UC Merced

UC Merced Electronic Theses and Dissertations

Title

The Settlement Patterns at Las Cuevas, Belize during the Late Classic Period

Permalink

https://escholarship.org/uc/item/8ts6q7px

Author

Carvajal IV, Pedro

Publication Date

2016

Peer reviewed|Thesis/dissertation

eScholarship.org Powered by the California Digital Library
University of California

UNIVERSITY OF CALIFORNIA, MERCED

The Settlement Patterns at Las Cuevas, Belize during the Late Classic Period

A Thesis submitted in partial fulfillment of the requirements for the degree of Master of Arts

in

Individual Graduate Program with an emphasis in World Cultures

by

Pedro Carvajal IV

Committee in charge:

Associate Professor Holley Moyes, Chair
Professor Mark Aldenderfer
Assistant Professor Nicola Lercari

2016

Table of Contents

The thesis of Pedro Carvajal IV is approved, and it is acceptable in quality and form for publication on microfilm and electronically:

Assistant Professor Nicola Lercari

Professor Mark Aldenderfer

Associate Professor Holley Moyes, Chair

University of California, Merced

2016

List of Tables

List of Figures and Illustrations

Dedications

This thesis is the results of efforts of a number or people who have provided assistance to this research. I am incredibly grateful and indebted to them all and am delighted to be able to thank them.

I would first like to thank my advisor Dr. Holley Moyes, whose guidance both in the field and academia proved paramount. I am indebted to her for her support of my research and educational pursuits from the moment I started my academic career at University of California, Merced. On top of providing me with my first field opportunity at Las Cuevas, she continued to find other opportunities to enhance my skill set.

While my field seasons may not have been long, settlement survey is still quite an arduous task. I would like to thank Mark Robinson, Nicholas Bourgeois, John Walden, Antonio Mai and his brother Javier Mai for trekking through the jungle and collecting data. I would also like to thank Erin Ray, Marieka Arksey, Shayna Hernandez, Patrick Wilkinson, Lauren Phillips, and Tamara Spann for their assistance and camaraderie in the field. I would like to thank Shane Montgomery and David Eberius for their computational expertise. I learned an incredible amount working beside them.

I would also like to thank my committee members and the University of California, Merced Department of World Cultures and History. I am very grateful to Dr. Mark Aldenderfer for his words of encouragement and advice during my academic career. I would also like to thank Dr. Nicola Lercari for taking the time out of his busy schedule to read my thesis while juggling his other responsibilities.

Abstract

This thesis examines the settlement patterns located in the vicinity of the Late Classic Maya site of Las Cuevas, Belize, a midsized center found 14km southeast of the large polity of Caracol, in order to examine the site's usage as a possible pilgrimage site. Using LiDAR data gathered in April and May of 2013, models were run to examine the population of Las Cuevas and its relationship to its neighbor Caracol. Based on the results of this study into the surrounding populations using LiDAR-derived data, I argue that a low-density population surrounding the site core and beyond supports the interpretation that Las Cuevas functioned as a pilgrimage site. The sparse population base would not have been able to sustain a typical polity consisting of a royal household engaged in political competition or warfare. This thesis examines new territory in settlement pattern models and is the first time that the patterns surrounding an ancient Maya pilgrimage site has been investigated. It is my hope that my work will serve as a model for future research.

Chapter One: Introduction and Organization

1.1 Introduction

In this study I will examine the settlement around the Late Classic (AD 700-900) Maya site of Las Cuevas, Belize, nestled within the foothills of the Maya mountains just east of the Guatemala and Belize border, and 14 km from the large polity of Caracol. The Las Cuevas site is of particular interest because despite its close proximity to such a large polity, there is little archaeological evidence that establishes a connection between the two (Moyes et al. 2012, Moyes et al. 2015). The unique quality of Las Cuevas is that it has a ritual cave complex running beneath the site core. This cannot be ignored as it appears to have been of great importance, as demonstrated by the remnant artifacts and extensive architecture found inside the cave, as well as a large construction built atop the cave complex itself.

The site has been under investigation by the Las Cuevas Archaeological Reconnaissance (LCAR) under the direction of Holley Moyes since 2011. During this time, the site core was mapped, excavations conducted, and a preliminary settlement survey taken. In 2013, an aerial LiDAR survey was flown (Moyes et al. 2015). It has been suggested elsewhere (Moyes et al. 2015) that the site of Las Cuevas functioned as a Late Classic pilgrimage center. In this thesis, I analyze the settlement patterns to explore whether this interpretation can be sustained. Was Las Cuevas a pilgrimage site or was it more likely to have functioned as a small/medium-sized independent polity like so many others? While pilgrimage sites have been found by archaeologists, there have been few models put forth standardizing their quantitative or qualitative attributes.

I will address the issue by examining the boundedness of the settlement, the density of the structures, and will estimate the surrounding population using LiDAR-derived data models. This thesis also seeks to help fill the gap in the development of pilgrimage site models found within archaeology by examining the role of Las Cuevas in the social landscape of the region.

This thesis is divided into two sections. The first includes two chapters and is concerned with the ritual study of the site of Las Cuevas. In Chapter 2 I introduce the site and discuss the cosmology of the Classic Maya and how the site's construction adheres to a ritual landscape. In Chapter 3 I discuss pilgrimages and their traits, and model what a pilgrimage site might look like in the archaeological record.

In section two, I address the question of site function posed in this introductory chapter. I present research from other scholars on site populations within the region and compare them to the site Las Cuevas. I discuss the methods of survey and identification of sites around Las Cuevas as well as the use of LiDAR and its techniques. which greatly aided my research. Ultimately I will discuss what place, if any, pilgrimage had at the site of Las Cuevas.

Chapter Two: The Setting

2.1 Introduction

In this chapter I discuss the site and setting of Las Cuevas to set the stage for my research. Although this chapter deals chiefly with the Maya lowlands, I emphasize that this region is but a small part of the Maya area and of a larger system extending through Central America as a whole.

2.2 Climate and Topography

The site of Las Cuevas can be found in the central Maya Lowlands in the Chiquibul Forest Reserve of western Belize (Figure 2.1). Similar to much of the region, Las Cuevas enjoys distinct wet and dry seasons in a moderate sub-humid climate.

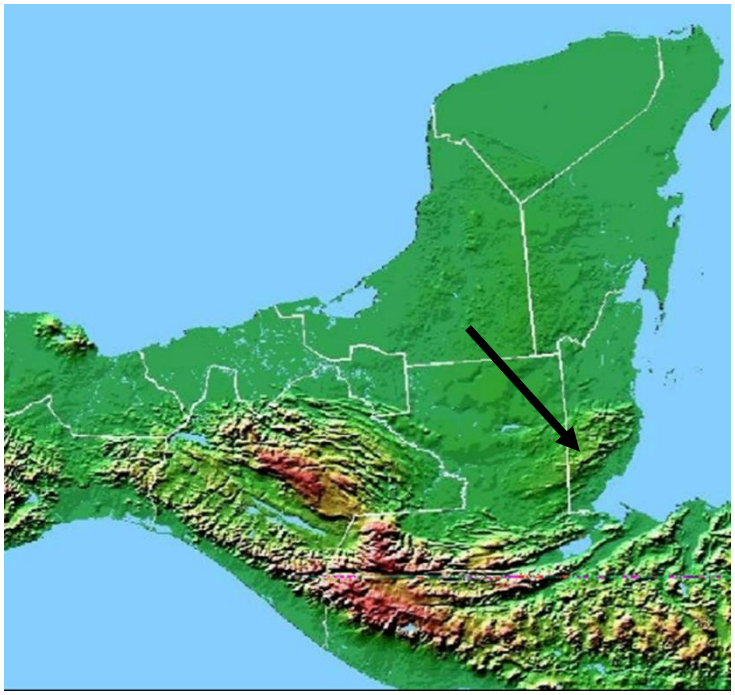

Figure 2.1. Map of Maya region. Arrow points to location of Las Cuevas.

Roughly 500m above sea level, the site experiences hot mornings and cool evenings. Annual precipitation averages roughly 1,500 mm a year, although it may vary as much as 500mm in either direction for a particular year (Coultas, et al. 1993, 1994).

The area surrounding Las Cuevas lies in the limestone foothills of the Maya Mountains. The terrain is uneven with hills and ridges undulating over the landscape. The elevation varies due to the hills, ranging between 450-550m (Murtha 2004: 94). The

limestone found within the region is comparatively pure calcite and the vegetation is mostly formed of dense, broad-leafed forest with a closed canopy and numerous palm trees also occurring in the area (Coultas, et al. 1993, 1994). There are a number of rivers that flow in the lowlands including the Rio Usumacinta, Rio Motagua, the Belize River, the New River, and the Rio Hondo (Morton 2007).

The average temperature of the region hovers around 23 degrees Celsius (73.4 F), with it ranging from as low as 10 degrees Celsius at night, reaching to almost 40 degrees Celsius during the day (Murtha 2002: 207). The rainy season begins a little before summer either in late May or Early June, and lasts until October or November (Morton 2007). Although infrequent to the area, there have been episodic droughts in the region (Murtha 2002: 93). While this data does not exactly model the environment during the time in which Las Cuevas was inhabited, particularly due to the proposed drought seen during that time it does provide context to the conditions that the site occasionally sustained.

While the exact length and severity of the drought(s) during the Maya collapse are still debated within the field, archaeologists do agree that there was a significant climate change during the Late and Terminal Classic Period. Some models depict be a "megadrought" to have occurred during that time, while more recent research depicts the drought phases between 800 to 1000 AD to have drier and wetter periods (Curtis et al. 1996, Hodell et al. 2005, Kennett et al. 2012; Leyden et al. 1998). No matter the exact length, the droughts during these times placed extreme stress on the Maya who relied heavily on an unirrigated horticultural system to sustain themselves.

2.3 The site of Las Cuevas

Nestled within the foothills of the Maya mountains, the mid-sized center of Las Cuevas is found 14km southeast of the large polity of Caracol (Figure 2.2). In four field seasons, the LCAR mapped 26 structures situated around two plazas, a ballcourt, a sacbe leading to a hillside, and an elite *plazuela* group set on a platform just to the north of Plaza A (Moyes 2014, Moyes et al. 2015). The surface architecture sits above a 15m deep dry cenote (sinkhole) with a massive cave entrance at its base on the east side amidst a dense and thorny jungle (Figure 2.3). Found within the cave's large entrance is an underground river that surfaces at the base of a sinkhole, which fills during heavy rains. The river is surrounded by plastered platforms, stairways, and terraces that ascend to the cave walls creating an amphitheater-like space. Although construction in caves is not rare, Las Cuevas is significant in the fact that it boasts the largest amount of architectural construction in any cave site within the Maya Lowlands (Moyes 2012). This suggests that the chamber was used for well-organized ceremonies catering to large numbers of participants and was most likely an important site in the Late Classic period (A.D. 700-900). A 335m cave system runs beneath Las Cuevas Plaza A and directly underlies Structures 1, 3, and 4 as well as the plazuela group (Moyes 2014).

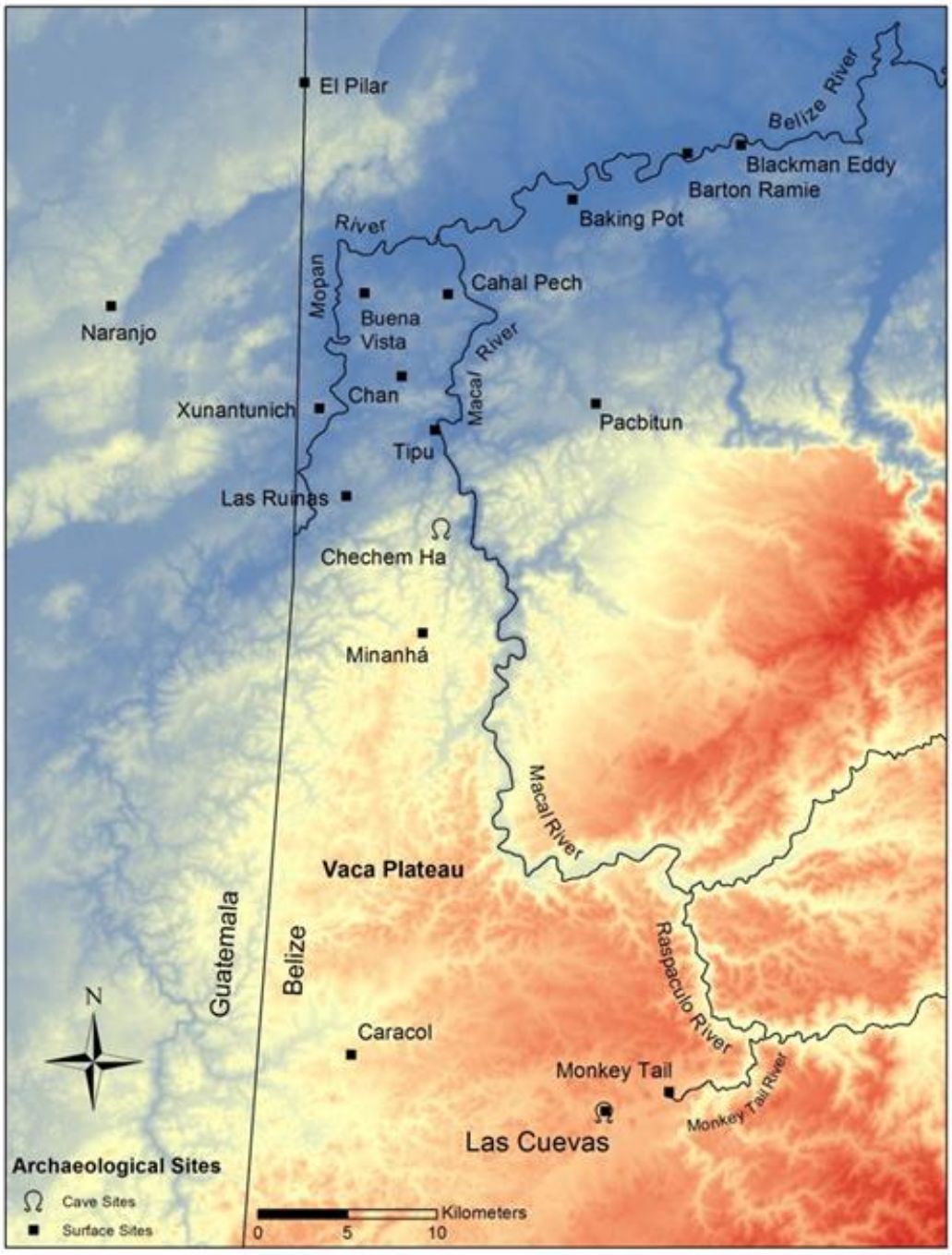

Figure 2.2. Map of western Belize showing Las Cuevas.

