A SPATIAL ANALYSIS OF CHACHAPOYA MORTUARY PRACTICES AT LA PETACA, CHACHAPOYAS, PERU

by

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ABSTRACT

Diversity of Chachapoya mortuary practices is not well understood archaeologically, even though the region has received some attention for the monumental constructions and visually striking mortuary complexes located high on open cliff faces. This may be due to the difficult accessibility and often poor state of preservation consistent with many Chachapoya mortuary and occupation sites. This thesis reconstructs mortuary practices at La Petaca in the Chachapoyas region of Peru, applying paleodemographic and GIS methodological approaches to facilitate and improve the bioarchaeological study of commingled skeletal remains in an open, disturbed communal funerary context. Research focused on SUP CF-01, a natural cave context utilized as a group burial. The sample of human remains retrieved from SUP CF-01 (n= 8182) estimated an MNI of 43 adults and 12 juveniles, including a range of demographic categories. By employing a total station to record the cave structure, and a GIS to analyze the deposit of commingled remains, this thesis was able to measure the distances between paired elements and to explore possible post-depositional practices that could have created this commingled and disturbed deposit. This bioarchaeological analysis incorporating demographic and spatial analysis indicated that this collective burial was a primary context, and most likely a result of a gradual accumulation of complete bodies and movement of later skeletonized elements to make room for successive burials. When compared to other mortuary contexts at this complex, including a comparative secondary cave context and over 120 constructed mausoleums, it appears that all community members were included in the mortuary practices at this complex.

To the place where it always rains.

ACKNOWLEDGMENTS

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CHAPTER ONE: INTRODUCTION

Archaeological and forensic contexts with human remains are frequently subject to complex taphonomic processes including commingling, which can complicate interpretation. These complications are often compounded in secondary contexts that have been affected by looting and post-depositional disturbances (Ubelaker and Rife, 2008). Analyses of commingled human remains can provide a great deal of biological data; however, researchers often overlook the possibilities of these contexts to interpret mortuary practices (Baustian et al., 2014). Since, traditional archaeological methods rely on careful excavation and collection techniques as well as detailed inventories and observations, these contexts are challenging (Byrd and Adams, 2008). In order to better reconstruct mortuary practices in contexts that have been disturbed, and the skeletal remains commingled, this thesis suggests a spatially analytic methodology through the utilization of a Geographic Information Systems (GIS). This alternative method is based on paleodemographic analysis of the remains, and is applicable to a wide range of contexts and preserves a more precise level of provenience during analysis. A biocultural approach that incorporates biological, sociocultural, environmental and other types of data will facilitate a more thorough interpretation of the mortuary context, which can lead to a better analysis of the population (Baustian et al, 2014).

Purpose of Research

The ultimate purpose of this study is to reconstruct funerary practices of the Chachapoya (AD 300-1452), an ancient Andean civilization found in the central Andes of Peru with diverse mortuary rituals that are currently not well understood. The most prevalent forms of mortuary architecture included individual anthropomorphic sarcophagi, which are common in the northern region of Chachapoyas, and burial *chullpas (*above-ground mortuary monuments used as group burials in many prehistoric and historic South American societies), which appear to be concentrated in the southern region. However the oldest radiocarbon dates for Chachapoya funerary contexts come from cave burials and it is not yet known what place they have within the larger ritual landscape (Nystrom et al., 2010). This thesis will explore the feasibility of a Geographical Information System to document and analyze mortuary contexts that have been disturbed and human remains commingled in a natural mortuary cave space. Additionally, this thesis will explore demographic categories of those that were chosen to be part of this mortuary practice and deposited in this context, a better suited demographic approach for this disturbed context than the popular demographic profile. The difficult accessibility and poor state of preservation (often byproduct of extensive looting) consistent with many Chachapoya occupation and ritual sites may have contributed to a lack of archaeological development in this region, therefore an improvement in the method for data collection may allow for a greater understanding of the Chachapoya population.

This study is focused on the spatial examination of commingled remains using a GIS based approach, a technology that was originally developed to assist researchers study spatial problems in both governmental and civilian research fields. Only within the past few decades has GIS been utilized to explore interpretations of inter and intra-site spatial questions within the field of archaeology (ESRI, n.d.; Gillings and Mattingly, 1999; Byrd and Adams, 2008). This system of recording can improve the ability of archaeologists to maintain provenience and analyze the relationships between skeletal remains in very fragmentary and commingled contexts. The research presented here will be guided by the following hypothesis: a GIS methodological approach will *facilitate* and *improve* the bioarchaeological study of commingled skeletal remains in an open disturbed communal funerary context within the mortuary landscape of La Petaca in the Chachapoya region of Peru.

La Petaca is a mortuary complex located on the vertical face of an exposed rock escarpment, and is home to caves, crevices, platforms and tombs. Situated on the west bank of the San Miguel River (in the south central Chachapoya region), La Petaca's placement within the landscape is notable, as it is surrounded by other Chachapoya and Inca period occupation sites and other important mortuary complexes. A sample of human skeletal material was excavated from a natural cavern located in the superior sector of the archaeological complex (SUP CF-01). The material collected from SUR CF-01, a secondary collective burial located in the SUR sector of the complex that includes a large amount of commingled and scattered human remains, is used as a comparative deposit to explore similarities and differences between these two open cave mortuary contexts at La Petaca.

This project is part of a larger research project at La Petaca and in the region to increase knowledge of understudied sites of Chachapoya occupation and burial practices, and will illustrate a *biocultural perspective* on funerary rituals that are not yet well understood within the overall framework of ancient Chachapoya social identity.

Theoretical Approach

Mortuary Analysis

Mortuary studies of Andean societies have become more prevalent in recent decades (Donnan, 1978, Dillehay, 1995, Isbell, 1997; Besom, 2001; 2009; Nystrom et al., 2010; Ruiz Estrada, 2008, 2009; Gerdau-Radonic and Herrera, 2010). These types of analyses not only allow researchers to study material remains as a way to interpret cultural practices and beliefs, but the biological remains also allow for demographic and paleopathological studies of the people buried in these locations (Storey, 1992; Buikstra, 1995; Parker Pearson, 1999; Gillespie, 2001; Hoppa and Vaupel, 2002; Seguy, 2008).

