I, Mack E Cline, hereby submit this original work as part of the requirements for the degree of Master of Arts in Anthropology.

It is entitled:
New Technology and Old Methodology: Using GPS and Remote Sensing to Map Structures Between Say Kah and La Milpa South

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New Technology and Old Methodology: Using GPS and Remote Sensing to Map Structures Between Say Kah and La Milpa South

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Abstract

The 2015 field season at Say Kah, Belize allowed an opportunity for a research question to be answered, is Say Kah a distinct community within the La Milpa influence sphere? The inclusion of newly available technology such as dual-band GPS, remote sensed data, and mapping software and well tested survey methods facilitated a survey and mapping project between Say Kah and La Milpa South. This study was completed cheaper and faster than similar survey work done in the region. The data collected allowed the relationship between Say Kah and La Milpa South to be studied as well as add context to Say Kah’s higher level of status in the La Milpa influence sphere. This new technology has been proven effective in a dense jungle canopy and has implications for the future of survey and mapping projects in the three rivers region.
Acknowledgments and Dedication

This work is dedicated to the memory of Michael J. Agnich

As a graduate student at the Department of Anthropology at the University of Cincinnati it has been my great fortune to be surrounded by talented and caring faculty. My committee has made my research and this thesis possible. I would like to thank my committee chair Dr. Vernon Scarborough whose unwavering support and endless patience helped bring this thesis to completion. His positive attitude and belief in me helped push me beyond what I thought I was capable. The words of wisdom he has shared with me over the last two years have helped guide me through graduate school and will continue to inspire me through the rest of my career.

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Chapter I: Introduction & Environment

The Maya civilization flourished for over 1500 years in an challenging environment building massive cities dominated by holy lords that ruled over vast trade networks (Demarest 2004:1). They were able to harness the environment to its fullest potential and spread across the area now referred to as Mesoamerica (Demarest 2004:8). The Maya constructed major cities like Tikal and Calakmul, which were the rival of anything that existed in Europe at the time and also humble farming communities. There were also many mid-sized settlements that are now having their mysteries unlocked; one such settlement is that of Say Kah.

Say Kah is located in northern Belize in the Rio Bravo Conservation Area, where it is investigated as part of the Programme for Belize Archaeological Project (PfBAP) directed by Fred Valdez (Figure 1). Say Kah and its larger neighbor La Milpa are located near the northwestern boundary of the ecological preserve. The site of La Milpa was first recorded by J Eric Thompson in 1938 when Belize was still British Honduras (Hammond et al. 1998:831). Investigations of La Milpa and its surrounding area began in 1992 and continue to this day.

Located to the southeast of La Milpa is the site of Say Kah, a mid-level settlement which was first recorded by Thomas Guderjan in 1990 (Guderjan et al. 1991) as part of the initial surveying of the newly created Rio Bravo Conservation Area. At that time it was unwittingly recorded as being 4km southwest of La Milpa obscuring its actual position (Guderjan et al. 1991). Fortunately, it was rediscovered by Jon Hagman a few years later, who had established a survey transect from Dos Hombres to La Milpa. Say Kah has since been under excavation, first
by Brett Houk (Houk et al. 2006, Houk et al. 2007, Houk & Hageman 2007, Houk & Lyndon 2005), and subsequently by Sarah Jackson (see below). Since Houk concluded his investigations of Say Kah in 2007, the trowel has been passed to Sarah Jackson who with Linda Brown have overseen investigations into the site ever since (Jackson et al. 2010, Jackson & Brown 2012,
Jackson & Brown 2016). Under their direction, excavations have been expanded from Group A to include Groups B and C, as well as the addition of the newly discovered Group D (figure 2).

During these three field seasons others scholars have also worked to contribute to an understanding of Say Kah and its place in history (Argo 2010; Coats 2010; Dorning 2012). The work of others has also helped to bring the mysteries of Say Kah into the light; the mapmaking work by Joshua Wright has helped to add geographic and spatial context, and the contributions of the many project members and local workers have significantly assisted in this project’s success.

It is to this ever growing database of knowledge that the Say Kah Archaeological Mapping Project (SKAMP) seeks to add. The primary goal of SKAMP is methodological in
design, with the creation of survey transects and structure mapping conducted between Say Kah Group A and La Milpa South. This survey has utilized advances in GPS technology that have recently become much more accessible by way of reducing monetary and labor costs associated with past and traditional data-station based mapping.

The data collected during this survey have been used to help add context to the relationships between Group A and La Milpa South by looking at structure density and placement between the two communities. Topographic data collected from NASA are used to determine the role, or lack thereof, of the environment in structure placement. While this project does have a research component to its analysis, it is predominantly a methodological study.

The use of new technology and old survey methods has been used to determine if Say Kah is a distinct community within the La Milpa influence sphere or if it has distinct borders. This study uses the data collected above to answer this question and discuss what makes Say Kah different than other secondary communities associated with La Milpa. It also puts new technology and survey techniques to the test in a challenging environment which will have implications for future survey and mapping projects in the area.

Environment

The area where Say Kah is located is today a dense jungle. This environment poses many challenges to archaeological work, and some especially challenging problems for survey work. The wildlife run the gamut from harmless such as spider and howler monkeys to the extremely dangerous, jaguars and poisonous snakes. These animals can affect a survey by forcing a detour or abandonment of a transect all together. However, it is the plant life that has a much more pronounced effect on survey and mapping methodology. The dense canopy can make receiving a
GPS signal difficult in some areas to impossible in others. The rapid growth of plants can cause a transect that is partially cleared on Monday to no longer be visible by Friday.

The need to clear most plant life in an area to do a proper data-station based survey is a highly time and labor intensive concern. This study sought to circumvent this problem through the use of dual-band GPS, which have recently dropped in monetary costs. The handheld GPS unit allows much more mobility, removing the need to move cumbersome survey gear traditionally used in the region.

Chapter Summaries

This thesis is organized into six chapters, the first of which serves as a brief introduction to the goals of this project and the area in which it is taking place. Chapter 2 goes into a much deeper background La Milpa and the secondary communities such as Say Kah and the La Milpa cardinal sites which are located in La Milpa’s sphere of influence. This chapter also examines most of the relevant information available concerning the communities in the context of a survey study.

Chapter 3 is a detailed presentation of the methodology for this project. This chapter deals with how the project was set up, carried out, and analyzed. This is the core of SKAMP, which seeks to use new technology and modifications of previous survey methods in creating a cheap and effective methodology that can be easily altered to the needs of other projects.

Chapter 4 gives a detailed reporting of what was found within the survey area as well as how much of it was covered. This chapter only reports what was found while the following chapter will discuss why the structures were built and the implications of their location. Chapter 5 will also discuss previous findings by other scholars and compare them to what was actually
found during this field season, with the role of topography examined as a factor in where people chose to settle.

Chapter 6 offers a final assessment of what worked well with the methodology employed and what could have been altered to fit different research objectives. The survey methodology is compared and contrasted with other types of projects in the region. The role of new technologies for survey projects, and how they may affect developing theoretical interests is also discussed.
Chapter II: Strategy and Background

The primary goal of SKAMP was to undertake a methodological study utilizing new technology and old survey methods, however these results would be used to answer a research based problem. The research goal of SKAMP is to help elucidate the relationship between La Milpa South and Say Kah. This has been done with data gathered in part from structures between the two communities. The types of sites, the environment, and the topography are considered to prove there are two distinct communities here.