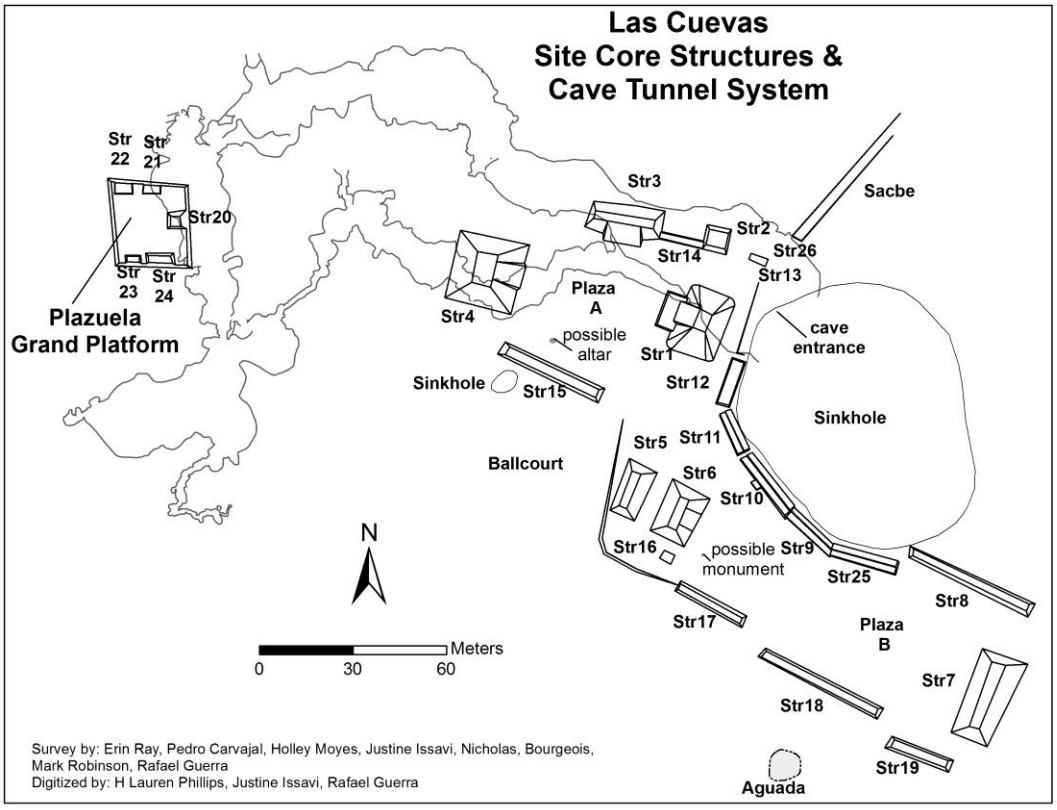

Figure 2.3. Map of Las Cuevas site core.

Plaza A contains a set of east/west twin structures of similar height (8m based on post- excavation and cleared of debris), as well as a northern palace and a low southern structure. Correlations can be drawn between the Las Cuevas' Plaza A and of Tikal's North Acropolis. Both have east/west oriented twin structures which are believed to mark the path of the sun as well as a northern palace and a low southern structure thought to represent the underworld (Moyes et al. 2015; Ashmore 1991:200-203). Although it has not been excavated, the large northern range structure (Structure 3) is suspected to be an elite palace (Moyes 2014). Another similarity between Plaza A and Tikal's North Acropolis that it is oriented on a north/south (axis is 23° east of north) with the ballcourt to the south of the eastern structure. The ballcourt is the western structure of Plaza B and has steps off the back protruding into the plaza (Robinson et al. 2013).

Despite their close proximity, Plaza A and Plaza B are distinct. While they are similar in that both have long and low linear structures along their north and south borders, Plaza B's orientation has a northwest/southeast axis. The northern structures hug the circular rim of the sinkhole outside of the cave entrance (Moyes 2014). While typically an ideal Late Classic Maya site plan should have the two plazas set on a north/south or east/west orientation depending on the site's political leaning (Ashmore and Sabloff 2002), with particular site layouts being more common with certain polities

over others, Plaza B is to the southeast of Plaza A. The cenote appears to dictate that the architecture not follow Maya constructional norms, defining the shape and size of Plaza B instead of orientating the plazas on cardinal directions like many other sites. Another interesting thing to note is the orientation of the plazas to the cave system itself. Structure 1 is arranged so that it sits directly above the cave entrance and the cave tunnels run below the three largest structures of Plaza A. The ceramic analyses and accompanying AMS dates indicate that the site was constructed during the Late Classic period (post AD 700) and with a few Terminal Classic ceramic markers. Therefore, the site was most likely in abandonment by AD 950 to 960 (Moyes et al. 2014).

Chapter Three: Cosmology, Caves, and Pilgrimages

3.1 Introduction

In this chapter I discuss the religious and political setting of Las Cuevas. Maya cosmology, Maya cave use, and Classic Period Maya social and political organization.

3.2 Maya Cosmology

The cosmology of the Classic Maya has in large part been reconstructed from iconography and inscriptions on ceramics, monuments and murals as well as a multitude of ethnographic resources ranging from written accounts from the Spanish and Postclassic codices, to even present day narratives and practices of the contemporary Maya. While much of the Postclassic belief system appears to share many of the same practices and beliefs as its predecessors in the Classic period (Freidel et al. 1993), it must be noted that the Maya beliefs most likely did not remain entirely the same over time. What follows integrates broad ideas of Maya cosmology that are widely accepted and are reinforced by overwhelming evidence that these beliefs were practiced in the Late Classic period.

The Maya cosmology is laid out as a three tiered universe, consisting of a middle, upper and underworld (Coe 1999). The middle world was where humans lived, believed to be a rectangular plane floating in a large ocean, which during the Classic period was depicted in art as being on the back of a water creature, such as a crocodile, turtle or peccary floating in the 'Primordial Sea' (Freidel et al. 1993; Schele and Freidel 1990). The four sides of the world were oriented in the four cardinal directions (Coe 1999, Freidel et al. 1993) and the four corners were believed to be marked by the rising and setting of the sun during the solstices (Freidel et al. 1993).

The upper world lies above the middle world and was often represented in art as a 'sky band' where the gods of creation resided (Christenson 2003). It was also believed that the royal ancestors would also reside in the upper world upon death (Coe 1999). While the sky represented good and light, the underworld represented darkness, death and evil but was an ambiguous place that also stored riches, wealth, bounty, and fertility (Thompson 1970). The nine-tiered underworld also known as Xibalba (Tedlock 1985) existed below the middle world and acted as the land of the dead inhabited by the twelve lords of Xibalba who presided over disease and death (Schele and Freidel 1990). The Maya also believed the souls of the dead were forced to journey through Xibalba and partake in tests of wisdom and courage similar to that faced by the 'Hero Twins' in the *Popol Vul*, a sixteenth century book on Maya creation (Christenson 2003).

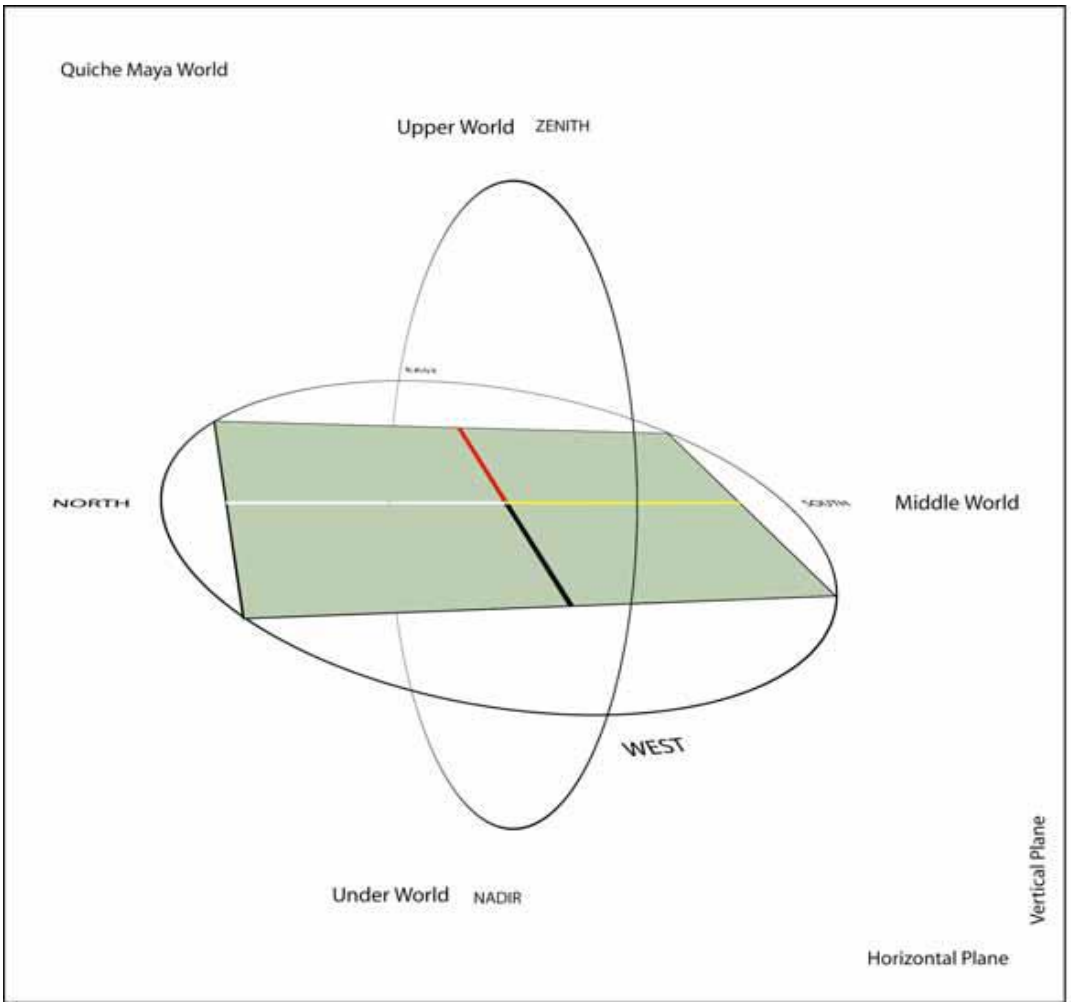

Figure 3.1: The multi-layered model of the Maya cosmos (Coe 1999)

The Maya also believed there were particular locations that served as connection between the different worlds. The principal location was the axis mundi, a giant ceiba tree which grew in the middle of the middle world and connected all three worlds, with the canopy reaching the upper world, and the roots penetrating Xibalba (Freidel et al. 1993). Geographical features were also seen as connections to other worlds, with mountains allowing people to communicate to the heavens and caves as entrances to the underworld.

3.3 Maya Cave Use

Aside from the negative connotation caves had in the Maya cosmology in their connection to the underworld, there was and still is also a positive association with caves. The Maya believed caves were connected with life, fertility, and rain, and it is likely that caves were multi-purpose ritual spaces (Brady and Prufer 2005; Moyes and Brady 2012; Thompson 1959). Ethnographic and ethnohistoric sources such as the *Popul Vuh* indicate

that caves were also associated with particular deities (Christenson 2001) and ancestor worship (Thompson 1959). Ethnographic research has detailed rituals requesting rain and crop fertility as well as preventing illness or disease (McNatt 1996; Christenson 2001). Due to the porous geology of many of the caves and the humidity of the region, caves have been used as a source of virgin water (*zuhuy ha*), a ritualized water believed to be pure as it dripped from the interior of caves (Thompson 1970; McNatt 1996). Death rituals are also believed to have taken place in caves, as Maya human burials have been found in a number of caves in Belize (Brady and Prufer 2005; McNatt 1996; Moyes and Brady 2012; Prufer 2005).

3.4 Site Planning

Based on ancient Maya cosmological principles, one cannot help but recognize the full salience of the site's layout at Las Cuevas. The entire site is constructed to manifest the Maya three-tiered universe, containing the underworld, earth and sky (Moyes 2014) as well as the cave/water/mountain complex important in Maya cosmology (Brady and Ashmore 1999). While each domain has their own set of associated earth deities, caves were seen as locations where Lords of the Underworld as well as the rain god Chac could be contacted (Moyes 2012). Cave rituals were likely conducted by kings or elites, and it is no surprise that caves in the Maya region during and after the Classic period became political spaces (Moyes 2006; Moyes and Prufer 2013, Stone 1995). The extent of monumental architecture inside the cave entrance of Las Cuevas only enhances that idea, as resources needed to construct and maintain such a site suggest polity-sponsored ceremonies (Moyes 2014). Furthermore, the entrance to the site, which leads from Plaza B appears to be heavily restricted, indicating that attendance of rites conducted inside of the cave were restricted with access granted only to the elites and their entourages (Arksey 2014; Arksey et. al. 2015). Based on the configuration, size, labor investments and monumentality of the cave, both Moyes and Arksey conclude that the ceremonies held at Las Cuevas were performed by and for elites.

Caves are known to be an important factor for Maya communities in settlement location (Moyes and Prufer 2013). Ethnohistorian Angel García-Zambrano noted in his study of mid-16th century Town Land Titles (*Títulos de Pueblos y Tierras)* that the landscape's ability to act as and recreate the cosmological ideal landscape was an important aspect that immigrants took into account when deciding where to settle. To emulate their cosmology, the ideal location required a centrally located mountain that could represent the center of the cosmos. It was also ideal for the mountain to be covered with caves and springs, preferably with water coming out of caves. He also noted that should the landscape not provide an area that mimicked the ideological model, manmade modifications could be undertaken in order to recreate it (García-Zambrano 1994:217-218).

There is almost no doubt that with its particular attributes that Las Cuevas attracted settlers. While there is no central mountain in the region, Structure 1 directly

above the cave entrance appears to have been constructed as a manmade substitute to recreate the ideal landscape. This is similar as to other ancient Maya constructions that recreated their ideal cosmological landscape such as temples representing sacred mountains and their rooms found on their summits acting as caves (Vogt and Stuart 2005). Furthermore, the river running through the cave entrance chamber roars with life during heavy rains, which could be seen as the cosmological life-giving water as well as a marker of rainy season. Besides the architectural features and the site plan, there are other reasons why we believe Las Cuevas was a relatively important site. A ceramic assemblage containing non-local materials has been found within the site, with styles originating from both southern Belize and the Belize Valley (Kosakowsky et al. 2013). Compounded with the fact that Las Cuevas is isolated from any large population center and is over an hour's walk from any nearby river, this suggests people went a great distance to visit the site and to bring offerings.