Early Twentieth century researchers critiqued the study of funerary practices, arguing that mortuary practices were a kind of fashion unrelated to other customs and practices within society (Kroeber, 1927). The work of Robert Hertz in 1960 began a shift in anthropological mortuary interpretation suggesting that there was indeed a connection between the living and how they would care for their dead (Hertz, 1960; Gillespie, 2001; Rakita and Buikstra, 2005). The Saxe-Binford Approach emerged with the acceptance of "New Archaeology," based on the assumption that status differences in life would be reflected in differential burial treatment, which could then be extrapolated to interpret the general structure of the society (Gillespie, 2001). While this approach was responsible for popularizing mortuary analysis, there has been considerable criticism of this object-centric theoretical strategy. Hodder (1982) argued this approach can distort the archaeological evidence by ignoring the influence of individual agency. This post-processual critique shifted the paradigm towards an emphasis on agency of the individual as a contributor to variability of funerary ritual.

With an adaptation of the post-processual approach, this study can explore the interaction between the mortuary ritual and the social agents that created, shaped, and perpetuated these practices at SUP CF-01. This thesis will be guided by a bioarchaeological approach through analysis of both the burial environment and physical remains. By using multiple lines of evidence, this thesis creates an interpretative framework to explore the relationship between the material culture constructed, deposited and transformed and the biological remains deposited.

Methods of Analysis

Paleodemography

Paleodemography is a field of study that models statistics of past populations such as estimations of sex and age-at-death data gathered from skeletons excavated in archaeological contexts (Hoppa and Vaupel, 2002; Konigsburg and Frankenburg, 2002). These statistics include the construction of life tables, mortality curves, survivorship curves, crude mortality rates, and age-specific probability of death (Hoppa and Vaupel, 2002). These analyses can then be used to explore questions such as population structure, settlement patterns, mobility, mating practices, as well as status and gender roles. In order to explore these questions, paleodemographers must begin with a sample that is representative of the once living population. This requires a large and varied sample population. While the context of SUP CF-01 at La Petaca does not have this type of sample population, this study explores the demographic categories present at SUP CF-01 because it is the best way of exploring the mortuary practice.

The assemblage at SUP CF-01 was very disturbed and commingled, and therefore the demographic profile could not reflect individual osteobiographies (analyses of a population based on composite analyses of individual skeletons). Instead, this study will rely on a different approach, which first necessitates an estimation of the total number of individuals interred. The demographic estimates begin with the calculation of minimum number of individuals (MNI), which is the traditional method of quantification analysis that estimates the number of individuals present in a sample by first estimating the minimum number of elements present and using the maximum count of a bone type as the minimum number of individuals needed to create an assemblage (Adams and Konigsberg, 2004, 2008). Because of the commingled nature of the remains, this method then relied on osteometric sorting as a way to estimate pair matches. Statistic estimations of p-values indicated probable matches, which then guided future analyses. While detailed or specific demographic profiles could not be constructed from these data because of incomplete individuals, frequency estimates of age categories and sex estimations from specific elements present illustrate the biological categories that were chosen to be part of this mortuary practice. Demographic categories from SUP CF-01 were compared to SUR CF-01, and data from the Chachapoya site of Kuelap were used as additional reference material. This analysis will indicate the demographic categories of the population that was included in these mortuary contexts, which is an important component to the interpretation of this mortuary site.

Spatial Analysis

Traditionally, collective burials are stratigraphically recorded through precise horizontal documentation and mapping of the context (Adams and Byrd, 2008). Each exposed strata (layer) would be recorded through detailed photography and paper mapping techniques. Oftentimes, the provenience of commingled remains was not well-preserved after collection or excavation

(Adams and Byrd, 2008). By using an electronic transit integrated with an electronic distance meter called a total station, this project was able to record exact coordinates of elements and space within a mortuary structure. When these measurements are entered into a GIS, the Boolean based computer program can map the points in a 3D space, and attribute data describing the skeletal remains can be imported into a GIS geodatabase for La Petaca. This method makes qualitative and quantitative data easily searchable and comparable spatially. Attribute data within a GIS can be unlimited: pathological data, age, sex, and condition can be stored within this program, both as a spreadsheet, and more importantly, within each digitized shape element, thereby making each attribute searchable under a query. This method can create a visual database of skeletal elements and a coded model of the unit. While this method cannot completely recreate ritual patterns, it is hoped that a careful spatial analysis of the material remains will help discern patterning of bone distribution, primarily between the distance between paired elements, which can be interpreted as a byproduct of mortuary practices, as well as post-depositional practices. Additionally, by estimating the space available within the mortuary environment, this study explores the types of possible depositional practices that could have created the commingled assemblage.

Study Goals, Questions and Hypothesis

This section outlines the specific questions and issues that are addressed in this study. This research focuses on SUP CF-01, a small natural mortuary context, and tests the null hypothesis that it will not be possible to gain useful *demographic and mortuary information* using demographic and GIS analyses of the skeletal remains based on the disturbed context of the site. From the data collected from SUP CF-01, I have created a series of expectations for this thesis:

1. I expect that a GIS approach will map the 3D location of human skeletal remains within this disturbed natural mortuary context, an improvement over traditional archaeological mapping methods by providing more detailed provenience data and facilitating distance analysis.

2. I expect that the skeletal remains in SUP CF-01 will have a range of ages and include both males and females.

3. I expect that the skeletal remains from cave deposits SUP CF-01 and nearby SUR CF-01 will have similar demographics, indicating both are collective burials with similar purpose.

4. I expect to be able to identify a variety of taphonomic conditions at SUP CF-01 such as disturbances from human, animal, and/or gravitational forces.

5. I expect to find both small and large skeletal elements in SUP CF-01 with similar frequencies, which would indicate a primary burial context.