Study Goals

The research was conducted with the objective of showing Say Kah as a distinct community within the La Milpa influence sphere. While it is certain that La Milpa is the hegemon in the region with Say Kah under its influence, the latter distinguishes itself from other nearby sites. While Say Kah is now known to be located southeast of La Milpa, little is known about what surrounds the site both in terms of physical terrain and structures. There has been a tendency to study the site in locational bubbles. Data on the architecture, ceramics, and goods discovered at Say Kah have been collected and analyzed and this project will add to the record by revealing what lies outside this community in terms of structures (Jackson et al. 2010, Jackson & Brown 2012, Jackson & Brown 2016, Hammond et al. 2003).

The site of La Milpa has a history stretching back to the Late Middle Pre-Classic (600-400 BCE) (Tourtellot et al. 1993:97). There are two competing models that have been proposed to explain habitation between the initial founding and subsequent abandonment in the Late-Terminal Classic (800-925 BCE) (Hammond et al. 1998:831-832). Ceramic evidence points to two distinct periods of habitation separated by a period of near abandonment (Hammond &
The exact occupational history has yet to be determined, however these models do agree that the La Milpa Core was founded in the late Middle Pre-Classic and that its population and activities hit their height during the Late Classic (600-800 CE). This is significant as Say Kah has shown signs of occupation in the Early Classic period (Houk et al. 2007:139-147) before the construction of the four cardinal sites which were settled during the Late Classic population explosion (Everson 2003:91-93, Tourtellot et al. 2003:100).

The cardinal sites were founded in the Late Classic which was also the period that the La Milpa core underwent a massive building campaign, much like Say Kah which in this period expanded its elite center of Group A and added several other building groups (Houk 2007). Also during this Late Classic population explosion in which structures are built further and further from the core, the arms of the cardinal transects are filled in creating continuous habitation between La Milpa Core and the four cardinal sites (Tourtellot et al. 2003, Rose 2000).

The architecture found at Say Kah like that at La Milpa shows signs of elite inhabitance given its grandiose size (Houk 2003:61). This differs from the architecture found at the cardinal sites which is larger than the surrounding structures but is plainer in style. The cardinal sites were constructed to denote a cultural boundary (Tourtellot 2003:97). This cultural boundary is shown to take the shape of an Axis Mundi using the cardinal sites as the ends of the four directions (Everson 2003).
Say Kah, much like La Milpa Core and the cardinal sites, was constructed at the highest point of elevation in the immediate area. Group A sits atop a steep area of elevation with all the structures built at the edge of the hilltop. This gives them the effect of appearing much higher when viewed from the lower elevation layers outside Say Kah. It has been posited by Everson (2003) that elevation can be conflated with the higher status of structures in this region. The subsequent Say Kah groups of B and C were constructed at almost the exact same elevation as Group A, while Group D structures are at a higher elevation than the rest of Say Kah (Jackson & Brown 2016:21).

The cardinal sites show evidence of being planned in where they were built, what their purpose was, and what they represented (Hammond et al. 1998, Tourtellot et al. 2003:105-107, Everson 2003:128-138). Each of these sites is located roughly 3.5km from La Milpa Core, and they are almost perfectly aligned to the axis mundi, each being at a 90° in relations to Temple 1 located in the Grand Plaza of La Milpa Core. In the case of La Milpa South, it appears that the landscape was modified to ensure this uniformity (Everson 2003:143, Tourtellot 2003:103).

These cardinal sites are also the only places outside the La Milpa Core where stelae have been located to date. This may be taken as a sign of elite status, but it is likely due to their significance as ritual sites in marking a cultural boundary. Stela are often used to mark areas of ritual importance, with the stela themselves locking ritual behavior in time (Stuart 1996:149).

The status of the cardinal sites as purely ritual sites has been supported by Everson and Scarborough (Tourtellot 2003:103), who have shown they lack signs as administrative or water management centers; although they are situated for such tasks. The modifications made to terrain also separate La Milpa South from any nearby agricultural berms which is uncharacteristic of other structures in the South Transect (Tourtellot et al. 2003:103).
The inhabitants of Say Kah and La Milpa South would have almost certainly have been aware of each other and interacted, although to what extent is unknown. Today the area between La Milpa South and Say Kah is covered in dense vegetation, but the walk between the sites can be made comfortably in an hour. In antiquity, the forest was likely nonexistent given the needs of a population estimated to be as high as 46,000 in a 5km radius of La Milpa Core (Hammond & Tourtellot 2004:299). It is highly plausible that the majority of the wood between these sites would have been harvested given the needs of the people in the area (Lentz & Hockaday 2009).

Figure 3: Map of La Milpa South (Everson 2003:92).
It has also been demonstrated, through viewshed analysis, that the four cardinal sites which are further from La Milpa than Say Kah are all visible from atop Temple 1 putting Say Kah firmly in La Milpa’s purview (Tourtellot et al. 2003:103).

The area between Say Kah and La Milpa South is hilly and punctuated with the occasional bajo. The structures at Group A are oriented in a North-South axis, and there is a large plaza in the center. In the Early Classic, the structures were arranged in a U shape with the opening pointing northeast. In the Late Classic, the plaza was extended north and a series of structures built that closed off the U shape (Houk 2007). La Milpa South (figure 3) by contrast is organized in a circle with only one large pyramid at the east side and some smaller structures arranged around a central plaza with a stela in the north of the site. There is a residential structure that may have belonged to a caretaker (Tourtellot 2003:103). Further excavation will be required to determine the nature of all the associated structures.

The buildings that make up La Milpa South proper could fit into the plaza of Group A. If the surrounding residential structures are added, however, then the community is much larger, but also harder to differentiate as occupation is nearly continuous in the South Transect.

The area between Group A and La Milpa South communities is the focus of this study. This is where the methodology objectives connect with the research objective. The data collected through the mapping of structures in the survey area have added context to the relationship between these communities. The communities are no longer being compared in a vacuum but rather a more complete picture is developed.

The presence of continuous residential structures between the two locations, much like is found in the La Milpa East and South transects, would support the hypothesis that Say Kah is a
less distinct community like others in the La Milpa influence sphere. In this scenario structures would be found in similar density to the other transects that have been studied.

A lack of continuous structures between the two sites that cannot be explained as a result of environmental or topographic causes would then be explained politically or socially. In this scenario, Say Kah would have a distinct border around it and understood as usable land but left empty. This would support the idea that Say Kah had a higher status than other secondary communities in La Milpa’s area of influence.

Survey and mapping work has been used extensively to help determine what lies outside the La Milpa Core. These previous survey and mapping projects have helped to inform and guide SKAMP. The work done by John Rose (2000), which created a series of 250x250m survey blocks around the La Milpa core, helped to show the boundaries of the Early Classic inhabitants and the population explosion in the Late Classic. Likewise, the work done by Gloria Everson (2003) on the East Transect and the South Transect (Tourtellot et al. 2003), which confirm the findings of Rose and demonstrate the axis mundi as a model for habitation and confirm a cultural border of the 5km area around La Milpa Core, furthered assisted interpretation.

The work completed between Group A and La Milpa South to test if a social border exists within the La Milpa influence sphere is shown here to be instructive. A social border would take the form of a distinct habitation gap that cannot be explained through environment or topography but rather as a culturally constructed border. This will be visible on the landscape by a distinct lack of structures between the two communities. The areas revealed in previous survey work in the area show a high structure density even far from the La Milpa Core, so a lack of structures specifically between these two communities that is not due to topography or terrain will be social in nature.
The work done by previous scholars will inform this project not only from a methodological perspective but a research one as well. These projects all covered much larger areas than were covered by SKAMP but required significantly more time and labor. The time commitment that these projects had to make in order to add an excavation phase, even a minimal amount of excavation such as those by Rose (2000) who carried out three shovel tests for each 250x250m block, demonstrated that it would not be a feasible for excavation to be included in SKAMP.

