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Fremont Site Distribution in the Upper Escalante River Drainage

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by

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GRADUATE COMMITTEE APPROVAL

of a thesis submitted by

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This thesis has been read by each member of the following graduate committee and by majority vote had been found satisfactory.

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BRIGHAM YOUNG UNIVERSITY

As chair of the candidate's graduate committee, I have read the thesis of Deborah C. Harris in its final form and have found that (1) its Format, citations and bibliographic style are consistent and acceptable and fulfill University and department style requirements; (2) its illustrative materials including figures, tables, and charts are in place; and (3) the final manuscript is satisfactory to the graduate committee and is ready for submission to the university library.

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ABSTRACT

Fremont Site Distribution in the Upper Escalante River Drainage

Deborah C. Harris

Department of Anthropology

Master of Arts

A Fremont site distribution model for the Grand Staircase-Escalante National Monument during the period A.D. 500—1050/1100 posits that the Fremont subsistence strategy (seasonal mobility with dependence on both agriculture and hunting/foraging) is reflected by a site pattern of low-investment, seasonal or short-term habitation sites and isolated storage facilities at "lowland" elevations, and high-investment, long-term residence sites at "upland" elevations (McFadden 1998, 2000). This research assesses the model to evaluate its general precision, looking particularly at its success in modeling site locations for long-term residential versus seasonal/short-term habitation sites.

A database including more than 400 Fremont sites was created to evaluate the model. Data variables examined in this thesis included elevation, distance-to-water, and primary landform. Analysis of the elevation data demonstrates that the McFadden model does not fit the actual distribution of Fremont sites identified from survey. Further analysis also established that distance-to-water is not an effective variable in accurately modeling Fremont site patterning over this region. The association between functional site types and primary landforms, however, does appear to more accurately reflect site distribution as observed on the ground. Based on these results, a new model for Fremont site distribution in the upper Escalante River drainage is proposed.

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1 | Introduction

Archaeology has a long tradition of studying the complex relationships between people, place, and things. Its strength lies with its ability to develop meaningful insights into these fundamental relationships. Based on an assortment of perspectives and practices, archaeologists focus on identifying and answering important questions which illuminate the essential relationships between ancient human beings and the natural world.

Archaeological sites are a record of a specific set of events at a specific place at a specific points in time, reflecting human behaviors and choices that represent a particular cultural and social environment. These sites are useful in reconstructing how human groups adapted to changing environmental and cultural conditions.

Binford has defined culture as "man's extra-somatic means of adaptation to his environment" (1962:217). Hsu has added to the definition the statement that culture is the "manner in which every social organization operates to maintain itself and/or to undergo change due to external pressure or internal impetus" (1959:800). Archaeology attempts to explain these dynamics using material remains to reveal patterns hidden within masses of archaeological data. One approach useful in revealing settlement and subsistence strategies and even cultural boundaries for prehistoric peoples is the study of site and artifact distribution. Additional analyses focused on identifying relationships between archaeological sites and landscape features contribute to understanding prehistoric settlement strategies and assist in significantly enhancing explanations of past cultural landscapes or land-use sequences.

RESEARCH QUESTION/PROBLEM STATEMENT

Traces of many prehistoric societies are spread over and across the varied landscapes of the Colorado Plateau and Great Basin. One cultural group, the Fremont, is identified almost exclusively within the modern boundaries of the state of Utah (Figure 1.1). Fremont occupations appear archaeologically as a range of site types and include extensive communities with large sedentary populations along major transition zones between mountains and valleys (Aikens 1966, Janetski 2004, Janetski and Talbot 2000, Marwitt 1986). These communities include moderately sized settlements of pithouses suggestive of nuclear or extended family relationships such as have been identified along Clear Creek Canyon in central Utah (Janetski 1998, Janetski et al. 2000, Talbot 2005a). Elsewhere, such as in many parts of the Colorado Plateau, populations were smaller and communities more dispersed. In the southern parts of the state and within the Grand Staircase-Escalante National Monument (GSENM), Fremont occupations generally appear as even smaller pithouse groups or individual/isolated sites.

The intent of this research is to better understand the Fremont pattern of settlement and site distribution in the upper Escalante River drainage. Using inventory and excavation data, this study will examine patterns in the distribution of cultural remains that potentially reflect settlement and land-use strategies across varying environmental zones through the application of a settlement model as proposed by Douglas McFadden (1998 and 2000). McFadden argues that following the introduction of pottery to the Escalante drainage, and the significant contribution of agriculture to diet, the Fremont subsistence strategy consisted of seasonal mobility with dependence on both agriculture and hunting/foraging of local resources. He proposed that populations summered in the "lowlands" and wintered in the "uplands" – terms that remain undefined by McFadden in his model. According to this model, "low" elevation sites should appear as

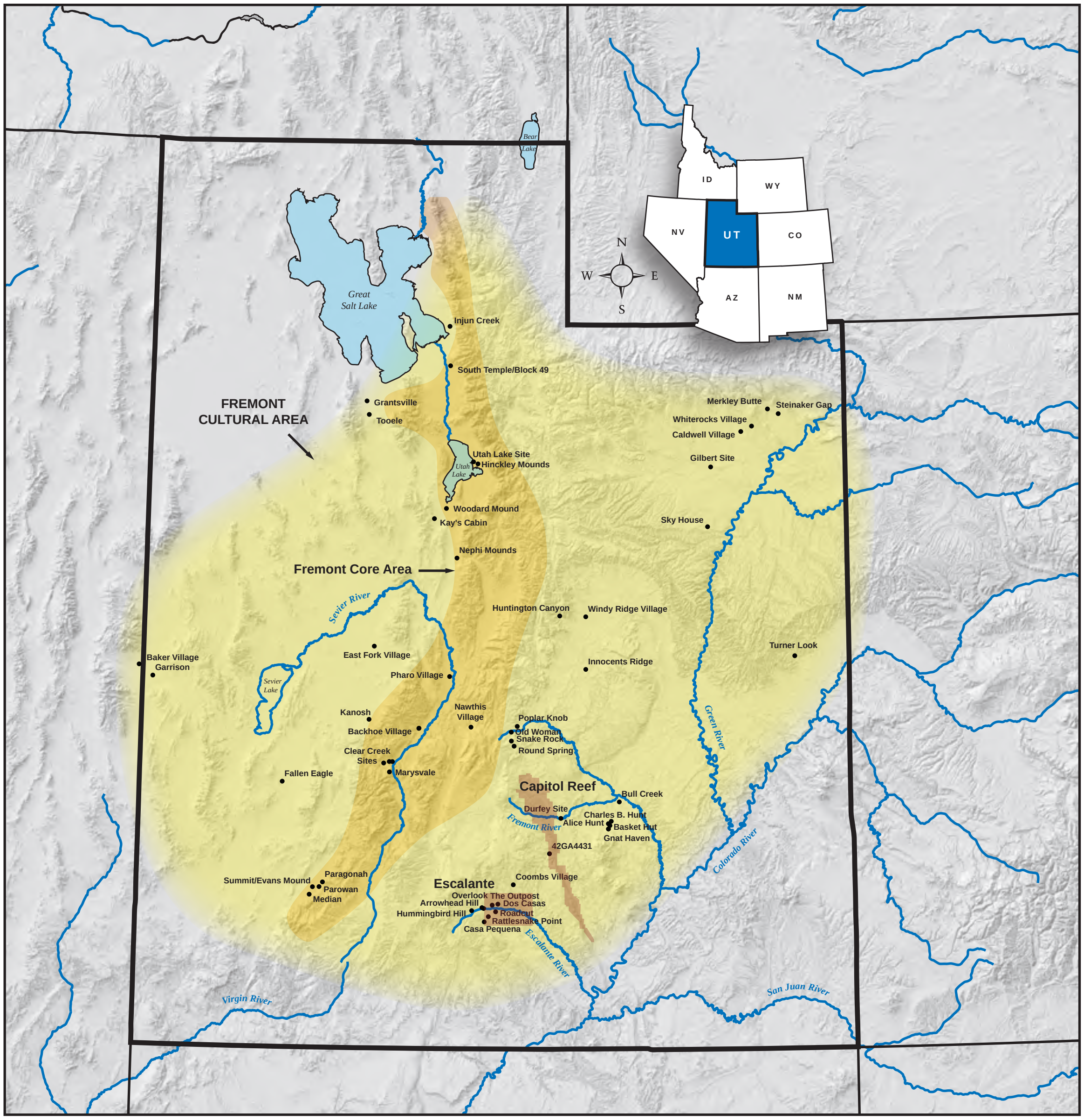

Figure 1.1 Fremont Cultural Area map showing Fremont core area (highlighted) and major sites in Utah. (Map courtesy of Scott Ure.)

isolated storage facilities or relatively low-investment seasonal habitation or short-term residences, while high-investment, long-term residences would be located at "upland" elevations. Although not explicitly stated, McFadden considers only pithouse and granary sites in the development of his hypothesis.

This study analyzes excavation and inventory data acquired over the course of a

5-year cooperative project (BYU Project) between the Bureau of Land Management (BLM) and BYU's Department of Anthropology Archaeological Field School and Office of Public Archaeology (BYU/OPA) to identify settlement and land-use strategies employed by the Fremont during the defined period. In addition to the sites included in the BYU Project, I analyze all applicable Fremont sites identified through previous survey and excavation within a defined study area (see below), and on file with the Utah State Historic Preservation Office (SHPO). Following the initial examination of the complete data set to determine the cultural affiliation and occupation period for each site identified during the study, I assign a function for each of the identified Fremont sites. After analyzing the data, I compare the results with McFadden's proposed settlement model for the upper Escalante River drainage, and make an assessment of the validity of McFadden's model for Fremont site distribution.

Study Area

McFadden's settlement model is based on the relationship between upland and lowland sites; therefore, a geographic region encompassing high to low elevation environments in the upper Escalante River drainage was defined for the study. The study area measures nearly 29 miles in an east-west direction, and just over 21 miles in a north-south direction. It is bounded at the northwest corner by T33S R1E Section 25, the northeast corner by T33S R6E Section 27, the southeast corner by T37S R6E Section 3, and at the southwest corner by T37S R1E Section 1 (Figure 1.2, Table 1.1). These boundaries are somewhat arbitrary in that they are not based on any specific topographic features. Instead, they are defined by taking the outermost section in each cardinal direction of the surveys conducted during the BYU Project and extending the area by one section (Figure 1.2). The designated sample area contains all the inventories and site

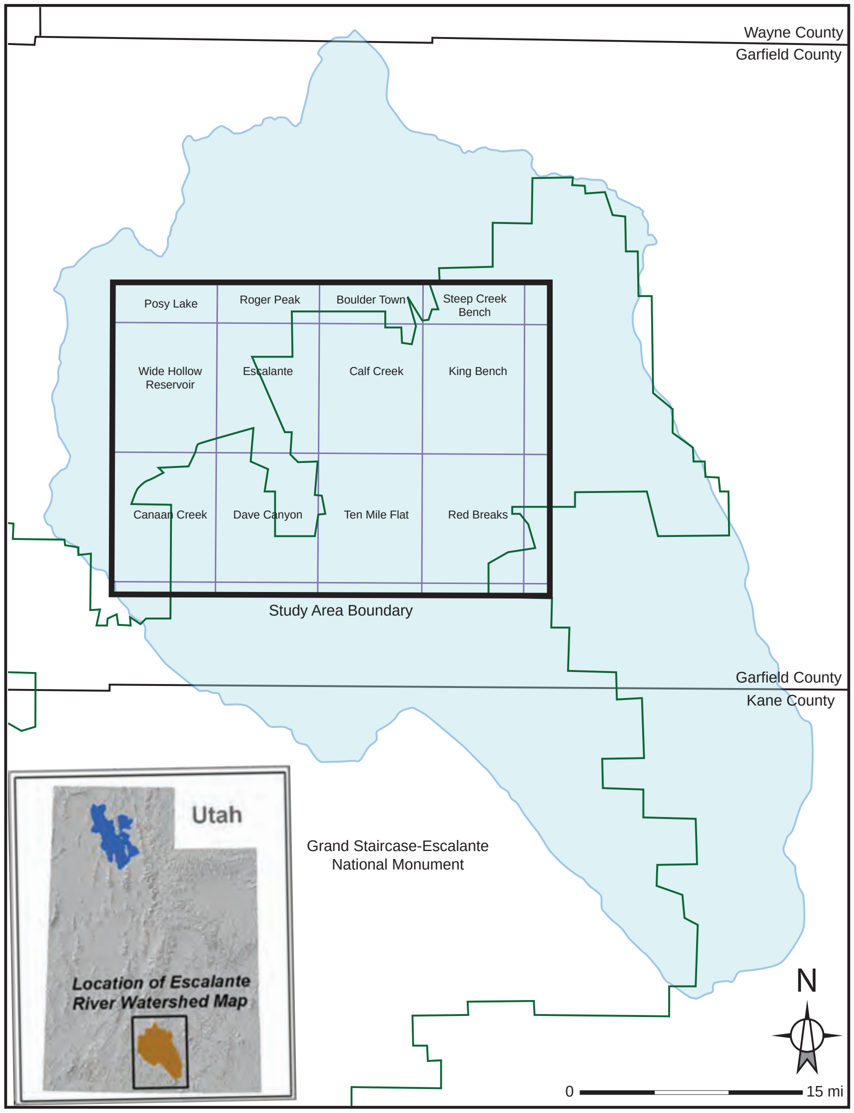

Figure 1.2. Study area map and surrounding region. The black box marks the boundary of the study area. The green lines outline the Grand Staircase-Escalante National Monument boundaries, while the blue area defines the Escalante River Watershed.

excavations from which the study data was obtained.

Thesis Organization

The chapters of this thesis are organized as follows. Chapter 2 reviews previous studies conducted in the area that are relevant to this study. Chapter 3 provides a brief

Table 1.1 Summary of Topographic Maps, Townships, Ranges, and Sections Included in Study Area. Each Corner Section is Highlighted in Red.

Topographic Maps (1:24,000)		**Range**					
	Township	**1E**	**2E**	**3E**	**4E**	**5E**	**6E**
Posy Lake, Roger Peak, Boulder Town, Steep Creek Bench, Lampstand	33S	25, 36	25 thru 36	25 thru 36	25 thru 36	25 thru 36	27 thru 34
Posy Lake, Roger Peak, Boulder Town, Steep Creek Bench, Lampstand, Wide Hollow Reservoir, Escalante, Calf Creek, King Bench, Pioneer Mesa	34S	1, 12, 23, 24, 25, 36	1 thru 36	1 thru 36	1 thru 36	1 thru 36	3-10, 15-22, 27-34
Wide Hollow Reservoir, Escalante, Calf Creek, King Bench, Pioneer Mesa, Canaan Creek, Dave Canyon, TenMile Flat, Red Breaks, Silver Falls Bench	35S	1, 12, 23, 24, 25, 36	1 thru 36	1 thru 36	1 thru 36	1 thru 36	3-10, 15-22, 27-34
Canaan Creek, Dave Canyon, TenMile Flat, Red Breaks, Silver Falls Bench	36S	1, 12, 23, 24, 25, 36	1 thru 36	1 thru 36	1 thru 36	1 thru 36	3-10, 15-22, 27-34
Death Ridge, Carcass Canyon, Seep Flat, Sunset Flat, Egypt	37S	1	1 thru 6	1 thru 6	1 thru 6	1 thru 6	1 thru 3

temporal and spatial context for the Fremont, while Chapter 4 presents an environment overview, including the regional geology, climate, and resources available in the study area. Chapter 5 is a general overview and discussion of settlement pattern studies, specifically addressing concerns such as some of the inherent problems in making appropriate determination of cultural affiliation, site dating, and site function.

The methodology used to perform the analysis, including a discussion of McFadden's proposed settlement model for the northern GSENM, definitions, and analytical tests conducted on the data appear in Chapter 6, while a descriptive presentation of the data makes up Chapter 7. The final chapter discusses the results of the study, interpreting the data to develop conclusions regarding patterns in Fremont settlement and site distribution.

2 | Previous Research

Interest in the prehistory of the area was ignited with the arrival of pioneer settlers into the region. "Dr. Edward Palmer may have been the first to actually excavate on (what is now) the Grand Staircase-Escalante National Monument. In 1877 he excavated a cave in Johnson Canyon and described his findings in a brief report [Palmer 1880]. Dr. W. H. Holmes visited Kanab a little later and published a short report on his observations in the area" (McFadden 2000:10). Archaeological assessments of the area within and around the GSENM have been conducted intermittently over the previous century (Metcalf 1998). Between 1915 and 1920, Neil M. Judd (Judd 1926) conducted limited excavation and survey near Kanab while Jesse Nusbaum completed a full-scale excavation of one site, again near Kanab. William Claflin and Raymond Emerson traveled throughout south-central Utah in 1927 in order to "determine the feasibility of an archaeological expedition into this and other regions of Utah. A direct consequence of the work was the defining of the Fremont culture of Utah" (Janetski 2005a:531) by Noel Morss (1931), who also conducted excavations at the Coombs site in Boulder. Julian Steward recorded 142 sites during a 1932 survey between Johnson Canyon and the Paria River (Steward 1941). An early survey on the Kaiparowits Plateau (Kluckhohn 1933) also "revealed the presence of a substantial number of prehistoric sites" (Metcalf 1998:32). All these projects pale in comparison to the Glen Canyon Salvage Project conducted during the late 1950s and early 1960s in anticipation of the creation of Lake Powell (Jennings 1966).

While the main focus of that project was the exploration of Glen Canyon, intensive surveys were also conducted on the southeastern portion of the Kaiparowits Plateau, Johnson Creek, and what is now the center of the GSENM (Metcalf 1998; McFadden 2000). Within the GSENM, Fremont material culture extends from the Escalante drainage basin on to portions of the Kaiparowits Plateau (Morss 1931, Steward 1941, Gunnerson 1959, Aikens 1962, Jennings 1966, McFadden 1998, 2000, Talbot et al 2000, Geib 2001, Jordan and Talbot 2002, Baer and Sauer 2003, Harris 2005, and many others). James Gunnerson's survey of the Kaiparowits Plateau recorded more than 250 prehistoric sites (Gunnerson 1959a). In addition, "In 1957 Gunnerson [1959b] excavated at ten sites in the Escalante drainage including two residential sites near the town of Escalante; (including) the Spencer Site, and Rattlesnake Point" (McFadden 2000). A comprehensive survey of the eastern edge of the Kaiparowits Plateau was conducted by Aikens (1962). Additional excavations were conducted on the Plateau (Fowler and Aikens 1963) and in Johnson Canyon (Aikens 1965). These archaeological traces "represent a long-lived local adaptation that began in the Archaic Period and continued as an identifiable entity until contact with the Anasazi during Pueblo II times" (McFadden2000:1).

RECENT RESEARCH

More recent survey work within the region has been conducted by numerous researchers. During 1972-1973, Moffitt et al (1978) surveyed the right-of-way for a 500 kV transmission line, identifying 62 archaeological sites. In 1977 and 1978 the Archaeological-Environmental Research Corporation (AERC) conducted a Class II cultural research survey in the Escalante and Kaiparowits area, identifying 199 sites, most of which consisted of lithic scatters and temporary campsites (Hauck 1979). West of the southern GSENM, Nickens and Kvamme (1981) excavated the Formative Kanab Site in

Kane County. Kearns (1982) surveyed a portion of the Kaiparowits Plateau and northern Escalante Valley. Of the 120 sites he recorded, eight were identified as Formative. Metcalfe (1982) inventoried portions of the geographic area known as The Cockscomb, and Bungart and Geib (1987) conducted test excavations of a number of sites in Bowns and Glen Canyon.

In the mid 1980s, Jacklin (1988) excavated two sites near Boulder, Apryll's Site and Mafeetahot, both Fremont in affiliation. Latady (1999) inventoried sections of the Petrified Forest State Park on the northwest side of Wide Hollow Reservoir. That work recorded 14 new sites, six of which were classified as Fremont. During the late 1980s, Northern Arizona University conducted numerous archaeological surveys throughout the Glen Canyon National Recreation Area (GCNRA), with small sections extending into the GSENM. The purpose of these surveys was to understand where sites were located and what types of sites were located in which areas, a modeling approach focused on general site location (Geib 1989). The inventory located 61 sites reflecting use from the Early Archaic through the Late Formative periods. Geib et al. (1999) reported on an extensive survey conducted on the western Kaiparowits Plateau to the south of the Escalante Basin.

The 1983 Tar Sands Project inventoried the region of the Circle Cliffs and the surrounding area. Over the course of the survey, 54 sites were recorded (Tipps 1988). Tipps (1992) also investigated a number of small sites along the Burr Trail on the Escalante Plateau and in the Circle Cliffs. McFadden (1996) dated a number of sites – primarily sheltered granaries in Escalante Canyon (see also Keller 2000). McFadden also recorded selected sites in the Main Canyon, the Little Desert, and the Cedar Pocket sample units. Madsen (1997) provided a preliminary assessment of archaeological resources within the GSENM, while Spangler (2001) completed a detailed survey of cultural resources in the Monument.

Geib et al. (2001) surveyed 17,280 acres on the central and western portions of the Kaiparowits Plateau to characterize and estimate the density, distribution, and diversity of cultural resources in the 800,000 acre plateau study area. Of the 710 archaeological sites identified during that survey, 38 could be attributed to the Fremont. Two power line surveys which crossed the GSENM (Watkins and Talbot 2004; Jardine and Talbot 2004) documented 47 prehistoric sites, four of which were Fremont. Additional excavation and intensive survey was conducted during the multi-year GSENM research project conducted by the BYU Archaeological Field School and Office of Public Archaeology during the years 1999-2004 (Talbot et al 2000, Baker et al 2001, Jordan and Talbot 2002, Baer and Sauer 2003, Harris 2005). The focus of the project was to obtain a variety of important data missing from the Escalante region, including information on prehistoric settlement patterns, material remains, architecture, and rock art through inventory and excavation. Of the 708 sites documented during the BYU Project, over 200 were attributed to the Formative Fremont culture.

3 | The Fremont

"The Formative period (A.D. 1-1300), and to a degree the transitional period leading up to it in the Grand Staircase-Escalante National Monument (GSENM) … is characterized by the practice of agriculture, the construction of substantial dwellings, the development of long-term storage facilities and eventually, the production of pottery. It is generally considered a stage during which mobile hunters and gatherers became more sedentary and presumably, more socially complex" [McFadden 2000:1].

The "Fremont" culture was first recognized and described by Noel Morss in 1931. He recognized the Fremont as a distinct culture through its reliance on horticulture as well as characteristic adobe or masonry architecture and other features unique to the region north of the Colorado River in Utah (see Figure 1.1). Subsequent research has led to various interpreation of what constitutes "the Fremont." Cordell described the culture as "a separate cultural tradition with five regional variants" (1984:213), while others recognize no real difference between the Fremont and Anasazi cultures (Madsen 1989). As a result, serious debate concerning what actually constitutes "The Fremont" remains on-going. Early discussion focused on two farming traditions, with eastern farmers in the Colorado Plateau identified as a Northern Periphery group (Steward 1933) and western farmers in the Great Basin, also part of the Northern Periphery, labeled as "Puebloan" (Judd 1926, Steward 1936). Later Fremont definitions varied from a northward extension of the more clearly defined Anasazi culture of the southwest (Gunnerson 1960), to that of two different – but aligned and unique – horticultural traditions (Fremont in the east, Sevier Fremont in the west) (Rudy 1953, Jennings et al. 1956). Both these traditions were felt to possess a "clear continuity with the Archaic tradition of the Great Basin though…some influences from either the Southwest or the Plains (are) indicated" (Aikens 1978:155). More detailed summaries of previous views of the Fremont are found in Madsen and Simms (1998) and Janetski et al. (2000).

Cordell (1984) has noted that some of the useful traits which characterize the Fremont are a distinctive coil-and-scrape gray ware pottery and the use of a distinctive type of moccasin, instead of the sandals as used by the Anasazi and others. More recently, David Madsen (1979, 1989) has described the prehistoric peoples occupying the western Colorado Plateau and the eastern Great Basin as societies distinguished by great variation and diversity, making it nearly impossible to summarize the culture under a single description. Continuum models (e.g. Madsen and Simms 1998) have further evolved to behavioral explanations arguing against definitional boundaries as restrictive and stereotypical (Simms 1990). Madsen and Simms contend that it is not possible to classify the Fremont using material remains. In their opinion, artifact trait lists sufficiently restricted to differentiate the Fremont from other farming cultures of the Southwest must by necessity exclude some of the Fremont. Conversely, generalized lists including all of the Fremont traits are too imprecise to set the Fremont apart from other agricultural groups in western North America. Other researchers (Janetski and Talbot 2000a) suggest that the Fremont culture is a recognizably unique tradition with many distinct characteristics distinguishing the Fremont from other contemporary agricultural groups. While recognizing variation at the scale of individual sites or at sub-regional levels, they note that at the regional scale, these differences largely disappear – and such patterning gives the Fremont a unique cultural identity. Thus, the Fremont themselves are no longer limited to boundaries defined by artifact lists but are recognized as diverse, flexible, and adaptable, practicing complex strategies within and across varying regions (Janetski and Talbot 2000a).

SPATIAL CONTEXT

As archaeological studies throughout the Colorado Plateau and Great Basin regions have demonstrated, Fremont populations were widespread, and their settlement and subsistence practices varied greatly over both time and space. In some areas people were highly mobile, gathering wild resources from scattered locales (Simms 1986). In other regions, archaeological remnants point toward settled groups practicing horticulture and growing crops in tended gardens or plots or tethered to lakes and streams in order to exploit rich but localized resources (Janetski 2004). Across the Fremont region recognized population densities for these people range from relatively dense to sparsely scattered. However, even though their local differences are great, enough cultural similarities can be recognized between the shared material culture and living patterns of each group to broadly categorize the widely-spread population groups as related and identifiable as Fremont. In my study, Fremont sites are recognized by their commonly recognized material remains – such as pithouse architecture, granary and cist storage structures, thin-walled gray pottery, modeled clay figurines, uniquely woven basketry, specialized moccasin design, and particular styles of rock art

TEMPORAL CONTEXT AND MATERIAL CULTURE

The archaeological work conducted across Utah and the eastern Great Basin suggests that the Formative period, lasting from around 100 A.D. to about 1250/1300 A.D. was a period when agriculture became a significant subsistence strategy. Table 3.1 summarizes the subsistence, settlement, and material culture characteristics generally used to describe the Fremont culture. Prior to 2000 years ago, the highly mobile Archaic system of

Table 3.1. Fremont Subsistence, Settlement, and Material Culture During the Formative Period.

Phase	Subsistence	Settlement	Material Culture
Late Formative (A.D. 1050/1100 - 1200)	*Expanded agriculture *Continued exploitation of local wild resources *Agricultural settlements gradually abandoned at end of period	*Moderately sized villages *Quadrilateral-style pithouses *Deep, rectangular, on-site storage structures *Surface jacal or adobe buildings	*Painted and corrugated ceramics *Increasing presence of Anasazi-style ceramics *Bull Creek and Parowan Basal-notched points *Bone awls, beads, and harpoon-type points reflect extensive domestic and economic activities *Complexly-decorated clay figurines
Agriculture with Ceramics (Early Formative -- A.D. 500 - 1050/1100)	*Increased reliance on agriculture *Semi-sedentary to fully-sedentary lifeway dependent on location *Subsistence supplemented by hunting/gathering within a "local" environment	*Small settlements or nuclear family households *Slab-lined, shallow, circular/ slightly oval pit structures or stone masonry features *On-site subterranean storage *Abundant off-site granary or cist storage features	*Fremont ceramic types, particularly thin-walled gray wares dominate artifact assemblages *Early period: simple gray ware ceramics with little surface manipulation or painted decoration *End-of-period: painted, incised, and punctated vessels *Large, non-transportable basin metates, two-hand style manos *Rose Spring corner-notched points, Eastgate expanding stem types *Stone and bone beads, bone awls and needles, stone balls, fired clay figurines *One-rod-and-bundle basketry
Pre-ceramic Horticulture (A.D. 100-500)	*Gradual shift from highly mobile hunter/gatherers *Growing reliance on horticulture together with hunting/gathering	*Small settlements *1-3 round, shallow pithouses *Internal sub-floor pits *External work area	*Small, corner-notch Rose Spring projectile points *Flaked stone tools and debitage *Basin metates, one-hand (bun-shape) manos *One-rod-and-bundle basketry *Incised stone tablets *Anthropomorphic figurines *NO ceramics

hunting and gathering which had governed subsistence for thousands of years shifted towards horticulture, and increasingly evolved into a strategy uniquely recognizable as Fremont (Janetski 1993; Janetski et al. 2005; Wilde and Newman 1989). "After a considerable period of transition, farming play(ed) an important role in the subsistence economy of eastern Great Basin peoples and by A.D. 1000 … Utah generally was populated by part- and full-time farmers. . . This time period and suite of strategies is known as the Fremont" (Janetski 2004:4). As a result of the more sedentary lifestyle required by farming, this period is generally characterized by permanent settlements having varying degrees of on and/or off-site storage, extensive middens, and distinct ceramic styles. Although we know more now, "Fremont culture origins (are) badly complicated by the fact that the complex seems to have emerged in a peculiar patchwork fashion" (Marwitt 1986:161). This is due to localized environmental or cultural factors, such as might be associated with the expansion of a farming strategy, as well as the fact that the hunting/gathering lifeway was at least seasonally retained.

Early agricultural period settlements were typically small, consisting of one-to-three round, shallow, pit structures with internal storage pits and associated external specialized work areas (Janetski 1997, Talbot 2000). Material culture during this early period consists of ground stone basin metates and one-handed manos, one-rod-and-bundle basketry, incised stone tablets, and anthropomorphic clay figurines (Marwitt 1986).

The Formative period is distinctly marked by the appearance of ceramics, particularly a thin-walled, plain, gray ware in the material record. At the same time, an increasing reliance on agriculture led to a semi-sedentary lifeway supplemented by hunting and gathering of resources within a "local" environ or region. Small settlements of three to six residences, as well as single or nuclear family households, exhibit slab-lined, shallow, circular or slightly oval pithouse or stone masonry styles with on-site subterranean/

sub-floor storage pits in combination with abundant off-site storage granaries. Large, non-transportable basin metates and two-handed manos are common. Projectile points include the earlier Rose Spring corner-notched points as well as Eastgate expanding stem points, and flaked stone tools are abundant. Artifact assemblages from this period also include stone and bone beads, bone awls and needles, fired clay figurines, stone balls, and the one-rod-and-bundle basketry exclusively produced by the Fremont (Cordell 1984). The end of the early and beginning of the late Formative periods are distinguished by the gradual introduction of, and then relatively common occurrences of painted, incised, and punctated ceramic forms supplementing the commonly occurring, local plain Emery Gray wares. Many of these wares are painted with styles that are distinctly Fremont, but show some similarity to decorative motifs found on some Anasazi wares. Changes in settlement from small, scattered hamlets to larger villages have also been noted in some areas (Talbot et al. 2005). By A.D. 1300, however, the practice of agriculture disappeared rather suddenly and the primary means of subsistence reverted to hunting and gathering during the post-Fremont period (A.D. 1300 until Euro-American settlement in the mid 1800s).

Fremont Chronologies in the GSENM

Previous archaeological research and analysis has enabled archaeologists to piece together a basic cultural sequence for the Fremont across the three topographic regions in the GSENM (Figure 3.1) that reflect the land use patterns observed during excavation and inventory projects previously conducted within the GSENM. This work resulted in a chronological framework (Table 3.2) for each of the Virgin Anasazi, Kayenta Anasazi, and Escalante Fremont cultures across those three topographic sections in the Monument, as each exhibits a geographically discrete pattern of settlement and material culture

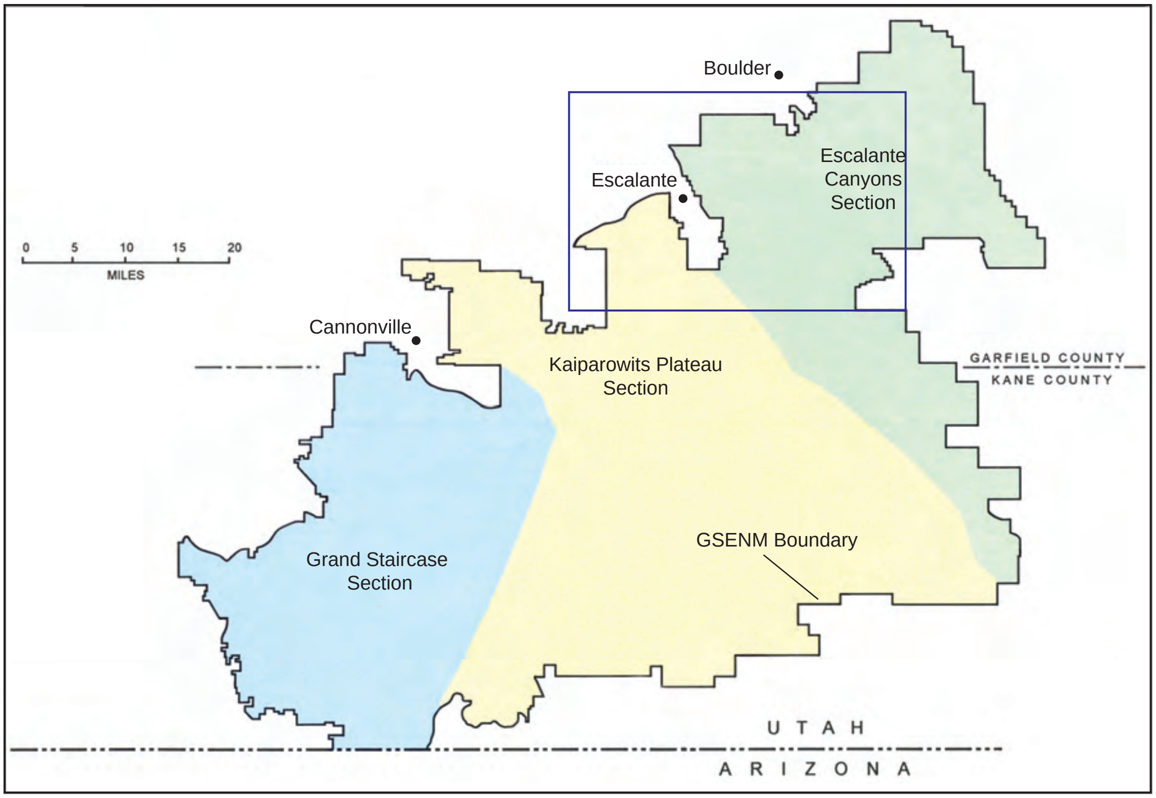

Figure 3.1. Three topographic sections making up the Grand Staircase-Escalante National Monument. The dark blue outline represents the study area boundary.

through time (McFadden 2000). On the Grand Staircase, the prehistoric cultural record reflects a Virgin Anasazi, rather than a Fremont, presence (McFadden 1998, 2000). The Kaiparowits Plateau was generally perceived to have been occupied by the Kayenta Anasazi (Lister 1964; Jennings 1966), but Geib et al. (2001) documented a Formative settlement pattern consisting of the remains of primarily Virgin Anasazi occupation on the Kaiparowits, observing only scarce Fremont habitations indicative of temporary camps associated with foraging and hunting. In the Escalante Canyons area of the GSENM, however, inventory conducted by Bureau of Land Management (BLM) archaeologists revealed abundant numbers of Fremont sites exhibiting significant variability in typology and size, as well as high apparent site densities. In an effort to explain the differences noted between the Kaiparowits and Escalante Canyons sections in the GSENM,

Table 3.2. Existing Formative Chronologies Across All Three GSENM Geographic Regions. (From McFadden 2000)

Cal. Years	Grand Staircase Virgin Anasazi McFadden 2000	Kaiparowits Plateau "Kayenta" Glen Canyon Project	Escalante Drainage "Fremont" After Geib 1996
1300		Abandoned	
	Pueblo III		
1200			Late Formative Period
1100	Late Pueblo II		
1000	Early Pueblo II		
900			
800	Pueblo I		Early Formative Period
700			
	Late Basketmaker III		
600			
500	Early Basketmaker III		
400			
300			Early Agricultural Period (to 400 BC)
200	Basketmaker II		
100			
0			

McFadden approached the Fremont culture in the GSENM "not as a monolithic whole, but as a local adaptation to the Escalante drainage and surrounding uplands" (McFadden 2000:128).

As more information became available through the various inventory and other research projects conducted across the Escalante River watershed and drainage, "several temporal frameworks (have been) employed to order material culture of the Fremont on the Colorado Plateau. Those relevant to (McFadden's) study include Black and

Metcalf's (1986) sequence for the San Rafael area; Schroedl's (1991) suggestions for the GSENM area, and most recently Geib's (1996) temporal organization of the data from the Escalante drainage in Glen Canyon National Recreation Area" (McFadden 2000:128). "Generally speaking, the cultural sequence in the monument follows that found elsewhere on the Colorado Plateau" (Madsen 1997:7) and described by Jennings (1978). With additional temporal information provided through ^{14}C and tree-ring dates, however, a particularly localized chronological sequence taking into consideration the results of the more recent research has been proposed for the Escalante River drainage region by McFadden (2000), and is utilized for this study (Table 3.3).

Escalante Phase (A.D. 100 – A.D. 500)

In McFadden's revised chronology, some previously utilized terminology is retained, such as Schroedl's "Escalante Phase," defined as the terminal phase of the Late Archaic (300 B.C.-A.D. 700) (Schroedl 1991). McFadden's proposed chronology preserves the "Escalante Phase" terminology but introduces modified dates of A.D. 100-500 as recent radiocarbon dates suggest this is the time frame representing the period when maize was introduced to the Escalante drainage (McFadden 2000). Additional material culture traits include the pithouse and the introduction of Rose Spring arrow points" (McFadden 2000:148). According to McFadden, "the introduction of maize to the Escalante drainage marks the beginning of the Escalante Phase; the phase terminates with the advent of pottery manufacture [Schroedl 1991:12]. These horizons represent significant culture change, they are archaeologically recoverable and unambiguous" (McFadden 2000:148).

Wide Hollow Phase (A.D. 500 -- A.D. 1050/1100)

The Escalante Phase is followed by a period designated as the "Wide Hollow Phase" when only Fremont ceramics are present, "a greater than 500-year period

Table 3.3. McFaddem's Revised Fremont Chronology for the Escalante Drainage (from McFadden 2000).

Cal. Years	**Escalante Drainage** Fremont McFadden 2000
1300	
1200	
1100	Late Formative Period (A.D. 1050/1100 - 1200)
1000	
900	
800	Wide Hollow Phase (A.D. 500 - 1050/1100)
700	
600	
500	
400	
300	Escalante Phase (A.D. 100 - 500)
200	
100	
0	

(A.D. 500 – 1050) during which Fremont material culture dominated the region" (McFadden 2000:128). The phase is further defined by McFadden (2002:152-153) as "the period when "Fremont" ceramics were introduced to the Escalante drainage, agriculture contributed significantly to diet and the patterning of settlement, and residential architecture, even if seasonally occupied, became standardized," although "subsistence practices and diet are not an integral part of the definition" (McFadden

2000:153). A relatively large number of radiocarbon-dated sites fall within this 550 year, predominantly Fremont period (McFadden 2000). Until recently, regional chronologies interpreted Fremont occupation in the Escalante drainage as contemporaneous only with a Late Formative Anasazi occupation. However, additional inventories and other research conducted in the area have clearly demonstrated that significant Fremont habitation began centuries earlier (McFadden 2000, Baker et al. 2001, Jordan and Talbot 2002, Baer and Sauer 2003, Harris 2005, Janetski et al. 2005).

Late Formative Phase (A.D. 1050/1100 -- A.D.1200)

"By A.D. 1050/1100 the sudden introduction of Anasazi traits, i.e., Bull Creek points, ceramics, unit pueblos, and a reliance on dryfarm agriculture marks the beginning of the Late Formative Period" (McFadden 2000:152), initially defined by Geib (1996). McFadden has noted that the expression of Anasazi culture, defined as the Fiftymile Mtn. Phase identified on the Kaiparowits (but also recognized in parts of the northwestern Escalante drainage) could possibly be sequential to the Fremont Wide Hollow phase. In terms of the Fremont culture, however, McFadden retains the temporal category of "Late Formative" to encompass the A.D. 1050/1100 -- A.D. 1200 period.

> "This is because the Wide Hollow phase … represents an indigenous long-term adaptation; on the other hand, the Fiftymile Mtn. Phase appears suddenly as an adaptation employing Kayenta ceramic, projectile point and architectural styles. At this juncture, it is not clear whether sites and strategies identifiable as Fremont continued into the 12th century in the Escalante drainage. The continuity, or lack of it, between the Wide Hollow (Fremont) and Fiftymile Mtn. (Anasazi) Phases remains to be demonstrated" (McFadden 2000:157).

Although there are no radiometric dates demonstrating cultural continuity between the Fremont Wide Hollow and the Anasazi Fiftymile Mountain phases, McFadden (2000) has noted a few sites in the Escalante drainage, which he designated as Fremont Late

Formative, that appear to reflect a blend of material culture between the Fremont and Anasazi. As described by McFadden, these developments are reflected by the increasing presence of corrugated and, particularly, painted Fremont pottery (Ivie Creek Black-on-white, Snake Valley Black-on-gray) with decorative patterns often mirroring some Anasazi motifs, as well as a growing quantity of Anasazi tradewares from the Mesa Verde and Kayenta areas (McFadden 2000). Other artifacts reflecting material culture during the height of the phase include a large assemblage of bone tools and complexly decorated clay figurines. Even though many artifacts tend to express aspects of Anasazi style and technique, "settlement patterns and the underlying adaptive strategy may be viewed as inspired by the Fremont" (McFadden 2000:158) as hunting and gathering continued to augment the resources gained via semi-sedentary agriculture. At the end of the phase, the farming adaptation appears to have been replaced by a predominantly foraging one (Madsen 1994), and the constellation of traits marking the presence of the Fremont disappears by A.D. 1300. (Janetski 1994).

4 | Environment

The 1.9 million-acre GSENM is located in southern Utah in the west-central part of the Colorado Plateau. Created September 18, 1996 by President Clinton, the GSENM was the first national monument placed completely under the management of the BLM to be administered according to the Federal Land Policy and Management Act. The Act directs the BLM to manage public lands on the basis of multiple uses and in a manner that protects not only the air and water within the boundaries of the GSENM, but also the quality of scientific, ecological, environmental, historic, and archaeological resources found within it (US Department of Interior 2000). "The Monument contains an array of geological, paleontological, historic, archaeological, and biological resources lying in a remote area comprised of canyons, plateaus, mesas, and cliffs set in an environment of colorful geologic formations" (Doelling et al, 2000:1). It is surrounded by several national and state parks on its east and west borders, the Dixie National Forest on the north, and the Glen Canyon National Recreation Area on the south (Figure 4.1).

As previously noted, the GSENM is divided into three geographic sections. From east to west these are the Escalante Canyons, Kaiparowits Plateau, and Grand Staircase/ Paria sections (Allison 1997, Doelling et al. 2000) (Figure 3.1). The north-central portion of the Escalante Canyons section, as well as a small area in the northeastern Kaiparowits Plateau section is included within the boundaries of this study.

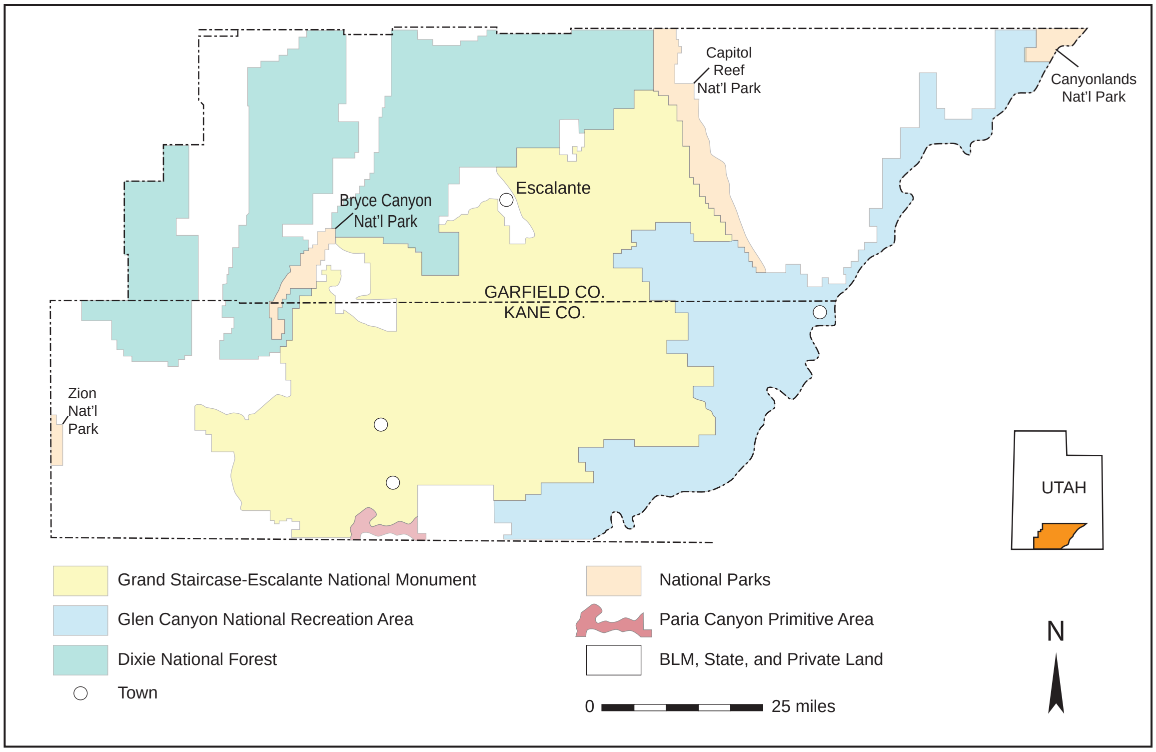

Figure 4.1. Index map showing location of GSENM and other federally managed lands. The Monument is encircled by national parks, a national recreation area, a primitive area, and a national forest. (Adapted from Doelling 2000).

GEOLOGY

Sedimentary rock units of Permian to Cretaceous age (100-300 Ma) make up the bulk of the three geographic sections of the GSENM. These units are locally overlain by Tertiary volcanic rocks in the NW corner of the study area. Between the time the sedimentary units were deposited and the volcanic units erupted the region was gently deformed by folding, then offset by extension-related faults (Doelling et al. 2000:4). Most of the rock units now dip gently westward.

The Kaiparowits Plateau forms the central geographic segment of the GSENM. It occupies a down-warped region of over 1,650 square miles between the Escalante Monocline to the west and the Waterpocket Fold to the east (Figure 4.2).