3.5 Pilgrimage

To understand whether Las Cuevas functioned as a pilgrimage place, it is instructive to define pilgrimage since it has been defined in as many ways as there are people defining it. Some claim that it is religious tourism (Saayman et al. 2014) while others argue that any secular site with a strong enough place attachment to draw in individuals could also be defined as a pilgrimage (Coleman 2013). The traditional definition of pilgrimage defines it as "a journey to a sacred place as an act of religious devotion" (Sykes 1982). This topic of pilgrimage is important to our question as to how the site was used as recent research in human behavioral ecology states that pilgrimages can be established as a way to institutionally reinforce social hierarchies via costly signaling, or as a method to promote social solidarity (Moyes 2014). If Late Classic ritual practices included pilgrimage, it would allow us to examine the function of religion and beliefs in the Late Classic politics and it effectiveness in creating cohesion and indicate cooperation among the Maya people in a time of social and environmental stress (Moyes 2014). The following section examines certain aspects of what a pilgrimage entails in order to see if the site of Las Cuevas meets such requirements.

3.5.1 Liminality

Pilgrimage is travel by an individual to a particular location, usually a sacred site (Stoddard 1997). Liminality, or how divorced something is from normal social life (Bowen 2013), often depends as to how far the person has traveled. This prompts the question of how far one much travel to call the journey a “pilgrimage,” but this has yet to be addressed by scholars.

Pilgrimages force the individual to remove themselves from the homogenization of their daily social life and enter a sacred and different space. I would argue that it is not distance that defines the pilgrimage, but the mental state of the pilgrim. . While most travel is not considered secular, pilgrimage forces the individual to enter a mental state of

consecration, allowing the person to experience something not as an individual, but as part of the shared identity of a pilgrim (Bowen 2013). By removing their normative identify and donning that of a pilgrim, the individual is able to experience something that they would normally not be able to in their daily lifes. This social aspect of pilgrimage allows one to separate those who are merely tourists looking for entertainment and those who travel to leave the mundane and experience the profane.

Another attribute of caves which make them attractive pilgrimage places is their physical and environmental liminal location. It is incredibly dark once one has traveled into a cave and away from the entrance. The natural geomorphology of the cave is different from what most people experience in their daily lives. The 3-dimensional shadowy aspect of caves can be confusing, with corridors and chambers appearing and disappearing in all directions. Natural obstructions and constrained pathways are disorienting, and shadows and lighting create a confusing environment (Montello and Moyes 2012).

3.5.2 Rituals

Rituals throughout the journey and at the destination play a factor in separating a pilgrimage from a more quotidian trip. Unique to the pilgrimage, rituals give pilgrims agency in the act of entering and acting out while traversing the liminal space of their journey. The rituals themselves can be a wide range of actions. For some religious pilgrimages special outfits are worn and normal habits are cast aside in order for the pilgrim to separate themselves from the mundane. For some, such actions are done in order appease a deity and show humility, for others it is a way for the individual to tell those around them that they are on an important journey (Bowen 2013). Similar to rites of passage, the rituals performed while traveling during a pilgrimage can be labeled as a rite of separation, allowing the pilgrim to remove him or herself from ordinary social life and take on the distinct role as a pilgrim (Turner 1978).

Another set of rituals that typically occur during pilgrimages happen once the individual has finally arrived at the sacred location. These rituals are often done in order to transfer materials, gifts or substance to a supernatural power in order to receive something in kind. We know that contemporary Maya still travel to caves to leave offerings while performing rain calling rituals in hopes of bringing rain for their crops (Christenson 2008). For some pilgrimages, the transfer of blessings from supernatural to the pilgrim is then passed on further when the pilgrim travels back home to share their new spiritual wealth with friends and family. This is often done by the pilgrim by returning with items imbued with power from the pilgrimage site that can be shared at home (Nordin 2009).

The material culture found at Las Cuevas clearly indicates that the site was used for ritual purposes and the site plan suggests a physical representation of an idealized sacred landscape (Moyes et al. 2015). Additionally, the architecture found within the

cave indicates that rituals were conducted for a large audience. The ceramics found within the cave also appear to have been imported from far and wide (Kosakowsky et al. 2013), suggesting that the ceramics were most likely used as an offering of some sort.

3.5.3 The Sacred

Another aspect of pilgrimage is the sacredness of the destination. Similar to the liminality argument, the sacredness of the site separates it from the normal and forces the pilgrim's journey, both spiritual and physical, to a destination they have not been to. Much like an initiate, a pilgrimage exposes the traveler to something new about their existence that they would not have experienced otherwise.

There is a modern argument as to whether or not traveling to certain secular sites would be considered a pilgrimage because place and group identities are not found only in religion (Proshansky et al. 1983; Reader 2007). There are many who claim taking a pilgrimage to Graceland to pay their respects and experience the life of Elvis Presley. There are others who claim yearly festivals and conventions such as Burning Man or Comic Con have many similarities to the Muslim pilgrimage known as the Hajj. They both draw incredibly large crowds of people on a yearly basis. They both play an important role in their respective group's institutions. Traveling to such events is often spoken of as life changing to those who participate. While the decision to go on a pilgrimage is an individual choice, the journey and experiences is done with fellow like-minded souls (Turner and Turner 1978). For this reason, the sacredness of a site does not rely on where the site falls on the secular spectrum, but is defined instead by how sacred the journey is to a group of individuals.

Much like a social institution, a pilgrimage is defined by the actions of like-minded individuals. Rituals and rules are defined are governed or dictated by a few but it is up to the individual to participate in the rites associated with a particular pilgrimage. By partaking in the same actions as their peers and those before them, the pilgrim is able to commemorate a particular belief and join in the history of that particular group's "metasocial commentary" on the mundane world around them (Bowen 2008, Geertz 1973). It is this desire to take part in something important and larger than the individual which gives these sites the sacredness that they are revered for.

3.5.4 Political Organization

John Kanter and Kevin Vaughn (2012) have proposed a model which states that pilgrimage centers can arise when there is climatic unpredictability and where religious leaders are thought to influence environmental, subsistence, and/or societal success. They predict that there would be an increase in investments of extravagant ceremonial events correlated with climatic instability and sustained poor conditions as well as an increase of construction of monumental infrastructure (p.70). Pilgrims could display their dedication

to the religious and political institution of divine kingship with the costly behavior of going on a pilgrimage. The ancient Maya royalty were seen as both religious high priests and political leaders within their society, somewhat similar to imperial cults as seen in Japan or Egypt (Sabourin 1973). Besides the royalty however, iconography and epigraphy also suggest of a class of politically powerful religious leaders who also existed at the time (Zender 2004). Either group creating a religious center in the Late Classic period would signal a weaker central political authority due to social stress caused by deteriorating environmental conditions and or population pressure (Moyes 2014).

Freidel (1981) also argues that festivals and fairs would also serve the local community by systematically integrating it into a larger regional network, allowing a scheduled time frame for people to trade across a broad sacred network. There is the issue however that intertwining trade with a sacred act does remove the pilgrim from the liminality of the pilgrimage, as trading economically was usually obligatory compared to the liminal experiences of the rituals performed on the pilgrimage. The elite members of society who organized the possible fairs and festivals would have tax the distribution of goods through these centralized exchange events while still ensuring the sacred and liminality of the event stayed intact (Freidel 1981). While it may seem difficult to balance the religious and economic undertones of pilgrimages, the two institutions of trade and religion may have been able to symbiotically coexist in large part to the fact that many Maya centers were believed to be themselves liminal spaces removed from the daily life of the dispersed residents living around them. Although many of the Late Classic period Maya centers had urban residential areas around them (Chase et al. 2011, Harrison 1970), there is evidence to suggest that the first substantial lowland public buildings were not places of residence (Freidel 1979, W. R. Coe 1965). If Las Cuevas were to fit such a model, we would expect to see a relatively low population both at and surrounding the site.

This project uses a comparative approach to study the strength of production based on population density found around the site of Las Cuevas to determine if a model of pilgrimage could be sustained. By estimating the population density of Las Cuevas and comparing it to other settlement sites locally, I seek to determine if the site may have had enough population to support a typical Maya polity with a dynastic ruler. While I do not have specific estimates for a minimum population size, I will rely on relative estimates based on comparative data. Should the settlement of Las Cuevas indicate that the surrounding area was not likely to be able to sustain a polity, the site would be expected to exhibit a low population. This would suggest that tribute or tithe by those visiting may have helped to support the site. High density would suggest that that Cuevas functioned as an independent polity, supporting a kingship, similar to many others.

I will also be evaluating settlement patterns to establish the relationship between Las Cuevas and the nearby polity of Caracol. If the settlement between Las Cuevas and Caracol is a continuous distribution during the same period it would suggest that Las Cuevas was either under the control or an extension of the Caracol polity. Therefore, it

would be unlikely that it was independent. A low population and continuous population distribution could suggest a pilgrimage site controlled by Caracol, whereas a high population separated from Caracol suggests a functional independent polity. A low population separated from Caracol's population would be an expectation for an independent pilgrimage site.

Chapter Four: Methodology

4.1 Introduction

Due to the lack of data and the short time frame, I was not able to conduct a full ground survey of the region surrounding Las Cuevas. However, a preliminary settlement survey was conducted in 2011 and I was part of the LCAR ground survey in 2014. Using the information from the preliminary settlement survey as well as the more recent one as a model for ground truthing the LiDAR data as a whole, we are better able to calibrate our LiDAR image to real-world structures. LiDAR data has come a long way since its inception into the field of archaeology and its high accuracy has proven to be adequate in comparison to the time consuming and labor intensive task of ground-truthing. In this chapter I describe how the LiDAR data was collected and how the survey was conducted. I also discuss how the border of the Las Cuevas was defined as well as discuss how the density of Las Cuevas compares with other sites.

4.2 LCAR LiDAR Survey

The majority of the data gathered for this research was done using LiDAR (or Light Detection and Ranging). LiDAR encompasses many techniques that use different types of lasers to construct images of objects. While some of the earliest forms of the technology relied on satellite data, it proved too course-grained for Mesoamerican archaeologists, as it did not allow researchers to examine anything through the dense canopies that plagued most of the sites (Chase et al. 2011). Until recently LiDAR, particularly airborne LiDAR, has allowed researchers to see through the foliage (King 1994; Pope and Dahlin 1985). These data can then be displayed by a Geographical Information System (GIS). When combined with the vast amount of resources and data gathering techniques we now have, many fields including the humanities have been able to spatially examine their data in ways we could have only dreamed of in the past. Analytic techniques such as least cost path analysis, which was first based on watershed analysis, prove that even highly advanced forms of GIS can be used and implemented in ways that further the study of archaeology (Howey 2011).

To appreciate the usefulness of the technology, it is important to comprehend just how far surveying methods have improved due to new methodology. From the earliest studies in settlement archaeology done in Belize such as those by Gordon Willey (Willey et al. 1978), pedestrian survey has been the for the most part the main technique used to survey a large landscape. This methodology is incredibly time and labor intensive, requiring people to cut transects often through dense jungle foliage. Once a number of transects have been cut, the methodology then calls for additional and often times smaller transects to be cut off the originals. Although somewhat effective, this method can sometimes prove to be misleading as projections based off of the sites and structures found can in some cases severely under or over-represent the actual densities of these features (Murtha 2002).

Compared to LiDAR, pedestrian survey does not come close to accomplishing the same tasks. What once took decades of ground mapping can now be done in a few days of LiDAR flyovers and a few weeks of post processing (Chase et al. 2011). LiDAR proves incredibly useful in determining the size and relative height of sites on the landscape, as it is able to largely ignore the vegetation and soil that has covered the sites. Despite it being an undeniable wealth of information, LiDAR does not make ground-truthing obsolete (Moyes and Montgomery 2016). Pedestrian survey still provides other information such as confirming the presence of structures and features. Test pitting can help determine the time in which the structures were used.. Due to the importance of the temporal aspect of the data, a settlement survey was conducted to examine some of the structures that were located on the LiDAR, and excavate test pits to determine their chronologies (Robinson et al. 2014).

Prior to the 2014 survey conducted using maps derived from the LiDAR data, a limited survey was conducted in 2011 which included systematic shovel test pitting along transects radiating from Plaza A and exploration of the surrounding area of Las Cuevas (Moyes et al. 2012). A number of structures were located during this survey but there was no time for broad systematic sampling of the settlement. In 2014 the co-director of the project Mark Robinson led a settlement and household archaeology survey program in which we were able to locate house mounds to target them for excavation using the LiDAR data, but we did not conduct a systematic ground survey to estimate the accuracy of the LiDAR (Robinson 2014). This did prove to be useful in that we were better able to calibrate expectations for images that were seen in the LiDAR with those on the ground.

The LiDAR data used for this research which included the west-central portion of Belize was acquired by the National Center for Airborne Laser Mapping (NCALM) in April and May of 2013 through a collaborative effort between multiple archaeological researchers. The campaign covered approximately 1050 km² (105,000 hectares) within the Vaca Plateau and along the Belize River Valley. NCALM used an Optech Gemini Airborne Terrain Mapper (ALTM) mounted on a twin-engine Cessna 337 aircraft, flying at 600m AGL and a ground speed of 60m per second. Three hundred and twenty-five north-south survey flight lines were flown spaced approximately 137m apart, which resulted in triple swath overlap. The laser was operated at a pulse rate of 125kHz with a beam divergence of 0.8mRad and a scan frequency of 55Hz. The nominal scan angle was 18 degrees with an edge cutoff of 1 degree. NCALM post-processed the data to remove modern structures and delivered point cloud data to us as .LAS files containing three dimensional *x, y,* and *z* values (Moyes and Montgomery 2016).

Our analyses are based on a 222 km^2 area surrounding Las Cuevas, a region spanning both sides of the Monkey Tail Branch of the Macal River. Data analysis was conducted using ESRI ArcGIS 10.2 and QCoherent's LP360. While ArcGIS was used to examine the data on the macro level, LP360 allowed us the ability to view possible sites in greater detail. Although the resolution was set by the LiDAR data, LP360 allowed a more user friendly experience in examining the possible sites both zoomed in and from a

side profile view. This began with the creation of a meter-resolution LiDAR-derived digital elevation model (DEM) based off identified ground-return points (.LAS files). DEMs were rasterized (gridded) models that smooth the point data by averaging points within each grid cell (Bonham-Carter 1994:25). Hillshades are the most common DEMs used to look at LiDAR derived data. To accentuate the area's topography, hillshades were generated and displayed using ArcMap 10.2. The advantage of hillshading is that it produces a 3-dimensional effect, casting light from a single direction. The illumination angle can be changed so that features are highlighted or suppressed (Bonham-Carter 1994:129-132). The disadvantage of hillshades is that they are technically a 2.5 dimensional model that do not allow us to directly measure features in the image, though each rasterized cell has a coded elevation. This elevation averages the points within that cell as a single value but does not account for the variation between single points. Measurements for *z* values (elevation) are best taken directly from the point cloud itself because those values are definitive for each point. Additionally, it is sometimes difficult for the eye to distinguish positive vs. negative relief structures in hillshade models. Therefore, is it prudent to consult other models to interpret LiDAR points such as viewing data in cross-section.