The work carried out by SKAMP is not only novel to the PfBAP study area from a methodological standpoint but from a research perspective as well. All the survey and mapping work that has been mentioned above was done to better understand the region in relation to La Milpa Core or to connect the mid-level communities to the La Milpa Core. The focus of SKAMP by contrast has been to connect two mid-level communities, Say Kah and La Milpa South.

This research has provided context to Say Kah’s status in the La Milpa influence sphere; it is doing so by examining the relationship between two sites associated with La Milpa, rather than by putting La Milpa at the center as previous research has done. By re-centering the center on Say Kah and its relation to La Milpa South, the possibility of a new narrative to arise is created. Previous research has asked the question how does this community relate to La Milpa Core? This framing carries a bias that this study seeks to circumvent. While it is almost certain that La Milpa is a political and cultural hegemon for the region, which included Say Kah, there exists the possibility for a different power relation to exist than the presumed hierarchal one that argues all roads lead to La Milpa. In a society that has a political organization that is more heterarchical than hierarchal it is important to explore this possibility of an alternate narrative (Scarborough et al. 2003).
The research cited above presents two likely outcomes for the determined survey area. The work of Everson (2003:63) in the East Transect Extension shows a dramatic drop-off in structure density beyond La Milpa East. The mainline for the SKAMP survey is directly even with Group A and La Milpa South. If this density holds, then it would be expected that the area north of the mainline will be more densely populated than the area south.

The maps created of the South transect (http://www.bu.edu/lamilpa/) show a less dramatic drop-off in density once beyond the La Milpa South boundary. This pattern is also likely to emerge as the survey area is located in the Southern periphery.

A large part of this project will rely on the use of GPS over traditional survey techniques. Previous attempts to do GPS-based survey and mapping work has been met with mixed results. GPS-based survey work was attempted by Joshua Wright in the 2011 field season, but he was unable to attain the minimum four satellites to get an accurate reading (Jackson & Brown 2012). This study will utilize GPS technology that was not available at the time of the 2012 field season and has only recently become readily available.

SKAMP was able to experiment with bringing new technology to update old methodology while answering a research-based question. The benefits and drawbacks of which will be discussed further in the methodology and conclusion sections of this thesis. The relationship of Say Kah to the greater La Milpa influence sphere as well as that La Milpa South will be examined based on the acquired data. Likewise the effectiveness of this new methodology has been tested and examined as part of the conducted research.
Chapter III: Methods

SKAMP was divided into three main phases, each containing several sub-phases. The three main phases were the planning phase, the field phase, and the laboratory analysis phase. The planning phase includes all work done ahead of time in the lab, choosing the equipment, setting up digital transects and background research. The field phase consists of all the work accomplished while in the study area, the survey, mapping, and data collection. The laboratory analysis phase is all the work done once back at the University of Cincinnati in the Department of Anthropology Maya research lab and the Department of Geography GIS and remote sensing labs.

Phase I: Preparation

The nature of the environment, and the short field season, required that as much work as possible be completed before entering the field. Determining the transect location was the first step in the planning phase. Maps were acquired from Norman Hammond and Francisco Estrada Belli showing the area of La Milpa (http://www.bu.edu/lamilpa/). These maps included topographic and structural data, which was collected from the initial mapping of the La Milpa region in the 1970s up through 2005.

Say Kah Group A was included in this map, although groups B and C subsequently required inclusion. The structure groups were added using data collected by Sarah Jackson (Jackson et al. 2010, Jackson & Brown 2012, Jackson & Brown 2015) over several field seasons. The maps were prepared using ArcMap version 10.2. The groups were added into the Geographic Information System (GIS) and georeferenced. The transect lines were then plotted
onto this updated map. Initially there were two proposed transect destinations, both of which began in Say Kah Group A. The first transect destination was the Survey Block 11 near the La Milpa core, however this route was not actualized. This transect was proposed to be 3km in length with various widths produced between 10 and 200ms. The different widths allowed for the transect to be quickly changed in the field depending on topographic and vegetation conditions.

This destination would have allowed for experimenting with new methodology and elucidating the relationship between the La Milpa community and the one at Say Kah. The previously mapped topography appeared to be generally flat with two small streams running through the transect area based on the LAMAP maps. The available maps show this route would have resulted in crossing several bajos or season swamps as well as a small river and require water management to be added into the analysis. This transect was ultimately not selected.

The second transect destination was La Milpa South, which is located 1.75kms from Say Kah Group A. This transect examination was implemented and facilitated the less common practice of studying the relationship between two periphery communities. This transect was placed over higher ground which was more likely to produce structures than the surrounding lower areas. The presence of an old logging road to the west was also helpful for moving equipment and safety.

Several shorter perpendicular transects were created along the principle transect ranging between 10m and 400m in length. Each transect line was labeled with a letter A-E positioning from North-South. These were marked in the field using pink flagging tape in accordance with the La Milpa Project color identification chosen for the field season. The transects also contained grids that allowed areas to be searched in blocks and structure densities to be quickly calculated.
in the field. Each grid block was labeled using the letter of the transect line above it, A1, A2, through A35. The transect system deployed in the field was 1.75km East-West and 200m North-South with 50m² blocks. The transect was initiated at a structure that was located just south of Say Kah Group A which was labeled as the Datum Structure. Based on the map, the bearing was set at exactly 270° (figure 4).

The transects were all saved in a geoTIFF format and converted to .kml file format using G-Raster. This format allowed these data to be loaded onto a Garmin GPSMAPS 64 series handheld receiver as custom maps. Previous seasons at Say Kah had attempted to use both Garmin handheld GPS unit as well as a Trimble handheld GPS device. They were both unable to establish acceptable accuracy for Position Dilution of Precision (PDOP), necessary for this type of study. The Garmin GPSMAPS 64 unit has the advantage of being accessible to the American Global Positioning Satellite Network (GPS) as well as the Russian GLONASS satellite network which previous models could not. Dual frequency units, such as the 64s, have been shown to have significantly higher accuracy under tree canopies (Naesset 2001).

The addition of the Russian system doubled the number of satellites that could be used in the calculation of location and error corrections. Both systems are comprised of 24 satellites in geosynchronous orbit at any given time. This allowed for a 1-3m accuracy even when in dense canopy and using non-averaged waypoints. The GPS was set to use a WGS84 Datum and a Universal Trans Mercator (UTM) as a projected coordinate system, both world standard systems. These two systems avoid distortions later when Space Radio Telemetry Mission (SRTM) data are added into the Geographic Information System that is created.
Figure 4: Actualized transects laid over the LAMP maps (http://www.bu.edu/lamilpa).
The use of a handheld GPS unit over more traditional Data Station-based survey provides significant time efficiency benefits. The more traditional method employed in this area by John Rose (2000:52-62), known as the Tikal method, provides sub-centimeter accurate data. One major drawback, however, is that it requires lines of sight to take readings, which in turn requires large areas of jungle to be cut. The Tikal method also calls for transects to be physically marked using large reference poles. This method is extremely labor intensive and time consuming. This methodology was not feasible given the available workforce and the timeframe for the study.

