91	<77

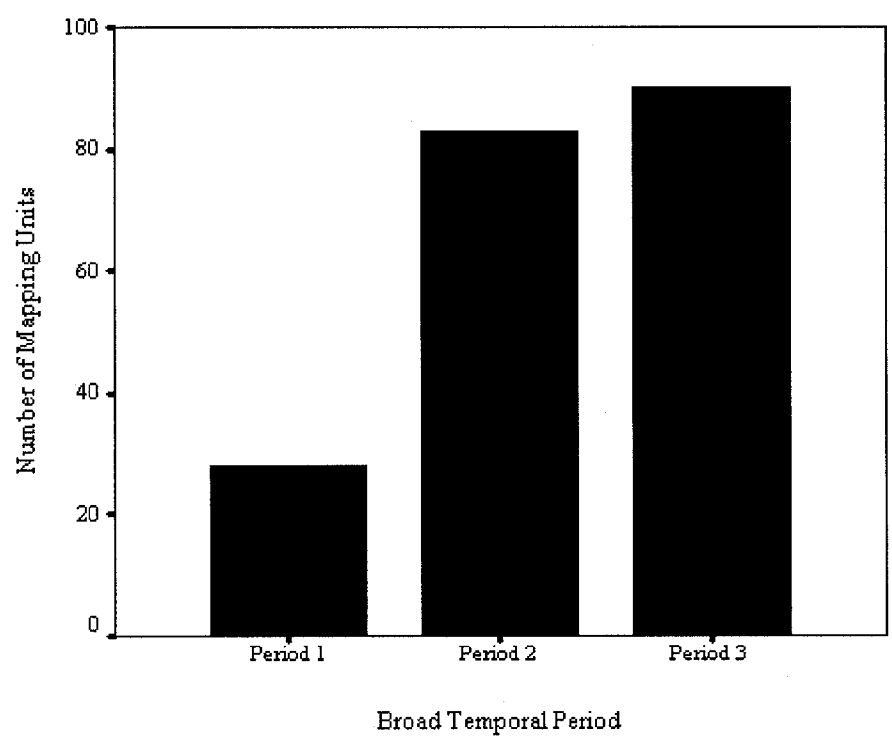

Figure 4.2. Frequency of mapping units within each broad temporal period.

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Of 207 mapping units, 30 were unable to be assigned to any period. Most of these un-datable mapping units had ceramic assemblages consisting of only one ceramic type, or few or no sherds. A few MUs had improbable assemblage compositions, i.e., 90% SFMGW, 100% decorated ceramics, and 100% corrugated TGW ceramics. These ceramic ratios may be the result of commingled artifact assemblages created by the intermixing of ceramics from other nearby mapping units.

Broad Temporal Period Subdivisions

Two broad temporal periods were subdivided because some mapping units had occupational ranges that did not span the entire period. Period 2 (AD 1000-1070) was sub-divided into Period 2.1 (AD 1000-1050) and Period 2.2 (AD 1050-1070) and Period 3 (AD 1070-1150) was sub-divided Period 3.1 (AD 1070-1115) and Period 3.2 (AD 1115-1150). These sub-periods were defined by using the well-dated mapping units within each sub-period to define threshold values for ratios of San Francisco Mountain Gray Ware to Tusayan Gray Ware, undecorated to decorated sherd frequencies, and uncorrugated to corrugated sherd frequencies (Table 4.2). The ratio threshold values were then used to assign all mapping units to a specific sub-period (Fig. 4.3). For example, MU 26.1, a Period 2 structure, was assigned to Sub-period 2.1 because its ceramic assemblage contained more than 45 percent SFMGW, more than 79 percent undecorated sherds, and more than 72 percent uncorrugated sherds.

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Table 4.2. Threshold values for each sub-period.

Ratio	Sub-period 2.1 AD 1000-1050	Sub-period 2.2 AD 1050-1070	Sub-period 3.1 AD 1070-1115	Sub-period 3.2 AD 1115-1150
Percentage of SFMGW	>45	<45	>24	<24
Percentage of undecorateds	>79	<79	>73	<73
Percentage of uncorrugateds	>72	<72	>18	<18

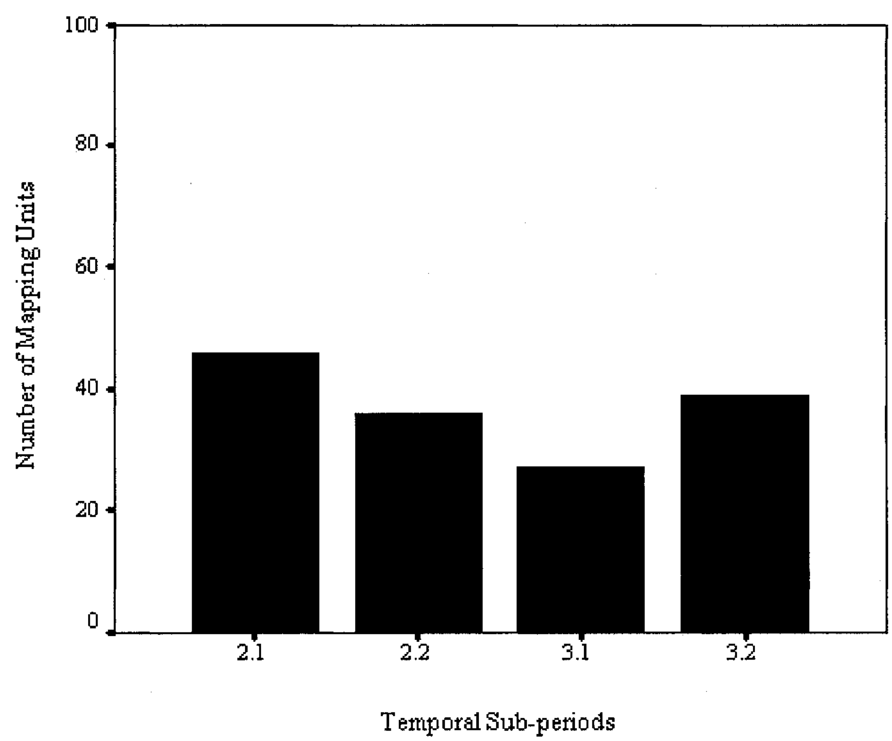

Figure 4.3. Frequency of mapping units within each temporal sub-period.

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A summary containing the occupational range, broad temporal period, and sub-period of each mapping unit can be found in Appendix E.

Ware-Groups

Two groups, the Cohonina and the Kayenta Anasazi, occupied the South Rim of the Grand Canyon from AD 700 to AD 1190 (Haury 1931; McGregor 1951; Wheat 1963; Euler and Chandler 1978; Effland et. al. 1981). These groups are primarily distinguished from one another based on a predominance of paddle-and-anvil manufactured San Francisco Mountain Gray Ware or coil-and-scrape manufactured Tusayan Gray Ware, respectively (Colton 1946; Schwartz 1990). Assuming differences in ceramic technology imply differences beyond material culture, changes in frequencies of ceramics can be used to identify locations of interaction and boundaries between groups (Euler and Chandler 1978). Because sherd frequencies of these different wares vary throughout the study area, a method was needed to assign structures to a group.

Because Kayenta Anasazi and the Cohonina occupations overlap within the study area, many mapping-unit ceramic assemblages contain both wares. Therefore, ware-groups were assigned by calculating the ratio of San Francisco Mountain Gray Ware to Tusayan Gray Ware. A mapping unit belonged exclusively to either the Cohonina or Anasazi ware-group if its ceramic assemblage was composed of 70 percent or more of either ware. If neither ware constituted 70 percent of the assemblage, then the structure was interpreted as "mixed" (Fig. 4.4). Appendix E provides the ware-group for each structure.

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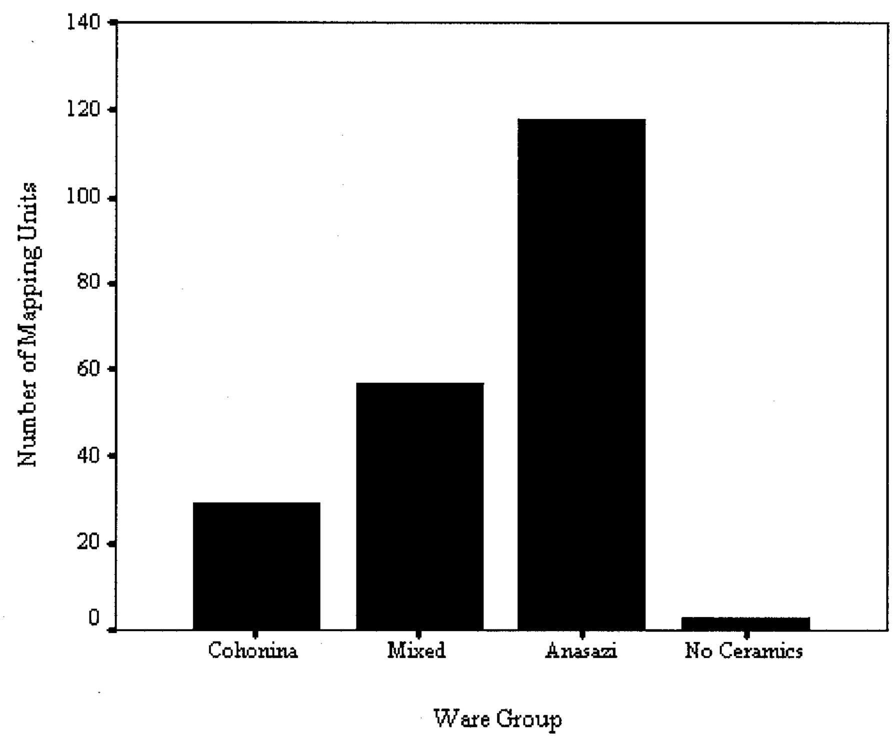

Figure 4.4. Distribution of ware-groups.

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Examination of Figure 4.5 reveals that most structures were Cohonina in Period 1 (AD 875-1000) and that by Period 2.1 (AD 1050) many more structures were associated with the Anasazi. The number of "mixed" mapping units peaks in Period 2.1, and none are found in Period 3.2 (AD 1150).

"Mixed" mapping units provide a way of gauging interaction between the Cohonina and the Anasazi culture groups. The beginning of Period 2.1 (AD 1000) marks the initial settlement by the Anasazi and the highpoint for group interaction. As will be seen in the following chapter, building rates increase dramatically post- AD 1000, and could be the result of the landscape opening up with the Cohonina abandonment of the study area.