6. I expect to be able to pair match elements based on morphology and metric similarities.

With these expectations, I plan to pursue the following questions about the mortuary practices of the people buried at SUP CF-01.

1. Is it possible to reconstruct mortuary practices from this significantly disturbed context?

2. Will the utilization of a GIS to document and analyze the remains help reconstruct mortuary practices at this cave mortuary context of deposition and disturbance?

3. What is the demographic profile present at SUP CF-01?

4. What can the spatial analysis of SUP CF-01 tell us about the commingled context at La

Petaca and what can that indicate about its role as a collective burial?

5. Can we model relative spatial dimensions of SUP CF-01 to understand how many individuals could have been buried in this context at once if this was meant to be a final resting place for multiple individuals?

6. Why were small spaces used as mortuary contexts for the deposit of several individuals?

7. What does the context of SUP CF-01 and its assemblage inform us about the role of cave burials in Chachapoya mortuary practices?

Organization of This Thesis

I will begin this thesis in Chapter Two by looking at the archaeological and ethnographic research of the Chachapoya culture, introducing the chronology of prehistoric Chachapoya population, and the excavations at the mortuary complex of La Petaca. Skeletal samples from two caves are utilized, and the collection from Kuelap employed as a comparative sample. Following a discussion of background material, I will examine the methodological and theoretical approaches used within this thesis, after which follows a discussion of how these two theoretical frameworks serve as an important component in Andean archaeological analysis. Chapter Three will discuss the chosen methods of data collection, demography and spatial analysis, articulating how each method was shaped by the commingled and disturbed context of SUP CF-01. Chapter Four includes the results divided into three sections. It will begin by presenting a summary of the excavation, next detailing the demographic categories of the population at SUP CF-01 compared to that collected from SUR CF-01. The third section of Chapter Four presents results from the spatial analysis of related bone element distribution, estimating the measure of distance between related elements and using One-Way ANOVA statistical test to calculate the significance of these findings. Chapter Five discusses the results of this thesis, exploring these data within the context of ethnohistoric, archaeological, and theoretical data. Conclusions, limitations and future considerations can be found in Chapter Six.

CHAPTER TWO: ARCHAEOLOGICAL BACKGROUND RESEARCH

This chapter will introduce the chronological background of the central Andes, and briefly describe the environment and geology of the Andean region, and then highlight the environment of the Chachapoyas region, which has played a role in the sociocultural development of this region. Next, this chapter will discuss the prehistoric Peruvian Chachapoya population, reviewing their chronology, and current archaeological interpretations. Then, this chapter introduces the research site, describing the mortuary complex and the types of structures that make up this unique site. Finally, this chapter explores mortuary analysis as a way to examine the creation of collective memory through the analysis of the biological and cultural material remains, first discussing pre-Hispanic Andean and then Chachapoya mortuary practices.

Overview of Andean Chronology and Environmental Background

The central Andes of Peru, a portion of the longest continental mountain range in the world, (Figure 1) have been of archaeological interest for a long time (Lanning, 1963; Patterson and Moseley, 1968; Isbell, 1997; Moseley, 2001). Moseley (2001) suggests that human populations have occupied this region for the last 12,000 years, and it appears that in the Central Andes, the development of civilizations was fairly rapid especially along the coast (Isbell and Silverman, 2002). Early sedentary communities (Preceramic VI, ca. 2700-1800 BC) consisted of sizeable villages with impressive monumental architecture (Isbell and Silverman, 2002).

Table 1 Andean Chronology (following Moseley 2001)

Period/ Horizon	Time Scale
Spanish Conquest	1532 AD
Late Horizon	1450 AD
Late Intermediate Period	1150-1350 AD
Middle Horizon	600-1350 AD
Early Intermediate	0-600 AD
Early Horizon	400-200 BC
Initial Period	2000-600 BC
Preceramic Period	3000 BC

Specifically, Peru's north coast, central coast, and north highlands appear to have constituted an interconnected cultural area with an extensive trade network and social interaction (Brush, 1977). Each ecological zone is delineated by unique environmental conditions: the dry coastal desert (*costa*), the Andean highlands (*sierra*), and the Amazon lowland forest (*selva*). A fourth intermediary zone is the *montaña* region that lies between the highlands and eastern lowlands, where we find the Chachapoya culture.

Figure 1 Illustration of South America demonstrating its topography, with orange colors highlighting high elevation; red box highlights the central *antiplano* region. Image courtesy of (www.worldmapsonline.com)

Microclimates vary within each ecological zone longitudinally, laterally and by altitude. The climate becomes increasingly drier towards the southern portion of the Andean region, and the western region across the Andean *cordilleras* from the Amazon basin to the Pacific Ocean is considered to be one of the driest deserts in the world. The climate of this *costa* is in direct contrast to the humid valleys across the eastern slope of the *cordillera* that experience heavy rainfall and mark the beginning of the tropical rainforest. Today the low-lying coast is characterized by "large-scale irrigated and mechanized plantation agriculture of sugar cane, cotton and rice", whereas the highland sierra relies on subsistence-oriented peasant agriculture, and upper *paramo* altitude zones are dependent primarily on tuber agriculture (Brush, 1977: 6).

Altitude has the greatest impact on the Andean microclimate, and Murra's (1972) model of vertical archipelagoes has largely influenced archaeological interpretation of sociocultural development. According to Murra (1972), Andean societies established *caserios* in noncontiguous ecological zones of different elevations in order to access goods produced in these distinct environments, preserving a cultural ideal of self-sufficiency. This model explains the success of some populations in harsh and difficult environments (Van Buren, 1996). While it is clear that adaptation to vertical archipelagos played an important role in the social structure of Andean populations, the general diversity in human adaptation to the natural environment has shifted the discussion more towards the general notion of ecological complimentarily, a partitioning of resources, rather than specifically vertical connections (Van Buren, 1996; Schjellerup, 1997).

