

THESIS

CUEXCOMATE OR TEMEZCAL?: DECIPHERING THE CIRCULAR ARCHITECTURAL
FEATURES AT ANGAMUCO, MICHOACÁN, MEXICO

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ABSTRACT

CUEXCOMATE OR TEMEZCAL?: DECIPHERING THE CIRCULAR ARCHITECTURAL FEATURES AT ANGAMUCO, MICHOACÁN, MEXICO

The Middle Postclassic Purépecha site of Angamuco in the Lake Pátzcuaro Basin, Michoacán, Mexico possesses a significant number of circular architectural features. Comparison of these features to similar structures across Mesoamerica suggests their function as cuexcomates (granaries) or temezcals (sweatbaths). Based on comparative research of storage structures and sweatbaths employed throughout Mesoamerica, identification of physical attributes associated with cuexcomates and temezcals provided a basic foundation for identification of these structures during field survey. The availability of GPS and LiDAR data enable the use of spatial statistics resulting in the identification of statistically significant spatial clustering of the circular features based on diameter. These clusters reside in elite and commoner residential and public/civic-ceremonial areas. Further inspection of these areas has provided insights into storage behavior, socio-economic characteristics, access, and urban development among the Purépecha. Future research at Angamuco providing the existence of additional circular features will aid in better identification of circular structure types and the expansion of storage knowledge and spatial analysis techniques employed at archaeological sites.

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INTRODUCTION

The human relationship to food is more than just production, processing, and consumption; instead it is the nexus between people, their environment, and their society (Ahrens and Fisher 2011). Unfortunately, food storage has been left behind in the quest to understand the complex nature of food within ancient societies. In complex societies food storage is associated with all levels of society and their related socio-political relationships. For instance, in Mesoamerica, food is used for sustenance, currency, gifts, building relationships through feasting, and symbolizing wealth and power (Rosenswig 2007; Gumerman IV 1997; Monaghan 1990). All of these aspects are connected to and dependent on the successful storage of food.

Food systems research has sought to unravel the intricate connections associated with the study of food in an array of disciplines including anthropology, archaeology, history, economics, nutrition, and environmental sciences (LaBianca 1991). The complex nature of food systems research envelopes all avenues of food, including storage, but specific research involving this concept have been minimal. Ethnoarchaeological approaches have proven very valuable for understanding storage; which has provided insights into food storage. Kent (1999) uses an ethnoarchaeological approach to develop a process for delineating storage from trash areas, using research conducted among the Kutse in the Kalahari Desert and applied to a Pueblo II Anasazi site. The most knowledge and insight into food storage comes from the work of Smyth (1988, 1990, and 1991) who employs an ethnoarchaeological approach in his research on modern storage behavior among the Maya. These concepts and theories in addition to models related to

the development and characteristics of complex societies and spatial statistics have shaped the analysis of this thesis.

Broadly, I will explore the existence of circular architecture in Mesoamerica by presenting archaeological examples of monumental and residential circular architecture found at sites throughout Mesoamerica. This will help to provide a comparison to the architecture found at Angamuco throughout my analysis. Next, I will provide a background on storage; focusing on storage techniques and behaviors found in Mesoamerica based upon archaeological, ethnoarchaeological, ethnohistoric, and ethnographic sources. An understanding of the employment of various storage techniques helps to decipher the functional aspect of the Angamuco structures. Then I will provide background information on the Lake Pátzcuaro Basin and an overview of the site of Angamuco. Regional characteristics play a role in the type of storage structure successful in the area as well as influence social aspects, so both the physical characteristics and prehistory will be discussed. Moreover, the site background focuses on the connection of physical and cultural characteristics evident by the site division between the Zona Alta and Zona Baja. To complement the previous sections a description on the collection and maintenance of the data will be provided with an overview of the techniques used in my analysis. I will then analyze the collected data, focusing specifically on spatial analysis. Finally, I will make inferences to the function of Angamuco's circular architecture from other regional archaeological examples, ethnoarchaeological, ethnohistoric, and ethnographic sources.

This thesis addresses specific questions regarding circular architecture at Angamuco with an emphasis on their function, social meaning, and spatial distribution. These questions include:

- 1.) Does the circular architecture represent civic-ceremonial/public or residential architecture?

- 2.) Are circular features associated with restricted, open, or some sort of dual access?
- 3.) How can the typology of the circular architecture be refined?
- 4.) Are these circular features differentially distributed? How?
- 5.) What is the function of these circular features?

Answering these questions will help to decipher the ubiquitous varieties of circular features present at Angamuco that may be associated with storage, sweatbaths, or other functions. This thesis represents an initial attempt to determine the function and distribution of features and to better understand their potential role in the development of social complexity during a critical period in Purépecha prehistory. My main finding is that the majority of this architecture represents storage facilities with a smaller percentage likely employed as sweatbaths. It is my hope that comparison of these data with other such features throughout Mesoamerica will greatly enrich our understanding of food storage techniques utilized by the Purépecha and provide insights into the social aspects associated with storage.

CHAPTER 1: THEORETICAL DISCUSSION

Food is culture. Relationships and access to food forms a fundamental element of any sociopolitical organization. In a complex society, food is used as a tool of influence and reflects wealth and power; which becomes a complicated issue in the context of complex societies reflected through the example of Angamuco. This chapter explores literature concerned with theoretical approaches and concepts regarding human and food interactions, space usage, development and characteristics of complex societies, and spatial statistics on an individual level and relationship level.

Food is the nucleus connecting all of these concepts and theories; which is precisely why it will be discussed first. How food is regarded beyond the value of subsistence reflects its level of influence on sociopolitical relationships and cultural ideals within a complex society. In Mesoamerica food played an important role within the structure of states and empires through trade, surplus, feasting, tribute, and religion among other things; which in turn impacted sociopolitical relationships and ideals in terms of wealth, power, and social identities. Food systems research (FSR) reflects a necessary tool to understand food storage as it relates to Angamuco and its identification in the form of cuexcomates (granaries) at the site. At its core FSR uses the food system concept for “reconstructing and analyzing changes in peoples’ daily lives” (LaBianca 1991:222) through an array of instrumental activities ranging from food procurement to storage to consumption and finally to food waste (LaBianca 1991). While FSR uses a well-rounded perspective to understand the interdependence and correlations between the different parts of food systems and foodways, multiple approaches have been utilized to explain the inner workings of this dynamic subject.

A plethora of food literature exists within anthropology and other disciplines ranging from overarching themes to specific topics allowing for a wide range of theories and methodological approaches to help explain the role of sustenance in cultures. Levi-Strauss employed a structuralist approach; focusing on the language of food, he created the culinary triangle encompassing raw, cooked, and rotten corners of the triangle to identify a culture's foodways in relation to a food's proximity to one of these corners (Harris 1987). Thinking of food as a symbolic language is at the core of structuralism and idealism; while it helps to examine the meaning behind how food is cooked, chosen or presented, it does not allow for its connection with environmental, economic, or biophysical factors. Unlike structuralism, the materialist strategy believes that the production and consumption of a society's food is ultimately influenced through nutritional, economic, biochemical, and other material aspects (Harris 1987). Some materialists may take on a Marxist viewpoint (Harris 1987, Mintz and Du Bois 2002); however, all materialists disregard symbolism as a weighted factor for food habits; instead considering economic, political, and practical factors as primary forces affecting food habits as described by Murcott 1988 (Mintz and Du Bois 2002). Another approach to food theory, functionalism, Grivetti and Pangborn 1973 consider foodways and food systems in terms of their influential nature toward social relationships (Mintz and Du Bois 2002). The theoretical approaches discussed above represent only a small portion of approaches employed in many different disciplines including anthropology, nutrition, and sociology, among others.

When considering these approaches, it is also necessary to take multiple aspects of food into account. By this I mean it is important to look at the symbolic and social roles of food. In complex societies, food is used more than just for subsistence and in fact it acts as a catalyst for the development of certain sociopolitical factors (Gumerman 1997). For instance,

Mesoamerican fiestas represent a celebration where food manipulates how someone's social status, wealth, power, and influence is perceived based upon the quantity, quality, and exotic foods at the feast. Feasting, especially competitive feasting, discussed by Hayden (1996) and Wiessner (1996) displays how hierarchical and political power, increased surplus, and debts are produced through feasting. From its initial production and procurement, food travels through a series of environments: distribution, storage, preparation, consumption, and waste. Each environment has its own set of factors changing the physical characteristics and movement of food; however, at the same time the symbolic nature of food is influencing a society's social and economic infrastructure.

Let us look at an example involving the distribution of food. In complex societies, food is mainly distributed through a market system. In addition to the market system, food is shared within familial groups, given as religious offerings, provided as tribute, included in a dowry, given to the royal family, and/or the administration redistributes it back to the public in times of distress (e.g. drought, siege, etc.). For each of these different types of distribution, food affects social status, wealth, power, influence, and economy within that particular society. These different aspects reside in the subtypes of the different food environments and their interrelated nature complicates our understanding of food and its reflection of a society's social structure.

Food storage represents a complex system residing within the already multifaceted subject of storage. Different perspectives may be used to unravel the intricate nature of food storage. Here I will briefly discuss the prominent viewpoints of Smyth (1989, 1990, 1991) and Smith (2012a, 2012b); using these perspectives I supply my own outlook on food storage. Smyth's (1989, 1990, 1991) ethnoarchaeology work on the association of storage with food processing (kitchen placement in relation to storage structure, washing, grinding, etc.),

consumption, and their spatial location among the Puuc Maya demonstrates this complexity. Thus, Smyth (1989, 1990, 1991) categorizes storage into central storage systems and domestic systems, which includes temporary, permanent and community storage. On the other hand, Smith (2012a) identifies two storage systems: small-scale storage and large-scale storage. Small-scale storage refers to domestic and community storage. This type of storage system is controlled by individual households or a community without any government influence. Within the large-scale storage system, which includes state, institutional, and commercial storage, the government is only involved in state storage. Both institutional and commercial storage are managed by non-governmental entities, such as temples and merchants. Institutional and commercial storage are similar to domestic and community storage, the main difference is that institutional and commercial storage are considered to be on a larger scale.

While this framework is detailed and well organized, I prefer to categorize food storage types slightly differently. First, I look at household storage, which can include a single family or multi-family household having their own granary or they could be sharing it with other households. Secondly, I explore authoritative storage, lumping state and institutional storage together (Smith 2012a) because there is not enough evidence to support these categories separately for Mesoamerican storage. Authoritative storage includes any storage structure that is controlled by the recognized authority (king, wealthy elites, government official, etc.) in a city, state, or empire. Household storage also includes Smith's (2012a) category of commercial storage since many households sell their surplus of maize at markets or to neighborhoods, so it should not be considered as part of authoritative storage. These two categories are meant to be more simplistic than Smith's (2012a) categories in order to provide a basic framework for studying storage that can still be built upon.

Understanding foodways and food systems only provides the first step to uncovering the function of the circular structures found at Angamuco. A long range of viewpoints explore different aspects of complex societies' development; however, I am concerned specifically with city spatial zones, such as residential and public neighborhoods and districts. Deciphering the function of the circular features at Angamuco relies heavily upon understanding the different neighborhoods and districts at the site. Different models exist in empirical urban theory for urban spatial planning; its association with city layouts and urban social dynamics which depend on the level, land size, and population size of urbanization of a city (Smith 2010; Smith 2011). In Mesoamerica, most cities contain one or more civic-ceremonial zones with a possible addition of an urban epicenter that contrast from the different levels of residential zones. Civic-ceremonial and residential zones represent the standard zones in Mesoamerican cities; however, specialty zones such as agricultural, and craft specialization zones may also reside in a city (Smith 2010). Currently at an early research stage in Angamuco's spatial zones, only civic-ceremonial and residential zones are considered in this thesis.

In order to later discuss those spatial zones at Angamuco definitions of each zone must be presented in the context of preindustrial and ancient cities. A designated area with a concentration of public architecture, usually a number of formal open spaces and monumental or public structures, represent a civic-ceremonial zone (Smith 2010). Architectural communication theory seeks to resolve the meanings behind cities and buildings, especially monumental architecture, which communicates statements involving status, power, wealth, and other urban social issues (Smith 2011). This theory will be most useful in examining any potential spatial patterns associated with the architecture at Angamuco, focusing on the circular features. In some cities, more than one civic-ceremonial zone may exist, differing in size and importance with one

recognized as the urban epicenter. If only one civic-ceremonial zone exists then it is designated as the urban epicenter; a “zone that served as the seat of administration, ritual, and display for a polity” (Smith 2010:138). The rest of the city consists of different tiers of residential zones, such as elite and commoners. Neighborhoods contain “a residential zone that has considerable face-to-face interaction and is distinctive on the basis of physical and/or social characteristics” (Smith 2010:139). In contrast, a district is comprised of one or more neighborhood; which represents a social or administrative identity within a city creating social or administrative districts (Smith 2010). As Rapoport notes (Smith 2011) the environmental-behavior theory involves the reciprocal relationship between peoples’ behaviors and their built environment; which further provides additional tools to understand what feature of an urban landscape were designed to manipulate specific human behaviors. Social districts include large residential zones that are identified through interaction patterns or social attributes, which are not associated with serving as residential units (Smith 2010). Similarly, administrative districts encompass large residential areas, but instead serve as administrative units in a city; which may or may not be identifiable with their inclusion of civic buildings used in administration (Smith 2010). Both neighborhoods and districts have been identified for a portion of Angamuco with the addition of complejos and functional units. These spatial zones identified by Fisher (2012; Fisher and Leisz 2013) currently exist for the main surveyed portion of the site with a few outlier zones identified. Furthermore, neighborhoods and districts at the site are not yet associated with all civic-ceremonial zones, social or administrative districts, or assigned different residential tiers. From a top down approach, there are districts, neighborhoods, complejos, and then functional units. Complejos entail a number of features representing commoner or elite residences or public/religious function situated around a shared plaza associated with only one function (Fisher

2012; Fisher and Leisz 2013). Residing within complejos are functional (domestic) units representing the basic urban functional zone at Angamuco. Each domestic unit contains a single or series of related features or buildings associated with only one function such as specialized production, residential, civic-ceremonial, storage, marketplace, or other functions (Fisher 2012; Fisher and Leisz 2013). These functional urban zones will play a role in determining the function of the different types of circular features identified at Angamuco.

Utilization of these spatial zones as well as the location of circular features and other features comes from the use of spatial statistics. The application of the anthropological and archaeological theories involving food system, foodways, storage, formation of complex societies, and urban spatial zones can all be associated with spatial statistics; but only within the context of spatial statistics. Geographic information systems (GIS) tools allow for the use of spatial statistics. When creating a map with GIS data, patterns are visible with the naked eye and are used as preliminary results. To enhance the identification of these patterns, spatial statistics techniques are used to confirm statistical spatial patterns. Multiple variables considered in spatial statistics provide different answers, so while focusing on your main objective other variables should be taken into consideration. Other variables include identifying naturally occurring physical barriers (e.g. rivers, mountains, etc), common social identities (e.g. social class, occupation, etc), and common attributes with distinctive organization (e.g. similarly sized houses grouped together next to another similarly sized house group). To help identify potential patterns, neighborhoods, and districts, spatial statistics tools such as average nearest neighbor, cluster and outlier analysis (Anselin Morans I), multi-distance spatial cluster (Ripley's K Function), spatial autocorrelation (Global Morans I), hot spot analysis, and high-low clustering are employed.

So what approach or perspective provides the best understanding of food systems and foodways? To answer this question, you need to ask yourself, what aspect(s) of foodways and food systems am I interested in understanding? Multiple avenues of food systems and foodways exist; so it is especially important in complex societies to identify your primary research objective. In the interest of this research, identifying the fundamentals of food storage as well as employing different perspectives will help to unlock the mysteries of Angamuco's circular structures and provide insights into the city's and possibly the Purépecha Empire's food systems and foodways. In order to gain this knowledge I will use anthropological and archaeological methods specified for food systems and foodways, while incorporating perspectives associated with the development of complex societies and spatial statistics.

CHAPTER 2: STORAGE IN MESOAMERICA

Food storage is an integral part of any sedentary civilization; however, it is rarely incorporated into general archaeological investigation in Mesoamerica. Food plays a fundamental part in any society; however, in complex societies food is integrated deeper into sociopolitical relationships. Within the areas of food production, processing, and consumption, avenues of sociopolitical relationships such as power, access, wealth, and gender have been explored to some extent in different regions of Mesoamerica (Ahrens and Fisher 2011). Moreover, in an article dedicated to food and complex societies all of these aspects of sociopolitical relationships along with food production processing, and consumption received attention (Gumerman IV 1997), but discussion of food storage did not occur. Food storage is essential, among other things, for sustaining a complex society and thus should receive adequate attention.

Knowledge of storage structures within archaeology are limited for multiple reasons including: variations of storage facilities, constructed from perishable materials, and most importantly recognizing storage facilities in the archaeological record is very difficult and when found the remains can rarely be definitively identified as storage structures. Ethnoarchaeological research done by Smyth (1991) among the Puuc Maya provides an in-depth analysis and understanding on storage practices beyond type of structure employed and helps to distinguish storage remains in the archaeological record. Smyth (1991) looks at the items stored, how these items are stored, access to storage facilities and the location of the stored items; but delves deeper into storage by understanding the relationship of the storage structure's location to the kitchen, water source, and residence within the Mayan houselot. Such research will help when

performing spatial analysis on the circular structures at Angamuco. Furthermore, it may even help to make connections between features at other sites hypothesized to represent storage buildings.

Types of Food Storage Structures

Based upon the environment, available resources, and the products to be stored; storage across regions and cultures in Mesoamerica contains both similarities and differences. Types of storage behavior can be categorized in numerous ways. According to Smith (2012a), there is small-scale storage which includes domestic and community storage and then there is large-scale storage that includes state, institutional, and commercial storage. It is obvious that storage behavior and the associated storage structures create a complex system.

Even though both Smyth (1991) and Smith (2012a, 2012b) provide important and relevant perspectives on storage systems in Mesoamerica, I prefer a slightly different perspective when trying to determine the storage behavior and structures employed at Angamuco. My approach simplifies those perspectives of Smith (2012a) and Smyth (1989, 1990, 1991) to include only household and authoritative food storage categories. Household storage encompasses single family and multi-family households that possess their own granary or share storage facilities with other households, such as a patio group. On the other hand, authoritative storage consists of those storage structures that are controlled by institutions associated with the ruling authority (king, wealthy elites, government officials, etc.) in a city, state, or empire. Examples of authoritative storage include granaries for temples, the household of the ruling authority, surplus granaries and tribute granaries.

Furthermore, understanding storage becomes more complicated with the variety of different storage structures employed throughout Mesoamerica and in some cases within the

same site. In the next section I will discuss the different storage techniques and storage structures used in Mesoamerica. Unfortunately, I am unable to provide a list of every storage technique and structure employed. As a result the discussion below includes the most commonly known and mentioned storage techniques and structures in archaeological, ethnohistoric, ethnographic, and ethnoarchaeology sources.

Throughout my research the cuexcomate represents a highly utilized storage structure in Mesoamerica. Even though other storage techniques could have been employed among the Purépecha at Angamuco, cuexcomates are believed to be represented by the numerous circular structures located throughout the site. The hypothesis framed throughout this thesis suggests that the circular buildings present at Angamuco represent the remains of cuexcomates.

A cuexcomate (*cuezcomatl*, *cuexcomatl*, used interchangeably with granary) consists of a circular stone foundation on top of which rests a vasiform wattle and daub superstructure topped with a grass lid (figure 1) (Hernandez Xolocutzi 1949). A minimal amount of information is known about this type of structure and the majority of our knowledge of cuexcomates comes from the archaeological record and ethnographic sources. Unfortunately, information about the general size of the foundation and superstructure, as well as the capacity of the structure is not well known. However, Starr (1908) observed cuexcomates in the Tlaxcalan towns of San Estevan and San Pedro that ranged in height from 6 to 12 meters or more. If further insights could be gained on such characteristics then additional inferences and connections could be made between these structures and social attributes; such as social status and volume of food production.



Figure 1: Cuexcomate located in San Nicolas Panotla (Starr 1908)

Archaeological investigations have provided further evidence for the employment of cuexcomates. Within the Aztec palace at Chiconautla a likely cuexcomate/cuexcomatl was uncovered. Cuexcomate, Calipo, and Site 3 are three Aztec-period sites in the state of Morelos that contain archaeological remains of circular structures thought to represent granaries (Smith et al 1989). Based upon the structure's shape, a beehive, and its construction of straw rings coated in mud, this structure proves a likely candidate for a cuexcomate (Elson 1999). As already noted, the base of a cuexcomate consists of stone situated in an enclosed circle, but in some cases there was a break in the circle form.

In addition to archaeological evidence, ethnographic and ethnohistoric sources provide further information on cuexcomates. According to Bugé (1987), the stone base of the granary allows for air circulation which in turn fully dries the corn, protecting it from insects and mildew. Such information highlights the structures need to efficiently protect its contents for a long period of storage. When looking at the frequency and location of cuexcomates, Starr (1908) observed in San Estevan that each house was associated with one or more cuexcomates. All of

this information is highly valuable and when combined with spatial analysis, cuexcomates will be understood in a wider perspective.

Another popular and well known storage facility utilized is that of the crib. Crib storage structures are well known among the Maya as a result of Smyth's ethnoarchaeological work among the Puuc Maya (figure 2) (Smyth 1989, 1990, 1991). Unfortunately, crib representation solely in the archaeological record is rare due to its construction of perishable materials. Crib employment at Angamuco is possible; however, confirmation of their usage is nonexistent due to their perishable infrastructure.

Furthermore, variations of the crib have been identified in other Mesoamerican cultural communities. Slightly different from those cribs found among the Maya are those cribs built by the Tarahumare. Although these store-houses are not built on stilts, they are square in plan and built with the interlocking corners of boards (Lumholtz 1973); which are similar to the structure of the Maya cribs. The Tepehuanes are another culture in Mexico that used a form of crib as their storage building. Housing ears of corn, this type of crib is made of bamboo sticks held together and sits a foot above the ground on a pine framework (Lumholtz 1973). Of the three storage types used in Tepoztlán, the *cincolote* is similar to other crib structures. Essentially this structure resembles a box with horizontally laid poles that connect at right angles (Redfield 1930). However, the *cincolote* is not mentioned to reside off the ground like the other crib examples. Variations in crib storage demonstrates its effectiveness to successfully store maize in many different regions and cultural groups in Mesoamerica.

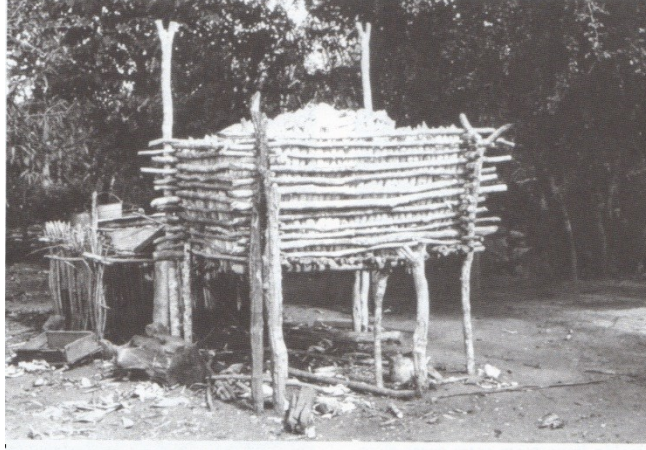


Figure 2: Maize crib used by the Puuc Maya (Smyth 1991)

In some instances, storage did not always occur in facilities detached from the house. Smaller quantities of food were commonly stored within the house (*troje*). Most commonly exploited for storage were the rafters of the *troje*, also known as *tapanco*. Ears of maize are placed onto planks through a trap door reached by a ladder (West 1948: 28). In other cases some of the corn is hung in bunches from the husks over poles in the house (figure 3). This corn is mainly used for seeds for the next year's crop or for immediate consumption (West 1948: 39). While not suitable for long term storage or for large quantities, storage in the house could reflect implications for socioeconomic status related to storage techniques.



Figure 3: Maize cobs stored in the rafters of the house (Smyth 1991).

Less commonly identified storage structures present more variation within the utilized storage facilities and techniques in Mesoamerica. For instance, some house lots, particularly those of the modern Sierra Tarascans contain small wooden storage buildings on stilts. Another variety of storage structure also used in house lots include a small plank *trojes* built upon a stone foundation and maize fodder is commonly stored in the loft of the gate roof (*puerta de golpe*) (West 1948). Another storage structure found among the Tarahumare are round store-houses. Built of stone and mud these round buildings are usually 4-6 ft. high with a pine board roof (Lumholtz 1973). Readily visible storage structures did not always exist in large quantities. Instead storage areas were once hidden from view to protect the stored contents. For instance, below-ground bell-shaped pits represented the storage facilities during the Formative period (Plunket and Uruñuela 2004).

The examples discussed above only provide a small portion of the storage structures and techniques employed throughout Mesoamerican occupation. Further difficulties arise when cultural groups utilize multiple storage facilities and techniques during the same time period. Furthermore, few storage structures have been identified in the archaeological record and in most

cases ethnographic and ethnohistoric sources provide minimal information. Such a large variety of storage facilities and techniques complicate current research and understanding of storage at Angamuco; especially with limited research (compared to Aztecs and Maya) focused on the Purépecha and Lake Pátzcuaro Basin.