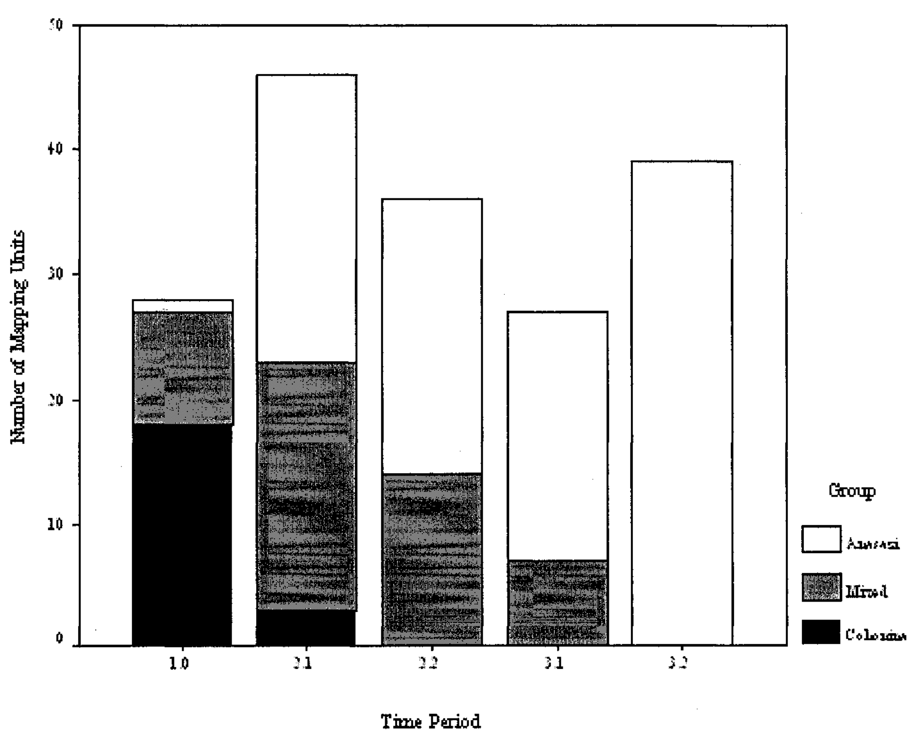

Figure 4.5. Distribution of groups through time.

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CHAPTER 5:

OCCUPATIONAL VARIATION

A number of analyses were performed to reveal differences, if any, in the variability of settlement patterns within the study area. Combinations of temporal, environmental, structural, and artifactual data were used in an attempt to better understand variation in activity patterns, locational preferences, population dynamics, and ware-group interactions through time.

Environmental Preference

Using the TES data discussed in Chapter 3, the new chronology developed in Chapter 4, and the UBARP GIS, the distribution of masonry structures in relation to environmental phenomena was plotted (Fig. 5.1). In order to determine if a TES unit was influential in determining structure placement, the percentage of the study area of the TES unit was compared with the percentage of structures located within the TES unit for each time period (Tables 5.1 and 5.2). It was assumed that if the percentage of structures located within a TES unit was higher than the TES unit's percentage of the total study area, then a preference for that TES unit was inferred for that time period. For example, if a TES unit contains 50 percent of the structures for a particular time period but only accounts for 10 percent of the study area, then it is reasonable to infer that the TES unit was a preferential locale for structure construction.

Inspection of Table 5.1 reveals that the highest number of preferable TES units within one period was five (in Period 2.1). Interestingly, Period 2.1 marks the initial settlement of the study area by the Anasazi and the largest number of "mixed" mapping

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units (Chapter 4). This predilection for structures to be placed in nearly all TES units could be attributable to the landscape being "full" during Period 2.1 with both Cohonina and Anasazi peoples. The most suitable locales for structure placement would have been already occupied in Period 1. Therefore, less desirable TES units were the only areas available for "late arrivals" constructing new masonry structures.

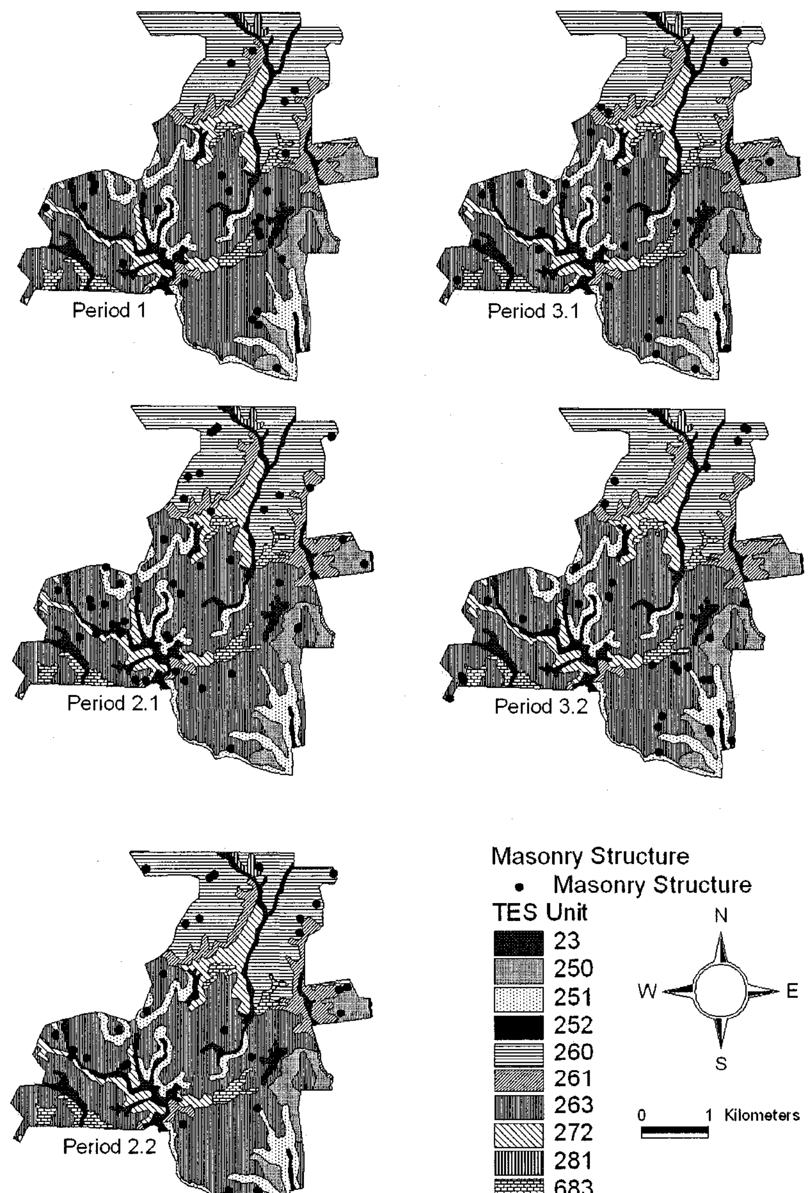

Figure 5.1. Distribution of masonry structures through time.

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Table 5.1. TES unit area percentage versus structure percentage by time period with "preferable" units in bold.

TES	%Area	Period 1 Structure %	Period 2.1 Structure %	Period 2.2 Structure %	Period 3.1 Structure %	Period 3.2 Structure %
23	7.3	0.0	2.2	0.0	0.0	0.0
250	5.8	3.6	**6.5**	**8.3**	**7.4**	**10.3**
251	8.9	0.0	2.2	2.8	**11.1**	2.6
252	.04	0.0	0.0	0.0	0.0	0.0
260	18.9	17.9	**23.9**	**30.6**	14.8	17.9
261	6.3	0.0	**6.5**	2.8	0.0	0.0
263	42.5	**75.0**	**50.0**	**52.8**	**66.7**	**69.2**
272	6.5	0.0	**8.7**	2.8	0.0	0.0
281	.5	0.0	0.0	0.0	0.0	0.0
683	3.4	**3.6**	0.0	0.0	0.0	0.0

Table 5.2. Number of structures per TES unit across time periods.

TES	Period 1	Period 2.1	Period 2.2	Period 3.1	Period 3.2	Percent	Total
23	0	1	0	0	0	.5	1
250	1	3	3	2	4	7.4	13
251	0	1	1	3	1	3.4	6
252	0	0	0	0	0	0.0	0
260	5	11	11	4	7	21.6	38
261	0	3	1	0	0	2.3	4
263	21	23	19	18	27	61.4	108
272	0	4	1	0	0	2.8	5
281	0	0	0	0	0	0.0	0
683	1	0	0	0	0	.5	1
Percent	15.9	26.1	20.5	21.0	22.2	100.0	
Total	28	46	36	37	39		176

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Structures were established in TES Unit 250 during Periods 2.1-3.2 and in Unit 263 during all periods. Combined, TES units 250 and 263 comprise nearly 50 percent of the study area, yet nearly 70 percent of all masonry structures are situated within their boundaries. Therefore, they are the most preferred TES units for the study area. Both Units 250 and 263 share the same soil taxa, *lithic ustochrepts,* and the same climax vegetation, class 2, both of which are the most common type for each variable and, therefore, are not influential in determining structure placement. Similarly, Units 250 and 263 share Soil Phase 4, which is common among most other TES units in the study area. Thus, soil phase is also not an influential characteristic with regards to structure positioning. Interestingly, both TES Units 250 and 263 have some of the lowest values for fuelwood, 4 and 5 cords per acre, respectively. Likewise, vegetal cover at climax is relatively low, 40 and 50 percent, respectively. These two variables, fuelwood and climax vegetation cover, could be considered influential in determining areas for structure construction. However, this idea is contradicted by TES Unit 260.

Unit 260 was a preferred area for situating structures in Periods 2.1 and 2.2, making it the third most preferential area through time. Unit 260 has much higher cords of fuelwood per acre (12.5) and vegetal cover (65%) than either Units 250 (4 cords per acre and 50 percent vegetal cover) or 263 (5 cords per acre and 40 percent vegetal cover). Considering that Units 250 and 263 have some of the lowest values for vegetal cover and fuelwood, and Unit 260 has some of the highest, yet all are considered "preferable" areas for structure locations, it would seem that fuelwood and vegetal cover were not important in determining where to construct a masonry structure in prehistory. Unit 260 comprises nearly 19 percent of the study area and combined with the other most influential

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environmental units, 250 and 263, constitutes 70 percent of the study area where 90.4 (n=169) percent of dated masonry structures occur.

The three TES units that were determined to be "preferable" locales for structure placement. All exhibit some of the lowest soil loss potential, varying from 5-6.6 percent. Similarly, all preferred TES units are the only ones to be at a "moderate" risk to erosion. Both of these values suggest that these TES units contain stable, gently sloping landforms that would provide suitably flat surfaces upon which to build structures. Unfortunately, the "preferable" TES units share similar values for all other TES characteristics with units that were determined to be undesirable with regards to structure placement. This evidence suggests that, except for processes of erosion, the TES variable groups (i.e., vegetal species at climax, economically important plants, and soil characteristics) are not effective in determining structure placement in the Upper Basin.