Instead this study relies on a two person team to conduct the research. The first team member’s job was to focus on cutting the trails. The second team member followed behind the cutter, using a compass to insure the proper bearing and using a handheld GPS unit to take waypoints. The various and previously determined transects were loaded onto the GPS in advance, and therefore do not need to be physically demarcated. The GPS does not provide the same level of accuracy for elevations as a Data Station-based survey, but this was overcome by utilizing the SRTM data. These data allow for topographic lines to be produced with 5m resolution.

The data were procured from NASA via Earth Explorer and filtered in ArcMap. They were loaded as a Digital Elevation Model (DEM) and run through a median filter using the focal statistics tool. Once the DEM had been smoothed, contour lines were produced at 5m resolution for the entire study area. This was not as accurate as the Data Station-based survey, but it was significantly cheaper in monetary costs as well as time and labor. The 5m resolution is useful in this type of study which is looking at a large area. The sub-centimeter resolution of a Data Station-based survey would be cluttered and less accurately show changes in topography. Picking the correct scale and resolution for a landform analysis is important in providing an
accurate look at changes in the topography and often less is more. The 5m employed here and the 1m employed later allow the area to be viewed and large changes in topography are easily identifiable.

**Phase II: Field**

Work was done during the first half of the PfBAP from 21/May/2015 to 14/June/2015. The field phase of this work was divided into two sub-phases that consisted of the survey phase and the mapping phase. The majority of the season was devoted to the survey phase with only the last few days spent mapping. This design maximized the area that was covered given the time allotted to the project. A one day buffer was included in the mapping phase scheduling to protect against unforeseen loss of fieldwork time. Because the rainy season was beginning, this was seen as a prudent move.

The goal of the survey phase was to cover as much of the proposed transect system as possible. During this phase, secondary transects were walked and possible structures recorded using GPS waypoints and field notes. The survey paths were recorded, via GPS, to help determine how thoroughly a transect line was covered and followed. Each line A-E was walked as accurately as possible. Lines were quickly drawn in the field between each secondary transect line on the handheld unit and walked. This was done for all the transects (figure 5) and allowed for more thorough coverage in areas of dense vegetation, ensuring survey lines were never more than 25m apart instead of the proposed 50m.

In addition to points taken at structures, several other features were waypointed. These points included areas where there were environmental features which resulted in a change of
survey path and areas of interest in explaining the abundance or lack of structures, such as bajos or cliffsides as well as the starting and stopping points for a day of survey. Many test points were taken for the purpose of georeferencing the Hammond and Estrada-Belli maps. These later points recorded locations of known structures on the La Milpa South transect and several at La Milpa South itself allowing the maps to be accurately lined up.
The paths taken attempted to follow the digital transect lines as closely as possible. However the nature of the environment did not always allow for this. The presence of previously unrecorded cliffs, swamps, sinkholes, and the occasional spider monkey attack complicated the process. The recorded paths and the SRTM data have helped to show when it was necessary to change direction due to topography as well as other obstacles recorded in field notes.

When a potential structure was discovered, a site scoring process was used. The potential site was given a score between 1-5, five unequivocally identifying a cultural site and one having some features of a cultural site, these designations based on several criteria.

**These criteria were:**

- The presence of artifacts on or near the structure.
- A rise in the landscape which could not be explained naturally.
- The presence of many evenly sized and worked limestone blocks.
- The appearance of evenly sized limestone blocks in unnatural lines and angles.
- Any cultural features that indicate human presence.

Once the survey phase was ended on 8/June/2015, the mapping phase officially began. Sites with a score of 3 or higher were revisited during this phase at which time a final judgment about which ones were critical to record was made. The locations were revisited in order from highest score to lowest. A more detailed examination was made of the potential site and more detailed notes taken. Once it was determined to be cultural, mapping of the structures and more extensive survey of the surrounding area was conducted to determine if there were other structures nearby. This was done to determine if other building groups were nearby such as seen in the other transects which consisted of many small groups of buildings.
A conservative approach was taken in determining if a site was cultural. In the end, six sites were determined to be definitely cultural and were mapped. All six sites were recorded using the various methods described above. When a site was determined to be definitely cultural, a radial survey was carried out in the surrounding area to locate additional cultural materials or structures. These structure groups as well as the other 3 sites will be discussed in further detail in subsequent chapters.

Three sites located during the survey required altered recording methods for various reasons. These sites were the Boulder Shrine which utilized the Data Station-based survey, and the Quarry Site and the Cave Site which lacked structures and required individualized recording techniques. The methods for recording will be discussed here, and greater details about each site will be given in subsequent chapters.

The Boulder Shrine was deemed unusual enough to require more intensive mapping than other sites. A Sokia SET 4E total data station with a TDS recon unit running Survey Pro 4.7 was used to map out this shrine and the surrounding landform.

The Quarry Site was recorded using sketch maps and a series of GPS waypoints along the border of the site. The site was first measured using a pace and compass method before a field map was sketched. The extent of the site was determined by looking for where exposed chert outcroppings and flakes dropped-off and stopped altogether. Once determined, these boundaries were recorded with averaged waypoints. The presence of heavy leaf coverage complicated the survey. Both members of the team walked and cleared areas every 5m until a clear boundary was determined. The area lined up well with topographic changes.
The Cave Site was recorded using an averaged waypoint and tape measurer. The survey was done quickly as fresh jaguar prints were located by the guide. Measurements were taken of the height and length of the cave opening, as well as several of the depth measurements to show its concave shape. A large number of pot sherds and pressure flaked cores were found strewn on the surface, and more could be seen in the crevices where the floor met the wall. These were left undisturbed to protect context for future study. Several large worked limestone blocks were also seen; they were likely standing at one point and had fallen into the cave.

All the structures were mapped using a handheld GPS unit, compass, and tape measure. Each structure was assigned a label S1, S2, S3, etc. and photos were taken and correlated with a GPS point in field notes. The most well-defined corner of a structure base was chosen and labeled as its datum. An averaged GPS waypoint was then taken, often giving a reading accuracy of 1-2m. A chaining pin was then planted at the datum. This served as a measuring point from which the tape was pulled, the structure width measured, and compass bearing recorded. This process was then repeated at the top of the structure.

This method of measurement allowed for the orientation of the structure, as well as the architectural dimensions recorded to centimeter accuracy. When multiple structures were found near each other, they were measured individually as described above; they were also measured in relation to one another. This approach allowed for increased accuracy by having two sets of measurements to compare. Likewise, multiple averaged point were taken at the boundaries of the groups of structures to assist in the geo-referencing process once back in the lab.
Phase III: Assessments

The assessment phase was conducted in the laboratories at the University of Cincinnati. This phase involved three sub-phases, which included cleaning the collected data, adding new data, and analysis of all compiled data. During this phase the field notes, collected GPS data, and other data collected from various sources were combined and a series of maps produced to display the relevant information.

While in the field, well over 100 waypoints were collected using the handheld GPS. Many of these points did not denote structures but rather starting or stopping points for the day, bajos, cliffsides, or the occasional pocket point collected by accident while walking. These locations needed to be analyzed and cross referenced with field notes to determine which points were denoting structures and which were the most accurate.

The points were transferred from the handheld GPS using DNRGPS, a freeware application that allows points to be exported and saved as shapefiles. The points were then loaded into ArcMap with all associated data, such as UTM coordinates, elevation, and notes that were taken with the point. This was then cross-referenced with the field notes taken during the survey and mapping phases.