Not only does the past contain circular architecture so does Mexico's recent history; which will hopefully provide further insights on storage utilization. While not popular in contemporary Mexico, recent history shows the employment of cuexcomates (granaries). The existence of the modern use of cuexcomates provides insights into past storage techniques and a template for possible use of cuexcomates at Angamuco. Below I will discuss ethnographic and ethnohistoric sources on storage in Mesoamerica which specifically describes the historic use of cuexcomates.

A description of the construction of the cuexcomates among the Tlaxcalan is as follows:

“first, a solid stone and mortar foundation is built half a meter below the ground and half a meter above; then, a good supply is made of loaf-like units, each about one meter in length, consisting of long grass stems (*Elyonurus ciliaris* HBK) well kneaded in clay; these units are placed, while still partly moist, in an overlapping fashion around and around to form the thick circular walls of the granary; finally the wall is faced on both sides with a heavy coating of daub” (Hernandez Xolocutzi 1949: 178).

Starr (1908) also describes observing granaries in the state of Tlaxcala and unlike other sources provides a clue as to the size of these structures mentioning 10 meters as a popular height.

Cuexcomates found in Morelos are similar, but contain a semi-circular opening near the roof instead of rectangular like the Tlaxcalan cuexcomates and maize is removed through a small hole near the base (figure 4) (Hernandez Xolocutzi 1949). As noted by Redfield (1930), three types of storage facilities are utilized in Tepoztlán: *ohuatlapil*, *cincolote*, and *cuezcomate*. Revisiting

this research, Lewis (1951) notes these structures resemble corncribs and are the solution to storing the family's supply of corn. During the last few decades of the twentieth century at Chalcatzingo, cuexcomates became essential for storing a household's supply of corn (Bugé 1987).



Figure 4: Tetimpa Project Archive, photograph by Olegario Batalla) (Uruñuela et al 2012, pp. 49)

Factors Affecting Storage

Across Mesoamerica a variety of storage structures were utilized; the decision to use each storage structure was affected by environmental and cultural factors. Environmental circumstances ultimately determine which storage structure is utilized based on how well it

preserved maize in certain climates. The length in which maize will keep in storage is not just dependent on the container but is also based on how the owner decides to store the maize. Moreover, the availability of certain resources is necessary to build different types of storage structures. After the best type of structure is identified for a certain region then based on cultural characteristics the owner decides the best size and spatial location for the granary. The complex nature of storage considers both environmental and cultural factors making it complicated to identify these storage features archaeologically.

Climatic factors influenced the productivity of agricultural crops, and so did it influence the type of storage structure used within different regions of Mesoamerica. Within the tropical environment of the Maya, protection from pests and spoilage affected the type of structure used for storage. Packed ear maize still containing the husk was only stored in cribs and the ventilation along with the tightly packed maize helped to regulate the temperature of the maize, preventing bacteria and insect infestation (Smyth 1991). In temperate climates with less humidity than that in the Maya region, ventilation was not necessary so storage structures such as cuexcomates could be used.

In order to build certain storage structures, access to particular building supplies was necessary. For instance, cuexcomates could not be used unless there was an abundant supply of stone for the bases. The inhabitants at Angamuco lived on a malpaís (ancient volcanic lava flow) where stone was easily obtained. Those cultures that used niches in caves for storage needed to live close to caves and a substantial supply of wood was needed for cribs and bins. Overall, access to certain building supplies affects the type of maize storage facility used but the structure is also influenced by the climate in which it is located.

The preservation of maize varies depending on the type of technique used but it is also dependent on the climate. The shelf life of maize varies depending on the type of technique used and the type of structure used. Storage techniques for maize include tightly packed ears with the husk, husked ear maize, and shelled maize. Furthermore, each technique has its own purpose and length of preservation. Maize used for daily consumption does not need to last for years, so shelled maize and husked ear maize are used for daily consumption since husked ear maize will last for six months and shelled maize will last up to a year (Smyth 1991). Leaving the husk on the ear will protect it more from pests and the elements, making it last for three years or more. This maize technique is only stored in cribs among the Maya and is usually a surplus that can be kept for a period of crop shortage or sold at market (Smyth 1991). It is unknown if ears of corn still in the husk were stored in cuexcomates, but it seems unlikely since there is only a small opening at the base to remove the grain. Storing ears of maize whether it includes the husk or not within a cuexcomate would be inefficient since ears of maize would take up more room than shelled maize. The storage techniques used in other storage structures is not well known. When stored in rafters maize is either an ear with or without the husk. The technique in which maize is stored influences the type of storage facility employed.

The capacity of storage structures depends on a few different factors. First of all, the capacity of the same type of storage structure varies based upon what technique is used to store the maize. Shelled grain in any type of granary will hold more than if the structure held ears of maize. The capacity for each type of storage structure is not positively known. The type of technique used to store the maize as well as the storage structure in which the maize is placed reflects the ways people will use the maize whether it is for daily consumption or held for a surplus.

Spatial location of granaries communicates a wealth of information that reflects cultural characteristics (Ahrens and Fisher 2011; Smyth 1991). Some Mesoamerican cultures prefer not to display their supply of maize so bell-shaped pits, house rafters, or structures within caves were utilized instead of easily visible *cuezcomatls* or cribs. Those households that preferred to display their stores of maize usually intended to communicate their wealth to those outside of the household. For instance, among the Pucc Maya, if a permanent storehouse resides within a solar (family residential space) than the family is wealthy because they produce a surplus of maize (Smyth 1991). Hendon (2001) suggests that by not displaying their storage, non-elites kept more power because they did not allow elites to know what they possess. Temporary versus permanent structures can also reflect wealth. Permanent structures suggest a supply of maize that would fulfill the sustenance needs of the family until after the next growing season or they may even contain a surplus whereas temporary structures could contain maize for tribute or enough maize to feed the family for only a short period of time. Of course the variables affecting the location of storage structures depend on each culture.

CHAPTER 3: SWEATBATHS

Circular structures found at Angamuco could also represent sweatbaths; so it is necessary to discuss the attributes of sweatbaths to provide a more comprehensive understanding of circular features found at Angamuco. “In Spanish a sweat house is called a temazcal, from the Nahuatl word *temazcalli*, which in turn is made up of *tema*, ‘to bathe,’ and *calli*, ‘house’” (Cresson 1938:90). In this paper I use sweatbath interchangeably with temezcal and sweat house. In Mesoamerica sweatbaths occur in both circular and rectangular form. However, I will focus on the circular sweatbaths and only mention similarities with rectangular sweatbaths found in Mesoamerica.

Representations of sweatbaths vary across Mesoamerica; which is why establishing a set of standard physical attributes is important for identifying the archeological remains of temezcals. Satterthwaite (2005) identifies these characteristics as a bench, drainage system, and a firebox. However, before I explore these attributes, it is necessary to identify the general construction of Mesoamerican sweat houses. While each sweatbath needs to contain the fundamental characteristics mentioned above that does not mean these buildings were homogeneous throughout Mesoamerica. Building materials such as stone, wood, and tile were used in many different combinations to build sweat houses. In addition to a variety of building materials used to build sweatbaths, these structures are found in circular, square, and rectangular plan forms.

Both square and round sweat houses have been found at the modern village of Milpa Alta and these structures help represent the diversity of sweatbaths found in the archaeological record and used during the recent past. The square temezcal is made of stone with a rounded wooden

roof; which contrasts with the circular sweat house comprised of stone and mud with a dome shaped roof (Cresson 1938). Another dome shaped structure was observed by Starr (1908) in the Tlaxcalan village of San Bartolome in which four people bathed inside (figure 5). In Morelos at the village of Tepoztlán, a square temezcal possesses a gabled roof made of wood and stone, covered by a layer of mud and stone and then covered with tile (Cresson 1938). An example of a rectangular sweat house is found among the Maya ruins of Los Cimientos-Chustum and represents a well preserved structure (Ichon 1977). Furthermore, a traditional sweatbath still used today in some Maya communities is a “small, rectangular, thick-walled wattle and daub structure with a beehive-shaped rock and mud oven protruding from the back wall” (Groark 2005:786). These are just a few examples that reflect the diversity of sweatbaths found within Mesoamerica.



Figure 5: Circular temezcal next to a Tlaxcalan house (Starr 1908).

No matter the shape or construction materials used, a temezcal must be compact in size. This does not necessarily mean that the dimensions have to form a small area, but instead must be able to retain the steam. In order to retain steam, the structure must be able to withstand the

heat of steam and not allow it to escape unless through a designated air hole. To further insure the steam stays within the sweathouse the doorway must be small, usually only large enough for an adult to crawl through. In regards to the compact size, it is not necessary for the temezcal to only be large enough to accommodate one person, but usually can fit three to four people. In fact a sweatbath can be larger to hold more than four people. This does not mean that a sweatbath cannot be larger than normal; just that a larger firebox or hearth must be used to compensate for the larger area.

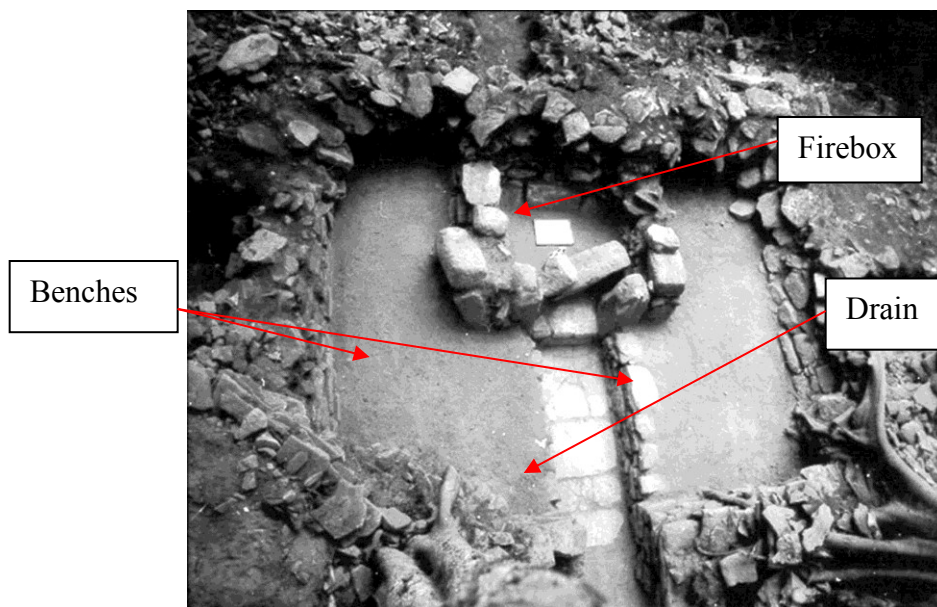


Figure 6: Overhead photo of the floor plan of sweatbath PN43A-2-1 at Piedras Negras. The drain is clearly located in the center with the benches on both sides of the drain and the firebox situated at one end of the drain (https://repository.library.brown.edu/studio/collections/id_615/).

Of course other buildings also possess these general plan forms and building materials; therefore, it is necessary to identify the other characteristics outlined to determine if a structure represents a sweatbath. The existence of a bench helps discern some circular structure as sweatbaths; however, it is not always a requirement. Benches, unlike other distinguishing characteristics of sweatbaths like drains and fireboxes, can be identified more easily during

survey work. Among the eight buildings thought to be sweatbaths at the site of Piedras Negras, only two structures contained benches (figure 6) (Cresson 1938). Benches present in Structure B-12 at Los Cimientos-Chustum are 2 meters long and reside on both sides of a drainage passage in the antechamber (Ichon 1977). Due to the poor preservation of the architectural remains at Angamuco, benches are not easily identifiable.

The presence of drains is another distinguishing characteristic of a temezcal. At the Maya site of Los Cimientos-Chustum, a 60 cm sunken passage in the antechamber represents part of the drainage system and turns into a narrow drain as it disappears beneath a platform in the central room (Ichon 1977). A drainage system is needed to carry away dirty water when the person washes himself off in the sweathouse (figure 7) (Cresson 1938; Icon 1977). Another ethnographic source, identified temezcals (*temascals*) at many of the houses in an Aztec town of Tamalin (Starr 1908). On the other hand locating them in only civic-ceremonial zones suggests a more restricted employment. Composed of plastered cobbles, a shallow sweatbath found within the Aztec palace at Chiconautla suggests the importance of the sweatbath among elites and how it can elevate a community (Elson 1999). Located in close relation to the North Ballcourt at Xochicalco, this temezcal displays the importance of sweatbaths not only to the ballgame (Molina and Kowalski 1999) but also to the Mesoamerican community. An excavated sweathouse at Los Cimientos-Chustum in Guatemala was uncovered on a ceremonial zone terrace, thus it suggests use for elite only and restricted to special situations, such as purification rites for ceremonies (Ichon 1977). It is evident that temezcals were found in locations associated with both commoners and elites and further examination will provide insight into the relationship between location and social identity.



Figure 7: Photo of the drain floor of sweatbath PN34A-2-1 at Piedras Negras
(https://repository.library.brown.edu/studio/collections/id_615/).

Just like the plan form of sweatbaths, fireboxes do not possess uniformity. Even though the main chamber of the temezcal at the village of San Francisco is rectangular the attached firebox is a rounded structure (Cresson 1938); which further reflects the variety of sweatbaths used in Mesoamerica. A more complicated firebox can be found among the modern sweathouses in Tepoztlán which possesses two levels with the upper level open to the steam room and the lower level containing a doorway to the outside (Cresson 1938). Unfortunately, fireboxes associated with possible temezcals have not been identified through survey work at Angamuco. Furthermore, the firebox is not always external but can be located inside the sweatbath within its own chamber (Cresson 1938; Ichon 1977). Excavations of multiple sweatbaths at Piedras Negras contain evidence of an internal firebox in which already hot rocks were placed (Houston et al 1998). Although a description of a temezcal found at Xochicalco did not mention a firebox, the remains of the hearth and stones used to produce steam (Molina and Kowalski 1999) still

provides the same amount of definitive evidence as an external firebox. Based upon the literature (Cresson 1938; Ichon 1977; Houston et al 1998) internal fire chambers or hearths are more common than external fireboxes.

Determining the spatial location and analyzing the relationship to other features is not necessary to identify a structure as a *temezcal*; however, it makes the identification process easier and enables the evaluation of social stratification. For instance, sweatbaths found in both elite and commoner residential areas could suggest their everyday importance and use. Within some contemporary Maya communities, each family owns their own steambath (*pus*) which is located a short distance from the back of the house or could even be built so that the entrance connects to the family dwelling (Groark 1997).

Understanding the function of a sweatbath is just as important as identifying their basic physical characteristics. The purpose behind the use of a sweatbath is based upon the beliefs of a culture. Therefore, a sweatbath's purpose varies across the cultures of Mesoamerica. Structures found at the Maya site of Palenque represent sweatbaths in plan; however, are believed to have never been used because of their symbolic nature (Houston 1996). Other functions include medicinal and religious aspects.

Mentioned earlier the sweatbaths found at the Cross Group at Palenque were symbolic sweatbaths meaning that they were not used to produce steam and heat, but instead represent a connection to divine birth and purification (Houston 1996). Of course not all sweat houses were built for symbolic religious purposes; instead religious beliefs infused the use and structure of a *temezcal*. Some contemporary Highland Maya communities still connect the materials used in construction of the sweathouse to the Earth Lord (pre-Columbian deity) who owns the structure and will inflict sickness on to those whom use it without first asking his permission through a

ceremony and presentation of gifts (Groark 1997). Religion is imbedded into the very presence of a sweatbath and is reflected through its association with Mesoamerican deities.

Similarly to religious beliefs, medicinal properties also influence the functions of the temezcal. In recent years, research has shown the traditional beliefs and use of contemporary sweatbaths among the Maya. A specific study examined the steambathing practices among a Tzeltalan speaking Mayan community in Chiapas and found three primary uses of the sweatbath: hygienic-preventive bathing, curative bathing, and female-centered bathing (Groark 1997). Based upon ethnohistoric and ethnographic sources, the maintenance and treatment of female health (e.g. pregnancy and menstruation) was traditionally the prominent reason for sweatbath usage.

A consensus of Mesoamerican cultures believed the sweatbaths contained healing properties and religious power. The methods of healing and rituals used within the sweathouse varied across cultures as did the actual architectural structure. Rectangular, square, and round temezcals exist in the archaeological record and ethnohistoric information adds to our knowledge of Mesoamerican sweatbaths. It is clear that circular temezcals existed in other regions of Mesoamerica; so did they exist at Angamuco? This question can and will be answered as the circular features are evaluated based on identified sweatbath attributes.

CHAPTER 4: Circular Architecture in Mesoamerica

Studies of Mesoamerican architecture have generally focused on traditionally shaped rectangular architecture and architecture associated with circular characteristics is often recorded as an anomaly. In fact circular architecture is much more common at Mesoamerican sites than typically recognized. This chapter will discuss well known examples of monumental circular architecture as well and their context within Mesoamerican society. It is important to note that these architectural features discussed below are not all completely circular but contain a large portion of circular aspects in the overall form of the structure.

The examples discussed below represent monumental architecture with circular characteristics found within different cultural areas of Mesoamerica. Because of their relevance to the thesis topic, architecture at Purépecha sites will be discussed first. Within the Purépecha Empire there exist a few sites that contain this form of monumental architecture: Tzintzuntzan, Old Jacona/Xucunan, and Paricuti. Tzintzuntzan, the Tarascan capital, possesses the most well-known monumental architecture for this region, the *yácata* (figure 8-9). The well-known *yácata* shape includes a stepped circular platform attached to a stepped rectangular platform representing the back with a ramp and a possible perishable superstructure located on top. A *yácata* falls into the category of a pyramid and such monumental architecture is representative of public buildings for ritual activities. At Old Jacona or Xucunan a variation of the form of a *yácata* exists. This structure looks like two *yácatas* from Tzintzuntzan connected to form one long rectangular back which contains two front oblong pieces instead of circular fronts. This structure contains eight to nine terraces and would also have had a perishable superstructure located on top of the platform (Pollock 1936). Another Purépecha site, Paricuti, also contains

architecture that is similar to Tzintzuntzan's yácatas. The site of Paricuti possesses a 12 tiered t-shaped structure which is 9.75 meters in height with an attached circular platform. A nearby burial suggests this possibly represents a religious function (Pollock 1936). Buildings discovered at these three Tarascan sites are similar in nature and may represent an evolutionary development of the yácata or simply provide evidence for the diversification of the yácata form. Moreover, it is evident that these structures contain circular characteristics and represent monumental/public architecture.



Figure 8: Partially reconstructed yácata at Tzintzuntzan.



Figure 9: Aerial photograph of the five yácatas at Tzintzuntzan (© 2011 LORE-LPB) (Bush 2012).

In the Nahuatl area, specifically the site of Cuicuilco in the Basin of Mexico, it contains circular architecture vastly different from that found among the Tarascans. Thought to represent a temple, this building is 27.43 meters in height and a base diameter of 117.96 meters (Pollock 1936). The size of this structure displays the magnitude of this monumental pyramid (figure 10). The pyramid of Cuicuilco emphasizes the importance of circular characteristics in Mesoamerican architecture. An erected cone of rock located on the very top platform is a unique characteristic; further emphasizing the variety of circular architecture present in Mesoamerica.



Figure 10: The circular pyramid of Cuiculco taken April 1997 (Gonzalez et. al. 2000).

Different from other types of circular architecture previously discussed, the structures from Xochicalco in the state of Morelos are circular chambers. Located in a hill known as Los Amates, the chambers are .2 to 2.5 meters in diameter at the base and rise a few meters in height to form a cone with a 50 centimeter diameter tip (Pollock 1936). More recent research at Xochicalco has shed light on other circular architecture present at the site. Located along the east-west avenue are 20 circular platforms known as the “Calendrical Altars” which may represent the 20 day-names of the 260-day ritual almanac (*Tonalpohualli*) (Molina and Kowalski 1999). Even though circular architecture is thought to be rare in Mesoamerica, there are at least two types of circular buildings present at the site of Xochicalco.

Similar to Xochicalco, two types of buildings with circular characteristics also reside at the Zapotec site of Quiengola. The first structure is conical in shape and resembles a traditional tiered wedding cake. The second building is a cylindrical stone platform only 3.34 meters in

diameter and .83 meters high (Pollock 1936). While small in size compared to other monumental architecture, its location in a plaza in front of a pyramid suggests its importance.

In the Maya region, the site of Chichén Itzá contains three different circular buildings which include Caracol, Casa Redondo, and 3B1. Caracol is a perfect example of a buildings' function in conjunction with its size reflecting its monumental nature. Situated on top of three platforms with large central staircase, Caracol is a round building with a domed topped that functioned as an observatory for the tracking of solar and lunar years as well as the Venus cycle (figure 11) (Evans 2008). Unlike Caracol, Casa Redondo is smaller in size which contains a round building built upon a circular platform with an existing stairway to the west. The diameter of the platform is 17 meters and the building on top of it has a diameter of 9 meters with a height of 3-4 meters (Pollock 1936). Overall, the total size of this structure suggests its monumental stature. Similar to Casa Redondo is structure 3B1. However, the preservation of this particular structure is poor and only 1 meter of exposed molding of a possible door jam suggests it is circular in form (Pollock 1936). Its measurements of 20 meters in diameter and 4 meters in height (Pollock 1936) put it in the monumental architecture category.

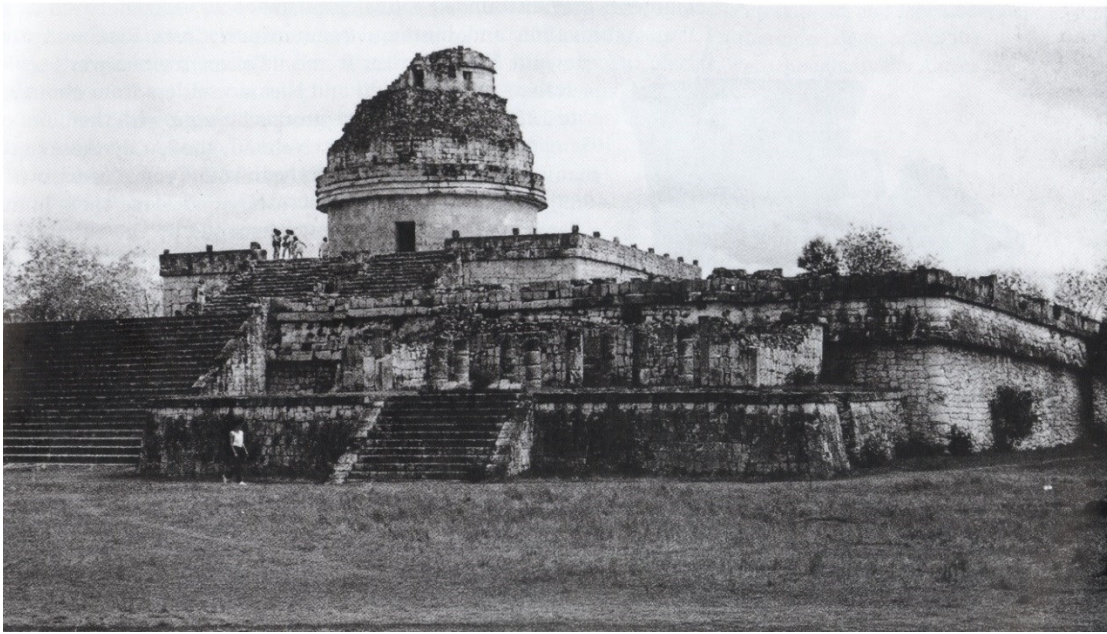


Figure 11: At Chichén Itzá, Caracol functioned as an observatory (Evans 2008).

In contrast to monumental circular architecture, examples of circular buildings that represent residential architecture are limited to only a few sites in Mesoamerica. Cuexcomate, Calipo, and Site 3 represent three Aztec-Period sites located in Morelos containing circular structures; which closely resemble those circular features present at Angamuco. The site of Cuexcomate was named after the many ruined cuexcomates found at its location. Within these three sites two different types of circular structures were found: Type A contains no internal floor that is surrounded by double-row circular stone wall and Type B is a low stone platform with a cobble floor (Smith et al 1989). In total only eleven circular structures were uncovered and were similar in size, averaging 4.1 meters in diameter (Smith et al 1989). Evidence such as maize or bean remnants were not found within the three excavated circular structures, thus they could not be definitively categorized as granaries. Even though excavation data did not provide very much information, examining the location of these structures provides further insight into their possible function. For instance, the five structures located in patio groups suggest similar

socioeconomic status (Smith et al 1989) whereas the three structures adjacent to isolated houses would suggest a higher socioeconomic status. Even though Calipo and Site 3 represent smaller settlements compared to Cuexcomate; these two sites contained the same Type A and Type B structures found at Cuexcomate.

In contrast to the circular monumental architecture at Chichén Itzá, a residential building with a circular form was also discovered at the site. This structure is known as 2B3, a possible private dwelling. Creating the structure is a low round stone wall with a 7 meter diameter that rests atop a rectangular platform (Pollock 1936). The wall is only .50 meters in height but debris suggests the wall was taller which probably held a wooden wall that held a thatched roof (Pollock 1936).

Another Mayan site, Ake, also contains circular architecture. A depression built into the fill of a mound is the basic form of this structure and possesses a few similarities to some circular buildings at Angamuco. However, evidence from the structure at Ake suggests that it contained a stone circular corbel vault or dome as its roof, making the total chamber 3.5 meters tall (Pollock 1936). This description implies a smaller structure size; also its height and domed roof could represent a possible sweatbath.