Units 251, 272 and 683 show minor increases (2% or less) in percent of masonry structures versus percent of study area (Table 5.1) in Periods 3.1, 2.1, and 1, respectively. With the exception of these three instances, all other TES units exhibit no influence on structure placement through time. Units 252 and 281 combined constitute less than one percent of the study area and have no masonry structures situated within their boundaries. More survey focusing on these TES units may reveal structures, but due to the fact that the only surveyed area of Unit 252 is on a very steep slope, and Unit 281 is primarily situated in creek beds, these units may have never been construction sites for masonry structures.

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Room Construction Rates

The annual rate of room construction for single-occupation structures is calculated by dividing the number of rooms dating to a particular period by the length of that period (Table 5.3). Prior to A.D. 1000, the land-use was remarkably light with an average of less than one masonry room built per year for the length of Period 1 (125 years). For the following 70 year span, the rate of room construction quickens, increasing 438.5 percent in Sub-period 2.1 (1.14 rooms per year) and peaking at 1.5 rooms per year (576.9 percent change from Period 1) in Sub-period 2.2. Period 2.2 marks the shortest dated time span of all periods, yet it has the second highest rate of room construction. Room construction drops off 62 percent between Period 2.2 and Period 3.1, only to double (193.5 percent increase) in Period 3.2.

Table 5.3. Average annual rate of room construction for single occupation structures.

Period	Span (years)	Number of Rooms	Annual Rate
1	125	32	.26
2.1	50	57	1.14
2.2	20	30	1.50
3.1	45	42	.93
3.2	35	63	1.80
Total	275	224	.82

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Table 5.4. Number of mapping units and rooms for each single and dual occupation period.

Period	Number of Mapping Units	Number of Rooms
1	25	32
2.1	39	57
2.2	21	30
3.1	27	42
3.2	39	63
1 & 2.2	1	1
1 & 3.1	2	2
2.1 & 3.1	5	5
2.1 & 3.2	2	2
2.2 & 3.1	14	24
2.2 & 3.2	1	1
Total	176	259

However, this pattern of single occupations is somewhat misleading because 25 of the 176 datable mapping units are dual component occupations (Table 5.4). In order to include multi-component occupations into the calculation of annual room-construction rates it was necessary to consider which rooms of the multi-component mapping units were used during which periods. Because it is not possible to delineate individual room construction dates within a single structure from surface data, room construction and land-use implications were considered the same for components of the dual-component mapping units. It was assumed that dual-component structures were built in a single construction period and all rooms were reused in the second occupational period. Therefore, room counts for mapping units with dual-components were included in both occupational period totals (Table 5.5). For example, one room was counted in Sub-

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period 2.2 and one room was counted in Sub-period 3.2 for MU 38.2, a dual-component one-room structure dating to Sub-periods 2.2 and 3.2.

Inspection of Figure 5.2 indicates a different trend than what was discovered with only the single occupation mapping units. Although the construction rates for Periods 1, 2.1, and 3.2 remain similar, those for Periods 2.2 and 3.1 increase nearly two-fold, 186.7 percent and 174.2 percent, respectively. The rate of increase remains similar between Periods 1 and 2.1, yet skyrockets in Period 2.2, increasing 218.8 percent, a difference of 87.2 percentage points from single occupations only. The rate slows further in Period 3.1 in a similar fashion, with 62 percent decrease in single occupations and 57.8 percent using all mapping units. Yet, the increase in activity is not as drastic in Period 3.2, increasing only 116 percent in constrast to nearly doubling (193.5 percent) when only single-occupations were examined.

Period 2.2 only represents 20 years (7.3 percent) of the 275 year range of the Upper Basin ceramic chronology. Yet, 19 percent of the rooms were constructed during this time. Clearly, this 20 year period, between AD 1050 and 1070, was the most active period for room building in the Upper Basin. As described in Chapter 4, the end of Period 2.1 marked the last time a "pure" Cohonina structure was built or occupied. The remarkable increase in room construction (218 percent) and decrease in number of preferable TES units (from five in Period 2.1 to three in Period 2.2 [Table 5.1]) is likely attributable to more preferred constructions areas becoming available as the Cohonina abandoned the study area.

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Table 5.5. Average annual room-construction rates for all mapping units.

Period	Single Period Mapping Units	Dual Period Mapping Units	Total Rooms	Average Annual Rate
1	25	3	35	.28
2.1	39	7	64	1.28
2.2	21	16	56	2.80
3.1	27	21	73	1.62
3.2	39	3	66	1.89

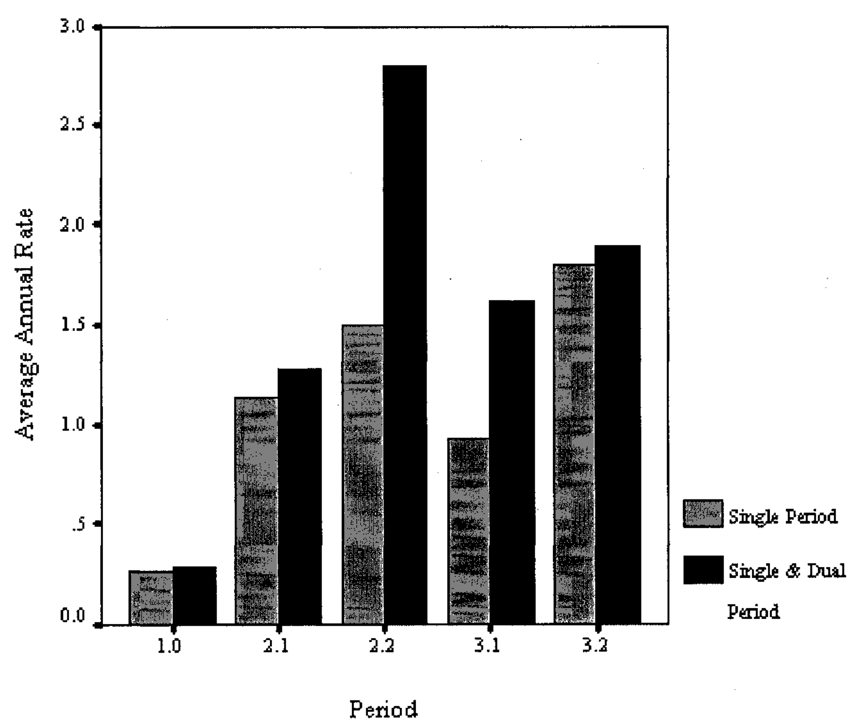

Figure 5.2. Distribution of average annual room construction rate by time period.

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Structure Size and Artifact Density

There is little variation with regards to the average number of rooms per structure through time - most structures in the Upper Basin have one room (Table 5.6). Floor space was calculated by multiplying the interior lengths and widths of each mapping unit's rooms (Table 5.7). Again, there is little variation in this variable through time. The difference between the largest average room and the smallest is no more than 30 centimeters on a side. This difference could be attributable to a simple measurement error when flexible tapes are used.

Artifact density was measured by totaling all artifacts within each structure's artifact enumeration unit. Similar to the size variables, there is little variation in artifact density through time. The difference between the highest average artifact density and the lowest is no more than a single artifact per square meter (Table 5.8).

Traditionally, variation in room size and artifact density values has been employed to infer function (use) and occupational intensity of architectural sites (Mindeleff 1887; Hill 1968; Adams 1983). Structures with many larger rooms and high artifact densities are considered perennial habitation sites, whereas structures with few smaller rooms and low artifact densities are described as seasonal limited-activity areas. Interestingly, as will be argued in the conclusion, it is rather difficult to apply this line of thinking to the Upper Basin dataset because while room size and artifact density are remarkably non-variable when examined independent from one another, the relationship between them is so highly variable.

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Table 5.6. Rooms per structure through time.

Period	Mean Number of Rooms per Structure	Standard Deviation	Median Number of Rooms per Structure
1	1.25	.518	1
2.1	1.39	1.022	1
2.2	1.51	.692	1
3.1	1.52	.922	1
3.2	1.57	.887	1

Table 5.7. Floor Space per structure though time.

Period	Mean Floor Space per Structure (m^2)	Standard Deviation	Median Floor Space per Structure (m^2)
1	19.62	8.64	17.43
2.1	22.61	20.44	17.13
2.2	22.90	22.36	14.50
3.1	23.48	18.95	17.52
3.2	17.52	10.17	15.99

Table 5.8. Artifact density per structure through time.

Period	Mean Artifact Density per Structure (pieces/19.6 m^2)	Standard Deviation	Median Artifact Density per Structure (pieces/19.6 m^2)
1	139.18	95.745	122.00
2.1	128.46	99.520	108.00
2.2	129.97	87.638	106.00
3.1	148.73	101.547	125.50
3.2	144.33	118.937	113.00

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CHAPTER 6:

CONCLUSION

Three major goals were accomplished with this thesis: (i) a new ceramic chronology was developed, (ii) the environmental variability according to the TES (Brewer et. al. 1991) was assessed and, (iii) aspects of Upper Basin occupational variability were revealed. This work was done to evaluate the "cross-canyon" land-use model proposed by Sullivan and his colleagues (2002).

The new Upper Basin ceramic chronology was very useful in revealing patterning in occupational variability. Without it, most of the analysis in this thesis would have been impossible. While use of the chronology was successful for placing structures into time periods, the time periods themselves could have had a higher resolution, that is, more periods with smaller time spans. Few masonry-structure assemblages contained ceramics that were useful in defining specific temporal periods, i.e., ceramics that could have only been produced in a short range of years. This lack of temporal period defining ceramics could be the result of the assemblages simply not containing diagnostic ceramics, but it may also be that more emphasis needs to be placed on identifying red wares, as so many AEUs contained high counts of the general categories of Tsegi Orange Ware or San Juan Red Ware. If more attention was placed on identifying the decorated black-on-red types, (i.e., Medicine, Tusayan, Middleton, and Deadmans) then it may be possible to further sub-divide the larger time periods. Nonetheless, tracking occupational variability through time would have been impossible without the new chronology.

While environmental variation of the Upper Basin was describable in terms of the TES survey, there is little in the way of patterning of TES units with regards to structure

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placement. Essentially, little to no relationship exists between settlement location and the characteristics that define the TES units themselves. While this may be attributable to the imprecise nature of the TES data, it is more likely that the environmental characteristics of the TES units themselves either do not reflect the environment during the 11th and 12th centuries, or the attributes associated with each TES unit were not influential in settlement placement choices.