The majority of the collected points were deleted, with only the averaged datum waypoints and the points denoting unforeseen survey path changes retained. The survey area was within 300km of a GPS station. The remaining points were then post-processed using data from the Chetumal GPS station which allowed point accuracy to be further increased.
Once the processing of each of structure datum was concluded, the drafting of the actual structures on the map could begin. The compass and tape measured measurements were drawn in Adobe Illustrator.

It was determined during the survey that the elevation data provided by the Hammond, Estrada-Belli map were not adequately detailed, and the elevation data taken by the GPS was not accurate enough due to the lack of a clinometer in the chosen model of GPS. SRTM data were then acquired and added to the map of the survey area. Contours were created in 5m intervals. This was sufficient and matched up with all the points that had been taken.

A series of maps were created; one for each of the structure groups, one of the Boulder Shrine, and one of the survey area that includes the Hammond, Estrada-Belli map. These maps were created with the intent of aiding the support of the research objective stated in the research section and showing the results of this methodology. An additional map was created for the Boulder Shrine using Surfer 11. This software was used due to its specialized landform analysis tools.

All the software used in this research, including that on the data collector, was available in the labs at the University of Cincinnati. It is also available for free or for less than $10 for any student using it for educational purposes. The exception being Surfer, which can be very expensive; this research could have been conducted without its use but since it was available it was used. The data sources used to create the maps were also free even without an educational license.

The data-station and associated equipment was provided by the Department of Anthropology at the University of Cincinnati. Only the GPS had to be purchased to conduct this
research. The goals of this project could have been completed without the use of the data-station, but it was likewise available and used. The availability of free data, cheap software, and new inexpensive GPS have made this type of study much more efficient and cheaper than past projects. The implications of changing technology on survey and mapping methods will be discussed at greater length in subsequent chapters.
Chapter IV: Survey Results

The total survey area proposed by SKAMP consisted of a 1.75km long by 200m wide area with a total area of $350,000m^2$. During the project, a total area of $240,000m^2$ was covered; this comprised 96 of the 140 survey blocks, each composed of 50x50m. Within this area three structure groups, one quarry, one shrine site, and one ritual cave were located and mapped (Figure 6). Two of these structure groups were located in the far west of the survey area near La Milpa South. The quarry was likewise located in the west half of the survey area. The Cave Site, the shrine site, and one structure group were, by contrast, located in the far east of the survey area near Say Kah Group A.

![Figure 6. Map showing areas covered during the survey.](image)

Sites

The sites are listed from west to east beginning with those closest to La Milpa South and ending with those closest to Say Kah Group A (figure 7). The site designations for structures are currently Sites 1, 2, and 3 to avoid bias, as it was not determined what the structures were used for. The maps for the structure groups (figures 8,9) are digitized field notes and do not accurately show orientation and space between structures. The GPS waypoints were intended to record this information, but 1-3m accuracy meant that when maps began to be created structures were in
some cases overlapping and in others much further apart than was observed. It was decided to add in field sketch maps for reference in terms of size and approximate location.
Structure Group 1

Structure Group 1 (fig 8) is the largest site located during the survey. It is the closest to La Milpa South Transect at 150m east of the border and located south of Structure Group 2 along the C transect line at UTM coordinates N 1969483.57 E 282776.31 Zone 16N. The site consists of seven structures arranged in a loose U-shape that opens to the south. The building grouping sits in area that is very flat in every direction except for the area on which it immediately rest that is slightly elevated. The structures are very visible in the landscape, sticking out as unnatural rises. Each of the structures was covered in nearly equal sized limestone blocks that appeared to have been cut. Structures 2-6 appear to be platforms that likely had perishable structures at their summits. Structure A stands out in that it is much steeper than the other structures as its summit surface area is rather limiting and not likely suitable for extended occupation.

Structure A is located at the southwest tip of the U next to what may have been an entrance into the structure group. The area inside the structure group is relatively level with a slope downward in elevation where the U opens. The structure is the tallest in the surrounding area and, even with the presence of trees, provided an excellent view.

The datum was placed in the southwest corner where the base of the structure measures 9.5m North-South and 5.5m East-West. The area atop the structure measured 3.5m North-South and 3m East-West. Structures B and C were both heavily deteriorated, and dense vegetation made pulling a tape measure accurately over them a difficult task. Structure B appeared to be rather small and square shaped. It roughly measured 3m North-South and 4.5m East-West. Structure C had a rectangular shape and roughly measured 5.5m North-South by 5m East-West.
Structures D and E comprise the northern section of the site and the bottom of the U shape. Structure D is rectangular and sits in the northeast corner of the site. The datum was placed in the northeast corner of the structure. The structure measures 4.6m North-South and 8m East-West and is very low to the ground relative to the other structures with a large flat top surface. Structure E sits in the northwest corner and is more square-like in shape than Structure D. The datum was placed in the northwest corner of the structure. It measures 5.9m East-West and 4.6m North-South. Heavy vegetation on the north side of the site made pulling a tape difficult.

Structures E, F and G run North-South and comprise the west half of the U shape. Structure F measures 6.8m North-South and 5.5m East-West. It is square in shape and oriented North-South. Structure G is north of Structure F and comprises the southern edge of the U. It measures 8m North-South and 5m East-West.

A brief pedestrian survey revealed several other possible structures southwest of the site. These were not thoroughly investigated due to lack of time and weather. Given the close proximity to La Milpa South, it is expected that population density would be higher, and it is likely that there were other structures in the area.
Figure 8: Sketch Map of Structure Group 1.
Structure Group 2

Structure Group 2 is located north of Structure Group 1 between the A and B transects lines about 200m east of the La Milpa South Transect at UTM coordinates N 1969577.97 E 282819.76 Zone 16N. Structure Group 2 consists of three structures, each covered in uniform sized limestone cobbles that measured a little larger than softballs. Cultural materials were present atop and between the structures. These included several large ceramic rim sherds that retained handles, chert scrapers, and an unidentified polished stone. These were on the surface, and it is likely that more are present beneath the leaf coverage.

The structures at the site were similar in size and placement to those at Structure Group 3, although slightly larger. Structure A is the longest, measuring 11.5m North-South and 5.5m East-West oriented at 300°. This structure contains a wide and low summit. The exact measurements for the other two structures were lost due to corrupted data files. They were both square in shape and roughly 5x5m.

Structure Group 3

Structure Group 3 (figure 8) is located northwest of the Boulder Shrine along the same ridge at UTM coordinates N 1969636.76 E 283406.74 Zone 16N. It is located along the A line approximately 650m west of Say Kah Group A. Structure Group 3 consists of four platforms, three of similar size and shape and one long rectangular building. All the platforms sit atop a slightly elevated area of land.
Structure A is rectangular in shape and sits in the east of the site with a North-South orientation at 260°. The datum was placed in the approximate southeast corner of the structure. The structure is 10.7m North-South and 6.3m East-West.

Structure B is west of Structure A and is square in shape. The datum was placed in the southwest corner. The structure is 6m North-South, and 6.20 East-West. Structure C is east of Structure B and square in shape. The south and west edges of the structure were deteriorated forcing a deviation of datum placement instead of its usual placement in the northeast corner. The structure measures 7m North-South and 4m East-West. It may have been slightly longer but

Figure 9: Sketch Map of Structure Group 3.
the deterioration made determining the corner impossible. Structure D was very deteriorated and an accurate measurement was unable to be taken. It appeared to be similar in size and shape to Structure C.

