AN EXAMINATION OF FOOD STORAGE IN GRAND CANYON NATIONAL PARK AND GRAND STAIRCASE-ESCALANTE NATIONAL MONUMENT

By Jenny Engleman

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ABSTRACT

AN EXAMINATION OF FOOD STORAGE IN GRAND CANYON NATIONAL PARK AND GRAND STAIRCASE-ESCALANTE NATIONAL MONUMENT

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Ancient occupation of the American Southwest was full of uncertainty. Precipitation was unreliable, and sufficient edible plants and animal resources were linked to the productivity of the environment. Communities had to be resourceful and flexible in the face of scarcity. To ensure reliable food sources, ancient peoples often stored crops and other plant foods in sealed masonry structures, or granaries, protected in alcoves high on canyon walls. This thesis research compares ancient methods for coping with scarcity by examining the presence of patterns in prehispanic granary construction in the Grand Canyon and the Fiftymile Mountain region of Grand Staircase-Escalante. Granaries in the two regions date between A.D. 1000 and A.D. 1250 and are associated with three main cultural groups: the Kayenta branch of the Ancestral Puebloans, the Virgin branch of the Ancestral Puebloans, and the Cohonina. Food storage practices are analyzed using adaptive concepts of optimization and risk minimization, adding to the understanding of the complex nature of human interaction with the environment. Although similar Ancestral Puebloan groups occupied the Grand Canyon and Grand Staircase-Escalante, the results of the research show variability in how granaries were incorporated into scarcity management.

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Chapter One – Why food scarcity?

In this chapter, I introduce food storage and describe the significance of understanding this method for coping with scarcity. Throughout history, humans faced environmental, cultural, social, and economic challenges, including dramatic ecological changes, warfare, drought, migration, and high mortality rates. Yet, humans continued to adapt to the less than ideal conditions. At the core of this type of resiliency is the influence of culture. The culturally focused model of resilience explains that humans negotiate stressors using a combination of learned characteristics (Clauss-Ehlers 2004, 2008). In essence, one's culture provides a means to be flexible when faced with uncertainty. Resiliency is also defined as the ability of a system to remain functioning in the face of stress and ability to recover after disturbances (Redman 2005; Redman and Kinzig 2003).

Survival in the American Southwest certainly required several types of resiliency. The Southwest is situated in an arid climate with unreliable precipitation, harsh wind, and drastic temperatures, making cultivating plants a risky task. Prehistoric peoples, however, have been exploiting regions across the southwest for thousands of years. The Colorado Plateau has been home to both mobile hunter-gatherer groups and sedentary agriculturalists for approximately the last 10,000 years (Fairley 2003; Lekson 2008; Neff et al. 2016; Plog 2008; Reid and Whittlesey 1997). Past inhabitants have figured out ways to navigate rough terrain and combat environmental uncertainty, making homes in the most rugged canyon settings. Key to the survival of past occupants of the Colorado Plateau is a reliable source of food. Through time, reliable food sources varied between hunting local animals and foraging and cultivating domesticated plants. To combat the marginal environmental setting, humans store food, either below the ground surface or in above ground masonry structures situated in sheltered alcoves, called granaries (Burns 1983; Dean 1996; Howey and Frederick 2016; Ingold 1983; Kuijt 2009; McFadden 1996; Minnis 1985; Powel 1987; Twiss 2012).

Research Questions

My study explores the presence and construction of granaries in two regions on the Colorado Plateau, comparing the interaction between humans and their environment. I compare the construction techniques and style of granaries in the Grand Canyon and Grand Staircase-Escalante National Monument to examine the similarities and differences in ways that humans adapt to canyon environments. Using key concepts from human behavioral ecology (Bird and O'Connell 2006; Codding and Bird 2015; Ferguson 2016; Hames 2015; Winterhalder and Kennett 2006), I examine the ways in which humans optimize their behavior relative to the marginal environment and minimize overall risk, thereby increasing the biological fitness of both the individual and the group.

Specifically, I examine the variation in style and construction of granaries by cultural group and then conduct regional comparison. Primarily, I evaluate the presence or absence of patterning in construction within the cultural groups and then estimate storage capacity. I compare the similarities and differences in the way the Ancestral Puebloans adapt to different canyon environments. Overall, I show the complexity and resiliency of human interaction to arid environments by using granaries as a proxy for adaptation.

Prehistoric communities in the Grand Canyon and Grand Staircase Escalante National Monument survived under similar environmental conditions, coping with unreliable precipitation in canyon environments. Ancestral Puebloan inhabitants in these two regions incorporated similar techniques of settlement and adaptation. Because of these foundational similarities, I expect that the method used to store food would also be comparable. I expect that the methods of food storage in these two regions to be similar and that statistical testing will show no significant difference between the Grand Canyon and Grand Staircase Escalante National Monument.

Significance

Both sedentary and mobile human groups have been storing food for centuries, greatly contributing to the survival of the group. The degree to which these storage features are visible in the archaeological record are variable, depending on the environment, construction method, group mobility, and duration of storage. Therefore, studying food storage in prehistory is problematic. Many of the sites or food storage features are difficult to access or the structural elements are poorly preserved. Furthermore, storage rooms may be used for multiple purposes and may be misidentified as habitation rooms. Similarly, subsequent use of a habitation room as a storage structure may deter study of food storage. Due to these limitations, storage features have not been subject to the same scrutiny as other archaeological features. Both environmental degradation and human visitation has significantly altered the state of archaeological sites. With human visitation to archaeological sites on the rise, the integrity of archaeological sites is only deteriorating. Although granaries are often situated in sheltered alcoves, the features are still subject to natural deterioration and impacts from small rodents and vermin. Granaries are relatively easily identified and do not require excavation, making them an ideal candidate of study.

By studying food storage, I add to the conversation about human-environment interaction, showing the complex nature of human decisions. Using the southwest as a model, archaeologists can better understand the ways in which humans manage food scarcity in other regions of the Southwest and the world. Aridity is a hurdle that humans have learned to overcome in various ways throughout history, commonly by storing food for times of unpredictable precipitation. Food surplus, achieved by storing food, has been linked to the development of hierarchy and complex societies (Kuijt 2011; Twiss 2012). Examination of food storage in the Southwest, in an area where little evidence of hierarchy exists, challenges the idea that surplus directly leads to complex hierarchical societies. This overarching concept has been applied throughout the world, and by evaluating its presence or absence in the Southwest, archaeologist can paint a more accurate picture of the past.

In the next chapter, I discuss relevant background information to my study and review the pertinent literature pertaining to the archaeology of food, food storage, and prehistoric habitation of the Grand Canyon and Grand Staircase Escalante, highlighting the debate between scarcity and surplus. Following the review of literature, I place my study within the framework of Human Behavioral Ecology. The concepts of optimization and risk management are center to understanding food storage and human interaction with the environment. In Chapter Four, I outline the methods I use to collect and analyze the data, detailing both the advantages and pitfalls of using legacy data. Chapter Five outlines the results of my study, primarily summarizing the quantitative characteristics of food storage, comparing the construction of granaries in the Grand Canyon and Grand Staircase Escalante National Monument. The following chapter estimates storage metrics and attempts to model the role of corn in prehistory. I conclude the thesis with a discussion of the implications of managing food scarcity by storing food in granaries. Furthermore, I make inferences about similarities and differences in granary construction in two regions of the Southwest. I call for future research to continue studying the intricacies of storage and the role of food in prehistoric communities.

Chapter Two – Environmental and Cultural Context and the Archaeology of Food

In this chapter, I discuss the relevant literature related to the archaeology of food and storage. Food, a basic element of existence, is a driving factor for human life. As a critical element to survival, securing a reliable food source consumed much time in prehistory (Minnis 1996; Twiss 2012). Securing food was not only necessary for survival, but also a crucial factor in social interactions through time. Equipped with resilience, past human populations used a variety of methods to adapt to fluctuating environmental conditions and population pressures (Burns 1983; Minnis 1996).

Central to their success in unpredictable environments, humans stored food for future use. The significance of food storage is evident during the Neolithic Revolution, in which many societies transitioned from a hunting and gathering form of subsistence to one dominated by agriculture (Kuijt 2009, 2011; Testart et al. 1982). Subsistence techniques changed in multiple regions of the world and was frequently accompanied by the appearance of storage features. Although not necessarily the drivers of domestication, food storage is a significant factor in social diversity (Kuijt 2011; Twiss 2012). Through years of archaeological research, the archaeology of food has developed from a focus on survival to an investigation of the social complexities associated with food production, distribution, exchange, and consumption (Kuijt 2009; Minnis 1985, 1996; Twiss 2012).

Certainly, the archaeology of food has played a significant role in myriad topics, however, a study of food cannot be separated from the means to store food for future use. The construction of food storage features indicates intentional decisions of a group of people. Construction may be linked to cultural style and can also hint at the level of social complexity, control, and trade networks that would be available to past occupants. Understanding the potential role that food played in society is crucial for examining patterns in food storage.

Although food storage studies are applicable worldwide, my study centers on two regions in the Southwest. I start the chapter by giving an overview of the arid environment in the southwest, followed by a brief outline of the culture history of the Grand Canyon and Grand Staircase Escalante. I continue with highlighting previous archaeological research in the Grand Canyon and Grand Staircase Escalante, followed by a review of previous research on the archaeology of food. I conclude with an explanation of how my own research fits within the existing literature.

Environmental Overview of the Northern Southwest

My area of focus comprises two regions of the Colorado Plateau, the Grand Canyon in northern Arizona, and Grand Staircase Escalante National Monument in southern Utah (Figure 1 through Figure 3). The Colorado Plateau covers approximately 140,000 square miles and includes the Four Corners region with elevations ranging from 3,000 ft to 14,000 ft above sea level. The Colorado Plateau is dissection by rugged deep canyons, plateaus, mesas, and sparse vegetation (Hoover et al. 2017). Temperatures across the Colorado Plateau vary by elevation. In general, precipitation across the plateau decreases from high elevations to low elevations (National Park Service 2016). Within my study area, this pattern in precipitation means that communities along the bottom of the Grand Canyon were subject to a less precipitation compared to communities that resided along the north or south rims (National Park Service 2016).

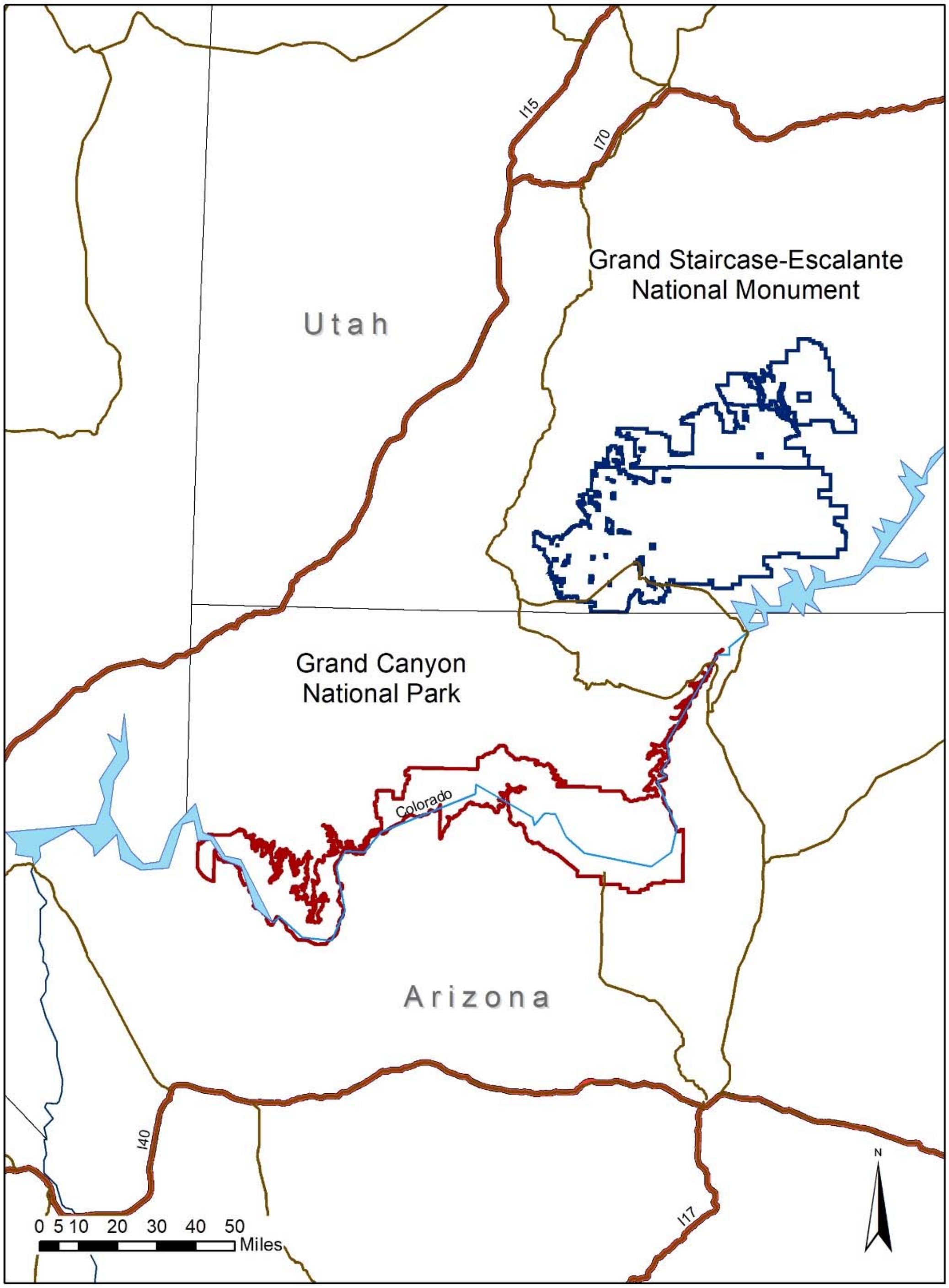

Figure 1. Landscape of the Colorado Plateau showing the location of the Grand Canyon and Grand Staircase Escalante National Monument.

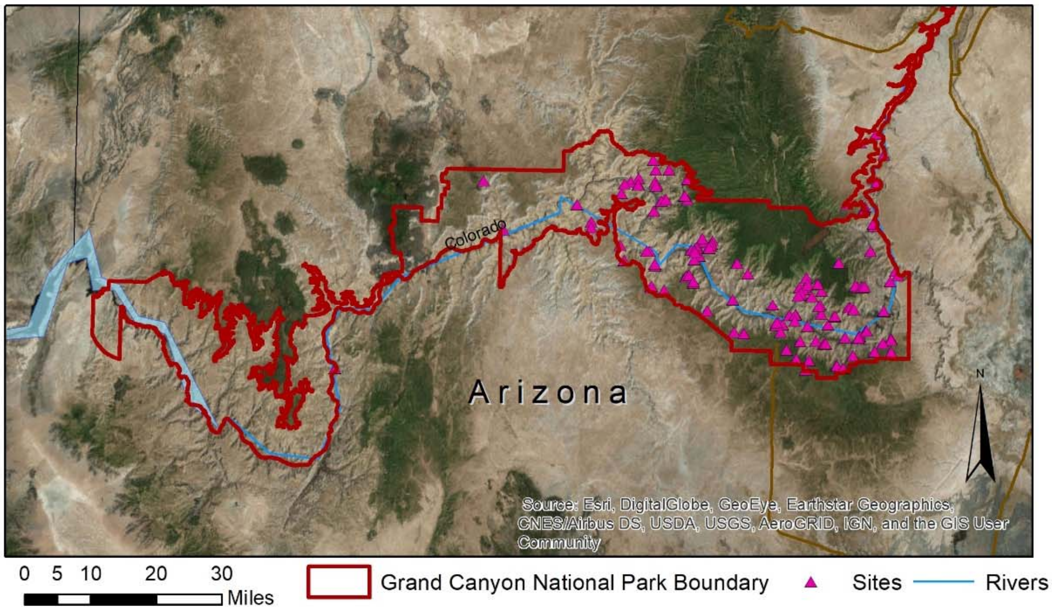

Figure 2. Detailed map of Grand Canyon National Park showing the archaeological sites.

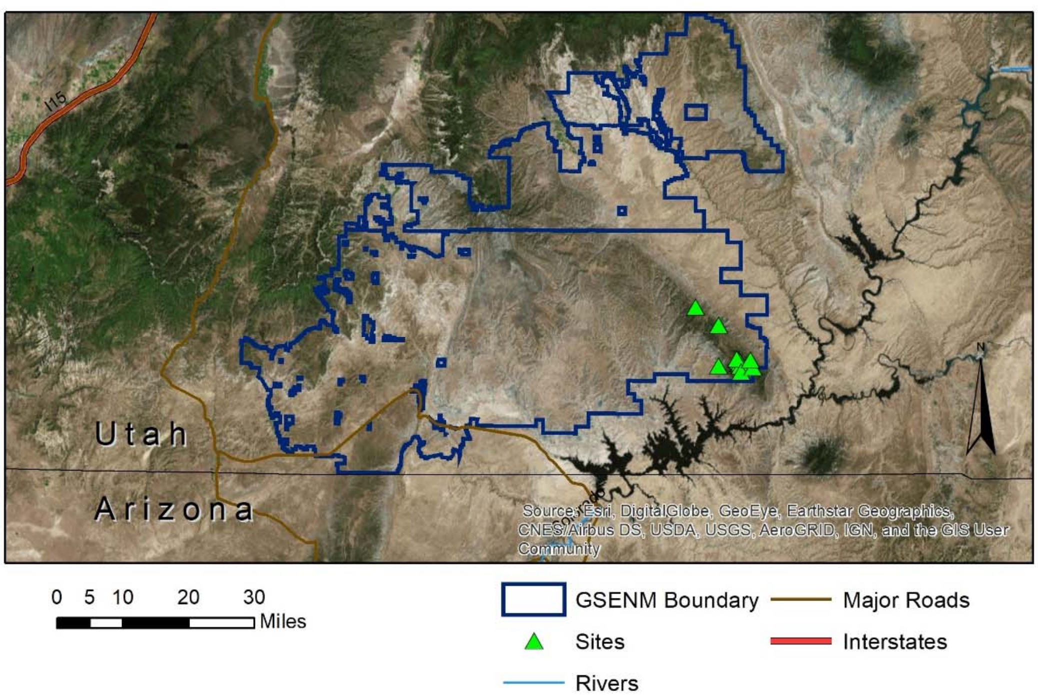

Figure 3. Detailed map of Grand Staircase-Escalante showing the archaeological sites included in this study.

Grand Canyon Environment

The Grand Canyon is a unique landscape with extreme diversity in geology, climate, vegetation, and topography, setting the stage for cultural activity that is equally diverse. The Colorado River cuts through the impressive canyon, exposing over 1.8 billion years of geological history (Neff et al. 2016). The variable elevation and precipitation in the Grand Canyon is fit for five biotic communities that house a wide variety of vegetation (Mink 2015). Within these biotic communities are areas that contain agricultural potential and useful wild vegetation (Fairley 2003; Mink 2015). Geologically, the canyon contains naturally occurring tabular stones used in construction of prehistoric architecture (Neff et al. 2016). Furthermore, eroding alcoves in sandstone and limestone in addition to small benches along the canyon walls provide suitable locations for well-protected food storage structures. The climate in the Grand Canyon changes dramatically in a short vertical distance, creating various microenvironments within the canyon. The Kaibab Uplift dips to the southwest leaving the North Rim of the Grand Canyon 1,450 ft higher than the South Rim (Mink 2015). The difference in elevation creates a cooler and wetter climate along the North Rim (Mink 2015). The most dramatic is the difference in climate between the North Rim and the Colorado River corridor, situated around 2,500 ft in elevation. Agriculturally speaking, the difference between the North Rim and the Colorado River corridor is striking. The number of frost free days along the bottom of the canyon average 331, compared to only 101 frost-free days on the North Rim (Neff et al. 2016).

Grand Staircase-Escalante Environment

Grand Staircase-Escalante National Monument (GSENM) covers 1.9 million acres in southern Utah and is separated into three broad regions: the Grand Staircase, the Kaiparowits Basin, and the Escalante Canyon (Doelling et el. 2000). The elevation in GSENM ranges from

4,000 ft at the edge of Lake Powell, to 9,280 ft at the summit of Canaan Peak. Variable topography and precipitation in the region produces upland, semi-desert, and desert climatic zones (Doelling et al. 2000). Precipitation typically occurs in the winter in the upland regions and in the summer months in the semi-desert and desert regions (Doelling et el. 2000). The variable terrain and precipitation is suitable for dry farming in the uplands and sub-irrigation systems in well-watered areas (McFadden 1997). The climatic zones are home to abundant flora and fauna to supplement agricultural subsistence (McFadden 1997).

Certainly, each of the study areas contains a unique geographical setting, however, common among them is the lack of reliable precipitation that offers significant challenges to subsistence agriculture. The Southwest is an arid environment in which vegetal growth is primarily dictated by the elevation and moisture content. An environment is considered arid when the net loss of moisture through both actual and potential evaporation exceeds the net gain of moisture through precipitation (Ingram 2010). Fluctuating weather conditions also trigger variability in wild plant production. The uncertainty of wild plant production then affects the location of game, causing additional issues for the reliability of food (Ingram 2010). Therefore, the Southwest is considered a low-productivity, high-risk environment. Considering these obstacles, continual settlement spanning decades shows tenacity in past communities.

Culture History in the Southwest

Archaeological research in the Southwest indicates that people have inhabited the Southwest for at least the last 10,000 years (Fairley 2003; Lekson 2008; McFadden 2016; Mink 2015; Nef et al. 2016; Sullivan et al. 2002; Plog 2008). The Southwest was originally occupied by nomadic hunter-gather groups that followed game and utilized wild plant resources along the way. Researchers argue that maize cultivation on the Colorado Plateau began in the first century B.C. (Mabry 2005; Smiley 2002). Maize was a staple in the diet of many sedentary groups of people on the Colorado Plateau, although diets were also supplemented by other cultigens, wild plants, and small game. Plagued by environmental pressures, the success of many of the agricultural societies in the Southwest were limited by precipitation coupled with population pressures.

Grand Canyon

Cultural history in the Grand Canyon has been the subject of numerous publications over the last couple of decades (Downum and Vance 2017; Fairley 2003; Mink 2015; Sullivan et al. 2002). The following is intended to be a brief summary of the cultural history in the Grand Canyon, rather than an exhaustive account of human history in the region. Extensive accounts of the prehistory of the Grand Canyon can be found in previous publications (Downum and Vance 2017; Fairley 2003; Mink 2015; Sullivan et al. 2002). The Grand Canyon has been utilized by humans for at least the last 8,000 years and is separated into the following temporal periods outlined in Table 1.

Table 1. Chronology of the Grand Canyon.

	Temporal Period	Date Range
Archaic Period		ca. 8,000-1,000 B.C.
	Early Archaic	ca. 8,000-5,000 B.C.
	Middle Archaic	ca. 5,000-3,000 B.C.
	Late Archaic	ca. 3,000-1,000 B.C
Preformative Period		ca. 1,000 B.C. – A.D. 400
Formative Period		ca. A.D. 400-1250
	Early Formative	A.D. 400-1000
	Late Formative	A.D. 1000-1250
Late Prehistoric/Protohistoric Period		A.D. 1250-1776
Historical Period		A.D. 1776-1950

To date, evidence of a Paleoindian occupation of the Grand Canyon is severely limited and only represented by a fragmentary Folsom point found along an eroded bench (Fairley 2003; Mink 2015). Although additional evidence of a Paleoindian occupation of the region is possible, current research shows that use of the area by mobile hunter-gatherers prior to 8,000 B.C was limited (Fairley 2003).

Archaic Period. The Archaic Period represents approximately 7,000 years of occupation in the Grand Canyon. During the Archaic Period, indigenous peoples were mobile hunter-gatherers, occupying small camps and leaving behind dispersed lithic scatters, lithic tools, and rock art. Of note, is the presence of split-twig figurines found in caves throughout the park during the Late Archaic period, interpreted as an element of hunting rituals (Fairley 2003; Schwartz 1958). The Archaic Period ends when indigenous peoples began utilizing cultivated plants.

Preformative Period. This period refers to a time after cultigens were introduced to the region, but prior to the appearance of ceramics (Fairley 2003). Evidence of early agriculture in the Grand Canyon is found in rockshelters and subterranean storage features (Fairley 2003).

Formative Period. Three main indigenous groups made use of the canyon in the Formative Period: the Virgin branch of the Ancestral Puebloans, the Kayenta branch of the Ancestral Puebloans, and the Cohonina (Downum and Vance 2017; Fairley 2003). Archaeological evidence shows that these groups interacted with one another, constructed dwellings, and cultivated plants. People lived in small communities in dwellings typically constructed of stone masonry and included either on-site storage rooms, cists (underground storage pits), or granaries isolated from the main habitation site (Fairley 2003; Mink 2015). The degree to which communities of people were sedentary, in the traditional sense, is still debated (Sullivan et al. 2002).

Archaeologists classify the past inhabitants primarily based on the ceramic assemblages found at the sites and to a lesser degree, on construction characteristics (Mink 2015). Although the presence of ceramic types does not equate to individual people, archaeological evidence is limited to material remains. Ceramic construction and design is linked to intentional human decisions, likely passed down through cultural transmission, and is therefore attributed to a group of people who make similar decisions (Neff 1993). Therefore, ceramic attributes are used as a proxy for cultural groups. Within the Grand Canyon, the three groups are separated regionally.

The South Rim was occupied by the Cohonina and the Kayenta Ancestral Puebloans, while the North Rim was inhabited by the Virgin Ancestral Puebloans (Downum and Vance 2017; Fairley 2003; Mink 2015). Of the three main groups, the Cohonina were the first to appear in the Grand Canyon (Downum and Vance 2017). The Cohonina were a semi-mobile group of people who participated in bi-seasonal movement in the Grand Canyon (McGregor 1951, 1956; Mink 2015). Cohonina people were horticulturalists who utilized wild resources to a greater extent compared to their Ancestral Puebloan neighbors (McGregor 1951, 1956). Researchers classify the Cohonina culture by the presence of San Francisco Mountain Grayware (McGregor 1951, 1956). According to mean ceramic dates coupled with population estimates rooted in the number of sites and architectural spaces, the mean date of Cohonina occupation occurred at around A.D. 1064 (Downum and Vance 2017). Within the Grand Canyon, the Cohonina no longer appear in the archaeological record after A.D. 1150. Researchers argue that the Cohonina were either subsumed within Kayenta Ancestral Puebloans (Fairley 2003) or relocated to Havasu Canyon and are the ancestors of modern Havasupai people (Schwartz 1989).

The Virgin branch of the Ancestral Puebloans are related to the early Basketmaker people of the area and are associated with various ceramic types. The Virgin Ancestral Puebloans were relatively sedentary and incorporated a combination of agriculture, hunting, and collecting wild plant resources (Lyneis 1995; Mink 2015). At the lower elevations, subsistence was thought to be almost entirely maize agriculture, as opposed to the higher elevations where there was a heavier influence of wild resources (Lyneis 1995; McFadden 1996; Mink 2015). Sites constructed by Virgin groups typically include roomblocks separated from storage rooms (Mink 2015). The mean date of occupation for Virgin sites is A.D. 1137 (Downum and Vance 2017).

The Kayenta branch of the Ancestral Puebloans are classified by the presence of Tusayan ware ceramics. During the Pueblo I period, surface rooms were primarily used for storage (Mink 2015). Throughout the Pueblo I and Pueblo II periods, Kayenta sites were relatively small and included either on site storage in the form of storage rooms and granaries or storage features situated at a distance from the main cluster of rooms (Mink 2015). According to architectural and population studies, the mean date of occupation for the Kayenta is A.D. 1129 (Downum and Vance 2017).

Occupation of the Ancestral Puebloan agriculturalists peaked between the eleventh and twelfth centuries (A.D. 1000-1150) and population began to decline shortly thereafter. The Cohonina were the first group to leave the Grand Canyon, followed by the Ancestral Puebloan groups (Fairley 2003). By A.D. 1300, the area had been completely abandoned (Mink 2015).

Figure 4. Nankoweap granaries in the Grand Canyon that date to the Pueblo period.

Late-Prehistoric/Protohistoric Period. The late prehistoric or Protohistoric period extends from A.D. 1250 to the A.D. 1776 when Spanish priests reached Havasupai country in the Grand Canyon (Fairley 2003). Late prehistoric/protohistoric sites in the Grand Canyon are identified by the presence of brown ware pottery and Desert side-notched projectile points (Downum and Vance 2017; Fairley 2003). Oral history states that several of the granaries in Havasu Canyon were constructed by the Havasupai people (Downum and Vance 2017). In the years after Ancestral Puebloan abandonment, indigenous peoples including the Prescott groups, the Pauite, Pai, Hopi, and Navajo utilized the canyon at various times prior to European settlement of the region (Mink 2015).

Grand Staircase-Escalante National Monument

Human occupation of Grand Staircase-Escalante extends back at least 10,000 years in the Escalante River drainage (McFadden 2012). Plant remains have been documented in the region in association with spear points, indicating at least some reliance on plants during the Paleoindian period (McFadden 2012). The Archaic period covers approximately 6,000 years between 6,000 B.C. and 100 B.C. Throughout the Archaic period, indigenous populations were mobile groups that relied on a combination of hunting and foraging native plants. The transition into the Basketmaker period occurred with the advent of maize agriculture (McFadden 2012). These early agriculturalists made distinctive baskets and perishables, but it wasn't until A.D. 400 that these groups began to produce ceramics (Lister 1964; McFadden 2012).

Table 2. Chronology of Grand Staircase-Escalante. Adapted from McFadden 2016.

Temporal Period	Date Range
Basketmaker II	A.D. 0 - A.D. 400
Basketmaker III	A.D. 400 – A.D. 700
Pueblo I	A.D. 700 – A.D. 950
Pueblo II	A.D. 950 – A.D. 1150
Pueblo III	A.D. 1150 – A.D. 1225

Ancestral Puebloan groups are considered descendants of the Basketmakers. In this region of the Southwest, the Virgin branch was relatively isolated from surrounding groups, which resulted in distinctive architecture, rock art, and ceramic styles (McFadden 2012). These ancient farmers primarily settled in various microenvironments suited for agriculture. People lived in small communities, occupying the same areas on and off for an extended period (McFadden 2012). Between A.D. 1070 and 1150, evidence of the Kayenta branch is present in the archaeological record indicating presence of a migrant population (McFadden 2012). By A.D. 1300, the region was abandoned by Ancestral Puebloan groups.

Figure 5. Well-preserved granary in Grand Staircase-Escalante National Monument.

Previous Archaeological Research

Extensive archaeological research in the Southwest began during the late 19th and early 20th centuries (Plog 2008). Interest in archaeological sites took root during a period of exploration in the west. Architectural remains of past inhabitants of the Southwest were different from archaeological sites in the east, sparking interest in many explorers and museum curators (Reid and Whittlesey 1997). The lure of the unknown lead to multiple expeditions to document the environment and cultural history of these new remote regions of the United States. Two extraordinary places in the Southwest, the Grand Canyon and Grand Staircase Escalante, are no exception to the appeal of Southwestern culture.

Grand Canyon. Cultural resources in the Grand Canyon have been known by living descendant populations for many years but were first documented during the era of early exploration. Early explorers recording environmental and biological data made brief mention of archaeological sites in the region. During his first trip on the Colorado River down the Grand Canyon in 1869, John Wesley Powell made note of multiple archaeological sites in the Grand Canyon (Fowler et al. 1969; Sullivan et al. 2002). Neil Judd, employed by the Smithsonian Institution, conducted the first trained archaeological research in the Grand Canyon between 1915 and 1920 (Mink 2015). Included in Neil Judd's survey in 1920 was documentation of granaries in upper Bright Angel Canyon and in the Upper Ribbon Falls area (Mink 2015). Beginning in the 1930s, archaeologists made large strides in understanding the prehistory of the region (Fowler et al. 1969). Researchers such as Edward Hall and Emil Haury conducted archaeological surveys and excavations along the canyon rim, significantly adding to our understanding of settlement and subsistence in the Grand Canyon (Mink 2015). During the years following, archaeological research continued to progress with contributions from Joe Ben Wheat, Walter W. Taylor, and Douglas W. Schwartz. In the early 1950s, Robert E. Euler began research in the Grand Canyon, eventually becoming the first staff anthropologist of the Grand Canyon in the mid-1970s. Euler focused on management within the park, conducting monitoring, test excavations, and acting as liaison to the neighboring Navajo and Havasupai tribes (Fairley 2003). Advances in understanding past human use of the Grand Canyon have been accompanied by advances in archaeological research in general and extensive archaeological studies have continued over the last 50 years. Recent research in the Grand Canyon is less focused on large excavations but rather answering specific research questions and managing the existing cultural resources in consultation with descendant populations.

Among the most attractive research topics are settlement patterns and subsistence strategies in the Grand Canyon. Several theories exist and include the Biseasonal Model (Schwartz et al. 1980), the Powel Plateau Model (Effland et al. 1981), the Havasupai Model (Effland et al. 1981), the Paiute Model (Effland et al. 1981), the Cross-Canyon Model (Sullivan et al. 2002), and the Unified Model (Fairley 2003). Each of the models predicts the duration of settlement in regions of the canyon and the type of subsistence appropriate to the microenvironment and level of mobility of the inhabitants. Although important to our understanding of the prehistory of the Grand Canyon, these theories are not central to my research questions.