The "cross-canyon" model presents evidence that supports the idea that settlements in the Upper Basin were constructed without consideration to water resources (cf. Norr 1997) and were located in areas where high concentrations of wild resources would have been located (e.g., "mixed" ecozones, Sullivan et. al. 2002). In contrast, it was found here that TES units that are preferential for structure locations are not the units with the highest concentrations of forage-type food plants. Yet, this does not necessarily contradict the "cross-canyon" model because the units with high concentrations of forage-type food plants are small in area. These TES unit distinctions could be too fine-grained, as well, meaning that most of the major differences between them are not that important in distinguishing between them. The most preferred unit through time, TES Unit 263, also is the largest in area and has a middle value in the distribution of forage-type food plants (Fig. 6.1). Therefore, it could be concluded that most of the Upper Basin was an anthropogenic environment (cf. Sullivan and Ruter in press) that had plenty of available food resources so inhabitants did not have to seek out the very small, but most concentrated, food plant areas. It is conceivable that the Upper Basin was the "Bread Basket" of the Grand Canyon.

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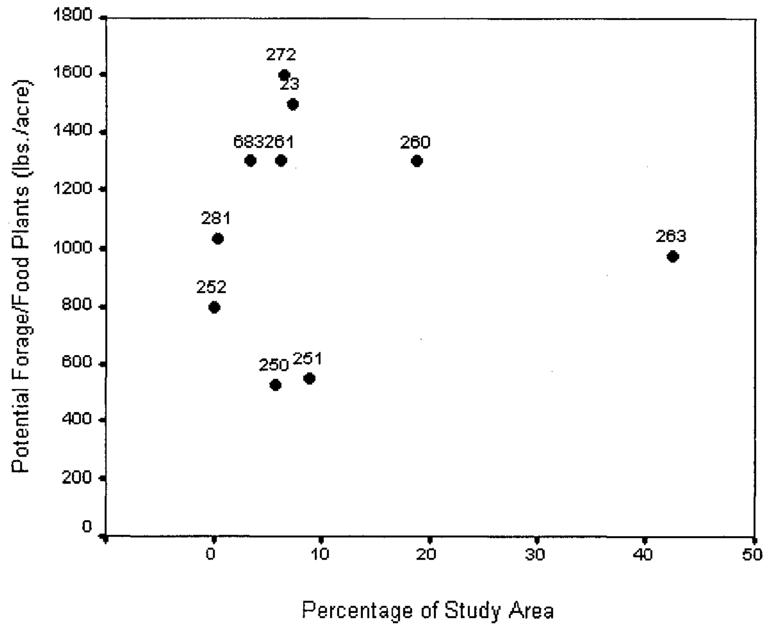

Figure 6.1. Distribution of TES unit potential forage-type food plants in relation to percentage of study area.

The analysis of occupational variability also supports the "cross-canyon" model. When artifact density is plotted against number of rooms, a high degree of variation is revealed (Fig. 6.2). There is no correlation between artifact density and room count (r^2 =.016). In fact, many one- or two-room structures have much higher artifact density values than the larger five- and six-room structures. Similarly, the relationship between artifact density and total floor space is highly variable (Fig. 6.3). There is little correlation between these variables (r^2 =.036), and many of the smaller structures have artifact density values greater than the largest structures.

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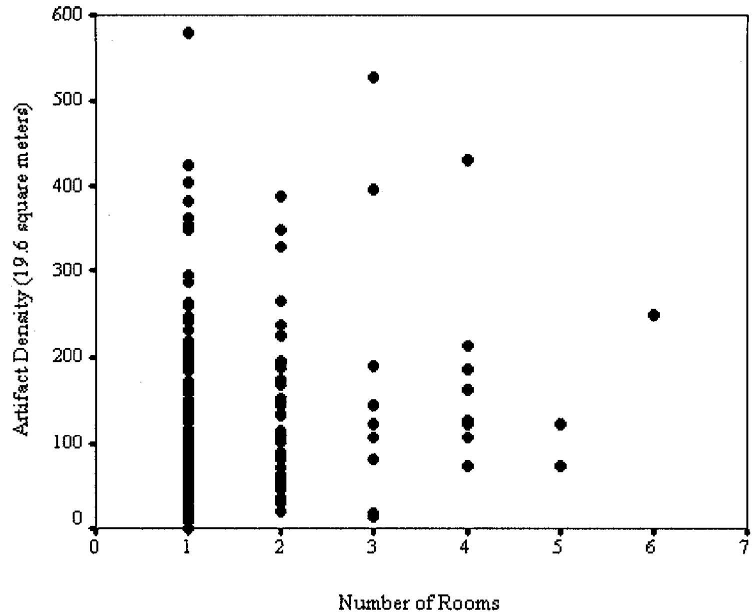

Figure 6.2. Number of rooms compared with artifact density (r^2=.0162).

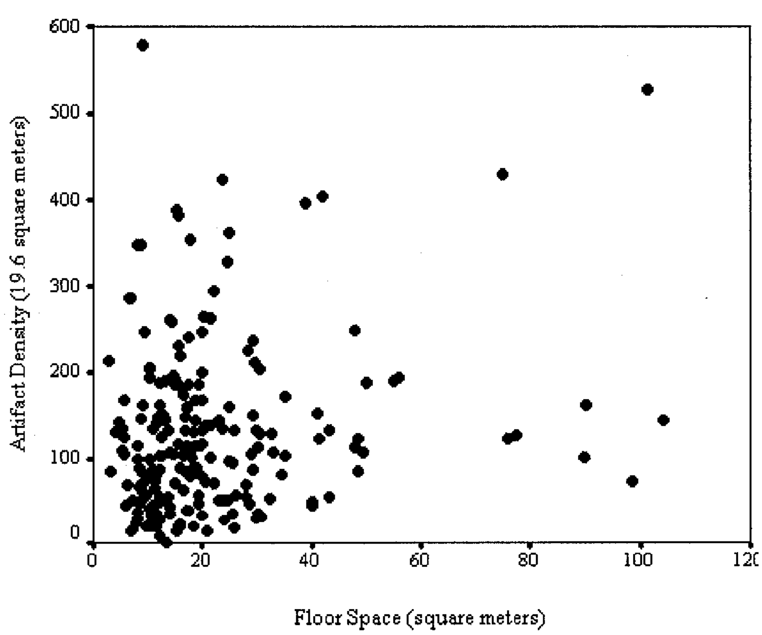

Figure 6.3. Floor space compared with artifact density (r^2=.0369).

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It is conceivable that, because the data for these analyses were collected from surface assemblages, formation processes could have affected the high variation in artifact density (Stein 2001). Assemblages that some would expect to have higher artifact densities (assemblages from larger mapping units) may have had artifacts transported to other localities by erosional processes, in effect decreasing their artifact density. Yet, as discussed in Chapter 5, most structures are situated on relatively flat terrain out of flood plains and with relatively shallow soils and, while many TES characteristics differ between preferential units, most mapping units are located in units that are at a similar risk to erosion and have comparable soil-loss potential. Therefore, the majority of mapping units is affected in a similar way with regards to erosional processes and any effect these processes have on ceramic assemblages should be universal across the landscape.

Another possibility is that assemblages expected to have higher artifact densities and do not were, in fact, subjected to differential burial processes (Schiffer 1987). Sediments washing down hills, carried by wind, or deposited from tree throw many have buried portions of these assemblages. As outlined in Chapter 2, every artifact in and around a masonry structure is pin-flagged. If trees are growing on structures, duff is removed to reveal the ground surface. The ground is scoured by crew members (on hands and knees) to locate every possible surface artifact, which are sometimes covered by a thin layer of sediment. Pains are taken to avoid establishing enumeration units in areas where it is clear that artifacts have been buried. Without a doubt, different burial processes are at work within the Upper Basin, but the procedure followed to establish an

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artifact enumeration unit maximizes the likelihood that the densest area of artifacts is observed without actually having to excavate the mapping unit.

Yet another possible influence on artifact density could be trampling by animals in the forest affecting artifact breakage and dispersal. However, it is very unlikely that elk or cattle in the Kaibab prefer trampling some masonry structures as opposed to others. If trampling does have an effect on artifact densities, it is likely that it affects all assemblages equally.

The weak correlation between artifact densities and room size and number is more likely a result of prehistoric human behavior, specifically variation in occupational intensity, as proposed in the cross-canyon land-use model (Sullivan et al. 2002). Rather than certain structures being only occupied seasonally and others only perennially, the weak correlations in Figures 6.2 and 6.3 are most likely the result of responses to variation in the severity of the "Spring Drought."

As argued by Sullivan and colleagues (2002), during some years, structures in the Upper Basin were abandoned during hot and dry springs. Inhabitants would leave the South Rim and move to the Inner Canyon and the North Rim, where water is more plentiful and temperatures are less extreme. Other years, when temperatures are more reasonable and water is more plentiful, inhabitants of the same structures are able to stay year-round in the Upper Basin. Similarly, all winters are very harsh on the North Rim causing people to relocate for the winter months in the Upper Basin and Inner Canyon. Yet, some years winters are less extreme and some individuals are able to stay year-round on the North Rim. These highly variable degrees of occupational intensity have a direct effect on artifact deposition. Some years certain structures receive an entire years-

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worth of deposition. Yet in other years, the very same structure may only be inhabited seasonally and artifacts that would have been deposited there are instead deposited at another location.

Future Studies

Some predictions can be made with regards to the distribution of structures associated with different groups, e.g., Cohonina, Mixed, and Anasazi (Fig. 6.4). There are more Cohonina structures clustered in the southeast portion of the study area. While more dispersed, Anasazi structures cluster more in the northwest portion. Mixed structures are the most widespread, but do cluster slightly in the northwest. If these patterns are able to be extrapolated to land outside of the study area, more Anasazi and Mixed structures should be discovered during future surveys of the land in the northwest. Similarly, more Mixed and Anasazi structures should be located in the unsurveyed areas in the northeast. On the other hand, unsurveyed areas to the southeast should contain more Cohonina-affiliated structures.

It would also be of interest to test the validity of the TES data used in this thesis. The data were collected with USDA Forest Service management goals in mind. It may be that the variables are inappropriate for answering archaeological problems. Analysis of remotely sensed data, e.g., LANDSAT imagery, would be useful in determining if the variables that are used to distinguish among TES units hold true or if other environmental patterning is revealed. Future studies involving the land-use questions posited in this thesis will benefit greatly as more technologically advanced remote sensing data (e.g.,

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Quikbird satellite imagery) become available and more archaeologists are trained to use them in their research.