4.3 Ground Survey Area and Methods

The goal of the 2014 settlement survey was to locate house mounds based on the LiDAR data and to test them for chronology. A small area of the LiDAR was selected for this purpose. We assumed that all sites were Late Classic, but were curious as to the time depth of the settlements. In spite of having 222 km2 of LiDAR mapping, the short field season of 2014 compounded by the thick vegetation and lack of established pathways forced us to focus our survey in an area that optimized our time spent. For those reasons, in area approximately 1.5 x 1km to the west of Las Cuevas was chosen as the target area. The zone contained a number of sites identified from the LiDAR ranging in size from single structures to plazuela groups with internal courtyards over 20m wide. This area allowed us to examine just how accurate our lab analysis of the LiDAR data was based on a number of sites of various sizes so that we could better calibrate our skills in assessing the LiDAR data (Robinson 2014). The zone's proximity to the site proper also allowed us to be relatively close by to the rest of the crew for safety in case of bad weather or a medical emergency.

The survey was supervised by Mark Robinson, with myself, Nicholas Bourgeois, John Walden, Antonio Mai and his brother Javier assisting. Our survey team was equipped with printed LiDAR maps, UTM coordinates extracted from the LiDAR data via ArcGIS, two handheld GPS units, compasses, excavation equipment and machetes. Basic information was collected to confirm the presence of sites and features and records of the number and size of structures encountered. Groups of structures that were not well defined on the LiDAR were mapped using a compass and distometer (Robinson 2014). Seven of the groups were selected for excavation in order gain insight as to the basic form and material culture of the settlements surrounding Las Cuevas. The six groups were all confirmed to Late Classic (600-900 A.D.) based on the ceramic assemblages

(Robinson et al. 2014). Aside from noting potential points of interest, areas without features were also chosen in order to confirm the presence/absence of structures and assess possible landscape features such as terraces and water features.

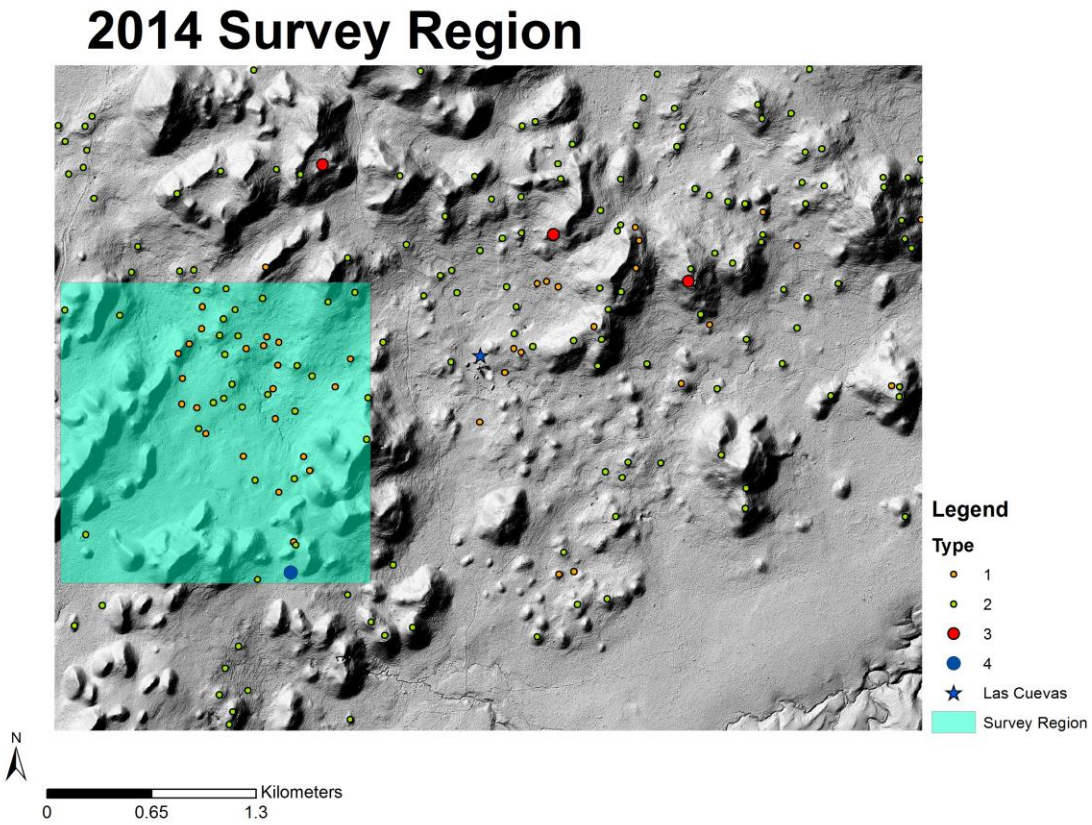

Figure 4.1: Survey region of 2014 Survey

In order to ground truth as much area as possible, movement between targets was often done with the group spread across with roughly a few meters separating each other. Trails were established and repeated in order to have quick access for excavation sites, to bypass certain areas of dense vegetation, and circumnavigate rough terrain. Sixty-nine settlement targets were visually identified as definite sites with an almost equal amount labeled as points of interest. With many of the points of interest being possible single structured sites, we were unsure as to whether or not the points were merely part of the undulating geography.

Sixty-nine groups located on the LiDAR were confirmed by ground truthing, with a further 45 architectural groups documented in the western survey area (Robinson 2014). Forty of the 45 sites were known points had been noted in our LiDAR imagery as those of possible interest, while the remaining four groups were found as part of the survey without LiDAR assistance. As most of the smaller sites were discerned on the DEM and labeled as points of interest, ground truthing helped us calibrate our LiDAR analysis with

the real-world data to aid in finding additional sites on the rest of the LiDAR image (Robinson 2014). Furthermore, several targets that had been labeled as potential sites were confirmed to instead be natural features. This also aided in our LiDAR analysis calibrations because we were able to better grasp the shape of the structures. While most of them were rock outcrops, one of the features to our amusement was an incredibly large tree stump the size of a small car. Overall, a total of 114 groups were positively identified at the end of the season adding 10 to the 104 structures located on the LiDAR image (Robinson 2014). Furthermore, other features such as caves, aguadas, terraces and causeways that appeared on the LiDAR were also ground-truthed and recorded.

Although only a small portion of the LiDAR was ground-truthed, the data that we were able to collect proved paramount. The survey gave us a firsthand experience as to the uniform shape that many of the structures had, as well as a few possible outlier shapes that were seen on the LiDAR. Understanding the visuals both in person and on the LiDAR image allowed us to further calibrate the overall LiDAR data and increased the number of sites found from roughly 600 to 855. While many of the added sites were labeled as points of interest, we were able to reliantly label many of them as sites due to the better understanding of what we were reading on the LiDAR data. Furthermore, thanks to the ground truthing we were able to use QCoherent's LP360 to examine the profiles of points of interest to increase our future accuracy. While it would be preferable to ground-truth the remaining points of interest on the LiDAR map, their sparse locations across the 219 km^2 coupled with limited field time make it impossible at this time.

4.4 Structure Labeling

The settlement data of the 222 km2 LiDAR map was analyzed using both ESRI ArcGIS 10.2 and QCoherent's LP360. Using 200 m^2 grids, ArcGIS was used to examine the LiDAR data and scan for sites and structures. Hillshades of different light angles were used in order to find structures that were hidden within the shadows of hills. While most of the sites were located and categorized with ArcGIS, those that were difficult to discern from the topography had their side profiles examined via LP360. Thanks to the ground truthing survey that I took part in during the 2014 field season, I felt much more comfortable with the accuracy of the sites that were defined on the LiDAR map. Once all the sites were defined and labeled they were then categorized into types (See figure 4.2) in order to understand where the higher density areas were as well as where administrative centers were located.

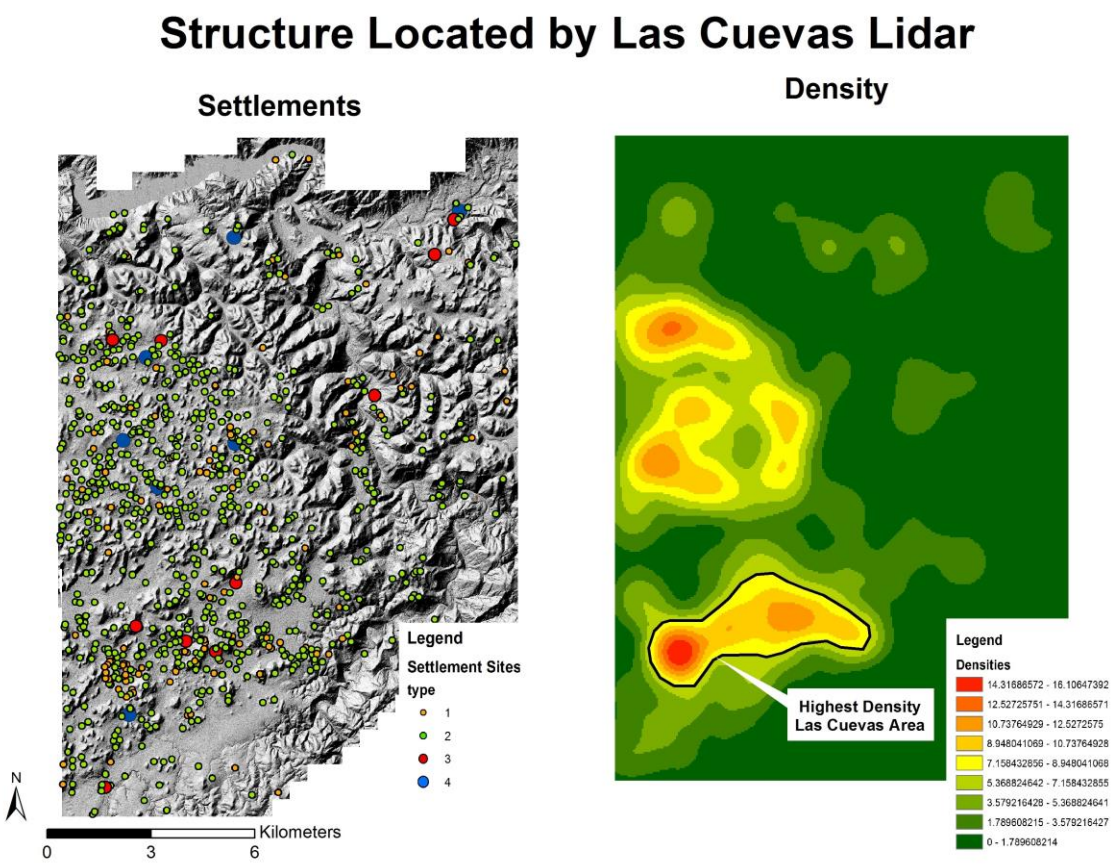

Figure 4.2. Settlement sites and their types around the site of Las Cuevas and their kernel density

Using both ArcGIS and LP 360 a total of 855 sites were located on the Las Cuevas LiDAR and are illustrated in Figure 4.3 We conducted a density analysis of the groups using ArcMap's Kernel Density tool. This analysis examines the density of chosen features around each output raster cell based on a predetermined neighborhood size area. In the case of the Las Cuevas data, the density magnitude was established to reflect the normal value over any given 50 square meter area. Density analyses were run on one shapefile containing the location of all sites found on the Las Cuevas LiDAR data. The density model was displayed employing a 9 ramped color display manual classification scheme that highlighted both moderate and high concentrations throughout the landscape. Results illustrated in Figure 4.2 show two distinct area of higher settlement density (shown in yellow and red), one to the north and one to the south. A karstic ridge running from east to west divides the two areas create a natural boundary between the two. The highest density of settlement surrounding the site core at Las Cuevas was found to be a 28 km^2 area around the site.

4.5 Investigation of Household Density with Comparative Data

In order to compare the household density of Las Cuevas to others, two sites were chosen, Caracol and Baking Pot. Caracol was chosen for comparison because of its close proximity to Las Cuevas and having an almost identical topography and environment. It is Las Cuevas' nearest neighbor and extensive research has been carried out both in the site core and periphery (Chase and Chase 2001, Chase et a. 2011, Murtha 2002). Furthermore, the relatively high population density surrounding Caracol presents this research with an arguable maximal ceiling in terms of the possible population expectations of Las Cuevas. With Las Cuevas being a much smaller site, I argue that it would quite unlikely for Las Cuevas to sustain a population density higher than Caracol, but that the nature of the site's function would also be a determining factor in site density. To test this notion, a second site was chosen for comparison.

The second site I chose to compare to Las Cuevas was the site of Baking Pot. The mid-sized polity of Baking Pot was chosen largely in part of its location. Baking Pot is a positioned between the dynastic kingdoms of Caracol to the south and Naranjo to the west. The site of Baking Pot was located in an area of very fertile soil, making it capable of producing a significant agricultural surpluswhich made it highly desirable to those in power (Hoggarth 2012). This surplus agricultural center was chosen because it represented an example as to the type of settlement one would expect see around Las Cuevas if it were a small agricultural producing polity typical of other Maya mid-sized sites. What follows are brief overviews of each site.

4.5.1 Caracol

One cannot discuss Las Cuevas without mentioning Caracol., which was one of the largest Maya polities and is the largest archaeological site in present day Belize. It was first reported to the Belizean government in 1927 and initial investigations were carried out by Linton Satterthwaite of the University of Pennsylvania. After a research hiatus of 30 years Drs. Arlen and Diane Chase began their program in 1983 (Chase and Chase 1987). Caracol has a rich history of occupation dating as early as the Middle Preclassic (~600 BC) all the way up to the Postclassic (AD 1100) (Chase and Chase 1987; Chase and Chase 1994). Las Cuevas, which has so far only dated to the Late Classic (AD 700-900) appears to have been occupied around the same time as Caracol's florescence in AD 500-850 (Murtha 2002).

Caracol is distinct when compared to other large Maya cities in that the settlement for the most part is dispersed throughout the region, with no clear settlement density around the site epicenter (Murtha 2002). Chase and Chase (2001) argue that the large causeways which radiate out of Caracol, some as far as 12km, were most likely used to incorporate the expansive settlement found throughout the region in terms of economics, politics, and even rituals. Besides connecting the surrounding area to the Caracol

epicenter of more than 150 structures, the causeways themselves terminate in large plazas and sometimes other epic buildings with elite and sometimes ritual constructions. These administrative and ceremonial centers acted as 'nodes,' which Caracol used to practice its 'administered economy' (Chase and Chase 2001). While still debated, the Chases argued that this system allowed Caracol to grow to a central polity population to at least 115,000 people during its apogee (Chase and Chase 1994b).