The examples discussed above clearly show that architecture with circular characteristics is not rare; however, they have not received similar attention given to rectangular architecture. Both monumental and residential buildings display complete or partial circular characteristics in the different cultures of Mesoamerica. A variety of circular architecture exists throughout the different regions in Mexico. In fact it is possible for a variety of circular structures to reside within the same site; such is the case of Angamuco.

CHAPTER 5: REGIONAL AND SITE BACKGROUND

Physical Characteristics of the Lake Pátzcuaro Basin

The geopolitical core of the Purépecha Empire was the Lake Pátzcuaro Basin (LPB) located in West Mexico in the state of Michoacán (figure 12). An area with a diverse environment, the LPB provided a setting well suited for the development of the Purépecha Empire. In total the LPB includes an area of 934 km² with an average elevation of 2369 m asl (Israde-Alcantar et al 2005; Metcalfe et al 2007). Situated at the southern border of the Mexican Plateau within the Mexican Volcanic Belt, the basin was once part of the Río Lerma drainage system; however, compartmentalization by lava flows resulted in the creation of a closed basin (Chacon-Torres and Muzquiz-Iribe 1997; Metcalfe et al 2007; Israde-Alcántara et al 2005).



Figure 12: Map of the location of Michoacán and the Lake Pátzcuaro Basin (© ESRI World Continents).

As a closed basin, Lake Pátzcuaro relies predominately on rainfall with very little from drainage; as a consequence the lake level continuously fluctuates. Creation of Lake Pátzcuaro resulted from volcanic activity during the late Pleistocene and the topography of the basin contains multiple volcanic mountains (Chacon-Torres and Muzquiz-Irube 1997) displaying the everlasting presence of volcanic activity in the basin. Annual rainfall averages 950 mm mainly accumulating during the period from May to September with temperatures as high as 88°F in the summer and as low as 43°F in the winter on average (Bradbury 2000).

Pine, oak, and fir forests naturally grow over the volcanic landscape; however, today not many forests remain in the basin. Over exploitation of these forest resources for housing

construction, railroad installation, firewood, and clearing for agricultural land resulted in evident deforestation of the basin's contemporary landscape (Works and Hadley 2004). Deforestation increases erosion in the basin, which is a result of human-environment interaction in conjunction with naturally occurring climatic processes. As a result, we as archaeologists must identify the environment and landscape of the LPB during the time of the Purépecha Empire. The geological origins and environmental attributes are less than hospitable in some areas in the LPB, but none the less, the basin provided an environment for the development and success of the Purépecha culture.

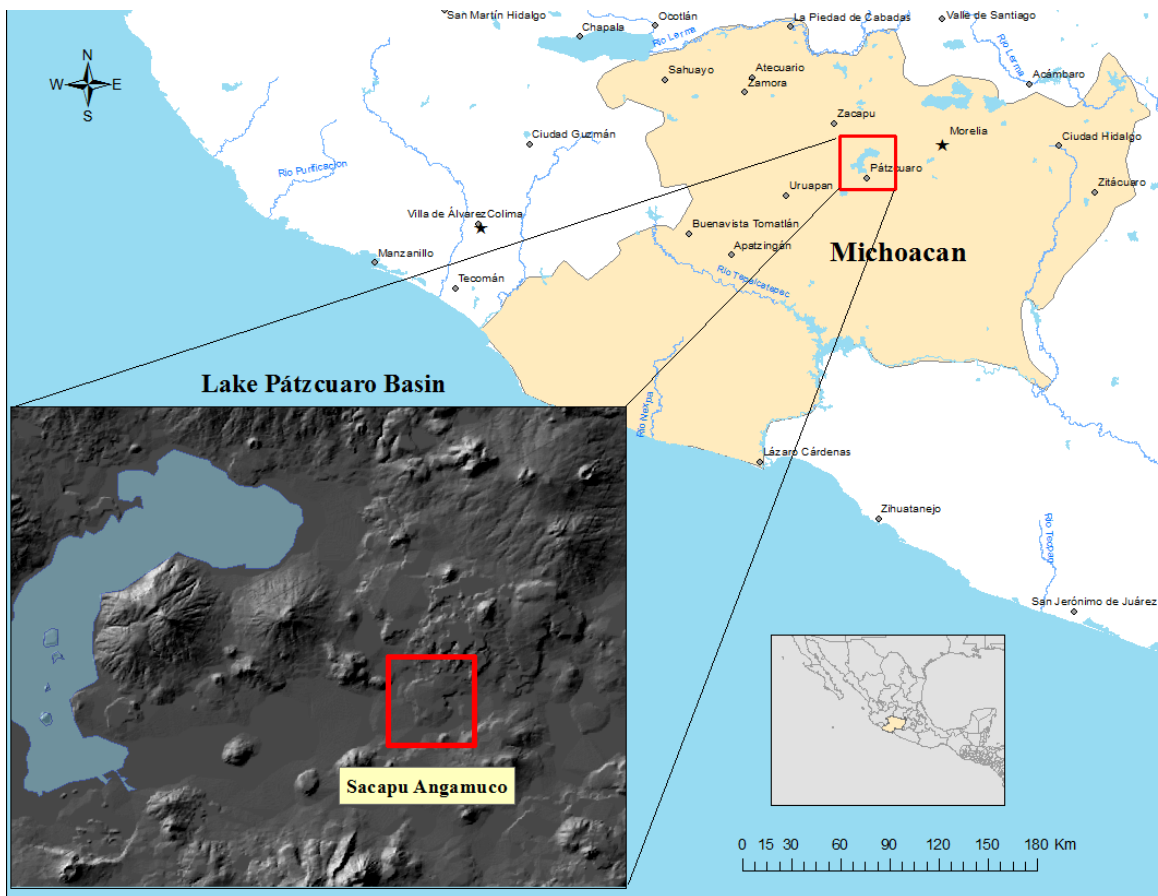


Figure 13: Map of the State of Michoacán with an inset of the Lake Pátzcuaro Basin and the location of Angamuco (©ESRI World Continents and World Water Bodies)

Cultural History of the LPB and Region

Compared to other regions of Mesoamerica little archaeological research has been conducted within the LPB (figure 13). Minimal information and evidence exist for the early human occupation in the LPB before the development of the Tarascan State. Furthermore, one of the best ethnohistoric records documenting the prehistory of the Purépecha is the *Relación de Michoacán* written by a Franciscan priest on his visit to Michoacán in 1525 or 1526 (Craine and Reindorp 1970). Time periods used in Mesoamerica with local phases for this region are displayed in Table 1 and referenced in this work.

Table 1: Identification of Mesoamerican time periods and local phases for the Lake Pátzcuaro Basin, Michoacán (Pollard 2008; Fisher 2010, 2011, 2012).

Period	Date Range	Local Phases
Late Postclassic	A.D. 1350-1525	Uacusecha
Middle Postclassic	A.D. 1000/1100-1350	Angamuco
Early Postclassic	A.D. 900-1000/1100	
Epiclassic	A.D. 600/700-900	Lupe-La Joya
Middle Classic	A.D. 550-600/700	Jaracuaro
Early Classic	A.D. 350-550	Loma Alta 3
Late/Terminal Preclassic	150 B.C.-A.D. 350	Loma Alta 1 & 2
Middle Preclassic	≥500-150 B.C.	Chupicuaro

The first evidence for occupation of the LPB occurs during the Late Preclassic and Early Classic Periods. Identification of Loma Alta Phase 2 and 3 sites in the LPB, Zacapu Basin, and Cuitzeo Basin represent growing settlements in size and number in the region. The Loma Alta

site in the Zacapu Basin (A.D. 250-350) possesses architecture, particularly sunken plaza/platform structures, and a new burial tradition that provides evidence for the start of social rankings. In fact it is around the Early Classic, Middle Classic, and Epiclassic periods when change in the social and political atmospheres in the region starts. Between A.D. 400-900, the distinguishable Mesoamerican ceremonial center appears in the region. This new addition to these settlements provided a larger opening for the development of social stratification.

Moving further into the Epiclassic and into the Early Postclassic (A.D. 900-1000/1100), the region starts to develop; setting the stage for the future empire. The trade of metal objects as well as the widespread movement of red-on-cream ceramics represents interaction and merging of the different cultural populations within Michoacán (Pollard 1993). Distinguishing Tarascan objects include the architectural *yácata*, copper and metal objects, unique tripod ceramic tobacco pipes (figure 14), and green obsidian pieces from the *Ucareo/Zinepacuaro* mine. In fact, it was during this time that the Zacapu Basin experienced an influx in population (Beekman 2010). Evidence such as this suggests the commencement of the empire earlier than previously suggested. Previous research (Pollard 1993) has demarked the Middle Postclassic as the birth of the Purépecha Empire; however, current research from Angamuco has established its initial occupation beginning in the Epiclassic and Early Postclassic periods (Fisher et al 2011; Fisher and Leisz 2013). This new evidence has changed the sequence of Tarascan state formation. It was not until the Middle Postclassic (A.D. 1000/1100-1350) that a centralized hierarchical bureaucracy appeared. Furthermore, *Tariacuri* emerged as the first true *cazonci* (king) of the Purépecha Empire.



Figure 14: Twisted stemmed tripod tobacco pipe from Angamuco (© 2013 LORE-LPB).

The Late Postclassic defines the most prosperous years and consequently the final years of the Purépecha Empire. With the emergence of a centralized state, control came in the form of a royal dynasty, administrators, other government officials, and elites whom assumed positions elevating them above the rest of the population; their power spread throughout the empire creating an evident distinction in social classes. At the fullest extent of its boundaries in A.D. 1470 (figure 15), the established tributary system kept the empire functioning. The tributary system extended into the three separate environmental regions within the Purépecha territory. These regions include the northern subhumid zone of the Mexican Plateau; the higher elevated cool, moisture forestlands; and the southern arid zone in the Rio Balsas depression (Malmstrom 1995).

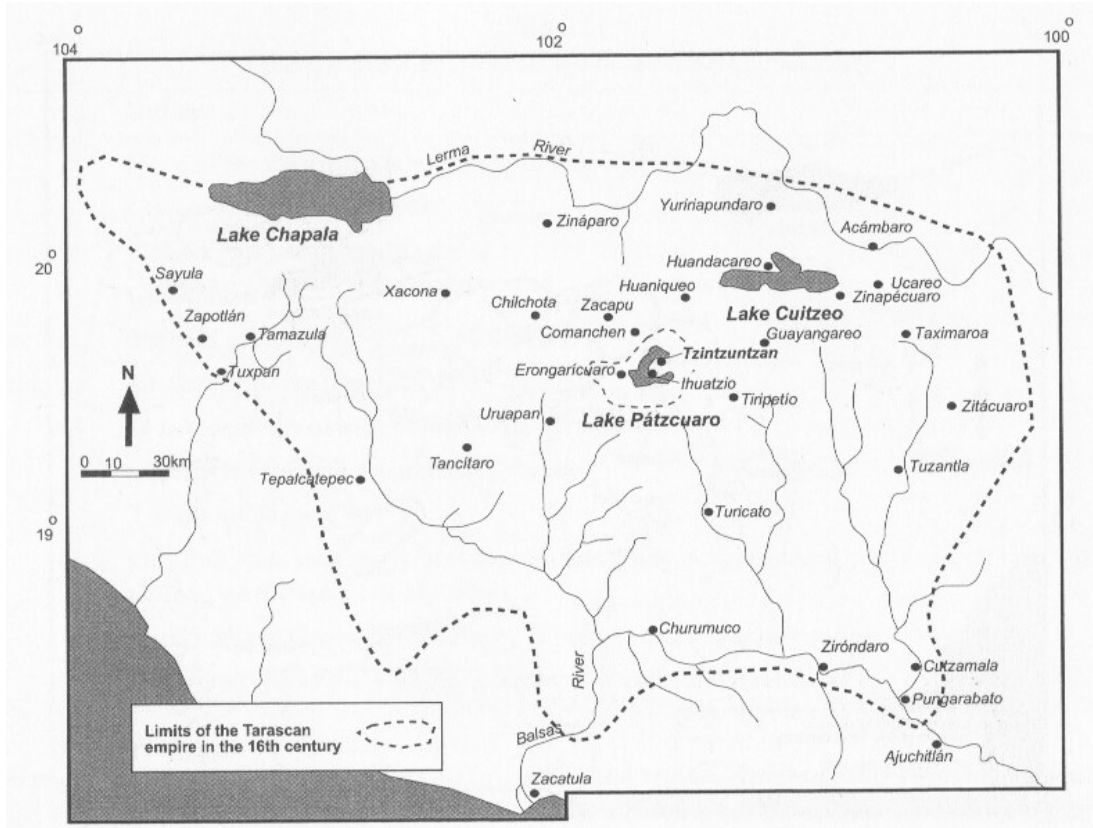


Figure 15: Map of the full extent of the Purépecha Empire (Pollard 2003, after Pollard 2003: map 1.2)

After Tariacuri's death, Tzintzuntzan replaced Pátzcuaro as the capital and remained as such until the Spanish Conquest. Tzintzuntzan also represented one of the major religious centers in addition to Ihuatzio (figure 16) and Pátzcuaro demarked by the construction of a yácata(s) and other pyramid types (Pollard 2003b). These religious centers embodied a new religious ideology of the Tarascan identity and Empire. The existence of an empire with a fully cohesive Tarascan identity stems from the establishment of a social system “produced by the conscious subordination and replacement of local ethnic-linguistic status as the basis for social or political power” (Pollard 2003b:80). A cohesive identity resulted in the people's loyalty to the empire; which allowed for a strong military hold of their borders, especially against the Aztecs. Successfully holding the borders against the Aztec displays the power and significance of the

Purépecha Empire; however, it was not enough to overcome the Spanish Conquest. At the time of conquest an estimated 80,000 people inhabited the LPB and the empire spanned the modern state of Michoacán with its farthest boundaries falling within adjacent areas of the modern states of Guerrero, Jalisco, Guanajuato encompassing over 65,000 km² (Pollard 2008, 1993, 1980). In A.D. 1522, the Spanish took control of Tzintzuntzan and the empire; but still allowed Tangáxuan II (Pollard 1993) to rule as a figurehead until his execution in A.D. 1530.



Figure 16: The dual pyramids at Ihuatzio, Michoacán.

Cultural history of the LPB and the region contains minimal information compared to other regions of Mexico. Furthermore, mystery still surrounds the origins of the Purépecha and their initial settlement into the LPB. From the data available, other areas of the region, especially the Zacapu Basin, experienced more development before the LPB. As the population of the basin increased so did the need for more resources. The lakeshore zone was highly fertile and one of the more desired types of land for agriculture, but because of lake level fluctuations

the amount of available lakeshore did not provide a constant amount of agriculturally available land. To help increase space available for agriculture, slopes of the basin were modified with human constructed terraces. The continually fluctuating level effected settlement patterns, resource availability, and social structure. During the Epiclassic and Early Postclassic periods the Purépecha Empire emerged; then in the course of the Middle Postclassic a major growth and expansion occurred in the LPB. Moving into the Late Postclassic, the empire rose into a great power to rival their Aztec neighbors; however, their time of greatness swiftly died with the Spanish Conquest of Tzintzuntzan and the entire Empire in A.D. 1522. Consequently the abandonment of the once stable built environment maintained by the Tarascans collapsed with the conquest acting as a catalyst for the abandonment of large-scale landscapes prone to erosion (Fisher 2005). As a result, deciphering the Purépecha prehistory continues to be difficult as erosion affects archeological remains and environmental history of the LPB.

Angamuco Background

The site of Angamuco was first documented by Fisher and was partially surveyed during 2009-2011 using traditional archaeological techniques. In 2011 LiDAR was obtained for 9 km² of the lower malpaís and indicates the presence of thousands of architectural features. Excavation at portions of the site are currently ongoing by Fisher. This work is documented in technical reports to the Mexican Government including Fisher 2009-2012 and academic publications (Fisher 2005; Fisher and Leisz 2013; Chase et al 2012; Fisher et al 2011).

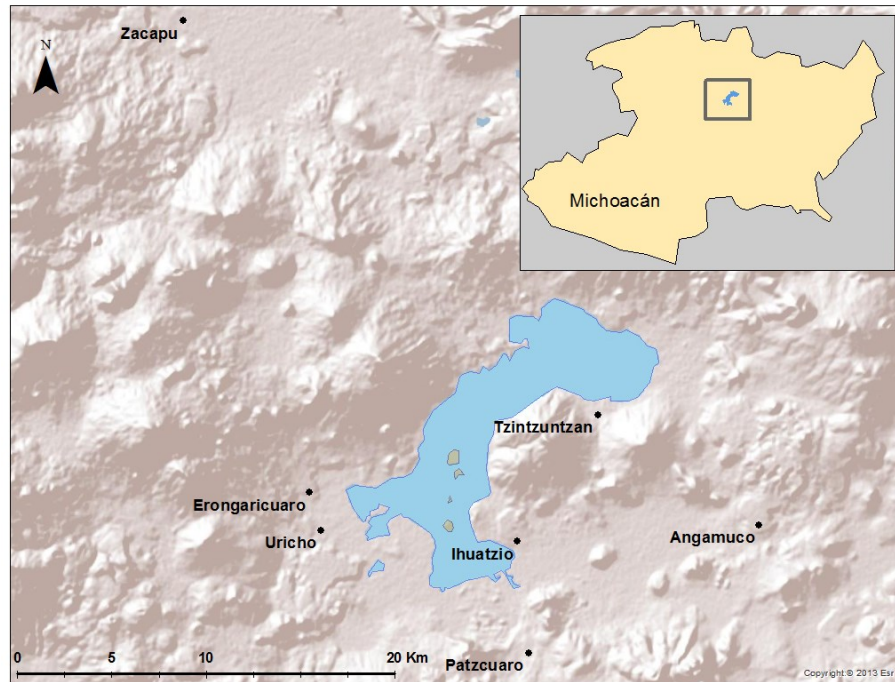


Figure 17: Map of key cities in the Lake Pátzcuaro Basin (©ESRI World_Shaded_Relief)

Angamuco lies to the east of Lake Pátzcuaro and to the southeast of Tzintzuntzan (figure 17). The site sits upon a geologically recent basaltic lava flow known as a malpaís resulting from a mid-Holocene (~6000 BP) volcanic event (Israde-Alcantara et al 2005) that forms the eastern edge of the LPB. An abundance of stone created during the lava flow provided an excellent building material source. However, this rocky environment encompasses many ridges and valleys with a minimal amount of flat surfaces. In order to live in such a rugged environment, the Purépecha worked with the natural landscape and modified it when necessary. The most noticeable modification is seen throughout the entire site in the form of terraces, both for agricultural and habitation purposes.

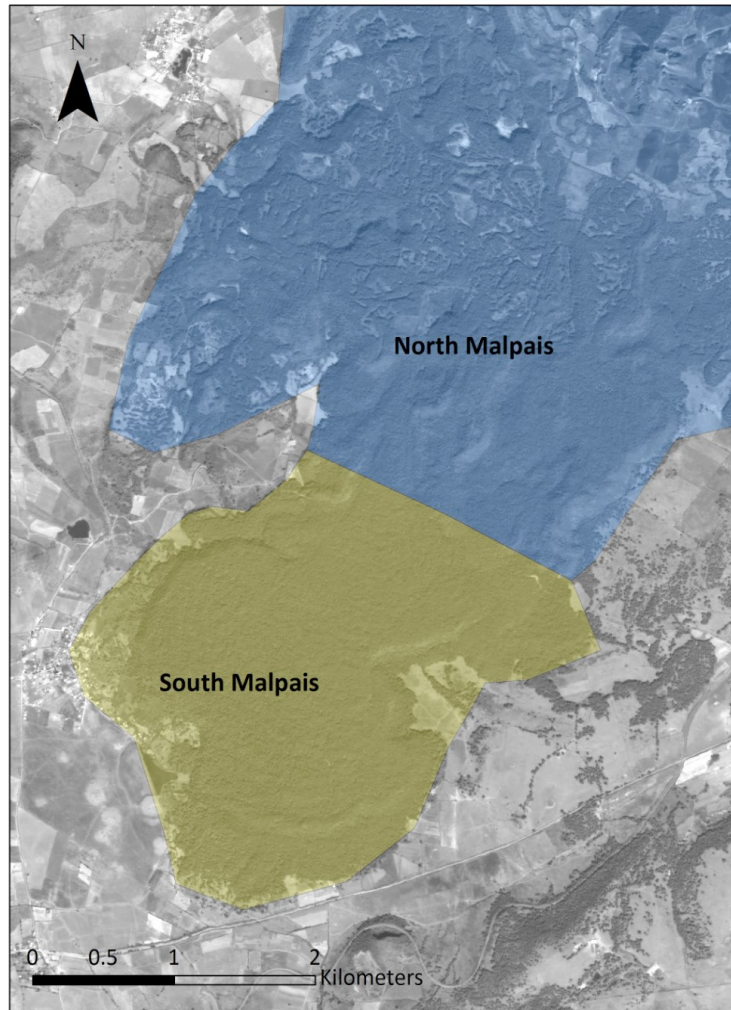


Figure 18: Map identifying the North and South malpaís zones at Angamuco (imagery processed by the Alaska Satellite Facility [PRISM © JAXA 2010]) (Bush 2012).

The malpaís consists of a northern and a southern area (figure 18); however, only part of the southern region has been extensively surveyed. Since survey began in 2009, the southern malpaís has been the focus of the LORE-LPB Project. In total the southern malpaís includes 12 km² and LiDAR data for 9 km² of this area shows a densely populated rugged landscape. Overall, 4 km² have been surveyed; but data collected in 2009 is not included in this study, making 2.5 km² the total area surveyed in 2010 and 2011. Furthermore, the surveyed southern section enabled the identification of two sections, the Zona Alta and the Zona Baja (figure 19).

The identification of these two areas is based upon physical environmental conditions, architectural features present, and intra-site group separations. A large ridge separates these two zones at an elevation of 2120 m (Fisher 2010, 2011, 2012) representing the transition from the Zona Baja to the Zona Alta. Resulting from these factors, it has been determined that the Zona Alta consists mainly of residential areas and the Zona Baja includes the majority of public and civic-ceremonial areas. Data collected during the 2013 excavation season contained artifacts dating the site from A.D. 900-1520 with three distinct phases of occupation (Fisher and Leisz 2013). Based upon the relationship of architectural features, functional zones have been identified: a) Zona 1: Civic-Ceremonial (Zona Baja); b) Zona 2: Elite 1 (Zona Baja); c) Zona 3: Elite 2/Commoner (Zona Alta); and d) Zona 4: Commoner (Zona Alta) (Fisher 2010). These two areas will be discussed in further detail below.

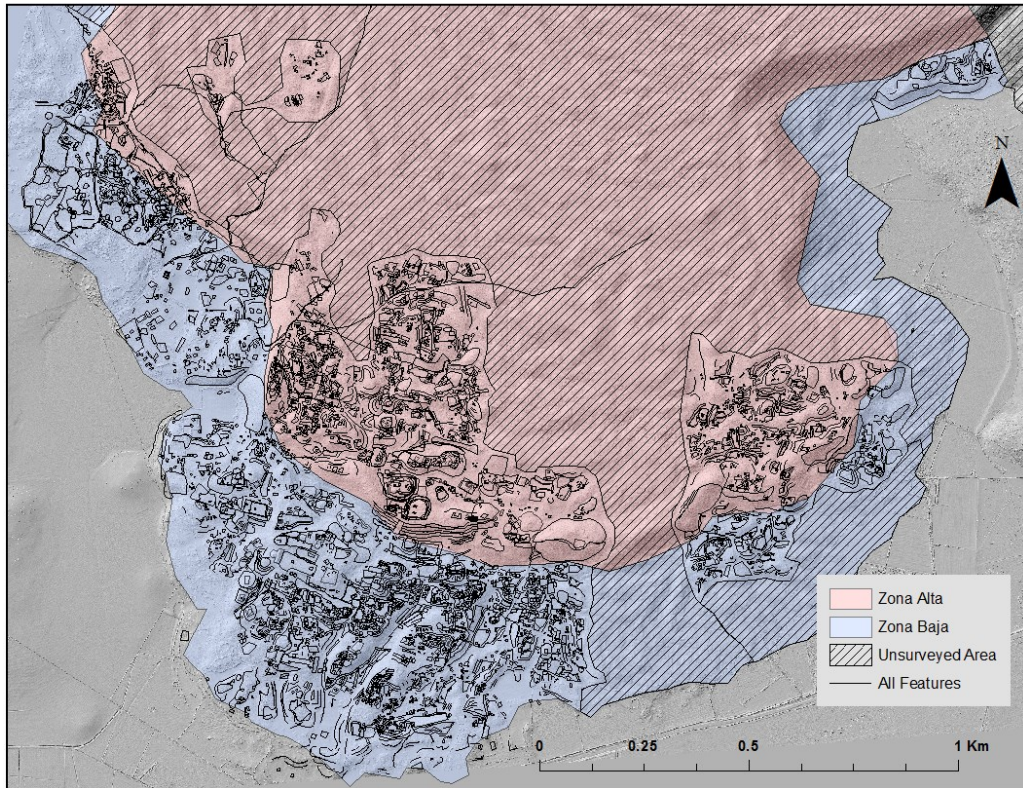


Figure 19: Map displaying the boundaries of the Zona Baja and the Zona Alta with all of the recorded structures (LiDAR data by Merrick & Company © 2011 LORE-LPB)

The Zona Baja refers to the smaller portion of the site that resides at a lower elevation than the rest of the site referred to as the Zona Alta. Located on the edge of the malpaís and contemporary cultivated fields, the Zona Baja has encountered a high level of human and animal disturbances due to agriculture activity and cattle grazing. Unfortunately, contemporary fields are dispersed within areas of archaeological remains creating a partial picture of the original structure of the site in certain areas of the Zona Baja. Because this portion of the site is more easily accessible than the Zona Alta there is a high level of disturbance from people and cattle. As a result of contemporary inhabitation, structures have been disturbed and rocks removed to build modern walls. So in the Zona Baja, identification of features is more difficult due to the existence of modern structures built with archaeological remains. After surveying 1.26 km² of

the Zona Baja, we concluded that this area contains large architectural buildings surrounding large open plazas. Monumental and civic-ceremonial architecture represents the majority of architecture present in the Zona Baja. For example, two pyramids have already been discovered, the yácata (MO 5037) and MO 2768. Even though the archaeological remains in this area are poorly preserved due to human and cattle disturbances, the large scale architecture has allowed for an understanding of the layout of the Zona Baja.