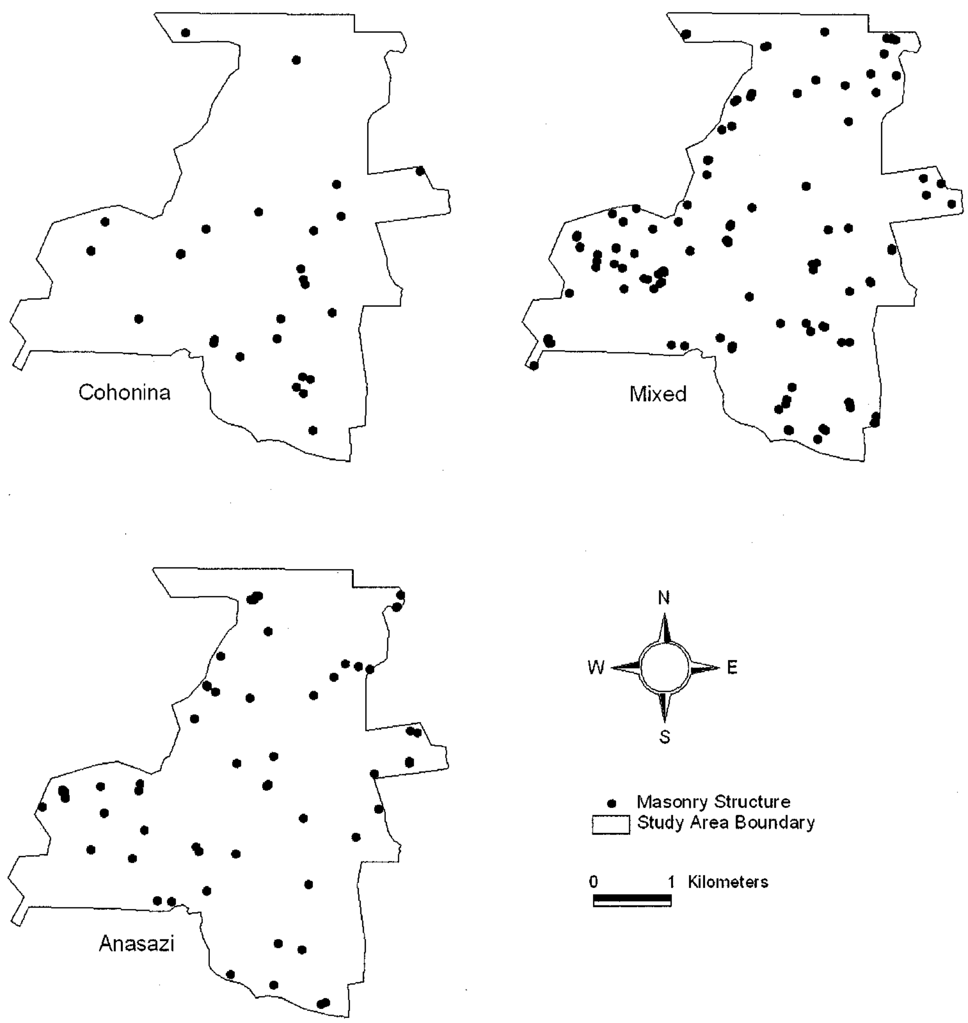

Figure 6.4. Distribution of masonry structures by group.

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Notes

1. For an excellent overview of GIS, see Chapter 1 of *A GIS Analysis of Factors Affecting Archaeological Site Placement in the Upper Basin, Kaibab National Forest, Northern Arizona* (Mink 1999).

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APPENDIX A: Data Dictionary of attributes for archaeological phenomena encountered during survey.

```
"UBARP 2002", Dictionary
"STRUCTURE", point, "", 1, seconds, 1, Code
  "MU Number", numeric, 2, 1.00, 6000.00, 1.00, required, required, Label1
  "FS Number", numeric, 0, 0, 6000, 0, normal, normal, Label2
  "Type", menu, required, required
    "Brush",[.4]
    "Depression",[0]
    "Hogan (masonry)",[.3]
    "Hogan (wood)",[.2]
    "Hunter Blind",[.6]
    "Masonry",[.1]
    "Sweat Lodge",[.5]
  "Length(struc)", numeric, 0, 1, 20, 1, required, required
  "Width(struc)", numeric, 0, 1, 20, 1, required, required
  "Scatlength", numeric, 0, 1, 200, 1, required, required
  "Scatwidth", numeric, 0, 1, 200, 1, required, required
  "# Rooms", numeric, 0, 1, 6, 1, required, required
  "Primary Ware", menu, required, required
    "None",[0]
    "Tusayan GW",[1]
    "San Francisco Mt. GW",[2]
    "Tusayan & San Frn GW",[3]
    "Tizon",[4]
    "Awatovi Yellow Ware",[5]
    "Unknown Grey Ware",[6]
    "Unknown Brown Ware",[7]
    "Unknown Ware",[8]
    "Other Ware",[9]
  "Camping", menu, required, required
    "None",[0]
    "Light",[1]
    "Moderate",[2]
    "Extensive",[3]
  "Vehicle Traffic", menu, required, required
    "None",[0]
    "Light",[1]
    "Moderate",[2]
    "Extensive",[3]
  "Wood Cutting", menu, required, required
    "None",[0]
    "Light",[1]
    "Moderate",[2]
```


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```
    "Extensive",[3]
  "Vandalism", menu, required, required
    "None",[0]
    "Light",[1]
    "Moderate",[2]
    "Extensive",[3]
  "Erosion", menu, required, required
    "None",[0]
    "Rivlet",[1]
    "Gully",[2]
    "Arroyo",[3]
  "Sedimentation", menu, required, required
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    "Light",[1]
    "Moderate",[2]
    "Extensive",[3]

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  "FS Number", numeric, 0, 0, 6000, 0, normal, normal, Label2
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  "Width", numeric, 0, 1, 200, 1, required, required
  "Primary Ware", menu, required, required
    "None",[0]
    "Tusayan GW",[1]
    "San Francisco Mt. GW",[2]
    "Tusayan & San Frn GW",[3]
    "Tizon",[4]
    "Awatovi Yellow Ware",[5]
    "Unknown Grey Ware",[6]
    "Unknown Brown Ware",[7]
    "Unknown Ware",[8]
    "Other Ware",[9]
  "Camping", menu, required, required
    "None",[0]
    "Light",[1]
    "Moderate",[2]
    "Extensive",[3]
  "Vehicle Traffic", menu, required, required
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    "Light",[1]
    "Moderate",[2]
    "Extensive",[3]
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    "Extensive",[3]
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    "Light",[1]
    "Moderate",[2]
    "Extensive",[3]
  "Erosion", menu, required, required
    "None",[0]
    "Rivlet",[1]
    "Gully",[2]
    "Arroyo",[3]
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    "Light",[1]
    "Moderate",[2]
    "Extensive",[3]

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  "Width", numeric, 0, 1, 200, 1, required, required
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    "San Francisco Mt. GW",[2]
    "Tusayan & San Frn GW",[3]
    "Tizon",[4]
    "Awatovi Yellow Ware",[5]
    "Unknown Grey Ware",[6]
    "Unknown Brown Ware",[7]
    "Unknown Ware",[8]
    "Other Ware",[9]
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    "Moderate",[2]
    "Extensive",[3]
  "Vehicle Traffic", menu, required, required
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    "Moderate",[2]
    "Extensive",[3]
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  "Moderate",[2]
  "Extensive",[3]
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  "Light",[1]
  "Moderate",[2]
  "Extensive",[3]
"Erosion", menu, required, required
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  "Rivlet",[1]
  "Gully",[2]
  "Arroyo",[3]
"Sedimentation", menu, required, required
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  "Moderate",[2]
  "Extensive",[3]

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  "FS Number", numeric, 0, 0, 6000, 0, normal, normal, Label2
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  "Width", numeric, 0, 1, 200, 1, required, required
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    "San Francisco Mt. GW",[2]
    "Tusayan & San Frn GW",[3]
    "Tizon",[4]
    "Awatovi Yellow Ware",[5]
    "Unknown Grey Ware",[6]
    "Unknown Brown Ware",[7]
    "Unknown Ware",[8]
    "Other Ware",[9]
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    "Light",[1]
    "Moderate",[2]
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    "Moderate",[2]
    "Extensive",[3]
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    "Light",[1]
    "Moderate",[2]
    "Extensive",[3]
  "Erosion", menu, required, required
    "None",[0]
    "Rivlet",[1]
    "Gully",[2]
    "Arroyo",[3]
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    "Light",[1]
    "Moderate",[2]
    "Extensive",[3]

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  "Type", menu, required, required, Label2
    "Alignment",[5.1]
    "Cist",[5.3]
    "Quarry",[5.8]
    "Rock Pile",[5.11]
    "Rock Art",[5.9]
    "Slabs",[5.12]
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    "San Francisco Mt. GW",[2]
    "Tusayan & San Frn GW",[3]
    "Tizon",[4]
    "Awatovi Yellow Ware",[5]
    "Unknown Grey Ware",[6]
    "Unknown Brown Ware",[7]
    "Unknown Ware",[8]
    "Other Ware",[9]
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```
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    "Moderate",[2]
    "Extensive",[3]
  "Vehicle Traffic", menu, required, required
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    "Extensive",[3]
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    "Moderate",[2]
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  "Vandalism", menu, required, required
    "None",[0]
    "Light",[1]
    "Moderate",[2]
    "Extensive",[3]
  "Erosion", menu, required, required
    "None",[0]
    "Rivlet",[1]
    "Gully",[2]
    "Arroyo",[3]
  "Sedimentation", menu, required, required
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    "Light",[1]
    "Moderate",[2]
    "Extensive",[3]