Chachapoya Chronology and Environmental Background

This thesis focuses on an Andean population that occupied a region in the north Andean highlands from the middle of the Early Intermediate Period (AD 200-300) until the Inca invasion of the Late Horizon (AD 1452) (Table 1). This cultural group is referred to historically as the Chachapoya (Church and Von Hagen, 2008). Figure 2 defines the approximate location of Chachapoya affiliated sites.

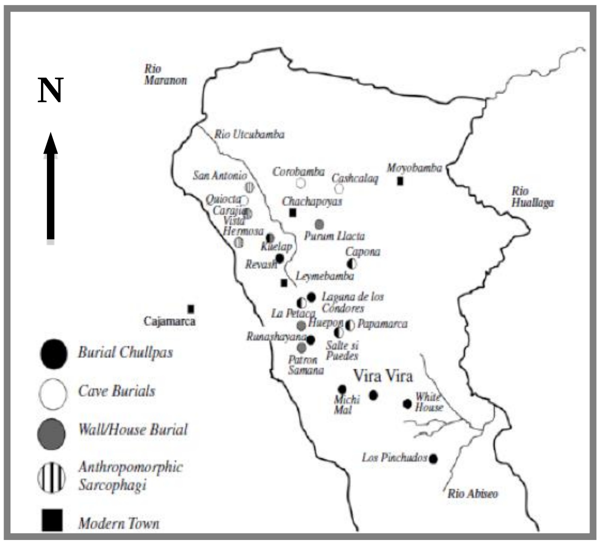

Figure 2 Map of the Chachapoyas region, with archaeological sites highlighted. Courtesy of (Nystrom et al., 2009, Figure 1)

It is proposed that the name Chachapoya was established by the invading Inca conquerors around AD 1452, and refers not to the people themselves, but the geographical province established by the Inca during their conquest (Church and Von Hagen, 2008; Von Hagen, n.d.). Because this region had been reorganized and transformed by the Inca occupation, it remains open to discussion whether the larger population and settlements in this area were connected by cultural affiliation, or were instead autonomous groups that occupied the same area. While Spanish chroniclers documented the region and populations they encountered, their purpose was to facilitate the process of colonization, therefore their accounts are inherently biased and limited (Ocasio, 2004; Schjellerup, 1997). Additionally, the majority of known historical documentation originates from legal documents with little mention of Chachapoya people or cultural practices.

Moreover, by the time the Spanish entered the region, the Inca conquest had ended and a great deal of information about the original cultures was lost or distorted by Inca imperial rule. Because of the paucity of Chachapoya ethnohistoric documentation, this thesis will be largely based on published archaeological and ethnographic surveys of the area; however, it will include as much applicable ethnohistoric documentation as available (Nystrom et al., 2010).

Chachapoya Chronology

Despite archaeological evidence that indicates this region may have been occupied intermittently as far back as 12,000 BP, the first widespread occurrence of occupation sites in the Chachapoyas province dates to the Early Intermediate Period (EIP), between approximately AD 200 and 400, during which there was a shift to settlements at higher elevations (Church, 2006). According to the archaeological record, settlements typically were established between 2,500 and 3,500 m.a.s.l. in semi-arid environments or conversely in lower eastern slopes encompassed in tropical forests (Church and Von Hagen, 2008). During the middle of the EIP, dramatic changes in pottery techniques indicate an expanding cultural sphere of interaction (Church and Von Hagen, 2008), and suggest sustained trade alliances across the Marañon Valley to the coastal cultures and an active Amazonian-Andean exchange. The height of Chachapoya monumental construction appears to have begun during the mid-Middle Horizon, around AD 800 (Ruiz, 1972). During this period, Wari influence is noted in textiles and some trade pottery, but no conquest directly occurred. The Late Intermediate Period (LIP) in the region extends from AD 1000 to 1350, and is marked by an increase in population and settlement expansion, as well as artistic development (Church and Von Hagen, 2008). Marking the genesis of “classic”

Chachapoya culture, many hamlets, villages, fortified urban complexes and cliff tombs date to this time period. While circular constructions (residences) are not unique in the Andean region, they tend to distinguish Chachapoya 'classic' construction. The Late Horizon (LH) AD 1100-1470, was a time of population expansion and increased complexity in mortuary construction until the arrival of the Inca approximately AD 1470-1490 (Nystrom, 2009).

In AD 1535 there was a great deal of change to the Chachapoya area (Currently considered a geographic province within the Amazonas region of Peru), a full three years into the Spanish invasion of the Incan Empire (Church and Van Hagen, 2008). The Chachapoya were confronted with an onslaught of European diseases and Spanish demands for navigational help as porters on expeditions (Von Hagen, n.d.; Cook, 1981). They were also forced into Spanish style villages called *reducciones*, farmlands were taken away, and the *Kurakas* (regional lords of the local kin groups) were stripped of power. The *reduciones* were oftentimes a great distance from their ancestral villages and burial sites, and laid out on a grid pattern with a central plaza in order to facilitate religious indoctrination (Church and Van Hagen, 2008; Schjellerup, 1997). Part of this indoctrination included the destruction of burial sites, and other cultural heritage (Gerdau-Radonic and Herrera, 2010) called *Extirpación*. Diseases such as smallpox, measles and diptheria swept across the Chachapoya landscape, and those that did not flee of their own accord were often died of these introduced infections. The Chachapoya town council records of 1540 stated, "The Indians are so reduced in number that these lands are almost depopulated" (Von Hagen, n.d.). It is estimated that within 200 years of Spanish rule, almost ninety percent of the region's estimated 300,000 people had perished (Von Hagen, n.d.)

Chachapoyas: Environment and Geology

The ancient Chachapoya occupied a province encompassing approximately 25,000 sq.m between the Marañon and Huallaga Rivers, in the modern Department of Amazonas (Church, 2006). Described as a crossroads between the western highland Andes and the eastern lowlands, this monteo-tropical zone is primarily covered by steep mountains and thick densely vegetated forests and referred to as the *caja de montaña* (Schjellerup, 1997). This area experiences minimal seasonal variation of temperature; however the months between September and March/April are considered to be the rainy ‘season’, while the rest of the year is considered to be the dry ‘season’. Rainfall can average between 800 and 2500 mm annually depending on topography and altitude, and humidity hovers around 90% (Schjellerup, 1997). Additionally, daily temperatures range from warm days to cold nights, which dictate the nature of both vegetation and human activity in the area (Schjellerup, 1997).