**Quarry Site**

The Quarry Site is located at UTM coordinates N1969624.83 E282998.97 Zone 16N, slightly north of the A transect. A series of chert outcroppings were located in the area. Many different sized pieces of chert (figure 10) were located such as large nodules that were likely knapped with hammerstones to accommodate the first stages of tool production. There were also small refined flakes that were likely created by way of the finishing stages of tool production and the associated debitage left behind.

![Figure 10: Various flakes located at the Quarry Site.](image_url)
Boulder Shrine

The Boulder Shrine is located at UTM coordinates N1969597.87 E283480.98 Zone 16N, and it is the most unexpected find of the 2015 SKAMP season. The site consists of a large boulder of limestone; the boulder itself likely originating as part of the large cliffside to the south of the shrine, with the depression left when it detached from the cliffside still visible. The boulder, while natural, has a two-tiered platform built around it. There is also a pile of rock located where the platform ends to the east of the boulder. It is very similar to a shrine site reported in Guatemala (Brown 2002:165).

The Shrine shared several elements with ones reported by Brown. A combination of natural features such as an unmodified boulder with a flat top located in area of elevation and left unmodified, and with cultural features such as a platform built around to facilitate activity areas. Likewise, a series of small cobbles were stacked and placed near the boulder; Brown reported 85 of these stacks at the 70 shrines she investigated (Brown 2003: 72-82). The area sloping down was often used to discard items and apparently kept the activity area in the shrine clean. Two such possible areas existed near the shrine but were not investigated (figure 11).

Mapping the Boulder Shrine was very time consuming, taking nearly half a day to transport, set up, and clear enough vegetation to get accurate readings. A total of 67 data points were taken in an area 55m North-South and 45m East-West. The Boulder Shrine was mapped using the data station due to the uniqueness of the site. A series of equally sized limestone blocks arranged in right angles could still be seen around the boulder. The location of the limestone blocks, the boulder, and the surrounding area was mapped to help give context to the site. A,
Figure 11: Data-Station based map of the Boulder Shrine Site.
X500,Y500,Z100 arbitrary grid was used and later georeferenced to an actual location using averaged GPS waypoints taken from three datums that were used during the mapping process.

The upper platform tier is still very visible with a series of equally sized limestone blocks that form a half square to the north of the boulder. They are arranged so that two right angles are still highly visible. The lower tier of the platform is less visible, with several of the limestone blocks having rolled down the hill or otherwise disturbed. It is possible that this lower platform is simply debris from the upper platform.

**Cave Site**

The Cave Site (figure 12) is located on the D transect line directly south of the Shrine Site at UTM coordinates N1969483.97 E283449.19 Zone 16N. The cave is located on top of a steep rise appearing as a hill from the ground below, but once atop it recesses in and is honeycombed with smaller caves.

This larger cave opening measured 7m across and 5.6m high with a concave shape. A narrow gap between the cave wall and floor ran the length of the cave and contained an abundance of cultural materials. While most were left undisturbed to protect context, some of the surface pieces were gathered and photographed. Sherds from perhaps two dozen different vessels were present on just the surface, though no whole vessels were discovered. While the majority of the sherds were plain, some contained incised patterns and various shapes and rim sizes. There was also several pressure flaked cores of different colored chert. More sherds were visible in a narrow and deep crevice that runs along the back of the cave. These were not disturbed or
counted; and even with a flashlight, it was not possible to determine how far back they were
distributed or if the area had been purposefully sealed.

The presence of fresh jaguar prints that had not been there the previous day confirmed
this as an active shelter for local wildlife. Given the presence of at least one adult jaguar and one
juvenile (both identified by the local guide), it was decided to limit the amount of time spent
investigating the site.

Figure 12: Cave Site.
Chapter V: Discussion of Intersite Settlement

Say Kah sits firmly in La Milpa’s area of control but seems to have a higher level of status than surrounding communities. This section will deal directly with the large gap in structures within the study area between Say Kah and La Milpa South. This section will also discuss the placement of structures within the study area as well as their possible purpose and what this tells us about the two communities.

The Survey Transect

Looking at the topography it is no surprise that the residents of Say Kah chose mainly to expand to the east and south. The land to the west is usable but the elevation difference between Group A and Groups B and C, for instance, is hardly noticeable while a dramatic elevation change happens west of Group A. Several sites were located to the west, all firmly within Say Kah’s purview. La Milpa South has been shown to have many sites within its immediate area and several more were added during this study. Each of these communities expanded during the Late Classic, but a gap remained between them.

The Boulder Shrine is the site located closest to Say Kah, at about 500m from Group A it could easily be walked to in just a few minutes. The foundation for the shrine appears to have formed naturally but was then modified by its users in direct association with Say Kah. It may have been an important marker of sacred space and a symbol of status for the local community at Say Kah. As they expanded their community by building more structures and becoming more self-sufficient, it is posited that the population initiated their own ritual and sacred space apart from that at La Milpa Core.
The pile of small cobbles located near the boulder are consistent with what Brown reports as *tabal*, which are used to place ritual offerings (Brown 2002: 73). Brown also explains that *tabal* is a marker informing practitioners form which direction to approach the shrine and the first place to visit (Brown 2002: 73). Brown visited 70 shrine sites and recorded 128 *tabal* in total (Brown 2002:75). This indicates that it is not uncommon for a shrine to have multiple entry points or activity areas. However, the Boulder Shrine in this study had a singular *tabal* located to the east of the Boulder where the platform ends, so anyone visiting the site would be approaching from the direction of Say Kah.

Directly south of this shrine atop the ridge from where the boulder originated is a series of small caves. Most were too small to be explored safely, but one larger cavity was visible in this honeycomb of topography.

Approximately 50m northwest of the Boulder Shrine is building Group 3. This small group consists of four platforms that may have had residential structures constructed of perishable materials atop. These are the only possible houses located near Say Kah within the survey transect. Their immediate proximity to the Boulder Shrine and the Cave Site make it possible that the occupants who lived here had some interaction with the shrine and perhaps were responsible for maintaining it.

A similar situation was demonstrated at La Milpa South with a likely caretaker home near the ritual site (Tourtellot et al.: 2003:103). Only one structure in La Milpa South was confirmed to be definitely residential, and it was posited that the person living there maintained the area. The three remaining structure platforms are similarly situated to easily interact with the Boulder Shrine.
While the Boulder Shrine and Cave Site can be easily reached from Group A in a few minutes, the elevation change can be somewhat strenuous if it were to be traversed on a daily basis. It is possible that the person caring for the shrine lived nearby instead of making the walk up and down from Group A or was located in one of the other groups depending on where they were allowed to settle. The average person would also have less reason to travel to a shrine on a daily basis, and this is perhaps why the community was willing to accommodate having a shrine attached to it instead of locating it in Say Kah proper. Further study would be necessary to prove this explanation but the proximity should not be overlooked given how close the shrine and the structure group are to one another and the lack of any other structures in the immediate area.

Structure Groups 1 and 2 are much closer to La Milpa South than Structure Group 3 is to Say Kah (figure 7). This is expected as La Milpa South shows higher levels of habitation. Structure Group 1 is 150m east of La Milpa South survey area, and Structure Group 2 is 200m east of it. It is worth noting that three other likely structure groups were located within a 50m radius of each of these groups, but they were not recorded due to either lower site ranking scores or lack of time. Of these sites that were not recorded, nearly all of them were located near La Milpa South with only one low ranking site near Say Kah.