Located at a higher elevation than the Zona Baja, the Zona Alta is located in the central area of the site. In total the Zona Alta encompasses 2.7 km² with only .62 km² surveyed. At a higher elevation, the terrain becomes more diversified with valleys, large slopes, and outcrops of natural rock. Change in the size, population, and distribution of the architecture signifies the change from the monumental Zona Baja to the residential Zona Alta. Buildings per square meter increase in number while in general the size decreases and in some areas neighborhoods are visibly apparent. While the large roadways present in the Zona Baja continue across the Zona Alta, smaller roadways also exist in this higher elevation zone. The presence of smaller roadways supports the Zona Alta as a residential area opposed to a civic-ceremonial zone. Even residing at a higher elevation, the Zona Alta still contains areas of poor preservation as a result of cattle grazing and firewood collection.

This chapter describes the Purépecha Empire and introduces the Purépecha site of Angamuco. Archaeological data and ethnohistoric documents have helped to unravel the mystery of the Purépecha people and the emergence of their empire. The *Relación de Michoacán* (Crain and Reindorp 1970) represents the best ethnohistoric document available for the Purépecha. However, data from Angamuco tells a slightly different story than the ethnohistoric documents, creating more mystery of the Purépecha Empire. The malpaís

represents a minimally fertile and rugged landscape; however, an extensive city in terms of area, population, and complexity resided on this landform dating to A.D. 900-1520. Occupation dates from Angamuco question the long accepted Middle Postclassic period as the emergence of the Tarascan State (Fisher and Leisz 2013, Fisher et al 2011, Fisher 2010, 2011, 2012).

Furthermore, yácatas are uniquely Purépecha and are monumental civic-ceremonial architecture that represents significant religious centers. Thus with this line of reasoning, Angamuco likely signified a religious center before its abandonment. Deciphering the circular features at Angamuco may additionally shed light on the mysteries surrounding the birth and growth of the Purépecha Empire.

CHAPTER 6: METHODS

The data analyzed in this thesis is from the 2010 and 2011 survey seasons combined with data from the 2013 excavation season. The field and survey methods employed at Angamuco are unique to the region. Geographic Positioning Systems (GPS) (figure 20) and LiDAR airborne imagery provided a detailed full coverage survey without the employment of a total station. Use of a total station would have been difficult in the rugged terrain of the malpaís, making GPS a more advantageous technique. Furthermore, the advanced technology of GPS and LiDAR provide more efficient and accurate data in the field (Fisher and Leisz 2013, Fisher 2010, 2011, 2012).



Figure 20: LORE-LPB crew member recording features using a Trimble GPS unit (© 2011 LORE-LPB)

Before beginning surveying, survey blocks of 1000 m² were created and assigned unique labels (e.g. J18, I18); which provided a quadrant grid over the malpais (figure 21). Each survey block was divided into quarters of 250 m²: northwest, northeast, southwest, and southeast. This grid system was loaded onto Trimble GPS units and groups of 2 to 3 people were assigned specific quadrants to survey throughout the field season. Use of LiDAR has allowed the LORE-LPB team to better pinpoint possible advantageous areas for survey. Detailed methodologies involving LiDAR and survey techniques can be found in Fisher et al 2011; Chase et al 2012; Fisher and Leisz 2013; Fisher 2010, 2011, and 2012.

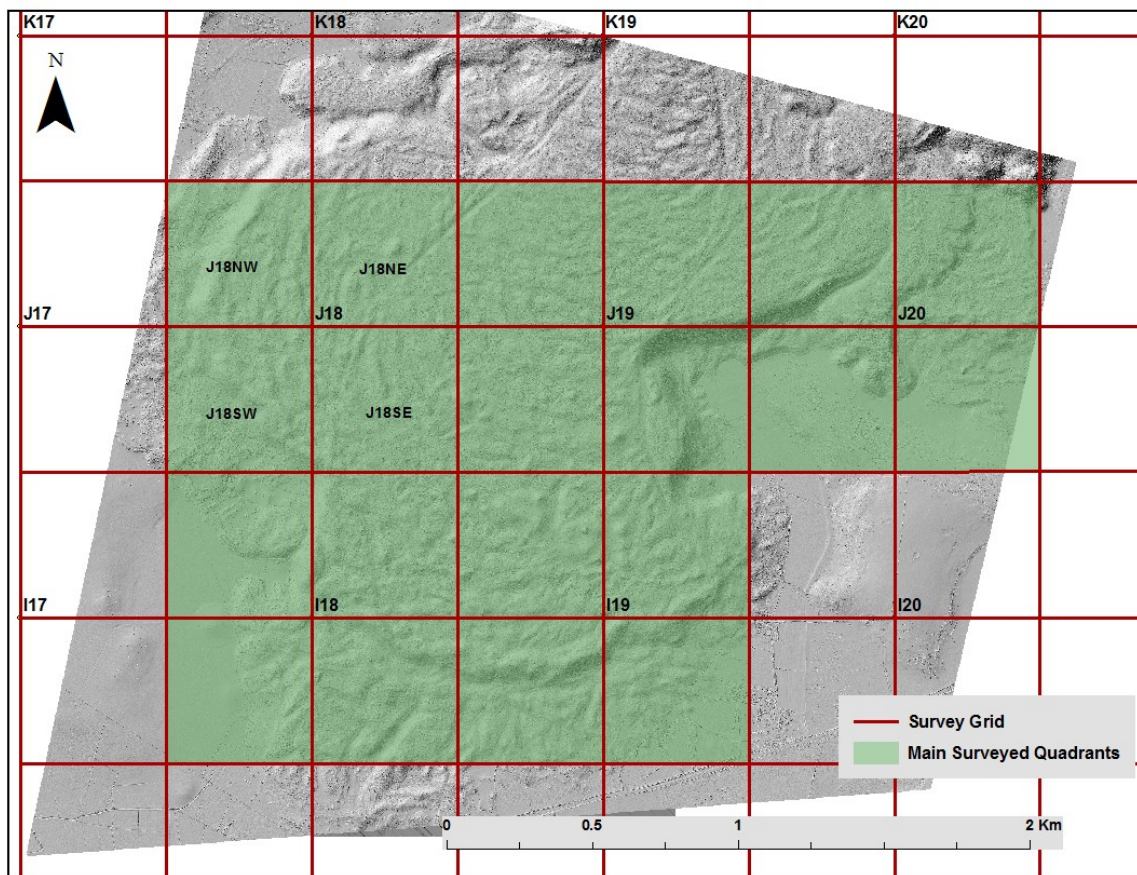


Figure 21: Map showing quadrants and labeling system (LiDAR data by Merrick & Company © 2011 LORE-LPB)

The collected GPS data from the 2010 and 2011 field seasons were used for the analysis in this thesis (Fisher 2010, 2011, 2012; Fisher and Leisz 2013). For the spatial analysis of these data, ArcMap provided the perfect conduit for this type of analysis. Employment of tools such as spatial autocorrelation, average nearest neighbor, and multi-distance spatial clustering analysis helped to determine spatial patterns of the circular structures at Angamuco. Results of these tools and others are discussed in the following chapter.

Data collected during the 2011 field season does not include field measurements for the recorded structures, including the diameters for circular features. Overlaying the GPS data for each circular structure with a DEM produced from the LiDAR identifies a highly accurate recording of the structures in the field. Even with this small margin of error, diameter measurements for the 2010 and 2011 circular features were measured in ArcMap using the measuring tool. A north-south and east-west diameter was measured in meters for each circular structure. Both measurements represent the diameter from the outer exterior wall to the outer exterior wall. Except for a few circular features, only the exterior wall outline was recorded for all other circular structures and the interior wall was not additionally recorded. So in order to keep measurements consistent, all analyses in this thesis use the distance between exterior edges as the diameter. Once every feature had two diameter values, the larger diameter was used for the analysis. The larger diameter value was chosen for consistency between structures and it better embodies the true diameter measurement while employed by the Purépecha. Furthermore, recorded small diameter values could possibly be a result of wall collapse and other poor preservation issues and thus not representing the original diameter value.

After establishing the diameters for all 296 circular features, a basic statistical investigation was possible. Basic descriptive statistics and other specific statistical enquiries

were generated using ArcMap and Excel. Both programs configured the same results for the basic enquiries; such as mean, standard deviation, etc. However, Excel calculated additional equations that included sample variance and skewness. Using Excel, creation of a histogram with 0.25 m groups visually displays the diameter value distribution (figure 22).

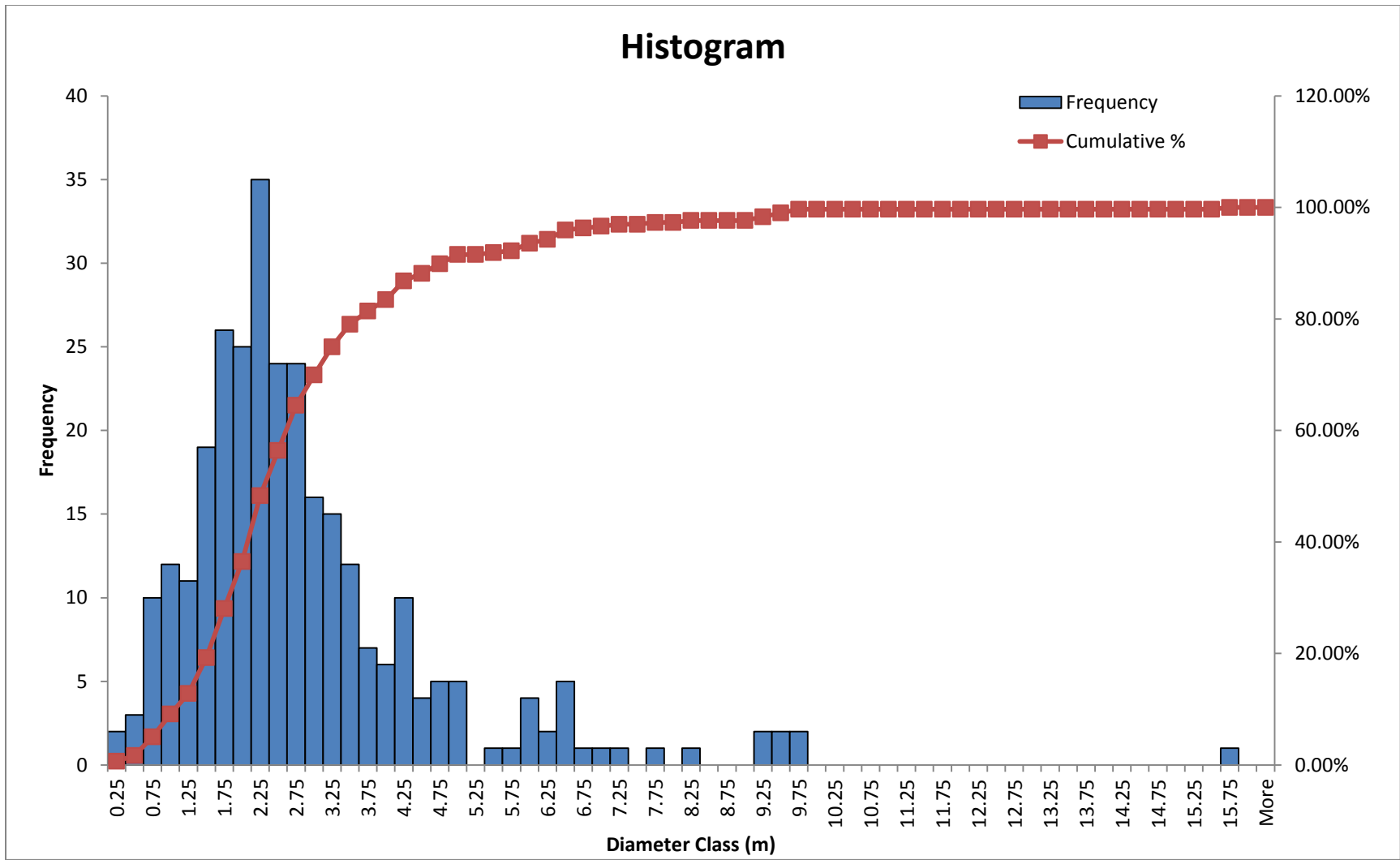


Figure 22: Histogram of circular feature diameters with a 0.25m bin.

Methods employed by the LORE-LPB team (Fisher 2010, 2011, 2012; Fisher and Leisz 2013) provide detailed and precise data of the remains of Angamuco preserved on the rugged landscape of a malpaís. Advanced technology of LiDAR with advances in GPS and GIS allow for efficient and accurate data collection. Moreover, spatial analysis of the GIS data highlights unique perspectives and avenues to examine the data collected at Angamuco. These advanced techniques and analysis tools are new to the region, making Angamuco a methodologically unique site and vastly adding information to the previous archaeological work done in the Lake Pátzcuaro Basin.

CHAPTER 7: MORPHOLOGICAL DISCUSSION

In total, Angamuco contains 296 architectural features with circular characteristics and the morphological types of these structures will be discussed below in greater detail. Table 2 provides an overview of each morphological type of circular feature identified at Angamuco.

Table 2: Provides a description and example(s) for each morphological type identified at Angamuco.

Form/Morphology	Description	Examples
Platform/Mound (Non-cuexcomate or non-temezcal) (Type A)	Includes a general platform or mound (at least 2 levels) found at Angamuco that are completely circular or have circular components.	Yácata, circular platform
Ground Level (Type B)	Round stone foundation built directly upon the surface of the ground.	Cuexcomate, room, temezcal.
Circular structure on a Mound (Type C)	Stepped rectangular/square mound of stone with a circular or D-shaped depression in the top of the mound with a stairway.	Cuexcomate
Semi-Subterranean (Type D)	Built partially into the ground or into another feature, such as a mound, platform, or terrace.	Cuexcomate, temezcal
Platform with Foundation (Type E)	Paved square/rectangular stone platform (Avg. 0.5 m high) with circular stone foundation built on top. Platforms are small in size making them hard to identify.	Cuexcomate

The following discussion presents the general morphological characteristics of these features by class. Ground level circular structures are the most common circular building recorded at Angamuco. This type of circular structure consists of a round stone foundation built directly upon the surface of the ground. The dimensions of this type of structure vary across the

site as well as their function. Buildings recorded within this category can represent granaries, rooms, or temezcals; possessing a range of diameters. For instance, located at the top of a terraced ridge that separates the Zona Alta and Zona Baja, MC 7087 represents a cuexcomate associated with an edificio compuesto. This structure consists of a 1 meter circular stone foundation that contains an entrance on its east side (figure 23). MC 7087 embodies one of the few well preserved ground level circular features identified as a cuexcomate at Angamuco. Reconstructed, MC 7087 would sit upon a stone foundation consisting of one or two more levels that was plastered together holding a wattle and daub vasiform superstructure with an open top covered by a roof. Figure 24 presents a drawing of a cuexcomate that provides a representation of a possibly reconstructed MC 7087 (Figure 23).



Figure 23: Field photo of MC 7087 (© 2011 LORE-LPB).

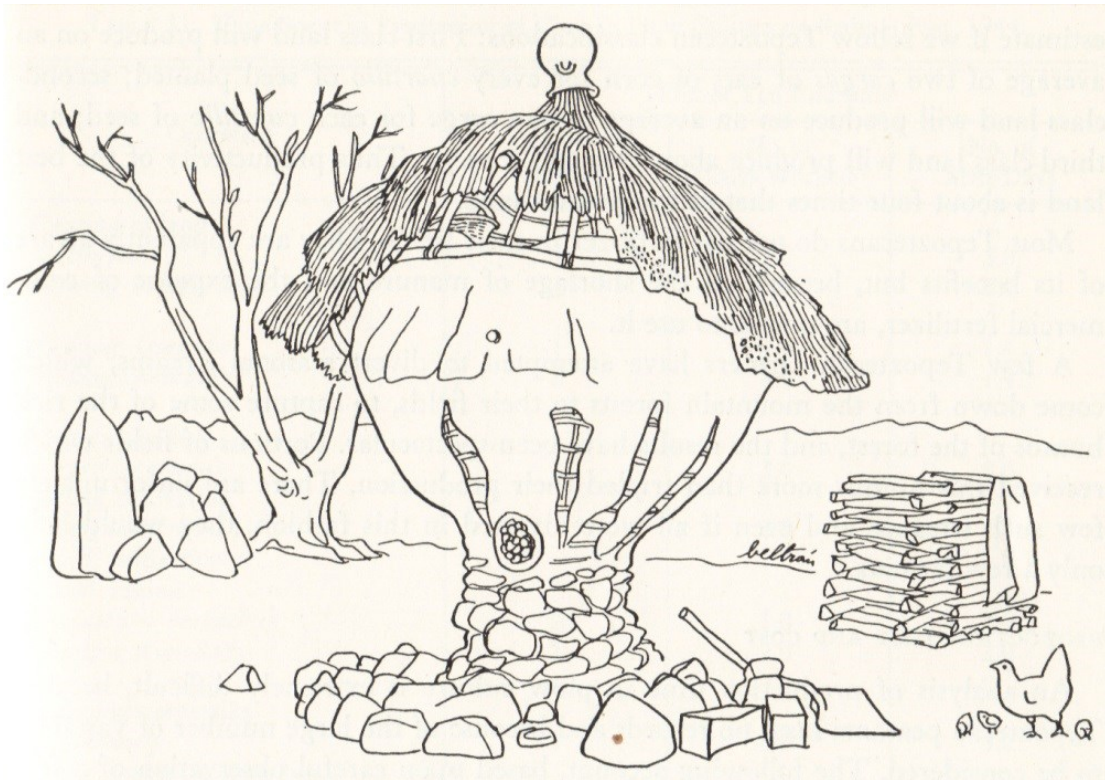


Figure 24: Drawing of a cuexcomate (Lewis 1951, pg. 143).

Ground level circular structures can also function as circular rooms. However, identification of circular rooms based on diameter size and within the context of surrounding features is not always easy; thus misidentification is possible. On the main platform MC 5169, a 9.57 m diameter room with a private patio is another example of a ground level circular structure (refer to figure 40). Even though this is one of the larger structures found within the main platform, the lack of characteristics evident of a temezcal, such as a bench or drain and its larger size strongly suggests that this structure represents a circular room. While it is clear that circular rooms do exist within the site, the majority of recorded ground level circular structures, based upon diameter, significant attributes, and context likely represent cuexcomates or temezcals.

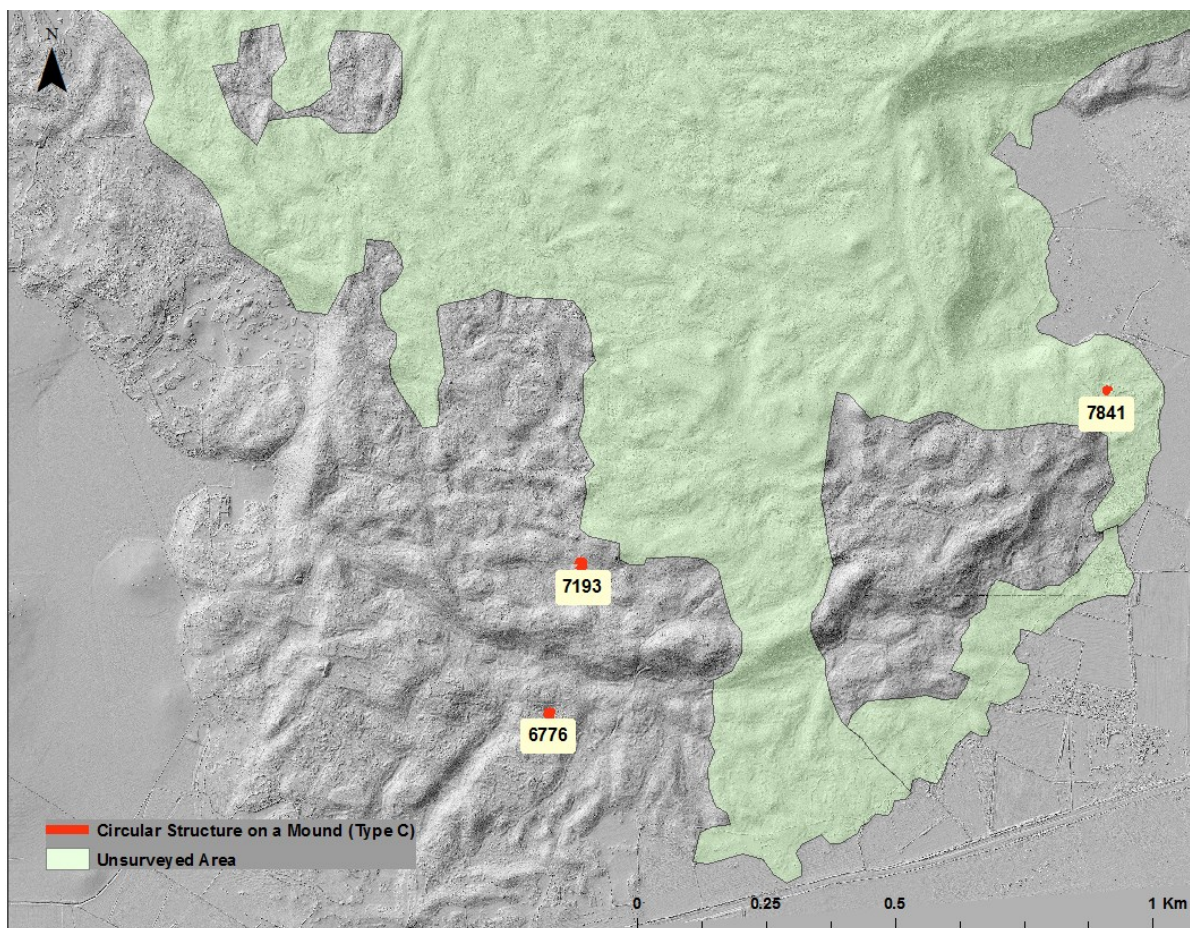


Figure 25: Map of the location of the three features categorized as a circular structure on a mound (LiDAR data by Merrick & Company © 2011 LORE-LPB).

The next type of circular structure also contains a combination of circular and rectangular characteristics like a *yácata*; which I have labeled as a circular structure on a mound. In total three features of this building type have been recorded at the site of Angamuco: MC 6776, MC 7193, and MC 7841. Figure 25 shows the location of these three features at the site. This type of structure consists of a mound (MO) made of stone with a plan form ranging from rectangular to square to almost circular. However, due to poor preservation it is difficult to positively identify the actual shape of the mound. Built into the top of the mound is a circular depression, surrounded by stone walls built upon the top surface of the mound. Given the preservation of these features it is possible that these depressions were not entirely circular, but contained a

straight wall forming a D-shape. In addition, the mound is stepped and contains a stairway to the top surface. A better preserved example is MC 7841 (figures 26-28). Built within the top of the 3 meter high MO 7839, the cuexcomate superstructure of MC 7841 would have been on display. If this cuexcomate was highly visible it would have reflected wealth and influence as well as limited access.



Figure 26: Looking north at MC 7841 and MO 7839 (© 2011 LORE-LPB).



Figure 27: Close up of MC 7841(© 2011 LORE-LPB).



Figure 28: MC 7841 and MO 7839 looking north with a LORE-LPB team member as a scale reference (© 2011 LORE-LPB).

Further west in the Zona Alta, MC 7193 resides in a slightly different context. Situated at the base of a habitation terrace (TR 7209) and within close proximity to a residential area, MC 7193 was for residential use. However, structures in this area are generously spaced and spacious suggesting a possible elite residential neighborhood. Differentiating from MC 7941, detailed measurements recorded for a field sketch (figure 29) identify a more circular plan form with a clearly imbedded staircase in the southwest side of the mound. The stairs leading up the mound provided easier access to the granary. A well-defined wall portion of the circular interior is still intact (figure 30) and the foundation of the round interior is clearly visible from the base of the mound (figure 31).

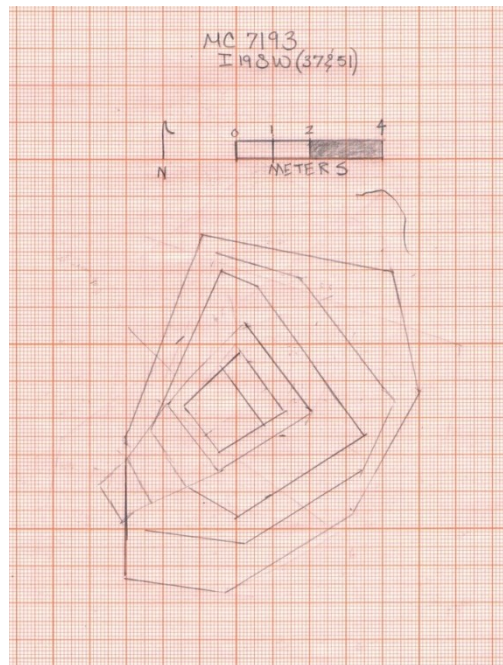


Figure 29: Field sketch of MC 7193 (© 2011 LORE-LPB).