Geologically, Chachapoyas is part of the Andes fold formed during the Tertiary-Quarternary as a response to major geologic uplifting (Schjellerup, 1997). The Oriental Cordillera is characterized by deep glacially carved V- and U- shaped valleys, separated by rocky limestone and sandstone peaks (Schjellerup, 1997; Church and Von Hagen, 2008). It is in this environment that we find an average altitude of 3,500 m.a.s.l, with steep peaks ranging between 4,000 and 5,000 m.a.s.l, and moist air from the Amazon generating humid and subtropical forests (Schjellerup, 1997). Despite the high altitude and difficult terrain, the ancient peoples who settled here created large-scale occupation sites at the ridge tops between the high mountain peaks (Church and Von Hagen, 2008).

Archaeological Site of La Petaca

Site Introduction

La Petaca is a natural exposed rock escarpment with a large number of funerary structures situated across its wide expanse. Located in the Department of Amazonas, province of Chachapoya, and district of Leymebamba, the mortuary complex is approximately 14.5 kilometers south of the modern town of Leymebamba and 75 kilometers south of the modern city of Chachapoya. The open cliff face is on the west bank of the San Miguel quebrada, overlooking the Rio Tambillo to the north and 2 km southwest of the *caserio* La Hoya (see Figure 3). The site is specifically situated at 820 41' 59.84274 North and 970 27' 22.81623 East (World Geographic System (WGS84)). La Petaca is located within the sub-alpine *paramo*, a transitional zone characterized by dense coverings of small bushes and trees and thick grasslands. At an average altitude of 3400 m.a.s.l., this area is impacted by high levels of precipitation and cool temperatures around 15° C, conducive to the nearby cultivation of high altitude quinoa and a variety of potatoes (Schjellerup, 1997). Nearby archaeological sites include Bóveda to the southwest and Tajopampa to the northwest.

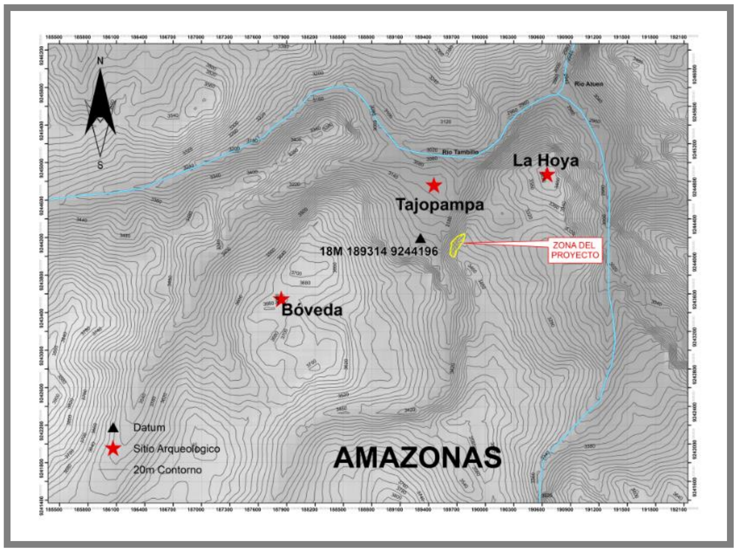

Figure 3 Original contour map of the region surrounding the archaeological site of La Petaca, where *zona del proyecto* indicates the archaeological complex of La Petaca, and red stars highlight the location of nearby archaeological sites.

<u>Description of Site</u>

The mortuary complex itself is located across different levels of the exposed rock escarpment, composed primary of sedimentary limestone and sandstone layers (Figure 4). Composed of a collection of structures placed on a vertical wall, the complex extends approximately 270 meters north-south and 100 meters tall from a defined lower ledge and for research purposes was divided into three major sectors identified as NORTH (NORTE), SUPERIOR (SUP) and SOUTH (SUR). The NORTH sector was not included in this investigation (Figure 4). Due to a natural undercutting of the cliff face the concave shape of the site prevents vegetation from growing directly on or around the structures and creates a dry overhang that protects the archaeological remains from rain. Like other highland Andean mortuary complexes (Isbell, 1997) the natural façade seems to create a harmony with the surrounding natural environment, and promotes a sense of permanence and immobility, illustrating a culture in harmony with nature.

Figure 4 Photo of the mortuary complex, orange oval indicates SUP sector, blue oval indicates SUR sector, red lines indicate ledges, yellow numbers designate each individual ledge.

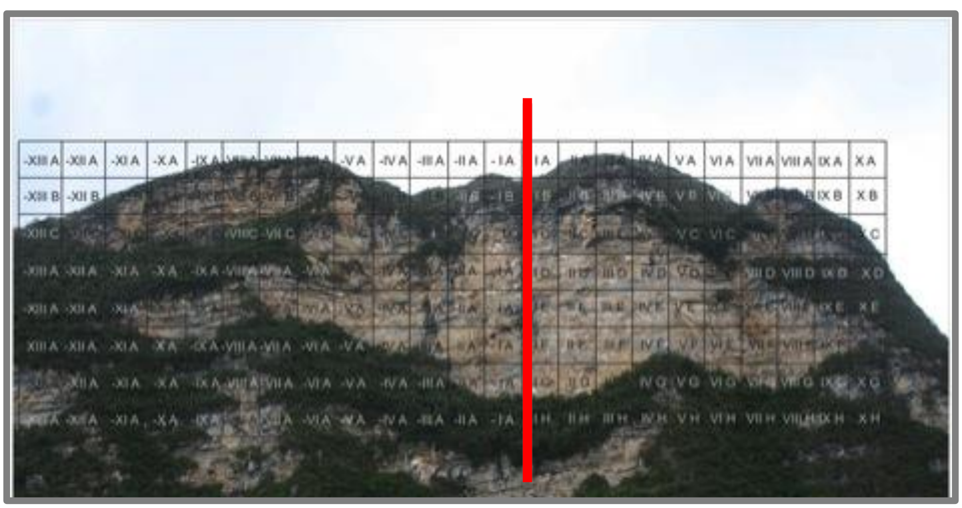

Figure 5 Photo of the mortuary complex, with gridding units of the gridding system employed at La Petaca, redline indicates the location of the baseline.