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    "Benchmark",[1]
    "Road",[2]
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    "Basin",[2]
    "Exposure",[3]
    "Tree",[4]
    "Packrat Nest",[5]
    "Other",[6]
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```
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    "Hearth (closed)",[5.5]
    "Hearth (open)",[5.6]
    "Trash",[5.13]
    "Wreckage",[5.15]
    "Wood Cutting",[5.14]
    "Other",[5.7]
    "Cairn",[5.2]
  "MU Number", numeric, 2, 1.00, 6000.00, 1.00, normal, normal, Label2
  "Length", numeric, 0, 1, 20, 1, normal, normal
  "Width", numeric, 0, 1, 20, 1, normal, normal
```


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APPENDIX B: Artifact enumeration forms.

UNIVERSITY OF CINCINNATI
UPPER BASIN ARCHAEOLOGICAL RESEARCH PROJECT
CERAMIC ARTIFACT ENUMERATION FORM

MU Number:__________ Date________ Recorder ________________

Enumeration Unit #__________ (EU 0 means total enumeration [i.e., no EU was established])

TUSAYAN GRAY WARE
- Lino Trad.____________________
- Lino Gray____________________
- Kana-a Neck-banded ____________________
- Medicine Gray____________________
- Coconino Gray____________________
- Tusayan Corrugated ____________________
- ____________________
- Moenkopi Corrugated____________________
- ____________________
- Kiet Siel Gray ____________________
- Tusayan Grayware ____________________
- ____________________
- Other____________________
- Tooled____________________
- Applique____________________

SAN FRANCISOC MOUNTAIN GRAY WARE
- Deadmans Gray____________________
- ____________________
- Deadmans Fugitive Red ____________________
- Floyd Gray ____________________
- Deadmans B/G (Black Mesa)____________________
- Floyd B/G (Kana-a)____________________

AWATOVI YELLOW WARE
- Plain____________________
- Black-on-yellow____________________
- Polychrome____________________
- Other____________________

SAN JUAN RED WARE (sand, black diorite [no sherd])
- Deadmans B/R (thick slip; Black Mesa)____________
- Middleton B/R (thin/no slip; Dogoszhi)____________

LITTLE COLORADO WHITE WARE (dark paste)
- St. Joseph B/W (Kana-a)____________________
- Holbrook A B/W(Black Mesa)____________________
- Holbrook B B/W(Sosi)____________________
- Padre B/W (Dogoszhi____________________
- Walnut B/W (interlock. triang. scrolls)____________
- A (Sosi)____________ C (Tularosa)____________
- Other: (e.g., Chevelon [corr.])____________________

TUSAYAN WHITE WARE (light paste)
- Lino B/G ____________________
- Kana-a B/W____________________
- Black Mesa B/W ____________________
- Black Mesa B/W (massive var.)____________________
- Black Mesa B/W (dots var.)____________________
- Kana-a + Black Mesa B/W____________________
- Sosi B/W (barbed) ____________________
- ____________________
- Sosi B/W (broad line) ____________________
- ____________________
- Dogoszhi B/W ____________________
- Flagstaff B/W ____________________
- Tusayan B/W ____________________
- Kayenta B/W____________________
- Shato (corrugated) B/W____________________
- Narrow Line ____________________
- Broad Line____________________
- Hatched ____________________
- Undec. Tusayan Whiteware ____________________
- Other____________________

TSEGI ORANGE WARE (sand, sherd [no black diorite])
- Medicine B/R (Black Mesa[1])____________________
- (Black Mesa[2])____________________
- Tusayan B/R (Dogoszhi)____________________
- Cameron Poly [3] (Dogoszhi)____________________
- Citadel Poly[4]____________________
- Kayenta Poly[5]____________________
- Kiet Siel Poly (Kayenta B/W)____________________
- Tusayan Poly[6]____________________
- Tsegi Orange Ware____________________

LITTLE COLORADO GRAY WARE
- Gray____________________
- Corrugated____________________

PRESCOTT GRAY WARE____________________
TIZON BROWN WARE____________________
OTHER GRAY WARE____________________
OTHER WHITE WARE____________________
OTHER BROWN WARE____________________
OTHER WARE____________________

1 -- Parallel lines and positive (solid) geometrics; 2 -- Curvilinear and negative geometrics.
3 -- Slipped exterior and differentially slipped interior.
4 -- No hachure and global exterior slip; wide lines and triangular elements.
5 -- White boundary lines on designs; 6 – No hachure and banded exterior slip, wide lines and triangular elements.

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UNIVERSITY OF CINCINNATI
UPPER BASIN ARCHAEOLOGICAL RESEARCH PROJECT
LITHIC ARTIFACT ENUMERATION FORM

MU Number:__________ Date______________ Recorder__________

Enumeration Unit #_______ (EU 0 means total enumeration [i.e., no EU was established])

DEBITAGE

Chert	Gray[1] Obsidian	Black[2] Obsidian	Brown/Red/Black[3] Obsidian	Quartzite	Other

TOOLS

IRP						
IRP Frag.						
Uniface						
Uniface Frag.						
Biface						
Biface Frag.						
Proj. Point (PPt)						
PPt Non-Base Frag.						
PPt Base Frag.						
CORE						
CORE Frag.						
HAMMERSTONE						
HAMMER Frag.						

GROUND STONE

	Sandstone	Quartzite	Limestone	Other
Metate				
Metate Frag.				
Mano				
Mano Frag.				
Other_______________				

1 = Presley Wash; 2 = Partridge Creek; 3 = Black Tank.

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APPENDIX C: Descriptions of TES units.

TES Unit 23 is the only unit with the fluventic ustochrepts soil taxa and a deep loam soil phase. Similarly, Unit 23 is the only unit to have the climax vegetation class containing *Artemisia tridentia, Bouteloua gracilis,* and *Pinus edulis.* Soil loss potential and natural soil loss are 11.9 percent and 2.7 percent, respectively. Under climax conditions, 55 percent of the ground's surface would be covered in vegetation and would yield 575 pounds per acre of herbaceous and woody plants. The maximum potential yield of forage/food plants is 1,500 lbs. per acre, second only to Unit 272 (1,600 pounds/acre). Maximum potential fuel wood yields 0 cords per acre, the lowest value shared with Units 252 and 683. Unit 23 is the only other unit besides 281 with the top 100 cm of soil classified as "fair" (rather than "poor") for use as topsoil. Unit 23 is at a "slight" risk to erosion upon removal of current vegetation.

TES Unit 250 has the most frequent soil taxa, lithic ustochrepts, along with the second most common soil phase, gravelly, fine sandy loam. Unit 250 also shares, with three other units, the typical climax vegetation class: *Pinus edulis, Juniperous osteosperma, Artemisia tridentata,* and *Stipa comata.* Soil loss potential (5%) and natural soil loss (.7%) are relatively lower than most other units. At climax, 50 percent of the ground's surface would be vegetal cover consisting of 425 pounds/acre herbaceous/woody plants and 525 pounds acre forage/food plants. Maximum potential yield of fuel wood is four cords/acre. Similar to all but two units (23 & 281), Unit 250's upper 100 cm of soil is classified as "poor" with regards to suitability for use as topsoil. Upon removal of vegetation, Unit 250 is considered at a "moderate" risk to erosion.

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TES Unit 251, while similar to most other units with regard to soil taxa, lithic ustochrepts, it is the only unit with a very gravelly, fine sandy loam soil phase. Unit 251's climax vegetation is the most common class: *Pinus edulis, Juniperous osteosperma Artemisia tridentata,* and *Stipa comata.* Unlike most other units, Unit 251 has the second highest values for potential soil loss (29.9%) and natural soil loss (4.2%). 50 percent of the unit's ground cover would be vegetal at climax with 425 pounds/acre herbaceous/woody plants and 550 pounds/acre forage/food plants, sharing some of the lowest values with Unit 250 for these variables. Along with Unit 250, 251 has the lowest non-zero yield at only 4 cords/acre of fuel wood. Similar to all but two units, Unit 251's upper 100 cm of soil is classified as "poor" with regards to suitability for use as topsoil. Unit 251 is at a "severe" risk to erosion upon removal of current vegetation.

TES Unit 252 has the most common soil taxa, lithic ustochrepts, along with the second most common soil phase, gravelly, fine sandy loam. It also shares the most frequent climax vegetation class, *Pinus edulis, Juniperous osteosperma, Artemisia tridentata,* and *Stipa comata.* Interestingly, Unit 252 has the highest values for potential soil loss (39.1%) and natural soil loss (5.3 %). Under climax conditions, 50 percent of the ground's surface would be covered in vegetation with 475 pounds/acre herbaceous/woody plants, 800 pounds/acre forage/food plants, and 0 cords/acre of fuel wood. Similar to all but two units, Unit 252's upper 100 cm of soil is considered "poor" for use as topsoil. Upon the removal of the current vegetation, Unit 252 is at a "severe" risk to erosion.