Grand Staircase-Escalante National Monument. Similar to the Grand Canyon, archaeological investigations in the area now designated as Grand Staircase-Escalante National Monument began during the age of exploration in the Southwest. In 1877, Dr. Edward Palmer excavated a cave in Johnson Canyon, reporting on his findings a year later (Harris 2009). Archaeological investigation by trained researchers occurred between 1915 and 1920, directed by Neil Judd, for the Bureau of American Ethnology (McFadden 2016). Jesse Nusbaum, from the Museum of the American Indian, conducted excavations at the significant Cave du Pont, the type site for early Basketmaker occupation in the region (McFadden 2016). In the early 1930s, Julian Steward investigated the relationship between the Cliff Dwellers and the Basket Makers in the area, observing differences in ceramics and architecture across the region, many of which still hold up today (McFadden 2016). Aikens conducted comprehensive survey along the Kaiparowits Plateau, centered on the relationship between the Virgin and the Kayenta peoples (McFadden 2016). Surveys in Glen Canyon Recreation Area also covered portions of the Kaiparowits Plateau (Geib et al. 2001) and recent work in the monument has been conducted by

Brigham Young University (Harris 2009). Most recently, McFadden compiled site chronologies from across the region, including many tree-ring dates from granaries (McFadden 2016).

Legacy Data

The Grand Canyon data that I used for my research is a compilation of all the research that has been done in the Grand Canyon to date. The data was digitized by students from Northern Arizona University in 2012 prior to a spatial analysis conducted for a recent publication of the Grand Canyon (Downum and Vance 2017). Students digitized information into a Microsoft Access Database, which contains information from original site forms extending back to the early 1900s. I used data from every instance that the site was visited, including notes from the early years of documentation. The data was collected in various ways including initial documentation from survey and site monitoring through the years. Although I incorporated the most recent site records, some of the site forms solely feature original data from the 1950s in which sites were identified via helicopter survey of remote reaches of the canyon. The variable state of the data created hurdles during research process and are detailed in the subsequent data and methods chapter.

The data I compiled from Grand Staircase-Escalante is a combination of legacy data and newly collected data. Legacy data was taken primarily from the Fiftymile Mountain region, along with several other unique intact granaries in close proximity. Like the Grand Canyon, the data are the result of various surveys and site monitoring over the years. The Fiftymile Mountain region of GSENM has been designated a Wilderness Study Area since 1979 (McFadden 2003). The remote setting of the Fiftymile Mountain served to protect the archaeological resources in the area. Originally surveyed in 1958 (Gunnerson 1959), this region of the national monument remained relatively understudied until the 2000 when a lightning strike caused a fire along the south end of Fiftymile Mountain, which in turn lead to a post-burn survey (McFadden 2003).

After the fire subsided, the area was intensively surveyed between the Fall of 2000 and the Summer of 2002 and resulted in 34 newly documented sites (McFadden 2003). In the intervening years, a series of small reconnaissance projects were conducted in the area by the Bureau of Land Management, Kanab Field Office, and Grand Staircase-Escalante National Monument.

Archaeology of Food Storage

Prior research on the archaeology of food storage encompasses a wide variety of interrelated topics. Emphasizing the impacts on the environment, food storage can be an adaptive strategy for coping with risk (Holley 1998; Ingold 1983; Kuijt 2009). Other researchers, however, view food storage as a mechanism for accommodating surplus, allowing for individuals to gain power over others through distribution and allocation of resources (Kuijt 2009; Twiss 2012). Resource allocation spans studies of social, political, and economic diversity. Although storing food is typically associated with sedentary groups, research has shown that mobile groups also stored or cached food in subterranean structures (DeBoer 1998). In fact, ethnographic study comparing foraging and agricultural groups found that food insecurities vary considerably and are not necessary linked to subsistence strategy (Benyshek and Watson 2006). The archaeology of food has been applied to ethnicity, gender, and ideology studies (Twiss 2012). The definition of "food" is a cultural construction whose parameters are determined by the society (Twiss 2012). No matter the cultural definition of "food," however, an inadequate supply certainly invokes a physical response.

Food stress

Food storage studies are frequently linked to the concept of food stress. Not having enough to eat caused severe stress among ancient peoples. Any physical shortage or perceived shortage of food can invoke a reaction and is considered food stress (Burns 1983; Minnis 1985;

Tainter and Tainter 1996). Paul Minnis is known for his studies on the social adaptations to food stress in the Southwest and includes the magnitude, frequency, extent, speed of onset, spatial dispersion, and temporal spacing as contributing factors to food stress (Minnis 1985, 1996). According to these criteria, food stress can be either acute or chronic. Environmental factors such as precipitation and the amount of land suitable for farming (in the case of agricultural communities) are critical factors that impact whether a food shortage is acute or chronic (Minnis 1985, 1996). Human responses to food stress vary according to the severity and frequency of the shortage; however, storing food is a common solution (Burns 1983; Dean 1996; Minnis 1985, 1996; Twiss 2012).

Other social adaptations to food stress include intensification or diversification of resources, or changes in economic systems through sharing, trading, or bartering (Kuijt 2009, 2011; Minnis 1985; Twiss 2012). Researchers in the Near East found that food storage provided evidence of both sharing and hoarding in densely populated communities, implying complex social relationships were aided by how food was stored (Bogaard et al. 2010). Inadequate food supplies certainly caused stress in prehistoric times and likely complicated social relationships within the community.

Chronic food stress is a byproduct of the high-risk environment of the Southwest, a problem which impacted ancient inhabitants. Researchers study episodes of paleoclimatic risk using tree rings, identifying periods that had more precipitation, therefore more conducive to farming, compared to periods of drought in which agriculture would prove difficult (Dean 1988). Environmental factors such as changes in moisture may be either high-frequency or low-frequency yet must be identified at the local level (Dean 1996). Recent research in the Grand

Canyon investigates the degree to which ancient agriculturalists were susceptible to dry periods (Ingram 2010).

Scarcity and Surplus

Food scarcity is best understood when compared to excess resources or surplus. The conversation surrounding scarcity and surplus is central to discussions about food storage and distribution of resources. Food storage in areas which are plagued by scarcity are interpreted differently than in areas that produce surplus food and need to store excess resources (Kuijt 2009). Scarcity is simply having inadequate resources to accommodate the number of inhabitants of the region (Minnis 1985). Surplus, on the other hand, is having enough food resources to not only cover the annual needs of a group, but also enough to overcome potential seasonal shortages and maintain food resources to be used as a commodity for trade (Garfinkel et al. 2008; Kuijt 2009). Surplus was a sign of wealth and facilitated social inequality by control of resources and payment to a centralized system (Garfinkel et al. 2008). Whether the food surplus was stored in a centralized or private location had economic implications, hinting at the existence of a larger political system in charge of controlling the surplus (Hildebrand and Schilling 2016; Kuijt 2009; Twiss 2012). Although inhabitants of the Southwest battled periods of varying degrees of scarcity, archaeologists infer that trade and distribution centers did exist across the Southwest (Klesert 2008; Wills and Windes 1989).

Coping with Food Stress

A common response to inadequate food supply is to store food. Over the last several decades, researchers have determined that humans stored food in four main ways throughout the world. Storage can be biological, social, environmental, or physical (Hildebrand and Schilling 2016; Ingold 1983). Biological storage is the formation of fat within the body; social storage is a type of resource exchange or sharing; environmental storage includes raising livestock such as sheep or cows, and physical storage is placing food in a structure or vessel for future use (Hildebrand and Schilling 2016; Ingold 1983). My research centers on the physical elements of storage. Communities utilized physical storage in the form of subterranean pits, above ground rooms, granaries, or ceramic vessels. Specifically, this thesis focuses on storage in the form of granaries.

Across this region of the Southwest, food storage strategies changed through time. Typically, food storage began in subterranean pits and then progressed to above ground storage rooms and granaries (Baker 2009). These storage strategies, however, are not mutually exclusive and groups often utilize a combination of storage techniques. Thann Baker detailed the changes in storage features in the Escalante Drainage in Glen Canyon (Baker 2009). Baker (2009) concluded that above ground masonry storage structures emerged at around A.D. 700 during an increase in maize agriculture. Masonry storage, in combination with other forms of storage, continued throughout occupation of the region, completely replacing other methods of storage by A.D. 1000 (Baker 2009).

The presence of food storage frequently couples with plant cultivation and the transition to agriculture; however, storage systems are not inextricably linked to agriculture (Ingold 1983; Kuijt 2011; Testart et al. 1982). Research in Southern Levant revealed that the presence of food storage preceded plant domestication and the appearance of status differentiation (Kuijt 2011). Although food storage increases after the domestication of plants, storage was not a driver for domestication (Kuijt 2011). Archaeologists found evidence of large-scale storage features in the Jordan Valley during the Pre-Pottery Neolithic A, approximately 1,000 years prior to plant domestication in the region (Kuijt and Finlayson 2009). Small-scale storage was also found in the same area and post-date the large-scale storage features, indicating that stored food transitioned from a communal resource to a personal household commodity (Kuijt and Finlayson 2009). Plant domestication occurred even later, after the transition in storage techniques.

Sedentism

Although storing food can be an indicator of increased sedentism in the archaeological record, mobile hunting and gathering groups also practiced storage or caching (Binford 1990; Holley 1998; Kuijt 2011; Morgan 2012). For mobile groups, caching food provided a means to adapt to unstable environmental settings and combat actual or perceived food shortages (Binford 1990; Holley 1998). Because human responses to food shortages are dependent on several factors including environmental conditions, social motivations, and historical development, examination of food storage must take these elements into account (Holley 1998). Over the last couple of decades, researchers found that physical storage is not a good indicator of mobility practices (Holly 1998; Morgan 2012). Therefore, to best understand food storage, we must detach from the linear thinking that storage couples with sedentism.

Social Complexity

Storage leads to social complexity due to the possibility of controlling resources, however, the ability to manipulate the food supply does not automatically result in food surplus (Kuijt 2011). Binford states that storage and subsistence are related to environmental variations and only areas rich in resources can support complex societies (Binford 1990). Certainly, environmental conditions must be suitable for accumulation of food to obtain surplus. The idea of having surplus drastically changes the social and economic structure of a community. Accumulation of resources shows cooperation and sharing among communities, however, hiding resources shows hoarding behavior that may indicate social stress (Bogaard et al. 2010). Having surplus food means that individuals can distribute or exchange excess, creating a hierarchical social system (Twiss 2012). Creating surplus also involves divisions of labor and control (Twiss

2012; Hildebrand and Schilling 2016). Research in Mesopotamia shows that food storage reflects a trend from egalitarian societies to stratified states in which production and distribution of resources is controlled by an elite few (Rothman and Fiandra 2016). Furthermore, the evidence of sealed storage structures shows an increase in control of the resource and control over other individuals (Rothman and Fiandra 2016). Sealing food sources further limits the ability of the group to access food at any given time. The production and distribution of food within larger communities shows cooperative elements of trade, exchange, and consumption among ancient populations (Klesert 2008). Archaeologists have also studied food storage in relation to population aggregation (Wills and Windes 1989). Distribution centers across the Southwest indicate trade networks and sharing among larger communities (Wills and Windes 1989).

The location and size of storage systems promotes differences in socioeconomic status among groups evidenced by the degree to which food was either stored publicly or privately (Bogaard et al. 2009; Kuijt 2011). Large-scale grain silos under the control of a few individuals promotes a hierarchical system with broad economic implications, whereas small-scale, privately owned food storage indicates local economies (Hildebrand and Schilling 2016). Hidden food storage may have been a mechanism for concealing food from an enemy or avoidance measures for members of the same group (DeBoer 1998; Bogaard et al. 2010). Perceived or actual threat influenced the location and accessibility of stored foods. Researchers have studied perceived risk and threat using GIS-based viewshed analysis (Boomgarden 2009) and using an economic model of caloric expenditure compared to granary construction (Phillips and Barlow 2012).

Carrying Capacity

The scale of the storage system also indicates the carrying capacity of the built and natural environment (Chesson and Goodale 2014). Human responses to nearing the carrying capacity can result in diversification of resources in the form of exchange and social interaction with other groups (Dean 1996; Minnis 1996; Rautman 1993; Twiss 2012). Dean (1996) defines carrying capacity as a dynamic boundary between a changing environment, population pressures, and cultural parameters. Carrying capacity is the maximum number of people that can be supported in a particular environment, considering both environmental and cultural parameters (Hassan 1978). Carrying capacity of the environment also depends on supplying sufficient nutrition to the inhabitants. Using tree-ring samples from the Southwest, researchers have conducted simulation studies to evaluate the carry capacity of the environment under prehistoric population pressures (Gumerman et al. 2003; Kohler 2012).

Economics

The caloric cost-benefit of constructing food storage was studied using an economic model (Phillips and Barlow 2012). The calories expended on construction and maintenance of granaries with difficult access were compared to varying degrees of perceived threat to determine whether they made sense economically (Phillips and Barlow 2012). The researchers developed an economic model to assess the probability of an external raid based on the location of storage features (Phillips and Barlow 2012). However, the placement of food storage is not likely reducible to a single characteristic. Economic models are applied to aspects of human behavior to understand the extent that human decisions confirm such models.

Nutrition

Ancient diet studies focus on the nutritional value and caloric intake of past populations (Twiss 2012). Researchers use simulations to study human interactions with the environment and estimate adequate food supplies. Reconstructive studies, like those conducted at Arroyo Hondo in New Mexico, show the value in identifying elements of food stress and associated coping mechanisms during periods of erratic precipitation (Wetterstrom 1986). Archaeological study of Arroyo Hondo examines the severity of food shortages by estimating the caloric needs of the population compared to the calories available for consumption in a maize-based diet and showing that protein-caloric malnutrition was especially evident in young inhabitants (Wetterstrom 1986). Diets dominated by maize often lacked other important nutrients and increases risk of human parasites (Reinhard 1988). Researchers used prehistoric nutrition studies of maize dominant diets to understand the role of diabetes in modern descendants (Reindhard et al. 2012). Other research among past Ancestral Puebloan inhabitants indicate a carbohydrate-rich diet and evaluate the energy costs of storing excess fat on the body (Osborn and Vawser 1991).

Threats

The Southwest is not without potential threats to stored food. Impacts including vermin and insects, moisture, drought, and conflict have the potential to hinder the success of storing food and in turn the overall success of the population that relies on the stored foods (Diehl and Davis 2016). These potential threats to storage features, while in use, also expedite deterioration after the storage is no longer used. Studies of physical storage are limited by lack of preservation, leaving only trace elements of their presence.

In sum, coping mechanisms for inadequate food supply depend on the severity and duration of food shortages. Both semi-sedentary and sedentary communities experienced food stress and developed coping mechanisms for the situation. Strategies for dealing with food stress range from physical storage to expanding social networks. Because food is critical to survival, an underlying theme throughout the archaeology of food is biological necessity. The study of food storage is inextricably linked to human biology and social complexity. To position my study in relation to these foundational concepts, I use a framework of human behavioral ecology to understand the role of food storage by way of optimal human behavior.

Chapter Three – Theoretical Framework

In this chapter, I present the theoretical framework with which I am evaluating the results of my study. By placing my research in a broader theoretical conversation, I contribute to the discussion of scarcity, viewed through adaptive mechanisms. I evaluate food scarcity through the lens of human behavioral ecology to highlight the complexity and resilience of past inhabitants. I analyze the resilient behavior of past agriculturalists in the Southwest to not only understand human behavior in this region, but also provide a basis for understanding human resiliency in arid environments worldwide.

I examine human behavioral ecology by tracing the development of the theory through time. Following the historical context, I outline the dominant concepts in human behavioral ecology that guide my interpretation of food storage. I will build upon the concepts of human behavioral ecology and show their relevance to examining food scarcity in the Southwest. Finally, I will discuss critiques of human behavioral ecology and academic responses in the context of my current study.

Humans are influenced by the environment, whether it be built or natural, and as such, will modify their behavior accordingly. Human behavioral ecology seeks to explain human behavior through an adaptive lens. In the broadest sense, human behavior is framed by biological fitness (Nettle et al. 2013). As biological organisms in the natural world, archaeologists expect to see behavior that maximizes biological fitness within the parameters of the ecological environment (Nettle et al. 2013). Human behavioral ecology evaluates the difference between what we expect in certain environmental conditions and what we see in the archaeological record (Hames 2015; Nettle et al. 2013). The means to store food was especially crucial for survival in times of environmental stress and increased population pressure; however, observed behavior does not always mirror expectations.

History of Human Behavioral Ecology

Rooted in evolutionary concepts, early human behavioral ecology focused on mobile hunter-gatherer and foraging societies (Gremillion and Piperno 2009; Hames 2015; Winterhalder and Smith 2000). Early researchers analyzed the behavior of mobile groups using the concept of optimization, in which groups adapt in the best possible way given the environmental conditions (Hames 2015; Winterhalder and Smith 2000). Over the next 25 years, researchers applied the concepts to different subsistence groups with an emphasis on production, distribution, and reproduction (Winterhalder and Smith 2000). Contemporary proponents of human behavioral ecology draw on ideas that view adaptive behavior as enhancing an individual's evolutionary fitness (Bird and O'Connell 2006; Codding and Bird 2015). Evolutionary fitness is simply the ability to survive and reproduce (Brid and O'Connell 2006). The emphasis of human behavioral ecology is human adaptability through learning and plasticity to various environments (Nettle et al. 2013).

Since the mid-1980s, researchers have been applying the concepts of human behavioral ecology to the origins of agriculture, analyzing the reliance on cultivated plants using a cost-benefit model of risk minimization (Keegan 1986; Winterhalder and Kennett 2006). The cost-benefit model examines risk minimization by weighing the physical cost of an action against the physical benefit of doing the same action. An action in which the benefits outweigh the cost, minimizes the overall risk of the activity. Other researchers analyze food production through the diet-breadth model, which shows the circumstances in which a broad diet is more efficient than a narrow one (Bettinger 2006; Gremillion and Piperno 2009). Simply, the diet-breadth model uses a ratio of time and energy to evaluate food choices (Figure 6) (Bettinger 2006). The diet-breadth model explains why humans or other animal species may sometimes exploit resources even if the cost may outweigh the benefit at times (Bettinger 2006; Gremillion and Piperno 2009).

Although influenced by biological fitness and adaptation, human behavioral ecology encompasses a range of concepts and models for analyzing human behavior. Researchers employ concepts of optimization, resource transfer, marital strategies, reproduction, and life history to understand human biological fitness (Hames 2015; Nettle et al. 2013). Although each concept is not applicable to understanding all elements of human behavior, the concepts help to explain humans' adaptive nature in various ecological settings. In the following section, I will highlight the concepts that are useful for understanding scarcity and food storage across the southwest.

Key Concepts in Human Behavioral Ecology

Optimization models analyze human behavior by establishing the most rational decisions that humans could make within particular ecological zones (Ferguson 2016). Rational decisions are those that are the most logical given myriad factors influencing the human decision-making process. The concept of optimization was commonly used to explain the food choices of foraging groups, referred to as Optimal Foraging Theory (Hames 2015; Stephens and Krebs 1986). Application of Optimal Foraging Theory allowed researchers to predict which foods were pursued, where foragers traveled, and how long they stayed in a single location (Hames 2015). A subset of the concept of optimization is called the diet breadth model, which aids in predicting food choices (Bettinger 2006; Gremillion and Piperno 2009). The diet breadth model states that as highly valued food becomes scarce, it becomes more efficient to accept less than ideal resources into the diet. The model implies that in times of food scarcity, the human diet became broader (Bettinger 2006; Gremillion and Piperno 2009). Most importantly, the diet breadth model shows under what circumstances a broad diet can be more efficient than a narrow one using a ratio of time (to procure resources) and energy (calories) (Figure 6). Ironically, this model was applied to early food production in the Neotropics to show that food production was a more efficient strategy than full time hunting and gathering (Gremillion and Piperno 2009; Piperno 2006). This model assumes that foraging communities intend to maximize their returns, in the case of calories expended versus calories consumed, ultimately maximizing fitness (Hames 2015).

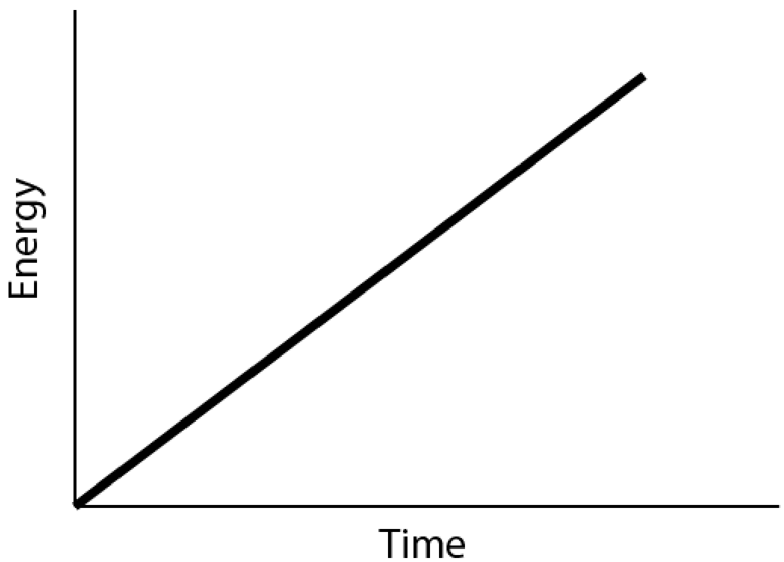

Figure 6. Simplified trends of time and energy according to the diet-breadth model.

Another way that humans can maximize fitness is through transfer of resources. The concept of resource transfer does not necessarily assume reciprocity and can occur through coercion or theft (Hames 2015). In the case of both hunter-gather communities and food producers, resource transfer is viewed as a way to minimize risk and optimize resources (Hames 2015; Ferguson 2016). In times of uncertainty, trade of goods or theft may be employed to acquire needed resources, which, in turn, will contribute to the biological fitness of the individual or the group (Hames 2015). The degree to which communities minimized risk through resource transfer is dependent on not only the ecological setting, but also on population pressures (Hames

2015). Sharing and exchange were especially important coping mechanisms in the harsh environment of the Southwest.

Optimization also deals with the costs and benefits of human decisions. The idea of opportunity costs outlines how change occurs from one behavior to another (Winterhalder and Kennett 2006). Behavioral change occurs when the value to two options are weighed against one another and the chosen option provides a greater number of returns (Winterhalder and Kennett 2006). The cost-benefit method of interpretation is useful for understanding some of the major transitions in the archaeological record, such as the domestication of plants and animals or the transition from hunting and gathering to agriculture (Bowles 2011; Codding and Bird 2015; Winterhalder and Kennett 2006). Human behavioral ecologists explain the apparent patterns in cultural behavior by examining the differences between what they expect based on environmental adaptation and what they observe in the archaeological record.

Additional concepts under human behavioral ecology that promote biological fitness include marital strategies, reproduction, and life histories. In short, human behavioral ecology assumes that individuals will choose a potential mate based on the number of resources the potential mate has, that there is an optimal number of offspring, and that there are age-specific schedules for mortality and fecundity based on the environmental setting (Hames 2015). Although the preceding concepts are not central to scarcity and food storage, biological fitness often involves a combination of elements. For instance, survival in a marginal environment may rely on both optimal reproduction strategies and exchange between groups.

Ecological Conditions

In fact, the entire ecological environment is central to human adaptation. Within human behavioral ecology, ecological conditions include the physical environment and social settings in which human adaptation takes place (Nettle et al. 2013). For example, humans may adapt to a lack of precipitation while also maintaining social cohesion under population pressures. The Mesa Verde region in southwest Colorado provides a good example for this complex relationship (Kohler 2012; Schwindt et al. 2016). The Village Ecodynamics Project is a comprehensive study of the Pueblo culture in the Mesa Verde region and includes an estimation of maize productivity and climate change (Schwindt 2016; Kohler and Varien 2012). Analysis of climatic data based on tree rings and population size indicates that although climate change affects the success of cultivation, people remained in the region during drought conditions showing that group survival was heavily impacted by the social and political climate (Schwindt et al. 2016). In this case, climate not only impacted the production of food, but also social interactions (Schwindt et al. 2016). The climate along with the social and political environment contributed to the entire ecological condition in which people lived. Therefore, an ecological condition is fluid and constantly changing.

Although the ecological conditions across the Southwest are constantly changing, the arid environment was a constant battle for past inhabitants. Through the lens of human behavioral ecology, human food storage, in the form of granaries, can be evaluated using a cost-benefit analysis of human interaction with the environment (Codding and Bird 2015; Hames 2015; Winterhalder and Kennett 2006). Food storage is a mechanism of human adaptation, the variation in style and location of which can be viewed as a response to periods of cultural or environmental change. Because environmental adaptation and human institutions do not act in isolation, an evaluation of human adaptation in terms of both social and environmental influences is necessary.

Agricultural subsistence in the Southwest during the Pueblo period was difficult due to the arid environment and unpredictable moisture conditions. To combat the unpredictability, humans stored food to prepare for times of drought or crop failure (Bogaard et al. 2009). The act of storing food was an adaptive measure that would improve the biological fitness of the group, while at the same time responding to the current environmental pressures (Codding and Bird 2015). Unreliable crops and a larger population meant that food storage systems were necessary for the survival of the group (Chesson and Goodale 2014; Kuijt 2011). Storing food also implies a certain degree of communal cooperation among residents of the region, at the very least among small families, thereby preparing for resource transfers as necessary (Kuijt 2011; Kuijt and Finlayson 2009).

Critique

Although useful for understanding elements of human adaptation to ecological conditions, human behavioral ecology has been subject to critique. Human behavioral ecology has been criticized for its reductionist approach (Winterhalder and Smith 2009; Nettle et al. 2013). However, proponents of the theory argue that complex socioecological phenomena are best explained through this reductionist method (Winterhalder and Smith 2000). Criticism of the optimization method is rooted in assumptions. Some researchers argue that assuming any human behavior is adaptive discounts elements of culture (Codding and Bird 2015). Although these assumptions exist, human behavioral ecology does not divorce the idea of culture from adaptation, considering multiple factors that result in human behavior (Codding and Bird 2015). A major critique of the simplicity of the adaptive nature of humans, stems from proponents of Niche Construction Theory, a biological theory in which organisms alter their environments (Stiner and Kuhn 2016). Critiques argue that humans alter their environments and explanations of adaptation cannot be understood in isolation from this concept (Stiner and Kuhn 2016). Proponents of Niche Construction Theory argue that human adaption often involves both intentional and unintentional actions, best explained by complimenting concepts of human behavioral ecology with Niche Construction Theory (Gillreath-Brown and Bockinsky 2017; Laland and O'Brien 2010). Other researchers critique human behavioral ecology for its limitations in methodology, explaining the limitations of supporting a hypothesis based solely on archaeological evidence (Stiner and Kuhn 2016). Although archaeological evidence is limited, many researchers use analogy to modern cultural groups to support their inferences about material culture. In studying food storage across the southwest, I observed both environmental and cultural conditions to evaluate adaptive mechanisms.

Although human behavioral ecology has its limitations, several concepts are valuable for understanding human interaction to the environment. The basis of human behavioral ecology is human adaptation through choices that increase biological fitness. Optimization assumes that humans will act in logical ways, and which in the case of my study, will explain food storage practices. Human behavior, however, is not this simplistic and optimization must be considered in the relation to cultural parameters that also guide human actions. Another crucial take-away of human behavior ecology, is the idea of risk minimization. One can argue that the act of storing food is intended to minimize risk, indicating that food storage and risk minimization are inextricably linked. Drawing on these basic concepts, I analyze the style and construction characteristics of granaries, searching for evidence which supports these concepts. In the following chapter, I discuss a detailed synopsis of the methodological process of evaluating granaries under this theoretical umbrella.

Chapter Four – Data Collection and Analysis

In this chapter, I discuss the methods for compiling and analyzing my data. Food storage is directly related to the ways in which past inhabitants are managing food scarcity in the northern Southwest. A backup source of food served as a reserve when crops failed, or wild resources did not produce the desired result. Patterning in the construction style, location, size, and number of storage features in the Grand Canyon and Grand Staircase-Escalante indicates that multiple groups of past inhabitants were managing food scarcity in similar ways. The absence of food storage patterns, however, could indicate adaptation to environments at a local scale, or variation in learned behaviors.

Grand Canyon Data

The Grand Canyon data are highly sensitive because if site locations were disclosed to the public, the safety of the sites could be threatened. Because the data are sensitive, I needed to obtain permission to use the data. I was granted permission to use the existing Grand Canyon site data in the Spring of 2017, per agreement of treatment of sensitive data, outlined in a non-disclosure document. The non-disclosure document outlined the proper security measures and treatment of the data. In accordance with the agreement with Grand Canyon, I stored the sensitive data on a secure computer in the Bilby Research Center at Northern Arizona University.

The Grand Canyon data comprise all the sites that archaeologists have documented within the park boundaries between the 1950s to 2015. The data are stored in a Microsoft Access Database, which includes over 3,000 archaeological sites. To pare down the sample, I wrote a database query to separate sites that contain "enclosures" from the remaining sites in the Grand Canyon. The site manual associated with the Grand Canyon database defines an "enclosure" as a free-standing structure that exhibits interior dimensions less than two meters and was intended to identify granaries (Grand Canyon National Park 2009). I used the "enclosure" query as my starting point to identify granaries in the Grand Canyon. I read through each of the site forms in which previous researchers coded structural elements of the sites as "enclosures" to confirm that the structures were intended for food storage. I eliminated the enclosures that I determined were not food storage, based on the size or potential function of the enclosure. For example, previous researchers coded structural remains as an "enclosure" that contained the remains of an agave roasting pit. I deleted sites like these from my sample because there is no evidence that the remains are granaries.

Researchers previously coded the data according to the original site forms. Coded information includes the number of structures, masonry rooms, rockshelters, depressions, middens, structure shape, and the number of a variety of artifacts. In addition to these predetermined attributes, I added elements of construction to the data tables including the shape of the granary structure (D-shaped, circular, rectangular), the elements used in construction (stacked masonry, upright slabs, or a combination), the construction materials (sandstone, limestone, quartzite, etc.), and the presence or absence of door lintels. Furthermore, I noted whether the granary was in an open or sheltered environment and if stored materials were accessed from the side or the top of the structure. I recorded the dimensions of the granaries, estimating the area and volume of each of the storage features and then calculated the averages of each dimension (length, width, etc.). I noted the site locations, elevations, temporal, and cultural association. Previous researchers determined the temporal and cultural affiliation of the sites, and in many cases, were based on the surface ceramic assemblage (Downum and Vance 2017) or association with dated sites in close proximity. The temporal and cultural affiliation of the granaries in my research relied on mean ceramic dating, conducted by researchers at

Northern Arizona University (Downum and Vance 2017). Because I used legacy data, I relied on the information on the site forms instead of personally visiting each of the sites. Revisiting the sites in the Grand Canyon that contained the remains of granaries was beyond the scope of my thesis.

Grand Staircase-Escalante Data

The Grand Staircase-Escalante data set, although small, provided a means to compare a small region of the Southwest, in which past agriculturalists were managing food scarcity in a similar arid environment. The data that I compiled from Grand Staircase-Escalante National Monument was a combination of legacy data and new data. The comparative sample from southern Utah includes 14 sites. Although the sites had been previously recorded, in August 2017, I revisited 10 sites in the Fiftymile Mountain region to obtain more detailed site information. I used a combination of original site forms and new measurements and photos to fill in missing information. Like the data tables for the Grand Canyon, I compiled identical qualitative and quantitative site attributes. Due to the lack of diagnostic artifacts at the sites, temporal association could only be inferred from sites in close proximity. Due to this obstacle, I was unable to create a chronology of granary changes in Grand Staircase-Escalante. Additional research is needed to create a granary construction chronology in this region. Because Grand Staircase-Escalante received National Monument status in the mid-1990s, the sites in this area were recorded more recently compared to the 1950s documentation of many sites in the Grand Canyon.

Assumptions

A basic assumption of my study is that it is possible to properly identify food storage structures using legacy data. Although a seemingly daunting task, I used the guidance of site coding in the Grand Canyon (Grand Canyon National Park 2009), previous definitions of storage rooms compiled for a guide to terminology of Pueblo architecture (Metzger and Nordby 1993), and site descriptions of Pueblo structures in northern Arizona (Dean 1967). I adopted the two-meter limit from the Grand Canyon site coding manual for the sake of consistency in identifying granaries in the Grand Canyon and in Grand Staircase Escalante National Monument. Using these guidelines, I defined granary attributes emphasizing the presence of an external seal. Although multiple sources agree that the presence of an external seal is diagnostic of sealed storage, the size of a granary can be variable. To be consistent with the Grand Canyon database, I limited granaries to enclosures that were less than two meters long or two meters wide unless otherwise specified in the original documentation that the larger structure was a granary.

Statistical Analysis

In order to identify patterns in granary construction, I first compiled data tables with a combination of quantitative and qualitative construction attributes. I took the quantitative granary attributes directly from the original site forms and coded each of the qualitative granary attributes into an Excel database for the sake of statistical testing. I ran a series of tests to determine the significance of the differences in granary construction techniques and identify patterns. In addition, I conducted a series of t-tests to compare the dimensions and date range of construction. The results of the statistical tests were compared within the Grand Canyon and Grand Staircase Escalante, and between the two regions, looking for variation within archaeologically defined cultural groups.