The SUP sector is approximately 70 x 25 meters (in a vertical plane) and consists of one long horizontal ledge that measures approximately 100 meters in length and supports approximately 20 separate mortuary structures in various stages of deterioration (Figure 4). The majority of stuctures identified were remnants of open chamber structures . These rectangular mortuary chambers/tombs are significantly different in construction than Chachapoya residences, which were almost always circular. These mortuary constrution dimensions were most likely a result of the narrow nature of natural ledges. Two natural cave/crevice contexts, SUP CF-01 and SUP-CF 02, were located at the northern most end of the ledge and contained large deposits of commingled and disturbed human and animal skeletal remains. SUP CF-01 was chosen to be the focus of this thesis due to the large skeletal assemblage and commingled nature of the remains, in order to test the feasability of using a spatially methodological approach to document and analyze this type of disturbed context.

The SUR sector is approximately 200 x 70 meters (vertically defined), relatively oval shaped with tapered northern and southern ends. A series of five large horizontal natural ledges supports the remains of at least 92 constructions in various states of preservation and contains various types of cultural material including human and animal skeletal remains, ceramics, gourds, lithics, and textiles (Figure 4). Structures were primarily stone plaforms that once supported rectangular, open tomb structures with a single rectangular entranceway and an enclosed roof. At least three structures were two storied, plaster-finished, and painted red and white. Additionally, one large cavern (SUR CF-01) identified in the central area of this sector held a large deposit of human skeletal remains, and was used as comparative demographic material for this thesis.

A baseline down the center of the mortuary complex was referenced to define 10 by 10 meter units along a vertical grid system. 10 by 10 m units were measured both outwards from the center baseline, forming a numerically labeled horizontal x axis (e.g. I, II, III), and downward from the baseline, an alphabetically labled vertical y axis (e.g. A, B, C) (Figure 5). Extending out from the center base line, to the south units are labled with positive numbers and to the north labeled with negative numbers.

Structures were labeled first by the abbreviation “EF” (*estructura funeraria* – funerary structure), with a preceeding numeric identifier unique to their sector (e.g. SUP EF-01, SUP EF-02, SUR EF-01). Caves and crevices were labeled first by the abbreviation “CF” (*contexto funerario* – funerary context) with a preceeding numeric identifier unique to their sector (e.g. SUP CF-01, SUP CF-02, SUR CF-01).

Mortuary Analysis

The archaeological record encompasses the material remains of a dynamic landscape that was created and shaped by active social agents. Mortuary practices including the placement of the bodies of the dead in specific locations provide a framework for archaeologists to examine the complex creation of social memory, as well as group and individual identity, as they represent the complex relationship between material culture and the memories of both the deceased and the living that cared for their dead (Chapman et al., 1990; Parker Pearson, 1999; Chesson, 2001). The theoretical paradigm used to interpret such data has evolved with changing views of social theory and practice that accompanied new schools of archaeological thought (Chesson, 2001).

Mortuary analysis has long been incorporated within archaeological methodology; however only during the past few decades has there been a renewed focus on the theoretical paradigm that shapes these analyses. More than just a methodological component to archaeological investigations, mortuary evidence can be used to investigate aspects of social systems (O'Shea, 1984). The study of mortuary behavior resulted from Twentieth century critiques of the belief that there is social meaning within funerary rituals (Rakita and Buikstra, 2005). One of the earliest criticisms was Kroeber (1927) whose classic cross-cultural study of funerary practices concluded that mortuary practices were a kind of fashion, and that they appeared uncorrelated to other customs and practices within the society. His work was widely cited, and while some research continued to study funerary rites, a new generation of anthropologists emerged very cautious of interpreting social behavior from mortuary practices. This cautious approach remained until the rediscovery in the 1960s of the contribution of Hertz's earlier work (1907), who stimulated a change in anthropological theory shifting the way anthropologists considered the role and meaning of mortuary practices, and influencing theoretical approaches emerging from the New Archaeology paradigm.

Social science theories have revolved around two very different paradigms: that of "holism" and the "individual" (Gillespie, 2001). Holism theories were the first to develop, and viewed society as an entity beyond that of the individual, where society actively determines behavior. This processual approach emphasized that ecomaterialistic characteristics determined cultural stasis, or in some cases, social change. The credit for this approach is attributed to the work of Saxe (1970, 1971) and Binford (1971), whose research was based on the assumption that status differences in life were reflected in differential treatment upon death, and that changes in burial treatments would reflect differences in the general structure of the society. For example, according to this assumption: those in societal positions with greater access to resources would have more elaborate mortuary treatments.

Processualists used both ethnographic and cross-cultural studies to investigate the variability within cultures (Parker Pearson, 1999). Binford (1971) examined the correlation between life status and social persona that was represented in death and mortuary remains, and concluded that more ‘complex’ societies often embraced more elaborate funerary practices. Arthur Saxe (1970) similarly documented the social dimensions of mortuary practices in his influential Ph.D. dissertation. Similar to Binford, he used ethnographic data to arrive at several conclusions that connected variation in mortuary practices with social complexity. However, he noted weaknesses in Goodenough’s role theory that heavily influenced Binford’s work. Goodenough’s (1965) theory of role identity defined concepts of social identity, recognizing that all individuals occupy several social identities, which are displayed at different times to different individuals or in difference social contexts. The synthesis of the Saxe-Binford Approach was a major contribution to the way anthropologists interpret ancient lifeways, influencing how “New Archaeology” processual archaeologists conducted their analyses, assuming a static and pattern specific archaeological record, with an emphasis on the deceased; this wasn’t enough for some, however.