Figure 30: Circular depression of MC 7193 (© 2011 LORE-LPB).



Figure 31: Complete view of MC 7193 (looking NE) (© 2011 LORE-LPB).

Differing from MC 7841 and MC 7193, MC 6776 resides in a densely populated residential area. This residential area includes two medium mounds demarking an entrance into an intricate and interconnected building complex highlighting a possible elite residential area. Evident in figure 32 and figure 33, MC 6776 is not as well preserved and defined as the other two structures. Moreover, it is located adjacent to a platform with a foundation type of circular feature, MC 7955.



Figure 32: MC 6776(© 2011 LORE-LPB).



Figure 33: MC 6776 interior (© 2011 LORE-LPB)

Even though this particular type of structure is large in size, it is not considered monumental architecture based upon its location in residential areas and the smaller diameter of the circular depression. Maybe not large enough to be considered monumental architecture, a greater investment of time and material, along with location, associated features and rarity imply a wealthy owner. A display of such wealth would be located within a wealthy neighborhood or a public storage area, thus suggesting limited access. Prominent display of a storage structure demonstrates the power and influence of the owner. Compared to other storage structures in Mesoamerica, these three circular structures on a mound (7841, 7193, and 6776) are unique to Angamuco.

Representing another structure category is the semi-subterranean pit containing rounded features. Most commonly found built into existing buildings and features such as platforms, terraces and mounds; poor preservation made it difficult to identify this particular type of circular

structure. Although not as common as ground level circular structures, this type of round feature is also commonly found at the site. Specifically, semi-subterranean structures that are built into terraces or hillslopes are an important type of building within this category. Some of these structures are found built into the wall of terraces and contain an opening in the front. Such a form could represent cuexcomates, suggesting easier access from agricultural producing terraces to food storage containers. Examples of such a structure are located on a habitation terraced area on the north eastern slope of the main platform containing this type of circular feature; MC 5147 and MC 5149. Never very large (less than 1 m at Angamuco) in diameter, their smaller sizes and locations of some semi-subterranean features possibly suggest temporary or short term storage needs (Uruñuela, Guevara, and Plunket et al 2012).

One set of examples are located on a hillslope that forms the division between the Zona Alta and Zona Baja. Hypothesized as a public storage area (Fisher 2011 and 2012), this hillslope is estimated to contain 12 structures but poor preservation makes this number difficult to confirm. Ranging from 1.3 m to 2.9 m in diameter these features are all located within 5 meters of each other implying the same function and associated ownership. Diameters such as these form the most common size at Angamuco and based on the cluster and outlier analysis, this group does not contain a statistically significant clustering of high or low values. Even if this grouping is not statistically significant, this clustering is still significant in terms of sociopolitical and socioeconomic information at Angamuco. Based upon the small size of these granaries and the lack of possible administrative buildings surrounding them, as well as the lack of control or possible management, these structures are not similar to Inka state storage facilities (Jenkins 2001). The high density of similarly sized cuexcomates situated along a major roadway with no other features in close proximity is unique to this site. In fact, there is no other instance of a

large number of similarly sized circular structures within close proximity located anywhere else at the site. During the Postclassic Period, tribute to the State was usually paid in the form of food and what better way to visually represent the power and wealth of the king than to locate tribute granaries adjacent to a highly traveled roadway. It is also possible that these structures acted as relief granaries for unexpected situations such as drought or war. If this area does in fact represent storage public context then understanding the spatial distribution of these features would be even more important to understanding Purépecha storage and how it is influenced by and influences sociopolitical and economic relationships. Semi-subterranean structures are common and mainly built into terraces, hillslopes, and other architectural features (i.e. mounds and platforms).

A small paved platform with a foundation represents the final form of circular architecture at Angamuco. This type of structure possesses a small rectangular to square stone platform, no more than .50 meters in height. Atop this paved platform resides a circular stone wall foundation. This foundation represents the base of a cuexcomate. Unfortunately, due to their small size and poor preservation as well as the dense vegetation cover, only two of these structures have been positively identified and recorded. These features include MC 7955 and MC 7957; both fit into category 1 in diameter size (figure 34-35). Compared to circular features at other Mesoamerican sites, this particular feature resembles the type B structures from the site of Cuexcomate and two other Aztec-Period sites in Morelos (Smith et al. 1989). It is possible that a number of small platforms documented did not contain any remains of circular walls and thus were not recorded in the circular feature category when logged during survey or they may not have been identifiable under the dense vegetation.



Figure 34: MC 7955, Type E. Next to MC 6776 (Type C) (© 2011 LORE-LPB).



Figure 35: MC 7957 (© 2011 LORE-LPB).

Doorways and Stone Bottoms

Once the type of circular structure is identified, secondary attributes can help further identify the function of the feature. The presence or absence of a doorway represents a secondary characteristic that affects the function categorization of circular features at Angamuco. Enclosed circular structures or circular structures with an opening (doorway) represent the broadest and most easily identifiable attribute of Angamuco's circular architecture typology. If a doorway exists then the feature is considered a granary, on the other hand if no doorway is present then the feature is considered a circular room. Of course this is a general distinction for categorizing circular structures and exceptions do exist. A circular feature with an entrance is considered a granary because some form of circulation in the form of an opening in the foundation was necessary for maize storage success. Although identifying doorways is difficult due to wall collapse and other poor preservation issues, evidence of an entrance is not always evident. It is also important to consider that ambiguity reflected in the presence or absence of an entrance. Granaries, as well as temezcals, will not contain an entrance in every case; but in actuality a doorway may have only been evident as part of the superstructure. As a result the foundations identified during survey may or may not have contained openings in their superstructures. This situation could also be true in regards to circular rooms.



Figure 36: MC 7087 well preserved with a distinct entrance (© 2011 LORE-LPB).



Figure 37: MC 2232. Example of a circular feature without an entrance and unpaved. The red shows an estimate of the features interior boundaries (© 2011 LORE-LPB).

Whether or not a doorway exists in a building provides clues as to the type of circular structure and its function. Platforms are the only circular structure category where the absence or

presence of an entrance is not part of the typology. Figures 36 and 37 exhibit the difference between a feature with an entrance and a feature without an entrance. Furthermore, it is important to understand that a doorway is not a determining characteristic for identify a cuexcomate or a temezcal; it is only one possible distinguishing characteristic.

Cuexcomates do not have entrances in their foundation; instead the presence of an opening serves the purpose of air circulation (Alpuche 2005). Some granaries may have multiple openings, but this type of round foundation, up to this point in the research, has not been identified at Angamuco. The need for air circulation is important, however; an opening is not always clearly evident on the circular structures documented. Just because an opening is not evident or does not exist on a circular feature, this does not automatically destroy the possibility that the structure is a cuexcomate. Another area for air circulation could replace the common opening in the foundation, or poor preservation and collapse could all explain the non-existence of an entrance in a possible cuexcomate.

The presence of an entrance or the lack therefor contains less ambiguity in association with temezcals than with granaries. Regardless of the shape or size, a sweatbath requires an entrance. Doorways for temezcals can be problematic in regards to the foundation or superstructure containing the doorway. Entrances built into the foundation are easier to detect than those built into the superstructure due to preservation issues. At Angamuco only foundations remain and it is difficult to identify doorways in the circular structures. The presence or absence of an entrance, in association with temezcals, does not solely determine its function but must be connected with other defining characteristics such as a bench.

Stone bottoms provide an additional identifying functional attribute. Stone bottoms occur in some circular features at Angamuco; making this a secondary attribute in the identification

process. Similar to doorways, wall collapses and poor preservation make identifying stone bottoms very difficult because a wall collapse could be mistaken for a stone floor. Also it is important not to misinterpret a foundation on a small platform with a stone bottom. Unlike the Type E (platform with a foundation), a stone bottom does not extend beyond the foundation like the platform. Minimal identification of stone floors at Angamuco has hindered our understanding of its relationship to location, feature type, and socio-economic implications. However, it is hypothesized that stone bottoms are evident of wealth because they would take more material and time to build.

Descriptive Statistics

Given the above discussion and the robust survey results it was possible to run several types of statistical analysis on the Angamuco circular structures. The following sections present these results for both the diameter and location of this common type of architecture. The results presented below represent spatial analysis and statistics tools along with general descriptive statistics (Table 3).

Table 3: This table displays the results of the descriptive statistics for Populations A and B. Population A includes all circular features recorded and Population B includes those circular structures with a diameter of 7.5 m or less.

	Population A	Population B
Count	296	287
Minimum	0.16 m	0.16 m
Maximum	15.67 m	7.14 m
Mean	2.765 m	2.55 m
Mode	1.9 m	1.9 m
Median	2.3 m	2.26 m
Range	15.51 m	6.98 m
Sample Variance	3.44	1.8
Standard Deviation	1.86	1.34
Skewness	2.45	1.06
Kurtosis	9.94	1.19
Standard Error	0.11	0.08

Before utilizing any spatial analysis tools, basic descriptive statistics were calculated using ArcMap and Microsoft Excel. Table 3 displays the descriptive statistics for the complete data set for the diameter of every circular structure thus far recorded at Angamuco. Diameters range from 0.16 m to 15.67 m with an average of 2.73 meters. Smaller diameters, less than 1, present a problem because features this small could not represent a cuexcomate or sweatbath. It is possible, however; that these diameters are a result of survey or ArcMap measuring error, but will still be considered in the data analysis. This is evident in the minimum diameter of 0.16 m.

The data is skewed to the right; a positive skewness of 2.45 with the majority of the diameter values greater than the mean. In conjunction with the skewness, the kurtosis result of 9.94 represent a data set which displays a distinct peak near the mean and has a heavy tail that has declined somewhat rapidly. The standard deviation indicates that the average difference between diameters is 1.86 m from the mean of 2.765 m. Results for both the sample variance and standard deviation indicate that the diameter measurements contain a low level of variation. A low degree of dispersion of diameter values reflects a stronger case for labeling circular structures at Sacapu Angamuco as granaries or sweatbaths. Results of the descriptive statistics present a low level of diameter variation and combining this with spatial analysis will verify the deliberate construction of cuexcomates and temezcals at Sacapu Angamuco.

Diameter Statistics

Distinguishing between the different diameter sizes of circular structures helps to distinguish between granaries and sweatbaths. Due to the poor preservation of the majority of these features, diameter size is the best way to identify different circular structures and their spatial patterns. Determining the diameter for some of these features was easy while for a portion of these structures it was more difficult because of their oblong shape. In order to solve this problem, a north/south and an east/west diameter was measured for each circular building based on the digitized GPS data. To determine the diameter of those structures with an oblong form, the larger of the two measured diameters was used. The largest dimension was used because it is most representative of the diameter of the circular structure compared to the smaller dimension. All of the diameters were based upon the exterior dimensions. The exterior dimensions represent the most standardized process to analyze the data; whereas the interior diameter could not always be discerned from the GIS data. Overall, the majority of diameters

fall between 0.16 and 5 meters with the largest circular feature possessing a diameter of 15.67 meters. Diameter range and frequency is best represented with a histogram, which visually displays a pattern of circular structures recorded at the site based on their diameter. Natural diameter breaks identified in ArcMap were compared to this histogram to help identify the correct diameter categories. Figure 22 presents a histogram of diameter distribution based on 0.25 m increments for all the recorded circular structures. This histogram represents an asymmetrical bimodal positively skewed distribution. Based on this distribution shape, structures measuring over 7.5 m in diameter represent outliers that are skewing the distribution results. In order to better understand the distribution a histogram based on a 0.15 m bin was created without those diameters measuring greater than 7.5 m (figure 38). This second histogram also presents an asymmetric distribution but is multimodal and positively skewed. With the removal of those outlier diameter anomalies, clear diameter groupings previously not identified are now evident.

Once the diameter had been determined, natural groupings identified by the histogram and ArcMap were then used to create distinct categories for the Angamuco data based on the size of the structure. Based on the histogram the circular structures were categorized into five classes (table 4): 1) Diameter less than or equal to 3.5 meters; 2) Diameter greater than 3.5 meters and less than 5 meters; 3) Diameter greater than or equal to 5 meters and less than or equal to 7.5 meters; 4) Diameter greater than 7.5 meters and less than or equal to 10 meters; and 5) Diameter greater than 10 meters and less than or equal to 16 meters.

Table 4: Table identifying the circular feature categories based on diameter size with structure frequency.

Categories	Number of Features
≤ 3.5 m diameter	234
> 3.5 m and < 5 m diameter	36
≥ 5 m and ≤ 7.5 m diameter	17
> 7.5 m and ≤ 10 m diameter	8
> 10 m and ≤ 16 m diameter	1
Total	296

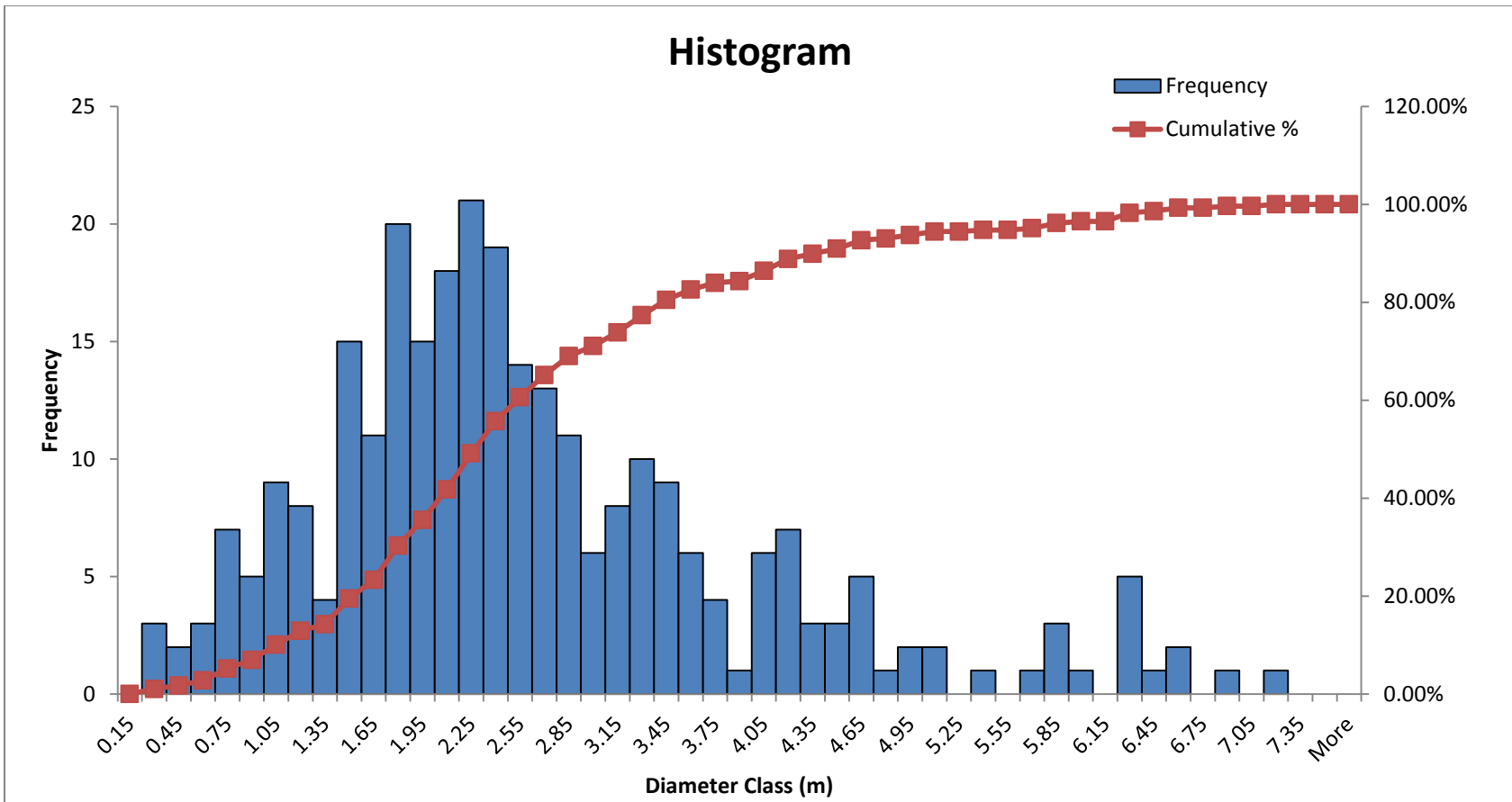


Figure 38: Histogram of circular feature diameters less than or equal to 7.50 m and based on a 0.15 m bin.

Diameter size highlights the primary characteristics for deciphering the function of the circular features at Angamuco. Figure 39 visually represents the distribution of these diameter classifications. Minimally, sweatbaths must be large enough to fit one adult and a granary must be able to fit a family's supply of maize. Based on natural groups present in the histogram, the diameter categories are also a reflection of realistic sizes for granaries and temezcals. In general, cuexcomates do not measure over 5 m and sweatbaths tend to measure over 7.5 m. However, category 3 represents some ambiguity, since it is possible that large granaries or small temezcals could fit into this diameter grouping. Furthermore, granaries recorded at the Purépecha site of Zacapu average 1.4 m in diameter (Michelet and Forest 2012) supporting these categories. In addition, granary diameters averaging 4.1 m recorded at Cuexcomate and two other Morelos (Smith et al 1989) sites provide further support. Two cuexcomate styles measuring 3 to 5.80 m and 3.21 to 3.96 m in diameter from contemporary Morelos confirm that diameters greater than 5 m do exist for granaries (Alpuche 2005).

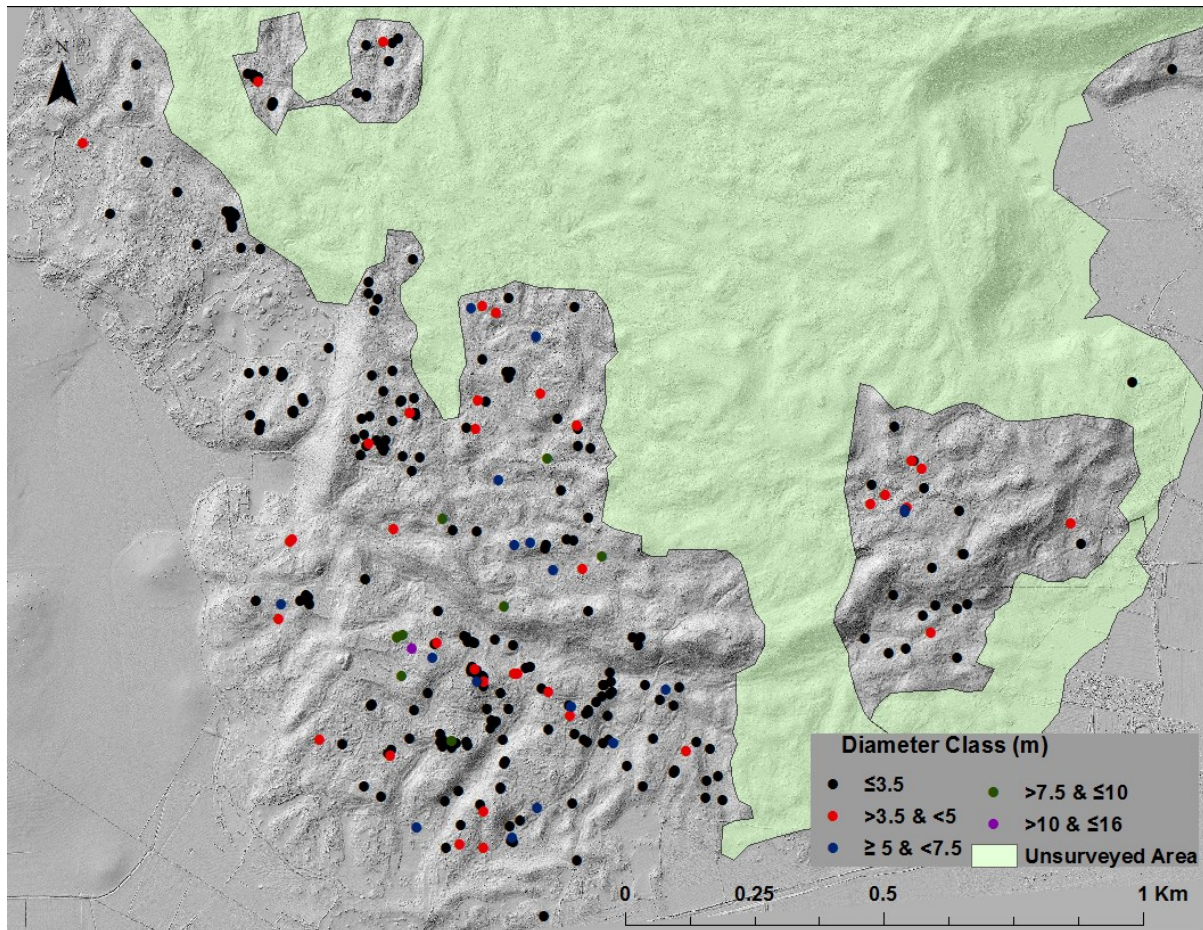


Figure 39: Map identifying the location of the different diameter categories at Angamuco (LiDAR data by Merrick & Company © 2011 LORE-LPB).

Categories 4 and 5 presented in table 4 symbolize an anomaly within the circular structures, large outlier diameters. These two categories include nine circular features possessing a diameter greater than 7.5 meters. Figure 40 highlights an important area of these large circular structures called the main platform at Angamuco (Fisher 2012, Fisher and Leisz 2013). The cluster and outlier analysis (Anselin Local Morans I) identified this specific area as a significantly statistical clustering of high values (HH). Distribution of these larger circular structures is important to deciphering the link between function, diameter size, and location. Located on the main platform, northeast and east of the yácata, possessing diameters greater than 8 meters, I hypothesize that these circular buildings are too large to signify cuexcomates.

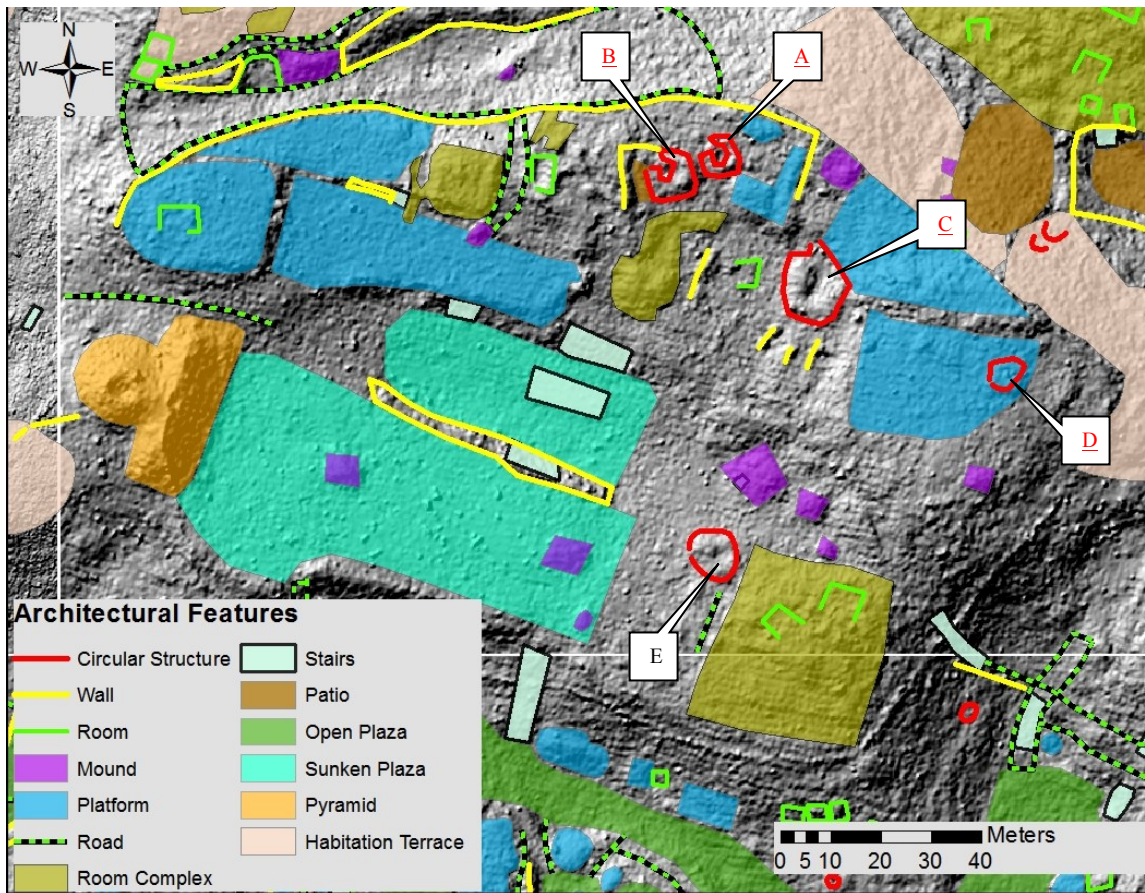


Figure 40: Highlighted area of the Yácata and the main platform; displaying the circular structures in context with other architectural features. List of circular features (MC) include: A) 5167; B) 5169; C) 5179 (15.67 m); D) 5191; E) 5203 (LiDAR data by Merrick & Company © 2011 LORE-LPB).