Challenges

A number of challenges exist when utilizing legacy data to gather new information. The underlying problems of using legacy data are the incomplete nature of the information and the built-in assumptions in data collected by another person (Wylie 2017). Wylie (2017) discusses the inherent biases, calling these characteristics the conceptual and technical scaffolding of legacy data (Wylie 2017). The success of using legacy data is linked to reconstructing relevant background information (Wylie 2017). In this study, I encountered challenges while compiling data tables. Documentation of sites ranged from the early 1950s to 2015, which significantly influenced the level of detail about the site that was recorded. Some of the original site documents were limited to passing mention of a granary, lacking details about the location or construction of the feature as well as a sketch or photograph of the storage feature. In contrast, more recently documented sites usually contained detailed dimensions, sketches, photographs, and descriptions of the storage features and the surrounding environment.

Although limited by the legacy data, the process of searching for trends in construction leads to inferences about aspects of human behavior that are the basis for variation. Though classifying elements of construction into categories may obscure subtle variation, overall trends show a collective ideology, likely framed by both environmental and cultural constraints. Comparison of cultural groups across two regions of the Southwest, shows the variation that may be possible within a culture, indicating that differences could be attributed to environmental conditions or interactions with other cultural groups that result in localized changes.

Chapter Five – Construction Patterns

In the previous chapter, I outlined the methods that I used to analyze patterns in managing food scarcity in two regions of the Southwest. Using existing legacy data from the Grand Canyon and Grand Staircase-Escalante National Monument, I examined both quantitative and qualitative characteristics of food storage to investigate the similarities and differences in adapting to unpredictable environmental conditions on the Colorado Plateau. Variation in food storage strategies shows not only differences within local environments, but also disparity within or between cultural groups. The results imply characteristics of learned cultural behavior, as opposed to a strictly adaptive strategy for storing food.

The parameters that I used to frame my analysis are crucial to examining the presence of patterns through an adaptive lens. In this chapter, I evaluate the presence of patterns in construction style, temporal period, and cultural affiliation of granaries in the Grand Canyon and Grand Staircase Escalante National Monument. I will begin by examining the basic trends in distribution and construction of granaries, followed by the results of statistical testing. After exploration of preliminary trends, I use the results of parametric statistical testing to evaluate the relationship between variables and draw conclusions about the construction styles and techniques of managing food scarcity.

Grand Canyon Results

Out of a total of 4,206 documented sites in the Grand Canyon, I identified 544 with constructed storage features consisting of granaries, storage rooms, cists, or a combination of two or more types of storage features. A total of 427 granaries are among the storage features and are the most well-represented storage type, to date. I categorized the storage features according to cultural affiliation using the results of mean ceramic dating conducted by previous Grand Canyon researchers (Downum and Vance 2017). For the purpose of my study, cultural association is categorized into three main groups of past occupants, classified by the types of ceramics constructed by each group of people. Culturally associated granaries are classified into the following cultural groups based on the majority presence (more than 50%) of ceramic types: the Kayenta Branch of the Ancestral Puebloans, the Virgin Branch of the Ancestral Puebloans, and the Cohonina. Although several granaries are associated with the Patayan, the small sample size was not incorporated into this study and was excluded from my analysis. Furthermore, I used the results of mean ceramic dating, to assign a date range to the storage features. Of the 427 granaries in the Grand Canyon, 186 granaries (44%) contained ceramics that were used to assign cultural affiliation while 241 granaries (56%) did not contain sufficient diagnostic artifacts that would indicate association with a cultural group. Cultural affiliation is dominated by the Kayenta (51%), followed by the Virgin (31%), the Cohonina (18%). Temporal association is outlined in Figure *7*.

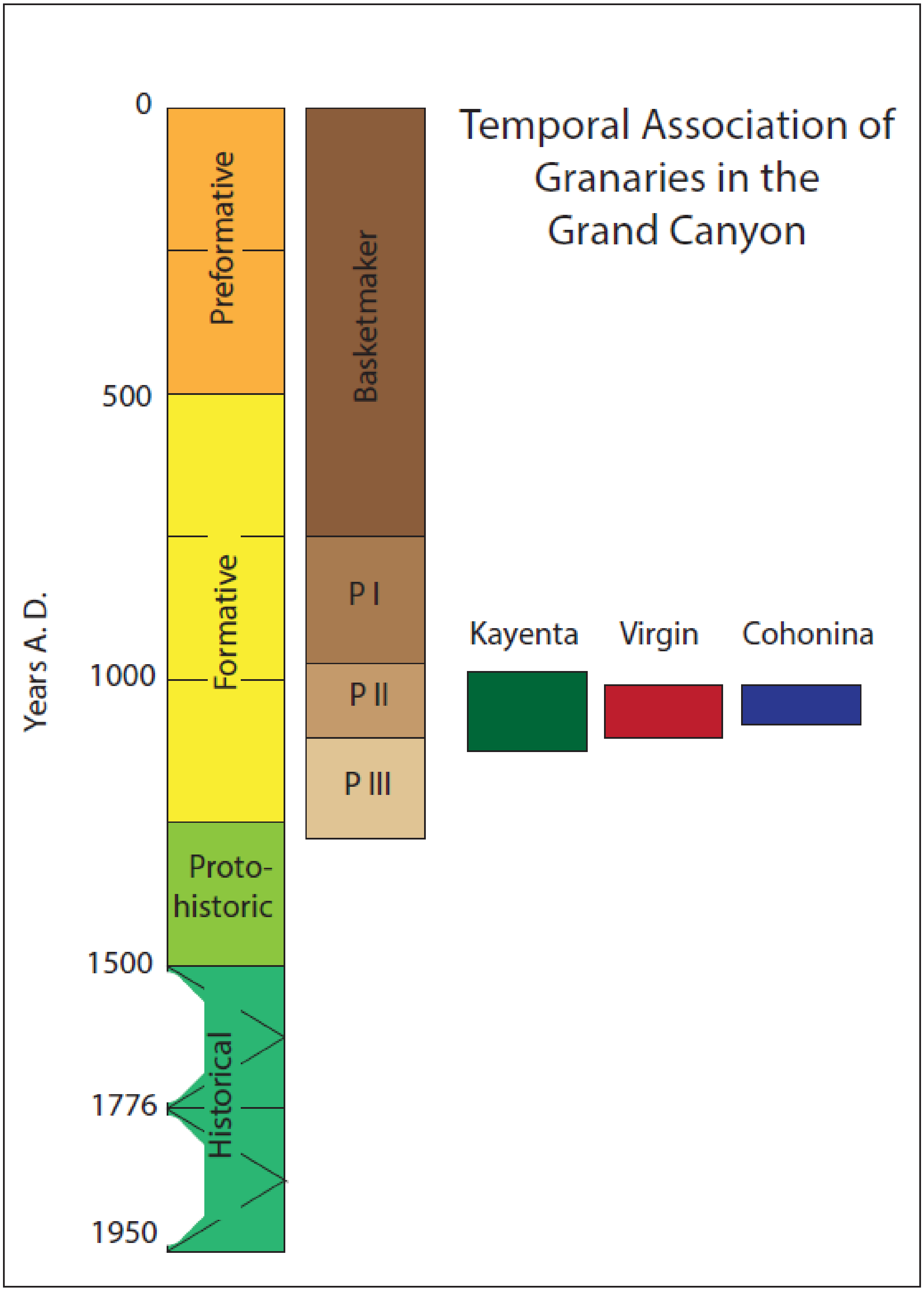

Figure 7. Temporal association of Grand Canyon granaries. Cultural and temporal association is based on mean ceramic dating.

Kayenta Branch Ancestral Puebloans. A total of 94 granaries are associated with the Kayenta Branch extend from the late Pueblo I to early Pueblo II period (A.D. 913-1190) and were constructed in the Grand Canyon between A.D. 1024 and A.D. 1183. The granaries exhibit unshaped stones of local material. Granaries are primarily situated in sheltered locations (96%) with access to stored materials from the side of the structure (65%). Access to the remaining 35% of the structures could not be determined due to the deteriorated nature of the structural remains. The granaries are constructed in a D-shape (95%) in a sheltered alcove in which the back wall is formed by eroded bedrock. Approximately 5% of the granaries exhibit a rectangular shape. The majority of the structures are constructed entirely using stacked stone masonry (91.5%), while a small portion of the granaries show a combination of stacked stone masonry and upright slabs (8.5%). A total of 30% of the granaries retained a lintel at the time of documentation. Five different material types are across the Grand Canyon. Material types are dominated by sandstone (69%), followed by limestone (12%), quartzite (10%), shale (6%), unknown igneous rocks (1%), and unspecified material types (2%). Kayenta granaries are typically small ranging from .32 m to 2 m long and from .15 m to 2 m wide. Average dimensions of the typical Kayenta granary are detailed in Table 3.

Virgin Branch Ancestral Puebloans. Granaries associated with the Virgin Branch of the Ancestral Puebloans primarily occur during the Pueblo II and Pueblo III periods, constructed between A.D. 1095 and A.D. 1178. A total of 58 granaries are associated with the Virgin Branch, all of which are D-shaped, situated in sheltered environments, and utilize eroding bedrock as the back wall of the structure. The granaries are constructed with unshaped stones and primarily stacked stone masonry (97%). A small number of granaries (3%) show a combination of upright slab and stacked masonry construction. Access to the stored goods is present on the side of the structure (43%); however, more than half of structures (57%) were in such poor condition at the time of documentation that access could not be determined. Virgin granaries comprise three material types including sandstone (69%), limestone (19%), and quartzite (7%), while 5% of the material types are unknown. Very few of the granaries (3%) retained lintels at the time of documentation. Table 3 outlines the average dimensions of Virgin granaries.

Cohonina. Cohonina granaries in the Grand Canyon are present between A.D. 1095 and A.D. 1171. A total of 34 granaries are associated with the Cohonina and are constructed in a D-shape in sheltered locations, utilizing eroding bedrock as the back wall of the structure. The stones are unshaped and access to the stored goods is primarily from the side (88%). Access could not be determined for a small number of granaries (12%) due to the limited structural remnants. Granaries are constructed with either stacked stone masonry (80%) or a combination of upright slabs and stacked stone masonry (20%). The Cohonina primarily used sandstone materials (74%); however, limestone was also used in construction (26%). Only 35 percent of the granaries retained evidence of lintels. The average dimensions of Cohonina granaries are depicted in Table 3.

Table 3. Average granary dimensions of the Kayenta, Virgin, and Cohonina in the Grand Canyon.

	KAYENTA (N=86)			**VIRGIN (N=58)**			**COHONINA (N=34)**		
	Mean	***Range***	***Std. Dev.***	***Mean***	***Range***	***Std. Dev.***	***Mean***	***Range***	***Std. Dev.***
Length (m)	1.40	0.32-2.00	.589	1.21	0.50-3.00	.726	1.78	0.34-3.20	.850
Width (m)	0.97	0.15-2.00	.483	0.92	0.40-2.50	.433	1.38	0.30-5.02	.900
Height (m)	0.66	0.15-1.50	.425	0.82	0.18-1.35	.305	0.91	0.25-1.47	.376
Area (m^2)	1.52	0.08-4.00	1.135	1.34	0.20-6.25	1.42	3.00	0.10-14.81	3.14
Volume (m^3)	1.50	0.02-4.00	1.257	1.30	0.04-6.25	1.42	3.05	0.07-21.77	4.18

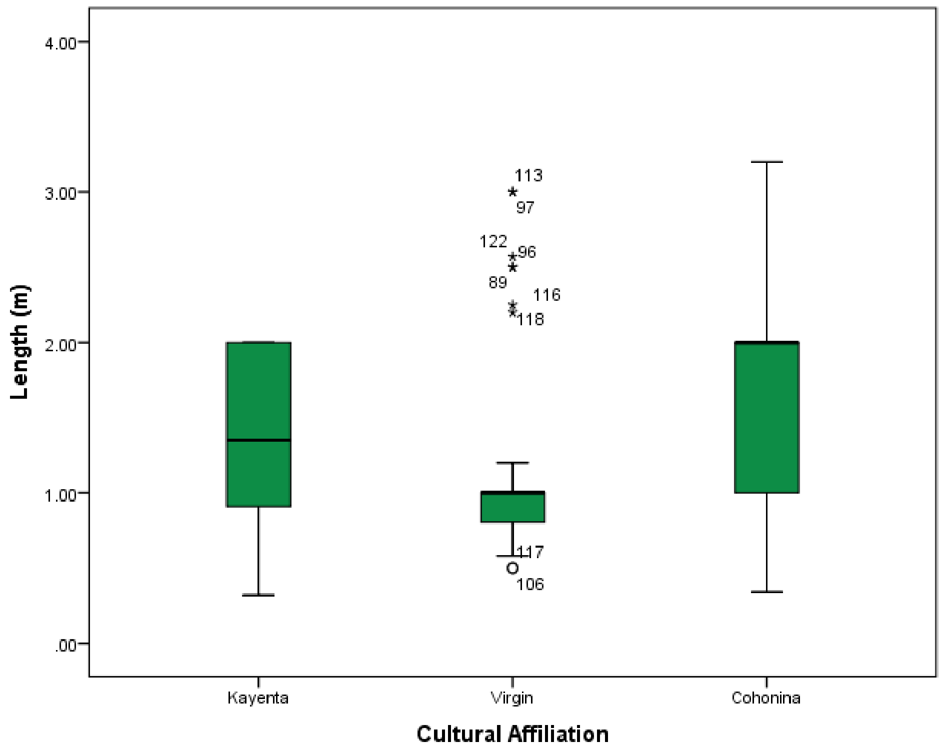

Figure 8. Comparison of granary length in the Grand Canyon.

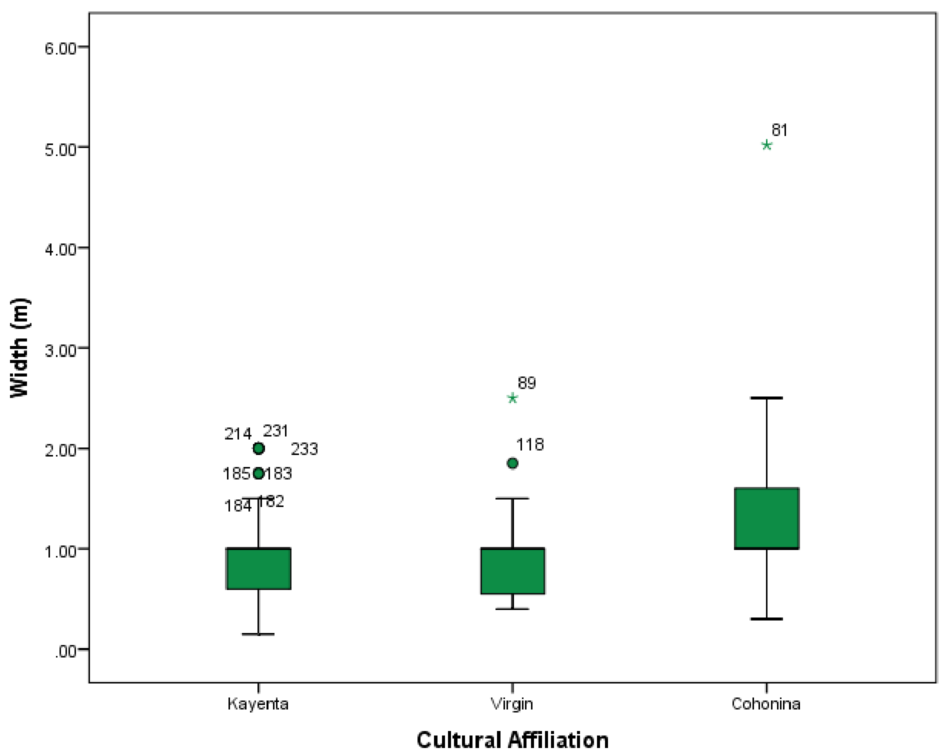

Figure 9. Comparison of granary width in the Grand Canyon.

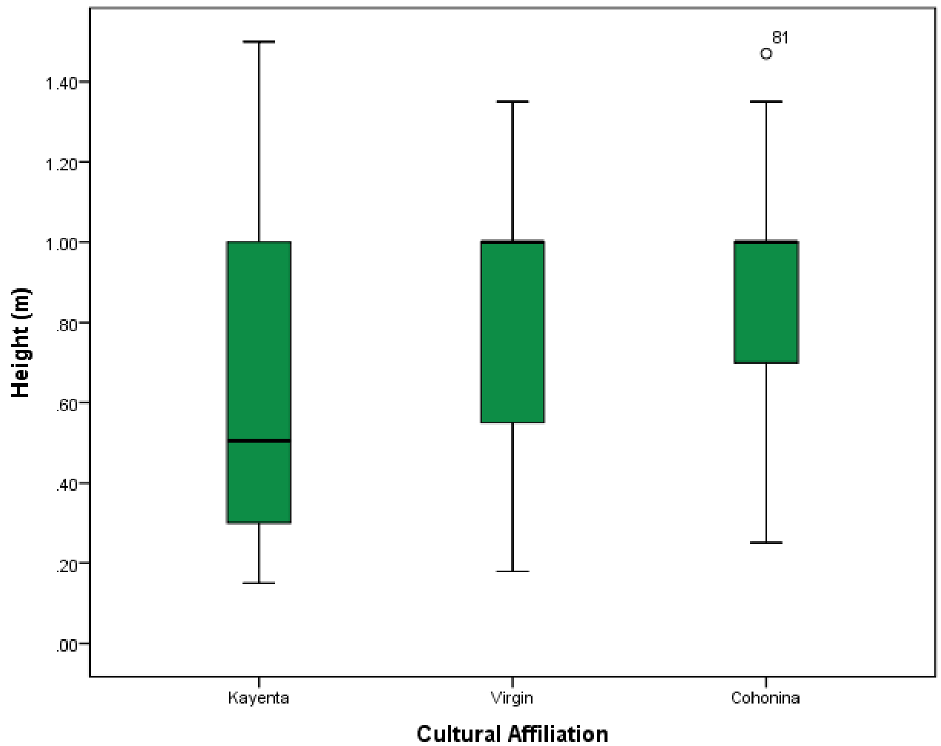

Figure 10. Comparison of granary height in the Grand Canyon.

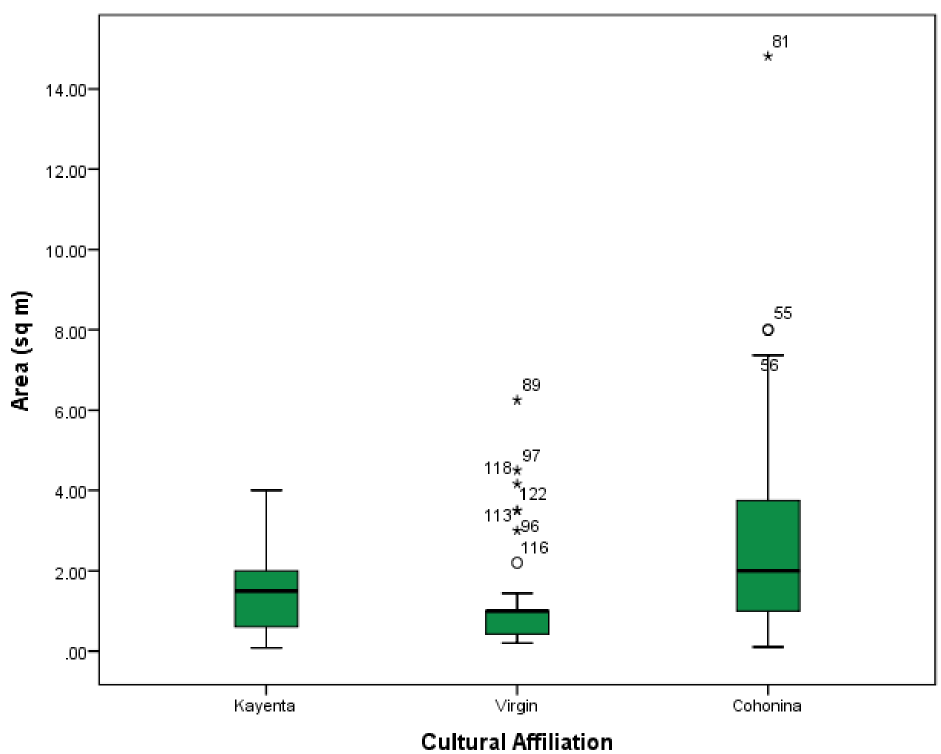

Figure 11. Comparison of granary area in the Grand Canyon.

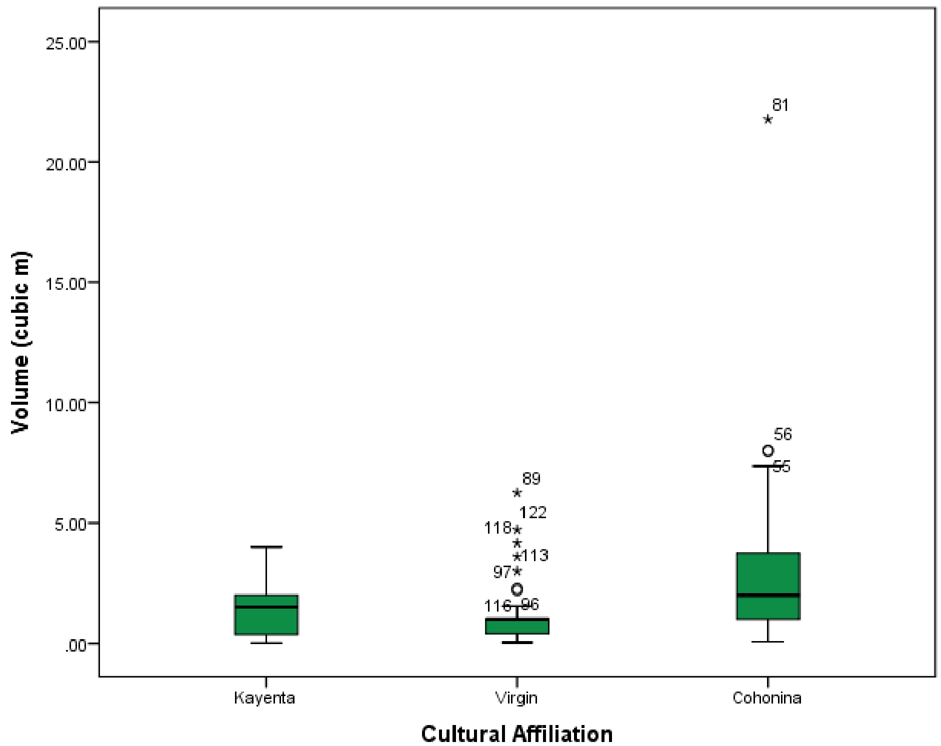

Figure 12. Comparison of granary volume in the Grand Canyon.

Variation by Cultural Group

In the following section, I detail the differences in granary construction between the three main cultural groups (Cohonina, Kayenta, and Virgin) in the Grand Canyon. Preliminary analysis of the categorical variables showed similar granary shape and location of the storage structures. Throughout the Grand Canyon, granaries typically incorporate whatever local material is available for construction and accommodate the shape of the small alcove in which the storage features are placed. The Kayenta appear to have used a combination of construction techniques, incorporating both stacked stone masonry and upright slabs. Due to the limited variation in the categorical variables, statistical analysis is not appropriate due to the small number of cases in certain categories, thereby violating the assumptions of the non-parametric statistical test. Therefore, I used statistical testing solely on the quantitative attributes. I ran a series of Independent t-tests to see if the differences in construction dimensions are statistically significant. I also conducted t-testing on the mean ceramic dates of the granaries in the Grand Canyon and then evaluated trends through time using regression analysis.

Granary Style

In general, granaries in the Grand Canyon are constructed with local, unshaped stones, and are situated in sheltered alcoves. Variation in construction style among cultural groups, however, was not found to be significant. Neither the location, shape, construction material, nor construction method was found to be associated with a cultural group. The slight variation in shape is likely attributed to accommodating the shape of the alcove, in which the storage feature is constructed. The majority of the sites exhibit stacked stone masonry construction, however, several sites within each cultural group used a combination of stacked stone masonry and vertical upright slabs. Conducting statistical tests on the nominal variables would violate the assumptions of a non-parametric test so a descriptive summary of the results is presented instead. A summary of the construction methods can be found in Table 4.

Table 4. Construction techniques of granaries in the Grand Canyon separated by cultural group.

Cultural Group	**Stacked Stone Masonry**	**Combination of Stacked Stone Masonry and Upright Slabs**
Grand Canyon Kayenta (n=94)	86 (91%)	8 (9%)
Grand Canyon Virgin (n=58)	56 (97%)	2 (3%)
Grand Canyon Cohonina (n=34)	27 (73%)	7 (27%)

Granary Size

Because the height of many of the granaries was either missing from the original documentation or the structure was too deteriorated to obtain a measurement, area was used as a proxy for granary size. Although there are many similarities in granary construction, the mean area ranges from 1.34 m^2 (Virgin) to 3.00 m^2 (Cohonina) within the Grand Canyon. Granaries associated with Ancestral Puebloan groups are generally smaller than granaries associated with the Cohonina. A series of t-tests comparing sites in the Grand Canyon show that there is a significant difference between the area of granaries associated with either the Kayenta or Virgin branches of the Ancestral Puebloans compared to the Cohonina. T-testing, however, did not show a statistically significant difference between the Kayenta and Virgin groups. Results show that the Cohonina constructed the largest granaries in the Grand Canyon, followed by the Kayenta, and Virgin branches of the Ancestral Puebloans; however, the only the area in the Cohonina granaries is significantly different.

Quantity of Granaries

I conducted statistical analysis on the number of granaries compared to several variables to look for correlations including granary size, number of structures on the site, and mean ceramic date. There was no statistical difference between the number of granaries per site and the average granary area. Using regression analysis, the data show a general positive trend. Figure 13 shows that the data tend to cluster around a small number of granaries with a small total area. The data, however, fail to follow the predicted statistical trend. If we assume that the number of granaries per site is an indication of the number or people who lived in the area, then I would expect the average area of granaries to also increase, showing an increased capacity for larger population.

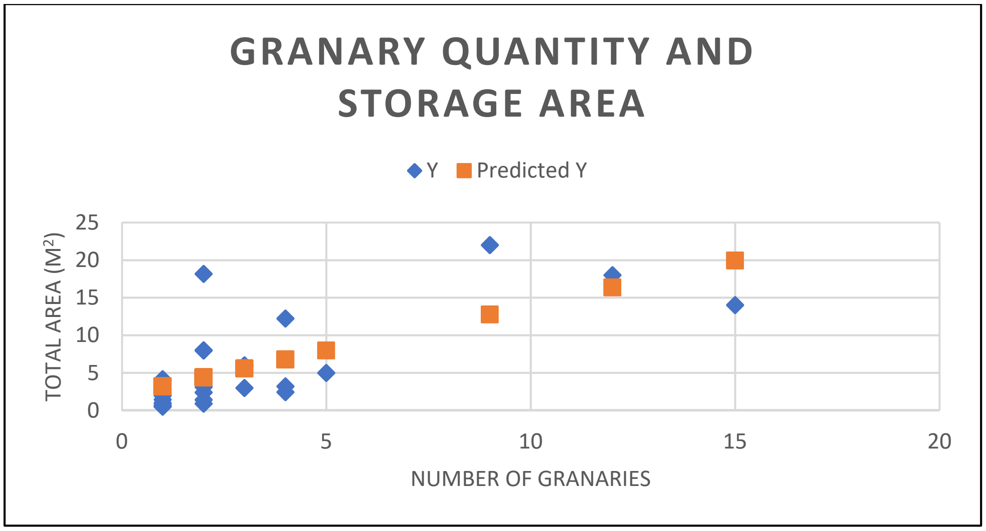

Figure 13. Regression analysis of number of granaries per site in the Grand Canyon compared to the average storage area.

Statistical analysis of the number of granaries compared to the number of rooms did not show a statistical correlation. If we assume that the number of rooms at a site is an indicator of the number of people who lived there, we would also assume that the number of storage features would also increase. A study of granaries alone, however, does not account for other forms of storage, some of which may not be readily visible in the archaeological record. Figure 14 depicts the number of granaries at culturally associated sites in the Grand Canyon compared to the number of rooms present at the same site.

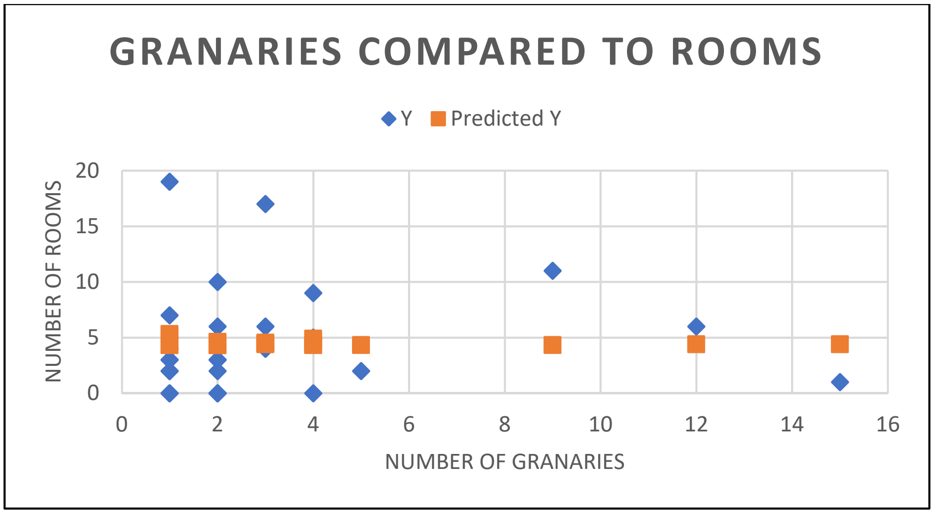

Figure 14. Number of granaries per site compared to the number of non-granary rooms in sites in the Grand Canyon.

Chronology

Sites that contain granaries in the Grand Canyon span the Pueblo II (A.D. 1000-1150) and Pueblo III (A.D. 1150-1250) periods. The Kayenta begin to construct granaries in the Grand Canyon at around A.D. 1024, followed by the Virgin and Cohonina at around A.D. 1100 (Figure 15). After approximately A.D. 1130, there appears to be an increase in the number of granaries in each of the three cultural groups. The number of granaries slightly decreases until each of the three groups is no longer visible in the archaeological record. Figure 15 summarizes the construction of granaries in the Grand Canyon based on mean ceramic dates.

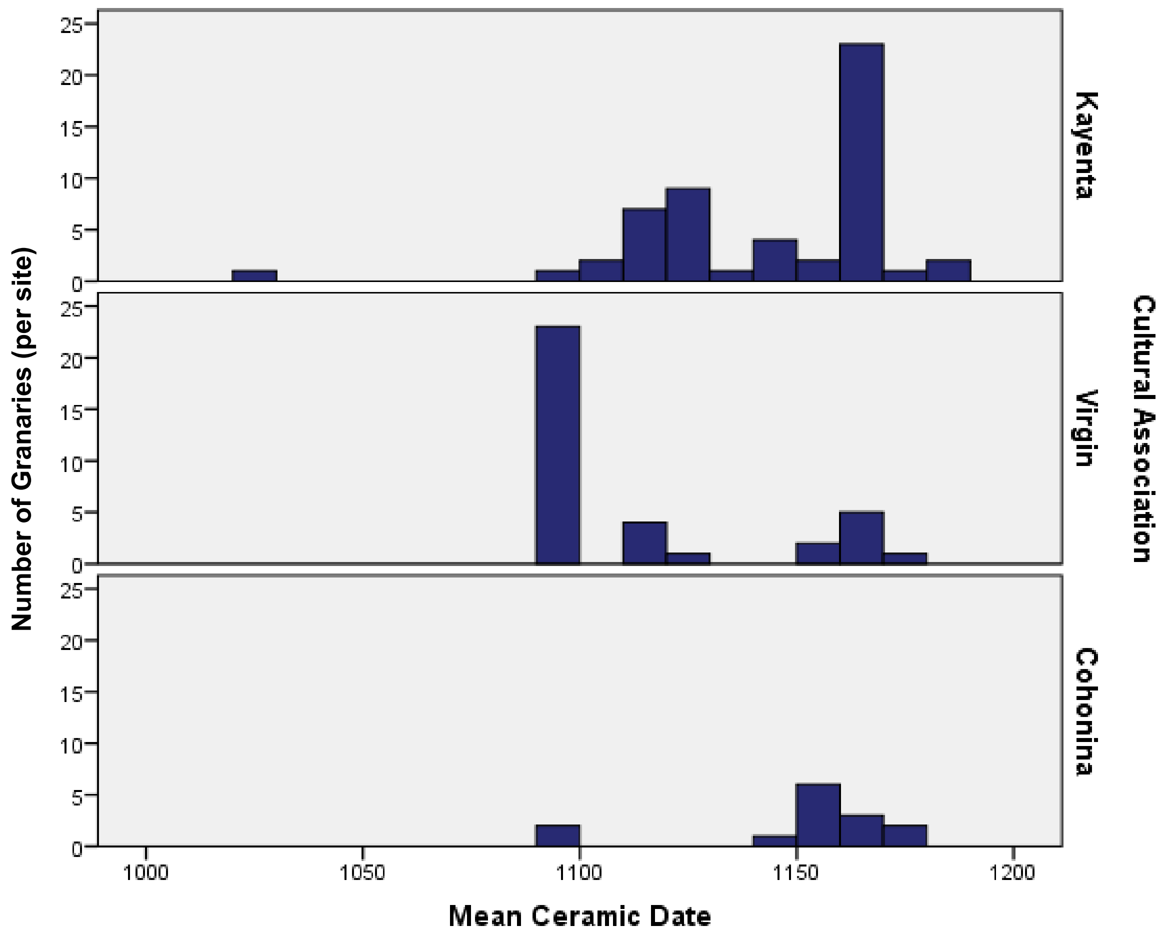

Figure 15. Number of granaries per site in the Grand Canyon through time organized by cultural group.