The more recent post-processual approach viewed mortuary practices as events that are actively shaped by the living and the status of the deceased, thereby reflecting cultural beliefs (Gillespie, 2001). This approach recognizes that it is the living that creates these rituals and funerary spaces, prepare the dead, and engage in extended mortuary practices. Practice theory greatly influenced this new approach to interpretation, shifting the focus of social identity from the intangible concept of ‘social persona’ to the idea that specific identities are created and transformed by social structure and active individual agents (the living, not the dead) (Hodder, 1982; Gillespie, 2001). Under this theory, practice dictates that human actions operate under the constraints of social control mechanisms, commonly referred to as 'structure' (Giddens, 1979; Bourdieu, 1997). This theoretical perspective embraced by post-processual archaeology permits the individual social freedom and agency to transform their cultural landscape including the creation of the landscape of the dead. Burials became contextualized within the social environment, embracing both social processes and human agency as direct contributors to funerary practices.

Burial Context

Careful inspections of the burial context are essential to the interpretation of mortuary practices. By evaluating the content of the remains present (whether they be skeletal, cultural, or natural), analyses can determine the nature of the mortuary practice that created the defined space. There are several different categories of burial contexts, which each indicate unique processes of creation.

Burials can either be interpreted as primary, indicating that the whole body was placed in the location as a final resting place and had not been moved, or secondary where human remains have often moved, possibly from their original primary context. These are often interpreted from the assumption that although small bones such as carpals and tarsals preserve well, they are not often collected and moved to the final burial location (Roksandic, 2002). Therefore, a concentration of large bones with a noted absence of smaller elements often is interpreted as a secondary context. Similarly, removal of the skull and larger 'trophy[1]' explain trophy elements

[1] Trophy elements are defined as the targeted removal of body parts, identified when skeletal

such as the femur and tibia, or in some cases an overrepresentation of these elements are also common indicators of a secondary collection (Roksandic, 2002). Conversely, more equal representations of both large and small elements are often interpreted as primary contexts.

Group burials can be categorized as either synchronous or diachronous. Synchronous burials are characterized as either primary or secondary, where primary synchronous mass burials often result from catastrophic events such as epidemics, massacres, or ritual suicides and secondary ossuaries occur when individuals decomposed elsewhere, and were redeposited at the same time in one location, regardless of the state of decomposition. Diachronic group burials are more common, and can also be divided into primary and secondary contexts. Successive primary burials require continuous access to a grave, and are considered collective burials. Conversely, secondary diachronic burials occur when individuals are interred after a specific interval, not necessarily a designated date. Therefore, diachronic burials differ from synchronous contexts by maintaining more uniformity in regards to the degree of decomposition (Metcalf, 1991). Bodies can become commingled within group burials in multiple ways; one way that is most applicable to this research are practices of accumulation that occur when complete bodies are collected and interred together. Duncan and Schwarz (2014) argue that this process of accumulation in a grave is more so an agglomeration that appropriates the concept of individual identity, and transforms individuals into a group of non-individualized bodies.

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elements are repeatedly missing from burials, or when cutmarks are found that are consistent with dismemberment (Smith, 1997).

Group and Individual Identity

It is important to clearly differentiate between group and individual identity while discussing mortuary practices however, the group can be difficult to classify as in many cases there can be several definitions of a “group”, which can range from the family, to the community, or other defined social units depending on the studied population. In these terms, the group is larger than the self, but inclusive of others, thus in mortuary treatment the group is often given primacy over the individual. Conversely, the concept of the individual can also play a large role in the interpretation and analysis of mortuary practices, as archaeology often assumes that the presence of a body serves as the unity and individuality of a person (Sofaer, 2006). The concept of the individual becomes complicated however, when remains are in a commingled and fragmented state, such as in many collective burial contexts. In their skeletal form, skeletal elements are no longer representative of a single cohesive physical unit, but instead are a collection of separate units that could hold multiple meanings, and these meanings are often unique to the population they are from (Busby, 1997; Cannon, 2001). Wagner (1991) proposes the concept of fractal bodies as a way to acknowledge that bodies play an integral role in the archaeological record even when they are no longer considered to be separate individuals. Frowler (2004) illustrates the importance of the group in mortuary practices by describing the fractal body as a potentially nested accumulation of ancestors where a singular human body is considered to be part of a greater whole. The emphasis of fractal bodies and group identity in the interpretation of mortuary practices became central to the approach of this thesis.

Social Memory and Landscape

Central to the theoretical interpretation of mortuary contexts is social memory, an abstract concept that encompasses many different types of knowledge and is created by and maintained by a community through collective and individual ritual action (Knapp and Ashmore, 1999). The materialization of cultural memory is often interpreted within the landscape. Within archaeology, landscape is an active component of the human experience (Knapp and Ashmore, 1999). It reflects the dynamic and recursive relationship between human actors and their landscape (Casey, 2008). Continually shaped through cultural processes, landscapes could be considered 'works in progress' (Casey, 2008; Tilley, 2008).

As such, the landscape and mortuary sites within become a focus and deposit of collective social memory, attributing special meaning to these spaces since they are created by social groups, not individuals. Identified in spaces such as natural features, humanmade structures, walkways, meeting places, or mortuary contexts, these physical markers reflect a continuous and transformative process, demonstrating that the living experienced a dynamic relationship with the dead (Knapp and Ashmore, 1999). Therefore, social memory is not stagnant, it continues to be shaped by life experience, and cemeteries provide a physical location where individuals and societies can visually display their cultural or social history. Social memory is renewed through practiced rituals that link the past present and future, and transformed through time (Knapp and Ashmore, 1999). Bioarchaeology can play a unique role in analyses of social memory because it incorporates spatial and contextual evidence of material and space in the interpretation of these social representations of death in the production and expression of social memory.