Rock units of the Kaiparowits Plateau consist mostly of clastic sedimentary

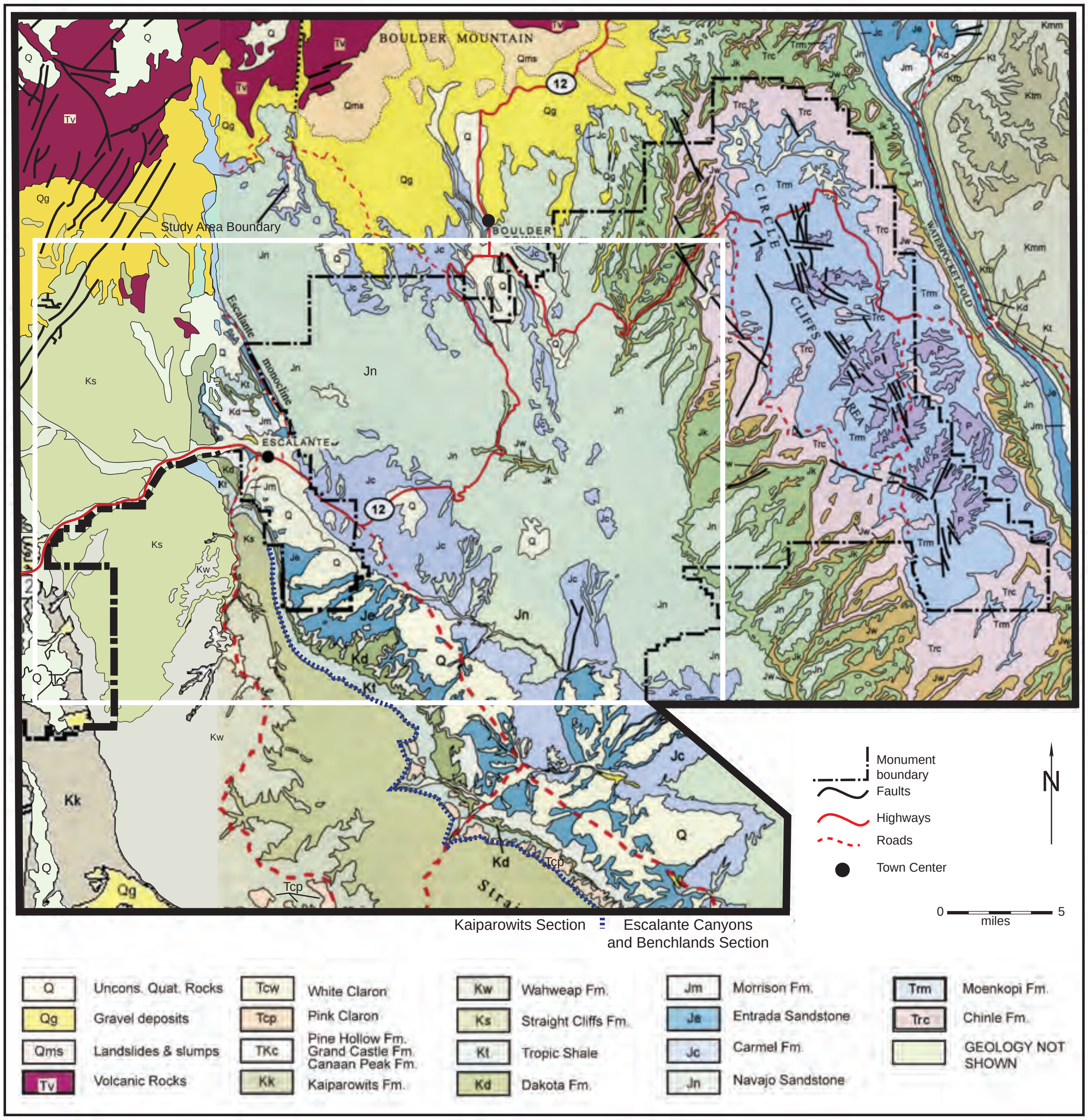

Figure 4.2 Geologic Map of the study area and surrounding region (adapted from Doelling et al. 2000). The geologic structures and formations shown on this map have influenced the topography, landforms, and vegetation in the study area through faulting, folding, deep downcutting of the Escalante River drainage system, and alluvial erosion.

successions with varying resistance to weathering. Differential erosion of these units forms a series of plateaus, buttes, and mesas that provide nearly comprehensive exposure of the underlying geologic strata. These strata consist mainly of Late Cretaceous and Quaternary units (Figure 4.2). The uppermost unit exposed in the Kaiparowits section

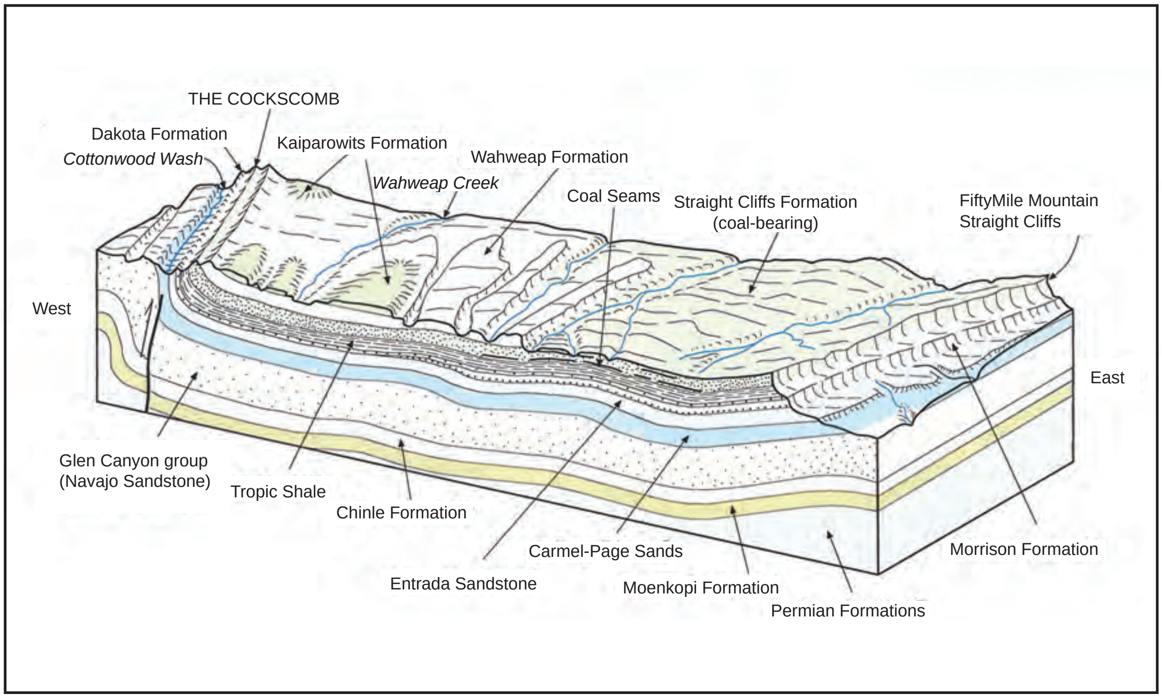

Figure 4.3. Geologic block diagram of the Kaiparowits Plateau section of the GSENM, looking north to south. The Straight Cliffs mark the east boundary of the section. Strata exposed in the study area are mainly Cretaceous formations which form vertical clifs, badlands, and broad slopes. (Adapted from Doelling et al. 2000)

is the 1,000 to 1,500 foot thick Wahweap Formation, which is capped by cliff-forming sandstone layers that overlie slope-forming mudstone, siltstone, and non-resistant sandstone. Underlying the Wahweap strata is the Kaiparowits Formation, a slope- and badlands-forming unit composed of heavily-weathered sandstone (Doelling et al. 2000). The alternating succession of mudstone, siltstone and sandstone preserves one of the best and most continuous records of Late Cretaceous terrestrial life with fossils of several different dinosaur classes and early mammals (Gillette and Hayden 1997).

Underlying the Kaiparowits Formation are the resistant west-dipping sandstone layers of the Iron Springs Formation that form the Straight Cliffs, where exposed fractures in the formation were often utilized by the Fremont for the purpose of granary storage. This prominent escarpment rises around 1,100 feet and extends for more than 50 miles northwest to southeast (Figure 4.3). These cliffs roughly mark the plateau's

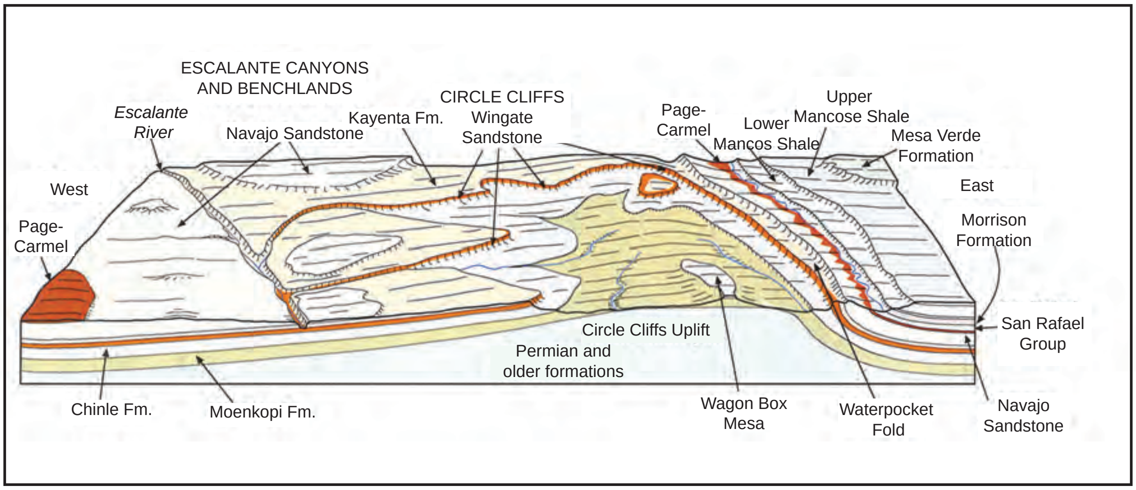

Figure 4.4. Block diagram across the Escalante Canyons section of the GSENM looking south to north. This section consists of two parts, the western Escalante Canyons and Benchlands (included in the study area), and the eastern Circle Cliffs uplift. (Adapted from Doelling et al. 2000).

east boundary with the Escalante Canyons section of the GSENM. Beneath the Straight Cliffs is the non-resistant, but colorful Jurassic Morrison Formation, rich with petrified wood used extensively by the Fremont for their lithic tools. These alternating mudstone, sandstone, siltstone, limestone, and ashy deposits are the most fertile source of dinosaur fossils in North America. Below the Morrison Formation is the resistant sandstone of the Entrada and Carmel-Page Formations. These two formations form flat tableland/mesas overlying small, occasionally steep rock crags or overhangs along the western edge of the Escalante River valley (Figures 4.2 and 4.3). Alluvial materials eroding from the formations into the Escalante Canyon provide arable soils suitable for agriculture.

The Escalante River section of the study area makes up the easternmost one-third of the GSENM, and is characterized by deep, narrow canyons incised into resistant sandstone (Figure 4.4). A broad deposit of Quaternary units forms a grassland valley, bordered on the west by the Straight Cliffs and the east by the tableland/mesa area of the "Big Flat," that extends south-southeast from the town of Escalante. The wide range of elevation and "specialized" environments resulting from this topography provide an ideal setting for examining site type and distribution across the landscape in order to evaluate the settlement and subsistence patterns of prehistoric peoples.

The Escalante River is especially notable for the multi-hued, steep, narrow canyons incised into the greater-than 1000-foot thick Jurassic Navajo Sandstone. However, between the canyons are large flat areas where less resistant units above the Navajo Sandstone are stripped away by erosion to form mostly featureless benchlands. This extreme variation in physiography contrasts with the more subtle plateaus, buttes, and mesas of the Circle Cliffs to the east. While the Circle Cliffs surround a large kidney-shaped physiographic basin, the Escalante Canyons and Benchlands area features the massive Escalante River Canyon consisting mostly of slot canyons, eroded fractures, caves, alcoves, upland benches, and a broad valley, many of which contain archaeological sites. The plateaus, sheer cliffs, and deep canyons in the boundaries of the landscape developed mostly during periods of intense erosion from wetter climatic cycles occurring over the past few million years.

In the southeastern part of the study area the Escalante River widens as it cuts down through the Chinle Shale, exposing petrified wood from ancient forests. The Morrison Formation in the headwaters of the Escalante River also contains vast deposits of petrified wood. These two units litter most of the Escalante drainage with petrified wood and chalcedony that was used prehistorically as an abundant source of tool stone. The Dakota Formation appears as a medium-gray, slope-forming stratum containing thin coal beds overlain by a resistant cap of orange, yellow-gray, or gray sandstone forming ledges reaching up to 80 feet thick.

The Entrada sandstone is divisible into three parts: the Gunsight Butte, Cannonville, and Escalante Members. Only the Escalante Member is present in the north half of the GSENM. It is primarily a fine-grained and massive sandstone whose upper deposits form rounded, bare-rock outcrops and cliffs marked by layers of high-angle, aeolian cross-stratification. The lower deposits are very friable and form earthy slopes and ridges. The Entrada sandstone deposits in the Escalante Member are located in the Escalante River valley (Figure 4.2), and outcrop as ridges along its edges and across its center segment.

The Carmel Formation is actually composed of a western marine element (Carmel Formation) interfingered with the eastern beach or dune deposits of the Page Sandstone. Both the Page and Carmel strata were deposited concurrently over much of the GSENM area. They outcrop along the boundary of the Kaiparowits Basin and Escalante Canyons sections of the GSENM and parallel the Hole-in-the-Rock road along the eastern side of the Escalante River valley as the Harris Wash member of the Page Sandstone. These cliff-forming rocks lie atop of, and appear very similar to, the underlying Navajo Sandstone deposits, although they are slightly darker in color. Deposits of angular chert cobbles, another highly-utilized prehistoric toolstone, are commonly found at the contact between the Page and Navajo formations.

The Navajo Sandstone is a light-colored, easily recognized and prominent cliff-forming formation. It generally forms bare-rock cliff or dome outcrops with high-angle cross-beds and in the Escalante Canyons section reaches between 1,100 to 1,300 feet thick. It is dominantly an aeolian deposit laid down in dunes above a shallow water table. Occasionally, a thick iron scum or froth accumulated on the tops of the water tables which hardened to form ironstone sheets within the sandstone. Locally these occur as disks, dumb-bells, or spheres known as “Moqui” marbles. These ironstones are commonly found at Fremont sites within the GSENM. The Escalante River and many of its major tributaries downcut through the Navajo Sandstone, forming the river canyon itself and the extensive slick-rock region which lie to its north and east (Figures 4.2, 4.4). Within the study area, the Chinle Formation is also found in the Circle Cliffs landscape area, along the northeastern boundaries of the study area (Figure 4.2). As the Chinle is a complex formation composed of many members, the simplest subdivision of the Chinle is into its lower ledge-forming and upper slope-forming elements. In the Circle Cliffs it is composed of interbedded sandstone, mudstone, claystone, siltstone, limestone, gritstone, and conglomerate sediments between 425 and 750 feet thick and contains abundant fossils and, as previously noted, an abundance of petrified wood.

The eastern edge of the Escalante River valley is bounded by the Escalante monocline (Figure 4.2), which forms the steep west limb of the Escalante anticline. The monocline is exposed as a northwest-trending structural flexure which folds the sedimentary strata down to the west. The feature predominantly involves the Jurassic Navajo Sandstone in the Escalante Canyons landscape, as most of the younger overlying rocks have been stripped off. This process exposed the Page Sandstone, which forms the "Big Flat" upland area lying between the river valley and the deep Escalante River Canyon, and contributes to the deposited alluvial material creating the flat grass and agricultural lands of the Escalante River valley (Figures 4.2 and 4.4).

ESCALANTE DRAINAGE

"Spanning five life zones from low-lying desert to coniferous forest, with scarce and scattered water sources, the monument is an outstanding biological resource. Remoteness, limited travel corridors and low visitation have all helped to preserve intact the monument's important ecological values. The blending of warm and cold desert floras, along with the high number of endemic species, place this area in the heart of perhaps the richest floristic region in the Intermountain West. It contains an abundance of unique, isolated communities such as hanging gardens, tinajas, and rock crevice, canyon bottom, and dunal pocket communities, which have provided refuge for many ancient plant species for millennia" (Clinton 1996).

The Escalante River headwaters begin as Boulder Creek on Boulder Mountain in the Aquarius Plateau north of the GSENM. The creek, and other tributaries stream south

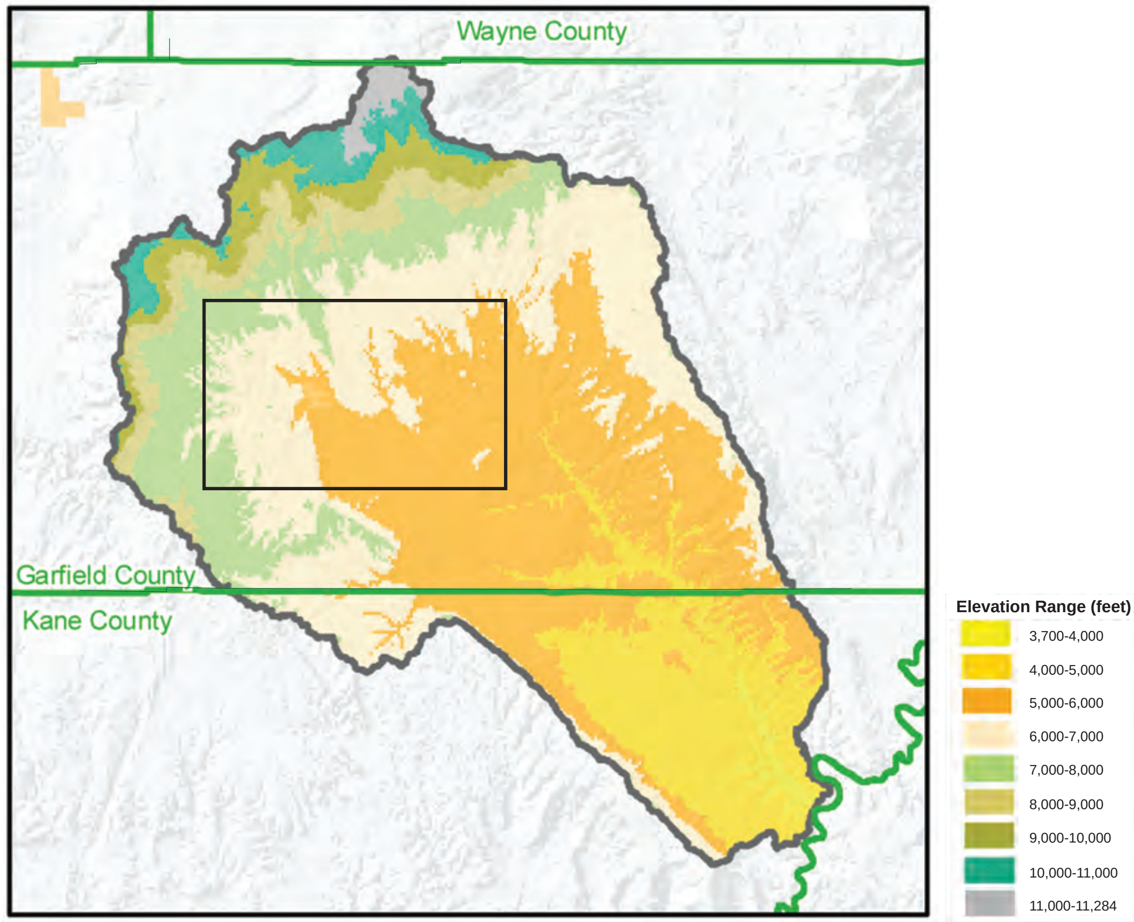

Figure 4.5. Illustration of the topography and elevation ranges across the Escalante watershed from the Aquarius Plateau, through the Canyonlands and south to the low Southern Plateau province. The study area boundary is outlined in black (Adapted from Adams and Judd 2003.)

through the GSENM to join the main flow of the Escalante River as it flows southeast to join the Colorado River at Lake Powell. As the streams and tributaries converge, they flow through three different physiographic regions – the Colorado Plateau, Canyonlands, and the Southern High Plateaus. The regions they traverse include high mountain elevations greater than 11,000 feet and descend through canyons and across valleys to an elevation of only 3,700 feet (Figure 4.5). Although the main stem of the Escalante River begins northwest of the town of Escalante, most of its flow comes from its side tributaries. Figure 4.6 delineates the boundaries of the watershed and illustrates the principal tributary network for the Escalante River. Its watershed includes more than 130

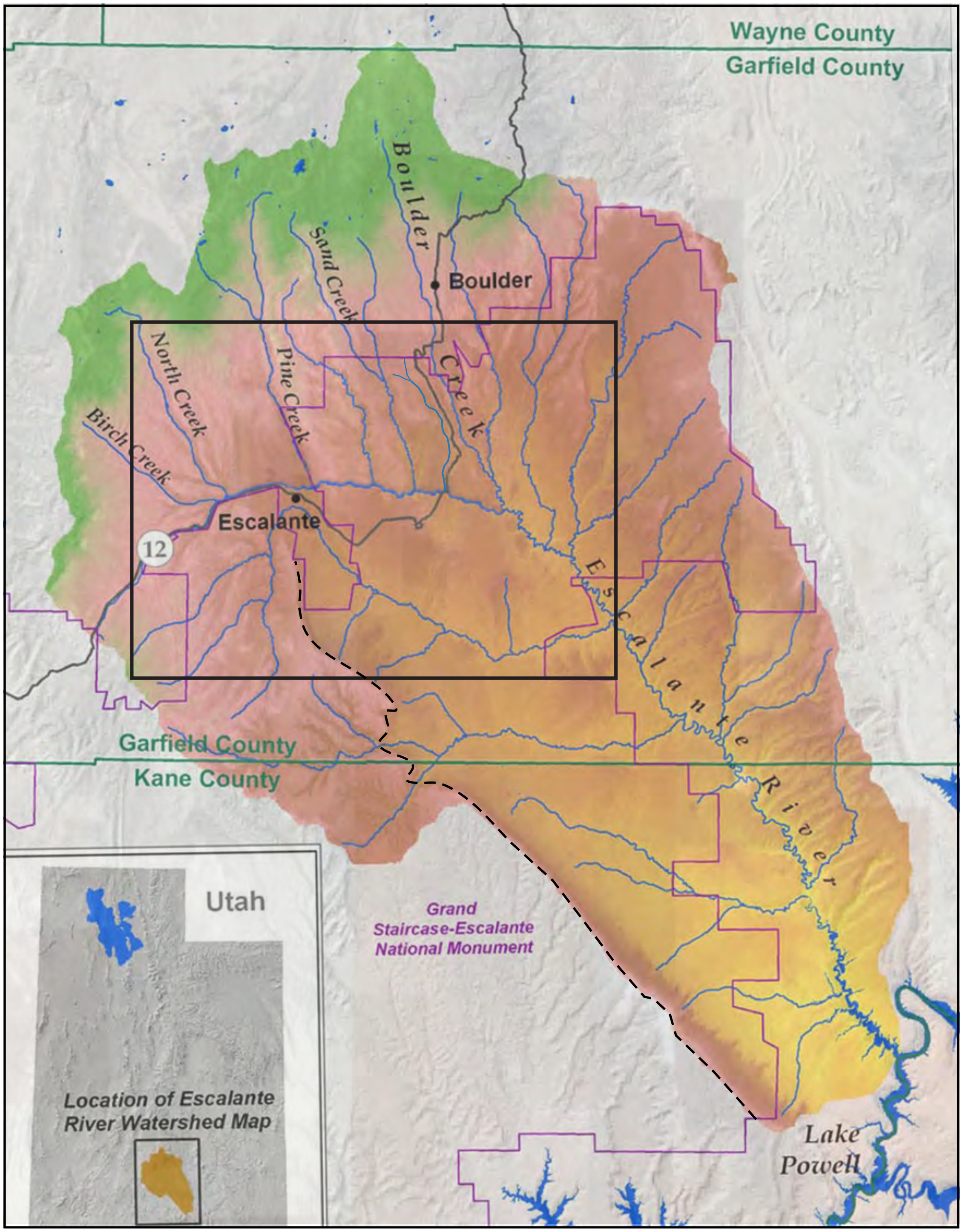

Figure 4.6. Map of the Escalante River Watershed showing the major streams in the watershed from its origins in the Aquarius Plateau in the north, south to Glen Canyon and Lake Powell. The GSENM is outlined in purple, the study area in black, and the dashed line represents the division between the Kaiparowits Plateau and Escalante Canyons and Benchlands physiographic sections inside the Monument boundaries.

Table 4.1. Summary of Primary Tributaries in the Escalante River Drainage (Adams and Judd 2003).

Watershed	Stream Miles	Area (mi^2)	Elevation (ft)		
			Mean	Min	Max
Birch Creek	13	45.7	8,851	7,107	10,594
North Creek	17.2	92.1	8,920	7,075	10,765
Pine Creek	24.3	97.9	8,433	5,688	11,178
Death Hollow (Mamie Creek)	30.5	46.3	7,723	5,412	10,034
Sand Creek	26.2	44.7	7,912	4,740	11,083
Sweetwater Creek	11.1	30.5	8,618	6,222	11,014
Calf Creek	838	9.5	6,036	5,235	6,836
Total	131.1	366.7			

*Stream miles measure only the length of the primary channel, not all the potential tributary streams and wash areas within the sub-watershed. Adams and Judd applied the convention of using the larger watershed area to include the tributary to the Escalante river formed by Mame Creek and Death Hollow.

miles of branching streams covering a greater than 360 square mile area, with streams flowing from a maximum elevation of 11,178 feet to a low of 4,740 feet before joining the main river flow (Table 4.1).

Water

The primary streams that influence Escalante River flow volumes are Birch Creek, North Creek, Pine Creek, Death Hollow (and tributary Mamie Creek), Deer Creek, Sand Creek, Calf Creek, Boulder Creek, and the unnamed stream flowing through The Gulch. Today, stream gauges placed in the beds of many of these streams have shown that some flow only intermittently – including the upper watershed streams of North Creek and Birch Creek – as they are diverted for irrigation (Adams and Judd 2003). Pine Creek is also diverted for irrigation use, but stream gauges on the drainage show fewer and shorter periods when the stream is dried up completely (Adams and Judd 2003). The tributaries that drain from the north off of the Aquarius Plateau – Pine, Death Hollow, Sand, and Calf Creek – are perennial streams enhanced not only by annual precipitation, but by

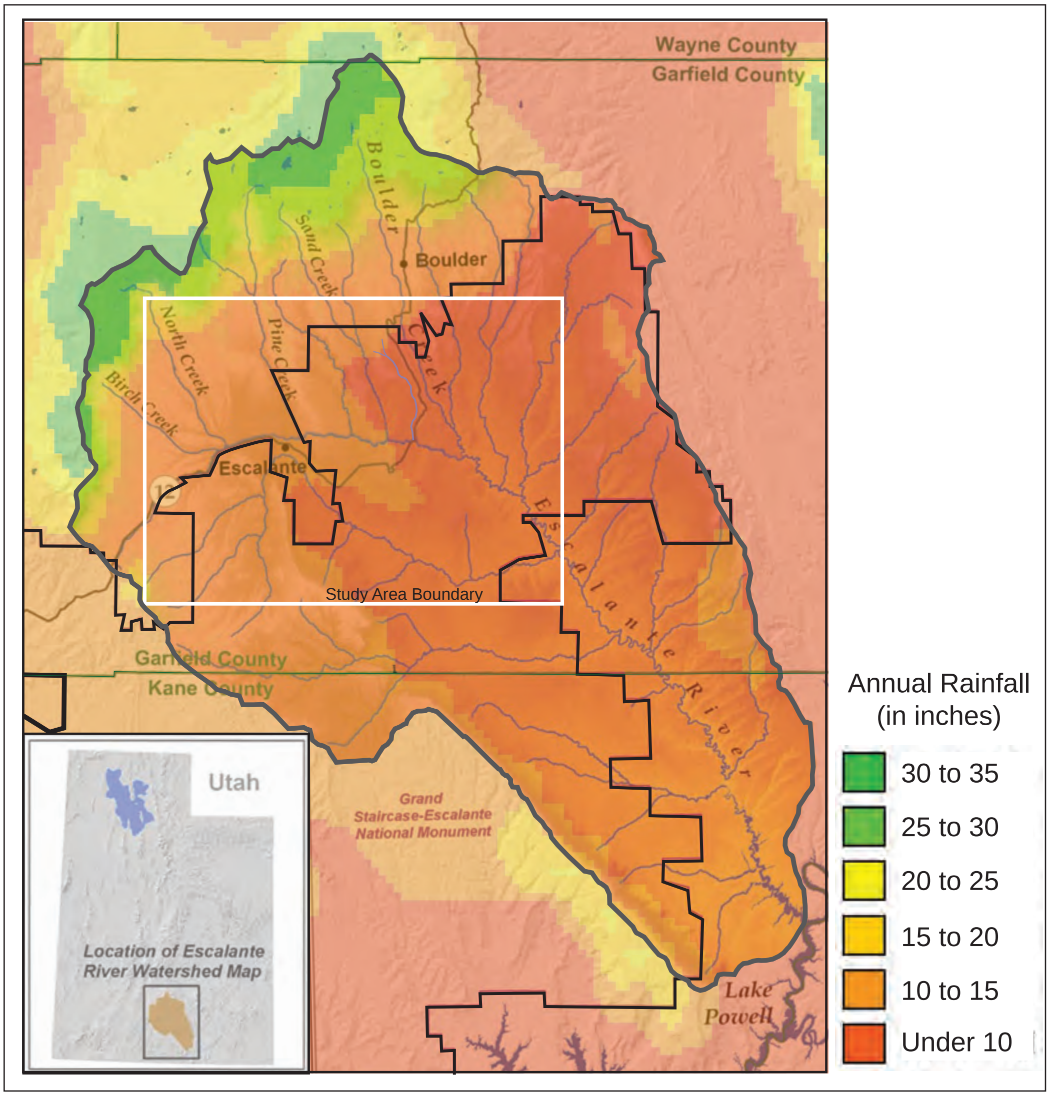

Figure 4.7. Average annual precipitation in the Escalante River watershed. (Adapted from Adams and Judd 2003)

springs and seeps flowing out of the Navajo Sandstone aquifer (Adams and Judd 2003, Robson and Banta 1995).

Annual precipitation in the watershed region varies from about 6 inches at the lowest altitude near Lake Powell (4,000 ft), to between 16 and 25 inches at the highest altitudes near Canaan Peak (9,280 ft) (Figure 4.7). The variations in altitude and precipitation produce three climatic zones: highland, semi-desert, and desert. The highland elevations in the watershed receive the majority of their annual precipitation as snow that melts during the spring while the majority of precipitation in the semi-desert and desert areas falls during the rainy season, particularly during the months of late summer and autumn (Doelling et al. 2000, Adams and Judd 2003). Two USGS stream flow gages located within the study area on Pine Creek and at the Escalante River near Escalante, Utah show that the peak flows occur in May with the melting of the snow pack. After the peak runoff the flows return to a consistent base flow of approximately 10 cubic feet per second (Adams and Judd 2003).

Vegetation

A series of recognized vegetation communities dominated by one or two important plant types exist throughout Utah. These plant associations, or zones, are affected significantly by local moisture, temperature, and soil conditions, and shift from one to the other across lines of both latitude and altitude. Predominantly below 7,500 – but up to 10,000 – feet in elevation, most of Utah is covered by brush-grassland communities which overlap with the pinyon-juniper community.

Native vegetation communities in the Escalante River watershed are influenced by topography, elevation, type of soil, limited presence of permanent water, considerable range in climate fluctuations, and seasonal flood events which occur regularly throughout the region. As an example, the majority of the watershed area falls within the elevation range (5,500 to 8,000 feet) of the Transitional life zone in the High Plateau/Mountains section of Utah, where mountain brush and ponderosa pine generally provide the predominant vegetative cover (Figure 4.8A). Within the Escalante River watershed area, however (Figure 4.8B), and particularly in the study area itself, the areas that elsewhere might fall in the Transitional life zone due to their elevation are covered with pinyon/juniper stands, sagebrush, and shadscale communities – types of vegetation expected

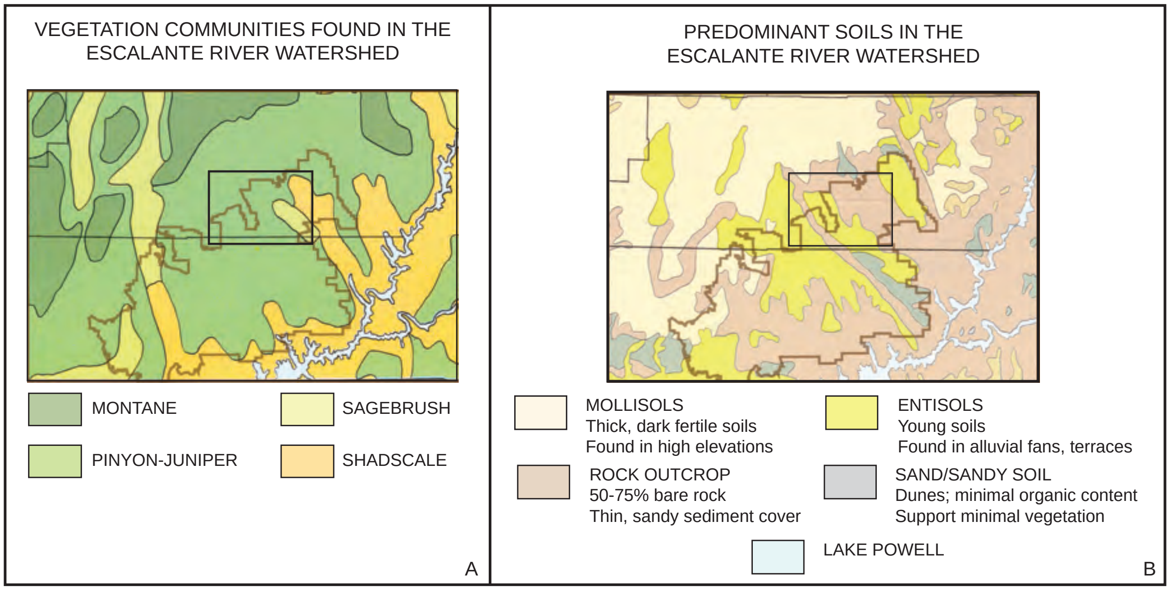

Figure 4.8. A) Within the Escalante River watershed, which lies within Utah's defined High Plateau and Mountain region, the predominant vegetation consists of pinyon-juniper communities with limited areas ocvered only by shadscale and sagebrush. B) Soils present within the watershed consist of rich, dark soils in the highest elevations areas, while young, alluvial soils, sand/sand dunes, and rock outcrops dominate the sediment types in the Transitional life zone (elevations between 5,500 feet and 8,000 feet). In the Escalante River watershed, these soils support the type of vegetation communities generally found in the lower elevation range Upper Sonoroan life zone. (Adapted from Foster 1968 and Wilson et al. 1975).

within the Sonoran life zone. The most probable explanation for the Sonoran vegetation is the type of soils present in the watershed (Wilson et al. 1975). The thick and dark fertile soils which support Transitional zone vegetation (Mollisols) are found only in the highest elevations in the northwest and northern boundaries of the watershed. The soils covering the remainder of the region are classified as rock outcrops (bare rock exposures covering 50-75 percent of the surface and occasional very thin, sandy sediment cover), sand/sandy soils (dunes or light soils which support only minimal vegetation), and entisols (generally thin, young soils without discernable horizons found generally in alluvial fans and terraces) (Hutchings and Murphy 1981). The preponderance of entisols, sandy soils, and bedrock over the study area exert a heavy influence on the types of vegetation which can be naturally supported.

The headwaters of the Escalante River lie in the Canadian vegetation zone (Figure 4.8A) in coniferous forests covered in Ponderosa pine and Douglas fir. At lower elevations, the conifer forest transitions into the pinyon pine and juniper zone, followed by the sagebrush, and shadscale zones. As the Escalante River traverses the Escalante Canyon physiographic region in the GSENM, it passes through spectacular canyonlands, through a maze of twisting, meandering, and interconnecting gorges incised by the river through massive Jurassic sandstone deposits. Riparian areas along the Escalante River serve as migration corridors for neotropical birds and provide micro environments for many relict and fragile plant communities which evolved in the canyons.

Figure 4.9 illustrates in more detail the vegetation classes and location patterning identified by the Utah GAP vegetation analysis within the northern watershed area (Adams and Judd 2003). (GAP refers to the process of identifying 'gaps' in protection for high biodiversity areas for wildlife species.) Identified vegetation layers or classes are mapped at a comparatively broad scale. Consequently, Figure 4.9 primarily identifies adjacent highland and mid-elevation vegetation communities but does not map the finer scale riparian communities that influence overhead canopy cover and shade, particularly within the Escalante River canyon. The riparian community most commonly found along the riverbank and in the canyon bottoms is dominated by native willows and cottonwood (Figure 4.10), but also includes box elder and invasive tamarisk and Russian olive trees (Adams and Judd 2003). The GAP study also confirmed the predominance of Sonoran zone vegetation at mid-level elevations, documenting large areas of pinyon/juniper stands, sage flats, and salt desert scrubland.

Faunal Resources

The wildlife of the watershed and GSENM are characterized by a diversity of species,

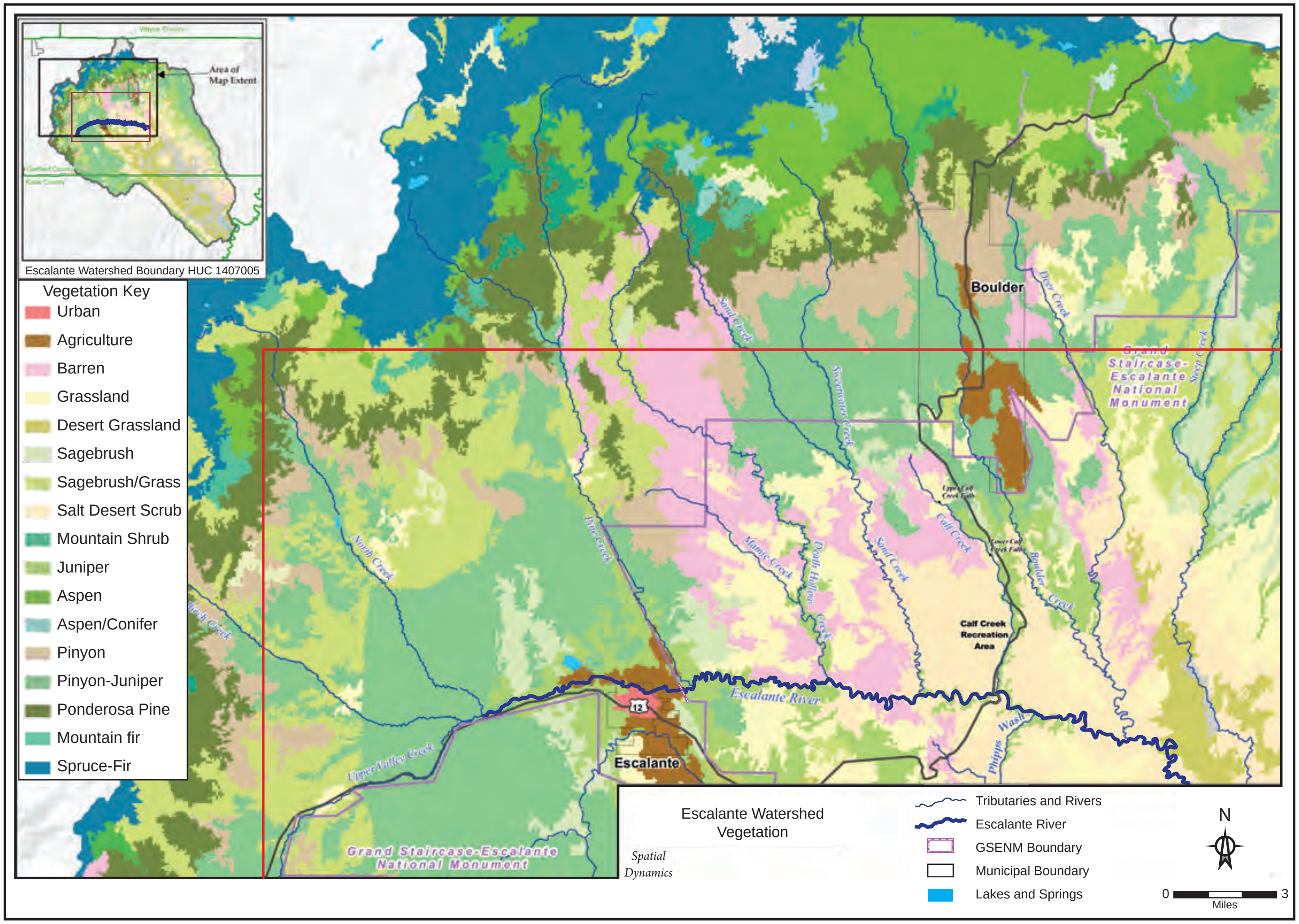

Figure 4.9. GAP vegetation analysis of the upper Escalante River watershed. Vegetation layers are mapped at a broad scale, and primarily identify upland vegetation communites but not the finer-scale riparian vegetation locations. Study area in red. (Adapted from map prepared by Spatial Dynamics, Adams and Judd 2003.)

Figure 4.10. Riparian vegetation in the riverbottom microenvironment along the Escalante River below its confluence with Death Hollow.

due in equal part to the variety in topography, elevation, and climatic zone, where northern and southern habitat species intermingle (BLM 1991).

Wildlife is abundant within the entire sample area. Nearly 300 species of amphibians, birds, mammals, and reptiles are documented in the GSENM and surrounding region. Historic records indicate the presence of mule deer, elk, pronghorn antelope, and mountain sheep, and all are found across the GSENM today. On-going habitat studies have also identified the modern presence of coyote, gray fox, red fox, kit fox, wolf, bobcat, mountain lion, black bear, and grizzly bear. Smaller carnivores include the long-tailed weasel, mink, badger, spotted skunk, skunk and river otters. Rodents common in the region include chipmunk, rock and pine squirrel, pocket gopher, mice, woodrat, muskrat, porcupine, and beaver. Cottontail and jackrabbit are also quite common. Riparian habitats, with their thick coverage of shrubs, grass, and trees, support the most dense and variable mammalian populations in the GESNM (Alston et al. 2000, Flinders and Rogers 2002).

Over 20 species of raptors including the endangered California condor, peregrine falcon, southwestern willow flycatcher, and the threatened bald eagle have been identified in the GSENM. Riparian corridors, particularly along the Escalante River, are also home to many neotropical birds. An additional 200 avian species are also living in the GSENM, including rare species such as burrowing owl, long-billed curlew, northern goshawk, blue grosbeak, and swainson's hawk. Coopers hawk, kestrel, and quail are some of the more common avian resources that may have been found in the area prehistorically. Other birds including jays, raven, lark, hummingbird, and several species of woodpecker are commonly found in the area today (National Park Service 2001).

Species of reptiles found in the Grand Staircase include the California Kingsnake, the plateau striped whiptail, and the endangered desert tortoise. Amphibians found include the tiger salamander, and the red spotted toad (Oliver 2003).

Excavation conducted at several Fremont sites in the study area have demonstrated the importance of various artiodactyls (ie.g.., pronghorn antelope, big horn sheep, and mule deer), canids (coyote or dog), and lagomorphs (jackrabbit and cottontail). Other small

mammals identified from excavation include small rodents such as gophers, ground squirrels, mice, voles, packrat, and similar species. Non-mammalian species consist primarily of lizards and other reptilia and amphibia, while occasional unidentified bird remains have also been recovered (Jordan and Talbot 2002; Baer and Sauer 2003; Harris 2005; Brad Newbold, personal communication).

CLIMATE

The Colorado Plateau is located in the interior, dry end of two, directionally opposite

Table 4.2. Climate Summary, Escalante, Utah from 1901-2003 (Station 422592) (from United States Dept. of Agriculture Natural Resources Conservation Service in Adams and Judd 2003).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temp (F)	40.4	45.6	54.4	63.2	72.7	83.5	88.5	85.6	78.4	66.8	52.6	41.9	64.5
Average Min. Temp (F)	13.9	20.2	26.2	32.5	39.8	47.1	54.1	52.4	44.2	34.8	24.2	16.1	33.8
Average Total Precip (in.)	0.95	0.79	0.84	0.57	0.6	0.47	1.21	1.83	1.16	1.06	0.65	0.8	10.92
Average Total Snowfall (in.)	8.8	4.1	3.4	1.1	0	0	0.1	0	0	0.1	2.1	6.1	25.8
Average Snow Depth (in.)	2	1	0	0	0	0	0	0	0	0	0	1	0.3

moisture trajectories, making the region a target for unusual climate fluctuations (Schwinning et al. 2008). Variations in elevation and precipitation over the Escalante River watershed area produce three different climate zones: highland, semi-desert, and desert. Highland zones are prone to sudden changes in weather throughout the year. At lower elevations, winter months are cold and relatively dry as the “rainy season” occurs from July to September and brings heavy thunderstorms and flash floods.

Long-term climate data has been collected since May 1901 at a weather station located in Escalante, Utah. Measured monthly temperature and total precipitation averages at the station over a nearly 102-year period are summarized in Table 4.2 (Adams and Judd 2003). June, July, and August are the warmest months, with average maximum temperatures ranging between 83° and 88° Fahrenheit, although summer temperatures regularly exceed 100°. Late summer monsoon-type weather patterns that influence the overall southern Utah climate produce higher levels of precipitation from July through September, which helps to moderate temperatures. Although the length of the growing season depends on elevation, precipitation, and temperature which fluctuate across varying macro- and micro-environments, the Escalante River Valley semi-desert zone remains frost-free from late April through late October, providing a greater than 150-day agricultural period.

Paleo Climate

Approximately 10,000 years ago, the climate of the Colorado Plateau began to adjust from a significantly wetter state to its current climate conditions. This Holocene period represents a stage of unparalleled climate variability, with "frequent multi-decadal excursions from the precipitation means, but no overall trends in aridity" (Schwinning et al. 2008:1). Paleo-botanical evidence from packrat middens across the Plateau indicates that the current climate pattern has been regionally dominant over the past 10,000 years (Betancourt 1990), although severe diversions away from median climate conditions lasting for decades are commonly documented, particularly in localized regions.

The prehistoric tradition of agriculture practiced across the Colorado Plateau region increased through time, attaining its maximum extent during the Medieval Warm Period (A.D. 800–1300). At its height, this period of increased precipitation during both the winter and summer extended the growing season and expanded opportunities for dry farming of maize to elevations between 5,249 – 7,546 feet (1600 and 2300 meters) (Petersen 1994). Although the overall period experienced a higher level of rainfall than occurs during the present climatic cycle, tree ring climate reconstructions across the entire Colorado Plateau region (D'Arrigo and Jacoby 1991, Meko et al. 1995, Benson et al. 2002, Ni et al. 2002, Gray et al. 2003, Salzer and Kipfmueller 2005, Cook et al. 2007) reveal several sustained drought periods between the late 10th and mid-13th centuries, dubbed the Medieval mega-droughts. The last of these is documented in several regions as peaking in A.D. 1253, shortly before the collapse of the Pueblo culture on the Colorado Plateau. The arrival of the Little Ice Age around A.D.1300 also caused a multi-decadal drought event (Peterson and Haug 2005). Some researches consider it to be one of several triggers leading to the sudden collapse of maize cultivation by the Fremont and Anasazi on the northern Colorado Plateau, and the gradual abandonment of the region (Schwinning et al. 2008).

5 | Site Distribution/Settlement Studies

The interaction between people and the environment is complex and dynamic, and the study of interactions between human populations and the environment is one of the major objectives in archaeological research. Settlement studies assist in identifying patterns in the archaeological record of mobility, site location, and setting that reflect the relationship between humans and the landscape. Settlement pattern analysis uses the physical remnants and patterns of human activity to identify subsistence, technology, and social adaptations to specific environments. Such studies assume that past human actions were driven by particular criteria dependant upon explicit – and evolving – needs to attain specific objectives (Janetski et al. 2005). Thus, settlement pattern studies are useful in revealing the spatial relationships between human activities and natural landscape features, as well as clarifying the intersection between human behavior and the cultural environment.