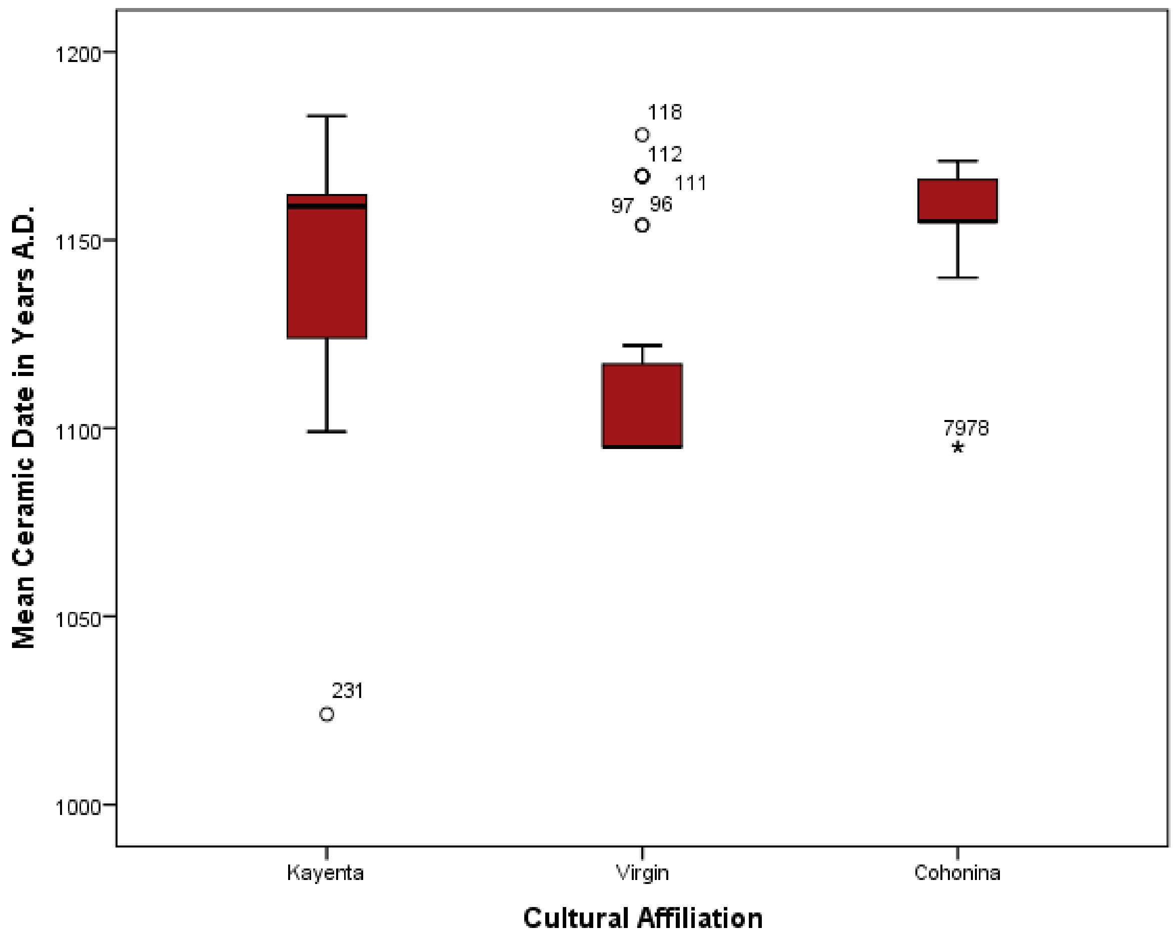

Figure 16. Mean ceramic dates of granaries per site in the Grand Canyon.

The number of granaries though time did not show a statistically significant increase. There was no statistically significant relationship between the number of granaries and the mean ceramic dates per site. Although the regression line does not display a statistical trend, analysis shows that the sites with a large number of granaries occur after approximately A.D. 1130, appearing during the middle of the Pueblo II period in the Grand Canyon (Figure 17). The trend in granaries through time occurs across all semi-sedentary occupants of the region and is not separated by individual cultural groups.

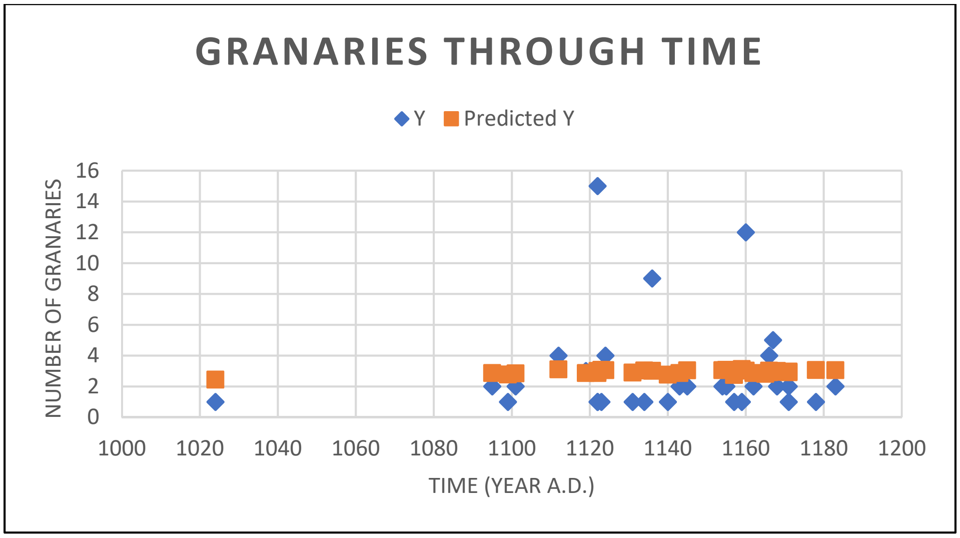

Figure 17. Number of granaries per site through time at the Grand Canyon.

Statistical analysis of the amount of storage space per site compared to the mean ceramic date per site was conducted using regression analysis. Although the line of regression is not a statistical trend, Figure 18 shows a general trend of an increase in storage space during the end of the Pueblo II period and beginning of the Pueblo III period. As there was also an increase in population in the Grand Canyon until about the mid-1100s (Downum and Vance 2017; Fairley 2003), the amount of storage is consistent with the population growth in the Grand Canyon at this time.

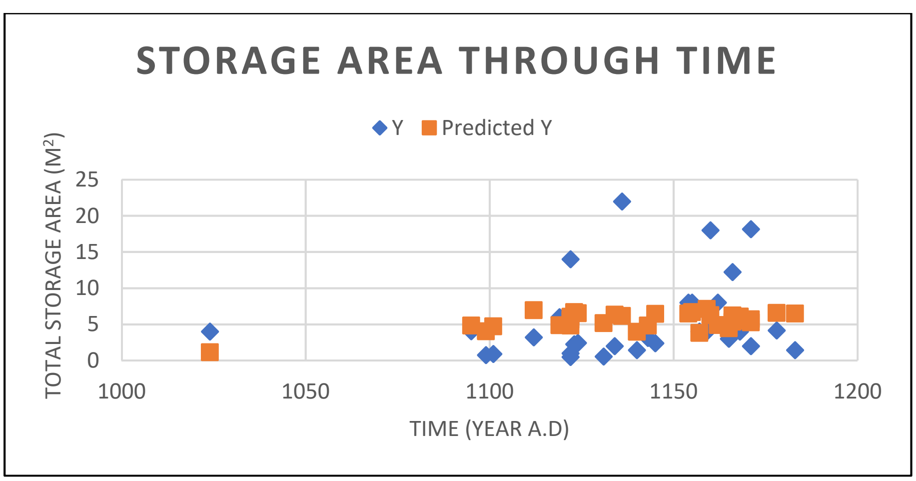

Figure 18. Storage area per site through time in the Grand Canyon.

Grand Staircase-Escalante Results

Data from Grand Staircase-Escalante includes a sample of sites from the Fiftymile Mountain region. Within the Fiftymile sample are a total of 24 sites, 13 (54%) of which contain granaries and were used to compare granary construction characteristics in the Grand Canyon. I used the small sample from Grand Staircase to test trends in granary construction techniques. Specific interest lies in evaluating commonalities in construction techniques among Ancestral Puebloan groups, in this case, the Kayenta and Virgin branches of the Ancestral Puebloans. The limited information about cultural association precludes separation of the Kayenta and Virgin branches of the Ancestral Puebloans in this region. Additional information such as subsurface testing or excavation would be needed to conduct the necessary analysis. For the purposes of this thesis, I compare Ancestral Puebloan construction techniques to the Virgin and Kayenta construction techniques in the Grand Canyon.

Granary Style

In the Fiftymile Mountain Region, 12 out of the 13 sites are situated in sheltered alcoves and one is an open-air storage site. All sites exhibit access to the stored goods from the side of the granary, while one site exhibits a single granary with access from the top of the structure. Granaries in this region are constructed of local sandstone materials, the majority of which are unshaped stones (69%). Documentation of several of the granaries describe construction using shaped sandstone masonry (23%) while construction of the granaries in the remaining sites are unknown, due to remote documentation from a helicopter. Eleven out of the 13 sites show stacked stone masonry construction. One site exhibits vertical slab construction and one site uses a combination of vertical slabs and stacked stone masonry. In addition, 11 out of the 13 sites contain D-shaped granaries while one contains a circular granary and the other a rectangular granary. Nine out of the 13 sites contained granaries that exhibit stone slab lintels. In Grand

Staircase Escalante, there are subtle differences among granary construction among Ancestral Puebloan groups; however, the differences were not found to be statistically significant. A summary of the average dimensions of granaries in this sample can be found in Table 5.

Table 5. Average dimensions of Ancestral Puebloan granaries in Grand Staircase-Escalante (n=13).

	Mean	Range	Std. Deviation
Length (m)	1.98	1-3.50	.669
Width (m)	1.50	.30-2.50	.482
Height (m)	1.06	.65-1.40	.264
Area (m^2)	2.94	.30-8.75	1.80
Volume (m^3)	3.07	.30-12.25	2.38

Granary Size

Within the Fiftymile Mountain region of Grand Staircase, granaries average 2.94 m^2 in area and 3.07 m^3 in volume. Although the granaries are situated in sheltered alcoves, many of the structures are deteriorated and measurements are best estimates of the actual dimensions of the structure. The granaries in the sample are similar in construction, yet one site exhibits granary construction unique from the rest. Site 42KA6941 consists of a series of six granaries located in a large alcove along the Straight Cliffs. The alcove exhibits evidence of previous granaries that were dismantled, and construction materials likely reused, in addition to the intact granaries. One granary is particularly large, measuring 3 m long by 1.5 m wide by 1.15 m tall, and is a bath tub shape with access to the stored goods from the top of the structure. The volume of this structure alone is large enough to feed a single family of five for an entire year. No artifacts were present to indicate that the site was used for habitation.

Variation by Group

In the small sample taken from the Fiftymile Mountain region of Grand Staircase Escalante, the granaries are attributed to the Ancestral Puebloans based on association with other sites in close proximity; however, the lack of diagnostic artifacts precludes association to specific branches of the Ancestral Puebloans. The Fiftymile Mountain region contains evidence of both Fremont and Ancestral Puebloan presence, including the Virgin and the Kayenta branches of the Ancestral Puebloans. The majority of the sites (11 sites, 84%) with granaries in my sample contained limited information about chronology and cultural affiliation, therefore limiting comparative analysis to construction techniques.

Comparative Results

In both the Grand Canyon and the Fiftymile Mountain Region of Grand Staircase-Escalante, agriculturalists used granaries to store foods. Among the Ancestral Puebloan groups, granaries are typically situated in sheltered alcoves. The storage structures are constructed using unshaped local materials, typically sandstone. The majority of granaries comprise stacked stone masonry, while several exhibit a combination of both stacked stone masonry and upright slab construction techniques. In short, granaries show expedient construction techniques in locations that naturally protect the contents inside.

Comparatively, granaries associated with Ancestral Puebloan groups in the Grand Canyon are smaller than Ancestral Puebloan granaries in the Fiftymile Mountain region. A series of t-tests show a statistically significant difference in size between both the Kayenta and the Virgin branches of the Ancestral Puebloans in the Grand Canyon compared to the Ancestral Puebloan groups in Grand Staircase-Escalante. Results of statistical testing are shown in Table 6. Although lumped into a single category of Ancestral Puebloan people, the significant difference in size of granary structures in two regions of the Southwest indicates that storage strategies are not uniform across cultural groups. Because the inhabitants are classified as the same cultural group, I would expect that the methods of food storage would also be similar; however, the results of this research show a statistical difference. Additionally, I compared the mean dimensions of granary size between the Cohonina in the Grand Canyon and the Ancestral

Puebloan groups in the Grand Staircase-Escalante; however, the results were not statistically significant.

Table 6. T-tests of independence comparing the Kayenta and Virgin branches in the Grand Canyon with Ancestral Puebloans in Grand Staircase-Escalante.

	Kayenta (n=94) and GSENM (n=13)	Virgin (n=58) and GSENM (n=13)
	Sig. (2-tailed)	
Length (m)	.002	.000
Width (m)	.000	.000
Height (m)	.005	.126
Area (m^2)	.001	.001
Volume (m^3)	.004	.002

*T-test for Equality of Means results based on equal variances not assumed.

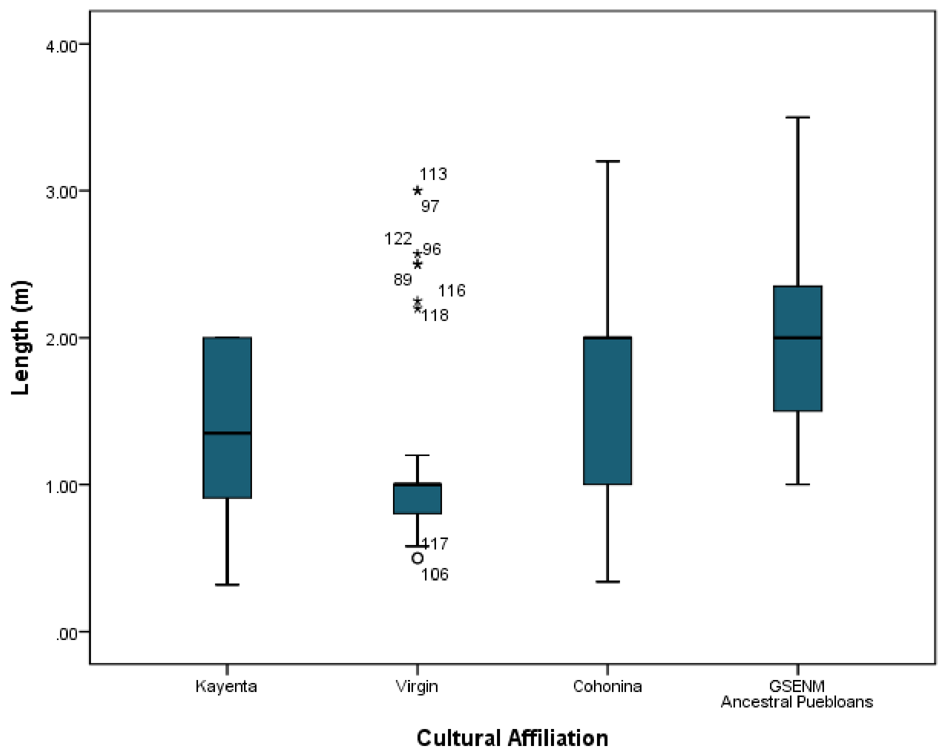

Figure 19. Comparison of granary length between the Grand Canyon and Grand Staircase-Escalante.

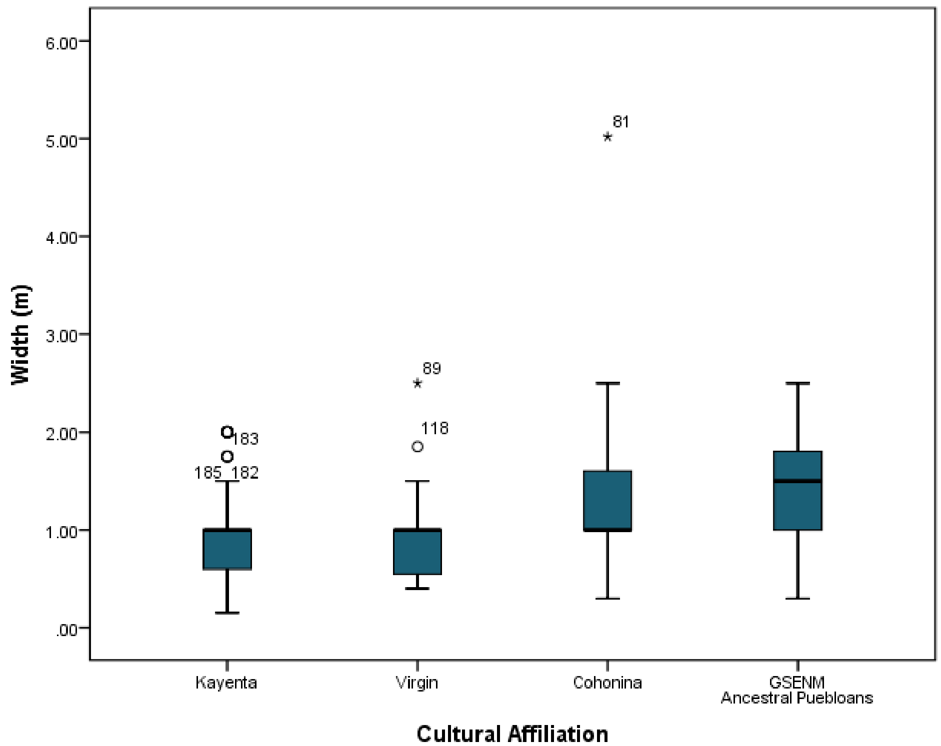

Figure 20. Comparison of granary width in Grand Canyon and Grand Staircase-Escalante.

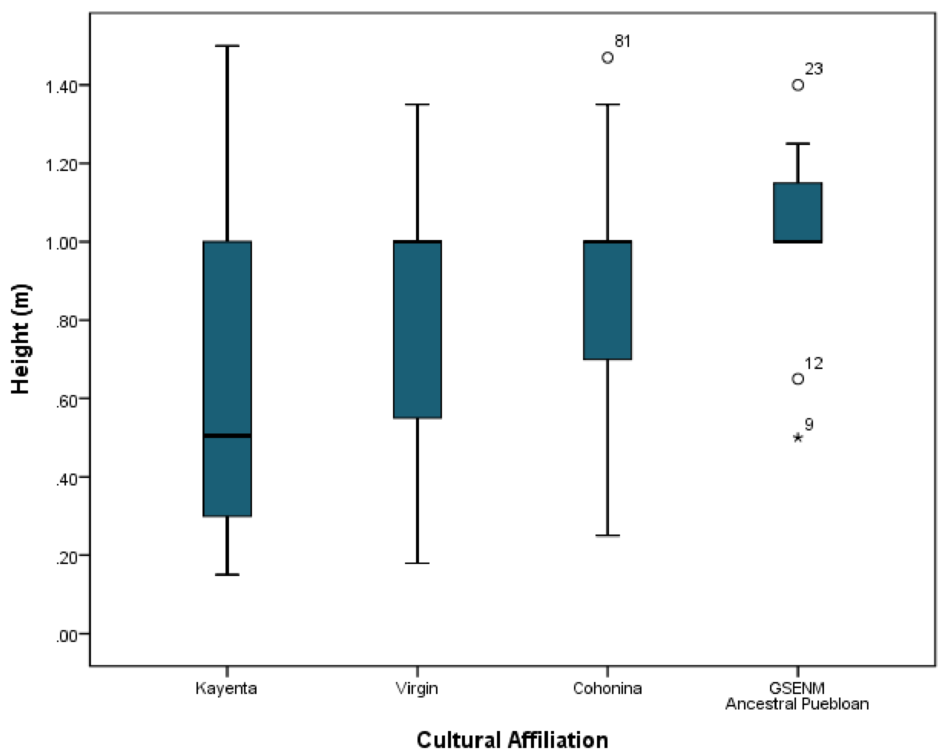

Figure 21. Comparison of granary height in the Grand Canyon and Grand Staircase-Escalante.

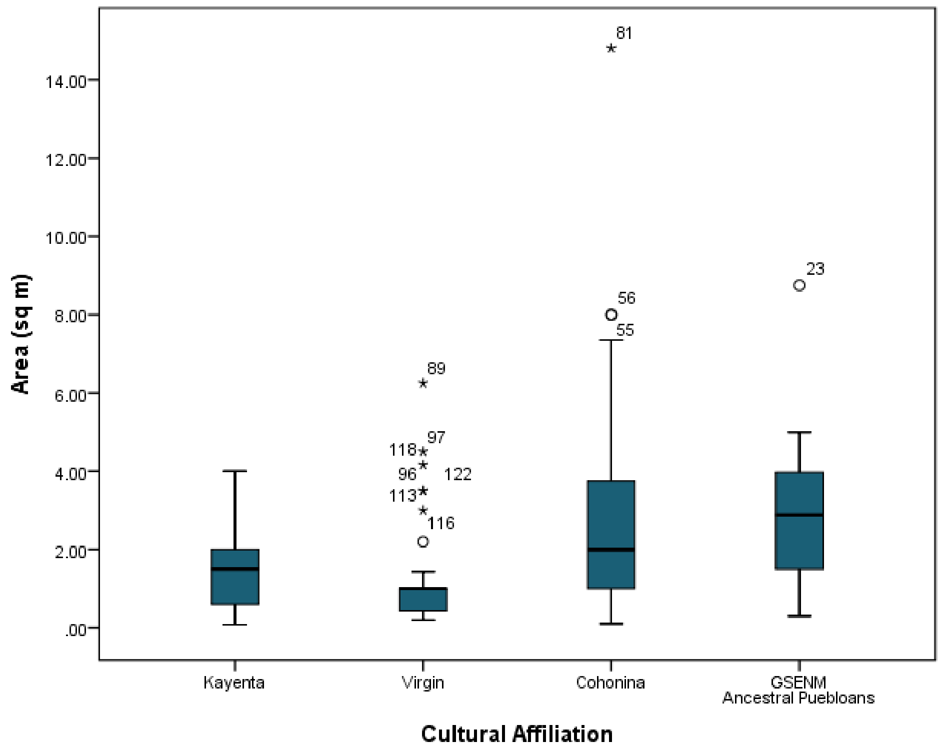

Figure 22. Comparison of granary area in the Grand Canyon and Grand Staircase-Escalante.

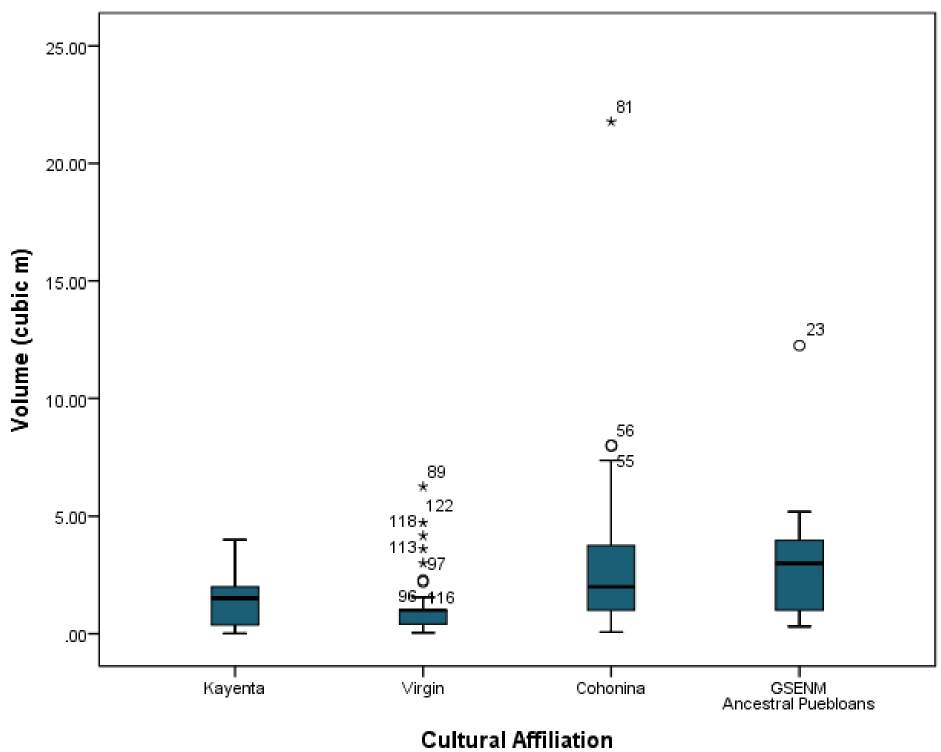

Figure 23. Comparison of granary volume in the Grand Canyon and Grand Staircase-Escalante.

In sum, granaries in the two regions of the Southwest do not show distinctively different construction patterns, yet variation in size exists within the Ancestral Puebloan groups. Analysis of the large data set in the Grand Canyon shows significant differences in size between the Ancestral Puebloan groups and the Cohonina. The number of granaries per site in the Grand Canyon seems to increase with population size through time. Comparison of granaries between the Grand Canyon and Grand Staircase-Escalante shows similar expedient construction techniques, yet a significant difference in the size of granaries constructed by Ancestral Puebloan groups. Variation within a cultural group could be attributed to any number of reasons including both environmental and cultural factors. In the following chapter, I quantify the role of granaries in Ancestral Puebloan communities by comparing the volume of food that could be stored in the two regions of the Southwest, thereby inferring characteristics of adaption in the Ancestral Puebloan groups. Because a reliable source of food is critical for survival, subtle differences in food storage techniques can be attributed to key characteristics of the community, such as differences in mobility, population size, trade networks, among others. I explore the possibilities in cultural variation as a result of food storage techniques in Chapter Seven.

Chapter Six – Modeling Food Storage in the Southwest

Certainly, the role of food played a significant role in society, depending on both environmental and cultural factors. During periods of scarcity, supplying adequate food likely consumed much of the time of the inhabitants. Evaluation of the number of granaries and estimates about the capacity of maize stored in the features, can aid in understanding the role that cultivated plants played in prehispanic societies of the Southwest. In the following section, I present a model for estimating the storage capacity of granaries in the Grand Canyon and Grand Staircase-Escalante, estimating the amount of maize stored in granaries thereby inferring the number of people that could reasonably rely on the stored goods. I then compare the amount of maize stored within the same cultural group cross regionally, between the Grand Canyon and Grand Staircase-Escalante. I use these estimates to infer the role of food storage in Ancestral Puebloan communities.

Quantifying Storage Capacity

Evidence of storage in the archaeological record is variable and is dependent on several elements including the method of storage used, the condition of the structural remains, and taphonomic processes. Due to the varying conditions of storage features at the time of documentation by researchers, limited information is available to reconstruct the full storage capacity of the structure. Therefore, to quantify storage capacity, several estimations must be made. Quantifying the storage capacity requires estimating the volume of each of the granaries and then estimating the number of people that could reasonably rely on the quantity of food stored. Estimations about adequacy of food storage are modeled after malnutrition studies conducted at Arroyo Hondo (Wetterstrom 1986), while estimations of storage needs are derived from simulation studies (Burns 1983; Gumerman et al. 2003; Scarry and Scarry 2005; Morgan 2012; Phillips and Barlow 2012).

Creating a model for food storage using archaeological records relies heavily on the estimated dimensions of the granaries themselves. I created a model of the typical granary in the Grand Canyon and Grand Staircase-Escalante based on averages in length, height, and width of the structures. Using these averages, I calculated the average volume of a storage, separated by the cultural groups in the Grand Canyon and Grand Staircase-Escalante. Furthermore, I calculated the average number of granaries per site in the two regions. Using estimates of corn requirements from ethnographic data and the average volume of the granaries, I calculated the number of people that could reasonably rely on the quantity of food stored.

Assumptions

In the process of developing any model for studying human behavior, there are several underlying assumptions that affect the outcome of the study. First of all, the calculations in the current model are based on the assumption that granaries stored corn. Although researchers argue that some storage areas were used to store cotton (Fairley 2003), I estimate adequate storage based on cultivated maize. Furthermore, to evaluate the presence of adequate storage, I assume similar requirements as modern Pueblo groups. According to ethnographic data, modern Pueblo groups try to keep a two-year supply of corn on hand (Gumerman et al. 2003). Ethnographic data estimates that each person requires 160 kilograms (kg) of maize per year (Gumerman et al. 2003). Although the caloric needs of an individual vary by age, the model estimates caloric needs using this ethnographic data. The model assumes a diet solely based on cultivated maize; however, realistically, the role of maize likely varied by kin group, local environmental setting, and season (Sullivan 1995). Subsistence strategies among the Kayenta and the Cohonina certainly differed by the degree of reliance on foraging (Sullivan 1995). Although foraging and hunting supplemented an agriculturally-based diet to an unknown extent, the purpose of the model is to understand the role of corn in society by examining the extent to which communities could have relied on corn.

Evaluating adequate food supply is not as simple as a basic model developed for the purposes of understanding the role of granary storage in communities. Storing food requires the time and energy to construct and maintain storage features. The model does not take into consideration the caloric expenditure of constructing granaries in varying locations or the constant maintenance of granaries. Furthermore, portions of stored foods were often lost due to moisture, vermin, conflict, or other unforeseen cultural or environmental disturbances. The simple model developed in this thesis does not accommodate the variable storage loss.

Regional Comparison

Across the Grand Canyon and Grand Staircase-Escalante, the storage capacity of granaries is variable (Table 7). Among Ancestral Puebloan groups in the Grand Canyon, the Kayenta branch exhibit fewer granaries per site, but can store a greater amount of food overall. The Virgin branch of the Ancestral Puebloan show a larger quantity of granaries per site but exhibit less overall storage space. The Cohonina show an intermediate number of granaries compared to the two Ancestral Puebloan groups and could store a larger quantity of food compared to other communities in the Grand Canyon. The Ancestral Puebloan groups in Grand Staircase-Escalante, on the other hand, also show an increase in the capacity of food storage in granaries per site yet exhibit the smallest number of granaries. Comparatively, Ancestral Puebloans in Grand Staircase could store 1,100 kg of additional corn (difference of 760 kg x average volume per site), compared to their Grand Canyon counterparts (Table 7).

Table 7. Average capacity of individual granary storage in the Grand Canyon and Grand Staircase-Escalante National Monument.

Cultural Group	Average area (m^2)	Average volume (m^3)	Average number of granaries per site	Average* corn stored in granaries (kg)	Maximum number of people supported in one year	Maximum number of people supported in two years
GRCA Kayenta	1.52	1.50	2.19	1,140	7.1	3.55
GRCA Virgin	1.34	1.30	3.41	988	6.2	3.1
GRCA Cohonina	3.00	3.05	2.83	2,318	14.5	7.25
GSENM Ancestral Puebloan	2.94	3.07	2.14	2,333	14.6	7.30

*Averages of stored corn based on estimate of 760kg per cubic meter of corn.

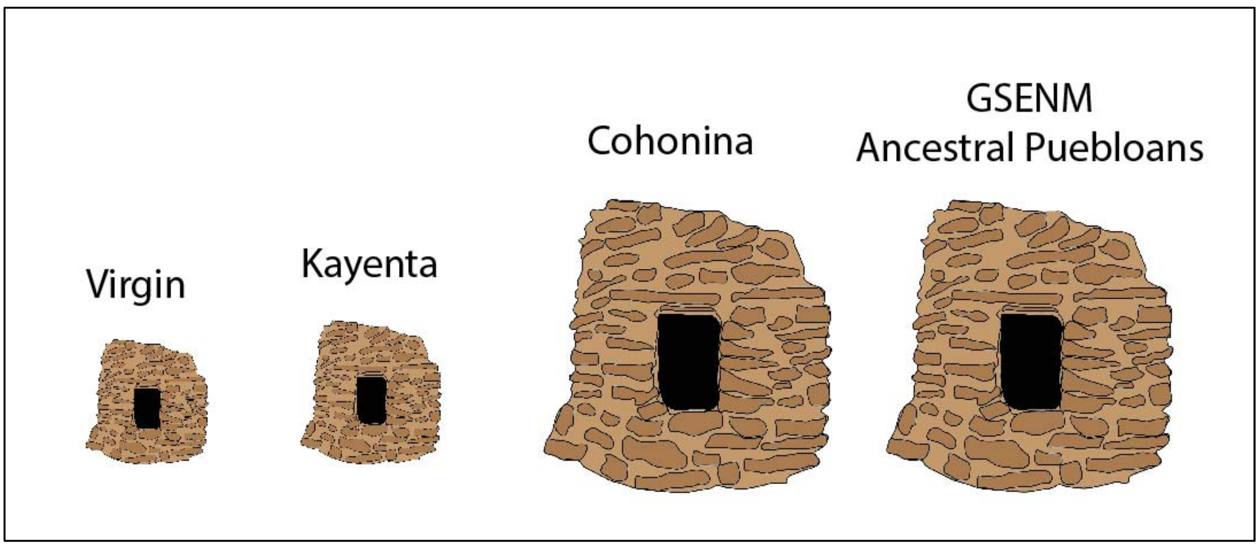

Figure 24. Comparison of the storage capacity per site. The size of the granaries is relative to the amount of corn that could be stored in a granary in each of the cultural groups.