Considering their large diameters, these circular structures represent sweatbaths and are considered monumental architecture. In addition, while some of these buildings are in better condition than others, benches are clearly evident in one of the structures; demonstrating a sweatbath function. Highly significant is MC 5179; which contains identifiable preserved benches with an exterior diameter of 15.67 meters and an interior diameter of 7.34 meters. In conjunction with the size of these structures, access is restricted based upon associated architectural features. Particularly, distinct entrances into these temezcals are highly restricted compared to other zones of the site labeled as elite or commoner residential areas. For instance, the entrance to MC 5169 is surrounded by a wall and is associated with an edificio compuesto

(complex of rooms) further restricting access to the entrance. Therefore, the entrance to MC 5169 can only be accessed through a private patio; creating limited access to this circular structure. Restricted access, location, and size contribute to the monumental civic-ceremonial function of these particular circular structures as well as suggesting their sweatbath function. These identified temezcals on the main platform represent outliers in size, but fit into a specific morphological category with other circular structures.

Statistical Spatial Distribution

Spatial statistics are a set of techniques used to describe and model spatial relationships, distributions, patterns, and processes with the use of space (i.e. length, area, proximity, etc.) directly in their mathematics (ESRI 2011). All of the spatial tools used in this analysis are considered inferential statistics that contain a null hypothesis. The null hypothesis for all of the tools used, except for the multi-distance spatial cluster analysis (Ripley's K-function), states that there is no spatial clustering of the values (complete spatial randomness) (ESRI 2012, 2011). In addition to the null hypothesis, the results of these tools are given in the form of a z-score and p-value; whose values determine the acceptance or rejection of the null hypothesis. In addition, each tool contained the weighted parameter of the diameter for each feature.

For consistency among the results, a distance of 350 meters was used as the fixed distance band for the parameter, conceptualization of spatial relationships. A fixed distance ensured that every tool analyzed the features within the same neighborhood context; otherwise variations in the results are possible and could provide different conclusions. The incremental spatial autocorrelation tool helps you to choose your fixed distance band by calculating a z-score at multiple distances. Results of the tool are presented graphically, which identifies the distance in which the spatial clustering of the data is most intense (figure 41; ESRI 2011).

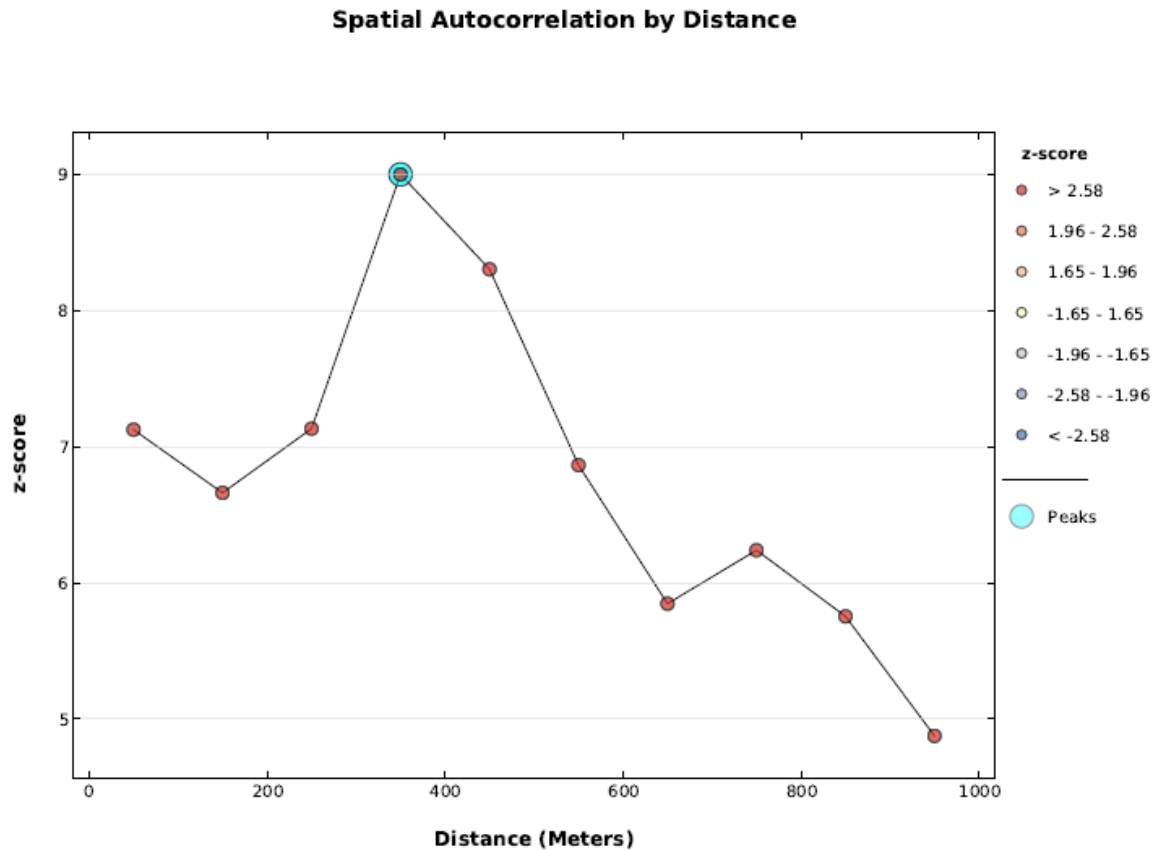


Figure 41: Graphical representation of the Incremental Spatial Autocorrelation tool. The peak located at 350 indicates the distance for the highest intensity of clustering present in the data.

The average nearest neighbor represents the initial inferential spatial statistics tool used to identify clustering in this analysis. The average nearest neighbor is a spatial statistics tool used to identify the presence or absence of clustering in a data set based on nearest neighbor distances. In order to determine if a data set exhibits clustering or dispersion, the average nearest neighbor calculates a ratio based upon measurements between each feature’s centroid and the centroid of its nearest neighbor. This tool did not have an option for a fixed distance band, so the tool automatically calculated the study area. The observed average distance divided by an expected average distance provides the ratio; which results in a clustered (less than 1) or dispersed (greater than 1) data set (ESRI 2012). A z-score and p-value are also calculated and their statistical

significance determines whether or not to reject the null hypothesis; which states that features are randomly distributed (ESRI 2012). At Angamuco the data set resulted in a 0.482198 ratio and a z-score of -17.042769; thus representing a clustered spatial population with less than 1% likelihood that the clustered pattern could be the result of random chance. This result identifies a spatial awareness of population growth and designated spaces for granary and sweatbath location, size, and duplication.

The high-low clustering (Getis-Ord General G) tool measures clustering or dispersion through the concentration of high and low values in the study area. Results from the high-low clustering of the circular structures' diameter present a small p-value of .001739 which is statistically significant, thus rejecting the null hypothesis. Because the p-value has rejected the null hypothesis, the z-score and General G index are considered to determine the presence of clustering. A positive z-score with a larger observed General G than the expected General G index indicate high diameter values clustered at the site.

Multi-distance spatial cluster analysis (Ripley's K-Function) provides another spatial statistics tool to help determine the presence of spatial patterns. The size of the neighborhood reflects the key component to the function of this tool. As the study area changes so does the distance between features; which affect the level of clustering. Overall "the tool computes the average number of neighboring features associated with each feature" (ESRI 2012:1) over a range of distances. This tool is helpful to use when identifying possible clustering within the whole site and then at the smaller scale of neighborhoods. When using this tool it is important to consider the use of a weighted field; the diameter value is an example of a weighted field. Wither weighted or unweighted, the relation between complete spatial randomness and the feature spatial distribution is always evaluated (ESRI 2012). For the circular feature data, the

tool was processed considering an unweighted field and a weighted field with the structure diameter. To determine clustering based solely on feature location, a confidence envelope of zero (permutations) and an unweighted field were used to determine a baseline for clustering (figure 42). Additionally the tool was computed with a confidence envelope of nine (permutations) with both weighted and unweighted fields (figures 43 and 44). All three of the graphs show evidence of clustering since the observed K is larger than the expected K at any given distance. Furthermore, the observed K value is larger than the high confidence envelope in all three graphs which indicates a statistically significant spatial clustering at that distance.

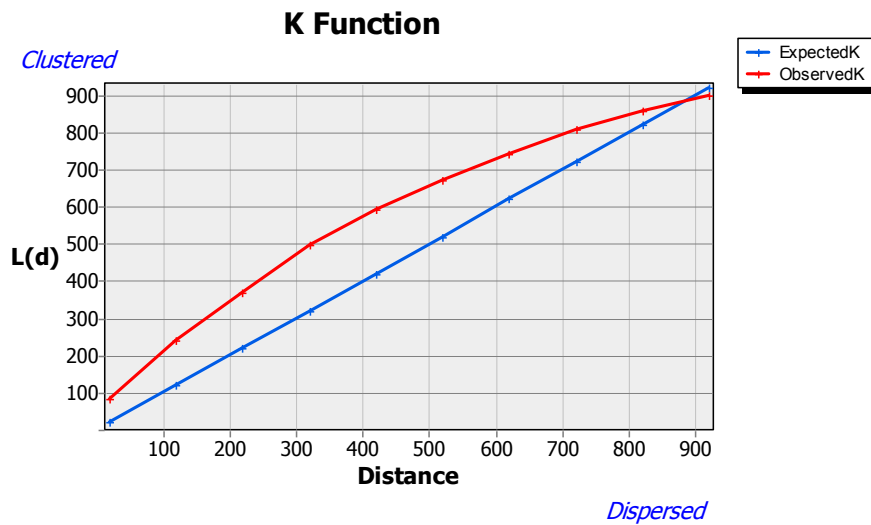


Figure 42: Graphic display of the multi-distance spatial cluster analysis for circular features with 10 distance bands containing a zero (permutations) confidence envelope and unweighted.

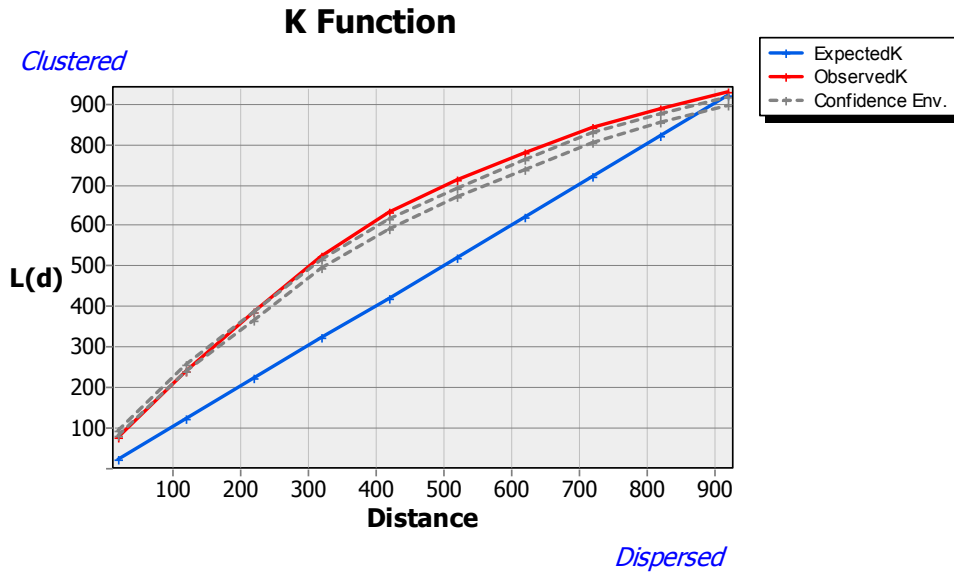


Figure 43: Graphic display of the multi-distance spatial cluster analysis for circular features with 10 distance bands containing a nine (permutations) confidence envelope and weighted.

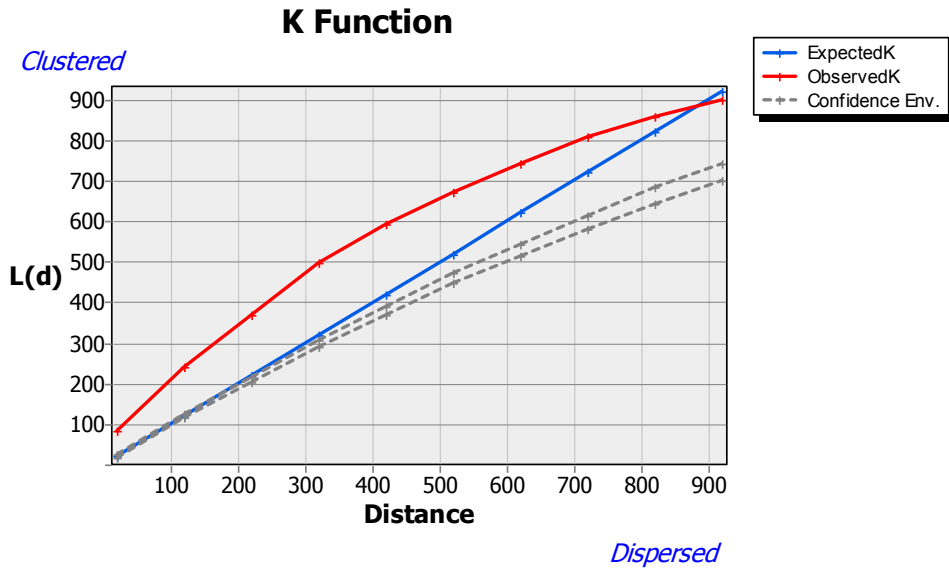


Figure 44: Graphic display of the multi-distance spatial cluster analysis for circular features with 10 distance bands containing a 9 (permutations) confidence envelope and unweighted.

Spatial Autocorrelation (Global Moran's I), another spatial statistic, is the simultaneous measurement of feature location value, and attribute in order to determine patterned clustering.

For every feature evaluate, the tool computes a deviation from the mean and a cross-product which determine the value of Moran's Index (ESRI 2012). Calculated results of the observed and expected index, p-value, and z-score determine if the null hypothesis is rejected or not. Within the study area of the circular buildings and their diameter, a positive Moran's index (.066211) and positive z-score (9.244892) indicate a clustering of high values near other high values and clustering of low values near other low values. Additionally, the p-value is statistically significant so the null hypothesis is rejected, thus the positive z-score indicates a more spatially clustered dataset.

Unlike the previous spatial statistics tools discussed, the cluster and outlier analysis (Anselin Local Moran's I) visually represents the results (figure 45). Based on weighted features, spatial outliers and feature attribute groupings of similar magnitude are identified with z-scores and p-values computed from the local Moran's I statistic (ESRI 2012). Results of a statistically significant cluster of high values (HH) or of low values (LL) are reflective of a high positive z-score. When a feature has a low negative z-score than that feature represents a spatial outlier of either a high value surrounded by low values (HL) or a low value surrounded by high values (LH) (ESRI 2012). The z-score and p-value for each feature is considered individually to determine the acceptance or rejection of the null hypothesis. Overall, 231 circular features were determined insignificant in terms of diameter whereas 27 HH, 2 HL, 11 LH, and 25 LL features were identified. Interpretation of these results suggests potential differentiation of socioeconomic neighborhoods and/or plaza groups.

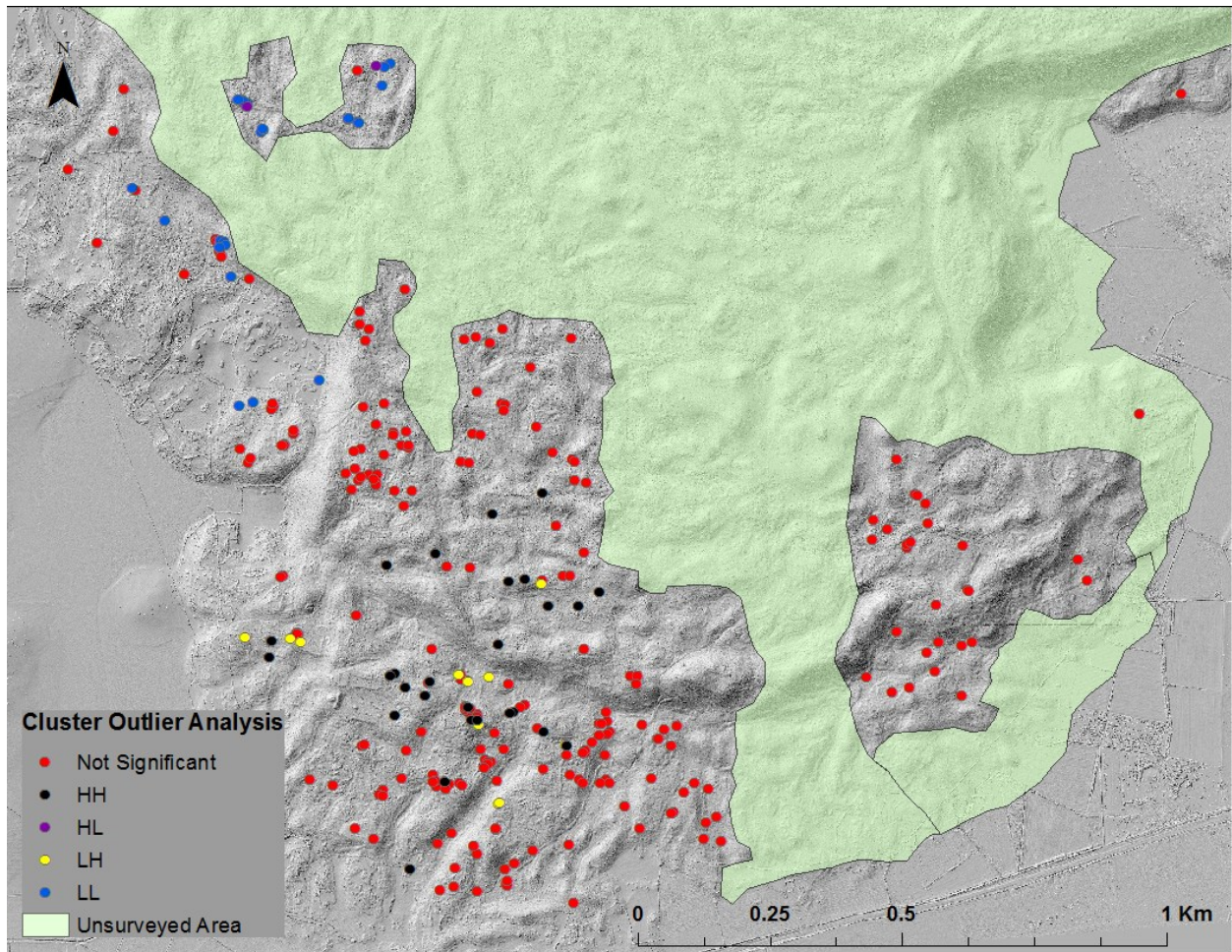


Figure 45: Map displaying the results from the cluster outlier analysis (LiDAR data by Merrick & Company © 2011 LORE-LPB).

Hot Spot analysis (Getis-Ord G_i^*) assesses “each feature within the context of neighboring features and compare the local situation to the global situation” (ESRI 2012:3) in order to identify statistically significant spatial clusters of either low values (cold spots) or high values (hot spots). Each feature is analyzed within the context of neighboring features resulting in an output of a z-score and p-value for each feature, which determine hot spots and cold spots. Figure 46 presents the results of the hot spot analysis tool for Angamuco’s circular features. A large positive standard deviation indicates statistically significant clusters of high diameter values, or hot spots. At the other end of the spectrum, cold spots are statistically significant

clusters of low diameter values identified by a large negative z-score. The results can also be looked at in terms of intensity. Moving from a high positive z-score to a large negative z-score, the diameter size decreases but at the same time the intensity of the diameter value clusters also decrease and then start to increase when the scale changes from a positive z-score to a negative z-score. There is a clear distinction between the location of cold spots and hot spots within the site of Angamuco. It is possible that the hot spots represent civic-ceremonial or elite residential areas and cold spots indicate commoner residential areas. A larger sampling size could further help to determine the relationship between these identified clusters and their location in the Zona Alta or Zona Baja.

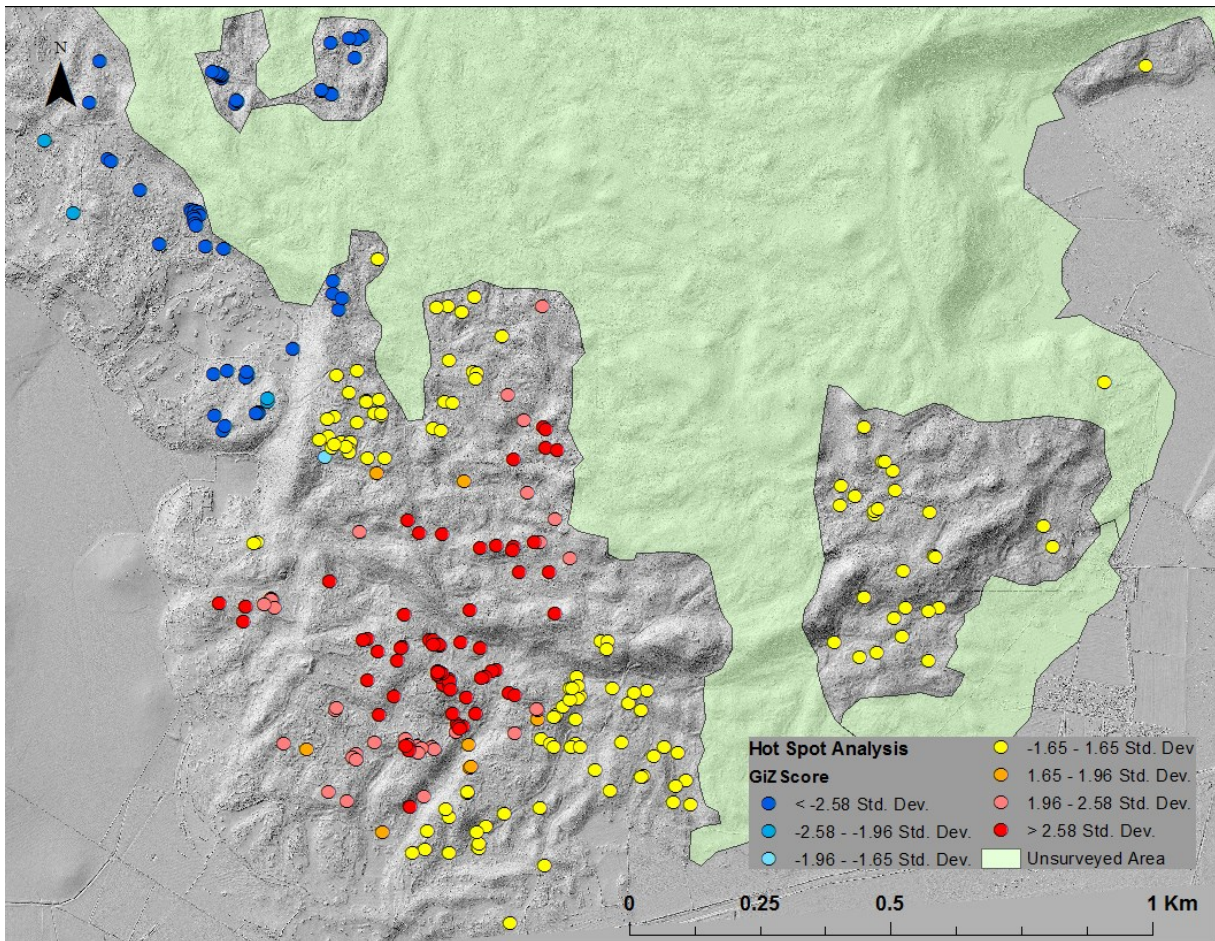


Figure 46: Map displaying the results from the hot spot analysis (LiDAR data by Merrick & Company © 2011 LORE-LPB).

The grouping analysis provides an additional tool for the identification and mapping of clusters. This tool detects natural clusters based upon the number of designated groups; determined by looking “for a solution where all the features within each group are as similar as possible, and all the groups themselves are as different as possible” (ESRI 2012:1). Specifying certain feature attributes to analyze along with specifying spatial constraints factor into the type of algorithm employed to identify the clusters. Changing the number of identified groups will show a change in the results, but an overall trend should be identifiable when this variable is manipulated. Figures 47 and 48 reflect the results of five and ten designated groups. Diameter values for the five groups of the grouping analysis are similar to the five natural groups identified

in the histogram with 0.25 m diameter classes (refer to figure 22). The groups identified with this tool represent the actual recorded diameters; whereas the histogram groups reflect a range of diameter values in which the recorded diameters fit within these ranges. As long as the value of the designated groups is larger than 1, the grouping analysis tool identifies a significant clustering of diameter values for the circular structures at Angamuco.