DEVELOPMENT OF SETTLEMENT PATTERNING STUDIES

"The term 'settlement pattern' is defined here as the way in which man disposed himself over the landscape on which he lived. It refers to dwellings, to their arrangement, and to the nature and disposition of other buildings pertaining to community life. These settlements reflect the natural environment, the level of technology on which the builders operated, and various institutions of social interaction and control which the culture maintained. Because settlement patterns are, to a large extent, directly shaped by widely held cultural needs, they offer a strategic starting point for the functional interpretation of archaeological cultures" (Willey 1953:1).

"Few research issues are more aptly approached through archaeological survey than questions of prehistoric settlement. Survey provides both contextual (i.e., topographic, environmental, soil, etc.) and specific site function, size, and structure information that is amenable to inferences at both the local and regional levels" (Janetski et al. 2005:15).

The study of ancient settlement patterning has developed through two largely independent traditions – American and English. The American tradition, applicable to this study, is originally rooted in L.H. Morgan's study entitled "Houses and House Life of the American Aborigines" (Morgan 1881). In this work, Morgan queried how the remains of aboriginal residential architecture in North America reflected the social organization of the prehistoric peoples who occupied them. Although the research was primitive by today's standards, the questions he asked remain at the core of modern studies in settlement patterning (Parsons 1972).

During the 1890s, C. Mindeleff also conducted a series of settlement pattern studies based on his investigations in the American Southwest. Using ethnographic analogy, he developed a simple model for reconstructing chronology and settlement composition from the archaeological record. Early settlement studies conducted by Steward (1937, 1938, 1941) engendered renewed interest in modeling prehistoric settlement processes. These stuies also resulted in "two major field programs concerned with locating and mapping archaeological sites on a regional scale with the express purpose of inferring sociological processes from changes in site patterning through time: the lower Mississippi Valley survey undertaken by Phillips, Ford & Griffin, and the famous Viru Valley survey carried out by Willey" (Parsons 1972:128).

The Mississippi Valley survey was focused on the analysis of ceramic artistic variability through space and time, but also attempted to apply a classification of site types to a random sample of sites based on their surface area and architectural style. Willey's Viru Valley study, however, focused explicitly on inferring cultural process through the process of regional settlement pattern analysis, identifying the potential utility and scope of settlement pattern studies in archaeology (Parsons 1972). The project also introduced innovative methodologies into the archaeological process, such as the utilization of aerial photos for site location and mapping, a focus on intensive sampling within a relatively small area as a means of identifying processes operating within a larger system, and a better defined site classification system based on location, architectural presence and style, midden areas, and total site surface area (Parsons 1972). Settlement pattern studies were further refined and used by archaeologists to conduct catchment analyses (Vita-Finzi and Higgs 1970) and to interpret social and technological change at the regional level (Adams and Nissen 1972), while others focused on the environmental determinants of settlement location (Haury 1956; Heizer and Baumhoff 1956; Williams 1956).

Throughout much of the 1950s and 1960s, archaeologists operated within an inductive framework where research into settlement patterns was based upon little or no theory (Dalla Bona 1994). Haggett et al. (1965) provided a more solid footing to "location" theory – concerned with the geographic location of economic activities – for archaeologists by introducing many relevant concepts into the discipline from geography, outlining theories of settlement hierarchies, sampling procedures and hexagonal lattices (Haggett et. al. 1965). Trigger (1968) summarized even more clearly the various aspects of settlement patterns and offered some determinants of settlement location. Concurrent research in other fields of archaeology also began to emphasize the importance of ecological variables in understanding settlement variability (e.g. Flannery 1968). Settlement studies expanded to incorporate both descriptive and theoretical projects. Three concepts, which continue to contribute to theoretical concepts of settlement patterning, were developed during this period. Willey noted that “settlements are a more direct reflection of social and economic activities than are most other aspects of material culture available to the archaeologist (and) offer a strategic meeting ground for archaeology and ethnology” (Willey 1956:1). Vogt stressed the significance of settlement pattern investigations in terms of providing a common meeting ground where archaeologists, ethnologists and geographers could unite their individual areas of expertise to explore joint questions of interest, such as the relationships of living arrangements to geographic features, the study of changes in cultural processes through time, and structural inferences regarding sociopolitical organization (Vogt 1956). Finally, Sanders (1956) provided useful definitions of scope and terminology. He was “particularly interested in analyzing the distribution of human settlement in the context of agricultural systems, local specialization, and interregional exchange … (and) distinguished between community settlement and zonal settlement patterns” (Parsons 1972:130).

As the importance of settlement studies to archaeological research increased, limitations in the existing theory, methodology and analysis for settlement analyses were recognized. During the 1960s, theoretical contributions included the development of the “settlement system” concept, which effectively delineates the difference between a “settlement pattern” (the geographic and physiographic relationships of a contemporaneous group of sites within a single culture) and the “settlement system” (the functional relationships among the sites contained within the settlement pattern) (Winters 1967). Increased rigor in sampling procedures, both within individual site areas and over large regions, was also required in order to permit “valid” quantitative manipulation of measurable data (Binford 1964). In the decade that followed the 1960s, the manner in which archaeological data was handled changed considerably. Many archaeologists adopted more systematic approaches to collecting and analyzing data

(Della Bona 1994). An expanding range of research questions could be addressed as computer analysis allowed the manipulation of increasing amounts of data as well as the generation of more detailed analyses. The analysis of minute differences in artifact types, macroscopic studies of ceramic variability, and regional studies of prehistoric culture change all became possible. These studies contributed to further refinement of the level of detail in which settlement variability was presented by archaeologists, often shifting the research emphasis from the study of single sites to the study of regions and their archaeological contents. Based on data obtained from multiple surveys, Binford (1980) developed a general model of hunter-gatherer systems based on subsistence and mobility strategies which form a continuum from “foragers” to “collectors.” Foraging strategies are marked by frequent movement of residential bases from which foragers leave and return on a daily basis in order to exploit to critical resources in the locations where they are encountered. Collecting strategies use logistically organized task groups to procure critical resources at temporary field camps or special-purpose locations which supply a larger group of consulers located at residential bases (Binford 1980).

Over recent decades, as archaeologists have shifted from functioning within one of a few theoretical frameworks (i.e. culture-history, processualism) to the post-processual era of numerous alternate theoretical camps (e.g. agency theory, cognitive archaeology, evolutionary archaeology, feminism, materiality, middle range theory, etc.) settlement patterning studies have continued to evolve and investigations range from large regional studies to the occasional examination of a single structure (Della Bona 1994). Ultimately, however, the motivating objectives of settlement pattern studies (i.e., describing a series of prehistoric sites with reference to their geographic and chronological position, describing settlement development in terms of function as well as sequence, reconstructing cultural institutions as much as they may be reflected in settlement arrangements, and comparing the settlement patterns across areas or regions) remain relatively unchanged.

Important Settlement Pattern Studies in the Great Basin

One of the earliest studies directed towards recognizing aboriginal social organization and the reconstruction of prehistoric cultural institutions in the American Southwest and Great Basin relied on regional and community settlement patterns to infer general development processes (Steward 1937, 1938, 1941). Thomas's (1973, 1983) innovative research in the Monitor Valley of Nevada specifically addressed settlement in the Great Basin and Colorado Plateau. With this study, the direction of hunter-gatherer archaeology in the region began to change substantively, focusing explicitly on ecological dynamics and cultural processes of systemic evolution and adaptation. The first settlement pattern study designed to identify sites using prediction was carried out in the Reese River Valley (Williams et al. 1973). Other researchers including O'Connell (1971), Bettinger (1977), Madsen and Berry (1975), and Madsen and O'Connell (1982) began long-term research programs that focused on understanding the operation and variability of the various prehistoric cultural systems identified within the regions of the Great Basin and Colorado Plateau. More recently, explicit evolutionary ecological and processual research endeavors have been developed and applied to the archaeological record of the region. Osborn (1984, n.d.), Simms (1984, 1985), and Simms and Isgreen (1984) have applied ecological theory similar to Charnov (1976), MacArthur (1972), and Pianka (1978) to the study of subsistence strategies and human nutrition, as well as to the organization of technology and human land use on regional and sub-regional scales. The goal of each research undertaking was to provide comprehensive and testable hypotheses to demonstrate the relationships between the static materials of the archaeological record and the dynamic prehistoric activities producing the record. These projects have contributed valuable knowledge and validate the concept that human settlement-subsistence strategies are highly complex responses to an array of environmental dynamics. These include the distribution of resources, seasonality of resources, human population dynamics (e.g., division of labor, labor scheduling, reproductive requirements, and mobility options), climatic systems, technological organization, and subsistence strategies, to name just a few.

Important Settlement Pattern Studies on the Colorado Plateau

As a result of the growing importance of settlement studies to archaeological work, settlement studies were also emphasized on the Colorado Plateau and in the American Southwest as a growing consensus of researchers recognized that a regional approach to studying variation in human settlement patterns was absolutely necessary to understand settlement systems (Dalla Bona 1994). The Southwestern Anthropological Research Group (SARG) research by Plog and Hill (1971) aimed to determine why – or how – prehistoric populations chose specific locations for particular activities. Clearly stated in their research was the delineation of "the formal variability in sites, variability in temporal loci of sites, and variability in the spatial loci of sites " (Plog and Hill 1971:8). Their work began the process of turning archaeological research from the elementary description of archaeological remains to the recognition of site distribution patterning.

In 1972, Lipe and Matson began conducting field studies on Cedar Mesa in southeastern Utah. Their research has expanded to include a large number of field studies and related analyses, including settlement pattern studies. Primary objectives of these projects have been to examine settlement patterns on Cedar Mesa and its associated canyons, and to compare those results with settlement patterning in the larger drainage region (e.g., Lipe 1971, Haase 1983, Benson 1984, Gumerman 1988, Mills 1989, Matson et al. 1990, Matson 1991, 1994, Varien et al. 1996, Bedell 2000, Morton 2002 and Matson and Chisholm 2007). Some of the results of these studies indicate the environmental and cultural factors that affected prehistoric Pueblo settlement on portions of Cedar Mesa, interpret community patters, explain temporal change, evaluate settlement variability through the use of artifact analysis, and infer social integration and organization.

GSENM/Escalante Drainage Settlement Pattern Studies

Evidence from the above-mentioned Great Basin settlement studies and from other research conducted in the southern Utah area clearly demonstrates that prehistoric peoples occupied the Great Basin over a long range of time, developing alternative subsistence strategies based on available resources, technologies, and environmental conditions. For example, the early use of cultigens by prehistoric peoples in the Zion National Park area has been definitely established (Connor and Vetter 1986, Heath 1986) while at other locations, evidence for horticulture is less visible. Additionally, while evidence of reliance upon some form of agriculture is widespread, the roles of cultigens in arid land adaptations, as well as the presumed differences in mobility, technology, and land use strategies that accompany horticulture, are poorly understood. "At issue is whether maize was first planted casually…or whether it was given considerable attention requiring Archaic populations to become seasonally more sedentary than they had previously been" (Cordell 1984:140). The question remains as to whether the cultivation of maize was opportunistic (as per Minnis 1992) or a necessity (i.e. Binford 1968a, Sanders and Webster 1978) related to a major shift towards intensive land use and economic reorganization (Wills and Hucknell 1994).

Previous research within and around the boundaries of the GSENM has largely been concerned with the description of manifestations of the Virgin or Western Anasazi (Wetherill 1934; Rudy and Stirland 1950; Schroeder 1955; Aikens 1965; Connor and Vetter 1986; Walling et al. 1986; Dalley and McFadden 1985; Moffitt et al. 1978; Tucker 1985) and Fremont cultures (Jennings 1978). Both groups relied heavily on agriculture for their subsistence. A 1968 study by Jen-Hu Chang study found that in general, successful Zea mays agriculture requires 110 frost-free days combined with a baseline temperature of 10° Celsius (50° Fahrenheit) throughout the growing season. This study implied that gross precipitation or temperature duration is not as critical for maize production as the timing of these variables in relation to the developmental stages of Zea mays. As previously noted, climatic data from the station at Escalante, Utah, indicates that both the frost-free and freeze-free seasons generally last from May 1 to early-October, or between 120-160 days (Table 4.2, US Dept. of Agriculture 2004), a more than sufficient time period for successful maize horticulture, although there is a marked reduction in the number of days between killing frosts as elevation rises (USDA Natural Resources Conservation Service 2004). As a result, maize horticulture was probably a significant component of prehistoric subsistence in and around the GSENM. The spatial and temporal variability in the climate of south-central Utah, however, indicates that prehistoric populations would also, by necessity, have to rely on more than one strategy to deal with the risk of agricultural failure, such as storage of food resources and alterations to mobility strategies as required.

The model used by Geib (1996) in a study of settlement of the lower Escalante River/Glen Canyon region concluded that Formative use of lowland areas was purely logistical. He found that temporary residences in the lowlands were established near ideal agricultural venues in order to take advantage of early maturation of crops, while permanent residences were maintained in the highlands (Geib 1996).

A recent settlement strategy study analyzing Pueblo II Kayenta affiliated sites within the northeastern most section of the GSENM covered an area ranging from the Waterpocket Fold of Capitol Reef National Park, west to Sand Creek, and south to the Escalante River and Glen Canyon Recreation Area boundary, and included the Circle Cliffs and Boulder Mountain as well (Wright 2001). Similar to Geib's study, three elevation zones defined the primary criteria in evaluating Kayenta settlement. In that study, highland (upland) sites were designated as those sited in elevations above 6,500 feet, where "pinyon-juniper woodland gives way to ponderosa pine and stands of aspen" (Wright 2001:3). Sites located between 5,500 feet and 6,500 feet were considered midland sites, while those identified between 4,500 feet and 5,500 feet were classified as lowland locations. Wright's study documented a different pattern of site distribution than found in the Glen Canyon. Instead, she noted that in the Circle Cliffs, the Kayenta Anasazi "stayed fairly close to home. . . (The) population was located at two clusters around Coombs Village and the Lampstand Ruins (and) people practiced intensive agriculture by means of dry farming methods" (Wright 2001:90-91). The population clusters are found in the midland zone. Wright's study also demonstrated that the lowland zone was only utilized to a minimum degree for very short-term logistical purposes (Wright 2001).

McFadden's Fremont settlement model for the A.D. 500-1200 year period across the three physiographic areas of the GSENM is based on ^{14}C and tree-ring dating efforts and the inventory of more than 1,000 sites (McFadden 1998). He noted that on the Grand Staircase, "the indigenous Virgin Anasazi depended heavily upon agriculture (and) the pattern of settlement seems to reflect a strategy of residential mobility that allowed them to shift among various arable settings, on an annual basis, as conditions changed. This adaptation appears to have restricted (Virgin Anasazi) architectural site locations to elevations between 5,000 feet - 7,000 feet – the prehistoric agricultural zone for dry farming” (McFadden 1998:91). As briefly described in Chapter 1, within the northern GSENM and Escalante River drainage, McFadden discerned a different settlement strategy, hypothesizing that for the Wide Hollow and Late Formative Fremont,

> *“seasonal mobility was the basis for Fremont adaptation;* ***during the summer, camps were occupied in the perennially watered canyons below 7,000 feet*** *(2,134 m) primarily to farm;* ***during winter, the uplands were occupied to hunt migratory mule deer and exploit an abundant source of firewood****. Concealed storage granaries facilitated this mobile lifestyle by securing seed corn for the following year, as well as providing short-term storage during their absence” (McFadden 1998:97).* (Emphasis added)

Thus, McFadden argues that lowland sites (those below 7,000 feet) would typically be small short-term camps with little faunal remains, although a large mammal could be found at these sites as the result of “target of opportunity.” He has additionally stated that the upland, winter occupation sites (presumably located above 7,000 feet) comprise the long-term, residential habitations during this period and would have more complex architecture and on-site storage indicating a longer stay (McFadden 1998:91).

The goal of this research is to evaluate the utility of the Fremont settlement model proposed by McFadden, particularly assessing the precision of the model in terms of general location for long-term residential versus seasonal habitation sites.

6 | Assumptions and Methods

ANALYTICAL ISSUES

Standard assumptions and methodologies governing the execution of settlement pattern studies presuppose that data utilized in settlement research represents "a relatively complete set of similar elements and (that) a consistent context for these elements is possible" (Fish 1999:204) to recognize. Furthermore, settlement models must be comprised of a set of testable hypotheses, which requires that models be explicit in the variables used and the manner in which they are manipulated and/or interact. Another important assumption is that the choices for activity locations made by prehistoric peoples were influenced by elements of the natural and physical environment, and that the environmental variables have survived to the present period to the extent that they may be understood by contemporary observers from the archaeological data (Binford 1968b). A final assumption asserts that correlations between archaeological sites and the natural/physical environment reflect the actual land use choices made by prehistoric decision makers, and identified correlations are not due to chance (Kellogg 1987, Dalla Bona 1994).

CHALLENGES

Several challenges are inherent when conducting settlement pattern analysis, depending on the scope and expectations of the research and the type of data available. Some of the most common problems which must be addressed include data collection, classification of site type and function, and recognition of cultural association and chronology (Wright 2001).

Data Collection

The first point relates to all of the data sources used to develop settlement patterning models. Regardless of its theoretical framework, every settlement model is built upon a limited number of primary variables, i.e., slope and aspect, primary/secondary landform, site elevation and distance-to-water, vegetation zone, soil characteristics (Dalla Bona 1994), and an on-site determination of site function, all of which should be recorded in a standardized format at the time of survey (in this case, the Utah Intermountain Antiquities Computer System [IMACS] (1992) form). Although most of the "recent" documentation is available in a generally consistent form, earlier (pre IMACS) site forms are often vague or incomplete, since they did not require the same level of site documentation as the current IMACS forms, or exhibit inaccuracies in site location, usually due to the scale of topographic maps used prior to the advent of satellite measurements through the Global Positioning System (GPS). During the data collection process, many of the site forms were incomplete and missing data for several of the critical categories. To compensate for this missing data, absent data were collected by comparing each site location as mapped on the USGS 1:24,000 topographic series maps in the Utah SHPO offices to the digitized versions of correspondent quadrangle maps (*All Topo Maps: Utah* produced by iGage, Salt Lake City). The data categories of UTM location, elevation, site area, and primary/secondary landform were generated from these maps. Distance to permanent water data were generated using GIS software. Vegetation zone, slope and aspect data, and where possible, soil characteristics were collected by examining aerial views of each site location as necessary.

Determination of Site Type

The variety of archaeological remains left by people in the past facilitates the comparison between differing types and functions of prehistoric sites allowing a broader perspective on what human society was like in the past. An archaeological site is defined as a recognizable cluster of architectural structures, distinct features, organic and environmental remains, and artifacts which are the residue of past human activity (Renfrew and Bahn 1991) reflecting "cultural meanings that influence how it (was) ordered, used, and valued" (Bruck and Goodman 1999:5). The accurate determination of site function is a necessary component of settlement pattern research, although the classification process can be rather complicated. Limited surface visibility due to heavy vegetative cover, naturally occurring damage due to the natural increase in overburden, soil deflation, erosion, agricultural usage, herd animal grazing, and vandalism are just some of the variables which may contribute to degrading (or destroying) sites and confuse the process of attaching meaningful site function during the site recording process.

Site functions are generally assigned based on an inventory of characteristics typical of specific activity areas. For example, an ephemeral hunting camp might be represented by a scatter of stone tools and debitage, a food processing site would primarily include ground stone artifacts, ceramic remains, and/or evidence of long-term storage, and a residential site would contain evidence of structural features, large midden areas, hearths, ash stains, grinding stones, ceramic sherds, structural debris, and a variety of other artifacts. For the purposes of this study, site function was determined by entering the artifacts and features described on the site form for each site into an Excel table (Appendix A). Site function (see Definitions below) was then assigned by comparing the material remains for each site against a checklist of expected material remains for six

Table 6.1. Site Typology Checklist

	Storage	Hunting Camp	Plant Processing Camp*	Complex Camp	Seasonal Habitation**	Long Term Residence
Granary/Cist	Required	Not Applicable	May or may not be present	May or may not be present	May or may not be present	May or may not be present
Trace Debitage (<25 flakes)	May or may not be present	Not Applicable	May or may not be present	Required	Required	Required
Moderate to Heavy Debitage	Not Applicable	Required	May or may not be present	Required	Required	Required
Lithic Tools 1 (diagnostic projectile point, late-stage biface)	Not Applicable	Required	Cannot be present	Required	Required	Required
Lithic Tools 2 (utilized flake, uniface, hammerstone, chopper)	Not Applicable	May or may not be present	May or may not be present	Required	Required	Required
Ground Stone Tools (mano, metate, mortar, pestle, slicks)	May or may not be present	Cannot be present	May or may not be present	May or may not be present	Required	Required
Ceramics (>100)	Not Applicable	Cannot be present	Cannot be present	Cannot be present	Required	Required
Light Ceramics	May or may not be present	Cannot be present	May or may not be present	Required	Not Applicable	Not Applicable
Soil Stain < 2 m^2	Not Applicable	May or may not be present	May or may not be present	May or may not be present	May or may not be present	May or may not be present
Soil Stain > 2 m^2	Not Applicable	Cannot be present	Cannot be present	May or may not be present	May or may not be present	Required
Plant Food or Basketry Remains	May or may not be present	Not Applicable	May or may not be present	May or may not be present	May or may not be present	May or may not be present
Hearth or Roast	Not Applicable	May or may not be present	May or may not be present	May or may not be present	May or may not be present	Required
Midden	Not Applicable	Cannot be present	Cannot be present	May or may not be present	Required	Required
Evidence of Light Architecture (wickiup, boulder rings)	Not Applicable	Cannot be present	May or may not be present	May or may not be present	Required	May or may not be present
Evidence of High Investment Architecture (stacked masonry, adobe, pithouse or other structural alignments)	Not Applicable	Cannot be present	Cannot be present	Cannot be present	May or may not be present	Required

(dark green)	Required
(light green)	May or may not be present
(red)	Cannot be present
(white)	Not Applicable

*Ground stone and/or ceramics required
**Some light architectural sites (boulder rings, stone foundations) with few artifacts grade into this category.

defined site functions (Table 6.1).

Cultural Association

Within the context of this study, select artifact classes, such as ceramics, diagnostic projectile points, clay figurines, distinctive architecture – particularly in relation to granary sites – and/or distinctive rock-art styles, were useful in determining the cultural association at the time of inventory. Ceramics, in particular, were used as an important tool in determining chronological classifications for sites included in the study. Since the 1920s, when the importance of change in ceramic style was first recognized as an important chronological indicator (Cordell 1997), a temporal sequence of ceramic types has been suggested for the Fremont, most recently by Watkins (2006), and if better defined in future, has the potential to be a robust technique in determining site chronology. In general, however, plain Emery gray wares appear earliest, while decorated Fremont pottery types (e.g., Ivie Creek Black-on-white, Snake Valley Gray, Snake Valley Corrugated, etc.) appear later. Identification on the IMACS form of the type(s) of ceramic sherds found at a site were a helpful tool in determining site chronology, i.e., whether a site was recognizable as the earlier Wide Hollow Phase or as Late Formative.

Sites that only exhibited diagnostic Fremont wares, or Fremont ceramics with a very small percentage of associated Anasazi sherds noted on the IMACS site form were defined as Fremont sites. (Site forms noting a majority of Anasazi sherds with Fremont ceramics in association were designated Anasazi sites and not included within this study.) One of the unfortunate side effects of this classification strategy is that it naturally eliminates from the data set the many small or ephemeral sites which do not retain diagnostic Fremont artifacts on the site surface, resulting in a cultural association of "Unknown Aboriginal" or "Unknown Prehistoric." As a consequence, many of the short-term or purely logistical sites which are 'probably' Fremont are not included in the settlement pattern data and are under-represented in the study.

DEFINITIONS

In this section, important concepts employed in settlement pattern studies are defined and clarified. The term *settlement strategy* as used here refers to where prehistoric peoples chose to live and the way in which they obtained their food, and thus is interconnected with subsistence studies. *Settlement patterning,* on the other hand, refers to the various interconnections between archaeological site location and the natural environment. In other words, settlement patterns are the actual way in which sites are spread out or patterned across the landscape whereas settlement strategy defines the reason why sites are located in specific places. *Site distribution* is a component of settlement patterning studies which looks at patterns in individual site location and does not address issues of internal site feature or artifact patterning.Additional concepts requiring more detailed explanation are discussed below.

Site Typology

While the initial premises of the McFadden model appeared sound, additional research (Baker et al. 2001; Jordan and Talbot 2002; Baer and Sauer 2003; Harris 2005) has revealed significant problems with the basic definitions used in the site typology or function classifications, as well as the probable oversimplification of Formative subsistence strategies and settlement patterns. During the fieldwork phase of the joint BLM/BYU Project, "sites were classified according to general size and complexity of features and other material remains, … (but) a site classification such as this is somewhat subjective, and a number of sites could have been placed into more than one site category" (Baer and Sauer 2003:147). The subjective nature of determining site function as employed during the Project also had ramifications in terms of developing accurate cultural chronologies for the region. A first step in addressing these issues is to redefine the site typology definitions so that analytical consistency can be applied to any inventory conducted within the region.

The following site function definitions were developed specifically for this research. They are loosely based on Binford (1968b), Geib et al. (2001), Talbot and Richens (2002) and Janetski et al. (2005), but have been modified to fit the requirements of this study. As mentioned previously, site functions were assigned by comparing the material remains recorded for each site against the material remains expected for each defined site function (Table 6.1). Out of the entire data set, 11 sites (three percent) did not meet all the categorical criteria for any one of the site function definitions. In these cases, each site was categorized somewhat subjectively based on the balance of the materials recorded (or not) on the site form. (It must also be noted that sites are often more complex than what the surface data show, and excavation always has the potential to clarify and/or redefine the function of an individual site.) However, the definitions generally fit the site types as encountered during the Project surveys and also proved useful when applied to information gleaned from the IMACS or earlier site record forms.

Long-term Residence

Long-term residence (LTR) sites are those typically occupied for at least half the year, with this permanence represented by some sort of high-investment structural feature. On the ground such a feature is commonly represented by a large soil stain (well over two meters in size), sometimes with a depression, and with associated ashy midden deposits. Often, evidence of sturdy residential structures such as large slabs or boulders protrude above the surface, providing traces of structural walls or a vent tunnel. Associated features might include smaller ash stains and slab-lined thermal pits. Artifacts tend to be diverse and abundant, with considerable numbers of lithic tools and debitage, ceramic sherds (Formative and Late Prehistoric sites only), and ground stone. External storage structures may also be found in close association with a long-term residential site.

Seasonal Habitation

Seasonal habitation (SH) sites, (often identified elsewhere as short-term residential sites) are those with evidence of relatively long-term occupations of several weeks of up to two-to-three months. Shorter occupation sites are marked by light structures (such as a wickiup) having no significant depth of cultural materials or depression and small midden deposits,. Longer term occupations, while temporary, may contain high-investment pithouse structures reflecting not only longer periods of intended stay, but probable repeated use on a seasonal basis. Tools and other debris are present, but in lesser quantities and with less diversity than a long-term residence, although more than 100 ceramic sherds must be present to classify a site as a seasonal habitation. Soil stains at these higher investment occupations may also reach sizes greater than 2 meters in diameter. Occasionally, unusual sites such as coursed masonry field houses, whose construction and artifact content denote specific functions better than other, less prominent sites, fall within this functional definition. Additionally, light architectural sites (boulder rings or dry-laid, single-course stone foundations) with few associated artifacts grade into this functional category.

Complex Camp

Complex camps (CC) are multi-functional, containing evidence for both plant processing and hunting. Functional complexity is a common feature of many of the larger sites, where repeated short-to-medium term occupations have resulted in an often-confusing array of hunting and processing or special use traits. Obviously teasing out individual occupations from such sites can be very difficult if not impossible. Geib et al. (2001:328) have identified the presence of metates as a critical feature of residential/ complex camps as these not only signify food processing but also consumption. The definition of the complex or residential camp also requires the presence of at least two stone tool classes, such as late stage bifaces, projectile points, unifaces, or utilized flakes as well as the metates or metate fragments, and the presence of at least one soil stain or midden, rather than simply relying upon the appearance of site multi-functionality. Many alcove/rock shelter sites fit into the complex camp category.

Logistical Procurement/Processing Camps

Two distinct types of short-term camp sites are defined here, each representing stays of from one to several days, perhaps even a week or two. Division of labor between male and female groups is a primary assumption for these two site types, with one site type representing primarily male activities and the other primarily female activities. They typically have no obvious midden or depression indicative of a buried structure, but will often contain light soil stains less than two meters in diameter. Lithic debitage can be variably abundant at logistical sites. In general, the less complex sheltered sites likely functioned as one of two types of logistical sites.

Plant Processing Camp

Plant processing camps (PPC) are inferred to have had a primary function related to plant collecting and processing. They are distinguished by the presence of ground stone and/or ceramics, with at least one of these required (inferred to be gender-specific, female activity). Other evidences of plant processing such as ash stains, hearths, or roasts may also be present. A low number of lithic flakes or simple chipped stone tools (utilized flakes, choppers, unifaces) and fewer than 100 ceramic sherds should be present in a processing camp. Again, length of stay is typically not very long at these types of sites; therefore, large circular stains over two meters in diameter would not be present. They have no obvious midden or buried structure.

Hunting Camp

Hunting camps (HC) are single component lithic scatters in association with projectile points, late stage bifaces (including drills), unifaces, utilized flakes, and other tools associated with faunal procurement and processing. Because hunting requires significant mobility, length of stay is probably not very long, and in general the numbers of macroflakes tend to be few, though micro-flaking can be much more significant as a result of tool sharpening/refurbishing. Hunting is inferred to be a gender-specific (male) activity and so hunting camps typically lack ground stone or ceramics. Small (usually less than two meters in diameter) soil stains representing thermal features are common at these sites.

Storage/Cache

Fremont storage granaries (ST), most of which have been badly impacted by vandals, can be found at ground level or in a cliff-face. Other storage or cache locations consist of pits in protected alcoves of various sizes, or in open, often slab-lined or masonry storage cists located away from residential sites. It is not uncommon to find a limited artifact assemblage, or even very light soil staining in association with a storage or cache feature. Clearly, however, human visitation was intended to be limited and brief. Sites recorded as consisting only of storage features were assigned a primary function of "storage" (ST).

Structural storage (granaries) or storage cists are, or may also be found, at long-term residential, seasonal, complex camp (particularly in alcoves), or at plant processing camp sites. When storage features were identified in association with one of the above site types, they were assigned as a secondary site function.

Thirty of the 405 sites exhibited a secondary, but strongly associated storage function. Of these, one long-term residence and one seasonal habitation each have an on-site masonry granary. Fifteen complex campsites and 13 plant processing sites, of which all but two are alcove rock shelters, contain granaries or slab-lined storage cists. In terms of this study, the multicomponent sites were analyzed in terms of their primary site function.

DATA COLLECTION

In ideal circumstatens, a randomly stratified program of survey would be conducted in order to reduce bias, to try to account for the fact that sites or artifacts may be distributed differently or with varying characteristics in different parts of the region to be surveyed. When such inventories are conducted, a subset of survey areas are selected which represent the characteristics of a much larger area. In some cases the study could divide the region to be surveyed into a series of subsample zones based on regional ecology or other landscape features of interest. Each one of these zones is then sampled independently of the other. This allows conclusions to be drawn about how each eco-zone or other subdivision was utilized by ancient populations. Elements could consist of rectangular quadrats, other geometrical units (polygons, circles), or non-geometrical spaces such as landscape elements or agricultural fields. Stratified sample surveys are designed to optimize the recovery of target sites in various environments and are effective for making generalizations, but require careful design with regard to units, spacing, and arrangement (Banning 2002).

As stated previously, the surveys conducted in the GSENM used for this study were project oriented, with most undertakings concerned with inventorying areas affected by planned, ground-disturbing activities (Glen Canyon Project, various right-of-way and construction projects) or planned land exchanges. In all cases, survey was carried out within defined areal boundaries, and surveys were conducted to cover the areas affected by project requirements – which unfortunately, introduced bias into the study.

The sites and survey sections included in this study are scattered across a 387,260 acre area whose boundaries have been previously described (Figure 1.2, Table 1.1). Elevations within the study area range from 4,790 feet to 9,280 feet. Data utilized for the research was collected from 16 site excavations and nine large-scale areal inventories conducted during the joint BLM/OPA Project (Figure 6.1), BLM surveys carried out by Doug McFadden in the GSENM (McFadden 2000), surveys conducted by Keller (2000) of “The Gulch” and the Escalante River Canyon beginning at its intersection with Highway 12 and continuing south to the Glen Canyon National Recreation Boundary, a survey of Harris Wash from its confluence with the Escalante River west to the Escalante River valley (Jennings 1966), two power-line surveys conducted by OPA personnel (Jardine and Talbot 2004, Watkins and Talbot 2004), several other BLM and USFS project surveys, and sites recorded from general survey but not associated with any specific survey project. (Table 6.2 lists all the projects within the study area with Fremont sites included in this research.)

Only sites from the Fremont period, as determined by the diagnostic features, artifacts, or ^{14}C dates (obtained from several of the excavated sites) are included in the analysis. Copies of the recorded site forms were obtained from the Utah State Historic Preservation Office, the Bureau of Land Management, Dixie National Forest, and OPA.

Once the relevant site forms were obtained, information from the forms was transcribed into a database format using a Microsoft Excel worksheet file to prepare the data for analysis (Appendix B). The number and types of ground stone artifacts, chipped stone tools, debitage flakes, and ceramic sherds were recorded. Other data categories include:

* number and size of soil stains (<2 meters, >2 meters),
* number of depressions, hearth/roast areas, midden, rock alignments or other light structures, rock walls, and pithouses,

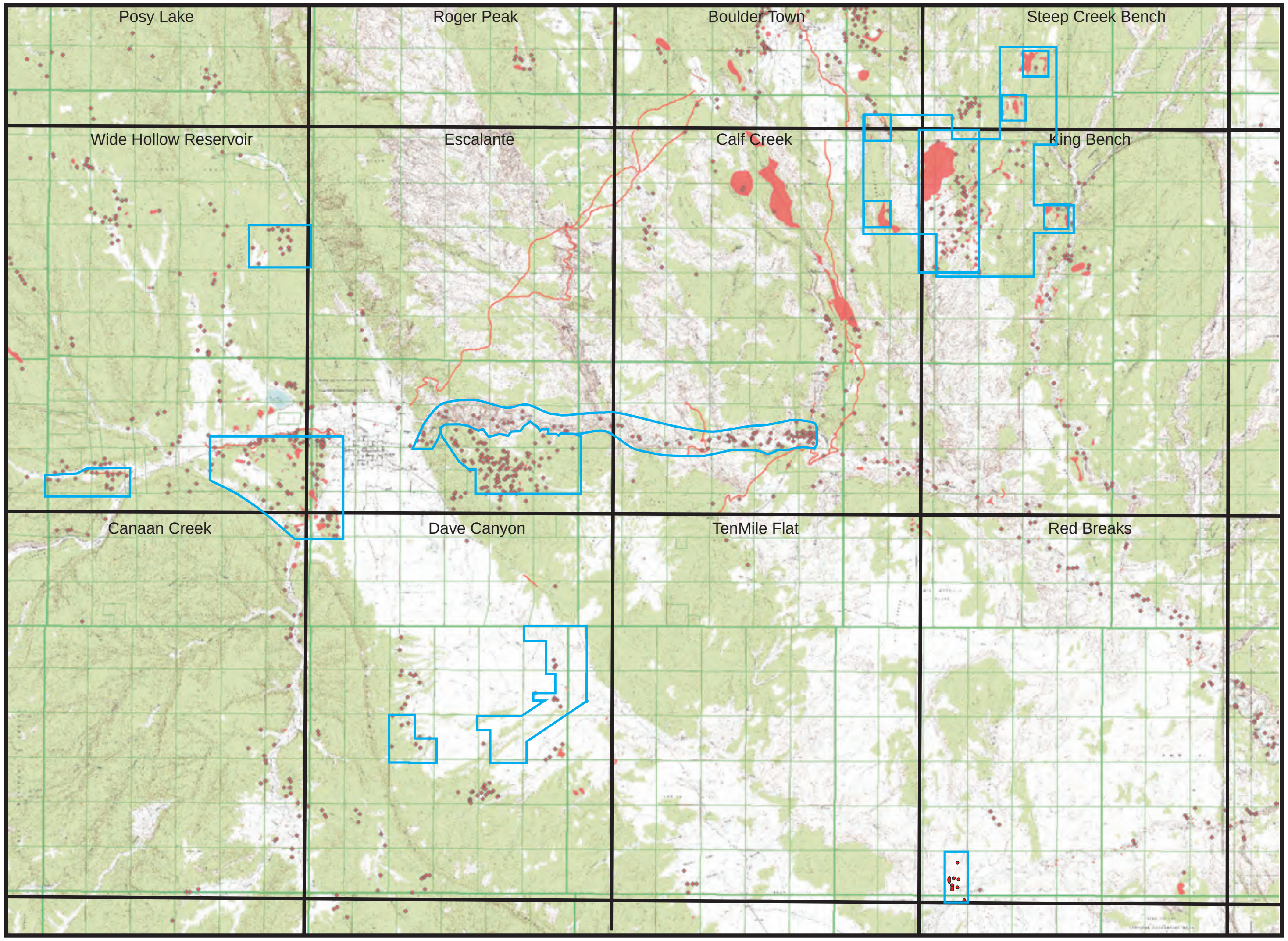

Figure 6.1. All archaeological sites identified by survey or excavation within the study area. Areas outlined in blue represent the generalized boundaries for acreage surveyed during the 1999-2004 BYU Project.

Table 6.2. List of Projects in Study Area with Identified Fremont Sites.

Project No.	General Project Title	Principal Investigator	Report Title	Authors
77AF0005	Cultural Resources Evaluation for the Central Coal Project	Hauck, R.	Cultural Resource Evaluation in Central Utah: 1977. Ca/Em/Ga/Gr/Sp/Sv/Ut/Wn Counties	Hauck 1977
77AF0068	Cultural Resource Evaluation in South Central Utah	Hauck, R.	Cultural Resource Evaluation in South-Central Utah: 1977-1978. Ga/Ir/Ka/Pi/ Wa/Wn Counties	Hauck 1979
81BL0234	Deer Creek Ranch Pipeline R/W	McFadden, D	Deer Creek Ranch Pipeline Right-of-Way	McFadden 1981
83BL0148	Boulder Creek (Haws) Sale Tract	Dalley, G.	Haws Sale Tract, Vicinity of Boulder	Dalley 1983a
83BL0149	Woolsey Exchange	Dalley, G.	Woolsey Exchange	Dalley 1983b
83BL0160	Coughlin Sale Wide Hollow	McFadden, D	Coughlin Sale - Wide Hollow	McFadden 1983
84BL0675	Gardner Pipeline and Pond	McFadden, D	Gardiner Pipeline and Pond	McFadden 1984
85BL0931	Burr Trail Upgrade	McFadden, D	Burr Trail Right-of-Way	McFadden 1985
87PD0123	Burr Trail Test Excavations	Schroedl, A	Archaeological Testing Along the Burr Trail, Garfield County, Utah.	Brown and Tipps 1987
87BL0858	The Gulch R/W	McFadden, D	The Gulch Right-of-Way	McFadden 1985
92FS0787	Highway 12 Evaluation	Jacklin, M	Highway #12 Evaluation	Jacklin 1992
93BL0328	Calf Creek Access Improvement	McFadden, D	Calf Creek Access	McFadden 1993a
93BL0367	Boulder Dump RPP, Burr Trail Tract	McFadden, D	Boulder Dump RPP, Burr Trail Tract	McFadden 1993b
96BL0372	Calf Creek Access Turnout	McFadden, D	Calf Creek Access Turnout	McFadden 1996a
00DN0030	The Gulch Survey	Keller, D	Archaeological Survey of The Gulch, Burr Trail to the Escalante River, Garfield County, Utah	Keller, 2002
00BC0182	Grand Staircase/Escalante Deer Creek Inventory	Talbot, R	Grand Staircase-Escalante National Monument Archaeological Survey and Testing Program: 1999 Inventory of the Upper Circle Cliffs Area	Talbot et al. 2000

Table 6.2 Contined.

Project No.	General Project Title	Principal Investigator	Report Title	Authors
00BC0259	BYU Escalante Drainage Surveys: Benches 2000	Janetski, J	The BYU Escalante Drainage Project: the Benches 2000	Baker et al. 2001
00BL0453	Monument Kiosks & Portal Signs	McFadden, D	Monument Kiosks and Portal Signs	Zweifel 2000
01BL0020	Deer Creek and Calf Creek Campgrounds Improvement	McFadden, D	Deer Creek and Calf Creek Campground Improvements	Zweifel 2001
01BC0172	Field School Survey and Excavations	Janetski, J	The BYU Escalante Drainage Project: Big Flat and Escalante Canyon Areas 2001	Jordan and Talbot 2002
01BL0778	Dispersed Camps Inventory	Zweifel, M	Designated Campsites	Zweifel 2004
02BL0016	Hwy 54 Right of Way	McFadden, D	Highway 54 Right-of-Way	McFadden 2001
02BC0274	BYU Escalante Drainage Surveys: Little Desert 2002	Janetski, J	The BYU Escalante Drainage Project: Little Desert, Main Canyon, and Escalante Desert Areas 2002	Baer and Sauer 2003
03BL0010	Steep Creek Fence	Zweifel, M	Steep Creek Fence	Zweifel 2003
03BC0162	BYU Field School and Excavations -- 2003	Janetski, J	The BYU Escalante Drainage Project: Black Hills, Escalante Flats, and Escalante Canyon 2003	Harris 2005
03BL0531	Steep Creek Too	Portillo, G	Steep Creek Too	Zweifel 2003
04BC0310	2004 BYU Field School-Escalante Drainage	Janetski, J	n/a	n/a
04BC0381	Sigurd to Glen Canyon Powerline	Talbot, R	An Archaeological Inventory of the Existing UP & L Sigurd to Canyon 345 kV Transmission Power Line in Sevier, Piute, Garfield, and Kane Counties, Utah.	Jardine and Talbot 2004
04BC0446	Garkane Boulder to Henrieville Powerline	Talbot, R	An Archaeological Inventory of the Existing Gar-Kane Boulder to Henrieville 69 kV Transmission Power Line in Garfield County, Utah.	Watkins and Talbot 2004

* presence of organic remains, exotic materials, figurines, fire-cracked or burned stone, charcoal, and adobe,
* the site area in square meters, and
* adverse effects due to looting, chaining, or road work.

Using these data, each site was assigned a site function and cultural association using the criteria described in the definitions above. Multi-component sites, where archaeological materials could be recognized as belonging to more than one cultural affiliation, were "managed" by defining the site type in terms only of its Fremont component, and then only if that facet could be identified as being the significant component of the site across its temporal entirety. This procedure prevented the analysis from being skewed by the inclusion of unrelated (non-Fremont) data.

GEOGRAPHIC CHARACTERISTICS

Geographic characteristics as entered on the IMACS site form, including elevation, distance to permanent water, primary landform, slope and aspect, vegetation, and depositional context were also included as part of the data set and provided important contextual data to assist in identification of correlations between site types and geographic features or locations. As previously noted, many pre-IMACS site forms did not include all these geographic categories, with the result that those data were not collected. When this occurred, aerial photos and GIS programming were used to obtain as much of the data as possible in a consistent manner.

Elevation

As McFadden's settlement model of the Fremont manifestation in the Escalante drainage concerns the relationship between Fremont sites and elevation zones, site elevation data was collected as an essential component of this study.

Distance-to-water

Distance-to-water was determined for each site using data generated using GIS software. The program calculated the closest, straight-line distance from the central location of each site to a perennially flowing river or stream, without consideration of topography.

Primary Landform

This data set was assembled from the primary landform designation as assigned on the IMACS form for each site in the study. Of the eight primary landform category options on the site forms, four are applicable to the sites in the Escalante River drainage – canyon, ridge, tableland/mesa ("mesa"), and valley. Figure 6.2 illustrates the general locations for each of the four identified landforms in the study area. These data are somewhat problematic in that they are qualitative rather than quantitative, and are dependent upon field interpretation by individual site recorders of site geomorphology.

Definitions for each of these landforms are taken or revised from the IMACS manual, Section 410 (1992).

Canyon

Any steep-walled feature cut by running water into bedrock, the sides of which are comprised of very steep slopes or cliffs rising from its bottom. Many canyons are named as such on U.S.G.S. Quad sheets, but the term can also apply to branches of these major canyons as well as gorges, ravines, or channels. Canyons are distinct from gullies which are cut into unconsolidated alluvium or colluvium. A canyon has slopes and cliffs in and on which there may be benches, fans, rimrock, colluvium and talus, landslides and slumps, caves and rockshelters.

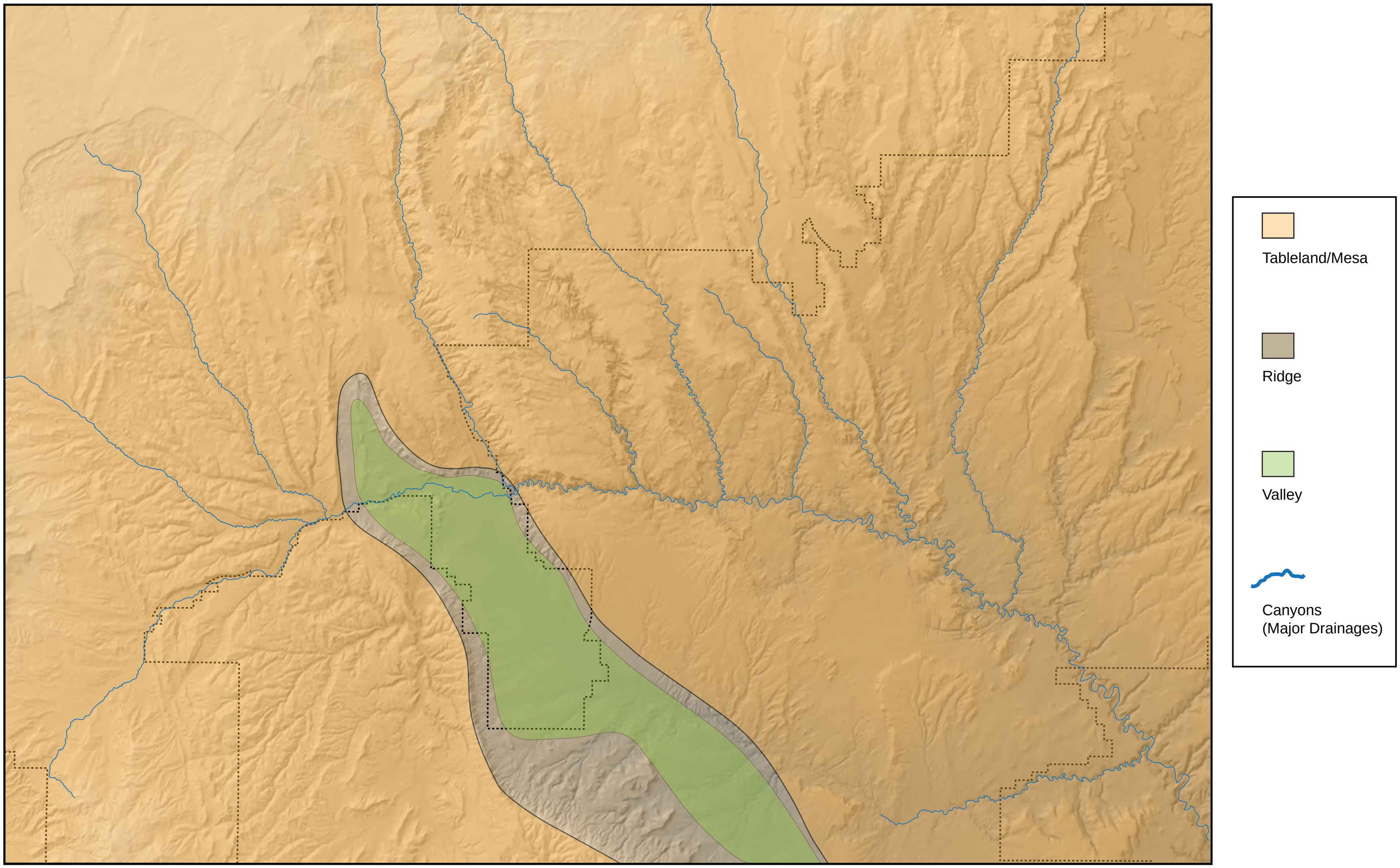

Figure 6.2. Generalized primary landform units in the project area.