If we use an estimate of 160 kg of corn per person, per year, we see that the Ancestral Puebloans in the Grand Staircase region could support the greatest number of individuals in a single year (Figure 24). This estimate is followed closely by the Cohonina's ability to store corn in the Grand Canyon. The Kayenta branch of the Ancestral Puebloans could support about half as many people as the Cohonina and the Ancestral Puebloans in Grand Staircase-Escalante. The

Virgin branch of the Ancestral Puebloans in the Grand Canyon had the potential to support the least number of individuals based solely on granary capacity.

Modern Ancestral Puebloans try to keep a two-year supply of maize on hand (Gumerman et al. 2003). The estimated storage capacity of granaries constructed by the Ancestral Puebloans indicates that a two-year supply of corn was difficult to maintain. If we assume that the average family consisted of five individuals, the Cohonina in the Grand Canyon and the Ancestral Puebloans in Grand Staircase-Escalante were the groups able to maintain the two-year supply with the average granary (Table 7, Figure 24). Reliance on a single storage feature for an entire family, however, posed series risk for potential failure The Ancestral Puebloan groups in the Grand Canyon would have required multiple granaries to establish the same storage capacity. Archaeologically, we can view diversifying storage in to several storage features as a less risky option.

Although classified under the same category of Ancestral Puebloan, differences in cultural characteristics such as storage shows distinction in specific areas on the Colorado Plateau. The degree to which the differences can be attributed to cultural or environmental factors is unknown, however, the dissimilarity shows techniques specific to the individual community. Using the estimates of storage capacity of granaries indicates the degree to which prehispanic communities relied on granaries to store food, yet also indicates the possible use of other storage techniques or changes in social networks. Greater capacity for storage in granaries could suggest surplus, an increase in reliance on domesticated plants, an increase in population, an increase in trade, or simply a greater reliance on one storage technique as opposed to also utilizing storage in pots, storage rooms, or subterranean storage features.

By comparing the typical granary in the Grand Canyon and Grand Staircase-Escalante, I show that there are differences in both the size and number of granaries in these two regions. Granaries constructed by Ancestral Puebloan groups in the Grand Canyon tend to be smaller and more numerous than granaries constructed by Ancestral Puebloans in Grand Staircase-Escalante. Ancestral Puebloan communities in Grand Staircase-Escalante can store a greater quantity of corn in granaries, either supporting a larger population or dealing with more uncertainty, compared to their counterparts in the Grand Canyon. This discrepancy is likely attributed to a combination of cultural and environmental factors and in the following chapter I discuss implications of the differences.

Chapter Seven – Discussion and Conclusions

This chapter wraps up my study with a summary of the similarities and differences in food storage techniques and summarizes the implications of the analysis. I show the significance of my research by highlighting the estimates of sufficient food, making inferences about the degree to which these communities relied on maize agriculture. Using a snapshot of two arid canyon environments, I connect the concepts of human behavioral ecology to show the complexity of human interactions to the environment. Certainly, prehistoric inhabitants of the southwest optimized biological fitness to some extent, however, the degree to which style and construction of food storage features is a sign of optimization and risk minimization is variable. Although the explanatory power of a single element of human adaptation is limited, detailed examination of a single element aids in our overall understanding of human decision making.

Patterns

Positive identification of patterns was limited to the size of granaries in the Grand Canyon compared to Grand Staircase-Escalante. This study did not identify differences in construction style or technique. Overall, the granaries constructed by Ancestral Puebloans in the Grand Canyon are smaller than those constructed by Ancestral Puebloans in Grand Staircase-Escalante. Among the Ancestral Puebloan groups, the Kayenta branch tends to construct larger granaries compared to the Virgin branch; however, the Virgin branch constructs a greater number of granaries per site relative to the number of habitation rooms. The Cohonina constructed larger granaries compared to both Ancestral Puebloan groups in the Grand Canyon.

Analysis of construction attributes did not show a significant difference that could be attributed to a culturally specific style. The deteriorated nature of many of the structures and limited information available using legacy data, however, contributed to the presence or absence of style. A more detailed structural analysis in the future may result in positive identification of a culturally specific granary style. Although identification of cultural patterns is limited, my results indicate a need for future research and standards for future documentation to get to the root of cultural patterning in granary construction.

Cultural. Cultural differences could certainly result in various storage techniques. Although prehispanic groups interacted and likely traded with one another, construction methods are part of a cultural tradition, passed down through generations. Construction methods, however, do not necessarily have to be drastically different from your neighbor. Each of the cultural groups utilized local construction materials and placed granaries in a sheltered location that would naturally protect the stored goods. The granaries show stacked-stone masonry, constructed relatively expediently. With the main difference in size of granaries, we can reasonably assume that the main cultural difference is the degree to which the cultural groups relied on granaries for food storage.

For example, Ancestral Puebloans groups in the Grand Canyon exhibit smaller granaries compared to the Cohonina in the Grand Canyon. This size disparity could be attributed to a greater reliance on long-term storage needs by the Cohonina. The Cohonina were semi-mobile horticulturalists, exploiting many wild resources (Schroeder 2002; Sullivan 1995; Mink 2015). These communities may have engaged in biseasonal mobility, in which summering and wintering occurred in different locations (Schroeder 2002; Sullivan et al. 2002; Mink 2015). The amount of storage that each community required could also be linked to the differences in subsistence practices.

Differences in granary size is also evident among Ancestral Puebloan groups in the Grand Canyon. The Kayenta branch exhibited granaries with a larger volume on average, compared to the Virgin branch. The increase in storage for the Kayenta could indicate the larger population of Kayenta in the Grand Canyon or that the Kayenta faced a greater degree of uncertainty. Similarly, the smaller and more relatively abundant granaries constructed by the Virgin branch could be an indicator for a smaller population size, a decrease in reliance on maize agriculture, or a decrease in agricultural uncertainty. Primarily occupying the North Rim of the Grand Canyon, the Virgin branch of the Ancestral Puebloans utilized wild plants to a greater degree compared to the Kayenta (Lyneis 1995; Mink 2015). Similar to the Cohonina in the Grand Canyon, the Ancestral Puebloans in Grand Staircase-Escalante constructed granaries that could accommodate a larger amount of stored goods.

Among the possible reasons for larger storage space is the role that storage in ceramic vessels played in each cultural group. Ceramic vessels were also used to store food and sometimes prior to storage in rooms, pits, or granaries (Skibo and Feinman 1999). Storage in pots allowed for transport, storage, and processing in a single vessel (Skibo and Feinman 1999). A larger storage volume could indicate storage in ceramic vessels inside a granary as opposed to storing corn directly in smaller sealed granaries. The degree to which communities used ceramic pots to store goods is also a factor in evaluating the role of storage structures. Increased reliance on storage in ceramic vessels could result in a decrease in reliance on storage in granaries.

Environmental. Although each cultural group in this study is located in an arid environment, the methods of utilizing environmental surroundings differed by cultural group. For example, reliance on agriculture is frequently linked with environmental setting. In the cooler extents of the Grand Canyon on the North Rim, researchers argue that the Virgin branch of the Ancestral Puebloans used wild plants to a greater extent than Virgin groups at lower elevations (Lyneis 1995; Mink 2015). In this example, the smaller granary volume supports a heavier reliance on foraging wild plants and a decreased reliance on granary storage for cultivated plants. In contrast, the Kayenta rely on agriculture to a greater extent, supported by an increased need for storage space.

Although the size of granaries could be indicative of variation in subsistence strategies, an increase in volume may also indicate unpredictable precipitation. A larger storage volume may indicate long-term reserves to cope with periods of drought. On the other hand, larger storage volume may suggest several favorable years, in which communities needed to store a surplus of food. An increase in storage volume means communities could conduct more extensive agricultural practices, which were not necessarily feasible in all geographical locations. In each case, an increase in granary volume can be considered an adaptive mechanism for changes in environmental conditions.

Discussion

Based on the similar cultural designation, I expected that Ancestral Puebloan groups in the Grand Canyon and Grand Staircase-Escalante would exhibit similar storage practices. The results of this thesis, however, show a significant difference. After examining food storage practices in the Southwest, I speculate that there are several possible reasons for the differences I observed over the course of this research:

1. Agricultural productivity
2. Method of storing goods inside granary
3. Consistency issues in granary documentation

The Fiftymile Mountain region in Grand Staircase-Escalante is situated around an elevation of 7,000 ft above sea level in an area that receives seasonal precipitation. Although similar to the elevation in the Grand Canyon, local environments in the Southwest are subject to varying degrees of precipitation and the retention of the moisture on the landscape. I infer that a combination of the precipitation regime during the Pueblo II period and the sediments in the

Fiftymile Mountain region were such that agriculture could have been more productive compared to the Grand Canyon. The extra productivity in agriculture would result in a larger quantity of goods that need to be stored for future use. The larger granaries in the Fiftymile Mountain region could be indicative of a pocket of increased agricultural productivity. Additional research is needed to investigation this speculation.

Another possibility for the significant difference in granary size may be the method of storing goods inside the granary itself. Corn, for example, may be stored on the cob or in seed form. The amount of space required for storing corn in the corn is certainly different that the amount of space required for storing seed. Furthermore, it is possible that seeds or corn kernels may be sealed inside a ceramic vessel inside the granary. A granary full of ceramic vessels would also require additional space, compared to a granary full of loose seed or corn cobs. The number of sealed granaries that still contain the original goods in the stored form are severely limited and therefore difficult to study in the archaeological record. We can only speculate on the state of the stored goods at this time.

The final possibility involves problems inherent in legacy data. Using legacy data, I must use the field methods and resulting measurements from various researchers through time. I must rely on the previous identification of granaries and assume that the measurements were done correctly. The state and quality of the data, however, between the 1950s and early 2000s likely differed. Differences in the area and volume of granaries may be the result of misidentification or mismeasurements of the structures through time. To control for this problem issue, a more detailed project that redocumented each analyzed feature would be necessary. Redocumenting each granary in my samples was beyond the scope of my thesis research.

Grand Canyon Chronology

Throughout the prehistory of the Grand Canyon, the Pueblo II period was the most heavily occupied, evidenced by habitation sites (Downum and Vance 2017) and supported by an increase in the number of granaries in the region. The increase in relative granary storage (per site) along with an increase in habitation sites during the Pueblo II period shows an increase in overall population. Data show an increase in the number of granaries after A.D. 1130, indicating an increased need for food storage after this period. The overall size of granaries was not statically different throughout the Pueblo period, but rather show an increase in the number of storage features per site. The increased storage capacity could support a larger community; however, additional storage volume alone is not necessarily linked to an increase in agricultural productivity. A larger population may result in more widespread trade networks and social relationships, which could result in an increased need to store traded goods.

The Kayenta branch of the Ancestral Puebloans inhabited the Grand Canyon for the longest span of time, compared to their prehispanic neighbors. The long-term occupation by the Kayenta is supported by the mean ceramic dates associated with Kayenta granaries. Kayenta granaries contain some of the earliest and latest mean ceramic dates in the canyon. Although the Kayenta inhabited the Grand Canyon for the longest period of time, they did not exhibit the largest quantity of granaries. The quantity of granaries cannot be linked to the span of occupation. The Kayenta branch showed a smaller number of granaries on average compared to the Virgin branch of the Ancestral Puebloans in the Grand Canyon, who inhabited the region for a shorter period of time.

The end of granary storage in the Grand Canyon occured during the late-1170s to mid-1180s. Although the Kayenta did not completely leave the Grand Canyon until A.D. 1200 to 1250, the storage structures were likely reused and maintained until abandonment of the area.

Evidence of granary maintenance is likely subtle, leaving minimal trace for archaeological inquiry. Furthermore, granary construction may no longer have been necessary towards the end of occupation when population decreased. Perhaps more expedient storage techniques were utilized such as storage in subterranean pits, ceramics, or in nearby storage rooms. Due to the importance of food sources for survival of the community, we can reasonably assume that the construction of granaries corresponds to the survival of the inhabitants.

Optimization

The concept of optimality in human behavioral ecology assumes that humans will engage in the most logical actions within a particular ecological context (Ferguson 2016). Storing food in granaries can be viewed as a rational decision. When a small community or family needs to ensure survival of the group, storing food for future use is a reasonable solution. The decision to store food in granaries, however, is not as simple as it seems. Although elements of storing food appear to be rational on the surface, a deeper analysis shows that the cost may in fact outweigh the benefits. I explore the cost-benefit of building granaries using the results of my research.

This study shows that there is a significant difference in granary size between Ancestral Puebloan groups compared to the Cohonina in the Grand Canyon, and between the Ancestral Puebloan groups in the Grand Canyon compared to the Ancestral Puebloan groups in Grand Staircase-Escalante. Constructing larger granaries requires more time, energy, and labor than small granaries, while a greater quantity of granaries also requires additional time, energy, and labor. I discuss both the costs and benefits of constructing larger versus small granaries under the umbrella of optimization.

A larger population requires more food and therefore additional food storage for security. Construction of larger granaries requires identifying a location that is suitable for the large structure, obtaining and hauling the necessary materials to the location, time, energy, and labor constructing the granary, and continual maintenance of the structure. In addition, there are countless hours of labor involved in cultivating and processing the food to be stored and transporting goods to the granary. Although marginal, the larger the granary, the more time, energy, and labor involved in its construction and upkeep. In addition to the costly construction, storing large quantities of food in a single granary exudes a higher degree of risk. If the structure is secure and undisturbed, then more food can be stored in a larger granary; however, if the structure fails for any number of reasons, a larger quantity of food is lost. Reliance on a single structure for food storage is inherently risky.

Optimization in food storage is complex, impacted by a combination of structure size, location, external threat, population pressures, and the caloric value of the stored goods. Although the elements of safety hint at optimal behavior, several aspects of granary construction do not appear to be the most rational decision. The high energy and labor costs combined with the high risk of using granaries indicate that this system of food storage was likely founded in learned behaviors that do not necessarily represent the most rational decisions. The use of granaries is likely not solely the result of optimal behavior but rather a combination of environmentally-based decisions and learned cultural behavior.

Risk Minimization

Storing food using any method involves a certain degree of risk, however, the risk may be increased or decreased with certain decisions. Risk is minimized when the benefits of an action outweigh the costs (Hames 2015). Storing food is a coping mechanism for food shortages and unreliable precipitation, therefore minimizing the risk of starvation; however, the degree with which food storage structures minimize risk is variable. Long-term activities that require additional time, energy, and planning are riskier than short term activities simply because there is more time for things to go wrong (Bettinger 2006). Given this philosophy, long-term storage practices are riskier than short-term storage practices.

The results of this study indicate that the Ancestral Puebloan groups in the Grand Canyon construct granaries that minimize the most risk. The Kayenta and Virgin branches of the Ancestral Puebloans in the Grand Canyon construct significantly smaller granaries than their Cohonina neighbors or Ancestral Puebloan groups in Grand Staircase-Escalante. The smaller the granary, the less time and labor involved in construction, maintenance, and filling the structure. If the structure fails, less food will be lost. The Virgin branch of the Ancestral Puebloans not only constructed the smallest granaries, but also constructed the largest number of granaries. In terms of risk minimization, the Virgin groups utilized granaries to minimize the most risk. Food was stored in multiple small structures, placing less pressure on the success of each structure.

Based on study of granaries alone, however, we cannot assume that Virgin groups were the only inhabitants to minimize risk of food scarcity. A key element to minimizing risk is the diet-breadth model, which states that in the face of scarcity humans will broaden their diets (Gremillion and Piperno 2009). Broadening diets may not be the only response to scarcity but broadening the food storage options may also be a strategy for minimizing risk. Using this concept, constructing multiple small granaries or storing food in several different ways, decreases risk, and may in fact be a response to scarcity.

The presence of food storage in the form of granaries is highly visible in the archaeological record and therefore easier to research in comparison to other storage strategies that are difficult to identify. Ephemeral or subsurface structures were likely utilized in addition to, or in place of, granaries; however, the extent to which these other options were used to minimize risk are unknown. The results of this study only hint at understanding the ways in which past communities coped with food scarcity.

Challenges

Over the course of this research, I encountered several challenges that impacted my data collection, processing, and analysis. Identifying patterns was a challenge due to the lack of consistent information in the legacy data over the last 70 years and among various researchers. Many of the sites in the Grand Canyon were documented in the 1950s and only include a brief description of the site, mentioning the presence of granaries in passing. Furthermore, the deteriorated nature of the sites, as described by the original recorders, has left little information to be gathered from the original documentation. In some cases, the granaries are no more than the remains of a single course of a wall with limited construction characteristics. Some data are limited to just the type of stone used in construction and an estimate of the original dimensions. The sites have been subject to environmental and human impacts through the years and even some of the most recently documented sites only contain limited information because of the condition of the site. Furthermore, because I did not personally visit the sites, I had to rely on descriptions from the original researchers. Although utilizing legacy data is problematic for many reasons, using existing data that would otherwise remain unevaluated contributes to our understanding of prehistory without adding to the curation problem or duplicating efforts.

Future Research

This thesis only touched the surface of potential research on coping with resource scarcity in the Southwest. There is a great deal of future research in granaries that would contribute to our understanding of storage practices. First of all, granaries need a more detailed documentation protocol that would aid in identification of cultural construction patterns. Much of the documentation is cursory at best and full redocumentation of the existing granaries would greatly add to the research potential. Although many granaries are not associated with temporally diagnostic artifacts or contain samples suitable for dating, detailed chronology would aid in our understanding of how these coping mechanisms change through time.

Spatial analysis of granary locations would also contribute to our understanding of granary construction. An evaluation of the number of isolated granaries versus granaries located in habitation sites would aid to understanding rational behavior in storage practices. Furthermore, estimating location of suitable agricultural lands in relation to granaries would provide a more complete picture of the costs and benefits of storing maize in naturally-protected alcoves. Viewshed analysis could shed lights on the protective nature of granaries from potential external threat.

A broader cross-cultural comparison of communities through the Southwest and the world would show the differences in coping mechanisms in arid environments. Storage in granaries is only one small way in which humans cope with arid environments. By comparing coping mechanisms in the Southwest to other arid environments worldwide, we can better understand the resiliency of the past and influence the way we cope in the present.

Conclusions

Human behavior is complex. Environmental pressures often dictate the circumstances to which humans must adapt, however, the adaptive mechanisms are limited by cultural parameters. Living in an arid environment such as the Colorado Plateau, requires time, energy, and planning for uncertainty. Although a risky behavior, agriculturalists stored food in granaries to cope with environmental uncertainty. Some methods of storage were riskier than others, indicating cultural differences in coping mechanisms. It is also reasonable to assume that storage in granaries minimized risk of food scarcity. These food storage practices, however, are not necessarily a good indicator of optimal human behavior.

Although the Grand Canyon and Grand Staircase-Escalante were home to similar cultural groups in arid, canyon environments, the methods in which these cultural groups adapted to uncertainty differ. Contrary to expectations, the Ancestral Puebloan groups in the Grand Canyon relied on granaries to a different extent compared to the Ancestral Puebloan groups in Grand Staircase-Escalante. Statistical testing of the area and volume of granaries in the two regions showed a significant difference. Although stylistic patterns were not identified in this study, trends in granary size indicates different strategies used to adapt to similar arid environmental settings. In fact, significant differences are visible among Ancestral Puebloan groups. The similarity in construction styles shows cohesion in method, yet variation in size indicates difference in adaptability. The results of this thesis research hint at the importance of evaluating a cultural group within their own local environment, as opposed to viewing them through broad cultural categories.

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Appendix A – Data Tables

Grand Canyon Data Tables

Site Number	Structures	Masonry_Rms	Enclosures	MCD	MCD_Plain	MCD_Deco	Kayenta pct	Cohonina pct	Virgin pct	Patayan pct	Length (m)	Width (m)	Height (m)	Length to Width Ratio	Area (sq m)
B:09:0200	1	0	1	0	0	0	0.00	0.00	0.00	0.00	1.50	1.00		1.00	1.50
B:09:0315	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.70	0.75		2.00	1.28
B:10:0001a	2	2	1	0	1152	0	0.05	0.86	0.10	0.00	3.20	2.50		1.00	8.00
B:10:0001b	2	2	1	0	1152	0	0.05	0.86	0.10	0.00	3.20	2.50		1.00	8.00
B:10:0001c	2	2	1	0	1152	0	0.05	0.86	0.10	0.00	1.00	1.00		1.00	1.00
B:10:0001d	2	2	1	0	1152	0	0.05	0.86	0.10	0.00	1.00	1.00		1.00	1.00
B:10:0001e	2	2	1	0	1152	0	0.05	0.86	0.10	0.00	1.00	1.00		1.00	1.00
B:10:0001f	2	2	1	0	1152	0	0.05	0.86	0.10	0.00	1.00	1.00		1.00	1.00
B:10:0001g	2	2	1	0	1152	0	0.05	0.86	0.10	0.00	3.20	2.30		1.00	7.36
B:10:0016	1	5	1	1171	1190	1188	1.00	0.00	0.00	0.00	2.00	1.00		2.00	2.00
B:10:0038a	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.60	0.60	0.37	2.00	0.96
B:10:0038b	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.60	1.10	0.50	1.00	1.76
B:10:0038c	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.40	1.40	0.53	1.00	1.96
B:10:0038d	0	0	1	0	0	0	0.00	0.00	0.00	0.00	2.00	1.30	0.50	1.00	2.60
B:10:0076a	1	4	1	1168	1132	1177	1.00	0.00	0.00	0.00	2.00	1.00	1.00	2.00	2.00
B:10:0076b	1	4	1	1168	1132	1177	1.00	0.00	0.00	0.00	2.00	1.00	1.00	2.00	2.00
B:10:0083	1	1	1	0	0	0	0.00	0.00	0.00	0.00	1.00	0.60	0.60	1.00	0.60
B:10:0118	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.50	1.00		1.00	1.50

Site Number	Structures	Masonry_Rms	Enclosures	MCD	MCD_Plain	MCD_Deco	Kayenta pct	Cohonina pct	Virgin pct	Patayan pct	Length (m)	Width (m)	Height (m)	Length to Width Ratio	Area (sq m)
B:10:0124A	0	0	1	0	0	0	0.00	0.00	0.00	0.00	2.20	1.40	0.60	1.00	3.08
B:10:0132	0	0	1	0	0	0	0.00	0.00	0.00	0.00	2.00	1.90	0.40	1.00	3.80
B:10:0133a	0	0	1	0	0	1088	0.00	0.00	0.00	0.00	0.85	0.65		1.00	0.55
B:10:0133b	0	0	1	0	0	1088	0.00	0.00	0.00	0.00	1.50	1.50		1.00	2.25
B:10:0133c	0	0	1	0	0	1088	0.00	0.00	0.00	0.00	0.85	0.65		1.00	0.55
B:10:0134	1	2	1	0	1190	0	1.00	0.00	0.00	0.00	2.00	1.00		2.00	2.00
B:10:0257a	0	0	1	0	0	0	0.00	0.00	0.00	0.00	0.75	0.50	0.50	1.00	0.38
B:10:0257b	0	0	1	0	0	0	0.00	0.00	0.00	0.00	0.75	0.50	0.50	1.00	0.38
B:11:0010a	1	3	1	1124	1126	1059	1.00	0.00	0.00	0.00	0.00	0.00		#DIV/0!	0.00
B:11:0010b	1	3	1	1124	1126	1059	1.00	0.00	0.00	0.00	0.00	0.00		#DIV/0!	0.00
B:11:0010c	1	3	1	1124	1126	1059	1.00	0.00	0.00	0.00	0.00	0.00		#DIV/0!	0.00
B:11:0014a	1	2	1	0	0	1133	0.00	0.00	0.00	0.00	2.00	2.00		1.00	4.00
B:11:0014b	1	2	1	0	0	1133	0.00	0.00	0.00	0.00	2.00	2.00		1.00	4.00
B:11:0014c	1	2	1	0	0	1133	0.00	0.00	0.00	0.00	2.00	2.00		1.00	4.00
B:11:0016	1	2	1	0	0	0	0.88	0.00	0.12	0.00	1.00	0.75		1.00	0.75
B:11:0019a	4	5	1	1124	1152	1055	1.00	0.00	0.00	0.00	1.00	0.50		2.00	0.50
B:11:0019b	4	5	1	1124	1152	1055	1.00	0.00	0.00	0.00	1.00	1.00	1.50	1.00	1.00
B:11:0019c	4	5	1	1124	1152	1055	1.00	0.00	0.00	0.00	0.80	0.80		1.00	0.64

Site Number	Structures	Masonry_Rms	Enclosures	MCD	MCD_Plain	MCD_Deco	Kayenta pct	Cohonina pct	Virgin pct	Patayan pct	Length (m)	Width (m)	Height (m)	Length to Width Ratio	Area (sq m)
B:11:0019d	4	5	1	1124	1152	1055	1.00	0.00	0.00	0.00	1.00	0.30		3.00	0.30
B:11:0024	0	0	1	0	0	0	0.00	0.00	0.00	0.00	2.00	1.00		2.00	2.00
B:11:0036a	2	3	1	1143	1151	1105	0.94	0.06	0.00	0.00	1.30	1.20	0.57	1.00	1.56
B:11:0036b	2	3	1	1143	1151	1105	0.94	0.06	0.00	0.00	1.30	1.20	0.57	1.00	1.56
B:11:0040a	2	2	1	0	0	0	1.00	0.00	0.00	0.00	1.20	0.50	0.50	2.00	0.60
B:11:0040b	2	2	1	0	0	0	1.00	0.00	0.00	0.00	1.20	0.50	0.50	2.00	0.60
B:11:0043a	3	5	1	0	1152	0	1.00	0.00	0.00	0.00	2.00	2.00		1.00	4.00
B:11:0043b	3	5	1	0	1152	0	1.00	0.00	0.00	0.00	1.00	1.00		1.00	1.00
B:11:0043c	3	5	1	0	1152	0	1.00	0.00	0.00	0.00	2.00	2.00		1.00	4.00
B:11:0061a	1	1	1	0	0	0	0.00	0.00	0.00	0.00	2.00	1.00		2.00	2.00
B:11:0061b	1	1	1	0	0	0	0.00	0.00	0.00	0.00	2.00	1.00		2.00	2.00
B:11:0061c	1	1	1	0	0	0	0.00	0.00	0.00	0.00	2.00	1.00		2.00	2.00
B:11:0061d	1	1	1	0	0	0	0.00	0.00	0.00	0.00	2.00	1.00		2.00	2.00
B:11:0061e	1	1	1	0	0	0	0.00	0.00	0.00	0.00	2.00	1.00		2.00	2.00
B:11:0061f	1	1	1	0	0	0	0.00	0.00	0.00	0.00	2.00	1.00		2.00	2.00
B:11:0062a	1	2	1	0	1169	0	0.97	0.03	0.00	0.00	2.00	1.00	1.00	2.00	2.00
B:11:0062b	1	2	1	0	1169	0	0.97	0.03	0.00	0.00	1.00	1.00	0.50	1.00	1.00
B:11:0062c	1	2	1	0	1169	0	0.97	0.03	0.00	0.00	1.00	1.00	0.50	1.00	1.00

Site Number	Structures	Masonry_Rms	Enclosures	MCD	MCD_Plain	MCD_Deco	Kayenta pct	Cohonina pct	Virgin pct	Patayan pct	Length (m)	Width (m)	Height (m)	Length to Width Ratio	Area (sq m)
B:11:0062d	1	2	1	0	1169	0	0.97	0.03	0.00	0.00	0.50	0.40	0.15	1.00	0.20
B:11:0062e	1	2	1	0	1169	0	0.97	0.03	0.00	0.00	0.50	0.40	0.15	1.00	0.20
B:11:0207a	3	4	1	0	0	0	0.00	0.00	0.00	0.00	2.30	1.10		2.00	2.53
B:11:0207b	3	4	1	0	0	0	0.00	0.00	0.00	0.00	2.30	1.30	1.80	1.00	2.99
B:11:0207c	3	4	1	0	0	0	0.00	0.00	0.00	0.00	2.60	1.70	1.80	1.00	4.42
B:11:0207d	3	4	1	0	0	0	0.00	0.00	0.00	0.00	4.00	2.10	1.80	1.00	8.40
B:11:0207e	3	4	1	0	0	0	0.00	0.00	0.00	0.00	1.70	1.10	1.15	1.00	1.87
B:11:0207f	3	4	1	0	0	0	0.00	0.00	0.00	0.00	1.20	1.00	1.15	1.00	1.20
B:11:0207g	3	4	1	0	0	0	0.00	0.00	0.00	0.00	1.80	1.00	1.15	1.00	1.80
B:11:0207h	3	4	1	0	0	0	0.00	0.00	0.00	0.00	1.80	1.10	1.10	1.00	1.98
B:11:0211	1	0	1	1123	1130	1086	0.98	0.00	0.02	0.00	1.50	1.50		1.00	2.25
B:11:0232a	1	1	1	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00		#DIV/0!	0.00
B:11:0232b	1	1	1	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00		#DIV/0!	0.00
B:11:0232c	1	1	1	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00		#DIV/0!	0.00
B:11:0232d	1	1	1	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00		#DIV/0!	0.00
B:11:0232e	1	1	1	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00		#DIV/0!	0.00
B:11:0279	4	4	1	0	1113	0	1.00	0.00	0.00	0.00	0.60	0.60		1.00	0.36
B:11:0372	1	1	1	0	0	0	0.00	0.00	0.00	0.00	1.00	0.85	0.60	1.00	0.85

Site Number	Structures	Masonry_Rms	Enclosures	MCD	MCD_Plain	MCD_Deco	Kayenta pct	Cohonina pct	Virgin pct	Patayan pct	Length (m)	Width (m)	Height (m)	Length to Width Ratio	Area (sq m)
B:11:0375a	4	2	1	0	1152	0	1.00	0.00	0.00	0.00	0.65	0.60	0.30	1.00	0.39
B:11:0375b	4	2	1	0	1152	0	1.00	0.00	0.00	0.00	0.40	0.40	0.30	1.00	0.16
B:11:0375c	4	2	1	0	1152	0	1.00	0.00	0.00	0.00	0.65	0.60	0.30	1.00	0.39
B:11:0375d	4	2	1	0	1152	0	1.00	0.00	0.00	0.00	0.65	0.60	0.30	1.00	0.39
B:11:0375e	4	2	1	0	1152	0	1.00	0.00	0.00	0.00	0.50	0.50	0.30	1.00	0.25
B:11:0386a	7	6	1	0	0	0	0.00	0.00	0.00	0.00	1.00	0.50	0.30	2.00	0.50
B:11:0386b	7	6	1	0	0	0	0.00	0.00	0.00	0.00	1.50	1.50		1.00	2.25
B:11:0386c	7	6	1	0	0	0	0.00	0.00	0.00	0.00	1.00	0.30	0.30	3.00	0.30
B:11:0386d	7	6	1	0	0	0	0.00	0.00	0.00	0.00	1.00	0.50	0.30	2.00	0.50
B:11:0386e	7	6	1	0	0	0	0.00	0.00	0.00	0.00	1.00	0.50	0.30	2.00	0.50
B:11:0386f	7	6	1	0	0	0	0.00	0.00	0.00	0.00	1.00	0.50	0.30	2.00	0.50
B:11:0404	1	1	1	0	0	0	0.00	0.00	1.00	0.00	2.50	2.50		1.00	6.25
B:11:0414a	3	3	1	0	0	945	0.00	0.00	1.00	0.00	1.00	1.00		1.00	1.00
B:11:0414b	3	3	1	0	0	945	0.00	0.00	1.00	0.00	1.00	1.00		1.00	1.00
B:11:0414c	3	3	1	0	0	945	0.00	0.00	1.00	0.00	1.00	1.00		1.00	1.00
B:11:0414d	3	3	1	0	0	945	0.00	0.00	1.00	0.00	1.00	1.00		1.00	1.00
B:11:0414e	3	3	1	0	0	945	0.00	0.00	1.00	0.00	1.00	1.00		1.00	1.00
B:14:0038	4	5	1	1099	1113	1125	1.00	0.00	0.00	0.00	1.00	0.75	0.35	1.00	0.75