Not much is known about Caracol's Preclassic and Early Classic time periods other than that the site was inhabited, albeit by a much smaller population of between 9,000 to 19,000 people (Chase 1997). Although a small percentage of features, artifacts, and burials are dated to this time period, the Chases advocate that the site of Caracol did not become an important political player in the Maya area until the Late Preclassic (100 BC to AD 250) and beginning of the Early Classic (250 AD-600AD, Chase 2000). Their notion is based on the large documented ritual deposits and architecture built during this time. This is when Caracol became a warring powerhouse and adversary of the large kingdoms of Tikal and Naranjo (Mart and Grube 2000). The Chases argue that due to a multitude of victories in war, Caracol saw a huge increase in its population, growing from 19,000 to over 100,000 people (Chase and Chase 1994). On top of the population boom, the construction of architecture, both mundane and monumental exploded at this time with terraces, plaza groups, causeways, and causeway terminus structures all built during the Early Classic (Chase and Chase 2001).

During the Late Classic, the site center of Caracol shifted to Caana ('Sky House'), a large palace structure that stands more than 40m high (Chase and Chase 1987). Although the structure was built as early as the second century AD, the Chases argue that major construction and modifications were added to it around A.D. 500 to 600 (Chase and Chase 1994). Caracol continued to flourish, until a war event occurred in A.D. 680 in which the site of Naranjo attacked Caracol, sending Caracol into a 118 year decline (Martin and Grube 2000). Although Caracol does show life again during the eighth and ninth centuries, it does not come close to its former glory and is apparently short lived. By A.D 890, a massive decline in settlement occurs and construction in the center of Caracol nearly ceases. While there is evidence of settlement use of Caracol up until A.D. 1100, the elite institutions disappeared for quite some time, as seen with many other Maya sites (Webster 2002).

4.5.2 Baking Pot

The site of Baking Pot, located 10km to the east of the modern day town of San Ignacio, rests on the southern bank of the Belize River. Baking Pot also experienced a long period of occupation similar to Caracol, lasting from at least the Middle Preclassic (Audet and Awe 2004) (~600BC) into the Postclassic period (AD 1100) (Hoggarth 2008). Similar to Caracol, Baking Pot reached its height as a small kingdom towards the end of the Late Classic period (Helmke and Awe 2008).

There is a distinct settlement epicenter at Baking Pot centered around the site core and radiating out 1.5km (Hoggarth et al. 2008). Although there is settlement outside of this area that is considered part of the Baking Pot polity, the more remote settlement is considered to be peripheral (Hoggarth 2012). The ceremonial center of Baking Pot is made up of two groups connected by a sacbe, and two more sacbes which radiate outward. In addition to the many plazuela groups and house mounds surrounding the site, archaeologists have uncovered elaborate burials and believe there to be a royal palace at one of the groups (Audet 2006). Due to this, Audet argues that the site of Baking Pot could have been a part of the Naranjo kingdom during the Classic period, later becoming an independent capital during the Late Classic period (Audet 2006). Baking Pot is estimated to have had a population of approximately 3,047 during its height in the Late to Terminal Classic period, encompassing 554 mounds that made up 416 house groups over a 9km² (Hoggarth 2012).

4.5.3 Typology for Settlement Groups

Using our LiDAR-derived models, we generated maps of individual structures and settlement groups that allow us to examine the distribution of settlement in our area, evaluate settlement density, and create preliminary population estimates based on these remotely sensed data. Although there are many ways to classify the variation found in ancient Maya house compounds or other structural groups, we chose to use a modified version of the classification scheme proposed by Timothy Murtha (2002) for his work at Caracol so that our analyses would be comparable and compatible. In his study of the Cohune Ridge, an urban area located 5 km north of the site core, Murtha surveyed a 4.1km^2 area representative of Caracol's urban population and settlement dispersal. We compare the Caracol settlement density data as well as his projected high and low population estimates of this area to those at Las Cuevas. Murtha categorized his residential settlements into 4 categories for his pedestrian survey (2002:115):

Type I. Single or multiple structures constructed around an open space without a formally constructed plaza.

Type II. Single or multiple structures constructed around a formally constructed or modified plaza.

Type III. Multiple structures constructed around multiple formally constructed or modified plazas.

Type IV. Large multiple structures constructed around a series of large formally constructed plazas. This type varies from previous groups as these units required more labor in their construction. These units often contain causeways, ball courts, or monuments, typically associated with elite architecture in the lowlands.

Because we are using remotely-sensed data we modified our types to be roughly commensurate with Murtha's. For instance, Murtha specifies whether plazas are "formally" or not formally constructed, but from remotely-sensed data this is impossible to determine. Therefore, our typology is based on what can be viewed in the LiDAR:

Type I. Single structures

Type II. Multiple structures constructed around a plaza

Type III. Multiple structures constructed around more than one plaza

Type IV. Large structures in height constructed around a series of plazas that may contain causeways, ball courts, or monuments.

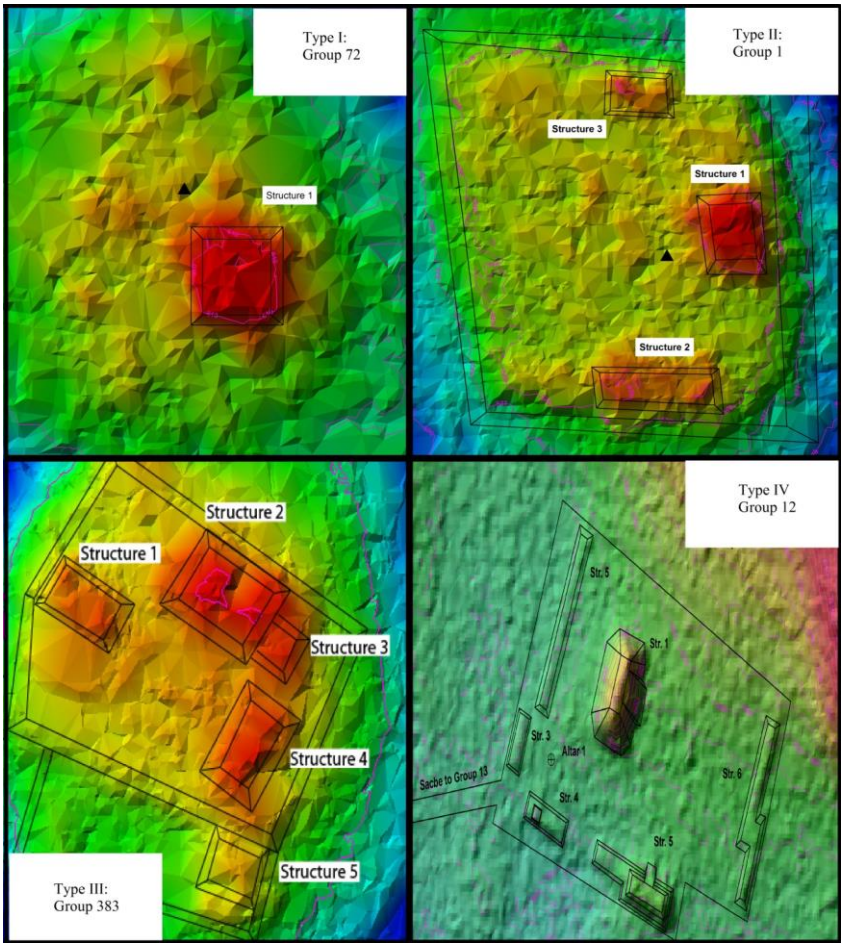

Figure 4.3. Examples of each Group Type as seen in the LiDAR data using ArcGIS

The Baking Pot data set required some work in order to compare it to the other two sites. Using a different methodology albeit with the same arguments, the Baking Pot structure

data was separated into three categories instead of four. Because Baking Pot had a different typology for their sites, it was impossible to do a direct correlation between the data sets of it and Las Cuevas and Baking Pot. The low status commoner structures match up to the combination of Type I and II structures of the other data sets. Due to the correlation, the data from Baking Pot was examined using 3 categories, with the first one representing the equivalent of Type I and II of the four categorical data. Baking Pot's typology was as follows:

Low Status Commoner: Structures with a minimum volume $8m^3$ and a maximum volume of $199m^3$

High Status Commoner: Structures with a minimum volume of $200m^3$ and a maximum volume of $699m^3$

Noble: Structures with a minimum volume of $700m^3$ and no maximum volume

Table 4.1: Comparative data of residential site types for the Las Cuevas LiDAR, Timothy Murtha's (2002:116, Table 4.2) survey on the Cohune Ridge area of Caracol, and Julie A Hoggarth's (2012:57, Table 3-4) survey on the center area of Baking Pot.

Settlement Type	**Area (km^2)**	**Number Found Total**	**Percent of Total**
All LiDAR Clusters	219 km^2	n=855	
Type I		119	14%
Type II		718	84%
Type III		9	1%
Type IV		9	1%
Northern LiDAR Clusters	135 km^2	n=514	
Type I		60	12%
Type II		444	86%
Type III		4	1%
Type IV		6	1%
Southern LiDAR Clusters	84 km^2	n=339	
Type I		59	17%
Type II		274	81%
Type III		5	1%
Type IV		3	1%
Cohune Ridge Survey	4.1 km^2	n=103	
Type I		22	22%

Type II		78	75%
Type III		1	1%
Type IV		2	2%
Baking Pot Survey	9 km^2	n=416	
Type I & II		347	83.4%
Type III		44	10.6%
Type IV		25	6%

4.5.4 Comparative Population Densities

The final stage of our analyses compares the population estimates between a 28 km^2 area surrounding the site core at Las Cuevas, which is our highest area of density, to the 4.1km^2 population estimates for the Cohune Ridge as well as the site core (9 km^2) of Baking Pot. Note here, that we are comparing our area of highest density area to one of Caracol's areas of lower density. While much of the Caracol region has yet to be ground-truthed, preliminary LiDAR work has shown the populations directly surrounding Caracol's site core to be much higher than the Cohune ridge urban population (Chase et al. 2011). Population estimates for all three site data sets were computed by assuming that between 3 (low estimate) and 5 (high estimate) numbers of people occupied each house structure. While some prefer to use the higher numbers between 6 and 10 based on sixteenth-century Spanish tax documents (Sanders 1981), the constant of five is the most commonly used constant (Murtha 2002). While these numbers are considerably lower than Table 4.2 details the comparative results. For the Cohune Ridge population estimate Murtha (2002:135-135, Table 4.4) counted all structures in the area (358), reduced that number by 25% for the number of structures that would have not been used as residentials (268), and multiplied that number by 3 persons for a low estimate (805) and 5 persons for a high estimate (1345). Due to the broad approximations of percentages of small structures being labeled as something else besides residential at a multitude of sites, ranging from 16% (Haviland 1970:193) to 40% (Tourtellot 1970:412), Murtha's approximation of 25% was used both as a rough average and in order to compare our data to his. By dividing the total number of persons by the area (4.1km^2) we estimate a population density of 196 people per square kilometer on the low side and 328 on the high side.

The Baking Pot estimates calculated their population with a different coefficient. I took their structure count during their apogee in the Late Classic period and extrapolated from there. While the other two data sets reduced the structure count by 25% for analyses, the structure count at Baking Pot removed groups with volumes below 8m^3 as they were classified as being non-residential (Hoggarth 2012). Instead of reducing the structure count further, I left the Baking Pot numbers of house structures as they were as I felt that the classification reduction was a suitable substitute for the logical reduction done by Tim Murtha. Baking Pot consisted of 554 mounds. Assuming 5 people per structure, there were 2770 people occupying the 9 km^2 and assuming only 3 people per

structure there were 1662. By dividing the number of people by the area, this leaves us with a low population density of 185 persons per square kilometer and a high density of 308.

In the area surrounding Las Cuevas there were 255 settlement groups that contained a total of 756 structures, which reduced by 25% for purposes of the analyses totals 567. Assuming 5 people per structure, there were 2835 people occupying the 28 km^2 area and assuming only 3 people per structure there were 1701. By dividing the number of people by the area, this leaves us with a low population density of 61 persons per square kilometer and a high density of 101 persons. This is considerably lower than that of the urban area of Caracol as well as the site of Baking Pot.

Table 4.2: Table showing the highest population estimates for the Las Cuevas surrounds, the Cohune Ridge area of Caracol (Murtha 2002:132), and the Baking Pot center (Hoggarth 2012:54).

	Low Population Estimate Surrounding Las Cuevas (3 persons per structure)	**High Population Estimate Surrounding Las Cuevas (5 persons per structure)**	**Low Population Estimate for Cohune Ridge (3 persons per structure)**	**High Population Estimate for Cohune Ridge (5 persons per structure)**	**Low Population Estimate Surrounding Baking Pot (3 persons per structure)**	**High Population Estimate Surrounding Baking Pot (5 persons per structure)**
Number of People	1701	2835	805	1345	1662	2770
Number of Structures	756	756	358	358	554	554
Number of Structures -25%	567	567	269	269	554*	554*
Area (km^2)	28	28	4.1	4.1	9	9
Population Density / km^2	61	101	196	328	185	308

*The numbers for Baking Pot were left alone due the removal of structures below $8m^3$ as they were considered too small to be residential.

4.6 Investigation of Site Boundaries

Most of the boundaries of Las Cuevas are apparent when examining both the geography of the region and the LiDAR data. There are natural boarders all around the site, with hills to the north and west, and the Macal River to the south and east. The settlement data also depicts the natural border to the east and south as the site density drops off precipitously as one gets near of the river. Perhaps due to the heavy and high

flow of the river during the rainy season, it is interesting to note that there appears to be almost no sites on the other side of the river embankment.

Another method that helped define the boundary between Las Cuevas and Caracol was the kernel density plot done on the settlement sites found on the LiDAR map. The methodology is discussed below, but it is important to note here that the kernel density map depicts two distinct groups of settlements. Compounded with the fact that Caracol's sacbes are constructed right up to the west of the northern group on our kernel density (Chase et al. 2011), it appears that the northern group is likely a continuation of the large Caracol settlement population. The stark population drop off between the two groups and the presence of a natural ridge line separating the two as illustrated in Figure 4.3 suggests, that this was the border between the two political units.