Ridge

An elevated, relatively narrow landform with steep sides which is a feature of a mountain, tableland/mesa, or hills. The bottom portion of the ridge along its sides is a foot, while the toe is at its distal end.

Tableland/Mesa ("Mesa")

A mountain or hill-sized landform with a flat or gently undulating top, bounded on one side by a cliff.

Valley

Low-lying land surrounded by mountains, either transversed by a stream, river, or ephemeral wash or containing a lake or playa. A valley receives the drainage from the surrounding highlands and is often filled by alluvial sediments. Also used in the vernacular for intermontane and intramontane basins.

Universal Transverse Mercator (UTM) Coordinates

Universal Transverse Mercator (UTM) coordinates for each site were also included in the database to ensure that each site was accurately plotted onto a GIS-generated topographic map to illustrate possible relationships between the sites which might appear through visual examination. GIS software also used UTM coordinates to standardize the measurement of distance to permanent water, allowing statistical analysis of distance-to-water in order to evaluate its significance in settlement patterning.

A description of the data, the statistical methods and analyses conducted on the data set to identify relationships buried within the data variables, and initial analytical results are discussed in the next chapter.

7 | Data

The BYU Project, as well as the other inventory and excavation projects conducted within the GSENM and upper Escalante drainage reveal important information about the nature of archaeological resources in the area. These studies provide supplementary knowledge about the history of human occupation in the region, offering insights into the settlement and land-use strategies employed by prehistoric peoples and providing useful information for the development of cultural resource management options.

Of the nearly 388,000 acres within in the study area, less than eight percent of the total area (29,667 acres) has been surveyed. The majority of the large-scale investigations conducted within the study area have been along major drainages (e.g., Escalante River, Calf Creek, North Creek, etc.) or in a few large acre surveys near Escalante (Big Flat, Little Desert), and on the Kaiparowits Plateau. Recorded sites are most abundant along the Escalante River Canyon and its catchment canyons. Particularly heavy site concentrations are also documented in the Big Flat and the Little Desert areas of the GSENM (Figure 7.1). Examination of Figure 7.1 shows the biases introduced by the strong focus on riverine surveys rather than general surveys. The limited amount of survey conducted on private land versus inventory conducted on public lands introduces additional bias into the data.

SITE TYPE DISTRIBUTION

Within the study area, 405 recorded sites are designated as Fremont by the reported

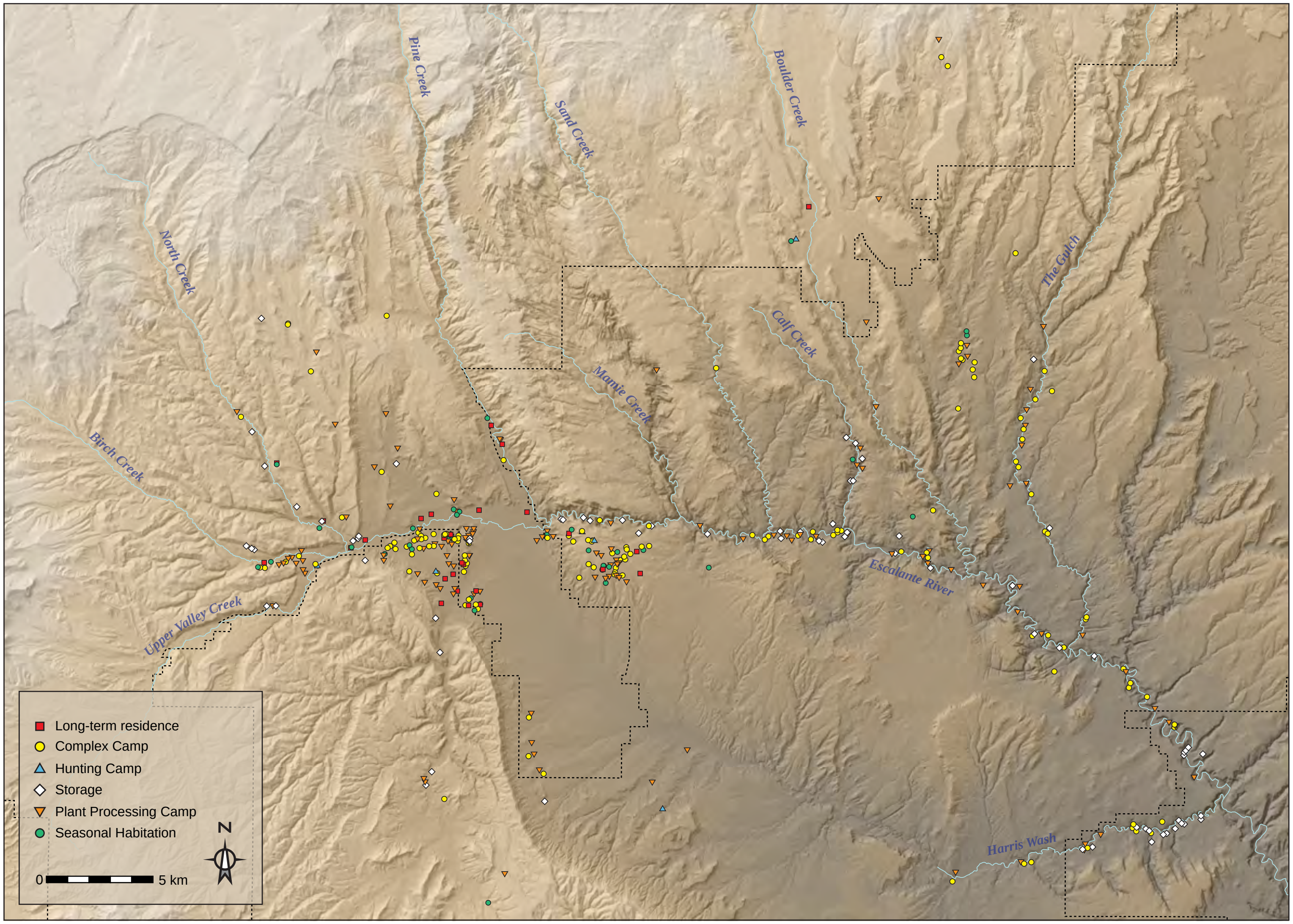

Figure 7.1. Map of study area showing distribution of all identified Fremont sites by site function.

presence of diagnostic artifacts and/or architectural features (Figure 7.1). This chapter describes the data in general terms and presents the analytical results of the research. The purpose of this study is to look at several variables that might influence site location and/or distribution. The variables selected for this research include elevation, distance from a site to permanent water, and primary landform. Other variables that could have been used, but fall outside the scope of this study, include site slope/aspect, primary vegetation, and type of soil.

As the McFadden model is elevation based, in this chapter I will describe the general characteristics of all the identified sites, first in terms of elevation, then by the other variables of distance to permanent water and site location by primary landform. Following the general data description, I will present the results of analytical tests conducted on the three selected geographic variables (elevation, distance to permanent water, and primary landform). A discussion of these results, as well as their implications for settlement patterning, is offered in the final chapter of this thesis.

Elevation

The relative frequency distribution (Figure 7.2A) which graphs the sites across 500-foot elevation classes shows that 30 percent (N = 119 sites) fall between 4,500 and 5,500 feet, 62 percent (N = 250) of the sites are located at elevations between 5,500 and 6,500 feet, and only 8 percent (N = 36 sites) lie in the higher elevations above 6,500 feet. The Fremont sites recorded within the study area range in elevation from 4,760 to 7,480 feet and have a median elevation of 5,995 feet.

Figure 7.2B is a boxplot comparison of each functional site type by elevation. This illustration identifies the elevation range for each of the types identified in the study area by 500 foot elevation classes. The area within each shaded box contains 50 percent, or

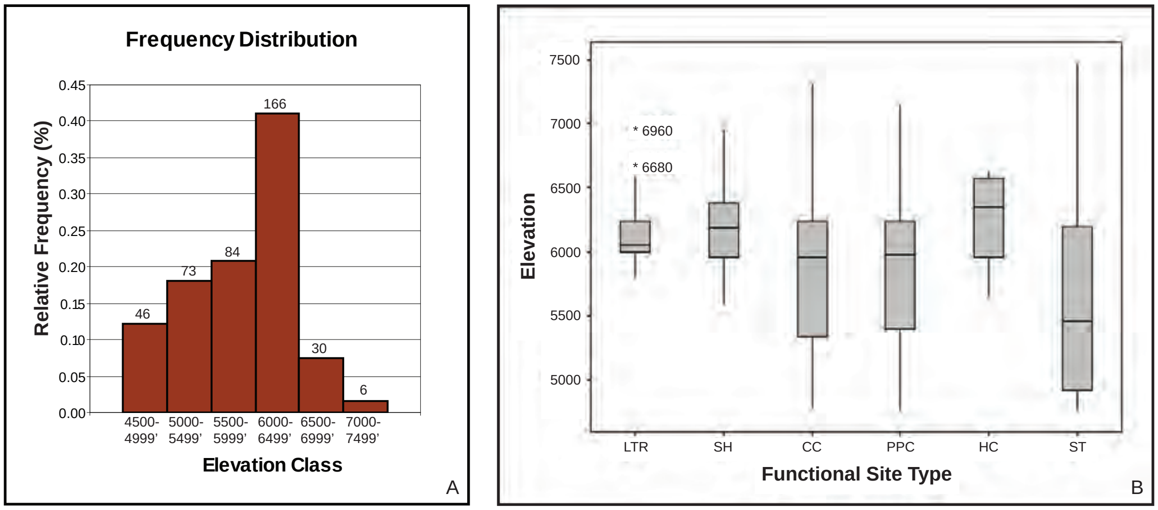

Figure 7.2. A) Frequency distribution of the 405 Fremont sites included in this study illustrating the relative percentage and total number of sites found within 500 ft. elevation classes. B) Box plot showing the elevation range for all the sites in the study divided into functional site types.

the inter-quartile range, of the data points, where the upper (Q3) and lower (Q1) edges (hinges) represent the 75th and 25th percentiles respectively. The line in the middle of the box indicates the median value of the data. In boxes where the median line is not equidistant from the hinges, then the site data are skewed toward one end of the elevation range. The ends of the vertical lines or "whiskers" indicate the minimum and maximum data values, unless outliers are present, in which case the whiskers extend to a maximum of 1.5 times the inter-quartile range. Points outside the ends of the whiskers are outliers. Summary data values for the boxplots are provided in Table 7.1. In this data set, all the data points for each functional site type fall within the range of the minimum and maximum elevation values (i.e., within the range defined as less than or equal to 1.5 times the inter-quartile range) except for two long-term residential sites. The elevation details for each functional site type are briefly described below and are more fully illustrated in Figures 7.3 (site distribution graph) and Table 7.2 (stem-and-leaf plots).

Table 7.1. Summary of Boxplot Values: Functional Site Type by Elevation.

	Long-term Residence	Seasonal Habitation	Complex Camp	Plant Processing Camp	Hunting Camp	Storage
Number of Sites by Type	27	33	138	127	6	74
Mean Elevation	6142	6155	5820	5859	6268	5612
Median Elevation	6060	6190	5960	5980	6350	5460
High Whisker	6600	6960	7320	7160	6640	7480
Q3 Hinge	6240	6380	6240	6240	6580	6200
Inter-Quartile Range	240	420	905	840	617	1280
Q1 Hinge	6000	5960	5335	5400	5963	4920
Low Whisker	5800	5580	4780	4760	5640	4760
Outlier Elevation(s)	6680					
	6960					

Long-term Residence

Twenty-seven sites are categorized as long-term residences. Twenty-five of the sites lie at elevations between 5,800 and 6,600 feet, with two outlier sites (6,680, and 6,960 feet). The lowest site elevation is 5,800 feet the highest is 6,960 feet, mean elevation of all long-term residences is 6,142 feet, and the median equals 6,060 feet, suggesting that the majority of the sites falling into this classification are found at the lower end of the statistically expected elevation range. In fact, 16 of the 27 sites identified as long-term residences are found at or below 6,060 feet. Fifteen (56 percent) of the sites lie within the inter-quartile range of 6,000 to 6,240 feet.

Seasonal Habitation

Thirty-three sites have been classified as seasonal habitations. All but two lie at elevations between 5,500 and 6,500 feet; the remaining two sites are located at elevations

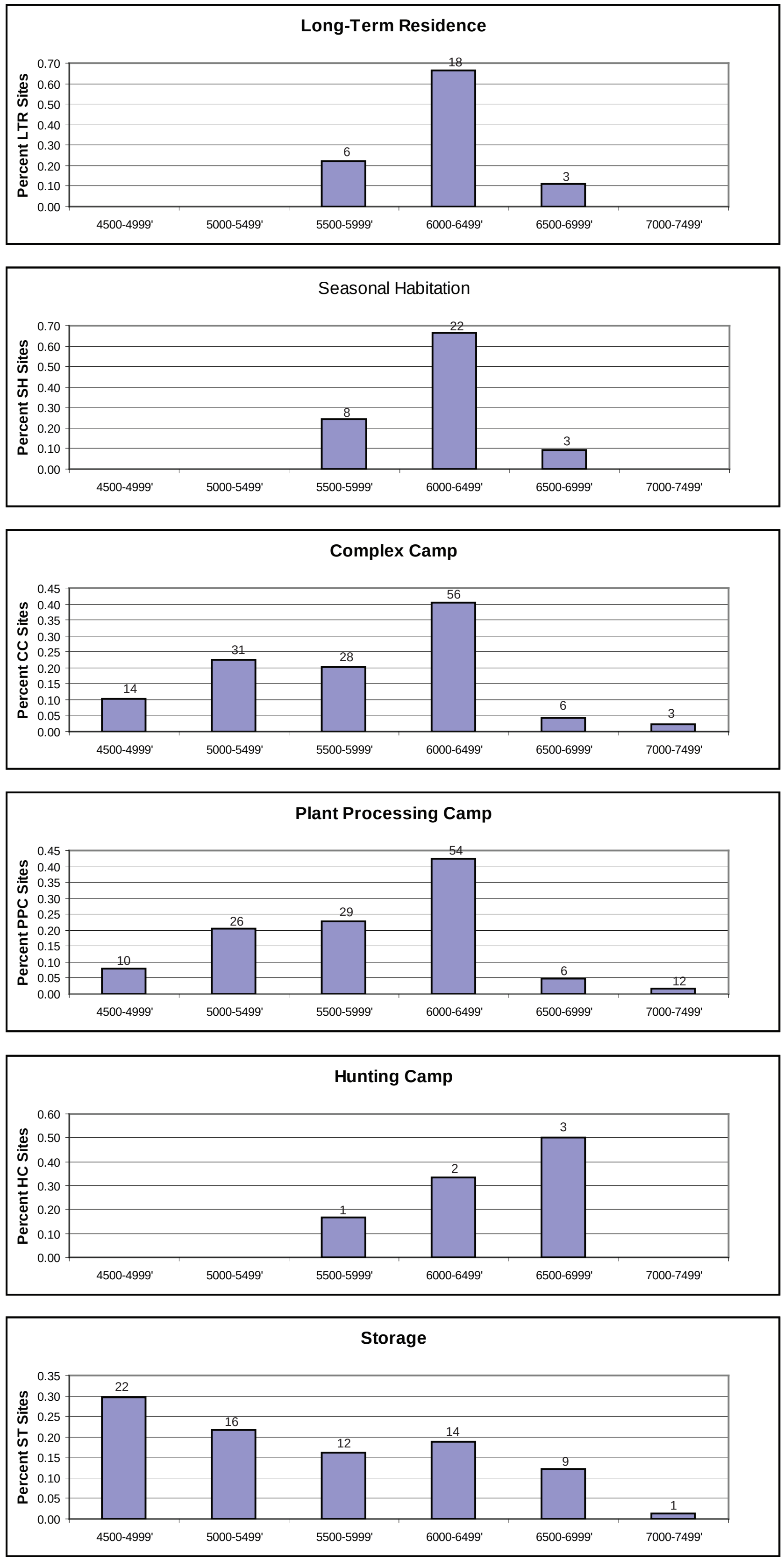

Figure 7.3. Site distribution graphs of all functional site types across 500 foot elevation intervals.

Table 7.2. Stem-and-Leaf Plots of Elevation for Each Functional Site Type.

Stem	Long Term Residence N = 27	Seasonal Habitation N = 33	Complex Camp N = 138	Plant Processing Camp N = 127	Hunting Camp N = 6	Storage N = 74
47			8	6		6889
48			012444568	0268		00000018
49			2456	26889		0222222667
50			00011	00		
51			00268	245		0
52			002	0024558		0045
53			000222245666	00234566		2668
54			00048	000588		0002448
55		8	8	0225		22
56		0	08	48	4	00000268
57		247	2446666	2222268		2
58	44	08	000444	034678		
59	368	2	224666666679	0022225688		4
60	000001466	00124	00000022224456889	0012344458888	7	1
61	22366	2269	0002469	2666668		0568
62	4	0001148	0022244445677888	000000234444446678888	0	0468
63	08	6	012345669	023456666		002
64	4	00448	0024458	00488		0
65		0		2	06	3
66	08		004458	008	4	
67				46		224568
68						0
69	6	26				2
70			0	0		
71				6		
72						
73			02			
74						8

just above 6,900 feet. The lowest site elevation is 5,580 feet, the highest is 6,960 feet, mean elevation of all the seasonal habitations is 6,155 feet, and the median equals 6,190 feet. Seventeen sites lie within the 420 foot inter-quartile value and fall fairly equally across that elevation range.

Complex Camp

The largest group of functional site type identified during the study is the complex camp. This data set consists of 138 sites, which range in elevation from 4,780 to 7,320 feet. Forty-five are located below 5,500 feet. Only nine complex camps were located at elevations above 6,500 feet. The mean falls at 5,820 feet, and the median at 5,960 feet, suggesting that complex camps tend to be located toward the upper-middle to higher elevations within the total elevation range. A dense concentration of sites (81) is found between 5,700 and 6,480 feet. A smaller site cluster includes 45 sites found at elevations between 4,800 and 5,480 feet.

Plant Processing Camp

One hundred twenty-seven plant processing camps are located at elevations between 4,760 and 7,160 feet. The mean elevation in the data set is 5,859 feet. The median is found at 5,980 feet, an indication that, similar to complex camps, a higher percentage of plant processing camps are located within the upper-middle to higher elevations. Seventy-seven sites were identified in an elevation concentration between 5,700 and 6,500 feet. Two smaller cluster groups were identified between 4,700 and 5,000 feet (12 sites) and 5,100 and 5,680 (30 sites).

Hunting Camp

Only six sites could be classified as related solely to hunting. Site elevations ranged from 5,640 to 6,640 feet with mean and median elevations of 6,268 and 6,350, respectively.

Storage

Seventy-four sites were identified as primarily storage or cache sites. In terms of elevation, these sites were documented as low as 4,760 feet and as high as 7,480 feet. Storage site concentrations were noted between 4,760 and 5,000 feet (22 sites) and between 5,200 and 5,680 feet (25 sites). Mean elevation equals 5,612 feet while the median equal 5,460 feet, indicating that storage sites tend to be found more in the mid-to-lower part of the elevation range. The lowest and highest site elevations across the entire data set were recorded at storage sites.

Distance-to-water

Boxplot comparisons of each functional site type by distance-to-water are illustrated in Figure 7.4, with statistical data for the boxplots provided in Table 7.3. Two-hundred sixty-three (263), or 65 percent, of the sites analyzed in this study are located less than 1000 meters from streams or rivers providing modern sources of permanent water (Table 7.4). An additional 120 sites (30 percent) are sited between 1000 and 4000 meters from the permanent sources (Table 7.4, Figure 7.5), but are generally located near large washes carrying seasonal rainfall and snowmelt from the higher plateau areas down into the Escalante Valley. Of the remaining 21 sites, one is a seasonal habitation located near the southern end of Alvey Wash and 15 are complex or plant processing camps (5 and 10, respectively) located in the south and western sections of the Escalante Valley, the western ridge lands between the valley and the Straight Cliffs, and on the Kaiparowits Plateau. (It is possible that small springs or seeps are associated with these sites.) Four of the locations are storage sites, and one is a hunting camp.

Of the 263 sites located within 1000 meters of permanent water, 15 are long-term

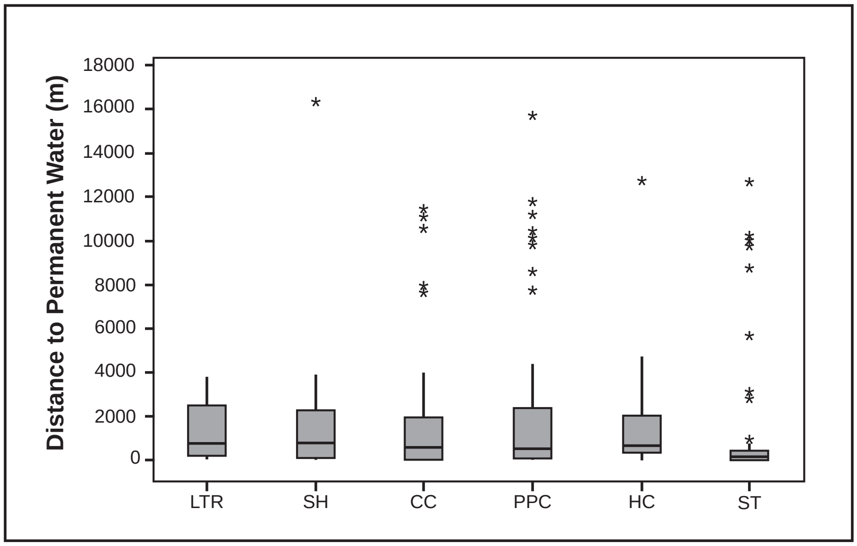

Figure 7.4. Boxplot illustrating the median, inter-quartile, quartile range, and outlier distances to perennial rivers or streams for each functional site type category in the study.

Table 7.3. Summary of Boxplot Values: Functional Site Type by Distance to Permanent Water.

	Long-term Residence	Seasonal Habitation	Complex Camp	Plant Processing Camp	Hunting Camp	Storage
Number of Sites by Type	27	33	138	127	6	74
Mean Distance-to-water	1394	1713	1387	1816	2839	984
Median Distance-to-water	818	810	609	604	774	180
High Whisker	3914	4032	4084	4483	4770	903
Q3 Hinge	2541	2277	2025	2431	2770	454
Inter-Quartile Range	2282	2115	1929	2298	2355	247
Q1 Hinge	259	162	96	133	415	107
Low Whisker	73	24	3	1	12	4
Outlier(s) Distance (m)		16429	7712	7826	12852	1007
			7909	8665		1022
			10650	9950		2940
			11287	9964		2950
			11456	10041		3071
				10128		5785
				10574		8837
				11304		9930
				11868		10243
				15220		12748

Table 7.4. Summary table: Distance-to-water and Percentage of Sites in Each 1000-meter Unit.

Distance (m)	No. Sites	Percent of Sites
0-1000	263	64.94%
1001-2000	41	10.12%
2001-3000	41	10.12%
3001-4000	32	7.90%
4001-5000	6	1.48%
5001-6000	1	0.25%
6001-7000	0	0.00%
7001-8000	3	0.74%
8001-9000	2	0.49%
9001-10000	3	0.74%
10001-11000	5	1.23%
11001-12000	4	0.99%
12001-13000	2	0.49%
13001-14000	0	0.00%
14001-15000	0	0.00%
15001-16000	1	0.25%
16001-17000	1	0.25%
Total	405	100.00%

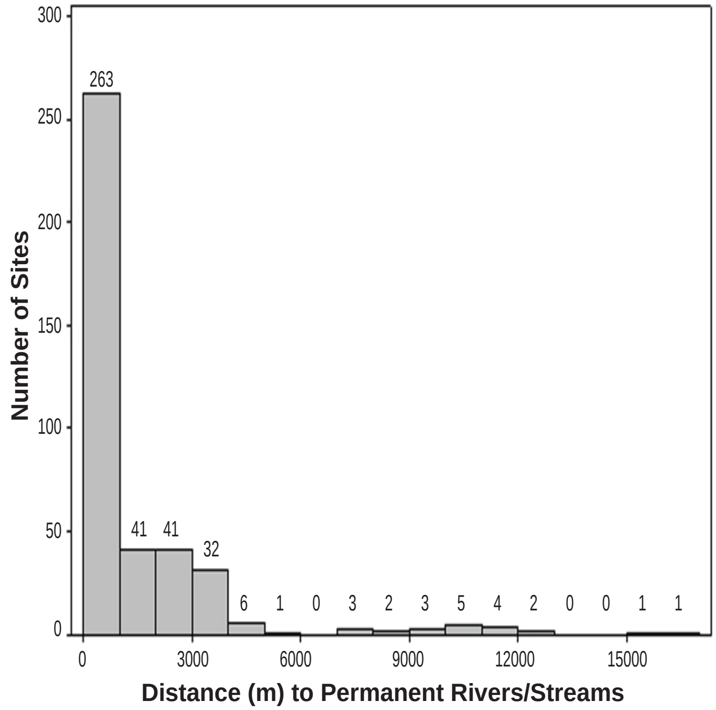

Figure 7.5. Histogram plot showing distance to the closest modern permanent water source from each site in 1000 meter units.

residences, 19 are seasonal habitations, 86 are complex camps, 75 are plant processing camps, 4 are hunting camps, and 64 are storage sites (Figure 7.6). This figure also illustrates the distance to modern perennial water in 1000 meter increments broken down by functional site type for the remaining 141 sites in the study area.

Primary Landform

Figure 7.7A displays the relative frequency percentage and total identified site count for each of the four landform designations used in the study. The 185 sites located in canyons represent 45.7 percent of all the study sites. Sites located on ridges comprise 4.7 percent of the data set, while mesa and valley sites make up 24.7 percent and 24.9

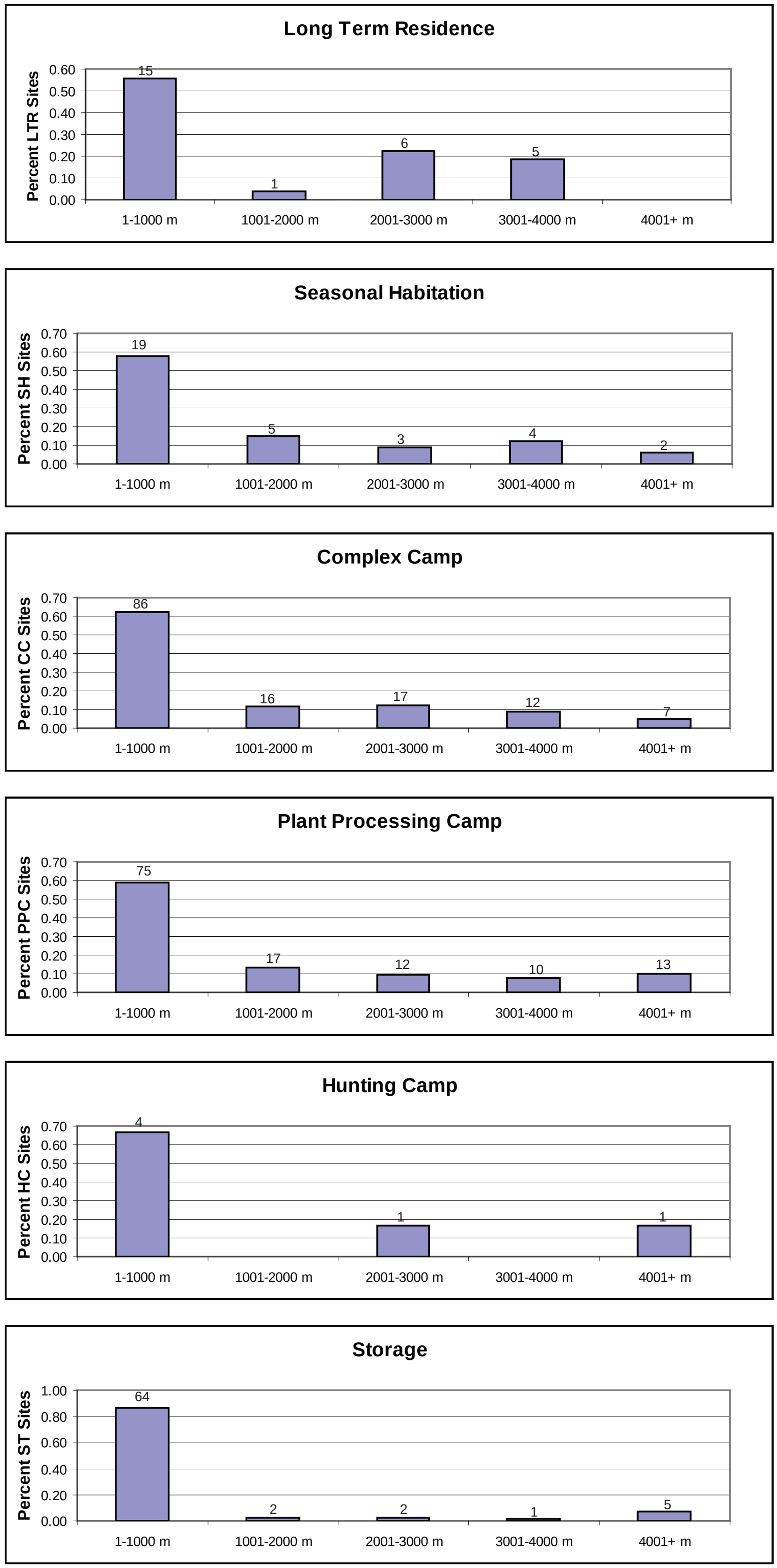

Figure 7.6. Bar chart breakdown of all functional site types in relation to site distance from perennial water (1000 meter units).

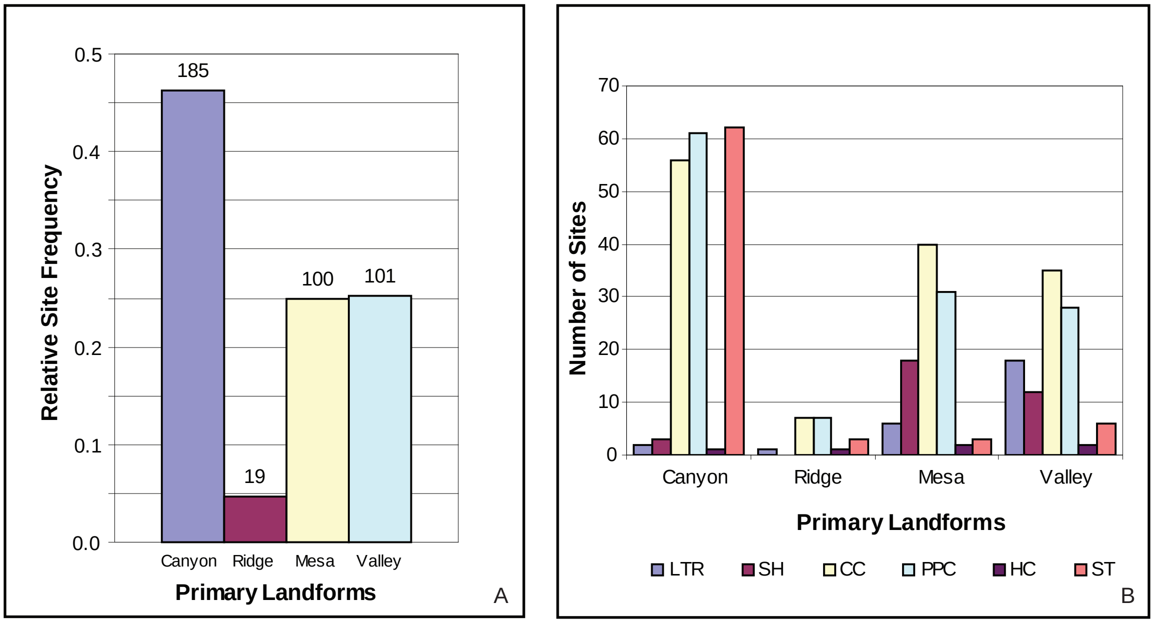

Figure 7.7. A) Frequency distribution of the 405 sites analyzed in this study illustrating the relative percentage and total number of sites found on the four defined landforms in the study area. B) Distribution graph of the functional site types identified on each of the four primary landforms.

percent, respectively. A breakdown of the observed numbers for each functional site type across each landform is shown in Figure 7.7B. In the most general terms, the graph shows that all functional site types were identified in all primary landform settings, with one single exception. No seasonal habitations were recorded on ridge locations.

Of the 27 long-term residence sites, one is located in a canyon setting, one is on a ridge, six are on the mesa, and 19 are found in the valley. The 33 seasonal habitation sites are found in the canyon (N = 7), on the mesa (N = 15) and in the valley (N = 11). Complex camps are found most often in the canyon (N=56), occasionally on ridges (N = 7), and regularly on the mesa and in valley locations (N = 41 and 34, respectively). Similarly, plant processing camps are also most common in canyon situations (N = 62) while only seven sites were found on ridges. These processing camps also appear equally on the mesa (N = 29) and in the valley (N = 29). Of the six identified hunting camps, one is located in a canyon, on one a ridge, two are on the mesa, and two are in the valley. Storage site locations are heavily weighted towards canyon locations. Of the 78 total storage sites identified, 58 are in a canyon, three were found on a ridge, seven on a mesa, and six in a valley setting.

STATISTICAL ANALYSIS

Understanding of prehistoric use of this region can be greatly enhanced if these archaeological observations can be used to test theoretical explanations of site distribution in the area by recognizing the spatial and temporal patterns in the archaeological record related to variations in the local or regional environment. As connections between the static archaeological record and environmental variables are identified, settlement analysis will aid in interpreting the data obtained from the study inventories.

Elevation

The boxplots shown in the general elevation data description (Figure 7.2B) illustrate the median, inter-quartile, and elevation spread for each functional site type. They demonstrate that all six functional site types are present between 5,500 and 7,000 feet, with complex camps, plant processing camps, and storage sites identified over the greatest spread in elevation. However, at this level of analysis, it is not possible to tease out the details in site patterning necessary to evaluate the data in relation to the McFadden settlement model.

As previously noted, the McFadden model for Fremont settlement does not describe the criteria used to distinguish 'upland' zones, where he suggests that permanent residential sites are located, from the 'lowlands,' his proposed setting for temporary, seasonal-use sites. Barring further clarification of these categories, site elevation stands as the only criteria used by McFadden to divide the upland from the lowland, and which he (McFadden 1998) has arbitrarily placed at 7,000 feet. In this study, only six of the 405 sites lie at 7,000 feet or above making it a meaningless, or at least not very useful, division point.

In an attempt to see patterning in the elevation data, I follow Wright (2001), applying the same elevation zone criteria to this research as that used in her settlement study of the Circle Cliffs. Modifying the settlement model proposed by Geib (1996) for the Glen Canyon Project, Wright defined three elevation zones consisting of lowlands (4,500 to 5,500 feet), midlands (5,500 to 6,500 feet), and highlands/uplands (above 6,500 feet). Table 7.5 summarizes the characteristics of each of these zones in the Escalante drainage in terms of topography, vegetation, and significance to human occupation (adapted from Wright 2001).

Figure 7.8 illustrates the functional site type distributions across each of the lowland, midland, and upland elevation zones described above. Twenty-nine percent of the total study sites (N=119) were recorded in the lowland range. Site types in this range are complex camps (45), plant processing camps (36), and storage (38). Sixty-two percent (N=250) of the sites, consisting of all site type categories (previously noted), fall within the midland zone. In this elevation range are long-term residences (24), seasonal habitations (30), complex camps (84), plant processing camps (83), hunting camps (3), and storage sites (26). The remaining nine percent of the sites in the data set (N = 36) lie between 6,500 and 7,499 feet. Again, all six functional site types were identified within this upland elevation zone (Figure 7.8) and are categorized as long-term residences (3), seasonal habitations (3), complex camps (9), plant processing camps (8), hunting camps (3), and storage (10). Initial viewing of the data as arranged into the three zones seems

Table 7.5. Summary of Geomorphic Characteristics and Significance to Human Occupation: Three Elevation Zones (Adapted from Wright 2001).

Elevation Zone	General Topography and Vegetation	Significance to Human Occupation
Lowlands (4,500-5,499 feet)	*Low, steep-walled canyons cut by intermittent streams/drainages. *Riparian vegetation and defined micro-environments in canyon bottoms. *Shadscale vegetation on benches.	*Drainage cuts provide water *Alcove shelter *Diverse floral/faunal resources, particularly bulbs/small mammals. *Some availability of agricultural soils. *Low elevation range for dry farming during Formative period = 5,249 feet (Schwinning et al. 2008).
Midlands (5,500-6,499 feet)	*Escalante Valley, dry benches, mesas, plateaus. *Bedrock sandstone formations. *Alluvial and aeolian soils with high permeability and water retention suitable for agriculture *High slope variability at valley edges (2 to 60%) *Pinyon-juniper woodlands, sagebrush, and grassland communities.	*Sufficient precipitation and number of frost-free days allows dry-farming. *Abundance of floral (e.g. ricegrass, prickly pear, juniper, etc.) and faunal (small and large mammal, reptile, avian) resources. *Small seeps and springs provide local sources of permanent water *Large wash-drainages provide seasonal water *Permanent rivers and streams of the Escalante River drainage system
Uplands (6,500+ feet)	*Bands of highly variable vegetation communities *Ponderosa Pine, Douglas Fir, Spruce, and Aspen above 9,000 feet. *Annual grasses and shrubs in alpine meadows. *Small lakes and streams on the high plateaus.	*Greater diversity of faunal resources, particularly large mammals and migratory waterfowl. *Higher precipitation, lower temperatures, fewer frost-free days. *Dry-farm agriculture difficult above 7,546 feet during Formative period (Schwinning et al. 2008).

mainly to suggest that the Fremont utilized the lowland zone as defined here purely for logistical purposes, but the mid- and upland zones were exploited at all levels for a variety of functions. Overall, sites tend to concentrate within the midland zone with the exception of storage sites, which seem to decrease in numbers as elevations rise.

The division of functional site types by elevation into lowland, midland, and upland zones illustrates one trend in site distribution – the lowlands (elevation less than 5,500 feet) were utilized for logistical purposes (i.e., complex camps reflecting plant

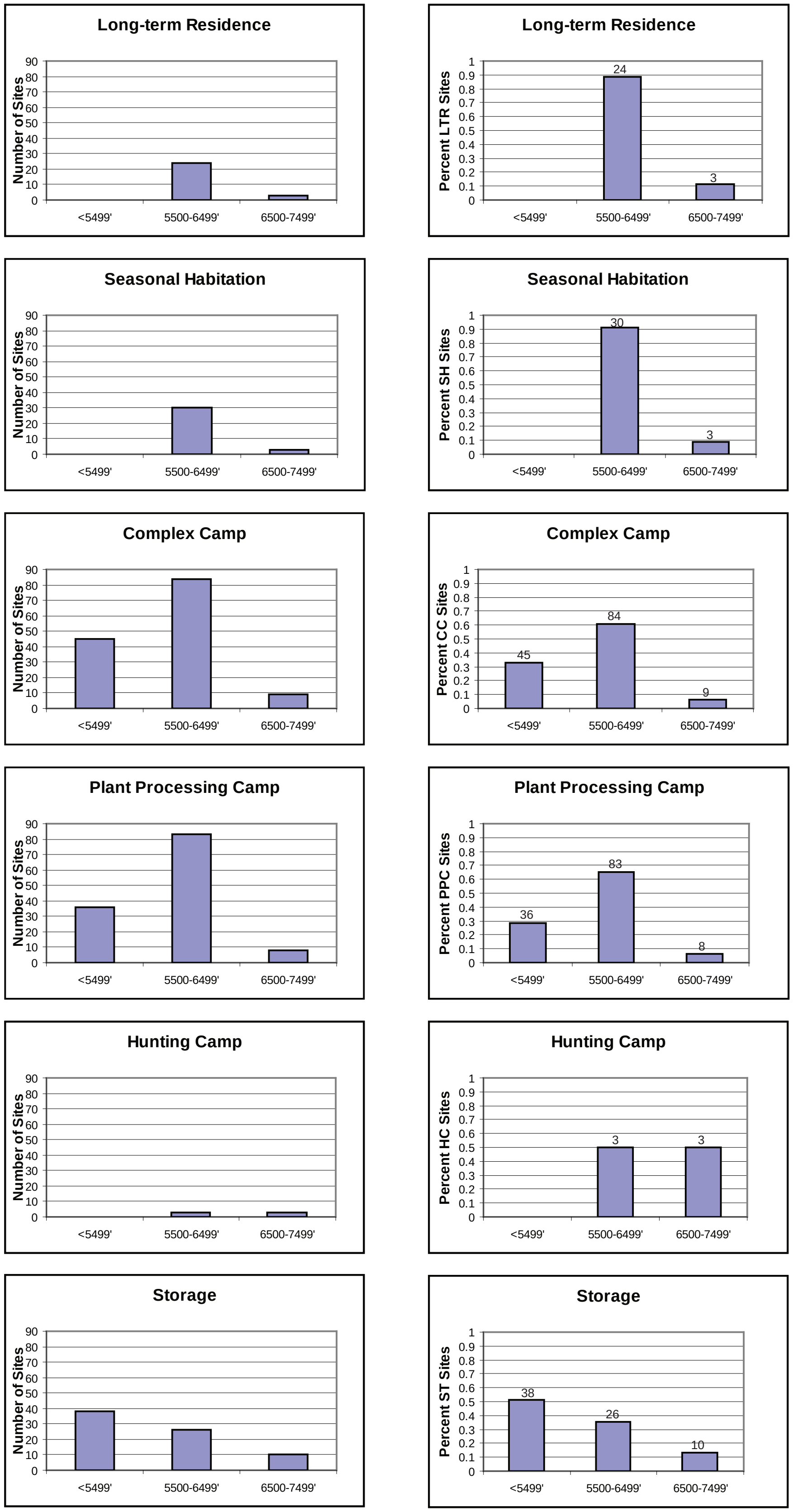

Figure 7.8. Bar charts illustrating the distribution of each functional site type by number and percent of site type as found in the lowland, midland, and upland elevation zones.

processing and hunting activities, plant processing camps, and storage) (Appendix C1) as hypothesized by McFadden (1998, 2000). However, the analysis also reveals high logistical-use site counts in the midland zone between 5,500 and 6,500 feet (Appendix C2), and these sites also make up 75 percent of the sites in the upland zone at elevations greater than 6,500 feet (Appendix C3). The presence of long-term residential, seasonal habitation, and hunting camp sites in both the midland and upland zones also complicates the analysis. In short, breaking the site data into these three elevation zones shows only that the majority of sites are concentrated within the midland zone, all site types are located in the mid- and upland zones, and, as previously mentioned, the lowland zone appears to have been used extensively for logistical purposes (Figure 7.8, Appendices C1-C3). At least at this level of analysis, an elevation-based model does not seem useful.

In order to evaluate the elevation-based model in more detail, the data was analyzed using 200 foot elevation units. Figures 7.9 A-F illustrate the break down of functional site type data by elevation into these smaller units. Similar to the more generalized data portrayed in Figure 7.8, these bar graphs illustrate tendencies toward certain elevations for each site type in greater detail. For example, long-term residence sites are located mostly between 5,800 feet and 6,399 feet, peaking in the range between 6,000 to 6,199 feet (Figure 7.9A). Figure 7.9B shows that most of the seasonal habitation sites are found between 5,800 and 6,800 feet, with the largest number located between 6,200 and 6,399 feet. No long-term residential or seasonal habitation sites were identified below the elevation of 5,400 feet.

As previously noted, complex and plant processing camp sites are spread over a much wider elevation range than the residential and seasonal habitation sites. Both types of camps are quite common between 4,800 feet and 5,400 feet. Site counts "slump" between 5,400 and 5,799 feet, rise quickly to peak between 6,200 and 6,399

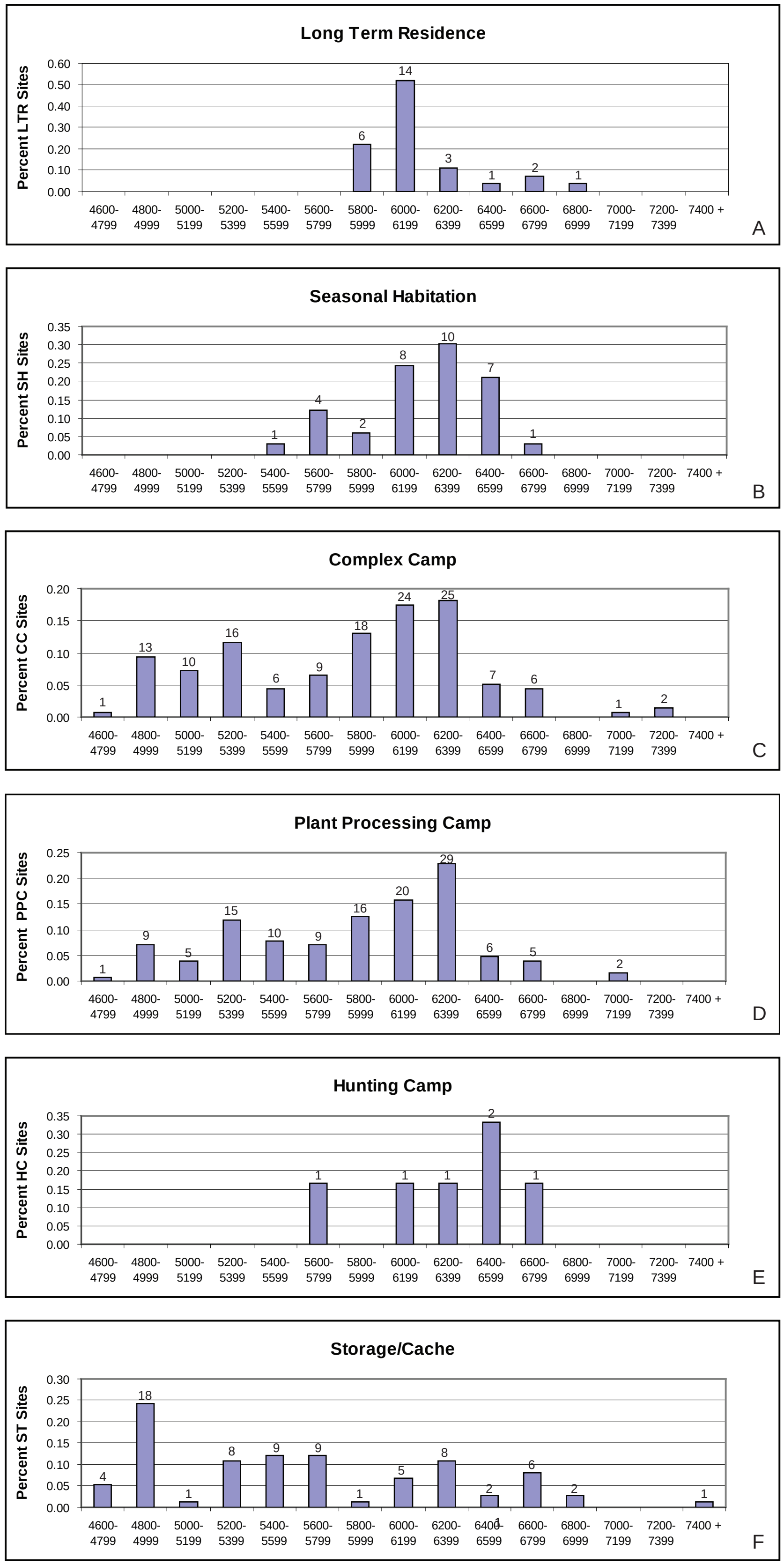

Figure 7.9. Breakdown of elevation data by functional site type per 200 foot elevation unit.

feet, and then drop steeply between 6,400 and 6,599 feet (Figures 7.9C and D). Figure 7.9E reveals the limited elevation range in which hunting sites were identified, and also clearly demonstrates the under-representation of sole-function hunting camps within the entire data set. Finally, Figure 7.9F exhibits a spike in the quantity of storage sites between 4,600 and 5,299 feet, with a somewhat "smoother" undulating pattern of rising and falling site numbers as elevation rises. Visually, these charts suggest that there are significant differences in site elevation patterning between at least some of the site types. However, these differences could easily be related to differences in the total number of sites by type across the complete data set.