Site Number	Structures	Masonry_Rms	Enclosures	MCD	MCD_Plain	MCD_Deco	Kayenta pct	Cohonina pct	Virgin pct	Patayan pct	Length (m)	Width (m)	Height (m)	Length to Width Ratio	Area (sq m)
B:15:0019a	2	1	1	0	1113	0	0.96	0.00	0.04	0.00	2.00	1.30	1.50	1.00	2.60
B:15:0019b	2	1	1	0	1113	0	0.96	0.00	0.04	0.00	2.00	1.30	1.50	1.00	2.60
B:15:0019c	2	1	1	0	1113	0	0.96	0.00	0.04	0.00	2.00	1.30	1.50	1.00	2.60
B:15:0045	1	5	999	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00		#DIV/0!	0.00
B:15:0046	1	5	999	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00		#DIV/0!	0.00
B:15:0050a	4	9	1	1166	1179	1178	1.00	0.00	0.00	0.00	1.75	1.75		1.00	3.06
B:15:0050b	4	9	1	1166	1179	1178	1.00	0.00	0.00	0.00	1.75	1.75		1.00	3.06
B:15:0050c	4	9	1	1166	1179	1178	1.00	0.00	0.00	0.00	1.75	1.75		1.00	3.06
B:15:0050d	4	9	1	1166	1179	1178	1.00	0.00	0.00	0.00	1.75	1.75		1.00	3.06
B:15:0063a	2	0	1	1145	1157	1175	1.00	0.00	0.00	0.00	1.20	1.00	0.80	1.00	1.20
B:15:0063b	2	0	1	1145	1157	1175	1.00	0.00	0.00	0.00	1.20	1.00	0.80	1.00	1.20
B:15:0072a	1	0	1	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00		#DIV/0!	0.00
B:15:0072b	1	0	1	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00		#DIV/0!	0.00
B:15:0073	2	4	1	0	0	1200	0.33	0.00	0.67	0.00	1.00	0.50		2.00	0.50
B:15:0076a	3	2	1	1154	1117	1157	0.19	0.00	0.81	0.00	2.50	1.40	0.65	1.00	3.50
B:15:0076b	3	2	1	1154	1117	1157	0.19	0.00	0.81	0.00	3.00	1.50	0.80	2.00	4.50
B:15:0091a	2	3	1	0	0	0	0.00	0.00	0.00	0.00	0.50	0.30	0.20	1.00	0.15
B:15:0091b	2	3	1	0	0	0	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00

Site Number	Structures	Masonry_Rms	Enclosures	MCD	MCD_Plain	MCD_Deco	Kayenta pct	Cohonina pct	Virgin pct	Patayan pct	Length (m)	Width (m)	Height (m)	Length to Width Ratio	Area (sq m)
B:15:0091c	2	3	1	0	0	0	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00
B:15:0091d	2	3	1	0	0	0	0.00	0.00	0.00	0.00	0.80	0.80		1.00	0.64
B:15:0091e	2	3	1	0	0	0	0.00	0.00	0.00	0.00	0.80	0.80		1.00	0.64
B:15:0094a	2	1	1	0	975	0	0.00	1.00	0.00	0.00	2.00	1.60	0.25	1.00	3.20
B:15:0094b	2	1	1	0	975	0	0.00	1.00	0.00	0.00	2.00	1.60	0.25	1.00	3.20
B:15:0094c	2	1	1	0	975	0	0.00	1.00	0.00	0.00	2.50	1.50		1.00	3.75
B:15:0094d	2	1	1	0	975	0	0.00	1.00	0.00	0.00	3.00	2.00		1.00	6.00
B:15:0095a	1	3	1	0	0	0	0.00	0.00	0.00	0.00	1.40	1.00	0.68	1.00	1.40
B:15:0095b	1	3	1	0	0	0	0.00	0.00	0.00	0.00	1.40	1.00	0.68	1.00	1.40
B:15:0095c	1	3	1	0	0	0	0.00	0.00	0.00	0.00	1.40	1.00	1.10	1.00	1.40
B:15:0108a	4	0	1	1112	1112	1125	0.47	0.01	0.53	0.00	1.00	0.80		1.00	0.80
B:15:0108b	4	0	1	1112	1112	1125	0.47	0.01	0.53	0.00	1.00	0.80		1.00	0.80
B:15:0108c	4	0	1	1112	1112	1125	0.47	0.01	0.53	0.00	1.00	0.80		1.00	0.80
B:15:0108d	4	0	1	1112	1112	1125	0.47	0.01	0.53	0.00	1.00	0.80		1.00	0.80
B:15:0109	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.35	1.00	0.60	1.00	1.35
B:15:0110a	4	3	1	0	0	0	0.00	1.00	0.00	0.00	2.00	1.00		2.00	2.00
B:15:0110b	4	3	1	0	0	0	0.00	1.00	0.00	0.00	2.00	1.00		2.00	2.00
B:15:0110c	4	3	1	0	0	0	0.00	1.00	0.00	0.00	2.00	1.00		2.00	2.00

Site Number	Structures	Masonry_Rms	Enclosures	MCD	MCD_Plain	MCD_Deco	Kayenta pct	Cohonina pct	Virgin pct	Patayan pct	Length (m)	Width (m)	Height (m)	Length to Width Ratio	Area (sq m)
B:15:0112a	0	0	1	1101	1132	1105	1.00	0.00	0.00	0.00	0.87	0.48	0.51	1.00	0.42
B:15:0112b	0	0	1	1101	1132	1105	1.00	0.00	0.00	0.00	0.91	0.54	0.51	1.00	0.49
B:15:0113a	1	2	1	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00		#DIV/0!	0.00
B:15:0113b	1	2	1	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00		#DIV/0!	0.00
B:15:0113c	1	2	1	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00		#DIV/0!	0.00
B:15:0113d	1	2	1	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00		#DIV/0!	0.00
B:15:0113e	1	2	1	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00		#DIV/0!	0.00
B:15:0115	0	0	1	0	0	0	0.00	0.00	0.00	0.00	2.00	1.00		2.00	2.00
B:15:0126a	1	1	1	0	0	0	0.00	0.00	1.00	0.00	0.65	0.55	0.55	1.00	0.36
B:15:0126b	1	1	1	0	0	0	0.00	0.00	1.00	0.00	0.65	0.55	0.55	1.00	0.36
B:15:0126c	1	1	1	0	0	0	0.00	0.00	1.00	0.00	0.65	0.55	0.55	1.00	0.36
B:15:0126d	1	1	1	0	0	0	0.00	0.00	1.00	0.00	0.65	0.55	0.55	1.00	0.36
B:15:0127	1	0	1	0	0	0	0.00	0.00	1.00	0.00	0.50	0.50		1.00	0.25
B:15:0129a	1	2	1	0	0	0	0.00	0.00	0.00	0.00	0.80	0.60		1.00	0.48
B:15:0129b	1	2	1	0	0	0	0.00	0.00	0.00	0.00	1.70	0.75	0.30	2.00	1.28
B:15:0129c	1	2	1	0	0	0	0.00	0.00	0.00	0.00	1.70	0.75	0.30	2.00	1.28
B:15:0129d	1	2	1	0	0	0	0.00	0.00	0.00	0.00	1.15	0.70	0.45	1.00	0.81
B:15:0170	1	0	1	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00		#DIV/0!	0.00

Site Number	Structures	Masonry_Rms	Enclosures	MCD	MCD_Plain	MCD_Deco	Kayenta pct	Cohonina pct	Virgin pct	Patayan pct	Length (m)	Width (m)	Height (m)	Length to Width Ratio	Area (sq m)
B:15:0183a	1	0	1	0	0	0	0.00	0.00	0.00	0.00	1.00	1.50		0.00	1.50
B:15:0183b	1	0	1	0	0	0	0.00	0.00	0.00	0.00	1.00	1.50		0.00	1.50
B:15:0194	0	0	1	0	0	0	0.00	0.00	0.00	0.00	2.00	2.00		1.00	4.00
B:15:0218a	0	0	1	0	1190	0	1.00	0.00	0.00	0.00	0.32	0.24	0.24	1.00	0.08
B:15:0218b	0	0	1	0	1190	0	1.00	0.00	0.00	0.00	0.65	0.30	0.28	2.00	0.20
B:15:0220	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.00	1.00		1.00	1.00
B:16:0002	0	0	1	0	1190	0	1.00	0.00	0.00	0.00	2.00	2.00		1.00	4.00
B:16:0003	4	4	1	1159	1113	1159	1.00	0.00	0.00	0.00	2.00	2.00		1.00	4.00
B:16:0004a	7	17	1	1119	1113	1051	0.88	0.13	0.00	0.00	2.00	1.00		2.00	2.00
B:16:0004b	7	17	1	1119	1113	1051	0.88	0.13	0.00	0.00	2.00	1.00		2.00	2.00
B:16:0004c	7	17	1	1119	1113	1051	0.88	0.13	0.00	0.00	2.00	1.00		2.00	2.00
B:16:0009a	1	6	1	1160	1190	1154	0.80	0.00	0.00	0.20	2.00	0.75		2.00	1.50
B:16:0009b	1	6	1	1160	1190	1154	0.80	0.00	0.00	0.20	2.00	0.75		2.00	1.50
B:16:0009c	1	6	1	1160	1190	1154	0.80	0.00	0.00	0.20	2.00	0.75		2.00	1.50
B:16:0009d	1	6	1	1160	1190	1154	0.80	0.00	0.00	0.20	2.00	0.75		2.00	1.50
B:16:0009e	1	6	1	1160	1190	1154	0.80	0.00	0.00	0.20	2.00	0.75		2.00	1.50
B:16:0009f	1	6	1	1160	1190	1154	0.80	0.00	0.00	0.20	2.00	0.75		2.00	1.50
B:16:0009g	1	6	1	1160	1190	1154	0.80	0.00	0.00	0.20	2.00	0.75		2.00	1.50

Site Number	Structures	Masonry_Rms	Enclosures	MCD	MCD_Plain	MCD_Deco	Kayenta pct	Cohonina pct	Virgin pct	Patayan pct	Length (m)	Width (m)	Height (m)	Length to Width Ratio	Area (sq m)
B:16:0009h	1	6	1	1160	1190	1154	0.80	0.00	0.00	0.20	2.00	0.75		2.00	1.50
B:16:0009i	1	6	1	1160	1190	1154	0.80	0.00	0.00	0.20	2.00	0.75		2.00	1.50
B:16:0009j	1	6	1	1160	1190	1154	0.80	0.00	0.00	0.20	2.00	0.75		2.00	1.50
B:16:0009k	1	6	1	1160	1190	1154	0.80	0.00	0.00	0.20	2.00	0.75		2.00	1.50
B:16:0009l	1	6	1	1160	1190	1154	0.80	0.00	0.00	0.20	2.00	0.75		2.00	1.50
B:16:0014a	2	3	1	1151	1127	1112	0.28	0.34	0.00	0.38	2.00	1.00	1.00	2.00	2.00
B:16:0014b	2	3	1	1151	1127	1112	0.28	0.34	0.00	0.38	2.00	1.00	1.00	2.00	2.00
B:16:0014c	2	3	1	1151	1127	1112	0.28	0.34	0.00	0.38	2.00	1.00	1.00	2.00	2.00
B:16:0014d	2	3	1	1151	1127	1112	0.28	0.34	0.00	0.38	0.50	0.30		1.00	0.15
B:16:0014e	2	3	1	1151	1127	1112	0.28	0.34	0.00	0.38	2.00	2.00		1.00	4.00
B:16:0014f	2	3	1	1151	1127	1112	0.28	0.34	0.00	0.38	2.00	1.00		2.00	2.00
B:16:0014g	2	3	1	1151	1127	1112	0.28	0.34	0.00	0.38	2.00	1.00	1.00	2.00	2.00
B:16:0014h	2	3	1	1151	1127	1112	0.28	0.34	0.00	0.38	2.00	1.00	1.00	2.00	2.00
B:16:0015a	1	1	1	1122	1113	1117	0.50	0.00	0.50	0.00	0.75	0.35	1.70	2.00	0.26
B:16:0015b	1	1	1	1122	1113	1117	0.50	0.00	0.50	0.00	1.70	1.70	1.20	1.00	2.89
B:16:0015c	1	1	1	1122	1113	1117	0.50	0.00	0.50	0.00	1.00	0.80	0.40	1.00	0.80
B:16:0015d	1	1	1	1122	1113	1117	0.50	0.00	0.50	0.00	1.40	0.80	0.30	1.00	1.12
B:16:0015e	1	1	1	1122	1113	1117	0.50	0.00	0.50	0.00	1.10	0.50	0.60	2.00	0.55

Site Number	Structures	Masonry_Rms	Enclosures	MCD	MCD_Plain	MCD_Deco	Kayenta pct	Cohonina pct	Virgin pct	Patayan pct	Length (m)	Width (m)	Height (m)	Length to Width Ratio	Area (sq m)
B:16:0015f	1	1	1	1122	1113	1117	0.50	0.00	0.50	0.00	1.10	0.70	0.50	1.00	0.77
B:16:0015g	1	1	1	1122	1113	1117	0.50	0.00	0.50	0.00	0.90	0.78	0.38	1.00	0.70
B:16:0015h	1	1	1	1122	1113	1117	0.50	0.00	0.50	0.00	0.90	0.80	0.40	1.00	0.72
B:16:0015i	1	1	1	1122	1113	1117	0.50	0.00	0.50	0.00	1.20	0.80	0.40	1.00	0.96
B:16:0015j	1	1	1	1122	1113	1117	0.50	0.00	0.50	0.00	1.20	0.90	0.70	1.00	1.08
B:16:0015k	1	1	1	1122	1113	1117	0.50	0.00	0.50	0.00	1.20	0.80	0.80	1.00	0.96
B:16:0015l	1	1	1	1122	1113	1117	0.50	0.00	0.50	0.00	1.00	0.80	0.40	1.00	0.80
B:16:0015m	1	1	1	1122	1113	1117	0.50	0.00	0.50	0.00	1.00	0.80	0.40	1.00	0.80
B:16:0015n	1	1	1	1122	1113	1117	0.50	0.00	0.50	0.00	1.00	0.80	0.40	1.00	0.80
B:16:0015o	1	1	1	1122	1113	1117	0.50	0.00	0.50	0.00	1.00	0.80	0.40	1.00	0.80
B:16:0021	1	4	1	1131	1131	1100	0.48	0.06	0.46	0.00	0.75	0.75		1.00	0.56
B:16:0022	1	3	1	1122	1113	1118	0.43	0.00	0.57	0.00	1.00	0.50		2.00	0.50
B:16:0025a	2	3	1	0	0	945	0.00	0.00	0.00	0.00	0.00	0.00		#DIV/0!	0.00
B:16:0025b	2	3	1	0	0	945	0.00	0.00	0.00	0.00	0.00	0.00		#DIV/0!	0.00
B:16:0025c	2	3	1	0	0	945	0.00	0.00	0.00	0.00	0.00	0.00		#DIV/0!	0.00
B:16:0025d	2	3	1	0	0	945	0.00	0.00	0.00	0.00	0.00	0.00		#DIV/0!	0.00
B:16:0026	1	3	1	1157	1152	1133	0.67	0.00	0.33	0.00	2.00	2.00		1.00	4.00
B:16:0027a	0	0	1	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00		#DIV/0!	0.00

Site Number	Structures	Masonry_Rms	Enclosures	MCD	MCD_Plain	MCD_Deco	Kayenta pct	Cohonina pct	Virgin pct	Patayan pct	Length (m)	Width (m)	Height (m)	Length to Width Ratio	Area (sq m)
B:16:0027b	0	0	1	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00		#DIV/0!	0.00
B:16:0027c	0	0	1	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00		#DIV/0!	0.00
B:16:0030a	1	2	1	1167	1184	1166	0.48	0.01	0.51	0.00	1.00	1.00	1.00	1.00	1.00
B:16:0030b	1	2	1	1167	1184	1166	0.48	0.01	0.51	0.00	1.00	1.00	1.00	1.00	1.00
B:16:0030c	1	2	1	1167	1184	1166	0.48	0.01	0.51	0.00	1.00	1.00	1.00	1.00	1.00
B:16:0030d	1	2	1	1167	1184	1166	0.48	0.01	0.51	0.00	1.00	1.00	1.00	1.00	1.00
B:16:0030e	1	2	1	1167	1184	1166	0.48	0.01	0.51	0.00	1.00	1.00	1.00	1.00	1.00
B:16:0031a	2	5	1	0	1165	0	0.79	0.21	0.00	0.00	1.00	1.00		1.00	1.00
B:16:0031b	2	5	1	0	1165	0	0.79	0.21	0.00	0.00	1.00	1.00		1.00	1.00
B:16:0031c	2	5	1	0	1165	0	0.79	0.21	0.00	0.00	1.00	1.00		1.00	1.00
B:16:0032a	4	4	1	0	0	1188	0.00	0.00	0.00	0.00	1.00	0.75	1.00	1.00	0.75
B:16:0032b	4	4	1	0	0	1188	0.00	0.00	0.00	0.00	1.00	0.75	1.00	1.00	0.75
B:16:0032c	4	4	1	0	0	1188	0.00	0.00	0.00	0.00	1.00	0.75	1.00	1.00	0.75
B:16:0032d	4	4	1	0	0	1188	0.00	0.00	0.00	0.00	1.00	0.75	1.00	1.00	0.75
B:16:0032e	4	4	1	0	0	1188	0.00	0.00	0.00	0.00	1.00	0.75	1.00	1.00	0.75
B:16:0032f	4	4	1	0	0	1188	0.00	0.00	0.00	0.00	1.00	0.75	1.00	1.00	0.75
B:16:0032g	4	4	1	0	0	1188	0.00	0.00	0.00	0.00	1.00	0.75	1.00	1.00	0.75
B:16:0032h	4	4	1	0	0	1188	0.00	0.00	0.00	0.00	1.00	0.75	1.00	1.00	0.75

Site Number	Structures	Masonry_Rms	Enclosures	MCD	MCD_Plain	MCD_Deco	Kayenta pct	Cohonina pct	Virgin pct	Patayan pct	Length (m)	Width (m)	Height (m)	Length to Width Ratio	Area (sq m)
B:16:0036a	4	6	1	0	0	1200	0.00	0.00	0.00	0.00	2.00	1.75		1.00	3.50
B:16:0036b	4	6	1	0	0	1200	0.00	0.00	0.00	0.00	2.00	1.75		1.00	3.50
B:16:0051	1	1	1	0	1190	0	1.00	0.00	0.00	0.00	0.00	0.00		#DIV/0!	0.00
B:16:0059a	2	9	1	0	1152	0	1.00	0.00	0.00	0.00	1.80	2.00		0.00	3.60
B:16:0059b	2	9	1	0	1152	0	1.00	0.00	0.00	0.00	2.00	1.00		2.00	2.00
B:16:0065a	3	15	1	1155	1034	1125	0.20	0.80	0.00	0.00	0.00	0.00		#DIV/0!	0.00
B:16:0065b	3	15	1	1155	1034	1125	0.20	0.80	0.00	0.00	0.00	0.00		#DIV/0!	0.00
B:16:0065c	3	15	1	1155	1034	1125	0.20	0.80	0.00	0.00	0.00	0.00		#DIV/0!	0.00
B:16:0065d	3	15	1	1155	1034	1125	0.20	0.80	0.00	0.00	0.00	0.00		#DIV/0!	0.00
B:16:0066a	3	6	1	0	0	0	0.00	0.00	0.00	0.00	1.50	1.50		1.00	2.25
B:16:0066b	3	6	1	0	0	0	0.00	0.00	0.00	0.00	2.00	1.00		2.00	2.00
B:16:0066c	3	6	1	0	0	0	0.00	0.00	0.00	0.00	1.50	1.50		1.00	2.25
B:16:0066d	3	6	1	0	0	0	0.00	0.00	0.00	0.00	1.40	0.30	0.45	4.00	0.42
B:16:0066e	3	6	1	0	0	0	0.00	0.00	0.00	0.00	1.40	0.30	0.45	4.00	0.42
B:16:0066f	3	6	1	0	0	0	0.00	0.00	0.00	0.00	1.40	0.30	0.45	4.00	0.42
B:16:0066g	3	6	1	0	0	0	0.00	0.00	0.00	0.00	1.40	0.30	0.45	4.00	0.42
B:16:0066h	3	6	1	0	0	0	0.00	0.00	0.00	0.00	1.40	0.30	0.45	4.00	0.42
B:16:0066i	3	6	1	0	0	0	0.00	0.00	0.00	0.00	1.40	0.30	0.45	4.00	0.42

Site Number	Structures	Masonry_Rms	Enclosures	MCD	MCD_Plain	MCD_Deco	Kayenta pct	Cohonina pct	Virgin pct	Patayan pct	Length (m)	Width (m)	Height (m)	Length to Width Ratio	Area (sq m)
B:16:0066j	3	6	1	0	0	0	0.00	0.00	0.00	0.00	1.40	0.30	0.45	4.00	0.42
B:16:0066k	3	6	1	0	0	0	0.00	0.00	0.00	0.00	1.40	0.30	0.45	4.00	0.42
B:16:0066l	3	6	1	0	0	0	0.00	0.00	0.00	0.00	1.40	0.30	0.45	4.00	0.42
B:16:0086	0	0	1	0	1113	0	1.00	0.00	0.00	0.00	0.84	0.76	0.38	1.00	0.64
B:16:0091a	7	11	1	1136	1113	1133	0.22	0.06	0.00	0.73	1.50	1.50		1.00	2.25
B:16:0091b	7	11	1	1136	1113	1133	0.22	0.06	0.00	0.73	1.50	1.50		1.00	2.25
B:16:0091c	7	11	1	1136	1113	1133	0.22	0.06	0.00	0.73	1.50	1.50		1.00	2.25
B:16:0091d	7	11	1	1136	1113	1133	0.22	0.06	0.00	0.73	1.50	1.50		1.00	2.25
B:16:0091e	7	11	1	1136	1113	1133	0.22	0.06	0.00	0.73	2.00	2.00		1.00	4.00
B:16:0091f	7	11	1	1136	1113	1133	0.22	0.06	0.00	0.73	1.50	1.50		1.00	2.25
B:16:0091g	7	11	1	1136	1113	1133	0.22	0.06	0.00	0.73	1.50	1.50		1.00	2.25
B:16:0091h	7	11	1	1136	1113	1133	0.22	0.06	0.00	0.73	1.50	1.50		1.00	2.25
B:16:0091i	7	11	1	1136	1113	1133	0.22	0.06	0.00	0.73	1.50	1.50		1.00	2.25
B:16:0154a	4	7	1	0	1113	0	1.00	0.00	0.00	0.00	2.00	1.00		2.00	2.00
B:16:0154b	4	7	1	0	1113	0	1.00	0.00	0.00	0.00	2.00	1.00		2.00	2.00
B:16:0163a	3	2	1	0	0	0	0.00	0.00	0.00	0.00	1.80	1.30	0.65	1.00	2.34
B:16:0163b	3	2	1	0	0	0	0.00	0.00	0.00	0.00	1.30	1.00	0.60	1.00	1.30
B:16:0219a	0	0	1	0	0	0	0.00	0.00	0.00	0.00	2.00	2.00		1.00	4.00

Site Number	Structures	Masonry_Rms	Enclosures	MCD	MCD_Plain	MCD_Deco	Kayenta pct	Cohonina pct	Virgin pct	Patayan pct	Length (m)	Width (m)	Height (m)	Length to Width Ratio	Area (sq m)
B:16:0219b	0	0	1	0	0	0	0.00	0.00	0.00	0.00	2.00	1.00		2.00	2.00
B:16:0219c	0	0	1	0	0	0	0.00	0.00	0.00	0.00	2.00	1.00		2.00	2.00
B:16:0226a	0	0	1	0	975	0	0.33	0.67	0.00	0.00	0.34	0.30	1.00	1.00	0.10
B:16:0226b	0	0	1	0	975	0	0.33	0.67	0.00	0.00	0.34	0.30	0.70	1.00	0.10
B:16:0226c	0	0	1	0	975	0	0.33	0.67	0.00	0.00	0.70	0.70	1.00	1.00	0.49
B:16:0264	0	0	1	0	0	0	0.00	0.00	0.00	0.00	3.00	1.00		3.00	3.00
B:16:0293a	3	3	1	0	0	0	0.00	0.00	0.00	0.00	3.00	2.50		1.00	7.50
B:16:0293b	3	3	1	0	0	0	0.00	0.00	0.00	0.00	3.00	2.50		1.00	7.50
B:16:0293c	3	3	1	0	0	0	0.00	0.00	0.00	0.00	3.00	2.50		1.00	7.50
B:16:0293d	3	3	1	0	0	0	0.00	0.00	0.00	0.00	1.00	1.00		1.00	1.00
B:16:0293e	3	3	1	0	0	0	0.00	0.00	0.00	0.00	1.00	1.00		1.00	1.00
B:16:0293f	3	3	1	0	0	0	0.00	0.00	0.00	0.00	2.00	2.00	1.00	1.00	4.00
B:16:0293g	3	3	1	0	0	0	0.00	0.00	0.00	0.00	2.00	2.00	1.00	1.00	4.00
B:16:0293h	3	3	1	0	0	0	0.00	0.00	0.00	0.00	2.00	2.00	1.00	1.00	4.00
B:16:0293i	3	3	1	0	0	0	0.00	0.00	0.00	0.00	2.00	2.00	1.00	1.00	4.00
B:16:0293j	3	3	1	0	0	0	0.00	0.00	0.00	0.00	2.00	2.00	1.00	1.00	4.00
B:16:0293k	3	3	1	0	0	0	0.00	0.00	0.00	0.00	2.00	2.00	1.00	1.00	4.00
B:16:0293l	3	3	1	0	0	0	0.00	0.00	0.00	0.00	2.00	2.00	1.00	1.00	4.00

Site Number	Structures	Masonry_Rms	Enclosures	MCD	MCD_Plain	MCD_Deco	Kayenta pct	Cohonina pct	Virgin pct	Patayan pct	Length (m)	Width (m)	Height (m)	Length to Width Ratio	Area (sq m)
B:16:0363	3	3	999	1112	1109	1125	0.73	0.27	0.00	0.00	0.00	0.00		#DIV/0!	0.00
B:16:0388a	0	0	1	0	975	0	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00
B:16:0388b	0	0	1	0	975	0	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00
B:16:0412a	1	0	1	0	1113	0	1.00	0.00	0.00	0.00	0.50	0.50		1.00	0.25
B:16:0412b	1	0	1	0	1113	0	1.00	0.00	0.00	0.00	0.50	0.50		1.00	0.25
B:16:0493	1	0	1	0	0	0	0.00	0.00	1.00	0.00	3.00	1.00		3.00	3.00
B:16:0512a	2	0	1	0	0	1125	0.00	0.00	1.00	0.00	0.96	0.94	1.08	1.00	0.90
B:16:0512b	2	0	1	0	0	1125	0.00	0.00	1.00	0.00	1.20	1.20	1.07	1.00	1.44
B:16:0801a	3	3	1	1183	1190	913	1.00	0.00	0.00	0.00	0.90	0.70		1.00	0.63
B:16:0801b	3	3	1	1183	1190	913	1.00	0.00	0.00	0.00	0.80	1.00		0.00	0.80
B:16:0823	1	0	1	0	0	0	0.00	0.00	0.00	0.00	1.70	1.10	0.85	1.00	1.87
B:16:0887a	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.50	1.50		1.00	2.25
B:16:0887b	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.50	1.50		1.00	2.25
B:16:0887c	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.50	1.50		1.00	2.25
B:16:0887d	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.50	1.50		1.00	2.25
B:16:1042a	8	10	1	1117	1055	1133	0.85	0.08	0.08	0.00	0.00	0.00		#DIV/0!	0.00
B:16:1042b	8	10	1	1117	1055	1133	0.85	0.08	0.08	0.00	0.00	0.00		#DIV/0!	0.00
B:16:1042c	8	10	1	1117	1055	1133	0.85	0.08	0.08	0.00	0.00	0.00		#DIV/0!	0.00

Site Number	Structures	Masonry_Rms	Enclosures	MCD	MCD_Plain	MCD_Deco	Kayenta pct	Cohonina pct	Virgin pct	Patayan pct	Length (m)	Width (m)	Height (m)	Length to Width Ratio	Area (sq m)
B:16:1198a	2	0	1	0	0	0	0.00	0.00	0.00	0.00	2.20	2.10		1.00	4.62
B:16:1198b	2	0	1	0	0	0	0.00	0.00	0.00	0.00	2.00	1.80		1.00	3.60
C:02:0033a	0	0	1	0	0	0	0.33	0.00	0.67	0.00	2.20	1.00		2.00	2.20
C:02:0033b	0	0	1	0	0	0	0.33	0.00	0.67	0.00	0.50	0.40	0.18	1.00	0.20
C:05:0001	12	19	1	1178	1181	1270	0.34	0.00	0.65	0.00	2.25	1.85		1.00	4.16
C:09:0001a	0	0	1								0.00	0.00		#DIV/0!	0.00
C:09:0001Aa	0	0	1	0	0	0	0.00	0.00	0.00	0.00	0.73	0.70		1.00	0.51
C:09:0001Ab	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.70	1.00		1.00	1.70
C:09:0001Ac	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.45	1.00		1.00	1.45
C:09:0001Ad	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.70	0.90		1.00	1.53
C:09:0001Ae	0	0	1	0	0	0	0.00	0.00	0.00	0.00	2.30	1.00		2.00	2.30
C:09:0001Af	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.81	1.25		1.00	2.26
C:09:0001Ag	0	0	1	0	0	0	0.00	0.00	0.00	0.00	0.75	0.75		1.00	0.56
C:09:0001Ah	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.60	0.75		2.00	1.20
C:09:0001Ai	0	0	1	0	0	0	0.00	0.00	0.00	0.00	0.80	0.75		1.00	0.60
C:09:0001b	0	0	1								0.00	0.00		#DIV/0!	0.00
C:09:0001Fa	1	0	1	1095	975	1088	0.28	0.72	0.00	0.00	1.60	1.26	1.35	1.00	2.02
C:09:0001Fb	1	0	1	1095	975	1088	0.28	0.72	0.00	0.00	1.60	1.26	1.35	1.00	2.02

Site Number	Structures	Masonry_Rms	Enclosures	MCD	MCD_Plain	MCD_Deco	Kayenta pct	Cohonina pct	Virgin pct	Patayan pct	Length (m)	Width (m)	Height (m)	Length to Width Ratio	Area (sq m)
C:09:0004a	1	3	1	0	0	0	0.75	0.00	0.25	0.00	0.60	0.40		1.00	0.24
C:09:0004b	1	3	1	0	0	0	0.75	0.00	0.25	0.00	0.60	0.40		1.00	0.24
C:09:0032a	3	6	1			1130	0.00	0.00	0.00	0.00	2.00	1.60	0.80	1.00	3.20
C:09:0032b	3	6	1			1130	0.00	0.00	0.00	0.00	2.00	2.00	0.70	1.00	4.00
C:09:0035a	3	0	1	1171	1131	1188	0.29	0.61	0.11	0.00	2.40	1.40	0.50	1.00	3.36
C:09:0035b	3	0	1	1171	1131	1188	0.29	0.61	0.11	0.00	2.95	5.02	1.47	0.00	14.81
C:09:0036a	3	0	1	0	0	0	0.00	0.00	1.00	0.00	0.58	0.50		1.00	0.29
C:09:0036b	3	0	1	0	0	0	0.00	0.00	1.00	0.00	0.58	0.50		1.00	0.29
C:09:0036c	3	0	1	0	0	0	0.00	0.00	1.00	0.00	0.58	0.50		1.00	0.29
C:09:0037	2	1	1	0	0	0	0.00	0.00	1.00	0.00	2.57	1.36	1.35	1.00	3.50
C:09:0038	1	0	1		1190		1.00	0.00	0.00	0.00	1.96	1.00	1.10	1.00	1.96
C:09:0060	1	2	1	1122	1120	1143	1.00	0.00	0.00	0.00	1.00	1.00		1.00	1.00
C:09:0073	1	1	1	0	0	0	0.00	0.00	0.00	0.00	2.25	2.00		1.00	4.50
C:09:0077a	11	10	1	1155	975	1166	0.00	1.00	0.00	0.00	2.00	2.00	1.00	1.00	4.00
C:09:0077b	11	10	1	1155	975	1166	0.00	1.00	0.00	0.00	2.00	2.00	1.00	1.00	4.00
C:09:0080	2	0	1	1024	688	1047	0.92	0.08	0.00	0.00	2.00	2.00		1.00	4.00
C:09:0136a	1	0	1	0	0	0	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00
C:09:0136b	1	0	1	0	0	0	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00

Site Number	Structures	Masonry_Rms	Enclosures	MCD	MCD_Plain	MCD_Deco	Kayenta pct	Cohonina pct	Virgin pct	Patayan pct	Length (m)	Width (m)	Height (m)	Length to Width Ratio	Area (sq m)
C:09:0136c	1	0	1	0	0	0	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00
C:13:0011a	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.75	0.80	1.55	2.00	1.40
C:13:0011b	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.80	1.80	1.25	1.00	3.24
C:13:0011c	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.80	1.80		1.00	3.24
C:13:0017	4	7	1	1140	1122	1147	0.23	0.77	0.00	0.00	1.80	0.80	0.80	2.00	1.44
C:13:0018	1	5	1	0	0	0	0.00	0.00	0.00	0.00	1.70	0.80		2.00	1.36
C:13:0019	1	4	1	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00		#DIV/0!	0.00
C:13:0020a	0	0	1	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00		#DIV/0!	0.00
C:13:0020b	0	0	1	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00		#DIV/0!	0.00
C:13:0021	0	0	1	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00		#DIV/0!	0.00
C:13:0022a	3	6	1	1162	1172	1165	0.72	0.00	0.28	0.00	2.00	2.00	1.00	1.00	4.00
C:13:0022b	3	6	1	1162	1172	1165	0.72	0.00	0.28	0.00	2.00	2.00	1.00	1.00	4.00
C:13:0040a	1	1	1	0	0	0	0.00	0.00	0.00	0.00	1.00	1.00		1.00	1.00
C:13:0040b	1	1	1	0	0	0	0.00	0.00	0.00	0.00	1.00	1.00		1.00	1.00
C:13:0041a	4	4	1	0	0	0	0.00	0.00	0.00	0.00	3.00	2.00		1.00	6.00
C:13:0041b	4	4	1	0	0	0	0.00	0.00	0.00	0.00	3.00	2.00		1.00	6.00
C:13:0042a	0	0	1	0	0	0	0.00	0.00	0.00	0.00	2.00	1.00		2.00	2.00
C:13:0042b	0	0	1	0	0	0	0.00	0.00	0.00	0.00	2.00	1.00		2.00	2.00