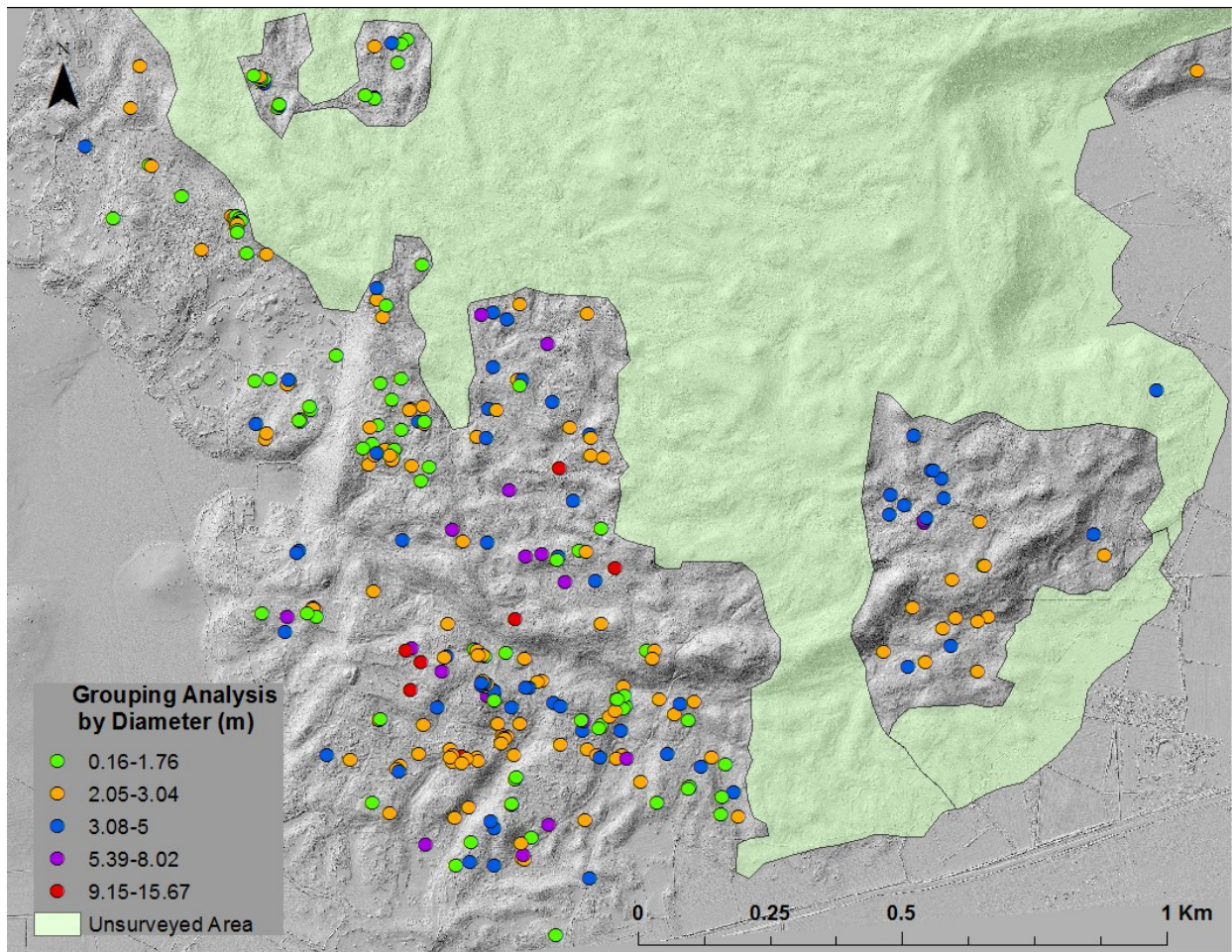


Figure 47: Map displaying the results of the grouping analysis for five diameter groups (LiDAR data by Merrick & Company © 2011 LORE-LPB).

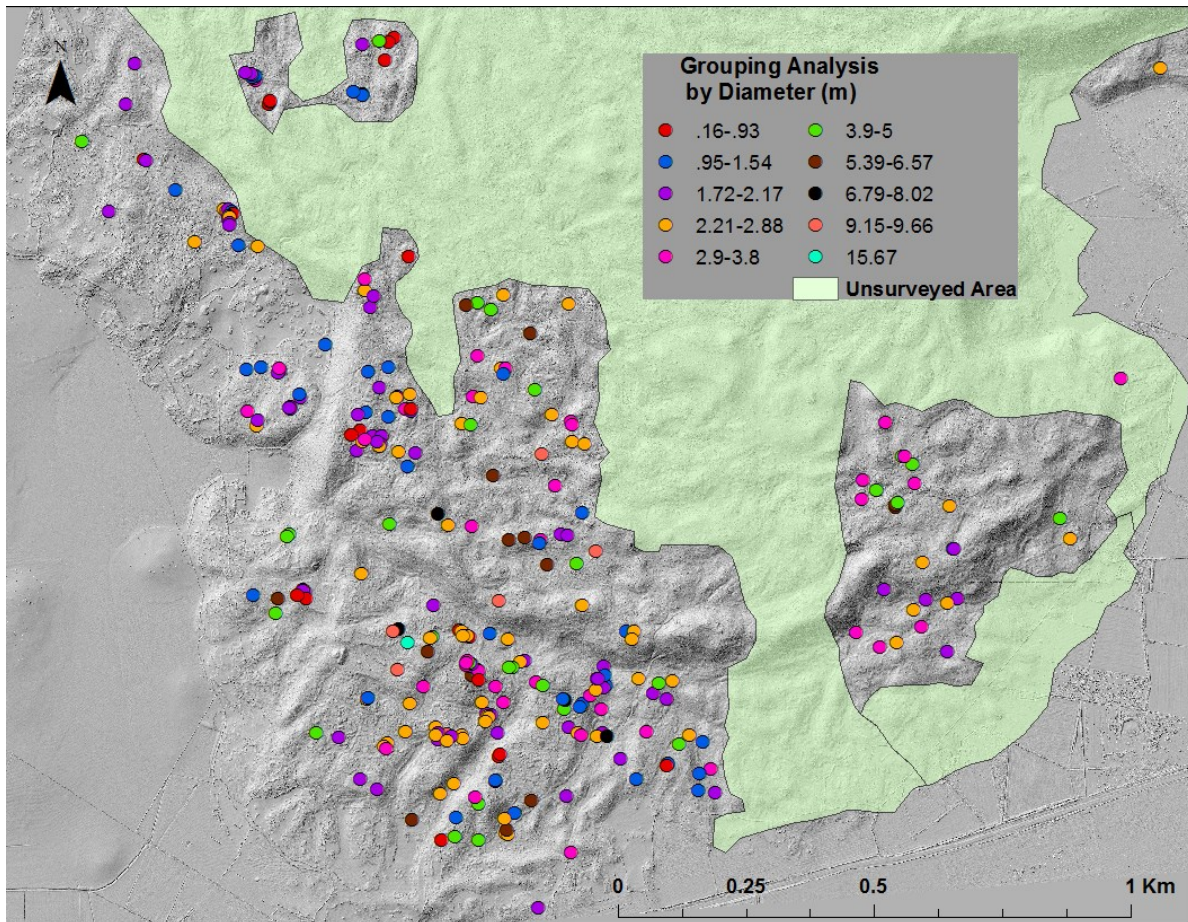


Figure 48: Map displaying the results of the grouping analysis for ten diameter groups (LiDAR data by Merrick & Company © 2011 LORE-LPB).

Buffer zones represent a proximity tool uniquely utilized in a variety of situations. In regards to this data set, buffers were employed similarly to the average nearest neighbor tool. Creating different buffer bands (15 m, 20 m, and 30 m), I focused on each circular features' proximity to one another. Understanding the distance separating one circular structure from another will help to pin point possible clustering and aid in determining the function for each of these buildings. Figure 49 visually represents the different buffer zone values for each circular feature so far recorded at Angamuco.

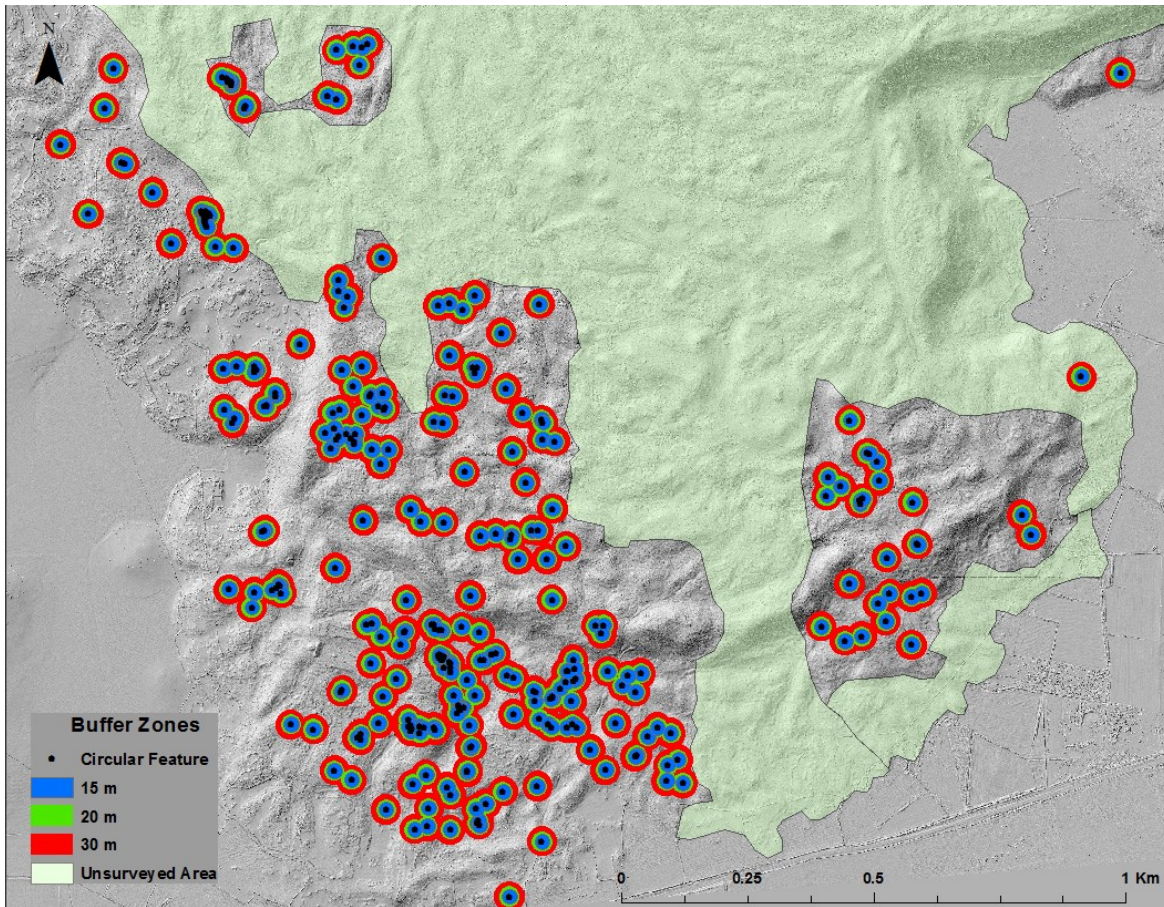


Figure 49: Map displaying the proximity of circular features to one another with buffer zones (LiDAR data by Merrick & Company © 2011 LORE-LPB).

After calculating the descriptive statistics, it is clear that the diameter values represent a low degree of variance. Examining the results of the spatial statistics, clustering of the circular feature location, with or without the influence of the diameter, is present. However, individually, the purely numerical and spatial results do not provide a complete picture for understanding and determining the function of the circular structures at Angamuco. Combining these two forms of results provides a picture of intentionally located structures with similar diameter measurements.

Context

Once the morphology of the structure is determined, observing the context in which a circular structure resides provides a better understanding of the function of the building. For instance, at Angamuco if a circular feature is associated with an open plaza surrounded by monumental architecture then it most likely represents a sweatbath; especially if it possesses a diameter greater than 5 m. Ethnohistoric documents and additional archaeological evidence helps to further understand the role of context relation to structure function. While traveling through Mexico, Starr (1908) noted that every house in Tlaxcalan towns was connected to one or more granary. This implies that cuexcomates, a type of circular building, was not rare in some regions of Mesoamerica; thus it is possible that all of the cuexcomate remains have not been identified at Angamuco and possibly at other sites.

Looking more closely at the context in which circular features reside at Angamuco also provides insight into socio-economic implications. An analysis of the nearest neighbor computed in ArcMap has determined that 83 circular features have a platform as their nearest neighbor. Table 5 lists the nearest neighbor feature associated with circular structures. While knowing the nearest neighbor can be helpful, to better understand a circular feature's context, more than just one associated feature must be taken into account. While looking at the nearest neighbor results, it is also important to take into account the size of the circular feature and the distance to its nearest neighbor. Furthermore, equally important is to know the size of the circular structure's nearest neighbor. For instance, a small (size category 1) circular building situated on top of a small platform could imply a small granary in a residential area; while a category 2 circular feature with a large platform as its nearest neighbor may represent a cuexcomate in a wealthier neighborhood. One factor cannot define the function of a circular

structure, so it is necessary to consider a variety of factors that affect the function and socio-political conclusions of each circular feature.

Table 5: Lists the number of circular structures and their associated nearest neighbor feature.

Number of Circular Features	Associated Nearest Neighbor Feature
83	Platform
51	Terrace
34	Wall
30	Plaza
27	Room
24	Mound
21	Road
8	Stairs
7	Patio
5	Room Complex
3	Other
2	Ball Court
1	Pyramid

Distribution

Distribution analysis of the circular features at Angamuco provides a basic understanding for these data. Multiple avenues of distribution can and must be explored for these features because each direction provides its own unique perspective. These perspectives can then be examined in connection to one another, resulting in new viewpoints and confirmation of already hypothesized interpretations. When working with the data from Angamuco, the distribution of circular features is examined in four different perspectives: 1) Zona Baja versus Zona Alta; 2) residential versus public; 3) socio-economic status; and 4) access.

To start, I look at the general layout of circular structures in relation to their presence in the Zona Baja or the Zona Alta. Of the 296 features, 170 reside in the Zona Baja and 126 in the Zona Alta (figure 50). What does this distinction suggest for the identification of cuexcomates and temezcals? Distinguishing the location of the structure between the civic-ceremonial Zona

Baja and the residential Zona Alta provides a fundamental factor affecting the function of the circular feature. Common knowledge of Mesoamerican cities identifies some form of a civic-ceremonial zone as an ever present attribute. At Angamuco, the civic-ceremonial/public area is demarked with larger architectural features, pyramids, and controlled entrances. So circular buildings in the Zona Baja contained a different meaning and usage compared to those features found in residential areas in the Zona Alta. Utilization of these structures was specifically for the royal family, government personnel, priests, and any necessary state function. The Zona Alta circular structures differ in their residential utilization represented through their use of different social classes.

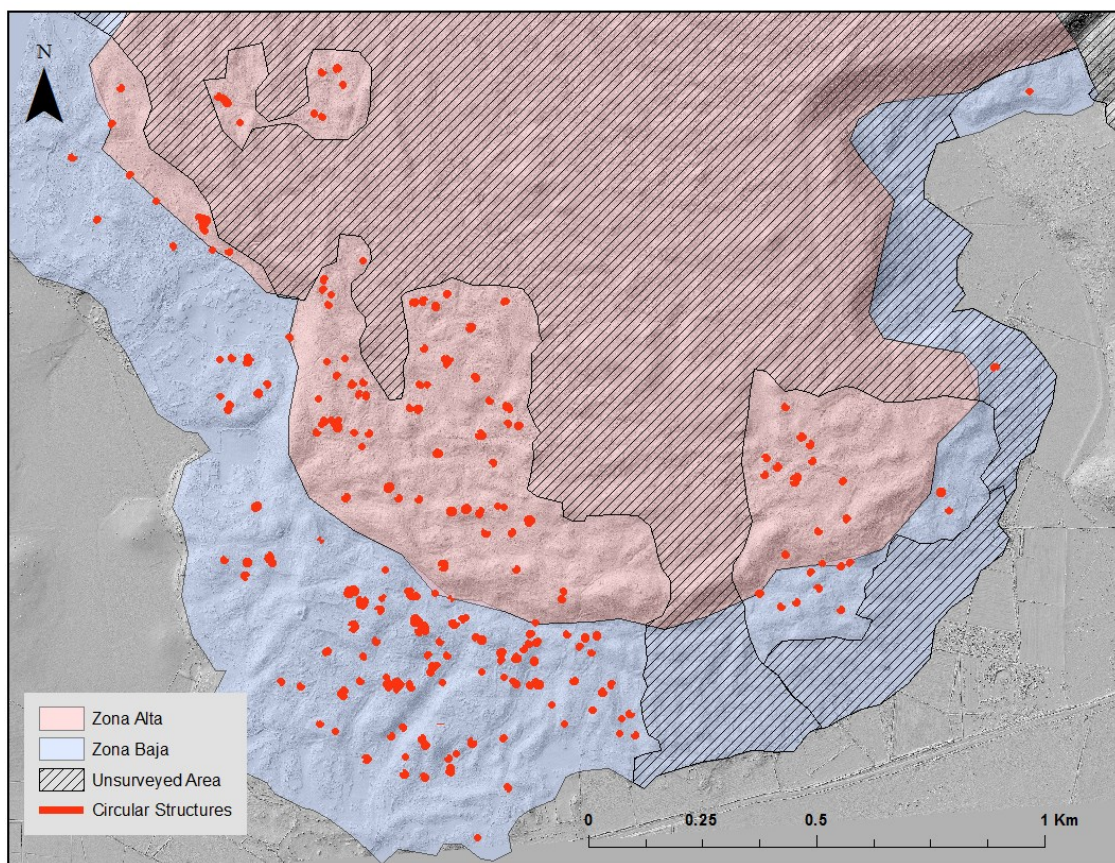


Figure 50: Map displaying the distribution of circular structures within the Zona Baja and Zona Alta (LiDAR data by Merrick & Company © 2011 LORE-LPB).

Identified as the civic-ceremonial zone, the Zona Baja contains circular feature groups not present in the Zona Alta. The potential public storage group of cuexcomates only exists at one location at the site and it is located within the Zona Baja. These category 1 structures seem small for the storage of tribute or public food. According to the *Relación de Michoacán* (Craine and Reindorp 1970), a chief-domo titled *Quengue* supervised the placement of corn brought to the *Cazonci* into granaries. While the identified cuexcomates do not represent large structures, it is possible that their quantity replaced the need for larger structures. The relationship between diameter foundation size and superstructure capacity is still unclear. At Tetimpa, estimated capacity of cuexcomates with a diameter base greater than 0.9 m held a ton or more of maize (Uruñuela et al 2012). A ton of maize multiplied by 12 granaries may represent a large enough amount to support the population of Angamuco in a food crisis situation for only a brief period of time.

Further discussion of these two zones in relation to circular features will aid in identifying their individual purpose. Already demarked as the particular zones, the Zona Alta and Zona Baja information overlaps with the public versus private discussion.

Public and Private Zone Associations

The hypothesized functional zones created by Fisher (2010) provide a foundation for identifying circular structures in relation to public and/or elite areas and commoner areas (figure 51). A majority of the circular features are related in close proximity to platforms associated with plazas and/or mounds; which tend to be examples of public or elite spaces. In contrast, smaller features situated in a plaza group imply a commoner residential area.

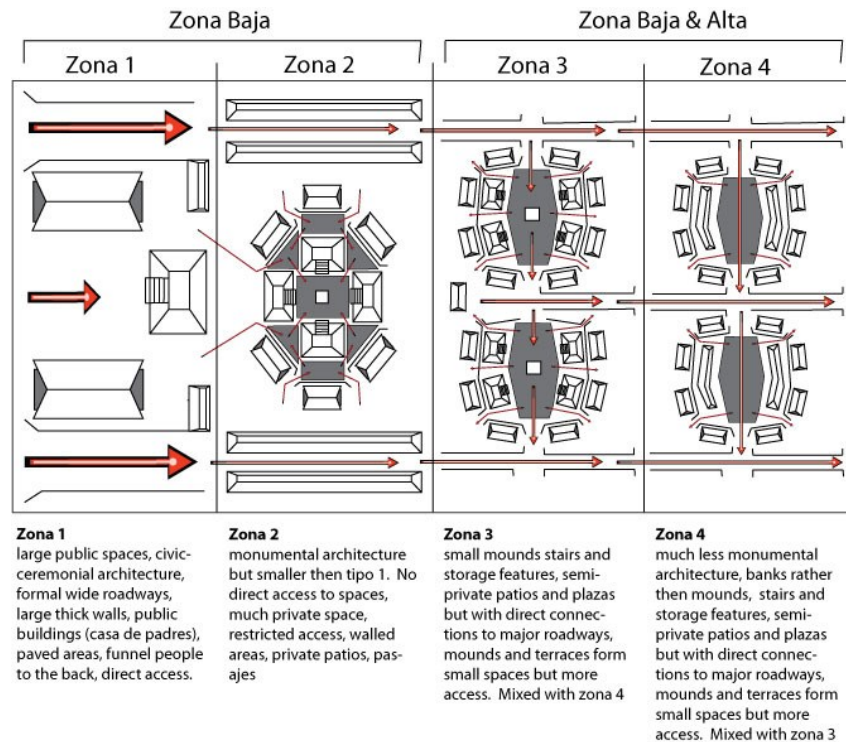


Figure 51: Functional zones created by Fisher (2010)

Along the southwestern edge of the Zona Baja, 75 m northwest of the main platform, a public/elite domain was identified by a large platform situated along the west edge of a large open plaza with an altar and a wall surrounding these features. On top of the platform, three large granaries and two small cuexcomates exist and one located west of the platform just outside the wall in a small corridor. This particular area is highly restricted and contains larger features that are not associated with commoner areas. Four out of the six round features were labeled as temezcals during survey. The presence of a grouping of possible sweatbaths on top of a platform overlooking an altar in an area with non-residential structures suggests a civic-ceremonial area. Furthermore, many religious rituals were conducted in temezcals so it is highly likely a complex was dedicated to ritual sweatbaths. A few more areas similar in public/elite architecture to this example exist at Angamuco; however, they seem to be the exception since most of the circular features are located in areas associated with domestic architecture.

As previously mentioned, a potential public storage area exists at the site along a major roadway in the Zona Baja (figure 52). Located within 5 m of each other, these 12 circular structures range from 1.3 m to 2.9 m. Close proximity and similar diameters imply the same function and associated ownership. Hypothesized as a public storage area, these features lack surrounding administrative buildings as well as an absence of security or management. Unfortunately, these deficiencies do not resemble government controlled storage facilities in the Inka State (Jenkins 2001); which does not help to support this area as a public storage center. The high density of similarly sized cuexcomates situated along a major roadway with no other features in close proximity is unique to this site. During the Postclassic Period, tribute to the State was usually paid in the form of food and what better way to visually represent the power and wealth of the king than to prominently display tribute granaries adjacent to a highly traveled roadway. It is also possible that these structures acted as relief granaries for unexpected situations such as drought or war. Stored grain collected for tribute must have existed somewhere in the city because the estimated population of the basin was 10,000 to 60,000 over its carrying capacity (Pollard and Gorenstein 1980). If this area does in fact represent public storage then understanding the spatial distribution of these features will be even more important to understanding Purépecha storage and how it is influenced and how it influences sociopolitical and economic relationships.

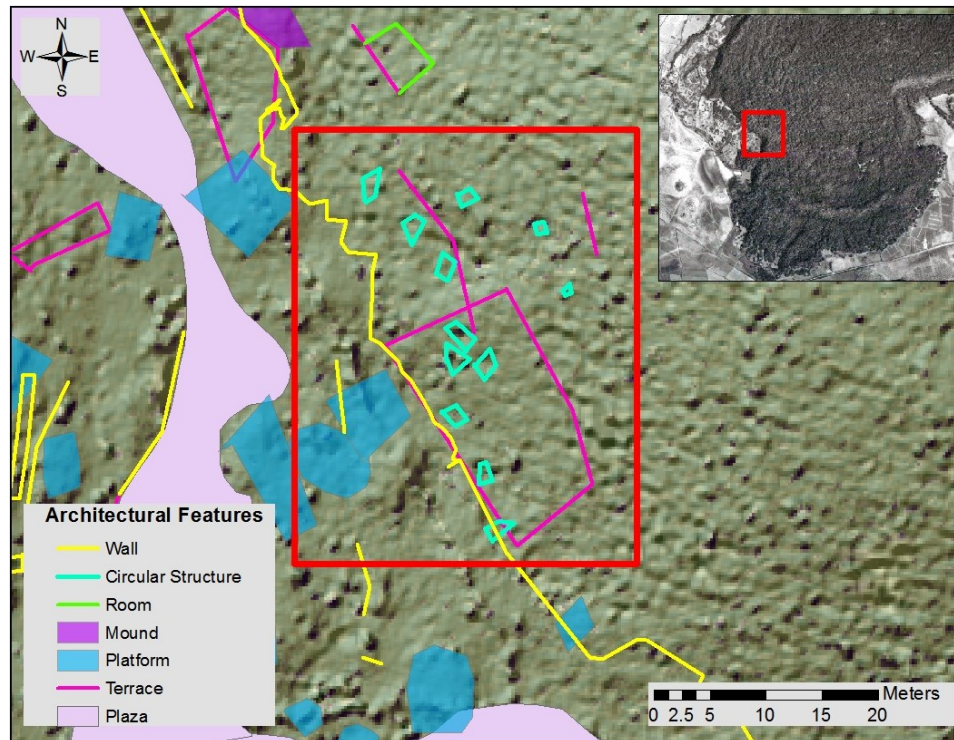


Figure 52: Map of the public storage area adjacent to a major roadway which is situated in the transitional area between the Zona Baja and the Zona Alta (LiDAR data by Merrick & Company © 2011 LORE-LPB).

Another area of importance with a clustering of circular features has been identified as El Palacio. Just to the east of the eastern edge of the main platform, El Palacio includes two walled plazas surrounded by circular and other architectural features on the east with a patio further to the east of these structures. Additionally, El Palacio sits atop a ridge modified with agricultural terraces. Figure 53 displays all of the features recorded at El Palacio with two circular features highlighted.