Mann-Whitney (2-Sample Rank) Test

Nonparametric statistical tests are designed for ordinal or nominal data and are used to evaluate hypotheses that do not require normal distribution or variance assumptions about the populations from which the data were taken. The main weakness of nonparametric tests is that they are less powerful than parametric tests and are less likely to reject the null hypothesis – the statistical hypothesis that states there are no differences between observed and expected data – when it is false.

The Mann-Whitney test is a nonparametric test that makes comparisons between two unpaired groups to determine if a difference exists between them. The test uses the "confidence interval" between sample medians to estimate corresponding differences between two unknown population medians which tends to equalize the data relationships by removing differences caused by large versus small sample numbers. The confidence interval consists of a random range of possible values for the differences in the population medians based on sample data.

Key assumptions of the Mann-Whitney test are that the data are independent random samples from two populations, and their data scale is continuous or ordinal. Unlike parametric tests, however, the Mann-Whitney test makes no assumptions about the distribution of the data (e.g., normality). This means that the analysis is testing the equality of the central tendency of the populations.

The first step in conducting the test is to rank all the values in the data set from low to high, with no concern in regard to which group each value belongs. (If two values are the same, then they are both assigned the average of the two ranks for which they tie.) The smallest value gets a rank of 1, while the largest value is given a rank of "N," where "N" is the total number of values in the two groups. The ranks in each group are then totaled and the sums compared to each other. The test then generates a significance probability value (p-value) based upon differences in the data rank sums. If the sums of the ranks are very different, the p-value will be small. Although there is no magic number which determines significance, this value is generally considered to be significant if it is below the alpha risk value of 5 percent – or the p-value is less than or equal to 0.05 (see Shennan 1997:65-68) – and is used to answer the following question: "If the populations really have the same median, what is the chance that random sampling would result in a sum of ranks as far apart (or more so) as observed in this experiment?" (Motulsky 1999:57). If the p-value is large, the data do not provide strong evidence that the population median values differ between the two independent groups. A small p-value indicates that differences in the samples are probably not due to sampling error, and the populations actually have different medians.

The Mann-Whitney test was conducted on the elevation data using Minitab 15 statistical software. Applying an alpha-value of 0.05 to determine the significance of calcuated results, the data categories of site type to elevation median were compared. Several tests between sets of two groups were conducted. The initial test evaluated whether there was a statistically significant difference when elevation data for long-term residences were compared to elevations for seasonal or short-term habitation sites using the test alternative of "greater than." This alternative meets the settlement pattern model as hypothesized by McFadden. Calculation of the median values for long-term residence sites (6,040 feet) versus seasonal habitation sites (6,200 feet) immediately contradicted the hypothesis, and when the test analyzed the data using the "greater than" alternative, the Minitab Mann-Whitney program failed and could not calulate a p-value+. A second test evaluated the same data groups, but defined the test alternative as long-term residential site elevations being "less than" seasonal habitation site elevations. In this case, the test did calculate a p-value of 0.1544, meaning that with this test alternative there is a difference in the median value between the long-term residence and seasonal habitation sites, but it is not statistically significant.

The Mann-Whitney test was then conducted over the entire data set to evaluate whether any statistical differences between functional site type groups and elevations could be identified. The calculated p-values for each test are summarized in Table 7.6. Statistically significant values are noted in red.

The results across all the functional site type groups show no statistical difference in terms of elevation medians between sites identified as long-term residence, seasonal habitation, or hunting camp. Although the low number of hunting sites identified within the data set tends to weaken the validity of the test and results for the hunting camp group, the test results still reveal a significant trend within the data set as a whole. Complex camp and plant processing camp median elevations (5,860 and 5,980 feet, respectively) are significantly lower than those of long-term residence and seasonal habitation site groups, and statistically, storage sites are different from all other functional type classes. Inferences from these results are discussed more fully in the next chapter.

Table 7.6. Summary of Results for Mann-Whitney Statistical Test: Elevation

Mann-Whitney Non-Parametric Test: Elevation Test Alternative: "not equal to" Calculated p-value (significant at <0.05)						
Site Type	Long-term Residence	Seasonal Habitation	Complex Camp	Plant Processing Camp	Hunting Camp	Storage
Long-term Residence	n/a	0.309	0.026	0.047	0.183	0.001
Seasonal Habitation		n/a	0.004	0.005	0.267	0.001
Complex Camp			n/a	0.840	0.038	0.032
Plant Processing Camp				n/a	0.011	0.018
Hunting Camp					n/a	0.038
Storage						n/a

Distance to Permanent Water

The distribution graph (Figure 7.6) revealed that 64.9 percent (N=263) of all the sites plot to within 1000 meters of a river or stream with perennial water. The boxplots in Figure 7.4 confirm that the distances to permanent water fall within very close ranges for each of the site type categories, with only 27 total sites (6.67 percent) plotting as outliers. Figure 7.10 separates the site type counts located within the first 1km distance into 250 meter units in order to further illustrate any patterns between site locations and distance-to-water. This graph shows that of the 263 total sites located less than 1000 meters from permanent water, 60.1 percent (N=158) are located less than 250 meters from a perennial river or stream. Each of the other 250 meter units contain site counts approximately equal to those found in each of the 1000 meter distance units outside the 1 km site breakout.

Within the first 500 meters, and particularly within the first 250 meters, site types are heavily dominated by complex camps, plant processing camps, and storage sites (see Figure 7.10 for relative percentages and site counts, Appendix D1). Complex and plant processing camps dominate the site counts within each of the other distance units, but are

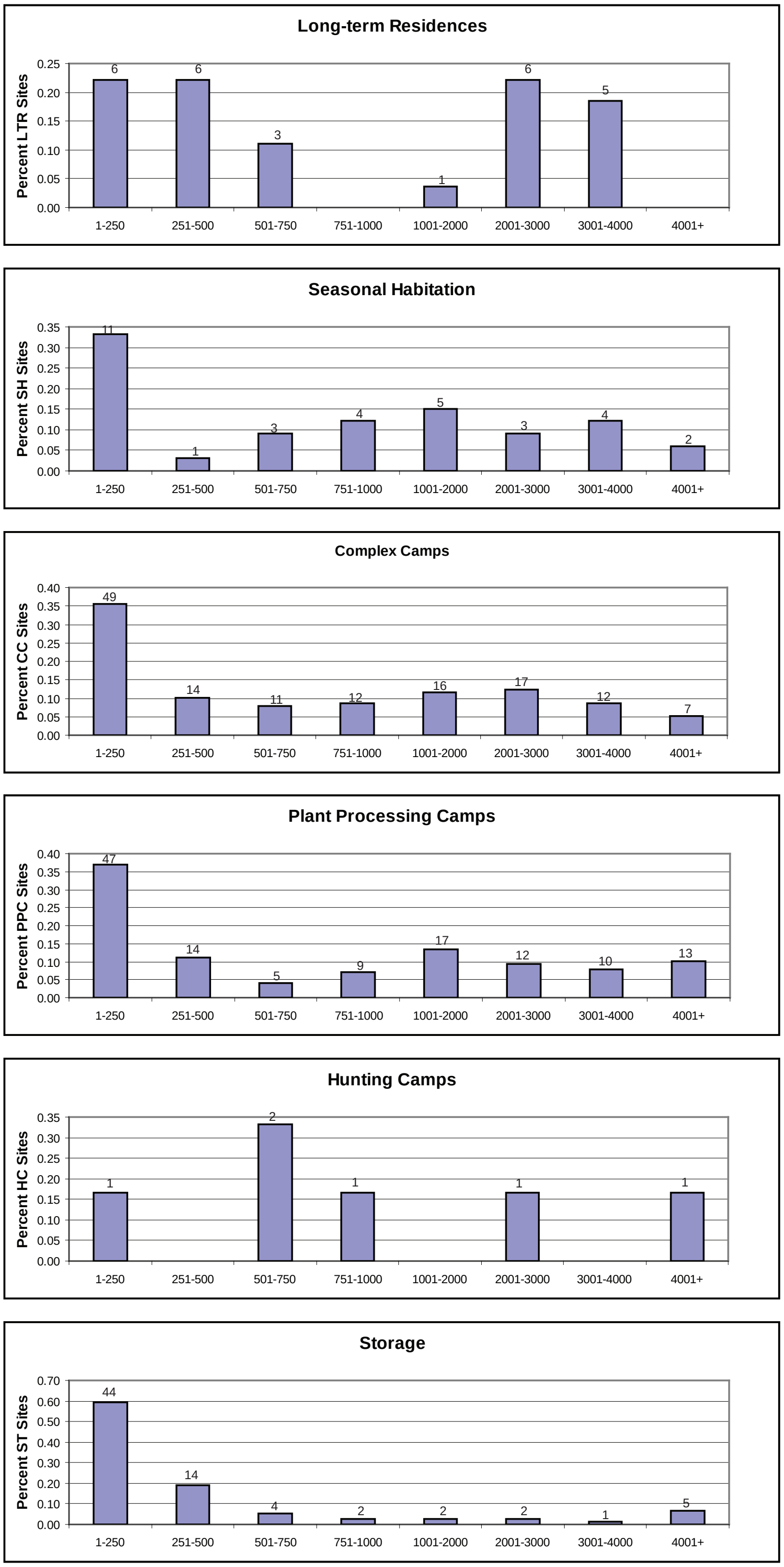

Figure 7.10. Distribution graphs showing the distance from sites to permanent rivers/streams by site type percent. The 263 sites which plot within within a distance of 1000 meters or less from a permanent water source are broken out into 250 meter increments in order to better illustrate the distance relationships between these sites and the nearest known perennial rivers and streams.

reflective of the overall high number of these site types over the other types within the data set. Most long-term residence sites are located less than 750 meters from a river or stream (Figure 7.10, Appendix D2), but several of these site types are found at distances between 1000 and 4000 meters (Figure 7.10, Appendix D3). (It is probable that during the Formative period, perennial springs or other permanent water sources were located at much closer distances to these sites than the modern distance to permanent water.) Seasonal habitation sites were found in every distance unit in approximately equal numbers, with the exceptions of having high counts at distances less than 250 meters, and low counts between 250-500 meters and at distances greater than 4000 meters.

Figures 7.11A-F are a set of line graphs comparing the distance to permanent water by functional site type, similar to Figure 7.9. Figure 7.11 substantiates the patterns noted in Figure 7.10, but they are similar enough that it is difficult to define any differences between the site types except for the high counts at close distance for the camp and storage sites as noted above.

Mann-Whitney (2-Sample Rank) Test

A Mann-Whitney test was also conducted on the data compiled for distance to permanent water. Summary results are shown in Table 7.7.

Results of the Mann-Whitney test reveal that although the site counts are much higher for complex and plant processing camps than all the other functional types except storage sites, there is no statistical difference in terms of distance to permanent water between any of the sites by category – except for storage. Storage sites are found at statistically significant shorter distances to water than all other site categories except hunting camps. As with the elevation test data, results for hunting camp data are not as strong as for the other type categories due to the limited number of sole-function hunting camp sites, but

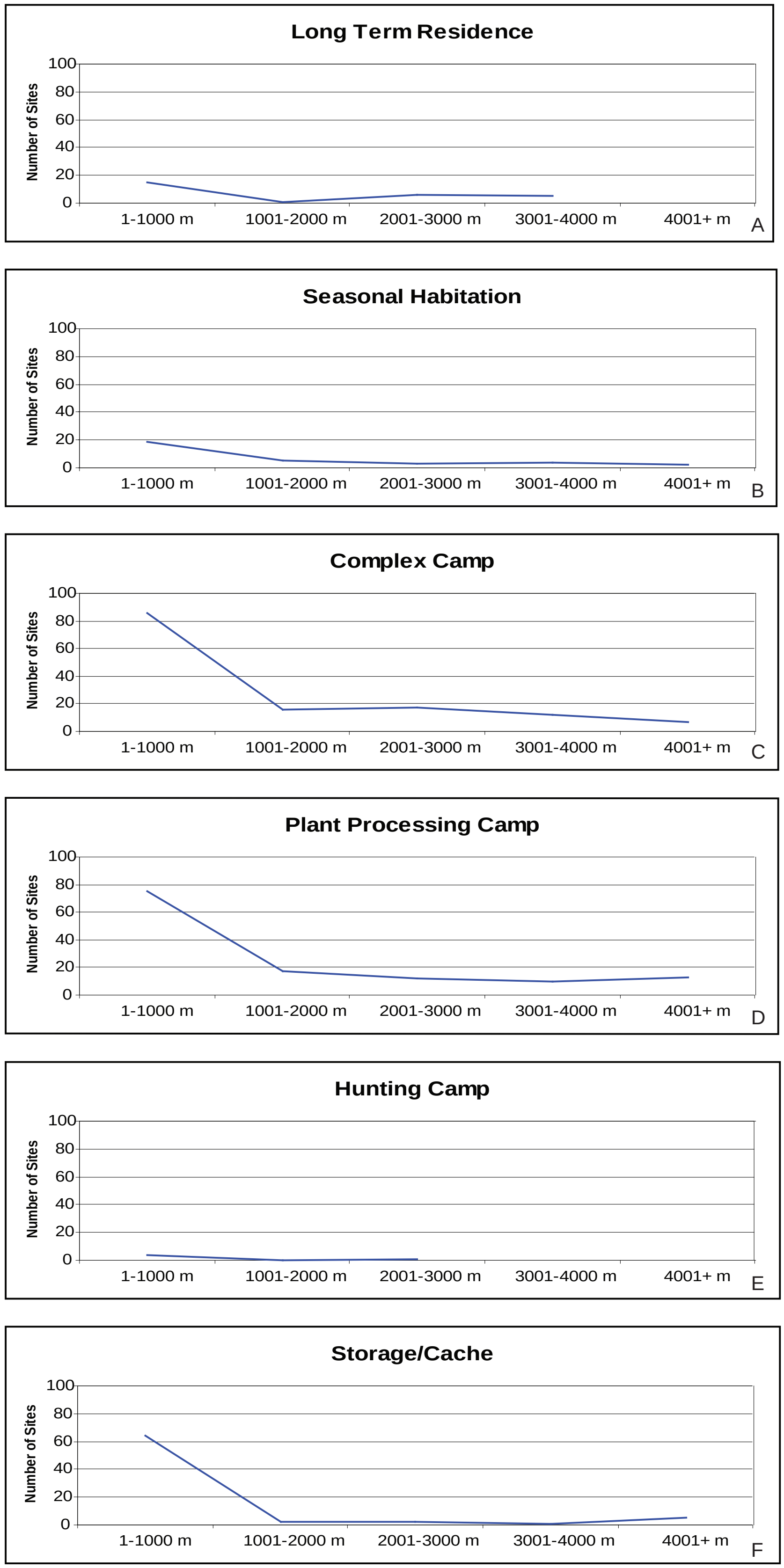

Figure 7.11. Breakdown of distance to permanent water data by functional site type in 1000-meter units.

Table 7.7. Summary of Results for Mann-Whitney Statistical Test: Distance to Permanent Water

Mann-Whitney Non-Parametric Test: Distance to Permanent Water Test Alternative: "not equal to" Calculated p-value (significant at <0.05)						
Site Type	Long-term Residence	Seasonal Habitation	Complex Camp	Plant Processing Camp	Hunting Camp	Storage
Long-term Residence	n/a	0.613	0.294	0.488	0.944	0.002
Seasonal Habitation		n/a	0.507	0.791	0.923	0.004
Complex Camp			n/a	0.482	0.649	0.003
Plant Processing Camp				n/a	0.684	0.001
Hunting Camp					n/a	0.056
Storage						n/a

there is an evident trend showing that the median of the few hunting camps in the data set is statistically no different from the median distance to water for the the storage sites. The boxplot showing the tight limits in the distance-to-water plot and a median distance of only 180 meters for storage sites (Figure 7.4, Table 7.3) clearly illustrate the difference in storage site patterning as well. Implications of this analysis are discussed further in the next chapter.

Primary Landform

Since the data assignment of primary landform for each recorded site is qualitative and nominal, the statistical tools used for data analysis are different from those used in evaluating the quantitative categories of elevation and distance-to-water.

Pearson's Chi-Square Test and Correspondence Analysis

In order to further evaluate the relationship of site patterning between the functional site types and the four primary landforms identified in the study area, a Pearson's chi-square test and correspondence analysis were conducted. The chi-square test is the most important and most used member of the non-parametric family of statistical tests and the

Pearson's chi-square is by far the most common type of chi-square significance test. The purpose of the chi-square test is to determine whether the observed counts or frequencies in a data set are markedly different from the frequencies that would be expected by chance, to test the hypothesis of "no association" for columns and rows of tabular data. The test is useful when analyzing nominal data. The chi-square is more likely to establish significance when an association is strong, the sample size is large, and/or the number of values of the two associated variables is large. A chi-square probability of .05 or less is commonly (again, somewhat arbitrarily) interpreted as justification for rejecting the null hypothesis that the overall association between the row and column variables in a data table is random.

The chi-square test is conducted by first organizing the observed values into a contingency table with specified row and column categories. The chi-square test calculates a probability statistic (p-value), or number ranging between 0 and 1. It is computed by comparing observed (O) and expected (E) counts using the equation $(O-E)^2/E$, and represents the probability of incorrectly rejecting a null hypothesis when the hypothesis is actually true. The p-value is then derived by summing the contributions from each of the individual cells in the contingency table. Generally, a p-value less than or equal to 0.05 is considered to represent a significant difference between the observed and expected results. The smaller the p-value calculated from the test, the smaller the probability that rejecting the null hypothesis is a mistake (see Shennan 1997:104-125 for test procedures).

Every cell in the contingency table contributes a calculated quantity to the p-value. If the calculated result within a given cell differs markedly from the expected frequency, then the contribution of that cell to the overall chi-square calculation is large. Correspondingly, if a cell value is close to the expected frequency, then its contribution

Table 7.8. Summary Results of the Pearson's Chi-Square Analysis: Cell Contributions to the Chi-Square Statistic

Site Type	Canyon	Ridge	"Mesa"	Valley
Long Term Residence	10.531	0.039	0.060	22.586
Seasonal Habitation	4.438	1.489	5.865	0.966
Complex Camp	0.917	0.096	1.490	0.002
Plant Processing Camp	0.201	0.282	0.154	0.200
Storage	16.703	0.034	6.871	8.322

	Chi-Square Value		P-Value	
Pearson Chi-Square	**81.246**	DF = 12	p-value =	**0.000**

to the overall chi-square is low. A large calculated chi-square value indicates that somewhere in the data, an observed frequency differs markedly from the expected frequency.

In order to perform the chi-square test, the functional site type and associated primary landform data were cross tabulated using the Minitab statistical program to generate the contingency tables necessary to calculate the Pearson's chi-square value, degrees of freedom (DF), and p-value. When the analysis was conducted using all site type categories, it could not be completed due to the small number of hunting camp sites in the data set, requiring that those six sites be removed from the analysis. The test was successful when the hunting camp site data was removed.

The contingency table showing each cell's contribution to the chi-square calculation is provided in Table 7.8. (All contingency tables generated to produce the chi-square are provided in Appendix E1.) Each cell contribution is a reflection of the difference between the actual site count of each type in each landform, and the expected site count if sites were located randomly. Large cell values (in red) indicate that there is a large discrepancy between the observed and expected results for that particular site type/landform relationship, and these are the cells which are important in calculating a chi-square value. (Moderate discrepancies between observed and expected results are indicated in orange.) By extension, the large calculated chi-square value (81.246) suggests that there is a large discrepancy between the observed and expected results when the entire data set is considered, while the small p-value of 0.0000 indicates that the discrepancy is statistically significant. In other words, the probability that the values in the rows and columns in the table are independent of each other is very small. Thus, the results indicate that for the sites included in this study, there is a statistically significant relationship between at least some of the functional site types and their primary landform locations. The implications of these results will be discussed more fully in the next chapter.

Correspondence Analysis

Correspondence analyses pick up where the chi-square test stops. Correspondence analysis is a method of perceptual mapping, where categorical variables are displayed in a "property" or "graph" space which maps their association in two or more dimensions. This map is a graphical tool which aids in visualizing relationships.

Correspondence analysis is used as a special case of canonical correlation, where one set of categorical (rather than numerical variable) data is related to another set. The technique defines a measure of distance between any two points, where points are the values (categories) of the discrete variables. Since distance is a type of measure of association (correlation), a point distance matrix provides the input to determine which category values are close together, or have corresponding relationships. Correspondence analysis starts with tabular data, usually two-way cross-classifications, using variables which are discrete: nominal, ordinal, or continuous variables segmented into ranges. The correspondence table is the raw, cross-tabulation of two discrete variables; the object of correspondence analysis is to explain the variation, or intertia, in the raw data table. (The correspondence analysis table generated to analyze the possible relationships between functional site type location and primary landform is included as Appendix E2). Row and column profiles show the relative frequencies of the discrete variable represented by each category. The row variables, the functional site types in this case, are normally the variables to be explained, and the column variables, primary landforms, are the explanatory variables. Results of the correspondence analysis and its implications in terms of site distribution are presented in Chapter 8.

8 | Discussion

The objective of this thesis was to test the validity of the site distribution model proposed by McFadden (1998, 2000) for the Fremont in the upper Escalante River drainage. This chapter restates and assesses McFadden's model, discusses the results of the data analysis presented in the previous chapter, and interprets the data to develop further conclusions regarding Fremont site distribution and settlement patterning.

ASSESSMENT OF THE MODEL

As previously stated, McFadden argues that following the introduction of pottery to the Escalante drainage around A.D. 500, and with significant contribution of agriculture to diet, the Fremont subsistence strategy in the Escalante River drainage consisted of "seasonal movement between farming locations in the canyons and winter residential sites in the uplands that were near big game winter ranges" (McFadden 2000:153) to allow hunting of "migratory mule deer and (to) exploit an abundant source of firewood" (McFadden 1998:97). According to this subsistence model, site distributions should reflect the following pattern. Lowland elevation and canyon sites should appear as relatively low-investment seasonal habitations, complex camp sites, short-term residences, or concealed storage granaries which facilitated a mobile lifestyle by securing seed corn for future planting seasons and provided short-term storage during periods of absence. Upland sites should appear as high-investment, long-term residential structures, having complex architecture and on-site storage indicative of longer periods of occupation (McFadden 1998:97). His observations, recorded from multiple surveys, suggested "numerous pithouse sites ... with little or no evidence for on-site storage in the Escalante area, Wide Hollow, Cedar Pockets, Fiftymile Bench and Fiftymile Mountain. areas suggest(ing) that this pattern was a long-lived and wide-spread adaptation to the Escalante drainage and surrounding uplands (McFadden 1996b, 1998)" (McFadden 2000:153).

Unlike Geib's (1996) Glen Canyon settlement model, McFadden does not discuss transportation costs in relation to the gathering and consumption of lowland resources (the amount of energy expended in relation to that gained when obtaining specific resources [Trigger 1997]). In Glen Canyon, where lowland and highlands are defined, lowland areas could be accessed in a day or less from the highlands. This led Geib to see the feasibilty of people residing for short-term or seasonal periods at "lower elevations to benefit from the availability of specific resources, particularly early crop maturation" (Geib 1996:182) while maintaining permanent residence in the highlands (Geib 1996). Geib used the positive benefit of low transportation costs in comparison to energy gains as an explanation the subsistence model.

McFadden's hypothesis suggesting a site distribution of upland permanent residences with lowland temporary-use and logistical sites is similar to that proposed by Geib, with the the exception of a higher expectation of granaries and off-site storage in the Escalante River canyon. However, initial results suggest that Fremont settlement strategies were more varied than McFadden's model predicts.

ANALYTICAL RESULTS

Visual reference to the map showing all the identified Fremont sites identified (by excavation and through survey) in the study area (Figure 7.1) demonstrates that the

Fremont liberally utilized the Escalante Valley, the Escalante River canyon, its tributaries, and localized areas of the mesa tops (particularly the southeastern areas of Big Flat where pinyon and juniper are plentiful) in multiple ways. Results from the analyses conducted on the data collected for the 405 Fremont sites may be used to further illuminate aspects of Fremont subsistence and assist in clarifying patterns of site distribution in the upper Escalante drainage.

Elevation

In Chapter 7, the gross analysis of site types relative to defined elevation ranges similar to Geib (1996) and Wright (2001) revealed a trend toward logistical and short-term camp sites at the lowest elevation range as McFadden has proposed. However, the analysis also showed a complex, intermingling of site types in the midland and upland elevation zones, contradicting the model. As previously stated, the Mann-Whitney Non-Parametric analysis uses the confidence interval between sample medians to estimate corresponding differences between two unknown population medians to equalize the data relationships. The purpose of this analysis was to determine if any statistically significant differences exist between individual site types in terms of elevation. Calculated p-values express the significance of differences between population medians as a number between zero and 1. Results are considered to be signficant if they are less than 0.05, meaning there is less than a five percent probability that the differences in the data set are likely to have occurred by chance. The smaller the p-value, the more significant the result.

Table 7.6 summarized the results of the Mann-Whitney test in terms of evaluating the location of functional site types relative to elevation. The analysis indicated that there is no statistical difference between the site location elevations of long-term residences and seasonal habitations (p-value = 0.3088), long-term residences and hunting camps (p-value = 0.1834), or seasonal habitations and hunting camps (p-value = 0.2673). Nor is there a statistical difference between the logistical site types of complex camps and plant processing camps (p-value = 0.8398). Conversely, there is a statistically significant difference between the site location elevations of long-term residences, seasonal habitations, and hunting camps when compared to complex and plant processing camps. The differences between seasonal habitation sites and the complex and plant processing camps are particularly significant when expressed as p-values, and storage site elevation differences are calculated to be statistically significant when calculated against all the other site types (see Table 7.6 for p-values).

Although addressed earlier, the results for hunting camps are somewhat weak due to the limited number of sites (6 of 405) identified in the study area. However, since the method removes inequalities due to large differences between the numbers of sites in each individual site type, the results at least indicate trends which should be addressed. In this case, the results suggest that hunting camps, seasonal habitations, and long-term residences are located within the same statistical elevations.

The McFadden hypothesis states that evidence of hunting, at least of large mammals, should be found mostly in the upland areas. The initial results from the various statistical tests suggests that hunting occurs over a wider elevation range, or that it is at least not limited only to sites in upland areas.

It is also necessary to acknowledge that the low number of identified hunting sites could be interpreted as a reflection of limited hunting by the Fremont. However, two issues should also be considered here. First, the number of identified hunting camps is limited due to the lack of diagnostic projectile points found on the surface at the many lithic scatters recorded from the multiple surveys in the study area. As previously noted, many of these sites probably represent hunting camps, but due to the lack of diagnostic chronological evidence, could not be considered within the parameters of this study. Second, an indication of hunting activity is one of the components required to assign the functional site category of "complex camp," which forms the largest class of Fremont site type in the study area. The abundant number of identified complex camps argues against limited hunting by the Fremont and infers that hunting was an important aspect of their subsistence.

Another inference which can be drawn from this data is that long-term residences and seasonal habitations occupy a more limited elevation range than complex camps or plant processing camps. In fact, although many of these logistical camp sites are found below 5,500 feet, the majority are located between 5,500 and 6,500 feet. Almost 10 percent of the sites occur above 6,500 feet and some are located above 7,000 feet in elevation. This result is contrary to that proposed by McFadden, who suggests that these types of logistical sites should be found in the lowlands. A better interpretation for Fremont logistical sites is that they reflect a pattern of hunting and gathering wherever useful resources were found based on microenvironments and/or seasonality of available plant and animal resources.

The elevation analysis results for the storage sites are interesting in that storage sites are found at both the highest and lowest elevations in the study, but their median elevation is the lowest of all the site types. This is most probably due to the concentrated occurrences of storage sites along the canyons of the Escalante River and its tributaries. Nearly half of the storage sites are located in the Escalante River canyon south of its confluence with Calf Creek and along Harris Wash where topographically, the entire area slopes down to the south and east as the Escalante River downcuts through the Navajo sandstone, following its course to the Colorado River. Therefore, the median elevation for the data set is probably influenced more by the general downslope of the landscape than by a deliberate selection of low elevation site locations for storage granaries.

In sum, McFadden's site distribution model based on elevation zones, or the even more general description of upland versus lowland, does not seem to provide a good explanation for site patterning as it is expressed in the upper Escalante River drainage.

Distance-to-water

The geographic variable of "distance-to-water" was also analyzed to determine whether it might explain site distribution for the Fremont in the study area. Initial analysis of the data did not prove to be very useful, as boxplots for each site type appear almost identical, with the exception of storage sites which plot as an extremely tight interquartile box and have a median site distance of only 180 meters (Figure 7.4). As summarized previously, nearly 65 percent (N = 263) of all the study area sites, of all functional types, are located less than 1000 meters from a perennial river or stream and 60 percent of those (N = 158) are found less than 250 meters from permanent water (see Figure 7.10). Furthermore, as distances from permanent water increase, the site patterning which is expressed at short distances from water is repeated. In other words, no differentiation in site patterning can be recognized through frequency or distribution graphs between the type of sites located close to permanent water and those located far away from a perennial water source.

In order to establish whether any patterns were hidden in the distance-to-water data, a Mann-Whitney analysis was also performed on this data set. Results of this test (summarized in Table 7.7) reveal no statistical difference between any of the site types with the exception of storage locations, and they in turn exhibit no statistical difference from the six hunting sites in the data set. Again, the low number of hunting sites weakens the results, but they do indicate a pattern towards preferential locations very close to permanent water sources.

Measurements for distance-to-water in this data set are based on straight-line distance rather than route-of-access, which introduces an immediate bias into the analytical process. For example, for most of the sites located on Big Flat, the nearest perennial water source is the Escalante River. However, the sites are located on top of the mesa and the Escalante River is located at the bottom of the extremely deep – and steep – Escalante Canyon. Accessing the river from the mesa top via the often vertical-walls of the canyon adds not only distance, but complexity as well. Therefore, the straight-line measurements for many of the sites do not accurately reflect a true distance-to-water measurement.

Another issue which affects the distance-to-water data is the appearance and disappearance of springs and seeps through time. Although it is not readily apparent, many of the sites, excepting the storage sites, located farther away from the modern perennial rivers and streams are probably associated with a spring or seep dependent upon weather and high water table levels. At various points in time, water tables in the study area may have been closer to the surface, particularly during the slightly wetter period of Fremont occupation. Streams that are ephemeral, or flow only seasonally today, such as the Alvey Wash, may have been perennially flowing streams in the past as well. In fact, many of the sites located at "long" distances from water lie directly along major drainages and very likely had easy access, at least on a seasonal basis, to water.

The p-values expressing statistical significance between distance-to-water measurements between storage sites and the other site types (Table 7.7) reflect the tendency of storage granaries to be located in the steep cliff walls of the riverine canyons in the upper Escalante River drainage. In these locations, actual distance-to-water is restricted to the relatively narrow boundaries defined by the canyon walls. It is interesting to consider, however, that the close proximity of most storage granaries to permanent water could be a very convenient benefit to people when they were accessing storage sites, and might exert some level of influence on granary locations.

The geographic variable of distance-to-water is not a useful explanatory vehicle to explain specific patterns in Fremont site distribution. Questions regarding prehistoric perennial water supplies versus modern sources, as well as inaccuracies introduced into the data set due to a reliance on straight-line measurements for distance-to-water rather than distance via actual access routes, render any specific site location conclusions based upon this data set unreliable. However, the general pattern of site location revealed by this data set is that *all* sites are close to water, with storage sites, as they are predominantly located in steep-wall canyon settings, found at closest distances. If sites were preferentially located near perennial sources, water would be available to:

1) irrigate fields (or alternatively, provide a high, natural water table to support dry-farming),

2) make adobe for pithouse and granary construction,

3) provide for basic necessities at logistical sites.

Therefore, the distance-to-water analysis does imply that perennial water sources were extremely important to the Fremont when selecting locations for residential and logistical settings.

Primary Landform

"Researchers who have carried out exploratory analyses in large, complex sets of spatial data are acutely aware of the value that different kinds of maps have in helping to direct archaeological research. Particularly relevant to archaeological purposes are maps that describe the distributions of single artifact (or variable) categories, standardized as proportions relative to some larger, encompassing set of categories. Such maps are useful for many things, including identifying portions of a site or region that exhibit unusually high or low quantities of key (variable) types. Such differences often relate to broader behavioral patterns, and these may sometimes be revealed by examining the proportion of other (variable) types within the same data assemblage and looking

for meaningful associations. Assuming recovery and analysis procedures have not introduced significant, systematic biases, maps based on observed proportions are difficult to fault as a compact description of what was actually on the ground"(Robertson 1999:137).

Four primary landforms are identified in the study area, all of which retain archaeological traces of occupation and assumed logistical use. The Escalante River canyon is steep and relatively narrow, but the river and its tributaries provide good transportation corridors into or through many different terrains containing numerous varieties of seasonal foods and other resources. The steep cliffs, cracks,and ledges in the canyon walls provide protected areas excellent for temporary shelter and storage, and scores of Fremont sites are spread throughout the entire drainage system (Appendix F1). The wide Escalante Valley, and smaller upper valleys, with their alluvial soils and plentiful water (particularly at the northern end of the Escalante Valley) also boast plentiful seasonal resources and provide excellent locations suitable for agriculture. The ridges and mesas around the Escalante Valley are relatively easy to access from the valley floor, either via moderately rising slopes or through large drainages. Although sites are less common on the ridges than in the valleys or on the mesas, all three landforms exhibit intensive and varied levels of exploitation (Appendices F2 - F4). The Straight Cliffs, which divide the Kaiparowits Plateau from the Escalante River valleyare a formidable barrier to the west, but access to the plateau is possible through drainages and canyons along its northern edge. However, very few Fremont sites have been identified to date on the Kaiparowits Plateau, and no sites have been found in the bedrock badlands located between Pine Creek and Mamie Creek north of the Escalante River (Figure 7.1). (Of course, the lack of identified sites could be due to a lack of diagnostic artifacts or a sampling bias.)

The analyses based on the identification of specific relationships between site types and landform locations provided some interesting results, and offer important insights into Fremont site distribution. Although portions of the elevation and distance-to-water analyses hinted that the selection for site location was related to a preferred landform, the chi-square and correspondence analyses conducted on the primary landform data set persuasively indicate that, at least for some of the site type classifications, there is a strong relationship between site location and landform.

As described in Chapter 7, the chi-square analysis evaluates row-and-column tabular data, testing to determine whether the actual counts in a data set are significantly different from expected counts. In other words, the chi-square analysis tests to determine whether the rows (functional site types) and columns (primary landforms) are independent of each other. When observed counts are different from expected counts, high chi-square cell values are generated, which indicate that the rows and columns are **not** independent.

The results of the chi-square analysis for the primary landform data were summarized previously in Table 7.8. In that table, moderate chi-square values were calculated for the following cells: seasonal habitation/canyon, seasonal habitation/mesa, storage/mesa, and storage/valley. High chi-square values were determined for the long-term residence/canyon, long-term residence/valley,, and storage/canyon cells. These results can best be understood by reviewing a tabulation of the observed versus the expected counts generated from the data (Table 8.1). Cells highlighted in yellow indicate that fewer sites were observed than would be expected if the row and column variables are independent. The green cells show the opposite, where observed site counts are higher than expected. Bolded numbers indicate the cells (listed above) containing large chi-square values, where the differences between observed and expected values are particularly robust, and indicate strong correlations – either positively or negatively – between the two variables. In this case, long-term residence site locations are well below what would be expected in

Table 8.1. Chi-Square Analysis of Site Type and Primary Landform Observed Versus Expected Site Counts

	Landform								
	Canyon		Ridge		"Mesa"		Valley		Total
Site Type	Obs	Exp	Obs	Exp	Obs	Exp	Obs	Exp	
Long Term Residence	**1**	**12.45**	1	1.22	6	6.63	**19**	**6.70**	27
Seasonal Habitation	7	15.22	0	1.49	15	8.11	11	8.19	33
Complex Camp	56	63.64	7	6.23	41	33.90	34	34.24	138
Plant Processing Camp	62	58.57	7	5.73	29	31.19	29	31.51	127
Storage	**58**	**34.13**	3	3.34	7	18.18	6	18.36	74
Total	184		18		98		99		399

a canyon location (i.e., one observed versus 12.45 expected), while nearly three times as many long-term residences were recorded in the valley than predicted (19 versus 6.70). Similarly, 58 storage sites were identified in canyon locations, where only 34.13 were anticipated. As noted in Chapter 7, the total chi-square statistic (81.246) indicates that there is a large discrepancy between the observed and expected results when the entire data set is considered, and the very low p-value of significance (0.0000) demonstrates the probability that the variables of site types and primary landform locations being independent, or random, is extremely small.

One of the most useful methods for quantifying archaeological data is correspondence analysis, "a multivariate statistical technique that...seeks to expose underlying structure in a complex data set by relating variables and/or cases to a smaller number of analytic dimensions that nevertheless capture a high proportion of the information contained within the original data set" (Robertson 1999:147-148). It is particularly productive in revealing patterns of association between canonical data sets. Once the raw data has been cross-tabulated, the resulting relationships are displayed on a correspondence map (graph) which plots points along computed factor axes. Each correspondence map displays two of the dimensions which emerge from the principal components analysis of point distances, and points are displayed in relation to these dimensions. Each point represents a component Eigenvalue, or the relative importance of the variance expressed for a given factor in the correspondence table and reflects distance from the centroid (represented by the intersection of the X and Y axes on a graph), or weighed mean of the row and column profiles. In most cases, only the first two dimensions are used in the correspondence map, as they explain the majority of the total inertia. The first axis (X-axis) always explains the most variance and has the largest value, the next (Y-axis) the second-most, and so on (see Analysis of Contingency Table section in Appendix F2). In this analysis, Axis 1 represents 83.8 percent of the total inertia (variance) and Axis 2 represents 14.1 percent, accounting for 97.9 percent of the total inertia over the entire data set. Thus, approximately 98 percent of the information contained in the original variable data set can be captured in a two-dimensional, easily graphed space.

The relative locations of these variables on the first two correspondence analysis axes are illustrated in Figure 8.1.

The correspondence map graphically illustrates the relationships between the analyzed data. "Geometrically, the principal inertia (Axis 1) is the weighted average of squared (chi-squared) distances from the centroid (intersection of the X and Y axes)" (Greenacre and Hastie 1987:440). The graph displays the strongest (or weakest) relationships between site types and landforms in the data set through close grouping or through graphical distance (Greenacre and Hastie 1987).

One way to begin to summarize the relationships described by Figure 8.1 is to define Axis 1 as representing the row variables of site types in the data set. Axis 2, on the other hand, represents the column variables of primary landforms (Appendix E, Table 8.1). The graphic representation of the data is particularly productive in revealing patterns of association. The two strongest associations, which show the numerical statistics in

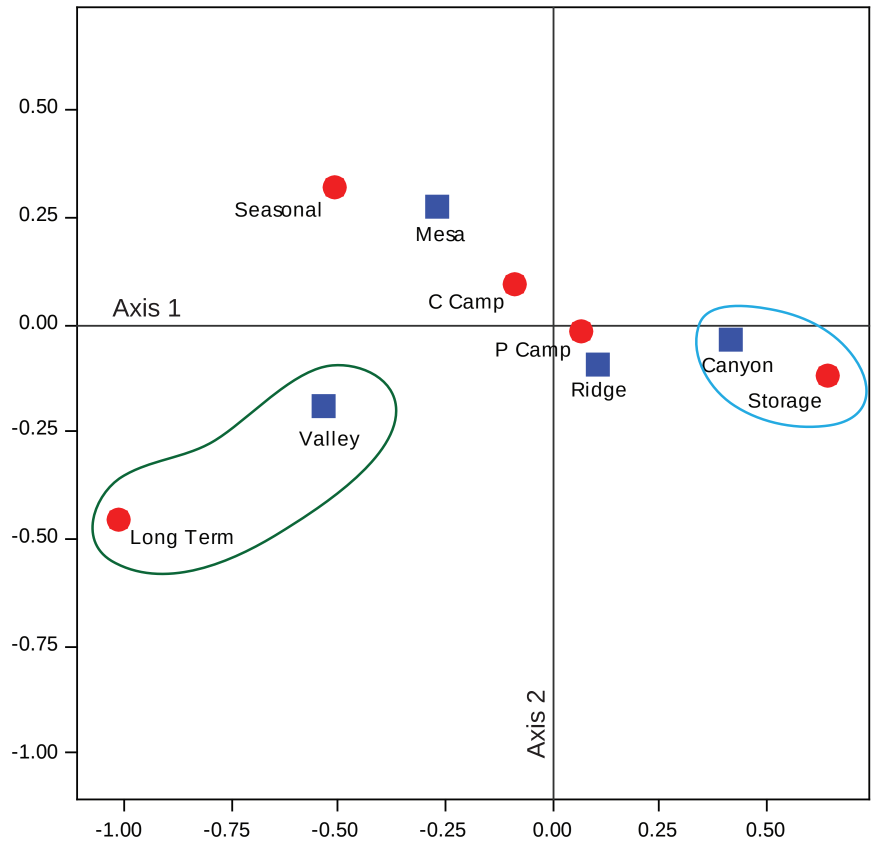

Figure 8.1. Correspondence Analysis map illustrating associations between variable categories of functional site type and primary landform.

the chi-square calculation in a more visual way, are circled. The analysis (Figure 8.1) demonstrates that a robust association exists between long-term residence sites and valley locations (Appendix F5). An even closer association is confirmed between storage/ granary locations and canyons (Appendix F6), and points to intentional selection of particular landforms for these site type locations. Seasonal habitation sites, although not as clearly associated, are plainly linked to both the mesa and valleys (Appendix F7). No obvious associations are expressed in the correspondence graph between any single landform and complex or plant processing camps (Appendix F8 and F9). (A map showing the spread of the six hunting camps across all four primary landforms is included as Appendix F10).

SUMMARY AND CONCLUSION

The purpose of this research was to better understand the Fremont pattern of settlement and site distribution in the upper Escalante River drainage, and to evaluate the precision of the McFadden model (McFadden 1998, 2000) to describe site distribution as observed during survey and excavation in the drainage. To accomplish this objective, I collected inventory and excavation data from over 1,400 IMACS site forms on file with the Utah SHPO, BLM, USFS, and BYU/OPA. Each of the site forms was analyzed to determine cultural affiliation, and eventually, 405 Fremont sites were identified and selected for the study.

The various analyses conducted over the course of this undertaking have demonstrated that the variables of elevation and distance-to-water are not effective in accurately describing the distribution of Fremont sites in the upper Escalante River drainage. However, chi-square and correspondence analyses, which I used to identify associations between functional site types and primary landform locations do appear to more accurately reflect site distribution as observed and recorded "on the ground."

Modified Fremont Site Distribution Model: Upper Escalante River Drainage

One major difficulty in the McFadden model is the imprecision of the "upland versus lowland" definition used to describe the probable locations for high-investment, long-term residential sites and low-investment, seasonal or short-term residences, respectively (McFadden 1998, 2000). An additional problem is the inclusion of only pithouse (or presumed pithouse) and granary sites in the development of the model. The exclusion of non-structural, ephemeral sites from the McFadden model limits its ability to accurately portray Fremont land-use strategies.

This study strongly suggests that the McFadden model does not accurately reflect

Fremont site distribution in the GSENM, and that a different model should be considered. A new model should better reflect the entirety of the Fremont complex in the upper Escalante River drainage and incorporate at least the following elements:

1. Inclusion of all functional site types (as defined here in Chapter 6) into the model. The site typology used here was developed specifically for this study, but could be applicable to other research as well. Briefly, each of the site types is summarized below: Whether this typology, or another is developed, it is important that the criteria used to define each site type is clearly defined.

2. The primary landform variable is only one of several geographic or other variables which could be used to evaluate site distribution in the upper Escalante River drainage. This study relied on landform criteria using established IMACS landform definitions (see Chapter 6) to describe site locations. The issue of accuracy in terms of primary landform assignments is somewhat problematic due to the qualitative nature and scale of the landforms, and the fact that accuracy of a site assignment to a particular landform is dependent upon field interpretation by individual site recorders. Whichever variable is selected, its definition(s) and the methods used for site distribution analysis need to be unambiguously stated.

3. At the time of this study, no Fremont sites have been identified that date to the post-A.D. 1050 period in the upper Escalante River drainage. McFadden's chronology for the region defines the Late Formative as a period when Anasazi ceramics and other material traits appear in the region, but also notes that there is no demonstrated continuity between the Fremont Wide Hollow Phase (A.D. 500 - 1050/1100) and the later expression of Anasazi culture on Fiftymile Mountain (McFadden 2000). However, at Rattlesnake, Arrowhead Hill, and Dos Casas there is evidence for late re-occupation or use of those Fremont sites by the Anasazi (Janetski 2009, personal communication). Given the lack

Table 8.2. Proposed Chronology for the Upper Escalante River Drainage.

Cal. Years	**Escalante Drainage** Fremont Harris 2009
1300	No Demonstrated Fremont Occupation
1200	Possible Virgin Anasazi Influx
1100	
1000	
900	
800	Wide Hollow Phase (A.D. 500 - 1050/1100)
700	
600	
500	
400	
300	Escalante Phase (A.D. 100 - 500)
200	
100	
0	

of identified late Fremont sites in the upper Escalante River drainage, I propose a new chronology for the region (Table 8.2). In this chronology, the Escalante and Wide Hollow phases as defined by McFadden are retained, but the Late Formative is dropped. Instead, for the post A.D. 1050/1100 period, the region appears to reflect a Fremont abandonment with a possible Virgin Anasazi influx into the area.