Site Number	Structures	Masonry_Rms	Enclosures	MCD	MCD_Plain	MCD_Deco	Kayenta pct	Cohonina pct	Virgin pct	Patayan pct	Length (m)	Width (m)	Height (m)	Length to Width Ratio	Area (sq m)
C:13:0043	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.50	0.20	1.50	7.00	0.30
C:13:0044a	2	5	1	1095	1103	1080	0.26	0.00	0.74	0.00	0.00	0.00		#DIV/0!	0.00
C:13:0044b	2	5	1	1095	1103	1080	0.26	0.00	0.74	0.00	0.00	0.00		#DIV/0!	0.00
C:13:0044c	2	5	1	1095	1103	1080	0.26	0.00	0.74	0.00	0.00	0.00		#DIV/0!	0.00
C:13:0044d	2	5	1	1095	1103	1080	0.26	0.00	0.74	0.00	0.00	0.00		#DIV/0!	0.00
C:13:0044e	2	5	1	1095	1103	1080	0.26	0.00	0.74	0.00	0.00	0.00		#DIV/0!	0.00
C:13:0044f	2	5	1	1095	1103	1080	0.26	0.00	0.74	0.00	0.00	0.00		#DIV/0!	0.00
C:13:0044g	2	5	1	1095	1103	1080	0.26	0.00	0.74	0.00	0.00	0.00		#DIV/0!	0.00
C:13:0044h	2	5	1	1095	1103	1080	0.26	0.00	0.74	0.00	0.00	0.00		#DIV/0!	0.00
C:13:0044i	2	5	1	1095	1103	1080	0.26	0.00	0.74	0.00	0.00	0.00		#DIV/0!	0.00
C:13:0044j	2	5	1	1095	1103	1080	0.26	0.00	0.74	0.00	0.00	0.00		#DIV/0!	0.00
C:13:0044k	2	5	1	1095	1103	1080	0.26	0.00	0.74	0.00	0.00	0.00		#DIV/0!	0.00
C:13:0044l	2	5	1	1095	1103	1080	0.26	0.00	0.74	0.00	0.00	0.00		#DIV/0!	0.00
C:13:0044m	2	5	1	1095	1103	1080	0.26	0.00	0.74	0.00	0.00	0.00		#DIV/0!	0.00
C:13:0044n	2	5	1	1095	1103	1080	0.26	0.00	0.74	0.00	0.00	0.00		#DIV/0!	0.00
C:13:0044o	2	5	1	1095	1103	1080	0.26	0.00	0.74	0.00	0.00	0.00		#DIV/0!	0.00
C:13:0044p	2	5	1	1095	1103	1080	0.26	0.00	0.74	0.00	0.00	0.00		#DIV/0!	0.00
C:13:0044q	2	5	1	1095	1103	1080	0.26	0.00	0.74	0.00	0.00	0.00		#DIV/0!	0.00

Site Number	Structures	Masonry_Rms	Enclosures	MCD	MCD_Plain	MCD_Deco	Kayenta pct	Cohonina pct	Virgin pct	Patayan pct	Length (m)	Width (m)	Height (m)	Length to Width Ratio	Area (sq m)
C:13:0044r	2	5	1	1095	1103	1080	0.26	0.00	0.74	0.00	0.00	0.00		#DIV/0!	0.00
C:13:0044s	2	5	1	1095	1103	1080	0.26	0.00	0.74	0.00	0.00	0.00		#DIV/0!	0.00
C:13:0044t	2	5	1	1095	1103	1080	0.26	0.00	0.74	0.00	0.00	0.00		#DIV/0!	0.00
C:13:0044u	2	5	1	1095	1103	1080	0.26	0.00	0.74	0.00	0.00	0.00		#DIV/0!	0.00
C:13:0044v	2	5	1	1095	1103	1080	0.26	0.00	0.74	0.00	0.00	0.00		#DIV/0!	0.00
C:13:0044w	2	5	1	1095	1103	1080	0.26	0.00	0.74	0.00	0.00	0.00		#DIV/0!	0.00
C:13:0045a	3	4	1	1166	1105	1176	0.25	0.75	0.00	0.00	2.00	1.00		2.00	2.00
C:13:0045b	3	4	1	1166	1105	1176	0.25	0.75	0.00	0.00	2.00	1.00		2.00	2.00
C:13:0045c	3	4	1	1166	1105	1176	0.25	0.75	0.00	0.00	2.00	1.00		2.00	2.00
C:13:0046a	3	6	1	1165	1205	1170	0.97	0.00	0.03	0.00	1.00	1.00		1.00	1.00
C:13:0046b	3	6	1	1165	1205	1170	0.97	0.00	0.03	0.00	1.00	1.00		1.00	1.00
C:13:0046c	3	6	1	1165	1205	1170	0.97	0.00	0.03	0.00	1.00	1.00		1.00	1.00
C:13:0049a	2	0	1	0	0	0	0.00	0.00	0.00	0.00	1.75	1.00		1.00	1.75
C:13:0049b	2	0	1	0	0	0	0.00	0.00	0.00	0.00	1.75	1.00		1.00	1.75
C:13:0054	1	2	1	0	0	1088	0.00	0.00	0.00	0.00	1.00	1.00	0.50	1.00	1.00
C:13:0060	1	2	1	1134	1159	1088	1.00	0.00	0.00	0.00	2.00	1.00		2.00	2.00
C:13:0091	3	1	1	0	1190	0	1.00	0.00	0.00	0.00	0.75	0.50		1.00	0.38
C:13:0093a	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.75	1.50		1.00	2.63

Site Number	Structures	Masonry_Rms	Enclosures	MCD	MCD_Plain	MCD_Deco	Kayenta pct	Cohonina pct	Virgin pct	Patayan pct	Length (m)	Width (m)	Height (m)	Length to Width Ratio	Area (sq m)
C:13:0093b	0	0	1	0	0	0	0.00	0.00	0.00	0.00	0.50	0.40		1.00	0.20
C:13:0093c	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.75	1.75		1.00	3.06
C:13:0093d	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.00	1.00		1.00	1.00
C:13:0147	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.00	1.00		1.00	1.00
C:13:0148	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.40	1.30		1.00	1.82
C:13:0353	1	1	1	0	0	0	0.00	0.00	1.00	0.00	1.00	0.50		2.00	0.50
C:13:0354a	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.10	0.80	0.50	1.00	0.88
C:13:0354b	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.20	0.65		1.00	0.78
C:13:0354c	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.00	1.30	0.40	0.00	1.30
C:13:0354d	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.50	0.90		1.00	1.35
C:13:0359	2	2	1	0	0	1088	0.67	0.00	0.33	0.00	0.55	0.15	0.30	3.00	0.08
C:13:0361	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.70	1.70		1.00	2.89
C:13:0375a	7	6	1	0	0	0	0.00	0.00	0.00	0.00	2.00	1.60		1.00	3.20
C:13:0375b	7	6	1	0	0	0	0.00	0.00	0.00	0.00	2.30	1.50		1.00	3.45
C:13:0387	2	2	1	0	1113	0	1.00	0.00	0.00	0.00	1.40	1.10		1.00	1.54
C:13:0390a	1	1	1	0	0	0	0.00	0.00	0.00	0.00	2.00	1.00	1.00	2.00	2.00
C:13:0390b	1	1	1	0	0	0	0.00	0.00	0.00	0.00	1.00	1.50	0.75	0.00	1.50
C:13:0413a	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.50	2.00		0.00	3.00

Site Number	Structures	Masonry_Rms	Enclosures	MCD	MCD_Plain	MCD_Deco	Kayenta pct	Cohonina pct	Virgin pct	Patayan pct	Length (m)	Width (m)	Height (m)	Length to Width Ratio	Area (sq m)
C:13:0413b	0	0	1	0	0	0	0.00	0.00	0.00	0.00	3.30	2.00		1.00	6.60
C:13:0413c	0	0	1	0	0	0	0.00	0.00	0.00	0.00	2.70	2.00		1.00	5.40
C:13:0413d	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.50	2.00		0.00	3.00
C:13:0413e	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.70	2.00		0.00	3.40
C:13:0429	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.05	0.50	0.50	2.00	0.53
C:13:0435	2	2	1	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00		#DIV/0!	0.00
C:13:0517	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.81	1.64		1.00	2.97
C:13:0674	0	0	1	0	0	0	0.00	0.00	0.00	0.00	0.85	4.00	0.45	0.00	3.40
C:13:0678a	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.50	0.50		3.00	0.75
C:13:0678b	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.50	0.50		3.00	0.75
C:13:0678c	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.50	0.50		3.00	0.75
C:13:0678d	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.50	0.50		3.00	0.75
C:13:0678e	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.50	0.50		3.00	0.75
C:13:0678f	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.50	0.50		3.00	0.75
C:13:0678g	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.50	0.50		3.00	0.75
C:13:0702a	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.20	1.00	1.00	1.00	1.20
C:13:0702b	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.20	1.00	1.00	1.00	1.20
C:13:0702c	0	0	1	0	0	0	0.00	0.00	0.00	0.00	2.00	1.00	1.00	2.00	2.00

Site Number	Structures	Masonry_Rms	Enclosures	MCD	MCD_Plain	MCD_Deco	Kayenta pct	Cohonina pct	Virgin pct	Patayan pct	Length (m)	Width (m)	Height (m)	Length to Width Ratio	Area (sq m)
C:13:0707a	0	0	1	0	0	0	0.00	0.00	0.00	0.00	2.10	0.90	0.60	2.00	1.89
C:13:0707b	0	0	1	0	0	0	0.00	0.00	0.00	0.00	2.10	0.90	0.60	2.00	1.89
C:13:0740	0	0	1	0	0	1125	0.00	0.00	0.00	0.00	1.22	0.82	0.67	1.00	1.00
C:13:0771	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.10	1.00	0.40	1.00	1.10
G:03:0051a	1	0	1	0	0	0	0.00	0.00	0.00	0.00	1.00	0.50		2.00	0.50
G:03:0051b	1	0	1	0	0	0	0.00	0.00	0.00	0.00	1.00	0.50		2.00	0.50
H:04:0083	1	1	1	0	975	0	0.00	1.00	0.00	0.00	0.50	0.50		1.00	0.25
I:01:0012	0	0	1	0	0	0	0.00	0.00	0.00	0.00	1.70	1.40	1.20	1.00	2.38
I:01:0013a	0	0	1	0	0	0	0.00	0.00	0.00	0.00	2.60	1.30	1.20	2.00	3.38
I:01:0013b	0	0	1	0	0	0	0.00	0.00	0.00	0.00	2.30	1.10	1.20	2.00	2.53
I:01:0013c	0	0	1	0	0	0	0.00	0.00	0.00	0.00	3.00	1.40	1.30	2.00	4.20
I:01:0122a	0	0	1	0	0	0	0.00	0.00	0.00	0.00	2.60	1.90	0.70	1.00	4.94
I:01:0122b	0	0	1	0	0	0	0.00	0.00	0.00	0.00	2.60	1.90	0.70	1.00	4.94

Site Number	Volume (cubic m)	Open(0)/ Sheltered (1)	Access: Side(1) Top (2) unknown (0)	Shape rectangular(1), circular(2), D-shaped(3), unknown(4)	Shaped (1) Unshaped (2) Unknown (0)	Unknown (0), Masonry (1), Uprights (2), Uprights and Masonry (3)	Construction Material Unspecified (0) Limestone (1) Sandstone (2) Basalt (3) Quartzite (4) Shale (5) Igneous (6)	Granary (Yes:1, No:0)	Storage Room (Yes:1, No:0)	Storage Cist (Yes:1, No:0)	Lintel (Yes:1, No:0)
B:09:0200	1.50	1	0	3	0	1	0	1	0	0	0
B:09:0315	1.28	1	0	3	1	1	1	1	0	0	0
B:10:0001a	8.00	1	1	3	2	3	2	1	0	0	0
B:10:0001b	8.00	1	1	3	2	3	2	1	0	0	0
B:10:0001c	1.00	1	1	3	2	3	2	1	0	0	0
B:10:0001d	1.00	1	1	3	2	3	2	1	0	0	0
B:10:0001e	1.00	1	1	3	2	3	2	1	0	0	0
B:10:0001f	1.00	1	1	3	2	3	2	1	0	0	0
B:10:0001g	7.36	1	1	3	2	3	2	1	0	0	0
B:10:0016	2.00	1	0	3	2	1	2	1	0	0	1
B:10:0038a	0.36	1	1	3	2	1	2	1	0	0	1
B:10:0038b	0.88	1	1	3	2	1	2	1	0	0	1
B:10:0038c	1.04	1	1	3	2	1	2	1	0	0	1
B:10:0038d	1.30	1	1	3	2	1	2	1	0	0	1
B:10:0076a	2.00	1	1	1	2	1	2	1	0	0	0
B:10:0076b	2.00	1	1	1	2	1	2	1	0	0	0
B:10:0083	0.36	1	2	1	2	3	2	1	0	1	0
B:10:0118	1.50	1	1	1	2	1	2	1	0	0	1

Site Number	Volume (cubic m)	Open(0)/ Sheltered (1)	Access: Side(1) Top (2) unknown (0)	Shape rectangular(1), circular(2), D-shaped(3), unknown(4)	Shaped (1) Unshaped (2) Unknown (0)	Unknown (0), Masonry (1), Uprights (2), Uprights and Masonry (3)	Construction Material Unspecified (0) Limestone (1) Sandstone (2) Basalt (3) Quartzite (4) Shale (5) Igneous (6)	Granary (Yes:1, No:0)	Storage Room (Yes:1, No:0)	Storage Cist (Yes:1, No:0)	Lintel (Yes:1, No:0)
B:10:0124A	1.85	1	0	3	2	1	2	1	0	0	0
B:10:0132	1.52	1	0	1	2	3	2	1	0	0	0
B:10:0133a	0.55	1	0	3	2	3	2	1	0	0	0
B:10:0133b	2.25	1	0	3	2	3	2	1	0	0	0
B:10:0133c	0.55	1	0	3	2	3	2	1	0	0	0
B:10:0134	2.00	1	0	1	2	1	2	1	0	0	0
B:10:0257a	0.19	1	1	3	2	1	2	1	0	0	0
B:10:0257b	0.19	1	1	3	2	1	2	1	0	0	0
B:11:0010a	0.00	1	1	3	2	1	2	1	0	0	0
B:11:0010b	0.00	1	1	3	2	1	2	1	0	0	0
B:11:0010c	0.00	1	1	3	2	1	2	1	0	0	0
B:11:0014a	4.00	1	0	1	2	1	2	1	0	0	0
B:11:0014b	4.00	1	0	1	2	1	2	1	0	0	0
B:11:0014c	4.00	1	0	1	2	1	2	1	0	0	0
B:11:0016	0.75	1	0	3	2	1	2	1	0	0	0
B:11:0019a	0.50	1	0	3	2	1	2	1	1	0	0
B:11:0019b	1.50	1	0	3	2	1	2	1	1	0	0
B:11:0019c	0.64	1	0	3	2	1	2	1	1	0	0

Site Number	Volume (cubic m)	Open(0)/ Sheltered (1)	Access: Side(1) Top (2) unknown (0)	Shape rectangular(1), circular(2), D-shaped(3), unknown(4)	Shaped (1) Unshaped (2) Unknown (0)	Unknown (0), Masonry (1), Uprights (2), Uprights and Masonry (3)	Construction Material Unspecified (0) Limestone (1) Sandstone (2) Basalt (3) Quartzite (4) Shale (5) Igneous (6)	Granary (Yes:1, No:0)	Storage Room (Yes:1, No:0)	Storage Cist (Yes:1, No:0)	Lintel (Yes:1, No:0)
B:11:0019d	0.30	1	0	3	2	1	2	1	1	0	0
B:11:0024	2.00	1	0	1	2	1	2	1	0	0	0
B:11:0036a	0.89	1	0	3	2	1	2	1	0	0	0
B:11:0036b	0.89	1	0	3	2	1	2	1	0	0	0
B:11:0040a	0.30	1	0	3	2	3	2	1	0	0	0
B:11:0040b	0.30	1	0	3	2	3	2	1	0	0	0
B:11:0043a	4.00	1	0	3	2	1	2	1	1	0	0
B:11:0043b	1.00	1	0	3	2	1	2	1	1	0	0
B:11:0043c	4.00	1	0	3	2	1	2	1	1	0	0
B:11:0061a	2.00	1	1	3	2	1	2	1	0	0	1
B:11:0061b	2.00	1	1	3	2	1	2	1	0	0	1
B:11:0061c	2.00	1	1	3	2	1	2	1	0	0	1
B:11:0061d	2.00	1	1	3	2	1	2	1	0	0	1
B:11:0061e	2.00	1	1	3	2	1	2	1	0	0	1
B:11:0061f	2.00	1	1	3	2	1	2	1	0	0	1
B:11:0062a	2.00	1	1	3	2	1	2	1	0	0	0
B:11:0062b	0.50	1	1	3	2	1	2	1	0	0	0
B:11:0062c	0.50	1	1	3	2	1	2	1	0	0	0

Site Number	Volume (cubic m)	Open(0)/ Sheltered (1)	Access: Side(1) Top (2) unknown (0)	Shape rectangular(1), circular(2), D-shaped(3), unknown(4)	Shaped (1) Unshaped (2) Unknown (0)	Unknown (0), Masonry (1), Uprights (2), Uprights and Masonry (3)	Construction Material Unspecified (0) Limestone (1) Sandstone (2) Basalt (3) Quartzite (4) Shale (5) Igneous (6)	Granary (Yes:1, No:0)	Storage Room (Yes:1, No:0)	Storage Cist (Yes:1, No:0)	Lintel (Yes:1, No:0)
B:11:0062d	0.03	1	1	3	2	1	2	1	0	0	0
B:11:0062e	0.03	1	1	3	2	1	2	1	0	0	0
B:11:0207a	2.53	1	1	3	2	1	1	1	0	0	0
B:11:0207b	5.38	1	1	3	2	1	1	1	0	0	0
B:11:0207c	7.96	1	1	3	2	1	1	1	0	0	0
B:11:0207d	15.12	1	1	3	2	1	1	1	0	0	0
B:11:0207e	2.15	1	1	3	2	1	1	1	0	0	0
B:11:0207f	1.38	1	1	3	2	1	1	1	0	0	0
B:11:0207g	2.07	1	1	3	2	1	1	1	0	0	0
B:11:0207h	2.18	1	1	3	2	1	1	1	0	0	0
B:11:0211	2.25	1	0	3	2	1	2	1	0	0	0
B:11:0232a	0.00	1	0	3	2	1	4	1	0	0	0
B:11:0232b	0.00	1	0	3	2	1	4	1	0	0	0
B:11:0232c	0.00	1	0	3	2	1	4	1	0	0	0
B:11:0232d	0.00	1	0	3	2	1	4	1	0	0	0
B:11:0232e	0.00	1	0	3	2	1	4	1	0	0	0
B:11:0279	0.36	1	0	3	2	1	6	1	0	0	0
B:11:0372	0.51	1	1	3	2	1	4	1	0	0	1

Site Number	Volume (cubic m)	Open(0)/ Sheltered (1)	Access: Side(1) Top (2) unknown (0)	Shape rectangular(1), circular(2), D-shaped(3), unknown(4)	Shaped (1) Unshaped (2) Unknown (0)	Unknown (0), Masonry (1), Uprights (2), Uprights and Masonry (3)	Construction Material Unspecified (0) Limestone (1) Sandstone (2) Basalt (3) Quartzite (4) Shale (5) Igneous (6)	Granary (Yes:1, No:0)	Storage Room (Yes:1, No:0)	Storage Cist (Yes:1, No:0)	Lintel (Yes:1, No:0)
B:11:0375a	0.12	1	1	3	2	1	5	1	0	0	1
B:11:0375b	0.05	1	1	3	2	1	5	1	0	0	1
B:11:0375c	0.12	1	1	3	2	1	5	1	0	0	1
B:11:0375d	0.12	1	1	3	2	1	5	1	0	0	1
B:11:0375e	0.08	1	1	3	2	1	5	1	0	0	1
B:11:0386a	0.15	1	1	3	2	3	1	1	0	0	0
B:11:0386b	2.25	1	1	3	2	3	1	1	0	0	0
B:11:0386c	0.09	1	1	3	2	3	1	1	0	0	0
B:11:0386d	0.15	1	1	3	2	3	1	1	0	0	0
B:11:0386e	0.15	1	1	3	2	3	1	1	0	0	0
B:11:0386f	0.15	1	1	3	2	3	1	1	0	0	0
B:11:0404	6.25	1	0	3	2	1	0	1	1	0	0
B:11:0414a	1.00	1	0	3	2	1	1	1	0	0	0
B:11:0414b	1.00	1	0	3	2	1	1	1	0	0	0
B:11:0414c	1.00	1	0	3	2	1	1	1	0	0	0
B:11:0414d	1.00	1	0	3	2	1	1	1	0	0	0
B:11:0414e	1.00	1	0	3	2	1	1	1	0	0	0
B:14:0038	0.26	1	1	3	2	1	1	1	0	0	0

Site Number	Volume (cubic m)	Open(0)/ Sheltered (1)	Access: Side(1) Top (2) unknown (0)	Shape rectangular(1), circular(2), D-shaped(3), unknown(4)	Shaped (1) Unshaped (2) Unknown (0)	Unknown (0), Masonry (1), Uprights (2), Uprights and Masonry (3)	Construction Material Unspecified (0) Limestone (1) Sandstone (2) Basalt (3) Quartzite (4) Shale (5) Igneous (6)	Granary (Yes:1, No:0)	Storage Room (Yes:1, No:0)	Storage Cist (Yes:1, No:0)	Lintel (Yes:1, No:0)
B:15:0019a	3.90	1	1	3	2	1	1	1	0	0	0
B:15:0019b	3.90	1	1	3	2	1	1	1	0	0	0
B:15:0019c	3.90	1	1	3	2	1	1	1	0	0	0
B:15:0045	0.00	1	1	3	2	1	2	1	0	0	0
B:15:0046	0.00	1	1	3	2	1	2	1	0	0	0
B:15:0050a	3.06	0	0	3	2	1	4	1	1	0	0
B:15:0050b	3.06	0	0	3	2	1	4	1	1	0	0
B:15:0050c	3.06	0	0	3	2	1	4	1	1	0	0
B:15:0050d	3.06	0	0	3	2	1	4	1	1	0	0
B:15:0063a	0.96	1	1	3	2	1	2	1	0	0	1
B:15:0063b	0.96	1	1	3	2	1	2	1	0	0	1
B:15:0072a	0.00	1	1	3	2	1	2	1	0	0	0
B:15:0072b	0.00	1	1	3	2	1	2	1	0	0	0
B:15:0073	0.50	1	1	3	2	1	2	1	0	0	0
B:15:0076a	2.28	1	1	3	2	1	2	1	0	0	0
B:15:0076b	3.60	1	1	3	2	1	2	1	0	0	0
B:15:0091a	0.03	1	1	3	2	1	1	1	0	0	0
B:15:0091b	1.00	1	1	3	2	1	1	1	0	0	0

Site Number	Volume (cubic m)	Open(0)/ Sheltered (1)	Access: Side(1) Top (2) unknown (0)	Shape rectangular(1), circular(2), D-shaped(3), unknown(4)	Shaped (1) Unshaped (2) Unknown (0)	Unknown (0), Masonry (1), Uprights (2), Uprights and Masonry (3)	Construction Material Unspecified (0) Limestone (1) Sandstone (2) Basalt (3) Quartzite (4) Shale (5) Igneous (6)	Granary (Yes:1, No:0)	Storage Room (Yes:1, No:0)	Storage Cist (Yes:1, No:0)	Lintel (Yes:1, No:0)
B:15:0091c	1.00	1	1	3	2	1	1	1	0	0	0
B:15:0091d	0.64	1	1	3	2	1	1	1	0	0	0
B:15:0091e	0.64	1	1	3	2	1	1	1	0	0	0
B:15:0094a	0.80	1	1	3	2	1	2	1	0	0	1
B:15:0094b	0.80	1	1	3	2	1	2	1	0	0	1
B:15:0094c	3.75	1	1	3	2	1	2	1	0	0	1
B:15:0094d	6.00	1	1	3	2	1	2	1	0	0	1
B:15:0095a	0.95	1	1	3	2	1	2	1	0	0	0
B:15:0095b	0.95	1	1	3	2	1	2	1	0	0	0
B:15:0095c	1.54	1	1	3	2	1	2	1	0	0	0
B:15:0108a	0.80	1	1	3	2	1	4	1	0	0	0
B:15:0108b	0.80	1	1	3	2	1	4	1	0	0	0
B:15:0108c	0.80	1	1	3	2	1	4	1	0	0	0
B:15:0108d	0.80	1	1	3	2	1	4	1	0	0	0
B:15:0109	0.81	1	0	3	2	1	0	1	0	0	0
B:15:0110a	2.00	1	1	3	2	1	2	1	0	0	0
B:15:0110b	2.00	1	1	3	2	1	2	1	0	0	0
B:15:0110c	2.00	1	1	3	2	1	2	1	0	0	0

Site Number	Volume (cubic m)	Open(0)/ Sheltered (1)	Access: Side(1) Top (2) unknown (0)	Shape rectangular(1), circular(2), D-shaped(3), unknown(4)	Shaped (1) Unshaped (2) Unknown (0)	Unknown (0), Masonry (1), Uprights (2), Uprights and Masonry (3)	Construction Material Unspecified (0) Limestone (1) Sandstone (2) Basalt (3) Quartzite (4) Shale (5) Igneous (6)	Granary (Yes:1, No:0)	Storage Room (Yes:1, No:0)	Storage Cist (Yes:1, No:0)	Lintel (Yes:1, No:0)
B:15:0112a	0.21	1	1	3	2	3	4	1	0	0	0
B:15:0112b	0.25	1	1	3	2	3	4	1	0	0	0
B:15:0113a	0.00	1	1	3	2	1	2	1	0	0	1
B:15:0113b	0.00	1	1	3	2	1	2	1	0	0	1
B:15:0113c	0.00	1	1	3	2	1	2	1	0	0	1
B:15:0113d	0.00	1	1	3	2	1	2	1	0	0	1
B:15:0113e	0.00	1	1	3	2	1	2	1	0	0	1
B:15:0115	2.00	1	0	3	2	3	2	1	0	0	0
B:15:0126a	0.20	1	1	3	2	1	2	1	0	0	0
B:15:0126b	0.20	1	1	3	2	1	2	1	0	0	0
B:15:0126c	0.20	1	1	3	2	1	2	1	0	0	0
B:15:0126d	0.20	1	1	3	2	1	2	1	0	0	0
B:15:0127	0.25	1	0	3	2	1	2	1	0	0	0
B:15:0129a	0.48	1	1	3	2	1	1	1	0	0	0
B:15:0129b	0.38	1	1	3	2	1	1	1	0	0	0
B:15:0129c	0.38	1	1	3	2	1	1	1	0	0	0
B:15:0129d	0.36	1	1	3	2	1	1	1	0	0	0
B:15:0170	0.00	1	1	3	2	1	2	1	0	0	0

Site Number	Volume (cubic m)	Open(0)/ Sheltered (1)	Access: Side(1) Top (2) unknown (0)	Shape rectangular(1), circular(2), D-shaped(3), unknown(4)	Shaped (1) Unshaped (2) Unknown (0)	Unknown (0), Masonry (1), Uprights (2), Uprights and Masonry (3)	Construction Material Unspecified (0) Limestone (1) Sandstone (2) Basalt (3) Quartzite (4) Shale (5) Igneous (6)	Granary (Yes:1, No:0)	Storage Room (Yes:1, No:0)	Storage Cist (Yes:1, No:0)	Lintel (Yes:1, No:0)
B:15:0183a	1.50	1	0	3	2	1	2	1	0	0	0
B:15:0183b	1.50	1	0	3	2	1	2	1	0	0	0
B:15:0194	4.00	1	0	3	0	1	0	1	0	0	0
B:15:0218a	0.02	1	1	3	2	1	2	1	0	0	0
B:15:0218b	0.05	1	1	3	2	1	2	1	0	0	0
B:15:0220	1.00	1	0	1	2	3	2	1	0	1	0
B:16:0002	4.00	1	1	3	2	1	0	1	0	0	1
B:16:0003	4.00	1	1	3	2	1	2	1	0	0	0
B:16:0004a	2.00	1	1	3	2	1	2	1	0	0	0
B:16:0004b	2.00	1	1	3	2	1	2	1	0	0	0
B:16:0004c	2.00	1	1	3	2	1	2	1	0	0	0
B:16:0009a	1.50	1	1	3	2	1	2	1	0	1	1
B:16:0009b	1.50	1	1	3	2	1	2	1	0	1	1
B:16:0009c	1.50	1	1	3	2	1	2	1	0	1	1
B:16:0009d	1.50	1	1	3	2	1	2	1	0	1	1
B:16:0009e	1.50	1	1	3	2	1	2	1	0	1	1
B:16:0009f	1.50	1	1	3	2	1	2	1	0	1	1
B:16:0009g	1.50	1	1	3	2	1	2	1	0	1	1

Site Number	Volume (cubic m)	Open(0)/ Sheltered (1)	Access: Side(1) Top (2) unknown (0)	Shape rectangular(1), circular(2), D-shaped(3), unknown(4)	Shaped (1) Unshaped (2) Unknown (0)	Unknown (0), Masonry (1), Uprights (2), Uprights and Masonry (3)	Construction Material Unspecified (0) Limestone (1) Sandstone (2) Basalt (3) Quartzite (4) Shale (5) Igneous (6)	Granary (Yes:1, No:0)	Storage Room (Yes:1, No:0)	Storage Cist (Yes:1, No:0)	Lintel (Yes:1, No:0)
B:16:0009h	1.50	1	1	3	2	1	2	1	0	1	1
B:16:0009i	1.50	1	1	3	2	1	2	1	0	1	1
B:16:0009j	1.50	1	1	3	2	1	2	1	0	1	1
B:16:0009k	1.50	1	1	3	2	1	2	1	0	1	1
B:16:0009l	1.50	1	1	3	2	1	2	1	0	1	1
B:16:0014a	2.00	1	1	3	2	1	2	1	0	0	0
B:16:0014b	2.00	1	1	3	2	1	2	1	0	0	0
B:16:0014c	2.00	1	1	3	2	1	2	1	0	0	0
B:16:0014d	0.15	1	1	3	2	1	2	1	0	0	0
B:16:0014e	4.00	1	1	3	2	1	2	1	0	0	0
B:16:0014f	2.00	1	1	3	2	1	2	1	0	0	0
B:16:0014g	2.00	1	1	3	2	1	2	1	0	0	0
B:16:0014h	2.00	1	1	3	2	1	2	1	0	0	0
B:16:0015a	0.45	4	1	3	2	1	2	1	0	0	0
B:16:0015b	3.47	4	1	3	2	1	2	1	0	0	0
B:16:0015c	0.32	4	1	3	2	1	2	1	0	0	0
B:16:0015d	0.34	4	1	3	2	1	2	1	0	0	0
B:16:0015e	0.33	4	1	3	2	1	2	1	0	0	0

Site Number	Volume (cubic m)	Open(0)/ Sheltered (1)	Access: Side(1) Top (2) unknown (0)	Shape rectangular(1), circular(2), D-shaped(3), unknown(4)	Shaped (1) Unshaped (2) Unknown (0)	Unknown (0), Masonry (1), Uprights (2), Uprights and Masonry (3)	Construction Material Unspecified (0) Limestone (1) Sandstone (2) Basalt (3) Quartzite (4) Shale (5) Igneous (6)	Granary (Yes:1, No:0)	Storage Room (Yes:1, No:0)	Storage Cist (Yes:1, No:0)	Lintel (Yes:1, No:0)
B:16:0015f	0.39	4	1	3	2	1	2	1	0	0	0
B:16:0015g	0.27	4	1	3	2	1	2	1	0	0	0
B:16:0015h	0.29	4	1	3	2	1	2	1	0	0	0
B:16:0015i	0.38	4	1	3	2	1	2	1	0	0	0
B:16:0015j	0.76	4	1	3	2	1	2	1	0	0	0
B:16:0015k	0.77	4	1	3	2	1	2	1	0	0	0
B:16:0015l	0.32	4	1	3	2	1	2	1	0	0	0
B:16:0015m	0.32	4	1	3	2	1	2	1	0	0	0
B:16:0015n	0.32	4	1	3	2	1	2	1	0	0	0
B:16:0015o	0.32	4	1	3	2	1	2	1	0	0	0
B:16:0021	0.56	1	0	1	2	1	2	1	0	0	0
B:16:0022	0.50	1	1	3	2	1	2	1	0	0	0
B:16:0025a	0.00	1	1	3	2	1	2	1	0	0	0
B:16:0025b	0.00	1	1	3	2	1	2	1	0	0	0
B:16:0025c	0.00	1	1	3	2	1	2	1	0	0	0
B:16:0025d	0.00	1	1	3	2	1	2	1	0	0	0
B:16:0026	4.00	1	0	1	2	1	2	1	0	0	0
B:16:0027a	0.00	1	0	3	0	1	2	1	0	0	0