TES Unit 260 has the most frequent soil taxa, lithic ustochrepts, along with the second most common soil phase of, gravelly, fine sandy loam. Climax vegetation would

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include *Pinus edulis, Quercus gambelii, Artemisia tridentata,* and *Stipa comata*, the second most common climax class. Both potential and natural soil loss are relatively low, 6.6 percent and .5 percent respectively. At climax, 65 percent of the ground's surface would be vegetal cover with 662.5 pounds/acre herbaceous/woody plants, 1,300 pounds/acre forage/food plants, and 12.5 cords/acre of fuel wood. Similar to all but two units, Unit 260's upper 100 cm of soil is classified as "poor" with regards to suitability for use as topsoil. Unit 260 is at a "severe" risk to erosion upon removal of current vegetation.

TES Unit 261 has the most frequent soil taxa, lithic ustochrepts, along with the second most common soil phase of, gravelly, fine sandy loam. Similar to Unit 260, Unit 261 also in the *Pinus edulis, Quercus gambelii, Artemisia tridentate,* and *Stipa comata* climax vegetation class. Potential and natural soil loss values are relatively high, 28.2 percent and 2 percent, respectively. At climax, 65 percent of the ground's surface would be covered in vegetation with 650 pounds/acre herbaceous/woody plants and 1,300 pounds/acre forage/food plants. Unit 261 would yield a relatively high amount of fuel wood at 12 cords/acre. The upper 100 cm of soil is considered "poor" with regards to its suitability as topsoil and would be considered at "severe" risk to erosion upon remove of current vegetation.

TES Unit 263 has the most frequent soil taxa, lithic ustochrepts, and the most common soil phase of, very gravelly loam. Similar to units 250, 251, and 252, Unit 263's climax vegetation class is *Pinus edulis, Juniperous osteosperma, Artemisia tridentata,* and *Stipa comata*. Potential soil loss is relatively low at a value of 5 percent with natural soil loss at 1.1 percent. Interestingly, Unit 263 would have 40 percent vegetal ground

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cover at climax, the lowest value for all units. Unit 263 would yield 650 pounds/acre herbaceous/woody plants and 975 pounds/acre forage/food plants. Fuel wood yield is relatively low at 5 cords/acre. The upper 100 cm of soil is considered "poor" as topsoil and upon the removal of current vegetation it would be at a "moderate" risk to erosion.

TES Unit 272 is unique in that it is the only unit to have the typic haplustalfs soil taxa and the gravelly loam soil phase. Unit 272 is also the only unit with the climax vegetation class containing *Pinus edulis, Juniperous osteosperma, Quercus gambelii,* and *Artemisia tridentata*. Potential soil loss is relatively low at 9.5 percent along with natural soil loss at 0.7 percent. At climax, 65 percent of the ground surface would be vegetal cover, 750 pounds/acre herbaceous/woody plants and 1,600 pounds/acre forage/food plants are also the highest values for these variables of any other unit. Unit 272 also has the highest yield of fuel wood at 14 cords/acre. Topsoil suitability of the upper 100 cm is categorized as "poor" with a "slight" risk of erosion upon removal of vegetation. Unit 272 is perhaps the most unique TES unit in the Upper Basin.

TES Unit 281 has the most common soil taxa, lithic ustochrepts, along with the second most common soil phase, gravelly, fine sandy loam. Unit 281 is the only unit with a climax vegetation class containing *Pinus edulis, Juniperous osteosperma,* and *Artemisia tridentate*. The potential soil loss value is relatively low at 8.3 percent along with a natural soil loss value of .95 percent. Fifty-five percent of the ground's surface would be covered with vegetation at climax. Unit 282 would yield 650 pounds/acre of herbaceous/woody plants, 1,037 pounds/acre of forage/food plants and a relatively high value of 10 cords/acre of fuel wood. Unit 281 is the only other unit besides 23 that is

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classified as “fair” for topsoil suitability. Upon removal of vegetation, Unit 281 is at a “slight” risk to erosion.

TES Unit 683 has the most common soil taxa, lithic ustochrepts, yet is unique in that it is the only unit with a very cobbly, very fine sandy loam soil phase. Unit 683 is also is the only unit with a climax vegetation class containing *Artemisia tridentata, Stipa comata, Agropyron cristatum,* and *Quercus gambelii*. Values for soil loss potential and natural soil loss are the lowest of all units, 3.15 percent and 0.15 percent respectively. At climax, Unit 683 would have 72.5 percent vegetal ground cover, also the highest of all units. Herbaceous/woody plants would yield 462.5 pounds/acre (the second lowest value) and forage/food plants would yield 1,300 pounds/acre, a relatively high value. Interestingly, Unit 683 would yield 0 cords/acre fuel wood, similar to both Units 23 and 252. Topsoil suitability is “poor” with a “slight” risk to erosion upon removal of vegetation.

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APPENDIX D: Ceramic date ranges.

Ceramic	Chronology Begin Date	Chronology End Date	Span	Breternitz Indigenous Begin Date	Breternitz Indigenous End Date	Breternitz Trade Begin Date	Breternitz Trade End Date	Breternitz Tree-ring Begin Date	Breternitz Tree-ring End Date	Colton Begin Date	Colton End Date	Sullivan Begin Date	Sullivan End Date
Lino Gray	575	875	300	354	1275	702	1045	575	875	500	750		
Lino B/G	575	875	300	430	1275	354	965	575	875				
St. Joesph	700	900	200							700	900		
LC Gray	700	1200	500							700	1200		
Tizon Brown	700	1890	1190							700	1890		
Kana-a B/W	725	950	225	636	1285	671	1275	725	950	700	950		
Floyd Gray	760	965	205	675	1189	687	965	760	965	700	900		
Floyd B/G	775	940	165	687	937			775	940	700	900		
Deadman's B/R	775	1066	291	837	872	678	1106	775	1066	750	1050		
Deadman's Fugitive Red	775	1150	375	687	1192	687	1207	775	1150	700	1050		
Deadman's Gray	775	1200	425	687	1205	687	1121	775	1200	700	1150		
Black Mesa B/W	875	1130	255	977	1390	701	1275	875	1130	900	1100	875	1130
Medicine Gray	890	1060	170			760	1275	890	1060	890	950		
Coconino Gray	890	1060	170			760	1061	890	1060	890	950		
Deadman's B/G	900	1115	215	763	1093	1058	1115	900	1115	900	1100		
Tusayan Corrugated	1000	1275	275	977	1390	799	1323	1000	1275	950	1275	1000	1275
Prescott	1025	1200	175	799	1256	799	1256	1025	1200	1000	1400		
Middleton B/R	1050	1130	80							1050	1130		

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Ceramic	Chronology Begin Date	Chronology End Date	Span	Breternitz Indigenous Begin Date	Breternitz Indigenous End Date	Breternitz Trade Begin Date	Breternitz Trade End Date	Breternitz Tree-ring Begin Date	Breternitz Tree-ring End Date	Colton Begin Date	Colton End Date	Sullivan Begin Date	Sullivan End Date
Tusayan B/R	1050	1200	150	977	1289	805	1279	1050	1200	1050	1150		
Sosi B/W	1057	1200	143	977	1285	813	1279	1075	1200	1070	1150	1057	1200
Doghozhi B/W	1064	1200	136	977	1390	813	1279	1085	1200	1070	1150	1064	1200
Cameron Polychrome	1065	1150	85	1057	1143	918	1127	1065	1150	1050	1100		
Walnut B/W	1065	1250	185	914	1390	957	1275	1065	1250	1100	1250		
Medicine B/R	1075	1125	50	977	1274	910	1160	1075	1125	1050	1100		
Holbrook	1075	1130	55	701	1279	1023	1061	1075	1130	1070	1110		
Moenkopi Corrugated	1075	1300	225	977	1390	813	1282	1075	1300	1050	1275		
Shato B/W	1080	1130	50	1109	1285	1059	1207	1080	1130	1050	1150		
LC Corrugated	1080	1275	195	1058	1282			1080	1275	900	1200		
Padre B/W	1085	1200	115	1086	1279	957	1275	1085	1200	1070	1150		
Flagstaff B/W	1085	1275	190	977	1390	914	1320	1085	1275	1125	1200		
Tusayan Polychrome	1100	1300	200	977	1289	914	1282	1100	1300	1150	1300		
Citadel Polychrome	1115	1200	85	1057	1285	911	1279	1115	1200	1125	1175		
Tusayan B/W	1125	1300	175	977	1289	957	1320	1125	1300	1225	1300		
Kiet Siel Gray	1200	1300	100	977	1285	1070	1282	1200	1300	1274	1300		
Kiet Siel Polychrome	1250	1285	35	1104	1285	1078	1282	1250	1285	1225	1300		
Kayenta B/W	1260	1300	40	1104	1495	1023	1320	1260	1300	1250	1300		

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Ceramic	Chronology Begin Date	Chronology End Date	Span	Breternitz Indigenous Begin Date	Breternitz Indigenous End Date	Breternitz Trade Begin Date	Breternitz Trade End Date	Breternitz Tree-ring Begin Date	Breternitz Tree-ring End Date	Colton Begin Date	Colton End Date	Sullivan Begin Date	Sullivan End Date
Kayenta Polychrome	1265	1285	20	1104	1495	1023	1279	1265	1285	1250	1300		

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APPENDIX E: Occupational range, broad temporal period, and sub-period of each mapping unit.

MU	Cultural Affiliation	Occupational Range Begin Date	Occupational Range End Date	Occupational Range Span	Multi-component Occupational Range Begin Date	Multi-component Occupational Range End Date	Multi-Component Occupational Range Span	Broad Temporal Period	Sub-period	Multi-component Broad Temporal Period	Multi-component Sub-division