Implications for Fremont Site Distribution

Survey data from the upper Escalante River drainage region now shows that

Fremont sites exhibit the following pattern of site distribution. Long-term residence sites (occupied for at least six months each year, consisting of sturdy, high-investment pithouse structures with extramural features, large middens, diverse artifact classes, and high artifact counts) are significantly associated with valley locations where agricultural fields and perennial water sources were nearby. Seasonal habitations (light construction wickiups to high-investment pithouses reflecting the expectation of seasonally repeated use for periods up to three months) are often located in valleys but are most common at mesa top locations, where seasonal resources are abundant but permanent water appears less reliable. These sites often have large middens and soil stains < 2 meters in diameter as well, but artifact densities and classes are limited. Granaries, slab-lined cists, and below-ground storage cists are heavily concentrated in canyons, where steep cliffs provide cracks, alcoves, and other sheltered spaces for protected storage. Finally, logistical sites (complex camps, plant processing camps, and hunting locations – see Definitions in Chapter 6), are found in all landforms and at all elevations, situated to take advantage of a variety of resources in local environmental "niches."

Site distributions as described above suggest that the Fremont lived in the valleys for much of the year in long-term residences, focusing their subsistence efforts primarily on agriculture but also spending significant periods of time in the mesas and in the canyons, hunting and gathering wild resources. (Faunal remains excavated from Arrowhead Hill, a long-term residential site near Escalante, Utah, indicate that the site was occupied at least during the spring and summer; large on-site storage pits also hint at winter occupation as well.) Many of the higher-investment seasonal habitations on the Big Flat mesa are located close to pinion-juniper stands, and on the mesa, pinyon nuts, juniper berries, prickly-pear, and ricegrass are readily available as food resources. The lack of storage and limited number of artifacts present at sites on Big Flat sites indicate that the mesa was utilized on a regular, probably seasonal basis, presumably for hunting and gathering. Surface expressions of these sites do not indicate seasonality, but the pinyon nut and ricegrass harvests would have occurred during the late summer and early fall periods.

DIRECTIONS FOR FURTHER RESEARCH

Although the associations between the variables of site type and primary landform seem strong, other variables which could affect site location should be analyzed. In relation to storage sites, an interesting query would be to investigate whether functional differences between storage sites locations in riverine canyons, and those located in smaller, but more localized, cliff formations located in the ridges and below the mesa tops around the Escalante Valley can be identified. Other geographic variables which ought to be addressed are vegetation, type and composition of soils, site area, artifact classes and density, and the slope and aspect of a site, particularly in terms of site directionality to take advantage of passive solar gain for site warmth.

Additional sites could be considered, and added into the data set, if a consistent method of assigning cultural affiliation to sites without diagnostic artifacts could be developed. Many lithic scatters lacking diagnostic artifacts or other identifiers are certain to be part of this Fremont landscape, but until propoer temporal classifications can be made, these types of sites could not be included in this study. Finally, there are many large areas which remain unsurveyed, particularly in the Escalante Valley and in the mesas east of the valley. Nonetheless, the intensive surveys along the main canyons have yielded a fairly comprehensive picture of site type distribution in the Escalante drainage. The large areal surveys conducted in the Little Desert area of the Escalante Valley and on Big Flat have demonstrated heavy and concentrated use of those areas. Additional survey in the valley (which is admittedly problematic, as most of the land is privately owned), and on the mesas and elsewhere could provide significant insight into Fremont-period land-use patterning as well as site, and by extension, population distribution throughout this region.

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APPENDIX A

Data Table:
Site Type Analysis Checklist

Table A.1. Site Function Checklist Data Table

			Ground Stone			Chipped Stone									Misc. Artifacts (Pres/Absc)			Soil Stains			Features								
Site No. (42GA..)	Site Type 1	Site Type 2	Portable	Non-Portable	Worked Bone Tools	Projectile Point	Biface	Drill	Scraper/Uniface/ Utilized Flake	Hammerstone	Core	Chopper	Debitage	Fremont Ceramics	Organics (Maize Cobs, Basketry, Bone, Etc.)	Figurines, Exotics, Shaped Stones,Etc.	FCR/Charcoal/Burned Stone	<2m	>2m	Depression	Hearth/Roast	Midden	Granary/Cist	Adobe/Mortar (Pres/Absc)	Rubble Piles/"Pits"	Rock Alignment/Wickiup/ Light Construction	Dry-laid Straight Rock Wall	Masonry/ Pithouse with Vent	Site Area (m^2)
35	ST												100	6									1						175
36	ST																						1						59
42	LTR		1			1	6		1				1000+	60+			X		2									1	3358
43	LTR		80			22	83	5	11	30	7	17	17339	2924		X	X		5	2	2			X				3	9002
51	LTR		1+			1+	1+		1+	1+	1+	1+	500+	633	X		X				1			X				1	8500
54	LTR		11				5+		5+				500+	1407					3	3	4								215600
90	PC		1			1	3+		5+	1		1											2						707
102	ST			1	1										X								3	X					105
103	ST													<10	X	X							13						1200
105	ST														X		X	1	1		1		12						650
106	ST																						1						71
108	ST														X		X												198
111	ST												100+		X		X						1	X					118
112	ST												<100	1	X														85
113	ST													1	X								1	X					42
277	ST												<10	2	X		X	1											39
279	ST												<100										1						105
280	ST											1			X		X	1					1	X					57
284	ST														X		X						5	X					1400
286	CC	ST	1			1							33	24	X		X						1	X					226
288	CC	ST	1			4			47	1		20	500+	50	X		X						9	X					600
289	ST						1		1					3	X								1	X					79
290	CC	ST				1			3		2	33	500+	10				1			1		1						475
291	PC		3	2+	2+						1				X		X												7067
292	CC		7	2+	2+		16						500+	4			X												18850
294	PC	ST											5	1			X				1		1	X					848
298	CC	ST	3+		1						3		500+	10		X	X	1											4555
300	CC		3			1								13															6600

Table A.1. Continued

Site No. (42GA..)	Site Type 1	Site Type 2	Ground Stone: Portable	Ground Stone: Non-Portable	Worked Bone Tools	Chipped Stone: Projectile Point	Chipped Stone: Biface	Chipped Stone: Drill	Chipped Stone: Scraper/Uniface/ Utilized Flake	Chipped Stone: Hammerstone	Chipped Stone: Core	Chipped Stone: Chopper	Debitage	Fremont Ceramics	Misc. Artifacts (Pres/Absc): Organics (Maize Cobs, Basketry, Bone, Etc.)	Misc. Artifacts (Pres/Absc): Figurines, Exotics, Shaped Stones,Etc.	Misc. Artifacts (Pres/Absc): FCR/Charcoal/Burned Stone	Soil Stains: <2m	Soil Stains: >2m	Depression	Features: Hearth/Roast	Features: Midden	Features: Granary/Cist	Features: Adobe/Mortar (Pres/Absc)	Features: Rubble Piles/"Pits"	Features: Rock Alignment/Wickiup/ Light Construction	Features: Dry-laid Straight Rock Wall	Features: Masonry/ Pithouse with Vent	Site Area (m^2)
301	PC						2					2	50	1															5500
528	LTR		1+		1+	2+	5+		5+	5+	2+	5+	500+	500+	X		X	1+	1+	1+	1+	1		X				1	87524
543	LTR		8						1			2+	500+	10	X		X	5	2	1	5			X				1	10014
554	HC					1	1+		1+		1+		100-500	5+															33338
557	CC						1			2	2		25	4			X		2					X				1	1100
773	PC		2										25+	5+										X					750
882	SH	ST	25	3		1	14	1					733	106	X	X	X	2					1	X					245
888	PC												25+	10+															625
889	PC	ST	2+										25+	5+	X		X						1	X					2016
891	ST																						2	X					13
893	PC																	3+			3+								32000
900	PC												25+	25+															72000
929	PC												10+	50+			X												12000
932	ST																						2	X					640
936	PC		5+														X												96000
944	CC		1							1			20	3	X					1			7						412
995	PC		4+										50+	1			X	3											345
998	PC												3	2			X	2											640
1006	CC		4	1									50	15	X		X		1										160
1099	ST																						1						50
1423	PC	ST	3+											25+									1+						800
1425	CC		5+			2+	2+		5+	1+		1+	50+		X		X	2			3								4800
1434	PC	ST					1			1			1	5	X	X	X	1					6	X					785
1437	ST														X								1						4398
1440	CC												50	5+			X	5			5								864
1459	PC												49	3			X	1			1								1200
1474	CC	ST	4			2								1									2	X					98
1478	ST																						2	X					7

Table A.1. Continued

Site No. (42GA..)	Site Type 1	Site Type 2	Ground Stone: Portable	Ground Stone: Non-Portable	Worked Bone Tools	Chipped Stone: Projectile Point	Chipped Stone: Biface	Chipped Stone: Drill	Chipped Stone: Scraper/Uniface/ Utilized Flake	Chipped Stone: Hammerstone	Chipped Stone: Core	Chipped Stone: Chopper	Debitage	Fremont Ceramics	Misc. Artifacts (Pres/Absc): Organics (Maize Cobs, Basketry, Bone, Etc.)	Misc. Artifacts (Pres/Absc): Figurines, Exotics, Shaped Stones,Etc.	Misc. Artifacts (Pres/Absc): FCR/Charcoal/Burned Stone	Soil Stains: <2m	Soil Stains: >2m	Depression	Features: Hearth/Roast	Features: Midden	Features: Granary/Cist	Features: Adobe/Mortar (Pres/Absc)	Features: Rubble Piles/"Pits"	Features: Rock Alignment/Wickiup/ Light Construction	Features: Dry-laid Straight Rock Wall	Features: Masonry/ Pithouse with Vent	Site Area (m^2)
1484	CC		3+			3+	1						9	80+	X	X	X												544
1537	CC		2+										25+	20+	X		X	2			1		3						600
1538	ST																						1	X					353
1539	ST																						3	X					353
1541	CC	ST	2+			2+	2+		2+		2+	2+	500+	10	X		X	5+			5+		5	X		1			78540
1544	CC		4			2	1+		1+	1+		1+	100-500	20+			x	1			1								500
1545	CC		5+								3+		100-500	10+				2			2								500
1549	PC	ST								1								1			1		1	X					225
1565	ST													1									1	X					25
1569	PC												100-500	25+							2								120
1572	CC		6							4	1		100-500	29				1	2										9189
1573	CC		4							1			100-500	25				1	1		1					1			3338
1580	CC								1	5			25-100	3				1	2		2					1			1178
1582	CC		1				1			1			25-100	50+				1											470
1585	LTR		9		12	11	19	1	3	26			3025	1256	X	X	X	6	2	4	4		1			9		2	20735
1586	CC		3				2		1	1		1	150	3			X	4	1		5					1			4398
1587	CC		3				2		1	1	2		50	10+			X	1	3		1								1964
1621	CC												25-100	5+				1			1								39
1719	CC		2+			2+					2+		10+	3+	X	x	X	1								1			450
1817	CC	ST	1								1		1		X					1			1	X					50
1818	ST													3									1	X					31
1819	ST												17	2+									4						95
1820	PC												100+	50+															5300
1821	PC												160	15															20
1822	PC												100+	10+															471
1823	PC												100+	10+															314
1824	PC													5+															79
1876	CC		5	1							6		200+	30+				1	1										495

Table A.1. Continued

Site No. (42GA..)	Site Type 1	Site Type 2	Ground Stone		Worked Bone Tools	Chipped Stone							Debitage	Fremont Ceramics	Misc. Artifacts (Pres/Absc)			Soil Stains		Depression	Features								Site Area (m^2)
			Portable	Non-Portable		Projectile Point	Biface	Drill	Scraper/Uniface/ Utilized Flake	Hammerstone	Core	Chopper			Organics (Maize Cobs, Basketry, Bone, Etc.)	Figurines, Exotics, Shaped Stones,Etc.	FCR/Charcoal/Burned Stone	<2m	>2m		Hearth/Roast	Midden	Granary/Cist	Adobe/Mortar (Pres/Absc)	Rubble Piles/"Pits"	Rock Alignment/Wickiup/ Light Construction	Dry-laid Straight Rock Wall	Masonry/ Pithouse with Vent	
2099	ST																						3	X					12
2100	ST																						4	X					7
2101	ST																						2	X					1
2104	ST																						1						32
2105	ST													5+									2	X					1
2106	ST																						1						?
2121	ST																						1	X					157
2121	ST																						3	X					2550
2123	PC														X		X												86
2246	CC		2			4	2		1	7			26-30	9				X			1								510
2294	ST																						1	X					2
2639	LTR		32			2+	6+		2				500+	30		X			4				2	X		1		3	9000
2661	PC		2+										3	10+															180
2662	CC		2+										25-100	10+				2	1		1					1			175
2664	CC		8			1							25	28			X		1							1			300
2665	CC		7			2	1		1	4			100-500	60				1	2		1								4948
2843	CC		1	1			1	1	1	1			50+	10+															1920
2844	PC									2	1		7	6															80
2853	ST																						2	X					1600
3096	PC		2+			1	1		5				25-100	12				1			1								1145
3097	PC		2+				3		3				25-100	4															1925
3098	CC		1				1		6				100-500	23					1							6			10200
3119	PC		1										<25	13				1											100
3144	LTR		6			6	6	2	4	2	6		175	330		X		1	1							1		1	4241
3234	SH		12							2			25-100	100+				2	1		2								2500
3460	ST												1										2						39
3465	PC		1			1	4				7	2	1000+	1															3770
3499	PC		20+							9+	9+	9+	100-500	3				1			1								8000

Table A.1. Continued

Site No. (42GA..)	Site Type 1	Site Type 2	Ground Stone: Portable	Ground Stone: Non-Portable	Worked Bone Tools	Chipped Stone: Projectile Point	Chipped Stone: Biface	Chipped Stone: Drill	Chipped Stone: Scraper/Uniface/ Utilized Flake	Chipped Stone: Hammerstone	Chipped Stone: Core	Chipped Stone: Chopper	Debitage	Fremont Ceramics	Misc. Artifacts (Pres/Absc): Organics (Maize Cobs, Basketry, Bone, Etc.)	Misc. Artifacts (Pres/Absc): Figurines, Exotics, Shaped Stones,Etc.	Misc. Artifacts (Pres/Absc): FCR/Charcoal/Burned Stone	Soil Stains: <2m	Soil Stains: >2m	Depression	Features: Hearth/Roast	Features: Midden	Features: Granary/Cist	Features: Adobe/Mortar (Pres/Absc)	Features: Rubble Piles/"Pits"	Features: Rock Alignment/Wickiup/ Light Construction	Features: Dry-laid Straight Rock Wall	Features: Masonry/ Pithouse with Vent	Site Area (m^2)
3543	PC					2	2						<25	25															150
3545	CC		5							1	1		25-100	<10				3	1		1					4			225
3566	PC		2+										25-100	10			X	3			3								1000
3597	CC		3							1	1	1	25-100	<25				1	1										400
3607	PC		5							1			25-100	<10				1											1920
3621	PC		18							4			100-500	<10				1			1								1680
3660	CC	ST	5+			1	5+			2+			25-100	50+				1					1	X					200
3738	SH											1	<25	3						1						1			320
3739	SH		3									1	25-100	<10															320
3742	SH		4				2			2	2	1	500	100			X	2								1			300
3744	SH												<25	<25												1			320
3745	ST													50									4	X					720
3746	PC													<25				2	1										375
3747	CC		3							2		2	25-100	25-100					1										800
3751	PC		1									1	25-100	<25					1					X					288
3752	LTR		6							3		1	25-100	25-100					1	1								1	100
3753	PC		4										25-100	4				1	1										480
3754	PC		11										25-100	<10			X	3											1000
3755	ST																						3	X					20
3756	SH		1				1						50-100				X	1		1	1					1			50
3759	HC					1							500+				X												30000
3876	PC		3				2					3	100-500	60															5760
3878	CC	ST	1+						1	2		2	500+	4	X		X	2					6						2420
3879	PC	ST	3	2									1	10	X				1				1	X					84
3881	ST													3	X								4	X					160
3882	ST														X								2	X					4
3891	SH		4			2	12		6			2	1304	113	X	X		8			3					1		1	1056
3907	ST																						1	X					40

Table A.1. Continued

Site No. (42GA..)	Site Type 1	Site Type 2	Ground Stone: Portable	Ground Stone: Non-Portable	Worked Bone Tools	Chipped Stone: Projectile Point	Chipped Stone: Biface	Chipped Stone: Drill	Chipped Stone: Scraper/Uniface/ Utilized Flake	Chipped Stone: Hammerstone	Chipped Stone: Core	Chipped Stone: Chopper	Debitage	Fremont Ceramics	Misc. Artifacts (Pres/Absc): Organics (Maize Cobs, Basketry, Bone, Etc.)	Misc. Artifacts (Pres/Absc): Figurines, Exotics, Shaped Stones,Etc.	Misc. Artifacts (Pres/Absc): FCR/Charcoal/Burned Stone	Soil Stains: <2m	Soil Stains: >2m	Depression	Features: Hearth/Roast	Features: Midden	Features: Granary/Cist	Features: Adobe/Mortar (Pres/Absc)	Features: Rubble Piles/"Pits"	Features: Rock Alignment/Wickiup/ Light Construction	Features: Dry-laid Straight Rock Wall	Features: Masonry/ Pithouse with Vent	Site Area (m^2)
4084	SH		11							1+			500+	<100				2	1	1	1					4			3840
4085	PC		3									2	100-500	<25	X											1			720
4086	LTR		30		7	15	29	7	6	24	3		2950	1159	X	X	X	3	2		2					1		2	9651
4087	PC		4	1						6	2	2	25-100	<25				3											750
4088	PC												25-100	3					1	1									480
4089	PC						1						25-100	<25					1										1280
4091	PC		4			1					1		500+					2			2								960
4092	SH		4							2			25-100	100+				2			2					1			300
4095	SH		17			3	4		6	2	3		616	16	X	X	X	2	1		2					1			7854
4104	PC		4										100-200						2		1								1414
4110	PC		11							2			25-100	<25				2			1								960
4111	SH		3							1		1	<25	<25							1							2?	560
4112	PC		4										1					2			2								160
4113	SH		7	1		1				2			100-500	25-100				3	1	1								1	2000
4114	PC												10				X	1	1		1								600
4115	SH		3			1							25-100	25-100				2	2	1	3					1		1	1280
4116	PC		5							2			<25	<10				1			1								700
4122	CC	ST	1				4						100-500	<25	X		X						1	X					1000
4123	PC	ST	2											1									1	X					160
4125	SH		2							3			500+	100-500				1	1		1							1	960
4126	ST																						2	X					8
4127	ST												<10	25-100									2	X					8
4135	SH		1									1	25-100	100-500					1		1							1?	640
4136	LTR									2			500+	500				1	1		1					1		1?	640
4138	ST			24										3									15						100
4140	ST																						1	X					6
4141	ST																						1	X					6
4165	CC						1						25-100	100+			X		3		3								100

Table A.1. Continued

Site No. (42GA..)	Site Type 1	Site Type 2	Ground Stone: Portable	Ground Stone: Non-Portable	Worked Bone Tools	Chipped Stone: Projectile Point	Chipped Stone: Biface	Chipped Stone: Drill	Chipped Stone: Scraper/Uniface/ Utilized Flake	Chipped Stone: Hammerstone	Chipped Stone: Core	Chipped Stone: Chopper	Debitage	Fremont Ceramics	Misc. Artifacts (Pres/Absc): Organics (Maize Cobs, Basketry, Bone, Etc.)	Misc. Artifacts (Pres/Absc): Figurines, Exotics, Shaped Stones,Etc.	Misc. Artifacts (Pres/Absc): FCR/Charcoal/Burned Stone	Soil Stains: <2m	Soil Stains: >2m	Depression	Features: Hearth/Roast	Features: Midden	Features: Granary/Cist	Features: Adobe/Mortar (Pres/Absc)	Features: Rubble Piles/"Pits"	Features: Rock Alignment/Wickiup/ Light Construction	Features: Dry-laid Straight Rock Wall	Features: Masonry/ Pithouse with Vent	Site Area (m^2)
4167	LTR		15			8	9		2	1	1		500+	671		X		2			2			X				3	3142
4168	SH		1	1									<10	100					1							1			78
4181	SH												0	2					1							1			100
4212	PC		2			1	3						100-500					1			1				2				8400
4332	ST								2				<10	1		X							1			1			78
4334	PC		1										<10										5						62
4336	ST														X								2			1			192
4337	ST													2	X								2	X					16
4398	CC		2	1					1				25-100	50			X	1	1		1					1			400
4507	ST														X								1	X					60
4509	PC		2				1				1		<10	6				1											5891
4510	ST																						1	X					4
4511	CC		3+			1	1				1+	1+	25-100	<50			X	15			15								50000
4515	PC	ST	5+	10+										25-100			X	2	1		1		1						14726
4516	CC		4								1		25-100	1			X	2			1								500
4517	CC		1				1+					3+	25-100	1			X	1	1		1								1178
4518	PC	ST	4		1+								<25	3	X		X	1			1		5	X		1			1200
4520	PC		2				1+					1	100-500	<25			X	4			4								9896
4521	ST													<10									6						14100
4524	PC		1+										100-500	<10															58905
4526	PC											3+	25-100	<10			X	1			1								157
4530	PC		1										25-100	<10	X		X	5			5					1			8836
4532	ST																						1	X					10
4533	CC		3+			1	1					1+	100-200	<10				2			2								4320
4534	CC		4+			2	4						100-500	<50			X		1										600
4535	ST																						1	X					157
4536	CC		3+	2+							1+	1+	25-100	<10	X			1								1			1178
4538	ST														X								1	X					15

Table A.1. Continued

Site No. (42GA..)	Site Type 1	Site Type 2	Ground Stone		Worked Bone Tools	Chipped Stone							Debitage	Fremont Ceramics	Misc. Artifacts (Pres/Absc)			Soil Stains		Depression	Features								Site Area (m^2)
			Portable	Non-Portable		Projectile Point	Biface	Drill	Scraper/Uniface/ Utilized Flake	Hammerstone	Core	Chopper			Organics (Maize Cobs, Basketry, Bone, Etc.)	Figurines, Exotics, Shaped Stones,Etc.	FCR/Charcoal/Burned Stone	<2m	>2m		Hearth/Roast	Midden	Granary/Cist	Adobe/Mortar (Pres/Absc)	Rubble Piles/"Pits"	Rock Alignment/Wickiup/ Light Construction	Dry-laid Straight Rock Wall	Masonry/ Pithouse with Vent	
4543	CC		1+						1+				100-500		X		X	1					1	X		8			8000
4544	CC		1	1			1					1	<25	<10				1			1								1250
4548	PC		2							9	2	2	25-100	<10			X	1											23652
4549	PC		5+									1+	25-100	<10							1								2356
4552	SH		1										25-100	<25												2			2400
4555	PC		1									2	100-500	4												1			1120
4556	PC		1										25-100	2				2			2								2356
4561	CC	ST	2	2+			1			2					X		X						1	X		3			3000
4562	CC		1				1+						100-500	>25				4											3927
4599	PC		2				1						500+	26				1			1								1256
4608	SH												500+	14												1*			2933
4609	SH		1										100-500	14												1			250
4610	SH												25-100	31												1*			825
4611	PC		2										500+	8			X												2875
4680	CC		3										25-100	25			X	1								1			3534
4684	CC		5+	5+			1				3		500+	<25			X	1					1						7069
4685	PC	ST	3	1							1		<25	25									3	X					47
4687	PC		1			1							100-500	3															36000
4688	CC	ST	1	12			2						<25	15	X		X	1+			1+		3	X		1			27489
4690	CC		1						2				<25	2												1			314
4692	CC		11			5	7			2			500+	50			X	4			4								5184
4693	PC	ST	6					1					85		X		X						1	X					393
4694	CC		4+			1	1			1			100-500				X	4			4								560
4696	CC		2			2	1+						50	20	X		X	2											125
4698	PC		12										25-100	10				1											589
4699	PC	ST	1	2									25-100	1	X		X	2			2		10	X					12000
4700	CC		2				4			1	2	1	25-100	<10	X			5	1		5					1			785
4704	ST														X								6	X					75

Table A.1. Continued

			Ground Stone			Chipped Stone									Misc. Artifacts (Pres/Absc)			Soil Stains			Features								
Site No. (42GA..)	Site Type 1	Site Type 2	Portable	Non-Portable	Worked Bone Tools	Projectile Point	Biface	Drill	Scraper/Uniface/ Utilized Flake	Hammerstone	Core	Chopper	Debitage	Fremont Ceramics	Organics (Maize Cobs, Basketry, Bone, Etc.)	Figurines, Exotics, Shaped Stones,Etc.	FCR/Charcoal/Burned Stone	<2m	>2m	Depression	Hearth/Roast	Midden	Granary/Cist	Adobe/Mortar (Pres/Absc)	Rubble Piles/"Pits"	Rock Alignment/Wickiup/ Light Construction	Dry-laid Straight Rock Wall	Masonry/ Pithouse with Vent	Site Area (m^2)
4710	CC	ST	2								2		<10		X								1	X		2			275
4711	CC	ST	5							1	1		<25	4	X		X	2			2		1						21
4712	PC		1			1							<25					1			1					1			12
4822	PC		1			1	5			1			1500+				X	18											35343
4831	PC					1					5		50+	27															6283
4832	SH		7			2				3	2		5000+	30	X		X	3	2		3					2			21599
4857	PC		1							1			150	30				1											4712
4859	CC		37	2			6			9	15		50000+	50+	X		X	10			1					1			34165
4886	CC		12	1						2	8		7000+	1			X	3	1										10603
4903	SH		4	1			6			5	6		5000+	30	X		X	4			1	1				1			11780
4904	CC		9				3			1	3		1000+	1	X		X	1			1								3925
4922	PC		5			1				2			150-200	15				1											945
4923	CC					1			1	1	1	1	40	8	X														60
4926	CC		21	1		2			1	3	9		20000+	5	X			5											7850
4937	CC		14			1	3			4			3000+	4	X		X	1											2475
4939	PC						1			1			50+	1															235
4941	CC		4				3			1	1		1500+	350+															470
4946	CC		10				1			2	2		8000+	1			X	2											12195
4958	CC		6			1	2						1000						1										23760
4960	CC		6			1	2						1000+	1			X	2	1		2					1			155510
4966	CC		2			1	1						2000+					1	1										14690
4974	CC		8				2			7	10		3500+	1				4				1							47831
4996	CC		4	4+		1							25-100	2												1			2250
5001	ST												<25										1	X					51
5002	CC		3				1				5		<25	8															24
5050	LTR		9				3		1	1	2		100-500	25				2	2			1						1	6480
5051	CC		2				3			1			200+	1				1											315
5054	CC						1			1				2			X				1								6

Table A.1. Continued

Site No. (42GA..)	Site Type 1	Site Type 2	Ground Stone		Worked Bone Tools	Chipped Stone							Debitage	Fremont Ceramics	Misc. Artifacts (Pres/Absc)			Soil Stains		Depression	Features								Site Area (m^2)
			Portable	Non-Portable		Projectile Point	Biface	Drill	Scraper/Uniface/ Utilized Flake	Hammerstone	Core	Chopper			Organics (Maize Cobs, Basketry, Bone, Etc.)	Figurines, Exotics, Shaped Stones,Etc.	FCR/Charcoal/Burned Stone	<2m	>2m		Hearth/Roast	Midden	Granary/Cist	Adobe/Mortar (Pres/Absc)	Rubble Piles/"Pits"	Rock Alignment/Wickiup/ Light Construction	Dry-laid Straight Rock Wall	Masonry/ Pithouse with Vent	
5056	CC					1	1	1					40							1		1				1			690
5058	HC					1	2						50					1											315
5060	CC		1	2			5			1			50	6															3360
5061	CC		4			1	4					1	100					3	5		3	2				1			7660
5062	CC		2			2	3						500	5			X	3			2								2000
5067	HC						1	1					5				X	1			1								75
5071	CC		2			1	1				1		1000+	2			X	1	1		1	1							6480
5072	CC		5							1		2	150+	33				2	1		2							1	940
5075	PC		7				1						25+	1			X	1			2								3830
5082	CC		2			2	4						100-500	2			X	4	2		2	1				1			3770
5085	PC					1				1			15	1															100
5088	SH		1				1						100-500	35				6	1		8							1	3535
5096	PC		3			1	2						500+					1	1			1							2356
5102	CC		1			2	1					1	200+	1							6								3300
5106	CC		1			1	1			1			25-100	5															236
5107	CC		1							1			25-100	1	X		X												118
5108	CC		3			1	6			2			500+	6				3	2		2								3318
5109	PC		4										12	3				1											1178
5110	PC												500+	2			X	2											3829
5113	CC		1+										100-500	10	X														1060
5117	CC		2										100-500	6					1		2								6480
5118	CC		28			1	5		1		1	1	500+	7				3	1	1	2								21991
5120	CC		2			1							50	6	X			1											1728
5124	CC		5				1			1		1	<30	3															2168
5125	CC		2			1	1			1			20								1								1767
5128	CC		1			1	3				1		100-500	80				1	1			1							2356
5131	LTR		4			2	5		1		1		25-100	10			X				1	1							3888
5133	LTR		9	1		1	1		2	7		2	500+	400+	X		X	2	3		1	1		X				2	2062

Table A.1. Continued

Site No. (42GA..)	Site Type 1	Site Type 2	Ground Stone		Worked Bone Tools	Chipped Stone							Debitage	Fremont Ceramics	Misc. Artifacts (Pres/Absc)			Soil Stains		Depression	Features								Site Area (m^2)
			Portable	Non-Portable		Projectile Point	Biface	Drill	Scraper/Uniface/ Utilized Flake	Hammerstone	Core	Chopper			Organics (Maize Cobs, Basketry, Bone, Etc.)	Figurines, Exotics, Shaped Stones,Etc.	FCR/Charcoal/Burned Stone	<2m	>2m		Hearth/Roast	Midden	Granary/Cist	Adobe/Mortar (Pres/Absc)	Rubble Piles/"Pits"	Rock Alignment/Wickiup/ Light Construction	Dry-laid Straight Rock Wall	Masonry/ Pithouse with Vent	
5134	CC		10							3			400+	40				3	1		3	1							7658
5135	ST									1				170										X					5
5136	SH		4	1		1			1				50	100+		X	X	1	2	1		1				1		1	687
5138	CC		3				1		3			1	400+	25				2											3456
5140	PC												300+	16				1											687
5141	ST																						2	X					353
5142	PC						1			1			50+	25					1			1							236
5143	ST			1											X	X							7	X					235
5147	PC	ST			1					1		1	4	2		X							1						160
5149	CC		1			2	2		1	1	7	1	2000+	7				2								1			2985
5150	ST																						1	X					8
5154	CC		1			1	4			1		1	2000+	10					1			1							3530
5156	CC		1						1				3		X								1	X					530
5157	PC					1	2		1			4	500+	3				2					1						16890
5158	ST																						3	X					60
5160	ST												1	1	X								2	X					60
5165	CC		4								2		25-100	2															610
5167	CC		10				1				10		500+	4			X	5	1										7069
5168	LTR		15+		10+	20+	50+	5+	10+	5+	5+	3+	2000+	500+	X	X	X		2	1	1	1	10+	1	1			1	62204
5169	LTR		15		10+	20+	50+	5+	10+	5+	5+	3+	2000+	500+	X	X	X		4	2	3	2	15+	X	1			2	15708
5170	SH					3		6	3	3	2		100-500	150+					2	1			1						2749
5171	CC		5		6	3	33	1	2				150+	65								1							550
5172	CC		1				1			3		1	25-100	40				2	1										1375
5173	CC					1	2			1			100-500	>10					2										982
5174	PC					2	1			2	3	1	25-100	1															785
5175	PC					1	1			1		2	100-500	25+				1	1										4595
5292	CC		6	1		1							25-100	20+															2100
5349	CC		1				1	1		1	2		500+	40+			X		2										2161

Table A.1. Continued

Site No. (42GA..)	Site Type 1	Site Type 2	Ground Stone		Worked Bone Tools	Chipped Stone							Debitage	Fremont Ceramics	Misc. Artifacts (Pres/Absc)			Soil Stains		Depression	Features								Site Area (m^2)
			Portable	Non-Portable		Projectile Point	Biface	Drill	Scraper/Uniface/ Utilized Flake	Hammerstone	Core	Chopper			Organics (Maize Cobs, Basketry, Bone, Etc.)	Figurines, Exotics, Shaped Stones,Etc.	FCR/Charcoal/Burned Stone	<2m	>2m		Hearth/Roast	Midden	Granary/Cist	Adobe/Mortar (Pres/Absc)	Rubble Piles/"Pits"	Rock Alignment/Wickiup/ Light Construction	Dry-laid Straight Rock Wall	Masonry/ Pithouse with Vent	
5350	PC					1	1			4	1		100-500	38					1			1							2827
5351	PC						7	1		1			100-500	10					1										2875
5352	PC		2				1			3			100-500	50				1											1357
5353	PC		5				3	1		1		2	100-500	3					1		1								1642
5355	PC										1		25-100	7															785
5357	PC						2				1		25-100	12															785
5363	CC		3				5			3	1		2000+	13								2							4241
5364	HC					1	3			4	3		1000+				X		1		1								943
5366	PC		1				3						70+	62															1964
5367	PC												<25	5			X	1			1								295
5368	SH		1				2						100-500	200+					1			1							4673
5370	CC		1							2			30	40+				2			2								380
5371	CC		2							3+		1	400	20				1	2		2	1							10053
5372	CC		4							4		1	1000+	20					2		1	1				1			18850
5373	CC						1		1	1			20-25	30					1										785
5374	CC		3							1			25-100	70+															785
5377	CC		3				1			3	1	1	75	<10															4712
5379	PC													200			X	1											707
5380	SH		3			1	2			1			500+	100+			X	1	2	1						1			30631
5381	PC		1							1			5	2															10487
5382	CC		2								4	2	500+	10+					2										1532
5383	PC												500+	12			X	1			1								2651
5384	PC					1	5		2	1			25-100	400			X	1	1		1								1373
5385	CC		1						1	4		3	500+	50+															3204
5388	CC					1	1			2	2		10000+	<11			X		1										22620
5389	PC						1						50-100	<10			X	1		1	2								1571
5390	CC		3				2		1	6			300+	<20			X	1	1		1								1728
5391	CC		1				1						100	7			X	2	3										7540

Table A.1. Continued

			Ground Stone			Chipped Stone									Misc. Artifacts (Pres/Absc)			Soil Stains			Features								
Site No. (42GA..)	Site Type 1	Site Type 2	Portable	Non-Portable	Worked Bone Tools	Projectile Point	Biface	Drill	Scraper/Uniface/ Utilized Flake	Hammerstone	Core	Chopper	Debitage	Fremont Ceramics	Organics (Maize Cobs, Basketry, Bone, Etc.)	Figurines, Exotics, Shaped Stones,Etc.	FCR/Charcoal/Burned Stone	<2m	>2m	Depression	Hearth/Roast	Midden	Granary/Cist	Adobe/Mortar (Pres/Absc)	Rubble Piles/"Pits"	Rock Alignment/Wickiup/ Light Construction	Dry-laid Straight Rock Wall	Masonry/ Pithouse with Vent	Site Area (m^2)
5392	PC					1	3		2	1			500+	<20															6283
5393	CC		2				1		1	2	1	1	2000+	50+			X	5	2			1				1			7854
5395	HC					1	1	1					50					1			1								785
5396	CC		2			1							350+	35+					2										1178
5397	PC						15			1	2		1500+	<10			X		1					X					1375
5398	LTR		2			1			1	12	1		100+	65				6	2		6	1						1	3927
5399	PC						1						5000+	50			X	1	3										37699
5406	PC		4							5	2		25	1				3	1										825
5407	PC		5			1	3		1				500+	<20			X	1	5		4	1							84823
5408	PC		1			1				1			150+				X												982
5409	PC		1				1						1000+	2															8797
5413	SH		5				1			6		1	100	100				4	1			1						1	5498
5414	PC		3								1	1	<25	10			X	3	2										2553
5416	PC		1				1						4000+	<10			X	1	1		1								41234
5417	PC		1										350+	2	X														283
5418	CC						3			3	1		100+	2					1										550
5419	PC		2			1	1						80	>50															1571
5420	LTR	ST	3				1						10000+	2					2	1		1	1	X				1	2513
5422	CC		1				3		2	5		4	50	5			X		3			1				1			1021
5423	LTR		9										1000+	20						1								1	13352
5426	LTR		2										100+	100+						1		1				1		1	393
5429	LTR		1			1				2			175+	175+			X											1	1728
5430	PC											1		1	X									X		1			160
5431	CC		9				2			1			100-500	7					3			1							1237
5432	CC		1							2		2	15	<10					1										196
5433	CC		7				1		1				5000+	3				2	4		2	2							6283
5434	CC		1	1						2			300-500	40+					2			1		X					943
5435	CC		1							2			50-100	32					1			1							628

Table A.1. Continued

Site No. (42GA..)	Site Type 1	Site Type 2	Ground Stone		Worked Bone Tools	Chipped Stone							Debitage	Fremont Ceramics	Misc. Artifacts (Pres/Absc)			Soil Stains		Depression	Features								Site Area (m^2)
			Portable	Non-Portable		Projectile Point	Biface	Drill	Scraper/Uniface/ Utilized Flake	Hammerstone	Core	Chopper			Organics (Maize Cobs, Basketry, Bone, Etc.)	Figurines, Exotics, Shaped Stones,Etc.	FCR/Charcoal/Burned Stone	<2m	>2m		Hearth/Roast	Midden	Granary/Cist	Adobe/Mortar (Pres/Absc)	Rubble Piles/"Pits"	Rock Alignment/Wickiup/ Light Construction	Dry-laid Straight Rock Wall	Masonry/ Pithouse with Vent	
5437	ST																						1	X					2
5438	PC					1	2		1	1	1		25-100	<20													1		236
5440	PC									1	1		50-100	20+			X		1										314
5441	PC									2		1	50-100	28					1										550
5445	CC		7				2			1	1	2	400-500	<10															7544
5446	CC		1				3			3	1		1000+	4															1571
5448	SH					1	6			2	2	3	500+	150+					1		1								589
5449	PC		4									2	200	40															379
5451	SH		1	4			2			2		1	2000+	50+				1	2		1	1						1	18850
5453	CC		2	1			2			1			1000+	1					2										4320
5454	CC						1						200-500	2			X	2											2356
5455	PC		6						1			1	100+	<20			X	1	2		1								1571
5456	LTR		8			1	2			1		2	1000+	100			X	1	4		3	3						1	29845
5457	SH		4				4		2			1	25-100	100+												1		1	1571
5461	CC		1				1		1				25-100	26			X		1										786
5462	PC					4	3			1			25-100	18					1										589
5463	PC		2			1				3			50-100						1										353
5465	CC		3				3			3			50-100	71			X	1											2678
5512	PC									2			1	3			X				1								80
5605	PC		1										100-500	8															13350
5812	ST											2		2	X								1						94
5813	ST																						1	X					7
5815	ST																						1	X					0
5816	CC		1				3		1	4	6	3	100+	3					1										28
5818	PC											1	2	5+			X		1										16
5820	ST																						1	X					4
5824	ST																						1	X					3
5827	PC		5+							2			25-100	<10				1											16

Table A.1. Continued

Site No. (42GA..)	Site Type 1	Site Type 2	Ground Stone: Portable	Ground Stone: Non-Portable	Worked Bone Tools	Chipped Stone: Projectile Point	Chipped Stone: Biface	Chipped Stone: Drill	Chipped Stone: Scraper/Uniface/ Utilized Flake	Chipped Stone: Hammerstone	Chipped Stone: Core	Chipped Stone: Chopper	Debitage	Fremont Ceramics	Misc. Artifacts (Pres/Absc): Organics (Maize Cobs, Basketry, Bone, Etc.)	Misc. Artifacts (Pres/Absc): Figurines, Exotics, Shaped Stones,Etc.	Misc. Artifacts (Pres/Absc): FCR/Charcoal/Burned Stone	Soil Stains: <2m	Soil Stains: >2m	Depression	Features: Hearth/Roast	Features: Midden	Features: Granary/Cist	Features: Adobe/Mortar (Pres/Absc)	Features: Rubble Piles/"Pits"	Features: Rock Alignment/Wickiup/ Light Construction	Features: Dry-laid Straight Rock Wall	Features: Masonry/ Pithouse with Vent	Site Area (m^2)
5832	CC		2				1			1			75	30	X		X	1											200
5833	CC						1					1	150+	15+					1							1			2400
5853	PC								2			2	<25	18															236
5855	ST																						1	X					295
5862	LTR		2				2+						100-500	>100				1	1		1							1	354
5863	LTR		1			1	1			1			500+	100+	X	X			3				2	X				1	30600
5900	CC		1			1	1						25-100	9															314
5904	PC										2		25	15			X	1	1		2								155
6254	LTR		1			15+	2+			2+	1		>100	500+								1						2	6293
6260	ST																						1	X					10
6261	ST																						1	X					10
6262	ST																						1						10
1585b	ST																						1	X					1

APPENDIX B

Data Table:
General Analysis

Table B.1. Data Table for Upper Escalante River Drainage Site Distribution Study

Site No. (42GA..)	PrimarySite Type	Secondary Site Type	Elevation	GIS Distance-toWater (m)	Primary Landform	Secondary Landform
35	Storage		5200	183.8	Valley	Terrace/ Bench
36	Storage		5240	275.3	Canyon	Ridge/Knoll
42	Long Term Residence		6040	2588.6	Valley	Alcove/Rock shelter
43	Long Term Residence		6010	3153.3	Valley	Slope
51	Long Term Residence		5845	378.9	Valley	Ridge/Knoll
54	Long Term Residence		5963	73.7	Valley	Alcove/Rock shelter
90	Plant Processing Camp		4880	145.7	Canyon	Ridge/Knoll
102	Storage		4800	32.0	Canyon	Dune
103	Storage		4780	452.6	Canyon	Slope
105	Storage		4780	56.5	Canyon	Cliff
106	Storage		4800	147.6	Canyon	Slope
108	Storage		4806	173.1	Canyon	Terrace/ Bench
111	Storage		4810	127.3	Canyon	Alcove/Rock shelter
112	Storage		4800	73.3	Canyon	Slope
113	Storage		4972	109.9	Canyon	Slope
277	Storage		4760	148.5	Canyon	Ridge/Knoll
279	Storage		4790	41.1	Canyon	Terrace/ Bench
280	Storage		4800	149.6	Canyon	Slope
284	Storage		4800	175.9	Canyon	Terrace/ Bench
286	Complex Camp	Storage	4810	67.2	Canyon	Alcove/Rock shelter
288	Complex Camp	Storage	4960	32.1	Canyon	Alcove/Rock shelter
289	Storage		4964	111.3	Canyon	Ridge/Knoll
290	Complex Camp	Storage	4800	72.9	Canyon	Cliff
291	Plant Processing Camp		4820	82.9	Canyon	Terrace/ Bench
292	Complex Camp		4820	140.7	Canyon	Terrace/ Bench
294	Plant Processing Camp	Storage	4864	205.2	Canyon	Cliff
298	Complex Camp	Storage	4945	163.5	Canyon	Ridge/Knoll
300	Complex Camp		4780	109.5	Canyon	Slope
301	Plant Processing Camp		4960	100.0	Canyon	Ledge
528	Long Term Residence		5840	319.4	Valley	Ridge/ Knoll
543	Long Term Residence		5980	3913.6	Valley	Mesa/Butte
554	Hunting Camp		5640	12852.1	Ridge	Ledge
557	Complex Camp		5995	638.6	Valley	Ridge/Knoll
773	Plant Processing Camp		6240	4181.1	Canyon	Alcove/Rock shelter
882	Seasonal Habitation	Storage	5600	16428.6	Canyon	Ridge/Knoll
888	Plant Processing Camp		6400	9964.0	Canyon	Alcove/Rock shelter
889	Plant Processing Camp	Storage	6360	10128.5	Canyon	Ridge/Knoll

Table B.1. Continued.

Site No. (42GA..)	PrimarySite Type	Secondary Site Type	Elevation	GIS Distance-toWater (m)	Primary Landform	Secondary Landform
891	Storage		6200	5785.4	Canyon	Terrace/ Bench
893	Plant Processing Camp		7000	15820.3	Tableland/ Mesa	Terrace/ Bench
900	Plant Processing Camp		6760	3428.8	Canyon	Slope
929	Plant Processing Camp		6260	1211.9	Valley	Alcove/Rock shelter
932	Storage		6300	9930.3	Canyon	Alcove/Rock shelter
936	Plant Processing Camp		5640	11869.4	Valley	Ridge/Knoll
944	Complex Camp		5220	21.6	Canyon	Alcove/Rock shelter
995	Plant Processing Camp		5480	120.3	Canyon	Slope
998	Plant Processing Camp		5520	117.4	Canyon	Dune
1006	Complex Camp		5320	69.0	Canyon	Alcove/Rock shelter
1099	Storage		5480	56.1	Canyon	Alcove/Rock shelter
1423	Plant Processing Camp	Storage	5720	108.2	Canyon	Terrace/ Bench
1425	Complex Camp		6000	25.5	Canyon	Alcove/Rock shelter
1434	Plant Processing Camp	Storage	5360	216.6	Canyon	Alcove/Rock shelter
1437	Storage		5600	64.0	Canyon	Alcove/Rock shelter
1440	Complex Camp		5440	181.7	Canyon	Alcove/Rock shelter
1459	Plant Processing Camp		7160	4482.5	Tableland/ Mesa	Alcove/Rock shelter
1474	Complex Camp	Storage	7300	4060.9	Canyon	Alcove/Rock shelter
1478	Storage		7480	2949.6	Ridge	Ridge/Knoll
1484	Complex Camp		6650	2296.6	Ridge	Alcove/Rock shelter
1537	Complex Camp		5400	85.4	Canyon	Ledge
1538	Storage		5100	159.4	Canyon	Ridge/Knoll
1539	Storage		5400	794.8	Canyon	Alcove/Rock shelter
1541	Complex Camp	Storage	4840	80.3	Canyon	Alcove/Rock shelter
1544	Complex Camp		5200	64.9	Canyon	Alcove/Rock shelter
1545	Complex Camp		5180	63.3	Canyon	Alcove/Rock shelter
1549	Plant Processing Camp	Storage	5000	105.5	Canyon	Alcove/Rock shelter
1565	Storage		6180	3070.6	Canyon	Slope
1569	Plant Processing Camp		6080	3706.0	Valley	Floodplain
1572	Complex Camp		6020	598.2	Valley	Alcove/Rock shelter
1573	Complex Camp		6190	684.2	Valley	Alcove/Rock shelter
1580	Complex Camp		5960	669.8	Valley	Ridge/Knoll
1582	Complex Camp		5920	620.1	Valley	Alcove/Rock shelter
1585	Long Term Residence		6160	679.0	Valley	Ridge/Knoll
1585b	Storage		6160	679.0	Valley	Mesa/Butte
1586	Complex Camp		6020	942.1	Valley	Ridge/Knoll
1587	Complex Camp		6040	979.5	Valley	Terrace/ Bench

Table B.1. Continued.