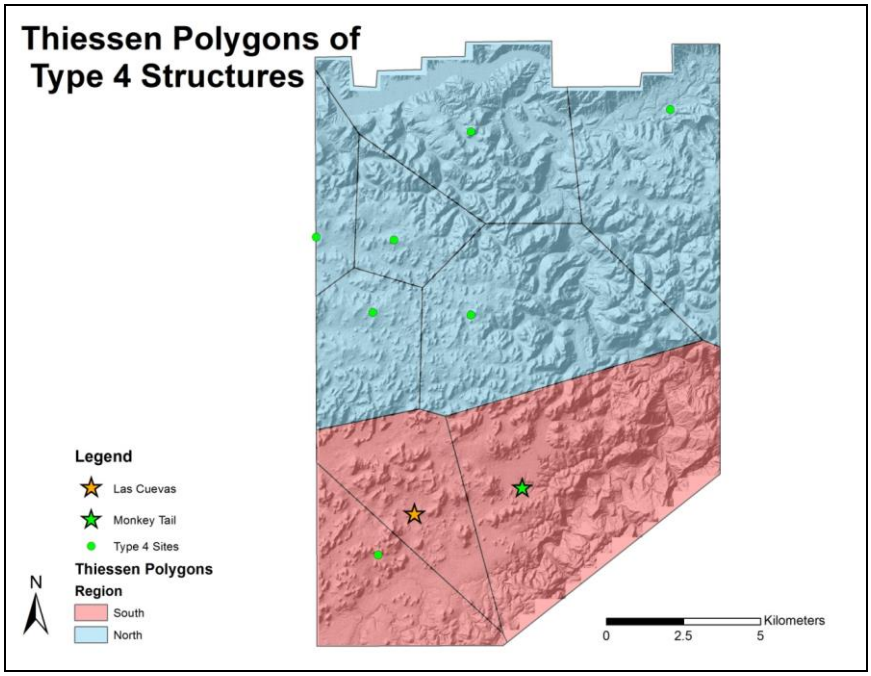

Figure 4.4. A map depicting the Thiessen polygons of the Type 4 Structures

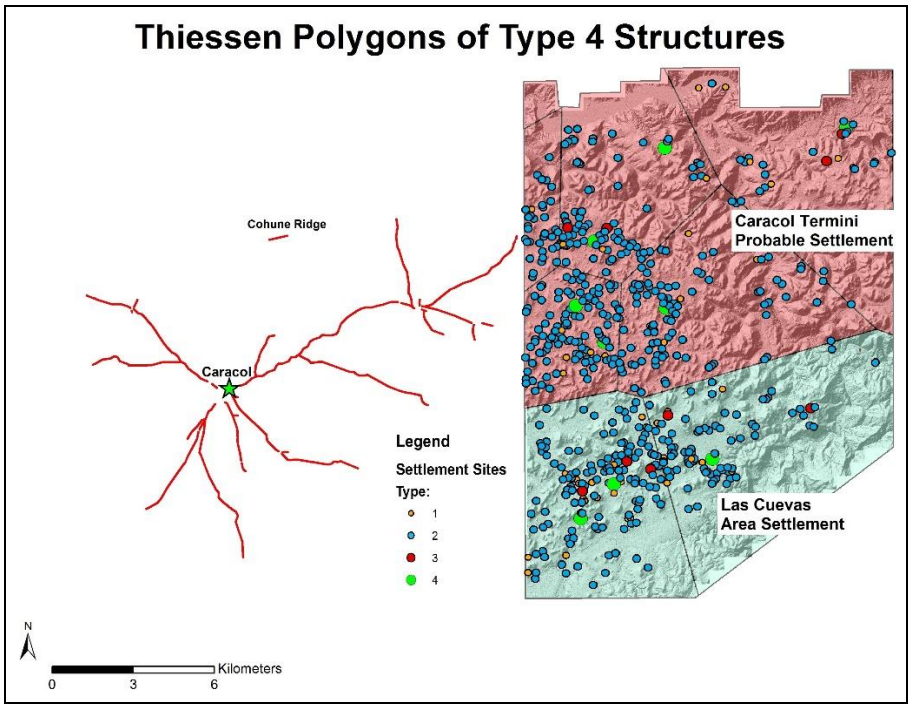

Figure 4.5. Map showing results of Theissen Polygon analysis juxtaposed with Caracol's road system. The division between the north and south areas is defines by polygon boundaries that follow a natural east/west oriented karstic ridge.

4.6.1 Thiessen Polygons

To further explore these data, a set of Thiessen polygons were constructed (Figure 4.4). This analysis creates polygons from a set of sample points to define area boundaries or an area of influence around selected sample points, so that any location inside the polygon is closer to that point than any of the other sample points. They are mathematically defined by the perpendicular bisectors of the lines between all points. In this case, we wanted to examine the relationship of Type IV, the largest sites found on the Las Cuevas LiDAR, to each other. While Thiessen polygons cannot precisely tell us exactly where the sphere of influence of each type IV site starts and ends, it does allow us to examine the relative borders between sites. The Thiessen tool found in ArcGIS v10.2, generated 7 polygons for the Cuevas LiDAR area (Figure 4.4). Note that the polygon boundaries reiterate the density analyses in that the east/west ridge forms a clear boundary between the northern and southern polygon sets. The conclusion is that the ridge acts as a physical boundary separating the sphere of influences of the type IV sites. Compounded with the data from the kernel density, the ridgeline north of Las Cuevas appears to be a natural boarder between the Las Cuevas and its related sites and the northern settlements. When I juxtapose the Caracol polity and its known causeways with our model, it appears that the northern polygons are close to Caracol's boundaries and may therefore be part of the Caracol sphere (Figure 4.5). In our model, I suggest that the

five polygons to the north of the ridge are part of the Caracol sphere of influence, whereas the two polygons to the south are likely to represent a separate political unit.

Chapter Five: Results

5.1 Introduction

This project uses a comparative approach to study the population density found around the site of Las Cuevas to determine if a model of pilgrimage could be sustained. By estimating the population density of Las Cuevas and comparing it to other settlement types locally, I hope to evaluate whether or not the site may have had enough population to support a typical Maya polity with a dynastic ruler. While I do not have specific estimates for a minimum population size, I will rely on relative estimates based on comparative data. Should the settlement of Las Cuevas indicate that the surrounding area was not likely to be able to sustain a polity, the site would be expected to exhibit a low population. This would suggest that tribute or tithe by those visiting may have helped to support the site. High density would suggest that that Cuevas functioned as an independent polity, supporting a kingship, similar to many others.

I also evaluated settlement density patterns to establish the relationship between Las Cuevas and the nearby polity of Caracol. If the settlement between Las Cuevas and Caracol proves to be continuous, it would suggest that Las Cuevas was either under the control or an extension of the Caracol polity. Therefore, it would be unlikely that it was independent. A low population and continuous population disbursement could suggest a pilgrimage site controlled by Caracol, whereas a high population and boundedness suggests a functional independent polity. A low population and boundedness would be an expectation for an independent pilgrimage site.

5.2 Density comparison of Las Cuevas with Comparative Data

The population density of Las Cuevas demonstrates a contrast with the comparative data. Las Cuevas had a population density of roughly 61 to 101 people per a square kilometer, while the Cohune Ridge of Caracol had 196 to 328 and Baking Pot had 185 to 308. Despite having a similar ratio of structure types, Las Cuevas had a much lower population density when compared to both Caracol and Baking Pot. This could be in large part due to the drought(s) which were occurring during the time of Las Cuevas' site usage.

5.3 Population Estimates

The population of the Las Cuevas area is roughly estimated to be about 1701 to 2835 people. While the population appears to match the size of Baking Pot's 1662 to 2770, it completely ignores the fact of the density, which illustrates Las Cuevas sustaining roughly the same amount of people but with three times the amount of land. This suggests that the population was much more highly dispersed over the landscape. Added to the fact that the Cohune Ridge nearby Las Cuevas was able to sustain a

population density roughly the same as Baking Pot with nearly identical geographical variables as Las Cuevas and the data suggests that the Las Cuevas area was much less productive.

5.4 Discussion

Despite its close proximity to Caracol, there appears to be a distinct separation between the settlement surrounding Las Cuevas and the settlement to the north. While the northern sites have sacbe's connecting some of Type IV sites to Caracol (Figure 4.5), as well as stela such as those found at the site of Mountain Cow and the Cohune Ridge, neither of those are found in the Las Cuevas region. Furthermore, the LiDAR kernel density analysis (Figure 4.3) depicts a distinct separation between the northern and southern populations, which interestingly follows both the natural boundary of the east to west karstic ridge that divides the groups, as well as the Theissen polygon border separating the north and southern Type IV administrative centers (Figure 4.4)

The settlement density data pertaining to the immediate high density area surrounding Las Cuevas was then compared to the Cohune Ridge of Caracol and the midsized polity of Baking Pot. Even though it residing next to the high density region of Caracol, Las Cuevas had roughly one third of the population of both the Cohune Ridge and Baking Pot. A less dense sustaining population suggests that the site of Las Cuevas must have relied on an import of goods entering the site. This observation supports a pilgrimage model.

Despite the possible influx of goods, Las Cuevas' economic model does not appear to match those of other civic or ceremonial sites. While most sites would act as a trading center for imported goods with what was being made locally, Las Cuevas does not appear to have any particular physical exports (Moyes et al. 2015). Instead, as Moyes and her colleagues suggest the commodity that Las Cuevas appears to have exported was of ideology and ritual, making the site a location of high devotional expression (LHDE). Renfrew argues that such locations suggest that their sites were used by large numbers of people who came to witness or participate in the rituals or ceremonies (2001). The large sinkhole at the entrance to the cave of Las Cuevas combined with the wide and relatively moderate decline of the cave entrance chamber does form a natural amphitheatre of sorts, which would have allowed a large group to view any rituals taking place deeper into the cave (Arksey and Moyes 2015). This attribute of Las Cuevas would have allowed a large gathering of pilgrims to take part in the sacred economy, allowing the pilgrims to receive the benefits socially gained by partaking in the religious experience. While the incoming resources of material goods or possibly labor for Las Cuevas was most definitely physical, the outgoing resource of sanctified experience(s) would have been entirely nonmaterial.

The site of Las Cuevas has many of the attributes one would expect to find at a pilgrimage site. First, caves are well known ritual spaces for the ancient Maya. Viewed as

an entrance to the Maya underworld, caves played an important role in rain calling and other agricultural rites (Brady 1989; Moyes and Brandy 2012). Because of their ritual importance, ceremonial caves such as Las Cuevas appeared to have only been entered when there was something important to conduct when it dealt with the Maya cosmology.

The material culture found at Las Cuevas does indicate the site being used for ritual purposes. The architecture found within the cave indicates that the site was used for large public ceremonies, and the site plan was a physical representation of as an idealized sacred landscape (Moyes et al. 2015). While the exact performances and rituals cannot be defined, there is little doubt that there were rituals conducted at the site of Las Cuevas. Pilgrimage sites are noted for their ability to draw in a transient population (Silverman 1994) and the ceramics found within the cave appear to have been imported from far and wide (Kosakowsky et al. 2013). Sadly, due to the site being heavily looted, it is difficult to say as to just how wealthy the artifacts were left (Moyes 2014).

By encouraging individuals to prove their commitment to the religious system by these acts of costly signaling would have most likely instilled the devotees with social benefits such as a beneficial reputation within their community or even trade with others while one is traveling on a pilgrimage (Kantner and Vaughn 2012). Kantner and Vaughn argue that this costly signaling reinforces the importance of the pilgrimage center, as people traveling long distances to visit such sites only demonstrates the influence of the site leaders' over both the supernatural and natural phenomena they claim to manage (2012).

Chapter Six: Summary, Conclusion and Future Research

6.1 Summary and Conclusion

The primary goal of this study was to better understand cave site usage of the Late Classic period Maya site of Las Cuevas, Belize. Specifically, my main intention was to examine as to whether or not the settlement patterns surrounding the site of Las Cuevas could support a pilgrimage model. An analysis of the settlement data surrounding Las Cuevas suggests that there was a low population density around the site, making the site unusual compared to other sites. It is argued that the individuals living around Las Cuevas appear to have no particular export, despite having a large non-local artifact assemblage during the drought that devastated Maya agriculture. This is also compounded with the fact that survey also found nothing that indicates an export economy. Furthermore, there was no evidence of roads, stela, symbols or artifacts associated with Caracol, despite the close proximity. It is argued that these facts suggest that Las Cuevas may have exported intangibles such as rituals and ideology, making the site a LDHE. Results of this study also suggest that the site of Las Cuevas was not a part of the Caracol polity and instead appears to be an independent entity, albeit short-lived.

In addition to exploring the question as to the site usage of Las Cuevas, this thesis also highlights the occurrence of pilgrimage in prehistory. Pilgrimage as a social construct of humanity is a well-known phenomenon, yet few pilgrimage sites are posited in the archaeological record. While the exact models and reasoning as to why those who partake in pilgrimages continues to be debated, one cannot deny that the people who choose to go on these journeys do so in order to accomplish a task that is inherently important to them. Ranging from merely being a religious form of tourism (Saaman et al. 2014) to acting as a means of social cohesion to construct a shared identity of a pilgrim (Bowen 2013), pilgrimages have played a role in human cultures. Pilgrimage practices are incredibly complex and pose a difficult task for archaeologists who wish to try to understand the behavior and economics of it within the material remains. This thesis contributes to a growing body of data on ancient pilgrimage and in methodologies designed to identity these sites.

6.2 Future Research Considerations

This study left several questions unanswered and suggests several avenues for further research. These include investigating the large sites (Type IV) to examine as to whether or not the ones labeled as Caracol's truly do depict the polity's far reaching influence, as well as further ground truthing and survey, and excavations of the many sites surrounding Las Cuevas to determine if some sort of export slipped through the cracks of the reconnaissance.

Another question that deserves further investigation is the relationship between Las Cuevas and the other nearby Type IV sites. At this time, little is known with regard

to the relationship between the sites despite their close proximity. While this thesis labeled Monkey Tail as part of the Las Cuevas polity due to their similar architecture and both surveyed sites have ceremonial structures, their proximity still proves perplexing. Data pertaining to the relationship between the handful of sites would provide evidence in regard to the sphere of influence Las Cuevas possibly had locally, as to what ritual purposes each site participated in, and perhaps aid in understanding who ruled the sites.

In addition to exploring the question of how Las Cuevas was used, this thesis also highlights the use of ethnographic data and theory in archaeological research. Pilgrimages can be incredibly complex, and one can only determine so much of this type of social construction through material remains before having to rely on inferences. It is only through a wealth of data collecting and refined research can one begin to uncover pilgrimage sites long lost and forgotten.