The Gap

A large drop-off in structure density exists between Structure Groups 1 and 2, which are located near La Milpa South and Structure Group 3 located near major Group A. (figure 7) The space between the two closest groups, 2 and 3, is nearly 600m. This is unprecedented in all of the previous structure mapping carried out in the area (Robichaux 1995, Rose 2000, Everson 2003, Tourtellot et al. 2003). Structure mapping done in La Milpa South transect, which is the closest geographically of previous survey projects, indicates that the largest gaps between structures are
around 100m and those are rare. The gap in this transect is six times larger than any in La Milpa South transect.

There exist several possibilities to explain this structure gap. It has been argued by Everson (2003) that La Milpa was settled in the pattern of an axis mundi with people filling in the areas between La Milpa Core and surrounding cardinal sites. This would explain the lack of habitation between Say Kah and La Milpa South but not the presence of Say Kah itself, which does not appear to fit into this cosmological model. It could be argued, then, that this is further evidence that Say Kah was independent of La Milpa. Rose’s study of 15 random blocks around La Milpa Core and Robichaux (1995) survey sample northwest of La Milpa Core, both show that structure density remains relatively high outside the arms of the axis mundi.

A concentric circle model of expansion (Everson 2003:5) is possible as well. La Milpa being a far larger community than Say Kah would have had a considerably larger circle of occupation than the cardinal sites marking its circumference. This would fit better with the findings of Rose (2000) and Robichaux (1995) in which settlers occupied an expanding circle rather than just expanding outward along four straight lines. Say Kah also expands in a radial pattern with groups B,C, and D being added to the east, southeast, and south respectively as well as the Boulder Shrine, Cave Site, and Building Group 3 all located to the west of Group A.

People do not expand out in perfect circles as models may best predict they will; the terrain and the environment play a strong role in determining where people can and will live. The area east and south of Group A is far more hospitable than that to the north and west, given the steep incline on which Group A is built. The elevation change between Group A and Groups B and C is hardly noticeable, whereas the change between Group A and the Boulder Shrine is extremely pronounced.
The steep change in elevation may explain why so few structure groups were located to the west of Group A. The relatively flat ground to the east and south would have been far more attractive for an expanding community. The only reason cultural sites may have been located to the west was because there were evocative natural features. It was certainly within the power of the local community, which erected the pyramids at Group A, to move a boulder, but instead they chose to construct a platform around it. In the case of the Cave Site, it could not have been moved; and if the community wished to utilize it, they would need to move to it.

The topography of the gap between Structure Groups 2 and 3 is another possible influence on why the drop-off in structure density occurs. While a relatively steep ridge runs across the south of the study area and impeded moving north-south, it did not interfere with east-west navigation. The areas above or below this ridge are relatively flat compared to those in La Milpa South transect.

This 600m gap between the two structures appeared to be vacant of any other structures. There existed many areas north and south of the ridge that would have been ideal to build on, areas showing much less topographical variation than in other surveyed zones. The pattern seems to suggest that the inhabitants of Say Kah preferred to settle east and south rather than trek down from their high ground, except for the instance of two immovable ritual sites and one small grouping built near them. It also appears that Structures Groups 1 and 2 are at the edges of La Milpa South habitation area.

The structure gap described above is much larger than any found in previous mapping work done in the area. While the topography played a role in why there is limited growth west of Say Kah compared to south and east, the same cannot be said for La Milpa South which seems to almost arbitrarily stop expansion eastward. There are no major topographic or environmental
changes that are evident that would deter expansion of the community. The drop-off in habitation then is likely social in nature as people recognized some form of territoriality or identity that was attached to where they settled.

While it is almost certain that Say Kah is a secondary site to La Milpa, as it is firmly inside La Milpa’s influence sphere and is much smaller in scale, it still appears to be a distinct site with some status. It contains larger architecture and is spread out over a wider area than other communities in the area. The presence of elite goods and burials that have not been found at other communities in the area are identifiable. This higher status may be the reason that usable land was left empty around Say Kah. This persisted even in the Late Classic population explosion that saw the addition of three more building groups to Say Kah and the construction of continuous structures from the La Milpa Core all the way out to the cardinal sites.

It is possible that residential structures may be found to the north of Say Kah and that this structure gap only exists between Say Kah and La Milpa South. It would then be helpful to remember here that the area surveyed for the project was ultimately chosen as it seemed most likely to contain structures. The area north contained to small rivers and was determined to be most likely swampy and not suitable for construction.
Chapter VI: Conclusions About Methodology

SKAMP set out to create a transect between La Milpa South and Group A in order to test new technology and old methodology with the goal of using the data to better understand the relationship between these two communities. The intention was also to link Say Kah to previous survey work through discovering and mapping what lies between Group A and La Milpa South.

This study utilized a combination of traditional survey methodologies that have been successfully used in the region for decades along with new technology that was not available just the year before. The success of those past projects done by scholars such as Rose (2000), Everson (2003), and Robichaux (1995) are the shoulders on which SKAMP stands.

The use of transects to study the area around or between archaeological sites is nothing new. Likewise, the use of compass and tape measurement is one of the most basic survey and archaeological techniques available. The deployment of a transect to link two periphery communities is new to the La Milpa study area, however. The use of GPS is commonplace now, but the recent advances in inexpensive dual-band GPS is new and allows its substitution for the older, more cumbersome GPS data-station based survey.

The GPS used for this study was the cheapest model available which could access both the American and Russian satellite networks. It was able to collect an accurate reading of 1-3m even under a dense vegetation canopy. More expensive available models would have provided yet more accurate readings inclusive of elevation data, allowing this method to further replace traditional data-station based survey. The inclusion of SRTM data was also a major factor in updating survey methodology from more traditional techniques.
Those data were collected in 2000 CE and allowed topographic intervals as small as 1m to be interpolated with high enough accuracy to be useful on the ground. Like the GPS, there are far newer and more accurate data sources available at higher costs. The equipment and data sources used in this study were more than adequate for this research, however the possibility for even greater accuracy is on the horizon. The future will completely eliminate the need for cumbersome and expensive data-station based survey and will drop in price radically over the next 10 years.

This study was methodologically a pilot study in the use of relatively cheap GPS-based survey in dense forest canopy. GPS survey is common all over the world and has even been used successfully in the PfB area by scholars like Cortes-Rincon (2011: 243) who employs Magellan Mobile Mapper 6 units which can get 1-2m accuracy but are significantly more expensive. A new Magellan unit can run well over a thousand dollars compared to the two hundred fifty dollar Garmin unit used in this study.

The SKAMP did employ a data-station to collect data at one of the sites due to its uniqueness. It did return more accurate data than were collected at other locations, but it also required a significant amount of time to transport and set up the unit. The area also needed to be cleared with the other team member requiring instruction and a crash course in survey methods. This consumed the better part of the day and significantly slowed down mapping.

While it would have been possible to collect data from this site using the same methods employed elsewhere, it would not have been as accurate. This is one area where the use of a cheap GPS unit reached its limitations. A slightly better unit capable of running ArcPad, such as a Trimble, would have easily captured the site using lines and polygons. Although it would have been possible to record the site using the Garmin unit, its accuracy at 1-3m may have
significantly exaggerated the size of the boulder and the platform which measures less than 10m on its longest side. A 3m margin of error at the points taken at each end of the feature would have made the platform 16m long. This margin of error would not have been reduced using post-processing techniques. Again, a more expensive unit would have allowed greater accuracy.

This technology is consistently dropping in price as well. The GPS unit used in this study, which became available one year before the writing of this thesis, has already dropped from $250 to $200. It will likely drop significantly lower when the 65 series units are released. Such technology will continue to improve and become less expensive and more accessible in the very near future allowing studies of this type to become even easier to undertake.