Site No. (42GA..)	PrimarySite Type	Secondary Site Type	Elevation	GIS Distance-toWater (m)	Primary Landform	Secondary Landform
1621	Complex Camp		6100	2710.3	Tableland/ Mesa	Slope
1719	Complex Camp		7320	4084.4	Tableland/ Mesa	Alcove/Rock shelter
1817	Complex Camp	Storage	5720	483.2	Canyon	Cliff
1818	Storage		6100	1007.4	Tableland/ Mesa	Slope
1819	Storage		6150	902.7	Tableland/ Mesa	Ridge/Knoll
1820	Plant Processing Camp		5873	601.2	Tableland/ Mesa	Saddle/Pass
1821	Plant Processing Camp		5921	672.6	Valley	Slope
1822	Plant Processing Camp		5920	461.6	Valley	Slope
1823	Plant Processing Camp		5980	573.1	Tableland/ Mesa	Terrace/ Bench
1824	Plant Processing Camp		6239	1102.3	Ridge	Slope
1876	Complex Camp		5353	36.9	Canyon	Slope
2099	Storage		6920	126.5	Valley	Alcove/Rock shelter
2100	Storage		6400	457.7	Valley	Alcove/Rock shelter
2101	Storage		6300	411.0	Valley	Ridge/Knoll
2104	Storage		5940	12748.0	Ridge	Alcove/Rock shelter
2105	Storage		6740	207.7	Canyon	Alcove/Rock shelter
2106	Storage		6750	235.4	Canyon	Ridge/Knoll
2121	Storage		5620	432.8	Canyon	Alcove/Rock shelter
2121	Storage		5680	432.8	Canyon	Ridge/Knoll
2123	Plant Processing Camp		5900	2431.1	Canyon	Alcove/Rock shelter
2246	Complex Camp		6390	11286.7	Ridge	Alcove/Rock shelter
2294	Storage		6320	10242.5	Canyon	Terrace/ Bench
2639	Long Term Residence		6680	295.3	Valley	Alcove/Rock shelter
2661	Plant Processing Camp		5960	485.5	Valley	Slope
2662	Complex Camp		5960	434.9	Valley	Ridge/Knoll
2664	Complex Camp		6000	507.1	Valley	Ridge/Knoll
2665	Complex Camp		5920	357.1	Valley	Dune
2843	Complex Camp		6680	87.3	Canyon	Alcove/Rock shelter
2844	Plant Processing Camp		6740	11.2	Valley	Cliff
2853	Storage		6720	186.3	Canyon	Alcove/Rock shelter
3096	Plant Processing Camp		5720	368.5	Canyon	Alcove/Rock shelter
3097	Plant Processing Camp		5720	603.9	Canyon	Ridge/Knoll
3098	Complex Camp		5800	440.7	Tableland/ Mesa	Outcrop
3119	Plant Processing Camp		5480	30.5	Canyon	Terrace/ Bench
3144	Long Term Residence		6130	3626.9	Valley	Delta
3234	Seasonal Habitation		6120	109.3	Valley	Terrace/ Bench
3460	Storage		5440	323.2	Canyon	Terrace/ Bench

Table B.1. Continued.

Site No. (42GA..)	PrimarySite Type	Secondary Site Type	Elevation	GIS Distance-toWater (m)	Primary Landform	Secondary Landform
3465	Plant Processing Camp		5300	10.4	Canyon	Terrace/ Bench
3499	Plant Processing Camp		5400	9950.0	Tableland/ Mesa	Terrace/ Bench
3543	Plant Processing Camp		6160	3150.4	Valley	Alcove/Rock shelter
3545	Complex Camp		6120	2884.7	Valley	Terrace/ Bench
3566	Plant Processing Camp		5220	268.7	Canyon	Ledge
3597	Complex Camp		6240	95.8	Canyon	Ridge/ Knoll
3607	Plant Processing Camp		5900	10041.4	Tableland/ Mesa	Ridge/ Knoll
3621	Plant Processing Camp		5840	8664.8	Tableland/ Mesa	Terrace/ Bench
3660	Complex Camp	Storage	6200	1116.4	Tableland/ Mesa	Ridge/Knoll
3738	Seasonal Habitation		6200	559.1	Valley	Alcove/Rock shelter
3739	Seasonal Habitation		6160	770.6	Valley	Alcove/Rock shelter
3742	Seasonal Habitation		5720	1264.0	Tableland/ Mesa	Terrace/ Bench
3744	Seasonal Habitation		6240	66.5	Valley	Terrace/ Bench
3745	Storage		6200	308.4	Canyon	Alcove/Rock shelter
3746	Plant Processing Camp		6400	784.8	Tableland/ Mesa	Alcove/Rock shelter
3747	Complex Camp		6400	662.4	Canyon	Alcove/Rock shelter
3751	Plant Processing Camp		6040	707.8	Valley	Alcove/Rock shelter
3752	Long Term Residence		6060	118.6	Valley	Alcove/Rock shelter
3753	Plant Processing Camp		6000	78.9	Valley	Alcove/Rock shelter
3754	Plant Processing Camp		6000	121.7	Canyon	Alcove/Rock shelter
3755	Storage		6760	54.4	Canyon	Alcove/Rock shelter
3756	Seasonal Habitation		6500	890.2	Valley	Alcove/Rock shelter
3759	Hunting Camp		6500	696.1	Valley	Ridge/Knoll
3876	Plant Processing Camp		4760	71.9	Canyon	Alcove/Rock shelter
3878	Complex Camp	Storage	5000	266.6	Canyon	Alcove/Rock shelter
3879	Plant Processing Camp	Storage	4990	185.5	Canyon	Alcove/Rock shelter
3881	Storage		4920	107.0	Canyon	Alcove/Rock shelter
3882	Storage		4920	129.5	Canyon	Terrace/ Bench
3891	Seasonal Habitation		6440	607.0	Tableland/ Mesa	Alcove/Rock shelter
3907	Storage		6280	606.9	Valley	Terrace/ Bench
4084	Seasonal Habitation		5800	297.6	Tableland/ Mesa	Alcove/Rock shelter
4085	Plant Processing Camp		5800	213.5	Canyon	Dune
4086	Long Term Residence		5800	2135.5	Tableland/ Mesa	Mesa/Butte
4087	Plant Processing Camp		6200	2560.7	Canyon	Mesa/Butte
4088	Plant Processing Camp		6240	2584.7	Tableland/ Mesa	Mesa/Butte
4089	Plant Processing Camp		6200	2654.1	Tableland/ Mesa	Mesa/Butte
4091	Plant Processing Camp		6240	2507.0	Tableland/ Mesa	Terrace/ Bench

Table B.1. Continued.

Site No. (42GA..)	PrimarySite Type	Secondary Site Type	Elevation	GIS Distance-toWater (m)	Primary Landform	Secondary Landform
4092	Seasonal Habitation		6400	1958.5	Tableland/ Mesa	Alcove/Rock shelter
4095	Seasonal Habitation		5580	2031.5	Tableland/ Mesa	Alcove/Rock shelter
4104	Plant Processing Camp		5010	133.2	Canyon	Alcove/Rock shelter
4110	Plant Processing Camp		6362	2022.1	Ridge	Alcove/Rock shelter
4111	Seasonal Habitation		6200	2829.9	Tableland/ Mesa	Alcove/Rock shelter
4112	Plant Processing Camp		6200	2773.8	Tableland/ Mesa	Terrace/ Bench
4113	Seasonal Habitation		6200	2523.1	Tableland/ Mesa	Alcove/Rock shelter
4114	Plant Processing Camp		6400	1397.9	Tableland/ Mesa	Alcove/Rock shelter
4115	Seasonal Habitation		6360	1259.9	Tableland/ Mesa	Ridge/Knoll
4116	Plant Processing Camp		6280	1452.1	Tableland/ Mesa	Alcove/Rock shelter
4122	Complex Camp	Storage	5860	530.1	Tableland/ Mesa	Alcove/Rock shelter
4123	Plant Processing Camp	Storage	4840	0.5	Canyon	Alcove/Rock shelter
4125	Seasonal Habitation		6600	109.3	Canyon	Slope
4126	Storage		6920	210.7	Tableland/ Mesa	Terrace/ Bench
4127	Storage		5600	158.7	Canyon	Slope
4135	Seasonal Habitation		6520	215.2	Canyon	Terrace/ Bench
4136	Long Term Residence		6960	339.7	Tableland/ Mesa	Alcove/Rock shelter
4138	Storage		6960	345.3	Tableland/ Mesa	Ledge
4140	Storage		5520	3.5	Canyon	Terrace/ Bench
4141	Storage		5600	95.3	Canyon	Alcove/Rock shelter
4165	Complex Camp		5600	216.9	Canyon	Ridge/Knoll
4167	Long Term Residence		5970	74.3	Valley	Alcove/Rock shelter
4168	Seasonal Habitation		6440	23.7	Canyon	Alcove/Rock shelter
4181	Seasonal Habitation		6480	56.1	Canyon	Alcove/Rock shelter
4212	Plant Processing Camp		5880	1605.3	Tableland/ Mesa	Alcove/Rock shelter
4332	Storage		6600	2939.8	Tableland/ Mesa	Alcove/Rock shelter
4334	Plant Processing Camp		4920	350.9	Canyon	Alcove/Rock shelter
4336	Storage		4920	134.6	Canyon	Alcove/Rock shelter
4337	Storage		4920	132.6	Canyon	Terrace/ Bench
4398	Complex Camp		4920	74.1	Canyon	Ridge/Knoll
4507	Storage		5800	8836.9	Tableland/ Mesa	Ridge/Knoll
4509	Plant Processing Camp		6240	4189.6	Canyon	Ridge/Knoll
4510	Storage		5250	5.9	Canyon	Ridge/Knoll
4511	Complex Camp		5320	30.8	Canyon	Terrace/ Bench
4515	Plant Processing Camp	Storage	5320	58.8	Canyon	Alcove/Rock shelter
4516	Complex Camp		5250	24.7	Canyon	Dune
4517	Complex Camp		5200	26.5	Canyon	Terrace/ Bench

Table B.1. Continued.

Site No. (42GA..)	PrimarySite Type	Secondary Site Type	Elevation	GIS Distance-toWater (m)	Primary Landform	Secondary Landform
4518	Plant Processing Camp	Storage	5160	95.1	Canyon	Cliff
4520	Plant Processing Camp		5200	7.4	Canyon	Alcove/Rock shelter
4521	Storage		5140	24.7	Canyon	Alcove/Rock shelter
4524	Plant Processing Camp		5200	104.1	Canyon	Plain
4526	Plant Processing Camp		5240	349.9	Canyon	Terrace/ Bench
4530	Plant Processing Camp		5150	208.4	Canyon	Ridge/Knoll
4532	Storage		4980	121.2	Canyon	Ridge/Knoll
4533	Complex Camp		4960	10.3	Canyon	Ridge/Knoll
4534	Complex Camp		5000	128.2	Canyon	Dune
4535	Storage		4950	76.7	Canyon	Ridge/Knoll
4536	Complex Camp		4920	137.5	Canyon	Ridge/Knoll
4538	Storage		4920	21.6	Canyon	Ridge/Knoll
4543	Complex Camp		4900	24.8	Canyon	Ridge/Knoll
4544	Complex Camp		4860	22.0	Canyon	Alcove/Rock shelter
4548	Plant Processing Camp		5400	38.3	Canyon	Ridge/Knoll
4549	Plant Processing Camp		4850	241.1	Canyon	Terrace/ Bench
4552	Seasonal Habitation		6200	35.2	Canyon	Ridge/Knoll
4555	Plant Processing Camp		6200	90.6	Valley	Terrace/ Bench
4556	Plant Processing Camp		4980	24.5	Canyon	Mesa/Butte
4561	Complex Camp	Storage	5200	2.7	Canyon	Ridge/Knoll
4562	Complex Camp		4880	919.6	Canyon	Mesa/Butte
4599	Plant Processing Camp		4840	34.6	Canyon	Mesa/Butte
4608	Seasonal Habitation		6220	633.2	Tableland/ Mesa	Terrace/ Bench
4609	Seasonal Habitation		6210	216.2	Tableland/ Mesa	Alcove/Rock shelter
4610	Seasonal Habitation		6040	28.9	Tableland/ Mesa	Alcove/Rock shelter
4611	Plant Processing Camp		6000	104.8	Tableland/ Mesa	Alcove/Rock shelter
4680	Complex Camp		6050	106.1	Tableland/ Mesa	Alcove/Rock shelter
4684	Complex Camp		5600	51.6	Canyon	Slope
4685	Plant Processing Camp	Storage	5480	56.4	Canyon	Terrace/ Bench
4687	Plant Processing Camp		5550	329.5	Canyon	Slope
4688	Complex Camp	Storage	5450	20.5	Canyon	Terrace/ Bench
4690	Complex Camp	Storage	5400	19.1	Canyon	Alcove/Rock shelter
4692	Complex Camp		5400	90.7	Canyon	Alcove/Rock shelter
4693	Plant Processing Camp	Storage	5400	144.2	Canyon	Ridge/Knoll
4694	Complex Camp		5300	97.5	Canyon	Ridge/Knoll
4696	Complex Camp		5300	65.5	Canyon	Slope
4698	Plant Processing Camp		5300	425.9	Canyon	Ridge/Knoll

Table B.1. Continued.

Site No. (42GA..)	PrimarySite Type	Secondary Site Type	Elevation	GIS Distance-toWater (m)	Primary Landform	Secondary Landform
4699	Plant Processing Camp	Storage	5350	101.6	Canyon	Terrace/ Bench
4700	Complex Camp		5300	8.1	Canyon	Slope
4704	Storage		5250	202.7	Canyon	Alcove/Rock shelter
4710	Complex Camp	Storage	5100	96.5	Canyon	Ledge
4711	Complex Camp	Storage	5100	81.9	Canyon	Terrace/ Bench
4712	Plant Processing Camp		5000	150.4	Canyon	Ridge/Knoll
4822	Plant Processing Camp		6520	7825.5	Tableland/ Mesa	Slope
4831	Plant Processing Camp		5880	911.4	Tableland/ Mesa	Slope
4832	Seasonal Habitation		5770	3610.7	Tableland/ Mesa	Slope
4857	Plant Processing Camp		5760	3572.0	Tableland/ Mesa	Ridge/Knoll
4859	Complex Camp		5760	3131.9	Tableland/ Mesa	Slope
4886	Complex Camp		5740	3754.7	Tableland/ Mesa	Slope
4903	Seasonal Habitation		5740	3613.7	Tableland/ Mesa	Alcove/Rock shelter
4904	Complex Camp		5740	3869.2	Tableland/ Mesa	Ridge/Knoll
4922	Plant Processing Camp		5720	3511.7	Canyon	Ridge/Knoll
4923	Complex Camp		5960	2941.0	Tableland/ Mesa	Slope
4926	Complex Camp		5840	2772.2	Tableland/ Mesa	Terrace/ Bench
4937	Complex Camp		5760	3849.9	Tableland/ Mesa	Alcove/Rock shelter
4939	Plant Processing Camp		5720	3685.6	Tableland/ Mesa	Alcove/Rock shelter
4941	Complex Camp		5760	3657.5	Tableland/ Mesa	Ridge/Knoll
4946	Complex Camp		5760	3927.9	Tableland/ Mesa	Slope
4958	Complex Camp		6440	7712.0	Tableland/ Mesa	Alcove/Rock shelter
4960	Complex Camp		6450	7909.0	Tableland/ Mesa	Ridge/Knoll
4966	Complex Camp		6160	2542.3	Tableland/ Mesa	Alcove/Rock shelter
4974	Complex Camp		5680	3009.6	Tableland/ Mesa	Plain
4996	Complex Camp		5010	133.2	Canyon	Ridge/Knoll
5001	Storage		4880	263.8	Canyon	Slope
5002	Complex Camp		5120	391.2	Canyon	Ridge/Knoll
5050	Long Term Residence		6385	818.4	Tableland/ Mesa	Terrace/ Bench
5051	Complex Camp		6360	918.6	Ridge	Slope
5054	Complex Camp		6480	1119.8	Ridge	Terrace/ Bench
5056	Complex Camp		6640	550.9	Tableland/ Mesa	Ridge/Knoll
5058	Hunting Camp		6640	548.9	Tableland/ Mesa	Ridge/Knoll
5060	Complex Camp		6640	913.6	Tableland/ Mesa	Ridge/Knoll
5061	Complex Camp		6400	2005.4	Tableland/ Mesa	Alcove/Rock shelter
5062	Complex Camp		6360	2083.1	Tableland/ Mesa	Ledge
5067	Hunting Camp		6560	851.3	Tableland/ Mesa	Slope

Table B.1. Continued.

Site No. (42GA..)	PrimarySite Type	Secondary Site Type	Elevation	GIS Distance-toWater (m)	Primary Landform	Secondary Landform
5071	Complex Camp		6600	980.8	Tableland/ Mesa	Ridge/Knoll
5072	Complex Camp		6600	917.2	Tableland/ Mesa	Alcove/Rock shelter
5075	Plant Processing Camp		6480	1430.2	Tableland/ Mesa	Terrace/ Bench
5082	Complex Camp		6320	2145.8	Tableland/ Mesa	Alcove/Rock shelter
5085	Plant Processing Camp		6440	1518.4	Tableland/ Mesa	Ledge
5088	Seasonal Habitation		6360	1965.7	Tableland/ Mesa	Alcove/Rock shelter
5096	Plant Processing Camp		6330	1986.2	Tableland/ Mesa	Alcove/Rock shelter
5102	Complex Camp		6340	1437.6	Tableland/ Mesa	Alcove/Rock shelter
5106	Complex Camp		6220	2421.5	Tableland/ Mesa	Alcove/Rock shelter
5107	Complex Camp		6240	2340.5	Tableland/ Mesa	Alcove/Rock shelter
5108	Complex Camp		6300	2137.9	Tableland/ Mesa	Slope
5109	Plant Processing Camp		6320	1992.9	Tableland/ Mesa	Alcove/Rock shelter
5110	Plant Processing Camp		6360	1829.4	Tableland/ Mesa	Slope
5113	Complex Camp		6350	1845.9	Tableland/ Mesa	Ledge
5117	Complex Camp		6250	2542.8	Tableland/ Mesa	Cliff
5118	Complex Camp		6280	1667.5	Tableland/ Mesa	Floodplain
5120	Complex Camp		6330	1782.1	Tableland/ Mesa	Terrace/ Bench
5124	Complex Camp		6223	1308.3	Tableland/ Mesa	Ridge/Knoll
5125	Complex Camp		6026	1216.7	Tableland/ Mesa	Ridge/Knoll
5128	Complex Camp		6267	1487.1	Tableland/ Mesa	Slope
5131	Long Term Residence		6305	1300.7	Tableland/ Mesa	Alcove/Rock shelter
5133	Long Term Residence		6240	2307.2	Tableland/ Mesa	Ridge/Knoll
5134	Complex Camp		6273	1045.4	Tableland/ Mesa	Slope
5135	Storage		6010	447.2	Ridge	Terrace/ Bench
5136	Seasonal Habitation		6210	1205.5	Tableland/ Mesa	Terrace/ Bench
5138	Complex Camp		6240	1009.9	Tableland/ Mesa	Ridge/Knoll
5140	Plant Processing Camp		5330	141.8	Canyon	Ridge/Knoll
5141	Storage		5360	16.3	Canyon	Ridge/Knoll
5142	Plant Processing Camp		5340	60.7	Canyon	Ridge/Knoll
5143	Storage		5360	255.7	Canyon	Terrace/ Bench
5147	Plant Processing Camp	Storage	5360	301.6	Canyon	Alcove/Rock shelter
5149	Complex Camp		5360	38.2	Canyon	Ridge/Knoll
5150	Storage		5380	8.0	Canyon	Terrace/ Bench
5154	Complex Camp		5320	4.6	Canyon	Floodplain
5156	Complex Camp		5340	255.0	Canyon	Alcove/Rock shelter
5157	Plant Processing Camp		5280	1.7	Canyon	Slope
5158	Storage		5400	218.4	Canyon	Ridge/Knoll

Table B.1. Continued.

Site No. (42GA..)	PrimarySite Type	Secondary Site Type	Elevation	GIS Distance-toWater (m)	Primary Landform	Secondary Landform
5160	Storage		5420	376.6	Canyon	Floodplain
5165	Complex Camp		5320	104.8	Canyon	Ridge/Knoll
5167	Complex Camp		5362	60.5	Canyon	Alcove/Rock shelter
5168	Long Term Residence		6000	258.9	Valley	Terrace/ Bench
5169	Long Term Residence		5931	269.8	Valley	Mesa/Butte
5170	Seasonal Habitation		6440	239.9	Canyon	Slope
5171	Complex Camp		5840	398.9	Valley	Terrace/ Bench
5172	Complex Camp		6440	261.3	Canyon	Ridge/Knoll
5173	Complex Camp		6420	273.6	Canyon	Alcove/Rock shelter
5174	Plant Processing Camp		6480	336.1	Canyon	Ledge
5175	Plant Processing Camp		6285	359.2	Canyon	Terrace/ Bench
5292	Complex Camp		7000	3680.5	Valley	Terrace/ Bench
5349	Complex Camp		6285	350.3	Canyon	Slope
5350	Plant Processing Camp		6280	234.3	Canyon	Ridge/Knoll
5351	Plant Processing Camp		6280	150.2	Canyon	Terrace/ Bench
5352	Plant Processing Camp		6280	442.9	Canyon	Ridge/Knoll
5353	Plant Processing Camp		6270	346.6	Canyon	Terrace/ Bench
5355	Plant Processing Camp		6350	338.8	Canyon	Slope
5357	Plant Processing Camp		6340	168.9	Canyon	Terrace/ Bench
5363	Complex Camp		6240	80.5	Canyon	Alcove/Rock shelter
5364	Hunting Camp		6200	11.5	Canyon	Mesa/Butte
5366	Plant Processing Camp		6240	1144.8	Valley	Slope
5367	Plant Processing Camp		6160	921.1	Valley	Terrace/ Bench
5368	Seasonal Habitation		6120	837.6	Valley	Ridge/Knoll
5370	Complex Camp		6080	540.2	Valley	Ridge/Knoll
5371	Complex Camp		6060	424.1	Valley	Ridge/Knoll
5372	Complex Camp		6200	585.6	Valley	Slope
5373	Complex Camp		6280	1745.9	Valley	Slope
5374	Complex Camp		6140	999.8	Valley	Slope
5377	Complex Camp		6100	873.0	Valley	Ridge/Knoll
5379	Plant Processing Camp		6200	1985.5	Ridge	Ridge/Knoll
5380	Seasonal Habitation		6190	68.8	Valley	Ridge/Knoll
5381	Plant Processing Camp		5926	83.9	Valley	Terrace/ Bench
5382	Complex Camp		5960	228.3	Valley	Slope
5383	Plant Processing Camp		6165	979.7	Valley	Slope
5384	Plant Processing Camp		6240	2464.0	Ridge	Ridge/Knoll
5385	Complex Camp		6000	466.6	Valley	Slope

Table B.1. Continued.

Site No. (42GA..)	PrimarySite Type	Secondary Site Type	Elevation	GIS Distance-toWater (m)	Primary Landform	Secondary Landform
5388	Complex Camp		6224	892.1	Tableland/ Mesa	Ridge/Knoll
5389	Plant Processing Camp		6030	2975.9	Ridge	Terrace/ Bench
5390	Complex Camp		5960	496.9	Valley	Plain
5391	Complex Camp		6270	971.1	Tableland/ Mesa	Ridge/Knoll
5392	Plant Processing Camp		6265	937.0	Tableland/ Mesa	Ridge/Knoll
5393	Complex Camp		6310	1204.9	Tableland/ Mesa	Alcove/Rock shelter
5395	Hunting Camp		6070	2076.4	Valley	Ridge/Knoll
5396	Complex Camp		6050	2213.5	Valley	Basin
5397	Plant Processing Camp		6080	2754.1	Ridge	Arroyo
5398	Long Term Residence		6000	819.8	Valley	Arroyo
5399	Plant Processing Camp		6300	1209.7	Tableland/ Mesa	Slope
5406	Plant Processing Camp		6040	996.2	Valley	Ridge/Knoll
5407	Plant Processing Camp		6080	1169.3	Tableland/ Mesa	Alcove/Rock shelter
5408	Plant Processing Camp		6200	1676.7	Valley	Slope
5409	Plant Processing Camp		6186	2063.0	Valley	Slope
5413	Seasonal Habitation		6020	809.5	Valley	Slope
5414	Plant Processing Camp		6020	881.8	Valley	Alcove/Rock shelter
5416	Plant Processing Camp		5980	3227.0	Valley	Alcove/Rock shelter
5417	Plant Processing Camp		5950	3425.3	Valley	Cliff
5418	Complex Camp		6000	1084.6	Valley	Ridge/Knoll
5419	Plant Processing Camp		6169	2194.7	Valley	Alcove/Rock shelter
5420	Long Term Residence	Storage	6120	2540.7	Valley	Terrace/ Bench
5422	Complex Camp		6020	879.5	Valley	Terrace/ Bench
5423	Long Term Residence		6000	3346.9	Valley	Ridge/Knoll
5426	Long Term Residence		6061	2079.2	Valley	Talus Slope (S)
5429	Long Term Residence		6000	2111.2	Valley	Alcove/Rock shelter
5430	Plant Processing Camp		6040	999.4	Tableland/ Mesa	Alcove/Rock shelter
5431	Complex Camp		6090	1707.0	Valley	Slope
5432	Complex Camp		6100	1914.5	Valley	Ridge/Knoll
5433	Complex Camp		6000	2005.7	Valley	Ridge/Knoll
5434	Complex Camp		5960	2138.0	Ridge	Ridge/Knoll
5435	Complex Camp		6000	2427.3	Valley	Terrace/ Bench
5437	Storage		6269	1021.6	Tableland/ Mesa	Ridge/Knoll
5438	Plant Processing Camp		6120	856.9	Valley	Terrace/ Bench
5440	Plant Processing Camp		6160	1653.6	Valley	Ridge/Knoll
5441	Plant Processing Camp		6080	1651.6	Valley	Ridge/Knoll
5445	Complex Camp		5940	3929.3	Ridge	Ridge/Knoll

Table B.1. Continued.

Site No. (42GA..)	PrimarySite Type	Secondary Site Type	Elevation	GIS Distance-toWater (m)	Primary Landform	Secondary Landform
5446	Complex Camp		5960	3637.0	Valley	Slope
5448	Seasonal Habitation		5920	3561.3	Valley	Slope
5449	Plant Processing Camp		5920	3342.5	Valley	Slope
5451	Seasonal Habitation		6010	4032.2	Valley	Slope
5453	Complex Camp		6045	3748.4	Valley	Ridge/Knoll
5454	Complex Camp		6084	3917.9	Ridge	Ridge/Knoll
5455	Plant Processing Camp		6010	3129.8	Ridge	Slope
5456	Long Term Residence		6000	3687.1	Ridge	Ridge/Knoll
5457	Seasonal Habitation		6005	3655.4	Valley	Mesa/Butte
5461	Complex Camp		5845	10650.9	Valley	Ridge/Knoll
5462	Plant Processing Camp		5790	10573.8	Valley	Alcove/Rock shelter
5463	Plant Processing Camp		5830	11306.9	Valley	Alcove/Rock shelter
5465	Complex Camp		5800	11455.8	Valley	Alcove/Rock shelter
5512	Plant Processing Camp		6680	10.2	Canyon	Ridge/Knoll
5605	Plant Processing Camp		5680	25.0	Canyon	Ridge/Knoll
5812	Storage		5720	121.9	Canyon	Cliff
5813	Storage		5660	96.9	Canyon	Cliff
5815	Storage		5600	39.6	Canyon	Cliff
5816	Complex Camp		5580	30.0	Canyon	Cliff
5818	Plant Processing Camp		5500	138.3	Canyon	Cliff
5820	Storage		5520	139.3	Canyon	Cliff
5824	Storage		5440	107.7	Canyon	Alcove/Rock shelter
5827	Plant Processing Camp		5320	69.0	Canyon	Alcove/Rock shelter
5832	Complex Camp		5360	191.5	Canyon	Alcove/Rock shelter
5833	Complex Camp		5360	53.1	Canyon	Terrace/ Bench
5853	Plant Processing Camp		5520	60.1	Canyon	Cliff
5855	Storage		5400	107.1	Canyon	Ridge/Knoll
5862	Long Term Residence		6600	199.6	Tableland/ Mesa	Alcove/Rock shelter
5863	Long Term Residence		6160	72.8	Canyon	Alcove/Rock shelter
5900	Complex Camp		5000	155.9	Valley	Slope
5904	Plant Processing Camp		5120	170.1	Valley	Alcove/Rock shelter
6254	Long Term Residence		6124	135.1	Valley	Ridge/Knoll
6260	Storage		6801	604.6	Canyon	Cliff
6261	Storage		6788	528.8	Canyon	Cliff
6262	Storage		6726	484.1	Canyon	Cliff

APPENDIX C

Elevation Analysis Maps

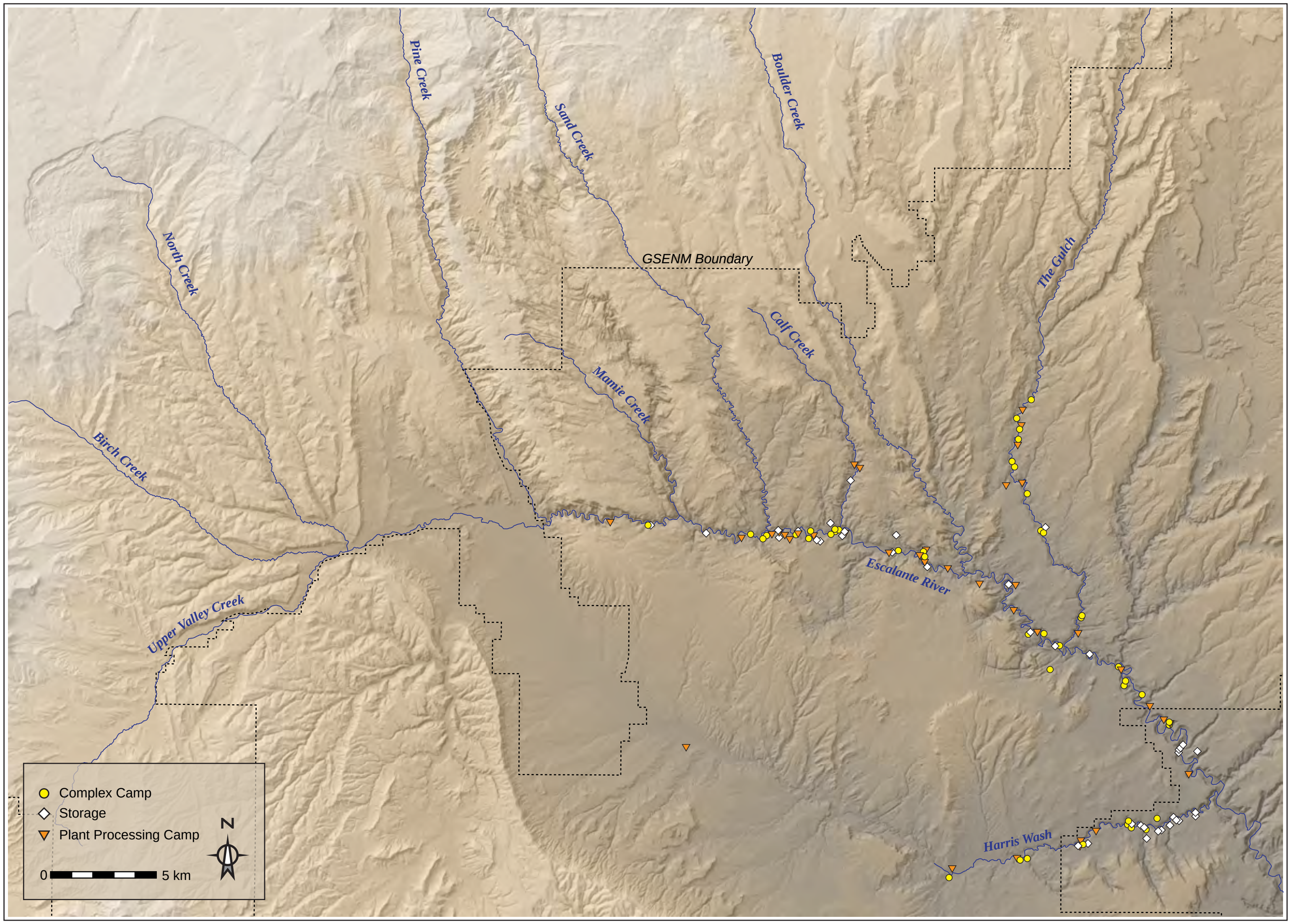

Figure C.1. All Fremont sites in study area located at elevations less than 5, 500 feet.

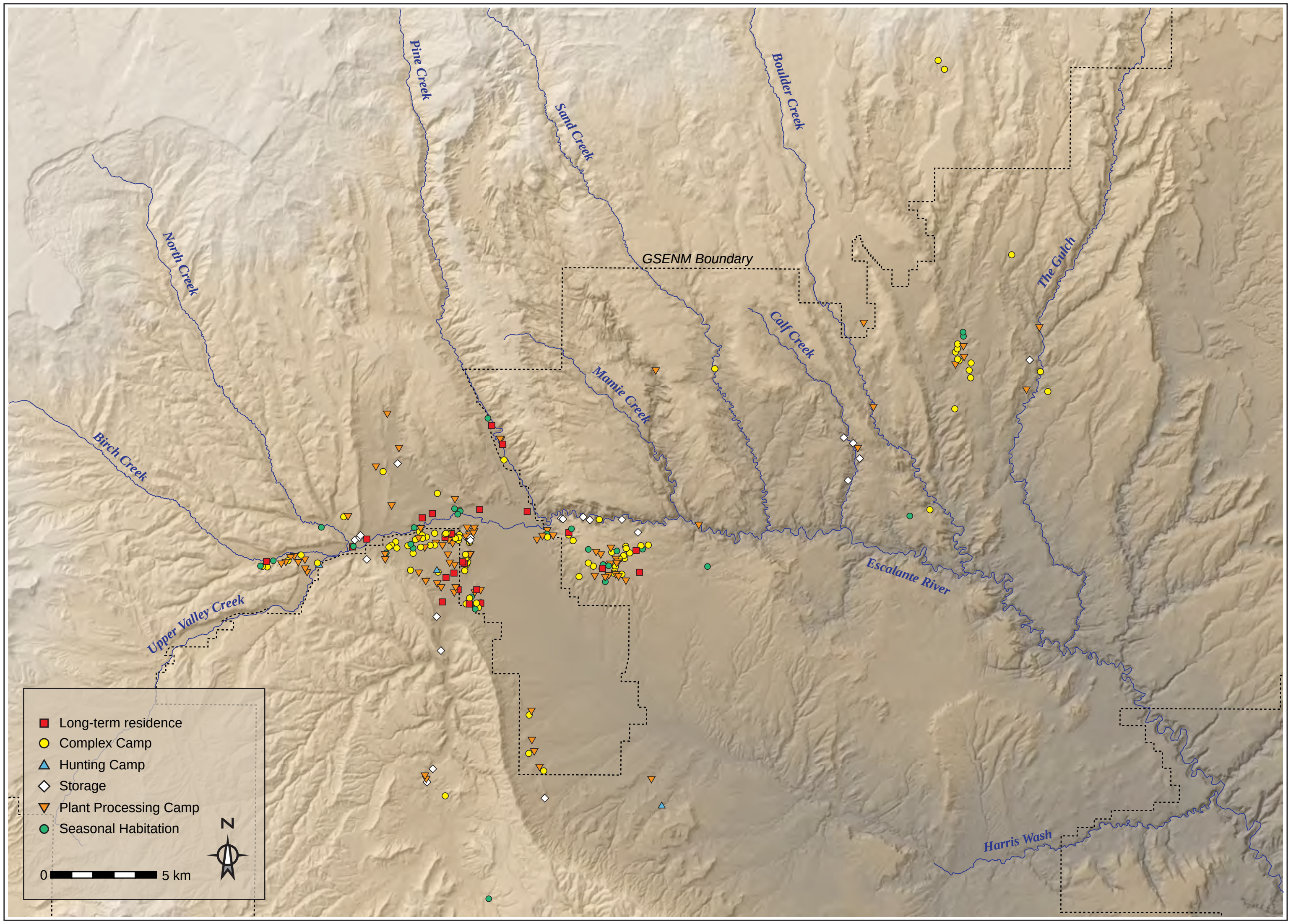

Figure C.2. All Fremont sites in study area located at elevations between 5, 500 and 6,500 feet.)

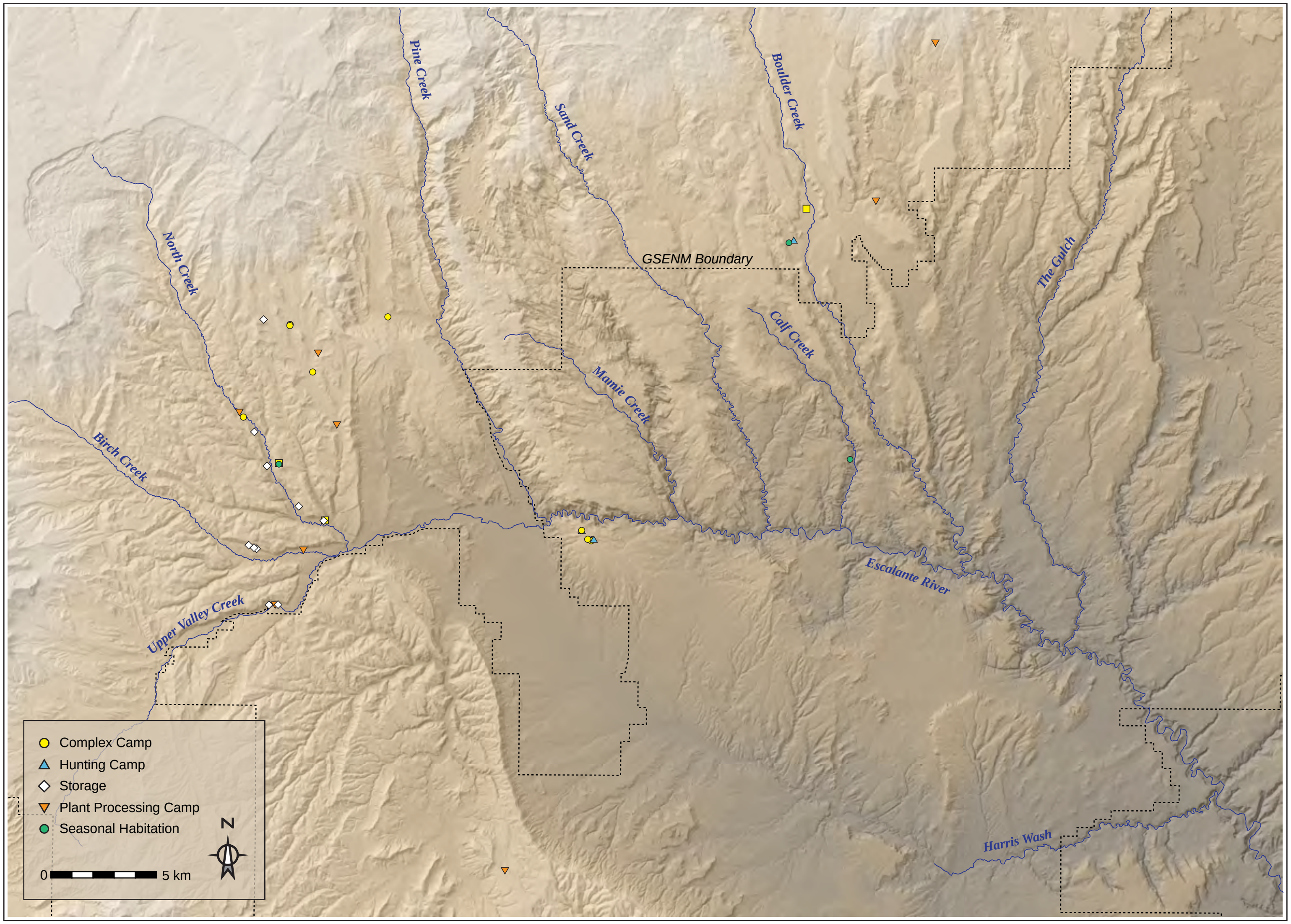

Figure C.3. All Fremont sites in study area located at elevations greater than 6,500 feet.

APPENDIX D

Distance-to-Water Analysis Maps

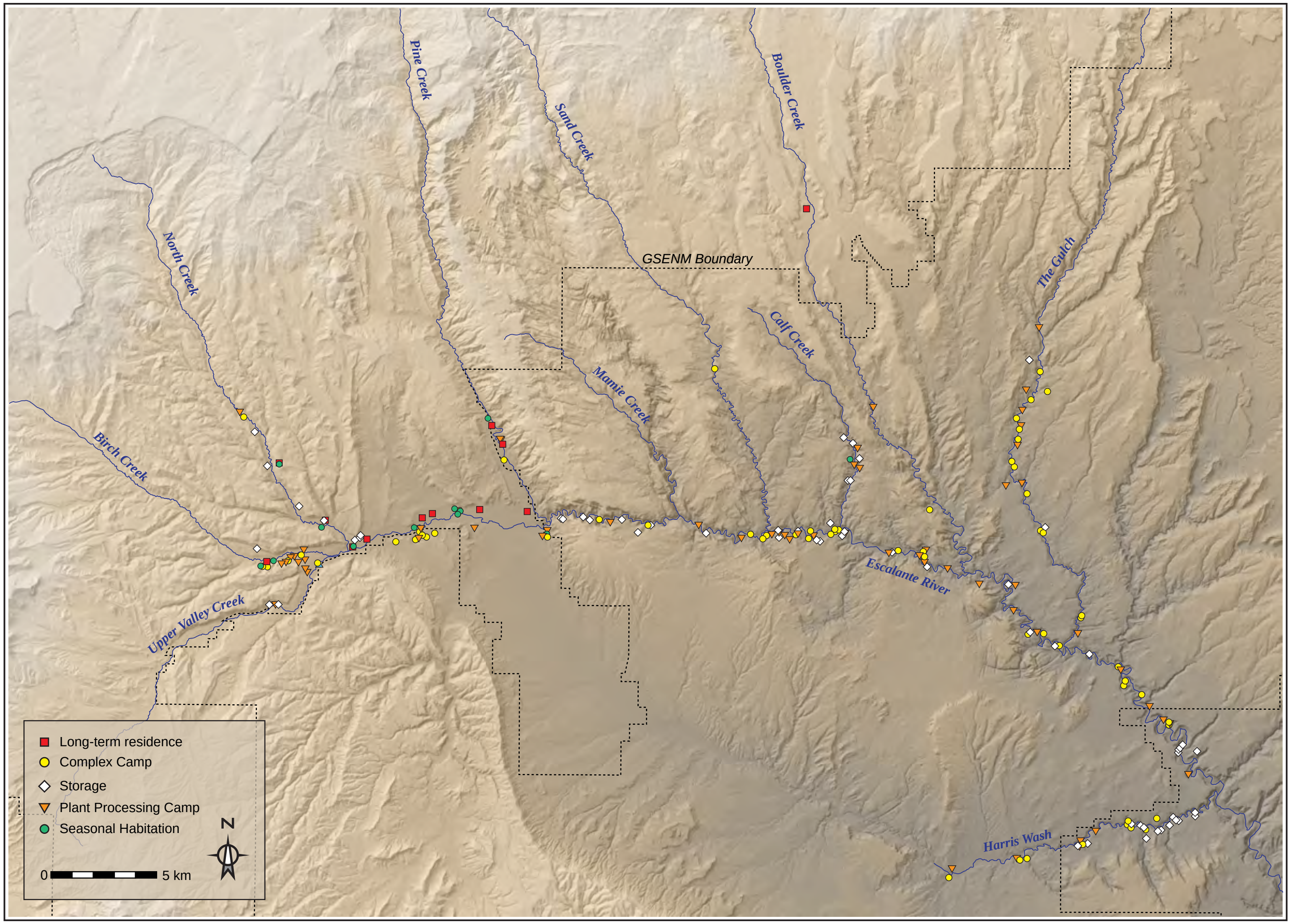

Figure D.1. All Fremont sites in study area located less than 500 meters from a permanent river or stream.

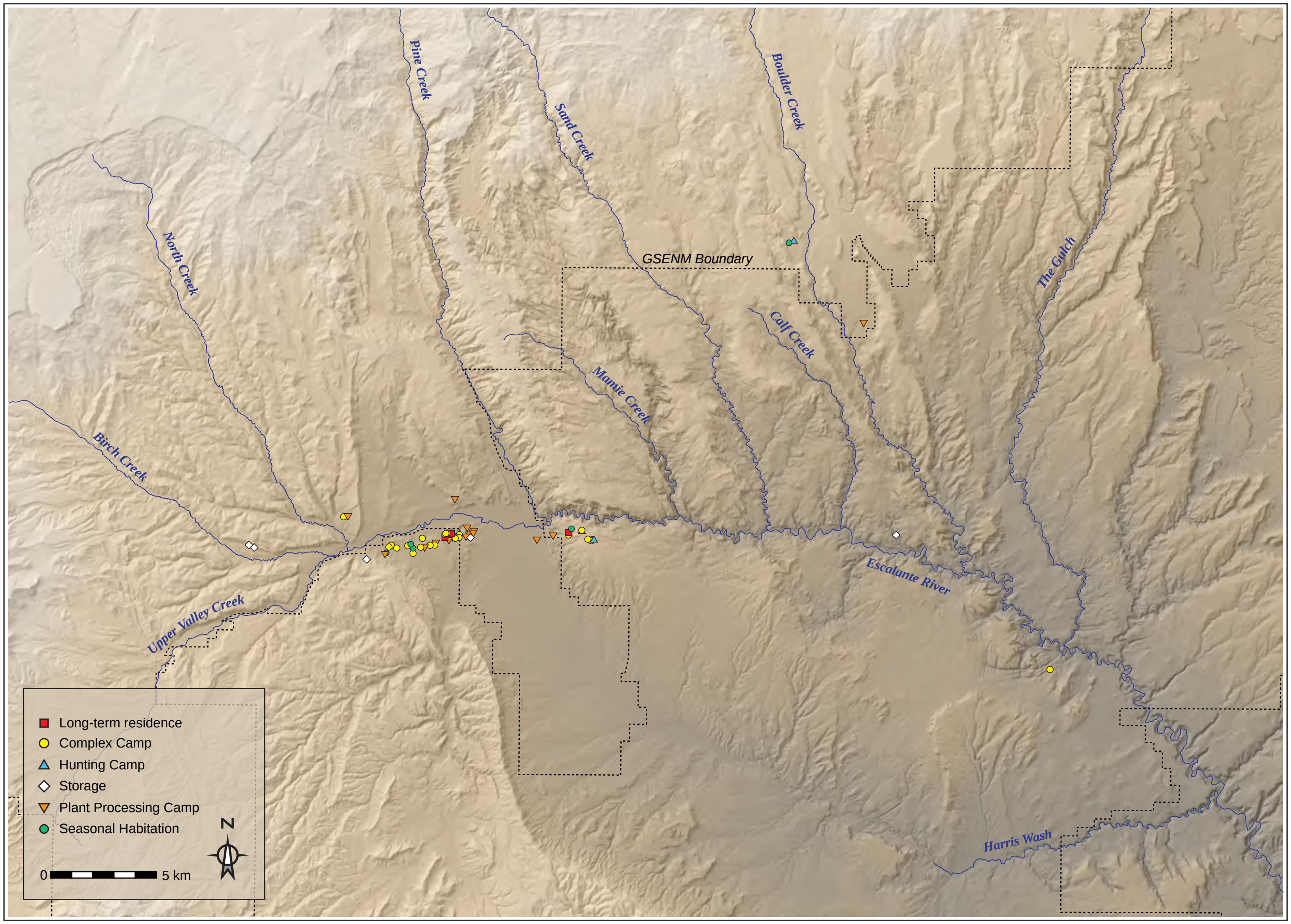

Figure D.2. All Fremont sites in study area located lbetween 500 amd 1000 meters from a permanent river or stream.