Bibliography

Arksey, Marieka
2014 Excavations in the Sinkhole. In *The Light and Dark Side of Las Cuevas: 3rd Report of the Las Cuevas Archaeological Reconnaissance Project: The 2013 Field Season*, edited by Mark Robinson and Holley Moyes, pp. 53-82. Report on file at The Institute of Archaeology, National Institute of Culture and History, Belmopan, Belize.

Arksey, Marieka and Holley Moyes
2015 Ancient Maya Ritual Pathways, Performing Power Outside the Cave at Las Cuevas, Belize. Papers of the 47th Annual Chacmool Archaeological Conference, Breaking Barriers, University of Calgary, Alberta, Canada.

Ashmore, Wendy
1991 Site Planning Principals and Concepts of Directionality Among the Ancient Maya. *Latin American Antiquity* 2(3):199-226.

Ashmore, Wendy and Jeremy A. Sabloff
2002 Spatial Orders in Maya Civic Plans. *Latin American Antiquity*, 13(2):201-215.

Audet, Carolyn M.
2006 *Political Organization in the Belize Valley: Excavations at Baking Pot, Cahal Pech and Xunantunich*. Ph.D dissertation, Department of Anthropology, Vanderbilt University: Nashville.

Audet, Carolyn M and Jaime J. Awe
2004 What's Cooking at Baking Pot: A Report of the 2001 to 2003 Seasons. *Research Reportsin Belizean Archaeology*, 1:49-59.

Brady, James E.
1989 Investigation of Maya Ritual Cave Use with Special Reference to Naj Tunich, Peten, Guatemala. Unpublished Ph.D. dissertation, Department of Anthropology, University of California, Los Angeles.

Brady, James E. and Wendy Ashmore
1999 Mountains, Caves, Water: Ideational Landscapes of the Ancient Maya. In *Archaeologies of Landscapes: Contemporary Perspectives*, edited by Wendy Ashmore and A. Bernard Knapp, pp. 124-145. Blackwell Publishers, Oxford.

Brady, J. E. and Keith M. Prufer
2005 *In the Maw of the Earth Monster: Mesoamerican Ritual Cave Use*. Austin: University of Texas Press.

Bonham-Carter, Graeme F.
1994 *Geographic Information Systems for Geoscientists, Modelling with GIS.* Pergamon Press, Oxford.

Bowen, John R.
2013 *Religions in Practice: An Approach to the Anthropology of Religion*. Florence: Taylor and Francis.

Chase, Arlen F., and Diane Z. Chase
1987 Investigations at the Classic Maya City of Caracol, Belize: 1985-1987. Volume Monograph 3. San Francisco: Pre-Columbian Art Research Institute.

1994 Studies in the Archaeology of Caracol, Belize. Monograph 7. San Francisco: Pre-Columbian Art Research Institute.

2000 Sixth Century Change and Cariation in the Southern Maya Lowlands: Integration and Disbursement at Caracol, Belize. *In* Traces of AD 536 and it's Aftermath.J.D. Gunn, ed. Pp. 55-65.

2001 Ancient Maya Causeways and Site Organization at Caracol, Belize. *Ancient Mesoamerica*, 12:273-281.

Chase, Arlen F., Diane Z. Chase., John F. Weishampel, Jason B. Drake, Ramesh L. Shrestha, K. Clint Slatton, Awe, Jaime J. Awe, and William E. Carter
2011 Airborne LiDAR archaeology, and the ancient Maya landscape at Caracol, Belize, *Journal of Archaeological Science*, 38:387-398.

Chase, Diane Z.
1997 Southern Lowland Maya Archaeology and Human Skeletal Remains:Interpretations from Caracol, Santa Rita and Tayasal. *In* Bones of the Ancestors: Studies of Ancient Skeletons. S. Whittington and D.M. Reed, eds. Pp. 15-27. Washington D.C.: Smithsonian.

Christenson, Allen J.
2007 *Popol Vuh: The Sacred Book of the Maya*. Norman: University of Oklahoma Press. Print.

2008 Places of Emergence: Sacred Mountains and Cofradía Ceremonies. In *Pre-Columbian Landscapes of Creation and Origin*, edited by John E. Staller, Pp. 95-121. Springer, NY.

Coe, Michael D
1999 *The Maya*. 6th edition. Thames and Hudson, London.

Coe, William R.
1965 Tikal, Guatemala, and Emergent Maya Civilization, *Science*, 147:1401-19.

Coleman, Simon
2014 Ritual Remains: Studying Contemporary Pilgrimage. In *A companion to the Anthropology of Religion*, pp. 294-308.

Coultas, C. Lynn, Mary E. Collins, and Arlen F. Chase
1993 The Effect of Ancient Maya Agriculture on Terraced Soils of Caracol, Belize. First International Conference on Pedo-Archaeology, Knoxville, 1993, Pp. 191- 201. The University of Tennessee.

1994 Some Soils Common to Caracol, Belize and Their Significance to Ancient Agriculture and Land-Use. *In* Studies in the Archaeology of Caracol, Belize. D.Z. Chase and A.F. Chase, eds. Pp. 21-33, Vol. Monograph 7. San Francisco: Pre-Columbian Art Research Institute.

Curtis, Jason H., David A. Hodell, and Mark Brenner
1996 Climate Variability on the Yucatan Peninsula (Mexico) during the Past 3500 Years, and Implications for Maya Cultural Evolution. *Quaternary Research*, 46(1):37-47.

Freidel, David
1979 Cultural Areas and Interaction Spheres: Contrasting Approaches to the Emergence of Civilization in the Maya Lowlands, *American Antiquity*, 44:36-54.

1981 Political Economics of Residential Dispersion, in *Lowland Maya Settlement Patterns*, edited by Wendy Ashmore, pp. 371-382, Albuquerque: University of New Mexico Press.

Freidel, David, Linda Schele, and Joy Parker
1993 *Maya Cosmos: Three Thousand Years on the Shaman's Path*. William Morrow, New York.

García-Zambrano, Angel J.
1994 Early Colonial Evidence of Pre-Columbian Rituals of Foundation. In *Seventh Palenque Round Table, 1989*, edited by Merle Greene Robertson and Virginia Field, pp. 217-227. Pre-Columbian Art Research Institute, San Francisco.

Geertz, Clifford
1973 The interpretation of Cultures. Basic Books, New York.

Harrison, Peter D.
1970 The Central Acropolis, Tikal, Guatemala: A Preliminary Study of the Functions of Its structural Components during the Late Classic Period" (Ph.D. diss., University of Pennsylvania).

Haviland, William A.
1970 Tikal, Guatemala and Mesoamerican Urbanism. *World Archaeology*, 2:186-198.

Helmke, Christophe and Jaime Awe
2008 New Site Description and Structure Designations of Baking Pot, Belize. *The Belize Valley Archaeological Reconnaissance Project: A Report of the 2007 Field Season*, edited by Christophe Helmke and Jaime J. Awe, pp. 81-102. Belize Institute of Archaeology, National Institute of Culture and History, Belmopan.

Hodell, D. A., Mark Brenner, and Jason H. Curtis
2005 Terminal Classic drought in the northern Maya lowlands inferred from multiple sediment cores in Lake Chichancanab (Mexico). *Quaternary Science Reviews*, 24(12):1413-1427.

Hoggarth, Julie A.
2008 Settlement Excavations at Baking Pot, Belize: Results of the 2007 Season." *The Belize Valley Archaeological Reconnaissance Project: A Report of the 2007 Field Season*, edited by Christophe G.B. Helmke & Jaime J. Awe. Institute of Archaeology, National Institute of Culture and History, Belmopan, Belize.

2012 Social Reorganization and Household Adaptation in the Aftermath of Collapse at Baking Pot, Belize. Unpublished Ph.D. Dissertation, Dept. of Anthropology, University of Pittsburgh, Pittsburgh, PA.

Howey, M.C.L.
2011 Multiple pathways across past landscapes: circuit theory as a complementary geospatial method to least cost path for modeling past movement. *Journal of Archaeological Science,* 38:2523-2535.

Kanter, John and Kevin J. Vaughn
2012 Pilgrimage as Costly Signal: Religiously Motivated Cooperation in Chaco and Nasca, *Journal of Anthropological Archaeology*, 31:66-82.

Kennett, Douglas J.,Sebastian F. M. Breitenbach, Valorie V. Aquino, YemaneAsmerom, Jaime Awe, James U.L. Baldini, Patrick Bartlein, Brendan J. Culleton, Claire Ebert, Christopher Jazwa, Martha J. Macri, Norbert Marwan, Victor Polyak, Keith M. Prufer, Harriet E. Ridley, HaraldSodemann, Bruce Winterhalder, Gerald H. Haug
2012 Development and Disintegration of Maya Political Systems in Respons eto Climate Change. *Science,* 338:788-791.

King, R. Bruce
1994 The value of ground resolution, spectral range and stereoscopy of satellite imagery for land system and land-use mapping of the humid tropics. *International Journal of Remote Sensing,* 15(3):521-530.

Kosakowsky, L.J., Holley Moyes Mark Robinson, and Barbara Voorhies
2013 At world's end: ceramic analysis at Las Cuevas. Research Reports in Belizean Archaeology: Papers of the 2012 Belize Archaeology.

Leyden, B.W., M. Brenner, and B.H. Dahlin
1998 Cultural and Climatic History of Cobá, a Lowland Maya City in Quintana Roo, Mexico. *Quaternary Research,* 49:111-122.

Martin, Simon, and Nickolai Grube
2000 Chronicle of the Maya Kings and Queens. Thames and Hudson, New York.

McNatt, Logan
1996 Cave Archaeology of Belize. *Journal of Cave and Karst Studies* 58(2):81-99.

Montello, D. R., and Holley Moyes
2012 Why dark zones are sacred: Turning to behavioral and cognitive science for answers. In *Sacred darkness: A global perspective on the ritual use of caves,* edited by Holley Moyes, pp. 385-396. Boulder, CO: University Press of Colorado.

Morton, Shawn G.
2007 *Procession Ritual at Naachtun, Guatemala During the Late Classic Period*. Unpublished Ph.D. Dissertation, Dept. of Archaeology, Calgary, Alberta, CA.

Moyes, Holley
2012 Constructing the Underworld: The Built Environment in Ancient Mesoamerican Caves. In *Heart of Earth: Studies in Maya Ritual Cave Use*, edited by James E. Brady, pp. 95-110, Association for Mexican Cave Studies, Bulletin Series No. 23, Austin..

2013 *Sacred Darkness: A global perspective on the ritual use of caves*. Boulder: University Press of Colorado.

2014 Las Cuevas: A Late Classic Location of High Devotional Expression. In *Dreams at Las Cuevas: Investigating a Location of High Devotional Expression, Results of the 2014 Field Season*, Robinson, Mark and Holley Moyes, Report on file at The Institute of Archaeology, National Institute of Culture and History, Belmopan, Belize.

Moyes, Holley and James E. Brady
2012 Caves as Sacred Space in Mesoamerica. In *Sacred Darkness: A Global Perspective on the Ritual Use of Caves*, edited by Holley Moyes, pp.151-170. Boulder, CO: University Press of Colorado.

Moyes, Holley and Shane Montgomery
2016 Mapping Ritual Landscapes Using LiDAR: Cave Detection through Local Relief Modeling (LRM). *Advances in Archaeological Practice: A Journal of the Society for American Archaeology*, 4(3):249-267.

Moyes, Holley and Keith M. Prufer, 2013. The Geopolitics of Emerging Maya Rulers: A Case Study of Kayuko Naj Tunich, a Foundational Shrine at Uxbenká, Southern Belize. *Journal of Anthropological Research*, 69(2):225-248.

Moyes, Holley, Mark Robinson, Laura Kosakowsky, and Barbara Voorhies
2012 Better Late than Never: Preliminary Investigations at Las Cuevas, *Research Reports in Belizean Archaeology*, 9: 221-231. Institute of Archaeology, NICH, Belmopan, Belize.

Moyes, Holley, Pedro Carvajal, and Shane Montgomery
2015 LiDAR at Las Cuevas: Settlement Surrounding an Ancient Maya Pilgrimage Site. Report on file at The Institute of Archaeology, National Institute of Culture and History, Belmopan, Belize.

Murtha, Timothy M.
2002 *Land and Labor: Classic Maya Terraced Agriculture at Caracol, Belize*. Unpublished Ph.D. Dissertation, Dept. of Anthropology, Pennsylvania State University, College Park, PA.

Nordin, Andreas
2009 Ritual Agency, Substance Transfer and the Making of Supernatural Immediacy in Pilgrim Journeys. *Journal of Cognition & Culture*, 9.

Pope, Kevin O. and Bruce H. Dahlin.
1989 Ancient Maya Wetland Agriculture: New Insights from Ecological and Remote Sensing Research. *Journal of Field Archaeology*, 16(1):87-106.

Proshansky, Harold M., Fabian, Abbe K., Kaminoff, Robert
1983 Place-Identity: Physical world socialization of the self. *Journal of Environmental Psychology*, 3: 57-83.

Prufer, Keith M.
2005 Shamans, Caves and the Roles of Ritual Specialists in Maya Society. In *In the Maw of the Earth Monster: Mesoamerican Ritual Cave Use*, edited by James E. Brady and Keith M. Prufer, pp. 155-185. University of Texas Press, Austin.

Reader, Ian
2007 Pilgrimage growth in the modern world; Meanings and implications. *Religion*, 37:210-229.

Robinson, Mark
2014 Awakening the Las Cuevas giant: Excavations at the western structure, Plaza A. In *Dreams at Las Cuevas: Investigating a Location of High Devotional Expression, Results of the 2014 Field Season,* Robinson, Mark and Holley Moyes, Report on file at The Institute of Archaeology, National Institute of Culture and History, Belmopan, Belize.

Robinson, Mark, Bourgeois, Nicholas, Walden, John, Carvajal, Pedro
2014 Preliminary Settlement Excavation at Las Cuevas. Cuevas. In *Dreams at Las Cuevas: Investigating a Location of High Devotional Expression, Results of the 2014 Field Season,* Robinson, Mark and Holley Moyes, Report on file at The Institute of Archaeology, National Institute of Culture and History, Belmopan, Belize.

Robinson, Mark, Holley Moyes, and Laura Kosakowsky
2013 Excavations at Las Cuevas: Architecture, Landscape, Chronology, and Site Identity. In *Research Reports in Belizean Archaeology,* 11, Institute of Archaeology, NICH, Belmopan, Belize.

Saayman, Andrea, Melville Saayman, and Agyapong Gyekye
2014 "Perspectives on the Regional Economic Value of a Pilgrimage." *International Journal of Tourism Research,* 16.4:407-414.

Sabourin, Leopold
1973 *Priesthood: A comparative study*. Leiden: E.J. Brill.

Sanders, William T.
1981 Classic Maya Settlement Patterns and Ethnographic Analogy, in *Lowland Maya Settlement Patterns,* edited by Wendy Ashmore, pp. 351-369, University of New Mexico Press, Albuquerque .