These advances in technology not only reduce monetary costs but those of labor. The survey conducted by Rose (2000) required teams of people cutting and taking measurements over multiple field seasons, since this technology was not available at the time. Too, the tools used for taking measurements on the ground have made some significant advances over the past few decades. The field of remote sensing has far outpaced the advances of data-stations and GPS units. Aerial imagery was the main form of remote sensing until 1960 when the Television and Infrared Observation Satellite (TIROS) was launched and laid the groundwork for the field of remote sensing to expand beyond images (Parcak 2009:19). Remote sensing as a field steadily advanced through the 70’s and 80’s but did not become useable in mainstream archaeology until the 1990’s (Parcak 2009:20-39). The most powerful remote sensing tool used by archaeologists today is LiDAR which became common in the 2000s. LiDAR coverage outside the United States is spotty and expensive to obtain, however, and at the time of writing unavailable in the La Milpa region.
The SRTM data used in this study is one of two free data sets that cover the area. The other data set is the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER); this data set has the same resolution as the SRTM data but is collected using different techniques. Comparison of the two revealed SRTM to be better for the purposes of this study. SRTM data are not as accurate as LiDAR as it uses radio waves instead of lasers to pierce through the jungle canopy, but it is freely available. SRTM data points are much further apart than LiDAR which can be found at 2m intervals stateside, making SRTM unsuited to mapping the types of structures that were found during this survey. The data intervals in SRTM are suited to topographic mapping, however, and allow a data station to create highly accurate 5m topographic lines.

The data collected for this study were subsequently cleaned and, through interpolation, 1m topographic lines created. This was a much higher resolution than initially imagined for the project. An earlier draft of this project’s methodology included extensive use of data-station based survey. In this earlier version, only SRTM data were used in a supporting way to help determine where to lay the transect, with more detailed data collected via data-station survey. The GPS was only used for the initial survey to mark areas of interest and those potential areas for setting up the data-station. This early envisioned version also anticipated much narrower transects which ran north-south as little as 50m compared to the 200m that were actualized. It was also not expected that using this latter methodology that the entire transect length would be surveyed.

Once in the field, the accuracy of the GPS was tested by taking averaged points at known locations and measuring the margin of error. It fell within the 1-3m range, which was a vast improvement over the previous 2011 season in which a signal could not be acquired (Jackson &
Brown 2012:95). It was determined that with such high accuracy from both the GPS unit and the SRTM data that the initial survey methodology could be extended as the main mapping technique. The success of this survey and mapping project has implications for future work carried out in this region.

One of the goals of this project from a methodological standpoint was to test the effectiveness of technology that has recently become very accessible. Another main goal was to determine how much area could be covered quickly and accurately as well as how cheaply it could be done in both monetary costs and labor expenditure. These goals were met and allowed for the bridging of the two ancient communities and to better understand their relationship to one another. This research goal was achieved cheaply compared to previous research given that the most expensive piece of equipment used, save the one site that utilized the data-station, was a $250 GPS unit. The other costs were negligible inclusive of only a compass, notebook, a tape measure, and other minor expenses.

The simplicity of this methodology and the skills needed to undertake the survey and operate the equipment used make it an ideal framework for future fieldwork projects. The low costs allow projects that would not normally engage in such survey activities the option to connect their site to neighbors or push forward the boundaries of their excavation area without needing specialists or expensive equipment in the field. This methodology would also be useful in pilot studies to show that an area requires further ground truthing.

The work presented here has proved to be useful as a pilot study. While the discovery and mapping of sites was highly successful and the sites themselves were able to help inform the relationship between Group A and La Milpa South, further excavation will be required to fully understand the context of each of the discovered sites. Compared to previous survey research
done in the region, this study has shown there are some major advantages in its approach, especially in the simplicity of the process.

The technical work that would normally be needed in the field, such as operating a data-station, or more traditional survey and topographic mapping is circumvented. Using freely available data, topographic lines can be determined without setting foot on the ground. Likewise, survey routes are planned and digital transects laid without the need to cut vegetation or view the terrain in person. This saves countless hours that would otherwise be spent setting up and breaking down survey gear that frequently needs relocation. The necessity of clearing terrain and establishing physical markers for transects which also require measurements and sightings using a compass and clear lines of site is significantly reduced.

Most significantly is the simplification in technical knowledge necessary on the ground. Traditional survey by data-station, transit, or other methods requires a considerable amount of technical knowledge and training to achieve accurate results. This more technical side of the survey can now be established before entering the field. One person can create a map of any area on earth and section off the area into survey transects. A person can quickly set up survey lines for dozens of people and load them onto handheld GPS units.

Once the planning phase has been completed and the survey areas set up, small teams or even individuals with the handheld devices need only to stay within the preset lines and record what is found by taking a waypoint and using a compass and tape measure. These are skills that any archaeologist that has completed a field school is well equipped to undertake. GPS operation is not a standard skill taught in every field school and units can range in difficulty of use, but the Garmin employed in this study has a very simple interface and a potential survey participant can be taught to use it effectively in less than an hour.
With this survey methodology now tested on the ground and the analysis complete, there are some areas where it can be improved for future use. The most obvious ways are to use higher grade GPS units, such as a survey-grade Magellan unit capable of sub-meter accuracy or a Trimble unit capable of running Arcpad which would aid greatly in measuring of structures and transferring and manipulating of data in the lab. The initial set up can also be improved by using higher quality remote sensing data. The free data used in this study was collected in 2000 and covers the entire planet; but for an investments of as low as $20, higher resolution data can be acquired from private companies such as LiDAR (the gold standard but also the most expensive remote sensing technology), it allowing resolution of less than 1m for the whole area and permitting a user to see most large structures in the area. Nevertheless, LiDAR still requires some ground truthing by surveyors to check for missed structures and the accuracy of predicted sites.

Aside from simply spending more money, which was the opposite of this project’s goal, the study may have been improved by combining the survey and mapping phases instead of having two distinct phases. The initial survey was done and potential sites recorded in a first phase. Then during the second phase, the same areas were re-examined with more extensive notes taken and each site scored. Many of these sites were then visited a third time at which point they were measured and recorded. The amount of time that was spent going back and forth over the same area could have been spent more simply by recording the potential sites and determining later which to keep and which to disregard. Several likely structure groups near La Milpa South were not recorded due to time constraints. More area would have likely been covered if so much time were not spent retracing previous paths.
In hindsight, the study may have been productively modified to cover a smaller area such as 100m North-South and 1.75km East-West, with shovel tests implemented every 50m to help elucidate if a drop-off in artefactual densities might exist in addition to any drop-off in visible structures. Such an alteration to the project would have also helped in dating buried surfaces and strengthening temporal conclusions. It is true, however, additional crew members would have been required to accommodate any excavations including that of shovel testing. The addition of shovel testing or test pits in the potential structures such as employed by Rose (2000:55) would have proven very helpful in determining a cultural presence at several sites identified in this study. Recovered artifacts would have added chronological data to the site descriptions.

The methodology and equipment tested in this thesis have proven successful. A simple and cheap survey process has been shown effective and, most crucially, it is easily modifiable. This method can be used inexpensively and quickly in a supporting role to gain information about what lies just beyond a site. It can also be the main focus of a study with higher grade equipment and more people in allowing a large area to be surveyed and mapped. The survey and mapping process can easily be adjusted to include some light excavation to help add context.
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