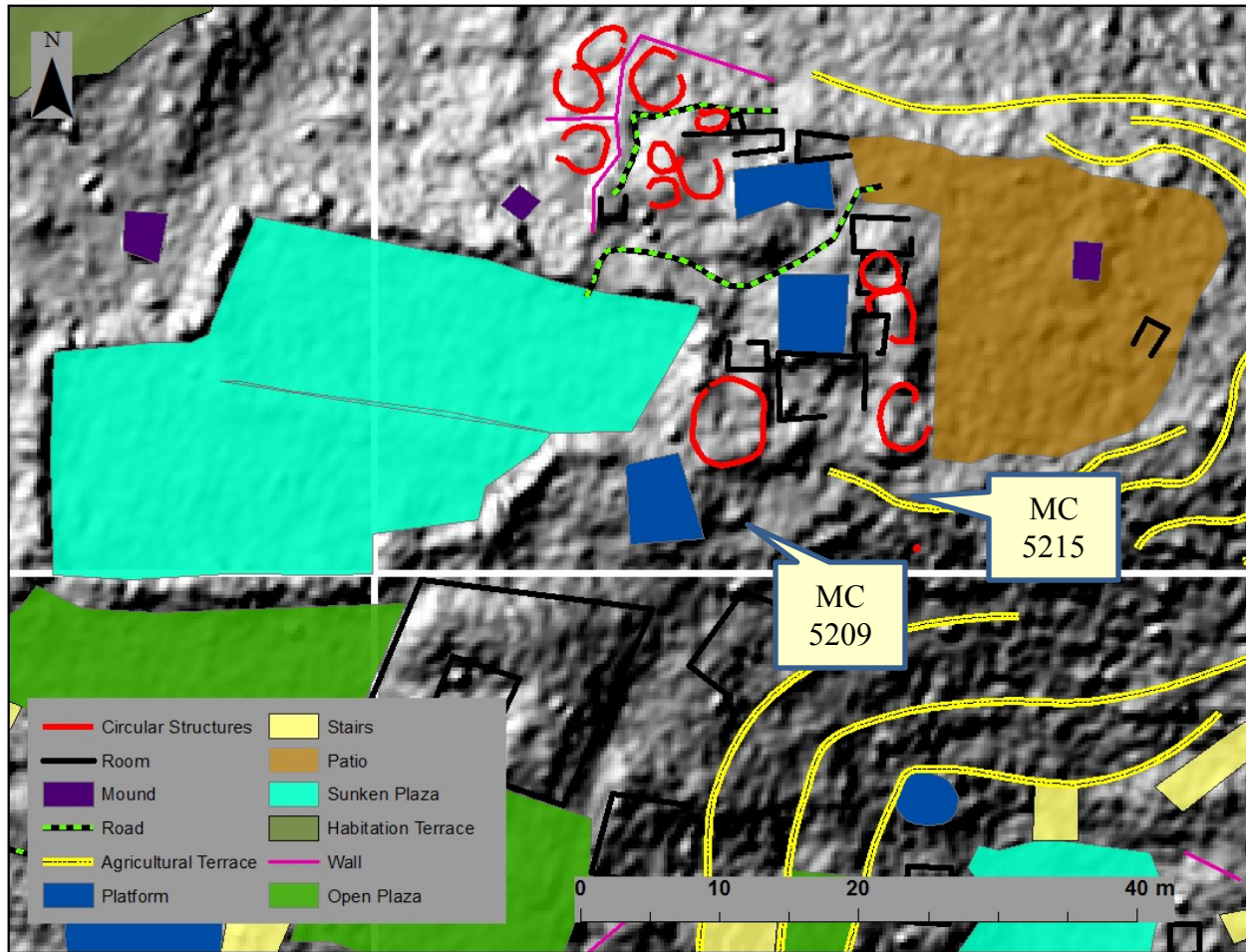


Figure 53: Map of El Palacio with two circular features highlighted (MC 5209 and MC 5215) (LiDAR data by Merrick & Company © 2011 LORE-LPB).

Thirteen circular features are associated with El Palacio and range in diameter from 0.16 m to 6.31 m. As shown in figure 53, the majority of these features are closely grouped together with a few of the structures sharing a common wall. El Palacio is a complex of structures that signifies a place of wealth; so it is reasonable to suggest that more than one granary and at least one temezcal are associated with this complex. The presence of at least one cuexcomate and sweatbath discovered at a palace or elite household at another Mesoamerican site (Elson 1999) provide support for the same situation occurring at El Palacio.

In 2013, the LORE-LPB team excavated select features at El Palacio. Two of these structures included MC 5209 and MC 5215. Previous survey data identified MC 5209 as a ground level temezcal. Thick walls with a diameter of 6.31 m, MC 5209 seemed a likely candidate for a sweatbath. Unfortunately, excavation revealed a structure not circular but square with two rounded interior corners. Furthermore, no evidence of a bench, firebox, or drain was discovered. Excavation of MC 5215 yielded slightly better results for uncovering the mystery of Angamuco's circular features. Figures 54 and 55 display the before and after excavation images of MC 5215. While not completely circular in nature, unidentified seeds suggest the storage of food and the structure is located conveniently close to agricultural terraces. From the current excavation data available, it is clear that survey data of circular features does not necessarily correspond to the structure's actual shape and function.



Figure 54: Unexcavated MC 5215
(© 2013 LORE-LPB Project).



Figure 55: Excavated MC 5215
(© 2013 LORE-LPB Project).

Previous examples described areas considered public/elite civic-ceremonial and elite residential zones and now two areas representing commoner residential groups will be discussed. Unlike other sites in Mesoamerica with recorded granaries, such as Tetimpa and Cuexcomate

(Smith et al. 1989; Plunket and Uruñuela 1998, 2000b), a blueprint of a residential grouping at Angamuco has currently not been identified. Unfortunately, granary location in association with other household structures (i.e. kitchen) discussed by Smyth (1991) cannot yet be applied to Angamuco to unveil more characteristics for identifying granaries. In order to help identify a commoner residential area, circular structures and their associated architectural features were examined in terms of complejos. Complejos represent units smaller than neighborhoods but one step above the individual household or functional unit. Figure 56 illustrates the circular features in relation to the identified complejos and their association with the Zona Alta and Zona Baja. While some complejos do not contain any or only a few circular structures, other complejos possess a large quantity.

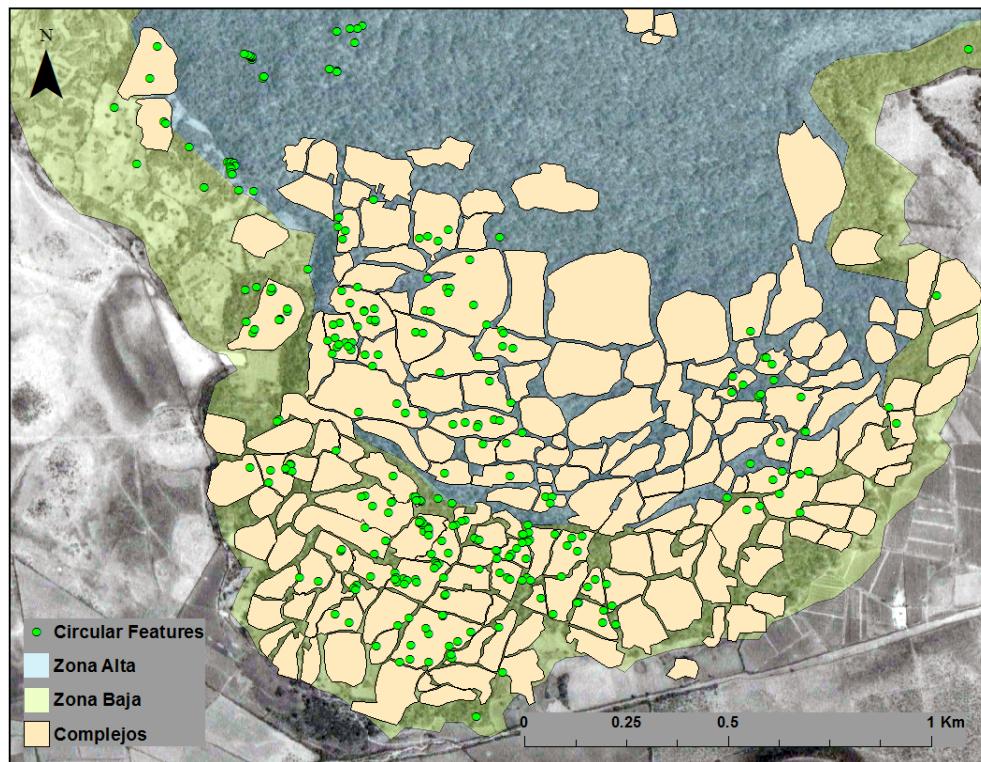


Figure 56: Identified complejos in relation to circular features and their location within the Zona Baja or Zona Alta (LiDAR data by Merrick & Company © 2011 LORE-LPB).

Using these complejos and other architectural features, I have identified two possible commoner residential groups. The first group displayed in figure 57, contains a plaza surrounded on three sides by five platforms. Three additional platforms are located in the area around the plaza. The two circular features located in the area possess 1 meter diameters and functioned at cuexcomates. Furthermore, these two granaries represent a statistically significant grouping of low diameter values (refer to cluster and outlier analysis). The small size of the plaza in conjunction with the small platforms and absence of other architectural features suggests this area is in fact a commoner residence for possibly two families.

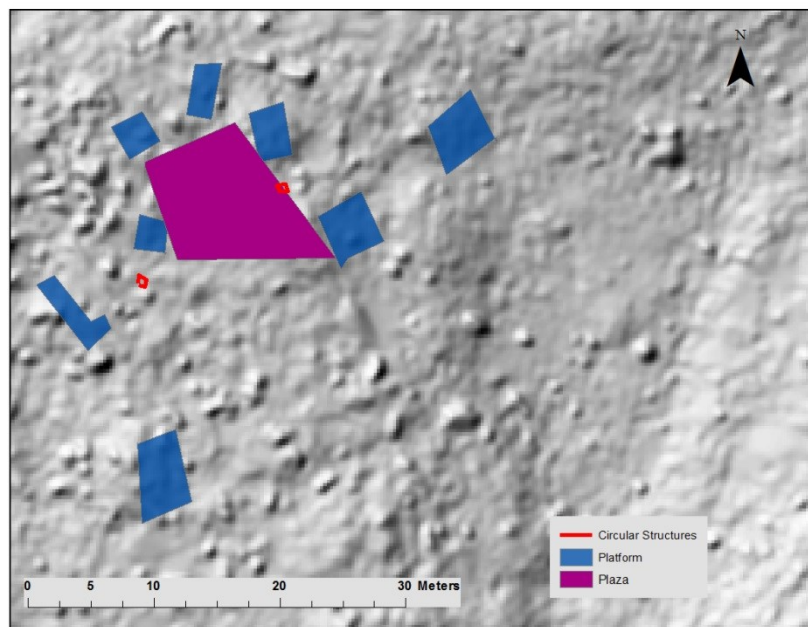


Figure 57: Map of a commoner residential area (LiDAR data by Merrick & Company © 2011 LORE-LPB).

The second commoner residential zone is encompassed into one complejo. Compared to the first commoner residence; a variety of architectural features create this second residential space as seen in figure 58. Platforms, rooms, and a complex of rooms share three patios and circular structures. Ranging from 1.25-2.59 m, the circular features represent a non-significant

diameter grouping according to the cluster and outlier analysis. Even though these three structures do not hold statistical significance in terms of their diameter, they do hold significance in regards to their associated architectural structures. Separation of the circular features implies the possibility of three different owners; which means at least three different nuclear families lived in this complejos. It is possible that extended family members also lived in this area and shared the granaries. The concept of sharing adds an additional factor when exploring the socio-economic implications of food storage.



Figure 58: Map of a commoner residential area (LiDAR data by Merrick & Company © 2011 LORE-LPB).

Analyzing the size, morphology, and location of the circular features provides inferences for their socio-economic and socio-political relationship within the Purépecha Empire. Inferring socio-economic and socio-political relationships from circular features is possible when size, morphology and location are taken into account. The examples of the main platform, public storage area, and El Palacio all represent public/civic-ceremonial or elite residential zones that

provide different clues for socio-economic and socio-political characteristics than the commoner residential examples.

The Puuc Maya demonstrate their wealth through the size and permanence of their storage structures; differing slightly from the demonstration of wealth through storage structures of the Purépecha. The permanence of cuexcomates suggests that the size and number of storage structures would be an indication of wealth instead of permanent versus temporary structures. However, this does not seem to be true at Angamuco since the frequency of larger structures is high compared to smaller circular structures and the majority of both features are located within domestic contexts. This possibly suggests that numerous granaries clustered in close proximity to one another may be a better indicator of wealth or public storage than foundation size. Maize could be stored in different forms (i.e. shelled, cob) which could account for numerous cuexcomates associated with one household. Thus a household must have enough maize to store large quantities in different forms indicating wealth through number and not size of granaries. At the site of Tetimpa in Pueblo, Mexico, patio groups contain, in general, two to three cuexcomates with a larger housing group possessing five storage structures (Plunket and Uruñuela 1998). Evidence from Tetimpa applied to Angamuco's residential areas supports the idea of multiples granaries associated with one housing group implies wealth.

Numerous or larger storage structures located in close proximity to elite household or elite restricted zones of the site are indicative of wealth and economic advantage. Furthermore, different storage structure characteristics and location are also indicative of differences in power. Elites had more power and control over important food resources and contained a smaller number of occupants compared to commoner households, but they would have had more access to larger amounts of food. Thus larger or multiple cuexcomates clustered together does not

indicate more people in that household; instead it suggests surplus. Moreover, the control of surplus is directly related to the amount of power and wealth someone possesses. Wealthier households would be capable of financing the construction of multiple and larger granaries. Confirmation of this statement would mean the circular structures on mounds represent elite households.

Inferring socio-economic characteristics from possible *temezcals* is much more difficult than with *cuexcomates*. Use of a sweatbath in Mesoamerica is a common practice for daily bathing, curing of a sickness, and religious rituals. For such a common practice, it's logical to assume every housing group contained a *temezcal*. Groark (1997) noted a sweathouse at every household in some contemporary Maya communities. Starr (1908) also observed *temezcals* associate with the majority of houses in the Aztec town of Tamalin. Problems arise with this assumption at Angamuco. Survey data and minimal excavation data prove that determining characteristics of a *temezcal* are not readily identifiable in the recorded circular features. Without the identification of distinct sweatbath attributes and with size ambiguity, only a small fraction of recorded circular features represent *temezcals* and only five structures have been positively identified.

Positively recorded sweatbaths reside on the main platform with only a handful found elsewhere at the site. Previously discussed, the main platform contains five sweatbaths that also signify the largest circular structures recorded at the site. Unlike other areas in Mesoamerica, current data at Angamuco suggests that *temezcals* in this city represented a form of privileged architecture. This means that commoners did not have the privilege or wealth to own a sweathouse and it is possible that only the royal family, religious temples, and the highest government officials represented those select few allowed to own a *temezcal*. Information in the

Relación de Michoacán (Craine and Reindorp 1970) mentions the *Cazonci* taking hot baths with his women and figure 59 shows temezcals depicted in this ethnohistoric document. From this image it is not possible to determine the relative size of the sweatbaths, but their circular foundation and domed superstructure correspond to the identified temezcals at Angamuco. Even with the connection between the ethnographic information and archaeological remains; the possibility of rectangular sweathouses cannot be ruled out as additional sweatbaths present at the site.



Figure 59: Temezcal depicted in the left portion of Plate 35 from the *Relación de Michoacán* (Craine and Reindorp 1970).

Access

Access is not easily deciphered with the status of these data. At this stage I can only hypothesize possible areas of restricted or open access in relation to circular structures. Within the context of this paper, access is defined as one's ability to enter or use a specific space, structure or resource. Unfortunately, archaeology's ability to identify access is limited to uncovered evidence and available data. At sites like Angamuco, defining access relies solely on

architectural remains. While useful, architectural remains do not always reveal the subtle layers of access associate with one area. For example, a civic-ceremonial center in its broadest meaning is accessible to the public. However, only the priests could access the secrets of the temples.

At Angamuco, access can only be determined through analyzing the placement of different architectural feature types and their associations with other features. On the main platform, the large temezcals represent highly restricted features based on the close proximity and type of their neighboring structures. Symbolism of certain architectural building types, such as a *yácata*, instantly creates a certain atmosphere of access. In other words, the type of structure present provides the initial form of access. The level of access could then possibly change when surrounding architectural features are taken into account in addition to the initial feature. For example, a strategically placed wall could represent a form of restriction and if its association to the circular feature was not taken into account than valuable information would be lost. More information on access at Angamuco will surface with more survey data to help identify typical elite and commoner residential layouts.

Comparison

Comparison of the Angamuco circular features within the Lake Pátzcuaro Basin and across Mesoamerica confirms the utilization of circular granaries and sweatbaths. In the Lake Pátzcuaro Basin, minimal archaeological information is available for comparison. The well-researched and documented data from French archaeologists in the Zacapu Basin provide useful information, especially on Purépecha architectural types. Excavation of circular structures averaging 1.4 meters in diameter from the Zacapu Basin (Michelet and Forest 2012) supports the

utilization of cuexcomates for food storage among the Purépecha. Other research in the LPB does not contain any evidence to support the employment of circular granaries or temezcals.

Outside of the LPB, additional evidence exists across Mesoamerica. Structures similar to Angamuco's Type E circular feature reside at three Aztec sites, including Cuexcomate. Contemporary cuexcomates in Morelos possessing diameters of 5 m provide evidence for larger granaries for residences than previously thought possible. If residential cuexcomates could be this large then state or royal granaries should be larger. In some areas, size is not necessarily the marker of wealth, but quantity is instead. Among the Tarahumare, each residence possessed 1-2 store-houses, some even had upwards of 14 store-houses per one dwelling (Lumholtz 1973). Multiple granaries for one household coincide with data collected from the site of Tetimpa (Plunket and Uruñuela 1998, 2000a, 2003). In the Maya region, utilization of maize cribs allowed for better air circulation thus providing a more efficient storage structure in that climate than cuexcomates. A variety of food storage techniques existed across Mesoamerica. However, no Mesoamerican site has recorded any architectural feature resembling the circular structure on a mound (Type C) identified at Angamuco, making this feature unique to this site.

Furthermore, the large temezcals on the main platform are also unique to this site. Circular sweatbaths are rare in Mesoamerica with only a few examples recorded archaeologically and little ethnohistoric information. In a Tlaxcalan village, Starr (1908) observed a domed shape building with four people bathing inside and evidence of circular temezcals have been found at the contemporary village of Milpa Alta. Considering the minimal extent of data confirming circular sweatbaths in Mesoamerica, the presence of five distinct temezcals at Angamuco is significant. Examination of these structures in conjunction with other circular features helps to understand socio-economic and socio-political implications of temezcals in Purépecha society.

CHAPTER 9: CONCLUSION

The Purépecha, unlike other cultures in Mesoamerica, have received minimal attention from researchers. This thesis has sought to change this lack of knowledge with an analysis on circular features at the site of Angamuco. Based on ethnohistoric information and archaeological data of similar features in Mesoamerica, I hypothesized that these circular structures present at Angamuco represent cuexcomates and temezcals. In addition, I provide information and define characteristics of both granaries and sweatbaths to help identify these structure types in future research in Mesoamerica.

In order to test my hypothesis, I utilized the GPS survey data collected over three field seasons by the LORE-LPB team. Analysis of these data using spatial statistics routines that are found within ArcGIS spatial statistics confirms overall clustering of the circular features based on diameter with certain areas of intense clustering. Spatial statistics tools such as hot spot analysis and high-low clustering displayed results of circular feature clustering based on diameter. In addition, comparison of these features with associated architectural structures creates a broader perspective to examine and identify the circular features.

The spatial distribution of the granaries demonstrates how storage structures provide insights into access, wealth, and power within a society. Most importantly, both small and large granaries are located in civic-ceremonial, elite, and commoner contexts demonstrating that size is not the only indicator of socio-economic status; quantity is also an indicator. Different combinations of size and quantity create different levels of socio-economic status. For instance, in most situations multiple small granaries associated with one location represent more wealth and status than just one large granary. Exceptions to this situation would be if that single granary

was a Type C building found at Angamuco. At most locations, multiple granaries are present indicating wealthier residences or a grouping of commoner residences. The ambiguous nature of some circular features makes it necessary to include the examination of associated features when determining socio-economic status.

Sweatbaths occupy an important place in Mesoamerican society. Ethnohistoric and ethnographic information identify the sweatbath as a common fixture in the Mesoamerican house complex and cultural practices. However, archaeological investigations have only revealed a substantial population of *temezcals* in the Maya region; little evidence has been found elsewhere in Mesoamerica. However, at Angamuco the use and ownership of a *temezcal* seems to be restricted to the elite and possibly only to a small population of the most important elites and religious institutions. Five large circular features identified as *temezcals* at Angamuco change the ideas of sweatbaths in Mesoamerican societies outside of the Maya region and provide insights into the socio-economic elements present at Angamuco. These *temezcals* located on the main platform with only a few additional identified structures support the hypothesis of highly restricted access to the use and ownership of sweatbaths at Angamuco. The lack of sweatbaths in residential zones at the site, support the hypothesis of a religiously significant structure with highly limited access to the majority of the population. Furthermore, the low population of identified *temezcals* at the site further supports this hypothesis; however, the lack of identified sweatbaths does not prove their absence within the site.

No matter the function of these circular features, socio-economic status is intertwined with their distribution. Spatial analysis represents an invaluable tool contributing to the identification of *cuexcomates* and *temezcals*; along with their overall relationship to site

formation at Angamuco. Significant clustering of circular structure diameters indicate planned development of the site with outlined rules and restrictions on the ownership of certain circular building types and sizes allotted for specific socio-economic classes. Examining areas of circular feature clustering provides smaller areas to understand the distribution of size and type, access, and socio-economic implications of the structures. Collective analysis of these sampling areas provides a broader perspective for the entire circular feature population at the site. The main platform, a public storage area, El Palacio, and two commoner residential areas represent these small samplings discussed in this thesis. These areas all contain distinct circular structure distribution enabling the identification of the function of the area and circular buildings present. After the determination of functional zones containing cuexcomates or temezcals, it is clear that both of these architectural structures represent residential and civic-ceremonial/public architecture. Based on a combination of factors in the samples areas, the type of access can be hypothesized. I hypothesize that there is evidence for both public and private access; however, dual access does not exist in any of the sampled spaces. I have developed a more detailed typology for the circular features at Angamuco that will assist to better identify possible cuexcomates and temezcals. Of course, this typology can only aid in the identification process; only excavation can positively determine a circular feature's function. Overall, the circular features at Angamuco represent cuexcomate with only a minute portion representing temezcals. Furthermore, unique circular morphologies and clustering of certain circular structures reside at the site.

At the beginning of this thesis I asked five specific questions and after the analysis of these data I am able to provide answers:

1.) Does the circular architecture represent civic-ceremonial/public or residential architecture?

Angamuco contains both forms of architecture. Unfortunately, monumental/public architecture is minimally represented in the surveyed features in comparison to residential architecture present at the site. However, defining the civic-ceremonial/public zones or elite residences is easier compared to commoner residential areas. So in order to ascertain and discern the monumental/public versus the residential circular structures, a close examination of their location and relationship to surrounding architecture and features is necessary.

2.) Are circular features associated with restricted, open, or some sort of dual access?

Access is hard to prove archaeologically with only survey data; however, smaller scale perspectives at the site allow for discernible information to develop basic hypotheses regarding access. There is evidence for restriction on the placement and use of sweatbaths.

3.) How can the typology of the circular architecture be refined?

During the initial encounter of circular structures at Angamuco, a simple typology was created; containing two groups: circular structure with an entrance and without an entrance. After the discovery of such variation in circular architecture, creating categories for the different forms of circular structures recorded is necessary to make connections between social aspects and function. The new detailed morphologies identified identify more common and rare types; which help to uncover associated socio-economic characteristics.

4.) Are these circular features differentially distributed? How?

Spatial analysis provides a perspective based strictly on the physical location of each feature. However, this basic information is utilized to present a more comprehensive picture of these structures across the site. Highlighting patterns, relationship to other features and zones in the site are just two ways the spatial analysis uses distribution to show how location influences the social and functional aspects of these circular structures. Analysis based on diameter size provides an additional perspective on the relationship between size, location, and socio-economic status.

5.) What is the function of these circular features?

An absolute determination of the function cannot be discerned just through survey but excavation is necessary to positively determine the existence of specific attributes for cuexcomates or temezcals. However, I hypothesized that most of the structures are granaries while others are sweatbaths. Further excavation data will help to positively distinguish between cuexcomates and temezcals at Angamuco.

Excavation data from the 2013 field season at Angamuco proves identifying circular features during survey is more difficult than previously thought. Future excavations on different circular feature morphologies and sizes will provide important information to better identify circular structures. Furthermore, at the current research stage at Angamuco, utilizing Smyth's (1991) work on storage and granary placement in association with the kitchen, water, and waste disposal locations is not possible until a blueprint of commoner and elite residential grouping areas is identified. Creating this foundation of site structure will further help solve the mystery of the circular features as well as open new avenues of research to understand the development of Angamuco and its role during the emergence of the Purépecha Empire. Future Research at Angamuco and in the Lake Pátzcuaro Basin will only strengthen our understanding of the

circular features employed by the Purépecha. Whether these structures were used as granaries, sweatbaths or something else, more data will help to decipher their function (s) that can then be related to other sites and regions in Mesoamerica.

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