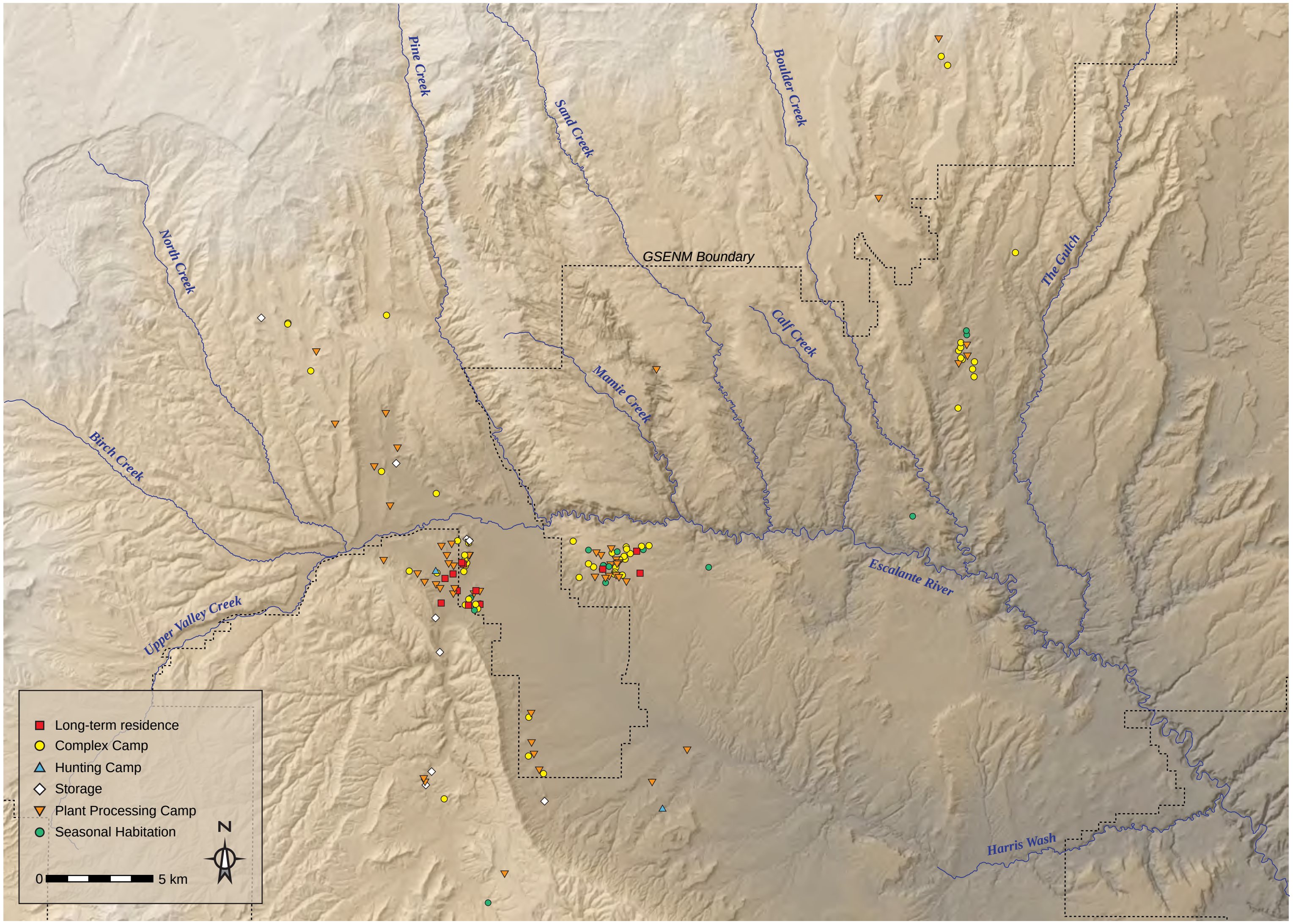

Figure D.3. All Fremont sites in study area located greater than 1000 meters from a permanent river or stream.

APPENDIX E

Chi-Square and Correspondence Analysis Calculation Tables

Table E.1. Calculation of the Chi-Square Statistic: Functional Site Type and Primary Landform

Observed Counts

Site Type	Canyon	Ridge	"Mesa"	Valley	Total
Long Term Residence	1	1	6	19	27
Seasonal Habitation	7	0	15	11	33
Complex Camp	56	7	41	34	138
Plant Processing Camp	62	7	29	29	127
Storage	58	3	7	6	74
Total	184	18	98	99	399

Observed Percentages

Site Type	Canyon	Ridge	"Mesa"	Valley	Total
Long Term Residence	3.70	3.70	2.22	70.37	100.00
Seasonal Habitation	21.21	0.00	45.45	33.33	100.00
Complex Camp	40.58	5.07	29.71	24.64	100.00
Plant Processing Camp	48.82	5.51	22.83	22.83	100.00
Storage	78.38	4.05	9.46	8.11	100.00
Total of All Sites	46.12	4.51	24.56	24.81	100.00

Expected Counts

Site Type	Canyon	Ridge	"Mesa"	Valley	Total
Long Term Residence	12.45	1.22	6.63	6.70	27.00
Seasonal Habitation	15.22	1.49	8.11	8.19	33.00
Complex Camp	63.64	6.23	33.90	34.24	138.00
Plant Processing Camp	58.57	5.73	31.19	31.51	127.00
Storage	34.13	3.34	18.18	18.36	74.00
Total	184.00	18.00	98.00	99.00	399.00

Cell Contributions to the Chi-Square Statistic

Site Type	Canyon	Ridge	"Mesa"	Valley
Long Term Residence	10.531	0.039	0.060	22.586
Seasonal Habitation	4.438	1.489	5.865	0.966
Complex Camp	0.917	0.096	1.490	0.002
Plant Processing Camp	0.201	0.282	0.154	0.200
Storage	16.703	0.034	6.871	8.322

Table E.2. Correspondence Analysis Table

Chi-Square Distances
(see Table 7.8)

	Canyon	Ridge	Mesa	Valley	Total
Complex Camp	0.917	0.096	1.489	0.002	2.504
Long-Term Residence	10.531	0.039	0.060	22.586	33.217
Plant Processing Camp	0.201	0.282	0.154	0.200	0.837
Seasonal Habitation	4.438	1.489	5.865	0.966	12.757
Storage	16.703	0.034	6.871	8.322	31.930
Total	32.791	1.940	14.440	32.075	81.246

Relative Inertias

	Canyon	Ridge	Mesa	Valley	Total
Complex Camp	0.011	0.001	0.018	0.000	0.031
Long-Term Residence	0.130	0.000	0.001	0.278	0.409
Plant Processing Camp	0.002	0.003	0.002	0.002	0.010
Seasonal Habitation	0.055	0.018	0.072	0.012	0.157
Storage	0.206	0.000	0.085	0.102	0.393
Total	0.404	0.024	0.178	0.395	1.000

Analysis of Contingency Table

Axis	Intertia	Proportion	Cumulative	Histogram
1	0.171	0.838	0.838	******************************
2	0.029	0.141	0.979	*****
3	0.004	0.021	1.000	
Total	0.204			

Table E.2. Continued.

Row Profile Contributions

				Component 1			Component 2			Component 3		
Category	Qual	Mass	Inert	Coord	Corr	Contr	Coord	Corr	Contr	Coord	Corr	Contr
Complex Camp	1.000	0.346	0.031	-0.086	0.406	0.015	0.094	0.490	0.107	0.043	0.104	0.155
Long-Term Residence	1.000	0.068	0.409	-1.009	0.828	0.404	-0.458	0.171	0.495	-0.039	0.001	0.024
Plant Processing Camp	1.000	0.318	0.010	0.067	0.678	0.008	-0.017	0.044	0.003	0.043	0.278	0.138
Seasonal Habitation	1.000	0.083	0.157	-0.510	0.673	0.126	0.321	0.267	0.297	-0.152	0.060	0.451
Storage	1.000	0.185	0.939	0.641	0.953	0.447	-0.123	0.035	0.097	-0.073	0.012	0.233

Column Profile Contributions

				Component 1			Component 2			Component 3		
Category	Qual	Mass	Inert	Coord	Corr	Contr	Coord	Corr	Contr	Coord	Corr	Contr
Canyon	1.000	0.461	0.404	0.420	0.991	0.477	-0.035	0.007	0.020	-0.020	0.002	0.042
Ridge	1.000	0.045	0.024	0.105	0.102	0.003	-0.094	0.081	0.014	0.297	0.816	0.938
Mesa	1.000	0.246	0.178	-0.267	0.483	0.102	0.276	0.517	0.652	0.001	0.000	0.000
Valley	1.000	0.248	0.395	-0.536	0.887	0.418	-0.191	0.112	0.314	-0.018	0.001	0.020

APPENDIX F

Primary Landform Analysis Maps

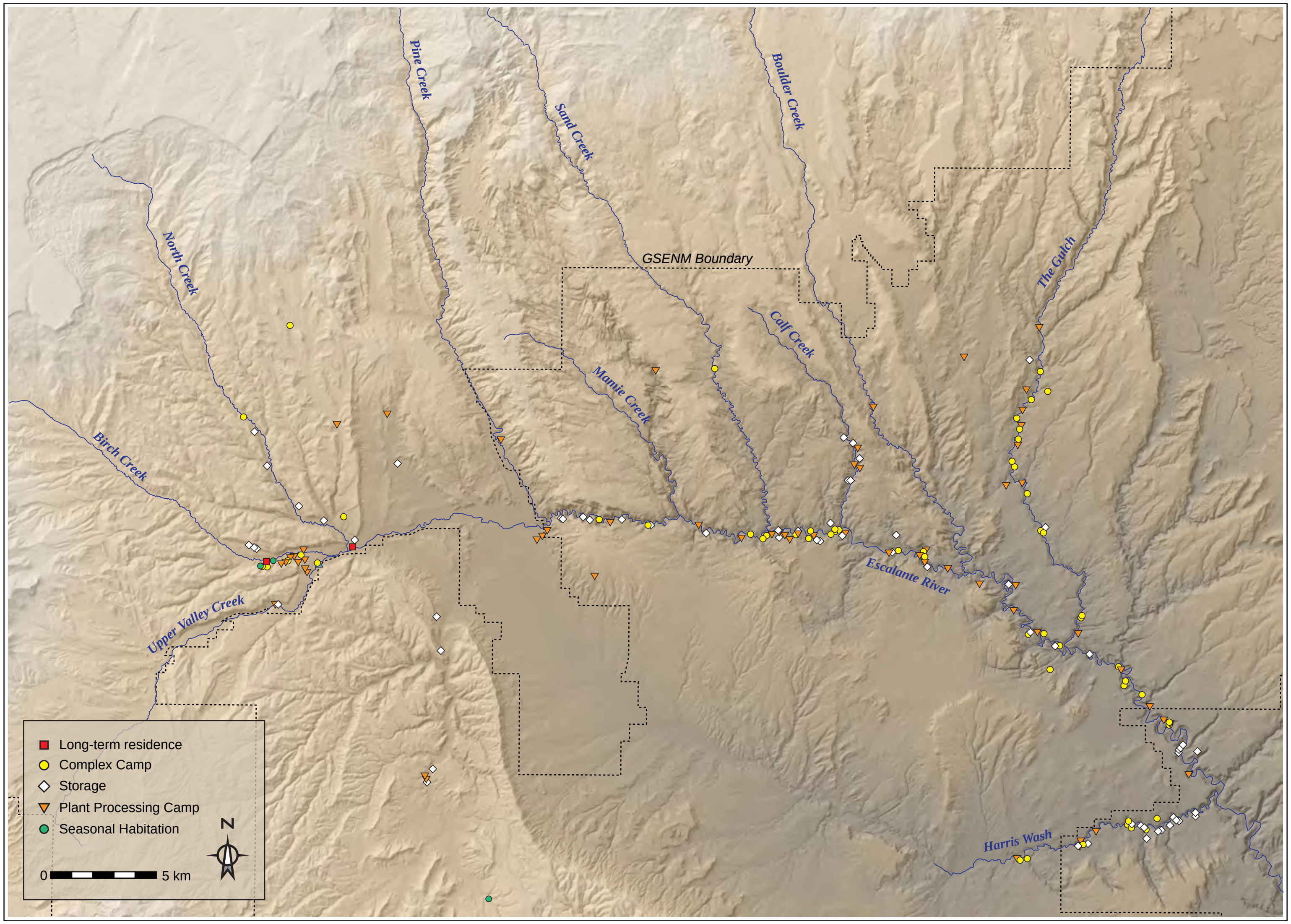

Figure F.1. All Fremont sites identified as canyon locations on Utah IMACS Site form.

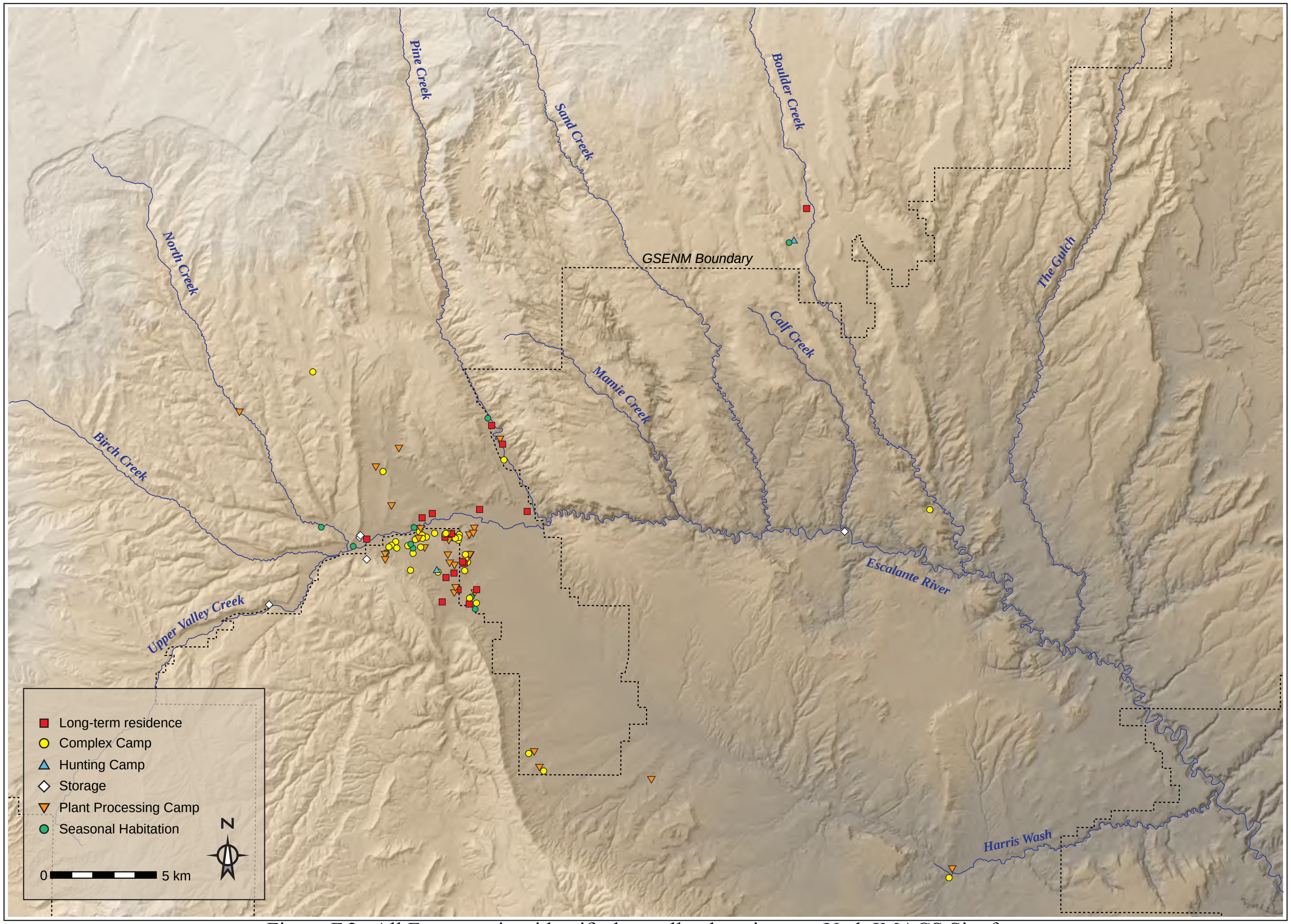

Figure F.2. All Fremont sites identified as valley locations on Utah IMACS Site form.

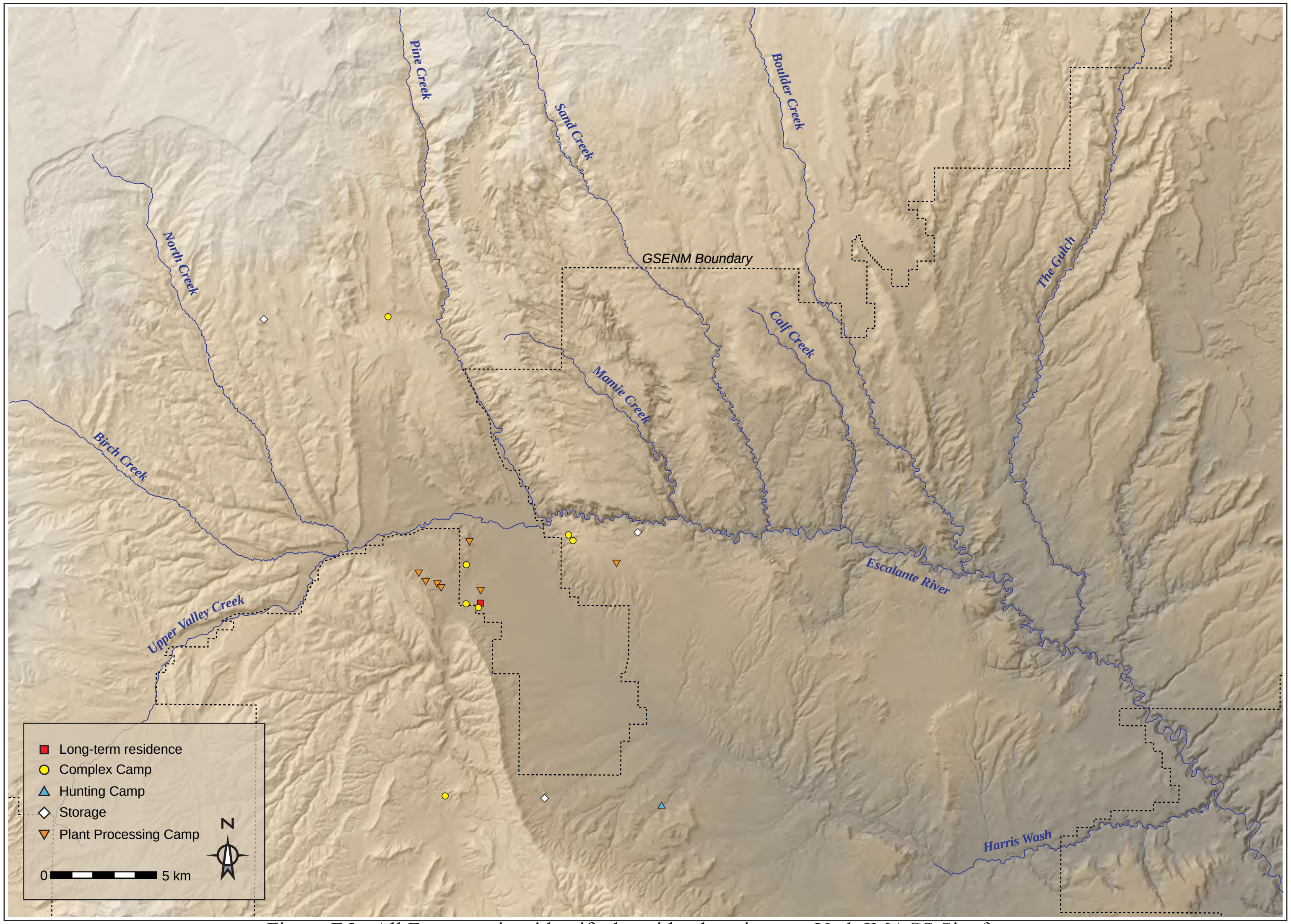

Figure F.3. All Fremont sites identified as ridge locations on Utah IMACS Site form.

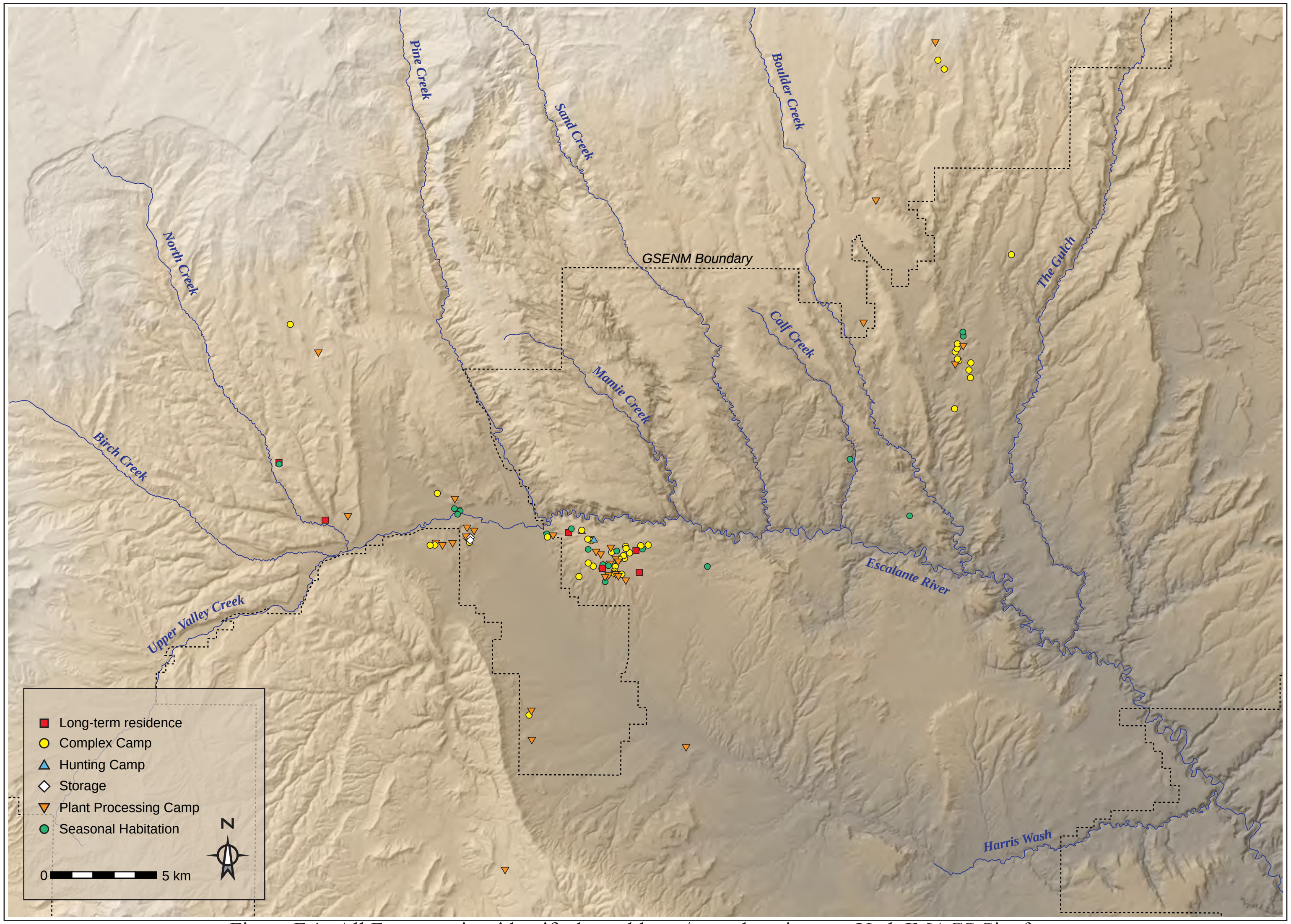

Figure F.4. All Fremont sites identified as tabletop/mesa locations on Utah IMACS Site form.

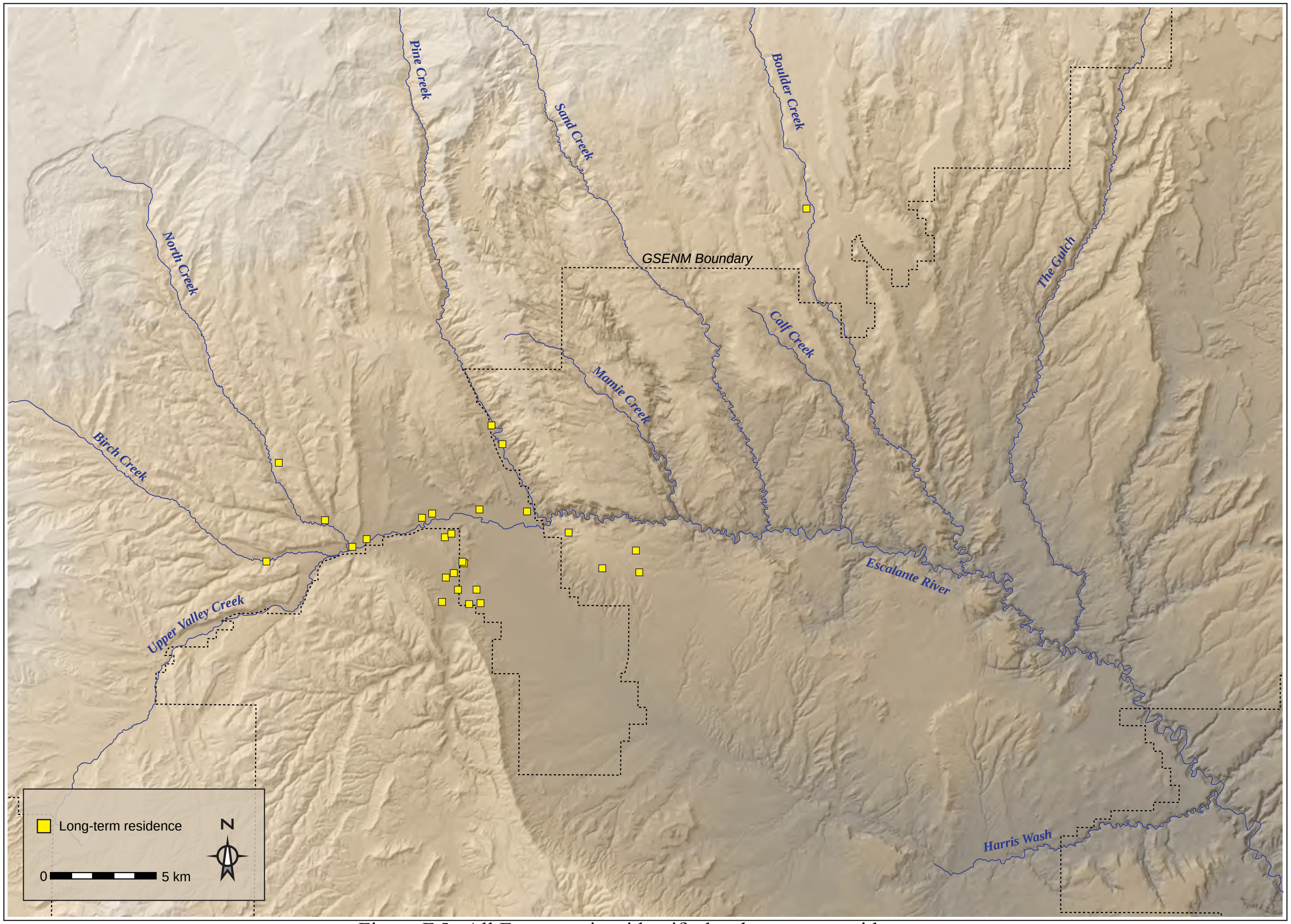

Figure F.5. All Fremont sites identified as long-term residences.

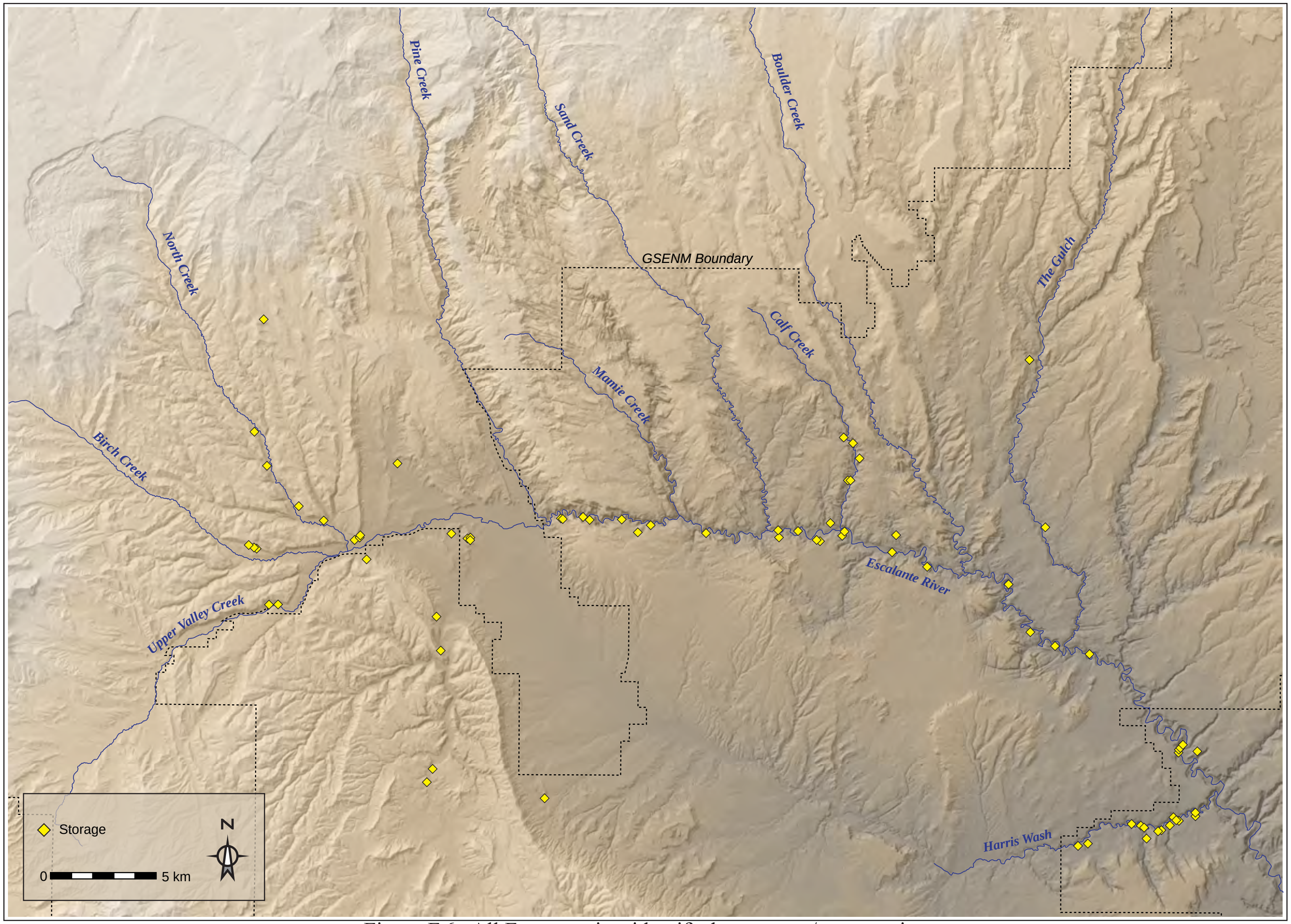

Figure F.6. All Fremont sites identified as storage/granary sites.

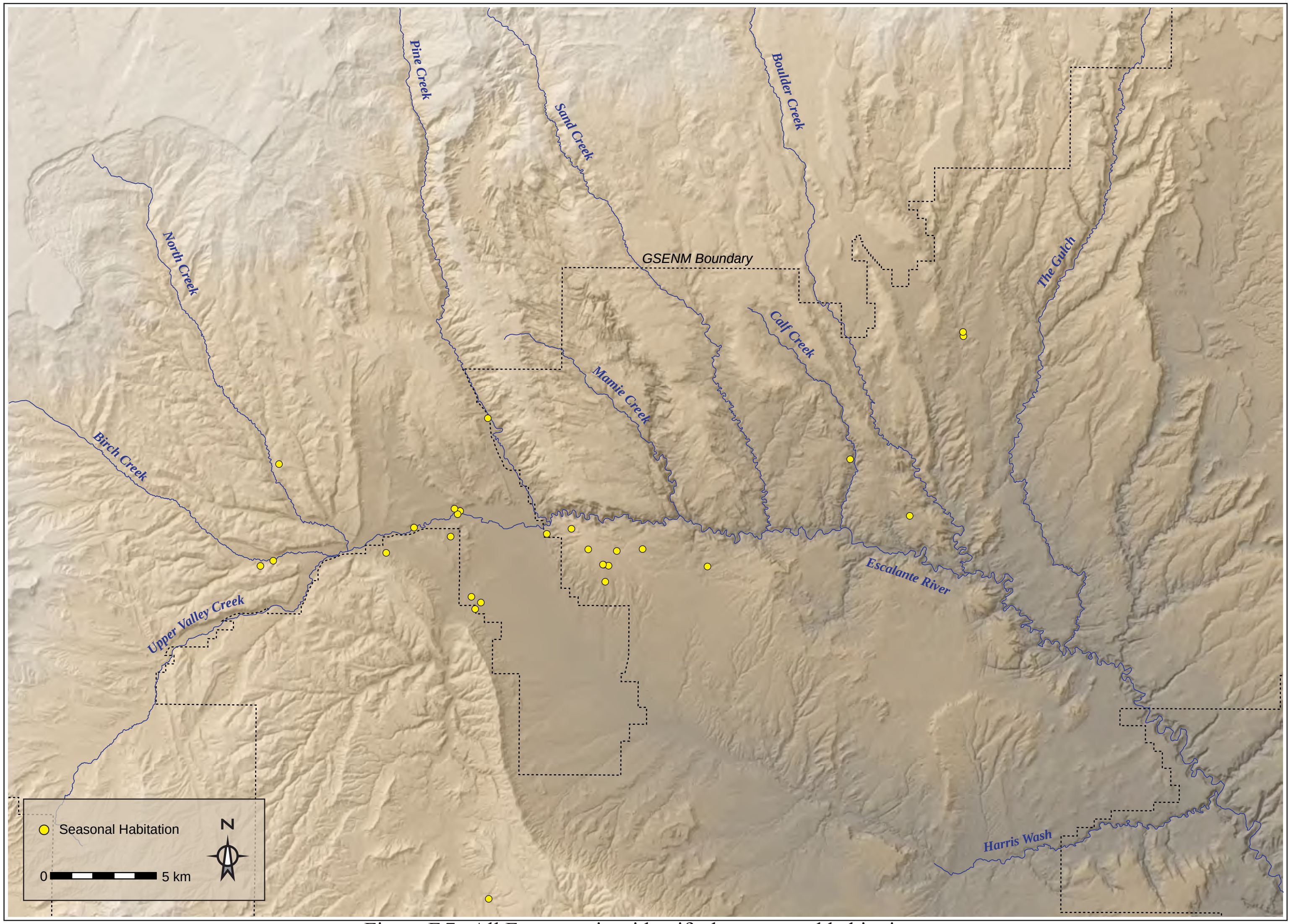

Figure F.7. All Fremont sites identified as seasonal habitations.

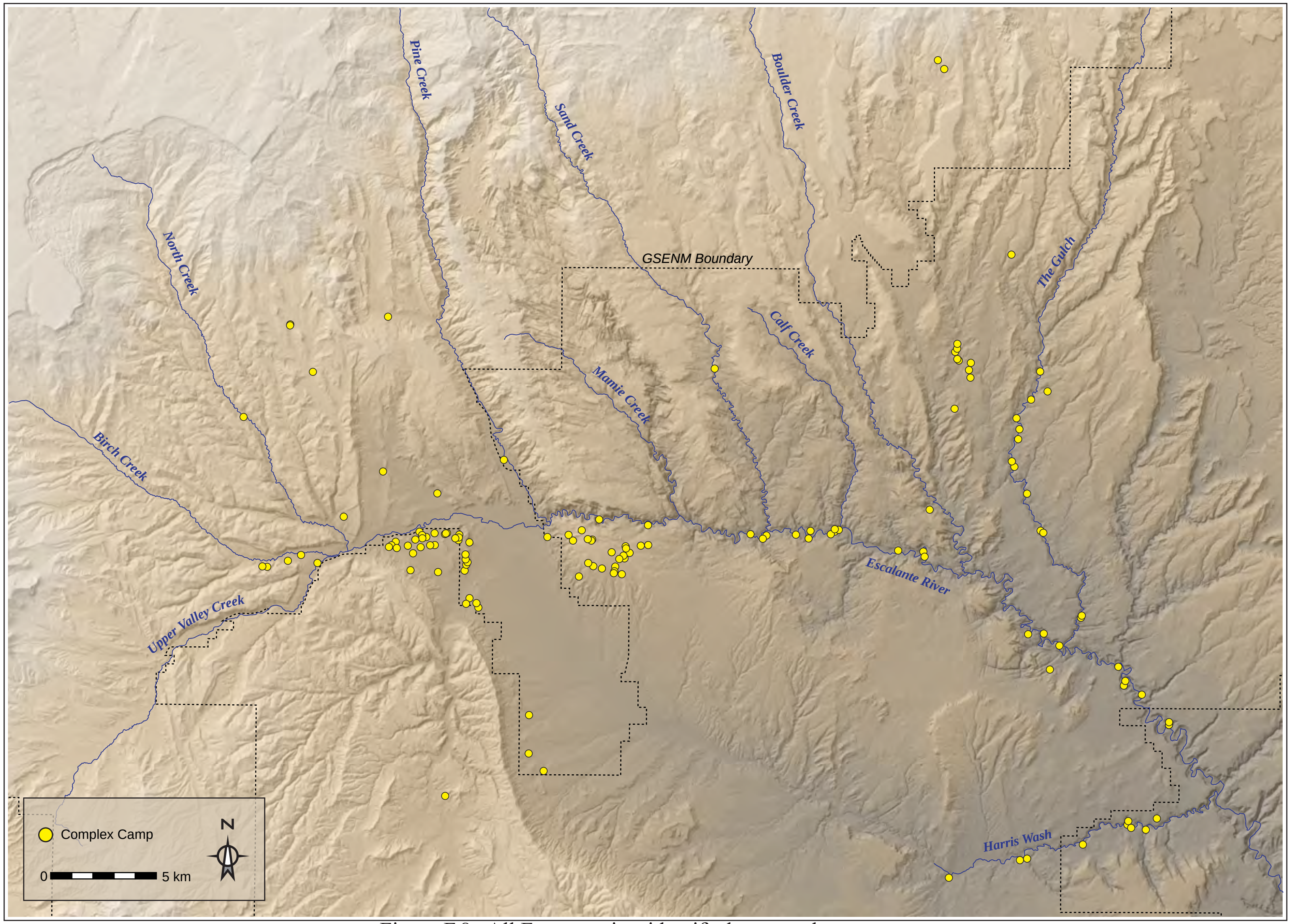

Figure F.8. All Fremont sites identified as complex camps.

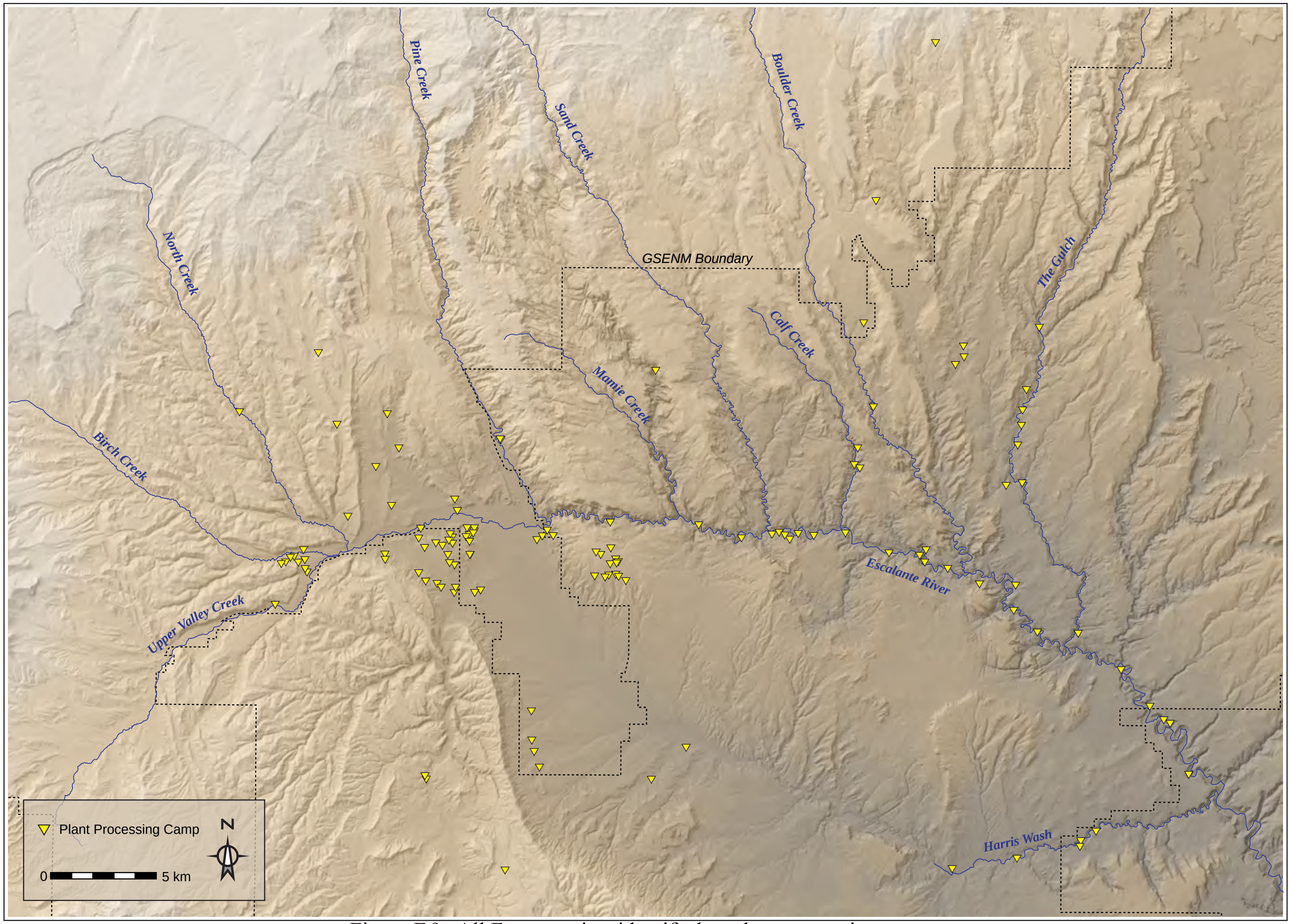

Figure F.9. All Fremont sites identified as plant processing camps.

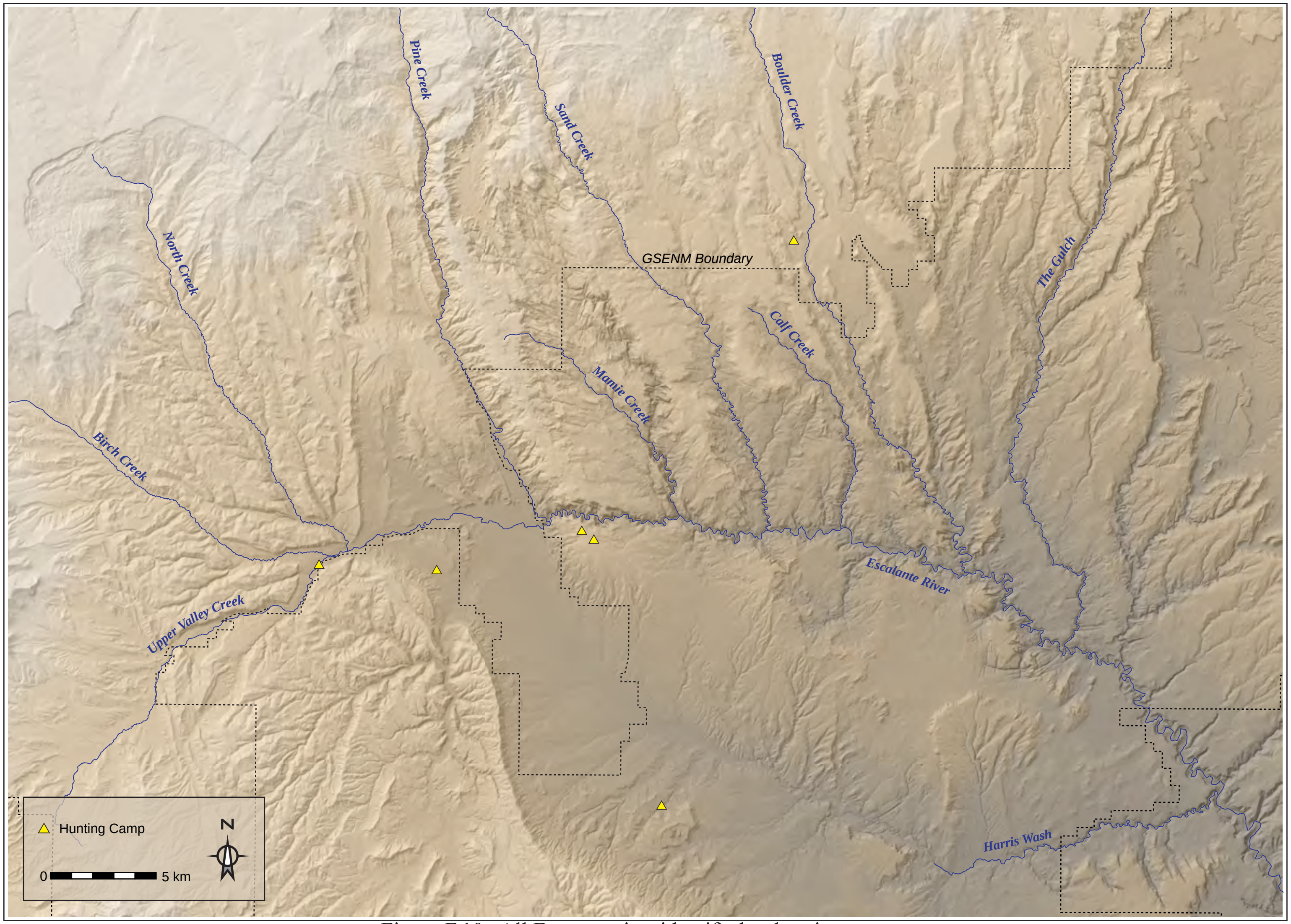

Figure F.10. All Fremont sites identified as huntingcamps.