14.1	Anasazi	775	1200	425				0	.0	0	.0
14.2	Cohonina	775	1200	425				1	1.0	0	.0
22	Anasazi	1000	1275	275				3	3.2	0	.0
26.1	Mixed	1050	1200	150				2	2.1	0	.0
26.2	Anasazi	1064	1200	136				0	.0	0	.0
26.3	Anasazi	1000	1200	200				2	2.1	0	.0
38.1	Mixed	775	1200	425				1	1.0	0	.0
38.2	Anasazi	1000	1066	66	1080	1150	70	2	2.2	3	3.2
43	Cohonina	775	1066	291				1	1.0	0	.0
47.1	Mixed	1000	1200	200				0	.0	0	.0
47.31	Anasazi	1000	1200	200				0	.0	0	.0
47.32	Anasazi	1000	1200	200				3	3.2	0	.0
51	Anasazi	1000	1275	275				3	3.2	0	.0
52	Anasazi	1050	1200	150				3	3.1	0	.0
52.2	Cohonina	700	1300	600				1	1.0	0	.0
53	Cohonina	775	1200	425				1	1.0	0	.0
55	Cohonina	775	950	175				1	1.0	0	.0
60	Anasazi	1000	1200	200				3	3.2	0	.0
61.1	Cohonina	775	1150	375				1	1.0	0	.0
61.2	Cohonina	775	1200	425				1	1.0	0	.0
61.3	Cohonina	775	1150	375				1	1.0	0	.0
65	Anasazi	1000	1275	275				0	.0	0	.0
76.1	Mixed	1000	1066	66				2	2.1	0	.0
76.2	Mixed	1000	1150	150				2	2.1	3	3.1
83.01	Anasazi	1085	1200	115				3	3.2	0	.0
83.02	Anasazi	1000	1200	200				3	3.1	0	.0

83.03	Anasazi	1085	1200	115				3	3.2	0	.0
83.04	Anasazi	1000	1200	200				2	2.1	3	3.2
86.1	Anasazi	1050	1200	150				2	2.2	0	.0
86.2	Anasazi	1057	1200	143				2	2.2	0	.0
86.3	Anasazi	1050	1200	150				2	2.2	0	.0
86.6	Anasazi	700	1300	600				3	3.2	0	.0
87	Mixed	1000	1200	200				2	2.1	0	.0
87.1	Anasazi	1057	1200	143				2	2.2	0	.0
88	Anasazi	1085	1200	115				3	3.2	0	.0
88.1	Anasazi	1085	1200	115				3	3.2	0	.0
90.1	Anasazi	1075	1200	125				3	3.1	0	.0
90.2	Anasazi	1000	1200	200				2	2.1	3	3.2
108.1	Anasazi	1057	1150	93				2	2.2	3	3.1
108.2	Anasazi	1057	1150	93				2	2.2	3	3.1
108.3	Anasazi	1080	1115	35				3	3.1	0	.0
108.4	Mixed	1000	1200	200				0	.0	0	.0
109	Anasazi	1000	1200	200				2	2.1	0	.0
114	Anasazi	1057	1200	143				3	3.1	0	.0
117.1	Anasazi	1085	1130	45				3	3.2	0	.0
117.2	Anasazi	1000	1130	130				2	2.2	3	3.1
118	Anasazi	1000	1150	150				2	2.1	0	.0
119	Anasazi	1000	1150	150				2	2.1	0	.0
120	Anasazi	1000	1200	200				3	3.1	0	.0
122	Anasazi	1000	1200	200				3	3.2	0	.0
123	Mixed	1000	1200	200				2	2.1	0	.0
123.11	Anasazi	1000	1275	275				2	2.1	0	.0
125	Anasazi	1057	1130	73				2	2.2	3	3.1
126.01	Mixed	1057	1200	143				0	.0	0	.0
126.1	Anasazi	1000	1275	275				0	.0	0	.0
126.2	Mixed	1000	1130	130				2	2.2	0	.0
126.3	Anasazi	1000	1150	150				3	3.1	0	.0
126.4	Mixed	1000	1150	150				2	2.1	3	3.1
126.6	Mixed	1057	1200	143				2	2.2	0	.0
127	Anasazi	1000	1275	275				3	3.2	0	.0
128	No	700	1300	600				0	.0	0	.0

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	Ceramics										
130	Anasazi	1000	1275	275				3	3.1	0	.0
201	Cohonina	1000	1200	200				0	.0	0	.0
202.1	Anasazi	1000	1200	200				0	.0	0	.0
202.2	No Ceramics	700	1300	600				0	.0	0	.0
202.3	Mixed	1064	1200	136				2	2.1	3	3.1
207	Cohonina	775	1150	375				0	.0	0	.0
208	Cohonina	775	1200	425				1	1.0	0	.0
209.1	Anasazi	1050	1130	80				2	2.1	0	.0
209.2	Anasazi	1000	1200	200				2	2.1	0	.0
209.3	Anasazi	1000	1130	130				3	3.1	0	.0
209.4	Anasazi	1000	1200	200				2	2.2	0	.0
209.5	Anasazi	1000	1200	200				2	2.2	0	.0
211	Anasazi	1085	1200	115				3	3.2	0	.0
216	Mixed	1000	1200	200				0	.0	0	.0
218	Anasazi	1000	1130	130				3	3.2	0	.0
220	Cohonina	1000	1150	150				2	2.1	0	.0
221	Anasazi	1000	1275	275				3	3.2	0	.0
222.1	Anasazi	1000	1200	200				3	3.1	0	.0
222.2	Anasazi	1085	1130	45				3	3.2	0	.0
222.3	Anasazi	1085	1130	45				3	3.2	0	.0
222.4	Mixed	1025	1060	35				2	2.2	0	.0
225	Anasazi	1057	1200	143				3	3.2	0	.0
229	Anasazi	1085	1200	115				3	3.2	0	.0
229.1	Anasazi	1115	1150	35				3	3.2	0	.0
230	Mixed	1000	1200	200				2	2.1	0	.0
232	Cohonina	775	1200	425				0	.0	0	.0
236.1	Mixed	1000	1150	150				2	2.1	0	.0
239.1	Mixed	1000	1150	150				2	2.1	0	.0
239.2	Anasazi	1000	1060	60				2	2.1	0	.0
257	Mixed	775	1200	425				1	1.0	0	.0
257.1	Anasazi	1000	1060	60				2	2.1	0	.0
276	Mixed	775	950	175				1	1.0	0	.0
301.1	Anasazi	1075	1200	125				3	3.1	0	.0

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301.2	Anasazi	1000	1275	275				3	3.2	0	.0
302	Cohonina	1000	1150	150				2	2.1	0	.0
306	Mixed	875	950	75	1057	1130	73	1	1.0	3	3.1
306.01	Mixed	1000	1130	130				2	2.2	3	3.1
306.3	Mixed	1000	1200	200				2	2.1	0	.0
307.1	Anasazi	1000	1150	150				3	3.1	0	.0
307.2	Mixed	1000	1200	200				2	2.1	0	.0
308	Cohonina	775	1150	375				1	1.0	0	.0
315	Mixed	1057	1130	73				2	2.1	0	.0
317	Anasazi	1057	1130	73				2	2.1	0	.0
318.1	Mixed	1000	1200	200				3	3.1	0	.0
318.2	Mixed	1085	1130	45				3	3.1	0	.0
318.3	Anasazi	1057	1200	143				3	3.2	0	.0
318.4	Mixed	775	1200	425				0	.0	0	.0
319	Anasazi	1057	1200	143				2	2.1	3	3.1
319.1	Anasazi	1050	1130	80				3	3.2	0	.0
319.2	Mixed	1065	1130	65				2	2.2	3	3.1
320.1	Anasazi	1000	1130	130				2	2.1	0	.0
320.2	Anasazi	1000	1130	130				2	2.2	3	3.1
326.1	Mixed	890	950	60				1	1.0	0	.0
359	Cohonina	775	1200	425				0	.0	0	.0
362.1	Anasazi	1000	1130	130				2	2.2	0	.0
362.2	Anasazi	1057	1130	73				2	2.2	3	3.1
502	Mixed	1000	1200	200				3	3.1	0	.0
552	Anasazi	1000	1130	130				2	2.2	0	.0
582	Cohonina	775	1200	425				1	1.0	0	.0
606	Anasazi	1000	1200	200				2	2.2	0	.0
614	Anasazi	1057	1130	73				3	3.2	0	.0
616	Anasazi	1000	1200	200				3	3.1	0	.0
653	Anasazi	1000	1200	200				2	2.1	0	.0
654	Cohonina	775	1200	425				1	1.0	0	.0
665.1	Mixed	1000	1130	130				0	.0	0	.0
665.2	Anasazi	1000	1200	200				2	2.1	0	.0
701	Cohonina	775	1200	425				1	1.0	0	.0
706	Anasazi	1080	1275	195				3	3.2	0	.0

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707.1	Anasazi	1075	1200	125				3	3.2	0	.0
707.2	Anasazi	1075	1200	125				3	3.2	0	.0
708.1	Mixed	775	1200	425				1	1.0	0	.0
708.2	Cohonina	775	1200	425				1	1.0	0	.0
709	Cohonina	775	950	175				1	1.0	0	.0
710	Mixed	1100	1200	100				3	3.1	0	.0
710.1	Anasazi	1075	1200	125				3	3.2	0	.0
719	Cohonina	775	1200	425				0	.0	0	.0
719.1	Cohonina	775	1200	425				1	1.0	0	.0
720	Cohonina	1057	1130	73				0	.0	0	.0
722	Anasazi	1075	1200	125				3	3.1	0	.0
724	Anasazi	1000	1200	200				0	.0	0	.0
729.1	Anasazi	1000	1150	150				3	3.2	0	.0
729.2	Anasazi	1000	1200	200				3	3.1	0	.0
729.3	Anasazi	1000	1200	200				2	2.1	0	.0
729.4	Mixed	1000	1275	275				2	2.2	0	.0
732.1	Anasazi	1000	1275	275				2	2.2	0	.0
732.2	Anasazi	1000	1275	275				2	2.2	0	.0
733	Anasazi	1050	1066	16				0	.0	0	.0
734	Mixed	1075	1130	55				3	3.1	0	.0
735.1	Mixed	1057	1066	9				2	2.2	0	.0
735.2	Mixed	900	940	40	1064	1115	51	1	1.0	3	3.1
738	No Ceramics	700	1300	600				0	.0	0	.0
738.1	Cohonina	1057	1200	143				2	2.1	0	.0
740	Mixed	890	1060	170				1	1.0	0	.0
741	Cohonina	775	1066	291				1	1.0	0	.0
741.1	Anasazi	890	950	60	1000	1060	60	1	1.0	2	2.2
744	Cohonina	775	1150	375				1	1.0	0	.0
745	Anasazi	1000	1200	200				2	2.2	0	.0
747	Anasazi	1064	1150	86				2	2.2	3	3.1
748	Anasazi	775	1200	425				0	.0	0	.0
757	Anasazi	1085	1275	190				3	3.2	0	.0
799.2	Mixed	700	1300	600				1	1.0	0	.0
902	Mixed	1057	1200	143				2	2.1	0	.0

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904.01	Anasazi	1085	1275	190				3	3.2	0	.0
904.02	Anasazi	1085	1150	65				3	3.2	0	.0
904.1	Anasazi	1057	1130	73				3	3.2	0	.0
905.1	Anasazi	1075	1200	125				3	3.1	0	.0
905.2	Anasazi	1000	1275	275				3	3.2	0	.0
911	Mixed	1057	1130	73				0	.0	0	.0
912	Mixed	1000	1200	200				2	2.2	3	3.1
922	Anasazi	1085	1200	115				3	3.1	0	.0
941	Anasazi	775	1200	425				0	.0	0	.0
944	Anasazi	1000	1130	130				2	2.2	0	.0
948.1	Mixed	1057	1060	3				2	2.2	0	.0
949	Cohonina	775	1200	425				0	.0	0	.0
951	Mixed	1000	1200	200				2	2.1	0	.0
978.1	Anasazi	1000	1130	130				2	2.1	0	.0
978.2	Mixed	1000	1200	200				2	2.2	3	3.1
978.3	Anasazi	1000	1200	200				2	2.1	0	.0
979	Mixed	1000	1200	200				2	2.1	0	.0
980	Mixed	1057	1200	143				2	2.2	3	3.1
983	Mixed	1000	1200	200				2	2.1	0	.0
1001	Anasazi	1000	1130	130				2	2.2	0	.0
1006	Mixed	1057	1200	143				2	2.2	3	3.1
1010	Anasazi	1057	1130	73				2	2.1	0	.0
1017	Mixed	1000	1200	200				3	3.1	0	.0
1018	Anasazi	1057	1200	143				2	2.1	0	.0
1018.1	Mixed	1057	1130	73				2	2.2	3	3.1
1084	Anasazi	1057	1200	143				2	2.1	0	.0
1154	Cohonina	775	1200	425				0	.0	0	.0
1185	Mixed	1000	1200	200				2	2.1	3	3.1
1186	Mixed	1000	1130	130				2	2.1	0	.0
1187	Anasazi	1085	1150	65				3	3.2	0	.0
1188	Anasazi	1085	1150	65				3	3.2	0	.0
1202	Anasazi	700	1300	600				0	.0	0	.0
1212	Anasazi	700	1300	600				0	.0	0	.0
1222	Anasazi	1085	1200	115				3	3.1	0	.0
1223	Anasazi	1085	1200	115				3	3.1	0	.0

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1224	Anasazi	1075	1130	55				3	3.2	0	.0
1238	Mixed	1000	1200	200				2	2.1	0	.0
1243	Mixed	1000	1066	66				2	2.2	0	.0
1700	Anasazi	1000	1200	200				2	2.1	0	.0
3001.1	Anasazi	775	1200	425				0	.0	0	.0
3001.2	Mixed	1075	1125	50				3	3.1	0	.0
5001	Anasazi	1064	1200	136				3	3.2	0	.0
5002	Anasazi	1085	1275	190				3	3.1	0	.0
5003.1	Anasazi	1085	1200	115				3	3.2	0	.0

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