Site Number	Volume (cubic m)	Open(0)/ Sheltered (1)	Access: Side(1) Top (2) unknown (0)	Shape rectangular(1), circular(2), D-shaped(3), unknown(4)	Shaped (1) Unshaped (2) Unknown (0)	Unknown (0), Masonry (1), Uprights (2), Uprights and Masonry (3)	Construction Material Unspecified (0) Limestone (1) Sandstone (2) Basalt (3) Quartzite (4) Shale (5) Igneous (6)	Granary (Yes:1, No:0)	Storage Room (Yes:1, No:0)	Storage Cist (Yes:1, No:0)	Lintel (Yes:1, No:0)
B:16:0027b	0.00	1	0	3	0	1	2	1	0	0	0
B:16:0027c	0.00	1	0	3	0	1	2	1	0	0	0
B:16:0030a	1.00	1	1	3	2	1	2	1	0	0	0
B:16:0030b	1.00	1	1	3	2	1	2	1	0	0	0
B:16:0030c	1.00	1	1	3	2	1	2	1	0	0	0
B:16:0030d	1.00	1	1	3	2	1	2	1	0	0	0
B:16:0030e	1.00	1	1	3	2	1	2	1	0	0	0
B:16:0031a	1.00	1	1	3	2	1	2	1	0	0	0
B:16:0031b	1.00	1	1	3	2	1	2	1	0	0	0
B:16:0031c	1.00	1	1	3	2	1	2	1	0	0	0
B:16:0032a	0.75	1	0	3	2	1	2	1	0	0	1
B:16:0032b	0.75	1	0	3	2	1	2	1	0	0	1
B:16:0032c	0.75	1	0	3	2	1	2	1	0	0	1
B:16:0032d	0.75	1	0	3	2	1	2	1	0	0	1
B:16:0032e	0.75	1	0	3	2	1	2	1	0	0	1
B:16:0032f	0.75	1	0	3	2	1	2	1	0	0	1
B:16:0032g	0.75	1	0	3	2	1	2	1	0	0	1
B:16:0032h	0.75	1	0	3	2	1	2	1	0	0	1

Site Number	Volume (cubic m)	Open(0)/ Sheltered (1)	Access: Side(1) Top (2) unknown (0)	Shape rectangular(1), circular(2), D-shaped(3), unknown(4)	Shaped (1) Unshaped (2) Unknown (0)	Unknown (0), Masonry (1), Uprights (2), Uprights and Masonry (3)	Construction Material Unspecified (0) Limestone (1) Sandstone (2) Basalt (3) Quartzite (4) Shale (5) Igneous (6)	Granary (Yes:1, No:0)	Storage Room (Yes:1, No:0)	Storage Cist (Yes:1, No:0)	Lintel (Yes:1, No:0)
B:16:0036a	3.50	1	1	3	2	1	1	1	0	0	0
B:16:0036b	3.50	1	1	3	2	1	1	1	0	0	0
B:16:0051	0.00	1	0	3	2	1	1	1	0	0	0
B:16:0059a	3.60	1	1	3	2	1	2	1	0	0	1
B:16:0059b	2.00	1	1	3	2	1	2	1	0	0	1
B:16:0065a	0.00	1	1	3	2	1	2	1	0	0	1
B:16:0065b	0.00	1	1	3	2	1	2	1	0	0	1
B:16:0065c	0.00	1	1	3	2	1	2	1	0	0	1
B:16:0065d	0.00	1	1	3	2	1	2	1	0	0	1
B:16:0066a	2.25	1	1	3	2	1	0	1	0	0	1
B:16:0066b	2.00	1	1	3	2	1	0	1	0	0	1
B:16:0066c	2.25	1	1	3	2	1	0	1	0	0	1
B:16:0066d	0.19	1	1	3	2	1	0	1	0	0	1
B:16:0066e	0.19	1	1	3	2	1	0	1	0	0	1
B:16:0066f	0.19	1	1	3	2	1	0	1	0	0	1
B:16:0066g	0.19	1	1	3	2	1	0	1	0	0	1
B:16:0066h	0.19	1	1	3	2	1	0	1	0	0	1
B:16:0066i	0.19	1	1	3	2	1	0	1	0	0	1

Site Number	Volume (cubic m)	Open(0)/ Sheltered (1)	Access: Side(1) Top (2) unknown (0)	Shape rectangular(1), circular(2), D-shaped(3), unknown(4)	Shaped (1) Unshaped (2) Unknown (0)	Unknown (0), Masonry (1), Uprights (2), Uprights and Masonry (3)	Construction Material Unspecified (0) Limestone (1) Sandstone (2) Basalt (3) Quartzite (4) Shale (5) Igneous (6)	Granary (Yes:1, No:0)	Storage Room (Yes:1, No:0)	Storage Cist (Yes:1, No:0)	Lintel (Yes:1, No:0)
B:16:0066j	0.19	1	1	3	2	1	0	1	0	0	1
B:16:0066k	0.19	1	1	3	2	1	0	1	0	0	1
B:16:0066l	0.19	1	1	3	2	1	0	1	0	0	1
B:16:0086	0.24	1	1	3	2	1	4	1	0	0	0
B:16:0091a	2.25	1	1	3	2	1	2	1	0	0	0
B:16:0091b	2.25	1	1	3	2	1	2	1	0	0	0
B:16:0091c	2.25	1	1	3	2	1	2	1	0	0	0
B:16:0091d	2.25	1	1	3	2	1	2	1	0	0	0
B:16:0091e	4.00	1	1	3	2	1	2	1	0	0	0
B:16:0091f	2.25	1	1	3	2	1	2	1	0	0	0
B:16:0091g	2.25	1	1	3	2	1	2	1	0	0	0
B:16:0091h	2.25	1	1	3	2	1	2	1	0	0	0
B:16:0091i	2.25	1	1	3	2	1	2	1	0	0	0
B:16:0154a	2.00	1	1	3	2	1	2	1	0	0	0
B:16:0154b	2.00	1	1	3	2	1	2	1	0	0	0
B:16:0163a	1.52	1	1	3	2	1	2	1	0	0	0
B:16:0163b	0.78	1	1	3	2	1	2	1	0	0	0
B:16:0219a	4.00	1	1	3	2	1	2	1	0	0	0

Site Number	Volume (cubic m)	Open(0)/ Sheltered (1)	Access: Side(1) Top (2) unknown (0)	Shape rectangular(1), circular(2), D-shaped(3), unknown(4)	Shaped (1) Unshaped (2) Unknown (0)	Unknown (0), Masonry (1), Uprights (2), Uprights and Masonry (3)	Construction Material Unspecified (0) Limestone (1) Sandstone (2) Basalt (3) Quartzite (4) Shale (5) Igneous (6)	Granary (Yes:1, No:0)	Storage Room (Yes:1, No:0)	Storage Cist (Yes:1, No:0)	Lintel (Yes:1, No:0)
B:16:0219b	2.00	1	1	3	2	1	2	1	0	0	0
B:16:0219c	2.00	1	1	3	2	1	2	1	0	0	0
B:16:0226a	0.10	1	1	3	2	1	2	1	0	0	0
B:16:0226b	0.07	1	1	3	2	1	2	1	0	0	0
B:16:0226c	0.49	1	1	3	2	1	2	1	0	0	0
B:16:0264	3.00	1	1	3	2	1	1	1	0	0	0
B:16:0293a	7.50	1	1	3	2	3	0	1	0	0	0
B:16:0293b	7.50	1	1	3	2	3	0	1	0	0	0
B:16:0293c	7.50	1	1	3	2	3	0	1	0	0	0
B:16:0293d	1.00	1	1	3	2	3	0	1	0	0	0
B:16:0293e	1.00	1	1	3	2	3	0	1	0	0	0
B:16:0293f	4.00	1	1	3	2	3	0	1	0	0	0
B:16:0293g	4.00	1	1	3	2	3	0	1	0	0	0
B:16:0293h	4.00	1	1	3	2	3	0	1	0	0	0
B:16:0293i	4.00	1	1	3	2	3	0	1	0	0	0
B:16:0293j	4.00	1	1	3	2	3	0	1	0	0	0
B:16:0293k	4.00	1	1	3	2	3	0	1	0	0	0
B:16:0293l	4.00	1	1	3	2	3	0	1	0	0	0

Site Number	Volume (cubic m)	Open(0)/ Sheltered (1)	Access: Side(1) Top (2) unknown (0)	Shape rectangular(1), circular(2), D-shaped(3), unknown(4)	Shaped (1) Unshaped (2) Unknown (0)	Unknown (0), Masonry (1), Uprights (2), Uprights and Masonry (3)	Construction Material Unspecified (0) Limestone (1) Sandstone (2) Basalt (3) Quartzite (4) Shale (5) Igneous (6)	Granary (Yes:1, No:0)	Storage Room (Yes:1, No:0)	Storage Cist (Yes:1, No:0)	Lintel (Yes:1, No:0)
B:16:0363	0.00	1	1	1,3	2	1	2	1	0	0	0
B:16:0388a	1.00	1	1	3	2	1	1	1	0	0	0
B:16:0388b	1.00	1	1	3	2	1	1	1	0	0	0
B:16:0412a	0.25	1	1	3	2	1	4	1	0	0	1
B:16:0412b	0.25	1	1	3	2	1	4	1	0	0	1
B:16:0493	3.00	1	1	3	2	1	0	1	0	0	0
B:16:0512a	0.97	1	1	3	2	3	2	1	0	0	1
B:16:0512b	1.54	1	1	3	2	3	2	1	0	0	1
B:16:0801a	0.63	1	1	3	2	3	1	1	0	0	0
B:16:0801b	0.80	1	1	3	2	3	1	1	0	0	0
B:16:0823	1.59	1	1	3	2	3	1	1	0	0	0
B:16:0887a	2.25	1	1	2	2	1	1	1	0	0	0
B:16:0887b	2.25	1	1	2	2	1	1	1	0	0	0
B:16:0887c	2.25	1	1	2	2	1	1	1	0	0	0
B:16:0887d	2.25	1	1	2	2	1	1	1	0	0	0
B:16:1042a	0.00	1	1	3	2	1	1	1	0	0	1
B:16:1042b	0.00	1	1	3	2	1	1	1	0	0	1
B:16:1042c	0.00	1	1	3	2	1	1	1	0	0	1

Site Number	Volume (cubic m)	Open(0)/ Sheltered (1)	Access: Side(1) Top (2) unknown (0)	Shape rectangular(1), circular(2), D-shaped(3), unknown(4)	Shaped (1) Unshaped (2) Unknown (0)	Unknown (0), Masonry (1), Uprights (2), Uprights and Masonry (3)	Construction Material Unspecified (0) Limestone (1) Sandstone (2) Basalt (3) Quartzite (4) Shale (5) Igneous (6)	Granary (Yes:1, No:0)	Storage Room (Yes:1, No:0)	Storage Cist (Yes:1, No:0)	Lintel (Yes:1, No:0)
B:16:1198a	4.62	1	0	3	2	1	1	1	0	0	0
B:16:1198b	3.60	1	0	3	2	1	1	1	0	0	0
C:02:0033a	2.20	1	0	3	2	1	1	1	0	0	0
C:02:0033b	0.04	1	0	3	2	1	1	1	0	0	0
C:05:0001	4.16	1	1	3	2	1	1	1	0	0	0
C:09:0001a	0.00	1	1	3	2	1	1	1	0	0	0
C:09:0001Aa	0.51	1	1	3	2	1	1	1	0	0	1
C:09:0001Ab	1.70	1	1	3	2	1	1	1	0	0	1
C:09:0001Ac	1.45	1	1	3	2	1	1	1	0	0	1
C:09:0001Ad	1.53	1	1	3	2	1	1	1	0	0	1
C:09:0001Ae	2.30	1	1	3	2	1	1	1	0	0	1
C:09:0001Af	2.26	1	1	3	2	1	1	1	0	0	1
C:09:0001Ag	0.56	1	1	3	2	1	1	1	0	0	1
C:09:0001Ah	1.20	1	1	3	2	1	1	1	0	0	1
C:09:0001Ai	0.60	1	1	3	2	1	1	1	0	0	1
C:09:0001b	0.00	1	1	3	2	1	1	1	0	0	0
C:09:0001Fa	2.72	1	1	3	2	1	1	1	0	0	0
C:09:0001Fb	2.72	1	1	3	2	1	1	1	0	0	0

Site Number	Volume (cubic m)	Open(0)/ Sheltered (1)	Access: Side(1) Top (2) unknown (0)	Shape rectangular(1), circular(2), D-shaped(3), unknown(4)	Shaped (1) Unshaped (2) Unknown (0)	Unknown (0), Masonry (1), Uprights (2), Uprights and Masonry (3)	Construction Material Unspecified (0) Limestone (1) Sandstone (2) Basalt (3) Quartzite (4) Shale (5) Igneous (6)	Granary (Yes:1, No:0)	Storage Room (Yes:1, No:0)	Storage Cist (Yes:1, No:0)	Lintel (Yes:1, No:0)
C:09:0004a	0.24	4	0	3	2	1	2	1	0	0	0
C:09:0004b	0.24	4	0	3	2	1	2	1	0	0	0
C:09:0032a	2.56	1	0	3	2	3	2	1	0	0	0
C:09:0032b	2.80	1	0	3	2	3	2	1	0	0	0
C:09:0035a	1.68	1	1	3	2	1	1	1	0	0	1
C:09:0035b	21.77	1	1	3	2	1	1	1	0	0	1
C:09:0036a	0.29	1	1	3	2	1	1	1	0	0	0
C:09:0036b	0.29	1	1	3	2	1	1	1	0	0	0
C:09:0036c	0.29	1	1	3	2	1	1	1	0	0	0
C:09:0037	4.72	1	0	3	2	1	0	1	0	0	0
C:09:0038	2.16	1	0	3	2	3	0	1	0	0	0
C:09:0060	1.00	1	0	3	2	1	1	1	0	0	0
C:09:0073	4.50	1	0	3	2	1	0	1	0	0	0
C:09:0077a	4.00	1	1	3	2	1	1	1	0	0	1
C:09:0077b	4.00	1	1	3	2	1	1	1	0	0	1
C:09:0080	4.00	1	0	3	2	1	5	1	0	0	0
C:09:0136a	1.00	1	1	3	2	1	2	1	0	0	0
C:09:0136b	1.00	1	1	3	2	1	2	1	0	0	0

Site Number	Volume (cubic m)	Open(0)/ Sheltered (1)	Access: Side(1) Top (2) unknown (0)	Shape rectangular(1), circular(2), D-shaped(3), unknown(4)	Shaped (1) Unshaped (2) Unknown (0)	Unknown (0), Masonry (1), Uprights (2), Uprights and Masonry (3)	Construction Material Unspecified (0) Limestone (1) Sandstone (2) Basalt (3) Quartzite (4) Shale (5) Igneous (6)	Granary (Yes:1, No:0)	Storage Room (Yes:1, No:0)	Storage Cist (Yes:1, No:0)	Lintel (Yes:1, No:0)
C:09:0136c	1.00	1	1	3	2	1	2	1	0	0	0
C:13:0011a	2.17	1	1	3	2	1	2	1	0	0	1
C:13:0011b	4.05	1	1	3	2	1	2	1	0	0	1
C:13:0011c	3.24	1	1	3	2	1	2	1	0	0	1
C:13:0017	1.15	1	1	3	2	1	2	1	0	0	0
C:13:0018	1.36	1	1	3	2	1	2	1	0	0	0
C:13:0019	0.00	1	0	3	2	1	0	1	0	0	0
C:13:0020a	0.00	1	1	3	2	1	0	1	0	0	0
C:13:0020b	0.00	1	1	3	2	1	0	1	0	0	0
C:13:0021	0.00	1	0	3	2	1	0	1	0	0	0
C:13:0022a	4.00	1	1	3	2	1	2	1	0	0	0
C:13:0022b	4.00	1	1	3	2	1	2	1	0	0	0
C:13:0040a	1.00	1	0	3	2	1	2	1	0	0	0
C:13:0040b	1.00	1	0	3	2	1	2	1	0	0	0
C:13:0041a	6.00	1	0	3	2	1	2	1	0	0	0
C:13:0041b	6.00	1	0	3	2	1	2	1	0	0	0
C:13:0042a	2.00	1	1	3	2	1	2	1	0	0	0
C:13:0042b	2.00	1	1	3	2	1	2	1	0	0	0

Site Number	Volume (cubic m)	Open(0)/ Sheltered (1)	Access: Side(1) Top (2) unknown (0)	Shape rectangular(1), circular(2), D-shaped(3), unknown(4)	Shaped (1) Unshaped (2) Unknown (0)	Unknown (0), Masonry (1), Uprights (2), Uprights and Masonry (3)	Construction Material Unspecified (0) Limestone (1) Sandstone (2) Basalt (3) Quartzite (4) Shale (5) Igneous (6)	Granary (Yes:1, No:0)	Storage Room (Yes:1, No:0)	Storage Cist (Yes:1, No:0)	Lintel (Yes:1, No:0)
C:13:0043	0.45	1	1	3	2	1	2	1	0	0	0
C:13:0044a	0.00	1	0	3	2	1	2	1	0	0	0
C:13:0044b	0.00	1	0	3	2	1	2	1	0	0	0
C:13:0044c	0.00	1	0	3	2	1	2	1	0	0	0
C:13:0044d	0.00	1	0	3	2	1	2	1	0	0	0
C:13:0044e	0.00	1	0	3	2	1	2	1	0	0	0
C:13:0044f	0.00	1	0	3	2	1	2	1	0	0	0
C:13:0044g	0.00	1	0	3	2	1	2	1	0	0	0
C:13:0044h	0.00	1	0	3	2	1	2	1	0	0	0
C:13:0044i	0.00	1	0	3	2	1	2	1	0	0	0
C:13:0044j	0.00	1	0	3	2	1	2	1	0	0	0
C:13:0044k	0.00	1	0	3	2	1	2	1	0	0	0
C:13:0044l	0.00	1	0	3	2	1	2	1	0	0	0
C:13:0044m	0.00	1	0	3	2	1	2	1	0	0	0
C:13:0044n	0.00	1	0	3	2	1	2	1	0	0	0
C:13:0044o	0.00	1	0	3	2	1	2	1	0	0	0
C:13:0044p	0.00	1	0	3	2	1	2	1	0	0	0
C:13:0044q	0.00	1	0	3	2	1	2	1	0	0	0

Site Number	Volume (cubic m)	Open(0)/ Sheltered (1)	Access: Side(1) Top (2) unknown (0)	Shape rectangular(1), circular(2), D-shaped(3), unknown(4)	Shaped (1) Unshaped (2) Unknown (0)	Unknown (0), Masonry (1), Uprights (2), Uprights and Masonry (3)	Construction Material Unspecified (0) Limestone (1) Sandstone (2) Basalt (3) Quartzite (4) Shale (5) Igneous (6)	Granary (Yes:1, No:0)	Storage Room (Yes:1, No:0)	Storage Cist (Yes:1, No:0)	Lintel (Yes:1, No:0)
C:13:0044r	0.00	1	0	3	2	1	2	1	0	0	0
C:13:0044s	0.00	1	0	3	2	1	2	1	0	0	0
C:13:0044t	0.00	1	0	3	2	1	2	1	0	0	0
C:13:0044u	0.00	1	0	3	2	1	2	1	0	0	0
C:13:0044v	0.00	1	0	3	2	1	2	1	0	0	0
C:13:0044w	0.00	1	0	3	2	1	2	1	0	0	0
C:13:0045a	2.00	1	0	3	2	1	2	1	0	0	0
C:13:0045b	2.00	1	0	3	2	1	2	1	0	0	0
C:13:0045c	2.00	1	0	3	2	1	2	1	0	0	0
C:13:0046a	1.00	1	0	3	2	1	2	1	1	0	0
C:13:0046b	1.00	1	0	3	2	1	2	1	1	0	0
C:13:0046c	1.00	1	0	3	2	1	2	1	1	0	0
C:13:0049a	1.75	1	0	3	2	1	1	1	0	0	0
C:13:0049b	1.75	1	0	3	2	1	1	1	0	0	0
C:13:0054	0.50	1	1	3	2	1	2	1	0	0	0
C:13:0060	2.00	1	0	3	2	1	2	1	0	0	0
C:13:0091	0.38	1	1	3	2	1	2	1	0	0	0
C:13:0093a	2.63	1	0	2	2	1	1	1	0	0	0

Site Number	Volume (cubic m)	Open(0)/ Sheltered (1)	Access: Side(1) Top (2) unknown (0)	Shape rectangular(1), circular(2), D-shaped(3), unknown(4)	Shaped (1) Unshaped (2) Unknown (0)	Unknown (0), Masonry (1), Uprights (2), Uprights and Masonry (3)	Construction Material Unspecified (0) Limestone (1) Sandstone (2) Basalt (3) Quartzite (4) Shale (5) Igneous (6)	Granary (Yes:1, No:0)	Storage Room (Yes:1, No:0)	Storage Cist (Yes:1, No:0)	Lintel (Yes:1, No:0)
C:13:0093b	0.20	1	0	2	2	1	1	1	0	0	0
C:13:0093c	3.06	1	0	2	2	1	1	1	0	0	0
C:13:0093d	1.00	1	0	2	2	1	1	1	0	0	0
C:13:0147	1.00	1	0	3	2	1	0	1	0	0	0
C:13:0148	1.82	1	1	3	2	1	1	1	0	0	0
C:13:0353	0.50	1	1	3	2	1	2	1	0	0	0
C:13:0354a	0.44	1	1	3	2	3	2	1	0	0	1
C:13:0354b	0.78	1	1	3	2	3	2	1	0	0	1
C:13:0354c	0.52	1	1	3	2	3	2	1	0	0	1
C:13:0354d	1.35	1	1	3	2	3	2	1	0	0	1
C:13:0359	0.02	1	0	3	2	1	2	1	0	0	0
C:13:0361	2.89	1	0	3	2	1	4	1	0	0	0
C:13:0375a	3.20	1	0	3	2	3	2	1	0	0	0
C:13:0375b	3.45	1	0	3	2	3	2	1	0	0	0
C:13:0387	1.54	1	0	1	2	3	2	1	0	1	0
C:13:0390a	2.00	1	0	3	2	3	2	1	0	1	0
C:13:0390b	1.13	1	0	3	2	3	2	1	0	1	0
C:13:0413a	3.00	1	1	3	2	1	1	1	0	0	1

Site Number	Volume (cubic m)	Open(0)/ Sheltered (1)	Access: Side(1) Top (2) unknown (0)	Shape rectangular(1), circular(2), D-shaped(3), unknown(4)	Shaped (1) Unshaped (2) Unknown (0)	Unknown (0), Masonry (1), Uprights (2), Uprights and Masonry (3)	Construction Material Unspecified (0) Limestone (1) Sandstone (2) Basalt (3) Quartzite (4) Shale (5) Igneous (6)	Granary (Yes:1, No:0)	Storage Room (Yes:1, No:0)	Storage Cist (Yes:1, No:0)	Lintel (Yes:1, No:0)
C:13:0413b	6.60	1	1	3	2	1	1	1	0	0	1
C:13:0413c	5.40	1	1	3	2	1	1	1	0	0	1
C:13:0413d	3.00	1	1	3	2	1	1	1	0	0	1
C:13:0413e	3.40	1	1	3	2	1	1	1	0	0	1
C:13:0429	0.26	1	1	3	2	3	2	1	0	0	0
C:13:0435	0.00	1	0	3	2	1	2	1	0	0	0
C:13:0517	2.97	1	1	3	2	1	2	1	0	0	1
C:13:0674	1.53	4	0	3	2	1	2	1	0	0	0
C:13:0678a	0.75	1	0	3	2	1	1	1	0	0	0
C:13:0678b	0.75	1	0	3	2	1	1	1	0	0	0
C:13:0678c	0.75	1	0	3	2	1	1	1	0	0	0
C:13:0678d	0.75	1	0	3	2	1	1	1	0	0	0
C:13:0678e	0.75	1	0	3	2	1	1	1	0	0	0
C:13:0678f	0.75	1	0	3	2	1	1	1	0	0	0
C:13:0678g	0.75	1	0	3	2	1	1	1	0	0	0
C:13:0702a	1.20	1	1	3	2	1	1	1	0	0	1
C:13:0702b	1.20	1	1	3	2	1	1	1	0	0	1
C:13:0702c	2.00	1	1	3	2	1	1	1	0	0	1

Site Number	Volume (cubic m)	Open(0)/ Sheltered (1)	Access: Side(1) Top (2) unknown (0)	Shape rectangular(1), circular(2), D-shaped(3), unknown(4)	Shaped (1) Unshaped (2) Unknown (0)	Unknown (0), Masonry (1), Uprights (2), Uprights and Masonry (3)	Construction Material Unspecified (0) Limestone (1) Sandstone (2) Basalt (3) Quartzite (4) Shale (5) Igneous (6)	Granary (Yes:1, No:0)	Storage Room (Yes:1, No:0)	Storage Cist (Yes:1, No:0)	Lintel (Yes:1, No:0)
C:13:0707a	1.13	1	0	3	2	1	2	1	0	0	0
C:13:0707b	1.13	1	0	3	2	1	2	1	0	0	0
C:13:0740	0.67	1	0	3	2	1	2	1	0	0	0
C:13:0771	0.44	1	0	3	2	1	4	1	0	0	0
G:03:0051a	0.50	1	0	3	2	1	1	1	0	0	0
G:03:0051b	0.50	1	0	3	2	1	1	1	0	0	0
H:04:0083	0.25	1	0	3	2	1	1	1	0	0	0
I:01:0012	2.86	1	1	3	2	1	1	1	0	0	1
I:01:0013a	4.06	1	1	3	2	1	1	1	0	0	1
I:01:0013b	3.04	1	1	3	2	1	1	1	0	0	1
I:01:0013c	5.46	1	1	3	2	1	1	1	0	0	1
I:01:0122a	3.46	1	0	3	2	1	1	1	0	0	0
I:01:0122b	3.46	1	0	3	2	1	1	1	0	0	0

Grand Staircase-Escalante Data Tables

Site Number	Structures	MasonryRms	Enclosures	Temporal Association	MCD_TR_Date	Culture_Code	Cultural Affiliation	Length (m)	Width (m)	Height (m)	Length to Width Ratio	Area (sq m)	Volume (cubic m)
42KA2679a	2	0	1	Unknown	Unknown	6	Ancestral Puebloan	2.2	1.8	1	1	3.96	3.96
42KA2679b	2	0	1	Unknown	Unknown	6	Ancestral Puebloan	2.18	1.82	1	1	3.9676	3.97
42KA2680a	2	0	1	Unknown	Unknown	6	Ancestral Puebloan	1.83	1.69		1	3.0927	3.09
42KA2680b	2	0	1	Unknown	Unknown	6	Ancestral Puebloan	2.5	1.5		1	3.75	3.75
42KA2681a	4	0	1	Pueblo II-PIII	Unknown	6	Ancestral Puebloan	2.5	2		1	5	5.00
42KA2681b	4	0	1	Pueblo II-PIII	Unknown	6	Ancestral Puebloan	1	1		1	1	1.00
42KA2681c	4	0	1	Pueblo II-PIII	Unknown	6	Ancestral Puebloan	1	0.3		3	0.3	0.30
42KA2681d	4	0	1	Pueblo II-PIII	Unknown	6	Ancestral Puebloan	2	2		1	4	4.00
42KA2682a	3	0	1	Unknown	Unknown	6	Unknown	1.5	1	0.5	1	1.5	0.75
42KA2682b	3	0	1	Unknown	Unknown	6	Unknown	1	1		1	1	1.00
42KA2682c	3	0	1	Unknown	Unknown	6	Unknown	1	1		1	1	1.00
42KA2683	1	0	1	Pueblo III	Unknown	6	Ancestral Puebloan	2	1.33	0.65	1	2.66	1.73
42KA2684	1	0	1	Unknown	Unknown	6	Ancestral Puebloan	2.39	1.9		1	4.541	4.54
42KA4425a	5	0	1	PII-PIII	Unknown	6	Ancestral Puebloan					0	0.00

Site Number	Structures	MasonryRms	Enclosures	Temporal Association	MCD_TR_Date	Culture_Code	Cultural Affiliation	Length (m)	Width (m)	Height (m)	Length to Width Ratio	Area (sq m)	Volume (cubic m)
42KA4425b	5	0	1	PII-PIII	Unknown	6	Ancestral Puebloan					0	0.00
42KA4425c	5	0	1	PII-PIII	Unknown	6	Ancestral Puebloan					0	0.00
42KA4425d	5	0	1	PII-PIII	Unknown	6	Ancestral Puebloan					0	0.00
42KA4425e	5	0	1	PII-PIII	Unknown	6	Ancestral Puebloan					0	0.00
42KA4452	1	0	1	Unknown	Unknown	6	Ancestral Puebloan	1	1		1	1	1.00
42KA4454	1	0	1	Unknown	Unknown	6	Ancestral Puebloan	2	2		1	4	4.00
42KA6064	1	1	1	Pueblo II	Unknown	6	Virign and Kayenta	2	1		2	2	2.00
42KA6065	3	0	1	Pueblo II	Unknown	6	Ancestral Puebloan	1.8	1.6		1	2.88	2.88
42KA6941a	6	0	1	1040-1220	1030-1220	6	Ancestral Puebloan	3.5	2.5	1.4	1	8.75	12.25
42KA6941b	6	0	1	1040-1220	1030-1221	6	Ancestral Puebloan	2.5	1	1	2	2.5	2.50
42KA6941c	6	0	1	1040-1220	1030-1222	6	Ancestral Puebloan	3	1.5	1.15	2	4.5	5.18
42KA6941d	6	0	1	1040-1220	1030-1223	6	Ancestral Puebloan	1.65	1.45	1.25	1	2.3925	2.99

Site Number	Structures	MasonryRms	Enclosures	Temporal Association	MCD_TR_Date	Culture_Code	Cultural Affiliation	Length (m)	Width (m)	Height (m)	Length to Width Ratio	Area (sq m)	Volume (cubic m)
42KA6941e	6	0	1	1040-1220	1030-1224	6	Ancestral Puebloan	1.8	1.7	1.1	1	3.06	3.37
42KA6941f	6	0	1	1040-1220	1030-1225	6	Ancestral Puebloan	1.5	1.5		1	2.25	2.25
42KA7191	1	0	1	Unknown	Unknown	6	Ancestral Puebloan	1	1		1	1	1.00
42KA7192	1	0	1	960-1170	Unknown	6	Ancestral Puebloan	2.35	1.4	1	1	3.29	3.29

Site Number	Open(0)/ Sheltered (1)	Access: Side(1) Top (2) unknown (0)	Shape rectangular(1), circular(2), D-shaped(3), unknown(4)	Shaped (1) Unshaped (2) Unknown (0)	Unknown (0), Masonry (1), Uprights (2), Uprights and Masonry (3)	Construction Material Unspecified (0) Limestone (1) Sandstone (2) Basalt (3) Quartzite (4) Shale (5) Igneous (6)	Lintel (Yes:1, No:0)
42KA2679a	1	1	3	2	1	2	1
42KA2679b	1	1	3	2	1	2	1
42KA2680a	1	1	3	2	1	2	1
42KA2680b	1	1	3	2	1	2	1
42KA2681a	1	1	3	0	1	2	1
42KA2681b	1	1	3	0	1	2	1
42KA2681c	1	1	3	0	1	2	1
42KA2681d	1	1	3	0	1	2	1
42KA2682a	1	2	1	2	3	2	0
42KA2682b	1	2	1	2	3	2	0
42KA2682c	1	2	1	2	3	2	0
42KA2683	1	1	1	2	1	2	0
42KA2684	1	1	3	2	1	2	1
42KA4425a	1	1	3	2	1	2	0

Site Number	Open(0)/ Sheltered (1)	Access: Side(1) Top (2) unknown (0)	Shape rectangular(1), circular(2), D-shaped(3), unknown(4)	Shaped (1) Unshaped (2) Unknown (0)	Unknown (0), Masonry (1), Uprights (2), Uprights and Masonry (3)	Construction Material Unspecified (0) Limestone (1) Sandstone (2) Basalt (3) Quartzite (4) Shale (5) Igneous (6)	Lintel (Yes:1, No:0)
42KA4425b	1	1	3	2	1	2	0
42KA4425c	1	1	3	2	1	2	0
42KA4425d	1	1	3	2	1	2	0
42KA4425e	1	1	3	2	1	2	0
42KA4452	0	0	2	2	2	2	0
42KA4454	1	1	3	2	1	2	0
42KA6064	1	1	3	1	1	2	0
42KA6065	1	1	3	1	1	2	0
42KA6941a	1	2	3	1	1	2	1
42KA6941b	1	1	3	1	1	2	1
42KA6941c	1	1	2	1	1	2	1
42KA6941d	1	1	3	1	1	2	1

Site Number	Open(0)/ Sheltered (1)	Access: Side(1) Top (2) unknown (0)	Shape rectangular(1), circular(2), D-shaped(3), unknown(4)	Shaped (1) Unshaped (2) Unknown (0)	Unknown (0), Masonry (1), Uprights (2), Uprights and Masonry (3)	Construction Material Unspecified (0) Limestone (1) Sandstone (2) Basalt (3) Quartzite (4) Shale (5) Igneous (6)	Lintel (Yes:1, No:0)
42KA6941e	1	1	3	1	1	2	1
42KA6941f	1	1	3	1	1	2	1
42KA7191	1	1	3	2	1	2	0
42KA7192	1	1	3	2	3	2	0