Schele, Linda and David Freidel
1990 *A Forest of Kings: The Untold Story of the Ancient Maya*. William Morrow and Company, New York.

Stoddard, Robert
1997 Defining and Classifying Pilgrimages. *Geography Faculty Publications,* 2:41-60.

Stone, Andrea
1995 *Images from the Underworld: Naj Tunich and the Tradition of Maya Cave Painting*. Austin, University of Texas Press.

Silverman, Helaine
1994 *The archaeological identification of an ancient Peruvian pilgrimage center*. World Archaeology Vol. 26.

Sykes, J. B.
1982 *The concise Oxford dictionary of current English,* 7th ed. Pg. 776. Clarendon Press, Oxford.

Thompson, J. Eric S.
1970 *Maya History and Religion*. University of Oklahoma Press, Norman.

Turner, Victor, and Edith L. B. Turner
1978 *Image and Pilgrimage in Christian Culture: Anthropological Perspectives*. B. Blackwell, Oxford.

Tourtellot, Gair, III
1970 The Peripheries of Seibal: An Interim Report. In *Monographs and Papers in Maya Archaeology*, edited by W. R. Bullard, Jr., Papers of the Peabody Museum of Archaeology and Ethnology, Vol. 61, Harvard University, Cambridge, MA..

Vogt, Evon Z., and David Stuart
2005 Some Notes on Ritual Caves Among the Ancient and Modern Maya. In *In the Maw of the Earth Monster: Mesoamerican Ritual Cave Use*, edited by James E. Brady and Keith M. Prufer, pp. 155-185. University of Texas Press, Austin.

Willey, Gordon J., Richard M. Leventhal, and William L. Fash
1978 Maya Settlement in the Copan Valley. *Archaeology*, 31(4): 32-43.

Zender, Marc Uwe
2004 *A Study of Classic Maya Priesthood*. Published Ph.D. Dissertation, Deptartment of Archaeology, University of Calgary, Calgary, Alberta, Canada.

Appendix A: Structure Group Data

The following table details the group ID, number of structures, and the group types (See Table 4.1) analyzed during this research.

Group	Number of Structures	Type
1	5	2
2	4	2
3	6	2
4	7	3
5	4	2
6	4	2
7	5	2
8	7	3
9	5	2
10	5	2
11	3	2
12	13	4
13	5	1
14	7	2
15	6	2
16	3	2
17	3	2
18	7	2
19	4	2
20	7	3
21	4	2
22	2	1
23	4	2
24	3	2
25	3	2
26	5	2
27	4	2
28	4	2
29	2	2
30	3	2
31	4	2
32	4	2
33	2	1
34	4	2
35	3	2

36	5	2
37	4	2
38	3	2
39	5	2
40	4	2
41	3	2
42	3	2
43	5	2
44	2	2
45	4	2
46	4	2
47	2	2
48	4	2
49	3	2
50	4	2
51	1	1
52	2	1
53	3	1
54	3	2
55	6	3
56	1	1
57	3	2
58	4	2
59	3	2
60	3	2
61	2	1
62	3	2
63	2	1
64	2	1
65	2	2
66	4	2
67	2	1
68	3	2
69	3	2
70	3	2
71	3	2
72	1	1
73	4	2
74	4	1
75	1	1
76	1	1
77	2	1

78	1	1
79	1	1
80	1	1
81	1	1
82	3	2
83	1	1
84	1	1
85	1	1
86	1	1
87	2	1
88	1	1
89	1	1
90	1	1
91	1	1
92	1	1
93	1	1
94	1	1
95	1	1
96	1	1
97	1	1
98	1	1
99	1	1
100	3	2
101	4	2
102	3	2
103	3	3
104	2	2
105	1	1
106	1	1
107	3	2
108	3	2
109	3	2
110	3	2
111	3	2
112	4	2
113	2	2
114	5	2
115	3	2
116	3	2
117	3	2
118	4	2
119	4	2

120	4	2
121	4	2
122	3	2
123	6	2
124	11	4
125	7	2
126	4	2
127	4	2
128	5	2
129	4	2
130	5	2
131	3	2
132	5	2
133	2	2
134	4	2
135	3	2
136	4	2
137	4	2
138	3	1
139	12	4
140	4	2
141	3	1
142	4	2
143	4	2
144	3	2
145	4	2
146	5	2
147	4	2
148	11	4
149	4	2
150	5	2
151	7	2
152	5	2
153	16	4
154	4	2
155	5	2
156	4	2
157	5	2
158	2	2
159	4	2
160	4	2
161	4	2

162	3	2
163	5	2
164	9	3
165	3	2
166	2	2
167	3	2
168	11	4
169	4	2
170	6	2
171	7	2
172	3	2
173	2	2
174	5	2
175	3	2
176	4	2
177	3	2
178	3	2
179	4	2
180	2	2
181	4	2
182	3	2
183	3	2
184	4	2
185	3	2
186	3	2
187	4	2
188	5	2
189	5	2
190	2	2
191	2	2
192	3	2
193	4	2
194	3	2
195	3	2
196	6	2
197	3	2
198	3	2
199	4	2
200	2	2
201	1	1
202	7	2
203	5	2

204	3	2
205	1	1
206	4	2
207	7	2
208	1	1
209	3	2
210	4	2
211	3	2
212	2	2
213	3	2
214	3	2
215	4	2
216	2	2
217	9	4
218	2	2
219	3	2
220	4	2
221	3	2
222	2	2
223	2	2
224	1	1
225	2	2
226	7	2
227	3	2
228	2	2
229	4	2
230	4	2
231	3	1
232	3	2
233	3	2
234	3	1
235	3	2
236	2	2
237	3	2
238	4	2
239	3	2
240	3	2
241	5	2
242	3	2
243	2	2
244	3	2
245	4	2

246	1	2
247	2	2
248	1	1
249	1	1
250	3	2
251	3	2
252	2	2
253	3	2
254	3	2
255	3	2
256	4	2
257	3	2
258	4	2
259	4	2
260	2	2
261	2	2
262	1	2
263	3	2
264	1	1
265	4	2
266	3	2
267	4	2
268	2	2
269	3	2
270	2	2
271	3	2
272	3	2
273	3	2
274	3	2
275	1	2
276	2	2
277	2	2
278	4	2
279	3	2
280	2	2
281	2	2
282	2	2
283	3	2
284	3	2
285	2	2
286	3	2
287	4	2

288	3	2
289	3	2
290	2	2
291	3	2
292	3	2
293	4	2
294	4	2
295	3	2
296	4	2
297	2	2
298	2	2
299	2	2
300	2	2
301	4	2
302	3	2
303	2	2
304	4	2
305	3	2
306	2	2
307	4	2
308	4	2
309	2	2
310	4	2
311	3	2
312	2	2
313	3	2
314	3	2
315	2	2
316	3	2
317	4	2
318	3	2
319	2	2
320	3	2
321	3	2
322	2	2
323	3	2
324	3	2
325	3	2
326	2	2
327	3	2
328	3	2
329	2	2

330	2	2
331	4	2
332	3	2
333	2	2
334	2	2
335	1	2
336	1	2
337	4	2
338	3	2
339	4	2
340	2	2
341	2	2
342	2	2
343	4	2
344	3	2
345	5	2
346	5	2
347	7	3
348	2	2
349	3	2
350	4	3
351	1	1
352	4	2
353	3	1
354	3	2
355	2	1
356	2	2
357	2	2
358	2	1
359	1	1
360	2	2
361	3	2
362	2	2
363	3	2
364	3	2
365	2	2
366	2	2
367	3	2
368	3	2
369	4	2
370	3	2
371	3	2

372	2	2
373	3	2
374	2	2
375	1	1
376	4	2
377	3	2
378	2	2
379	3	2
380	3	2
381	4	2
382	3	2
383	2	2
384	3	2
385	3	2
386	4	2
387	3	2
388	2	2
389	3	2
390	2	2
391	3	2
392	3	2
393	1	1
394	3	2
395	4	2
396	3	2
397	4	2
398	3	2
399	2	2
400	1	1
401	3	2
402	7	3
403	4	2
404	2	2
405	2	2
406	4	2
407	1	2
408	2	2
409	3	2
410	4	2
411	2	2
412	2	2
413	3	2

414	3	2
415	2	2
416	2	2
417	3	2
418	2	2
419	3	2
420	4	2
421	3	2
422	4	2
423	3	2
424	4	2
425	3	2
426	3	2
427	4	2
428	3	2
429	1	2
430	5	2
431	3	2
432	2	2
433	3	2
434	4	2
435	3	2
436	3	2
437	3	2
438	3	2
439	4	2
440	3	2
441	3	2
442	5	2
443	3	2
444	2	2
445	2	2
446	3	2
447	2	2
448	2	2
449	2	2
450	4	2
451	2	2
452	3	2
453	2	2
454	1	2
455	2	2

456	3	2
457	3	2
458	2	2
459	2	2
460	4	2
461	2	2
462	3	2
463	2	2
464	2	2
465	2	2
466	3	2
467	2	2
468	4	2
469	3	2
470	3	2
471	3	2
472	4	2
473	3	2
474	2	2
475	2	2
476	1	2
477	1	2
478	6	2
479	3	2
480	2	2
481	3	2
482	5	2
483	4	2
484	1	2
485	4	2
486	3	2
487	4	2
488	2	2
489	2	2
490	2	2
491	3	2
492	2	2
493	3	2
494	4	2
495	3	2
496	2	2
497	2	2

498	2	2
499	2	2
500	2	2
501	4	2
502	3	2
503	1	1
504	2	2
505	2	2
506	4	2
507	2	2
508	2	2
509	3	2
510	3	2
511	3	2
512	1	2
513	2	2
514	1	1
515	1	1
516	3	2
517	1	1
518	1	1
519	2	2
520	3	2
521	1	1
522	1	1
523	1	1
524	1	2
525	2	2
526	3	2
527	1	1
528	2	2
529	1	2
530	2	2
531	4	2
532	2	2
533	3	2
534	4	2
535	3	2
536	3	2
537	2	2
538	4	2
539	1	1

540	3	2
541	2	1
542	3	2
543	3	2
544	3	2
545	4	2
546	2	2
547	3	2
548	3	2
549	2	2
550	1	2
551	1	1
552	1	2
553	1	1
554	1	1
555	2	2
556	2	2
557	2	2
558	2	2
559	3	2
560	4	2
561	3	2
562	4	2
563	5	2
564	2	2
565	2	2
566	2	2
567	3	2
568	2	2
569	1	1
570	2	1
571	3	2
572	2	2
573	3	2
574	3	2
575	3	2
576	4	2
577	3	2
578	4	2
579	4	2
580	4	2
581	3	2

582	2	2
583	3	2
584	4	2
585	2	2
586	2	2
587	1	1
588	4	2
589	2	2
590	2	2
591	2	2
592	3	2
593	4	2
594	4	2
595	2	2
596	3	2
597	3	2
598	1	1
599	2	2
600	3	2
601	2	2
602	2	2
603	4	2
604	3	2
605	3	2
606	2	2
607	3	2
608	2	2
609	4	2
610	3	2
611	1	2
612	2	1
613	3	2
614	9	3
615	3	2
616	3	2
617	2	1
618	3	2
619	4	2
620	2	2
621	2	2
622	3	2
623	2	2

624	2	2
625	3	1
626	1	1
627	2	2
628	3	2
629	2	1
630	2	2
631	3	2
632	2	2
633	3	2
634	3	2
635	3	2
636	1	1
637	3	2
638	1	1
639	1	1
640	2	2
641	1	1
642	2	2
643	2	2
644	3	2
645	3	2
646	2	2
647	2	2
648	2	2
649	2	2
650	3	2
651	4	2
652	1	2
653	5	3
654	3	2
655	2	2
656	2	2
657	4	2
658	3	2
659	3	2
660	3	2
661	1	1
662	2	2
663	2	2
664	3	2
665	2	2

666	1	1
667	3	2
668	3	2
669	3	2
670	2	2
671	3	2
672	3	2
673	2	2
674	4	2
675	4	2
676	3	2
677	3	2
678	2	2
679	4	2
680	4	2
681	4	2
682	2	2
683	5	2
684	4	2
685	1	2
686	4	2
687	3	2
688	4	2
689	4	2
690	5	2
691	4	2
692	2	2
693	4	2
694	2	2
695	2	2
696	3	2
697	4	2
698	2	2
699	4	2
700	3	2
701	2	2
702	3	2
703	2	2
704	2	2
705	3	2
706	3	2
707	2	2

708	4	2
709	3	2
710	3	2
711	2	2
712	1	1
713	2	2
714	2	2
715	3	2
716	3	2
717	4	2
718	2	2
719	3	2
720	1	1
721	3	2
722	3	2
723	3	2
724	3	2
725	4	2
726	3	2
727	3	2
728	3	2
729	2	2
730	2	1
731	3	2
732	2	1
733	3	2
734	2	1
735	3	2
736	2	1
737	3	2
738	3	2
739	4	2
740	3	2
741	2	2
742	2	2
743	4	2
744	2	2
745	3	2
746	2	2
747	4	2
748	3	2
749	3	2

750	2	2
751	4	2
752	2	2
753	3	2
754	2	2
755	2	2
756	2	2
757	2	2
758	3	2
759	2	2
760	3	1
761	2	1
762	1	1
763	4	2
764	5	2
765	3	2
766	3	2
767	3	2
768	2	1
769	3	2
770	2	2
771	3	2
772	3	2
773	3	2
774	3	2
775	3	2
776	2	1
777	2	2
778	1	2
779	1	1
780	4	2
781	2	2
782	3	2
783	4	2
784	4	2
785	2	2
786	3	2
787	2	2
788	3	1
789	1	2
790	2	2
791	3	2

792	2	1
793	3	2
794	3	2
795	1	1
796	2	2
797	1	1
799	1	1
800	1	1
801	3	2
802	2	2
803	2	2
804	2	1
805	5	2
806	1	2
807	4	2
808	2	2
809	1	1
810	3	2
811	3	2
812	3	2
813	3	2
814	2	1
815	4	2
816	2	2
817	4	2
818	5	2
819	2	1
820	1	1
821	3	1
822	3	2
823	3	2
824	1	1
825	3	2
826	1	1
827	2	2
828	4	2
829	2	2
830	2	2
831	2	2
832	3	2
833	2	2
834	3	2

835	2	1
836	2	2
837	3	2
838	2	2
839	3	2
840	3	2
842	1	1
843	2	1
844	1	1
845	1	1
846	1	1
847	4	2
848	3	2
849	2	1
850	4	2
851	2	2
852	5	2
853	3	2
854	3	2
855	3	2