Energy Expenditure

In tandem with this discussion of the creation of mortuary spaces is the concept of energy expenditure as a means of interpreting mortuary complexity and practice. Tainter (1973) argues that the amount of involvement and the degree of activity disruption should positively correspond to the amount of energy that was expended during a mortuary act. This expands upon Binford's argument that the form of mortuary ritual is determined by the size and composition of the social group who ascribe 'status[2]' to the deceased (1971). Tainter's theory suggests that those of higher status will have more group involvement and activity disruption in their death, which would result in a large amount of energy expenditure in their burial. The opposite should be seen for those of lower rank in society. Peebles and Kus (1977) argued that different deposits of grave goods also indicate different status in society, and could be ranked accordingly. While this is difficult to measure in some cases, there appears to be a relationship between expenditure and mortuary practices, however determining this necessitates careful interpretation based on contextual evidence.

Andean Mortuary Practices

There are many different types of mortuary practices found across the Andean region. This section will discuss two fundamental aspects of Andean mortuary practices that are common to many pre-Hispanic cultures and unique in expression: ancestor veneration and mortuary contexts. While intertwined, ancestor veneration often dictates the mode and location

[2] Social status is interpreted as based on relative political (decision making) or economic (resource control) power.

of mortuary practices as ancestral mummies and bundles need to be accessible for practices of visitation and ancestor interaction. Mortuary structures differ between populations and regions in the Andes, and this section will discuss common types of structures found primarily in the Chachapoyas region and nearby locations.

Ancestor Veneration in Andean Society

The pre-Hispanic Andean mortuary landscape reflects an active community of ancestors that existed as an extension of the living (Doyle, 1988). Doyle (1988) describes the significance of ancestors in three specific areas: 1) creation myths, 2) the social definition of local kin group or communities (*ayllu*[3]), and 3) the restatement of an individual's connection to their community after they have become deceased and transformed into an ancestor. Frequently found in agricultural communities who depend on high levels of cooperation and group cohesion, performance rituals that emphasize honoring a common ancestor perpetuate individual and collective identities as they are based on the participant perception of common ancestry and result in a shared sense of common identity and collaboration among many descendants (Mantha, 2009).

Studies indicate that the relationship between the living and dead resulted in a set of practices that were designed to reaffirm the community's social relationship to the *ayllu*, as seen in many pre-Hispanic Andean populations (Crandall, 2012; Isbell 1997). According to the

[3] Where *ayllu* is defined in this context following Isbell (1997:98-99) as "a group of people who shared a resource attributed to a founder or ancestor and whose members could therefore be ranked in accord with the idiom of kinship when the founder was employed as a common ancestor".

Andean ethnohistorical record, ancestors were believed to have a power that they could exert in the physical world, and this power could either benefit the living community or result in disaster (Duviols, 1986; Gose, 1994). Under these conditions, it was very important for Andean societies to honor and care for their dead, often with ceremonies bringing offerings to the dead, and through the curation and manipulation of their bodies (Duviols, 1979, Doyle, 1988; Mantha, 2009; Lau, 2013). Therefore, it is clear that the pre-Hispanic Andean mortuary landscape reflects an active community of ancestors that existed as an extension of the living and required constant care and attention, as described by Pablo Jose de Arriaga (1968 [1621]:64) in his descriptions of the pre-Hispanic populations of Peru:

"They are persuaded that the dead feel, eat, and drink, and only with great pain can they be buried and bound to the earth. In their machays [burial caves] and burial places in the fields, where they are not interred, but placed in a small hollow or cave or little house, they have more rest."

This active and continual relationship with ancestors perpetuated the social structure of the *ayllu* through the performance of ancestor veneration ceremonies. Ethnohistoric documentation established a relationship between mortuary monuments and *ayllu* organization, and important to these descriptions was the role of the mummy (ancestor's body) in the production and reproduction of *ayllu* culture and ideology (Buikstra, 1995; Salomon, 1995; Isbell, 1997). Therefore, it appears that ancestor veneration propagated the social structure and organization of *ayllu* in the pre-Hispanic Andean landscape through ritual performance, which would occur in special places within the landscape.

Andean Funerary Architecture

Because of the special nature of the ancestral bodies as previously discussed, funerary structures are a visible way of making ancestors easily accessible for visitation and veneration. The specific locations and construction of burial structures are integral to the analysis of mortuary practices. Topography and available building materials appear to have been important factors to many Andean communities (Isbell, 1997; Lau, 2013). There is significant variation among Andean funerary architecture, ranging from individual underground tombs, above ground or collective creations, and natural spaces such as caves. Differences emerge between the coast and sierra highlands, where burying individuals in an extended positioning of the body is the more typical coastal mode, in comparison to highland traditions that typically deposited individuals in a seated position, often in a type of above ground structure (Mackey, 1982).

Above ground burials often manifest in single or collective mortuary mausoleums, referred to in the Andean region as *chullpas*. *Chullpas* emerged as a mortuary structure in the Andean central highlands during the Middle Horizon (A.D. 500-900), and are associated with ancestor veneration, and serve as monuments of social organization and territoriality (Isbell, 1997). Not restricted to the central highlands, *chullpas* range in style from the stone or adobe tower-like buildings with a corbelled vault or slab-roof common in the southern *altiplano* region, to the north central highlands where *chullpas* were often grouped into settlements and constructed as above ground tombs containing the remains of multiple individuals (Manthas 2004). Isbell (1997) argues that these structures were closely linked to the maintenance of local *ayllus* through practiced interaction with ancestors. Similar to cave contexts, *chullpas* were used to preserve the bodies of ancestors and provide accessibility, facilitating the practice of ancestor veneration. These monumental structures were visual markers and memorials prominently placed in the landscape, acting as repositories for cultural memory and indicating land controlled by specific *ayllus* (Hyslop, 1979).

Within the Andean highland region, caves were also selected as burial places, possibly because their environment was conducive to preserving bones and material remains, or possibly because they were already created and no work was involved (Fabre et al., 2009; Lau, 2013). In Andean and Amerindian belief, caves were often places of origin, providers of life, and sometimes considered places of emergence, or a connection to supernatural realms or underworlds (Duviols, 1986; Salomon and Urioste, 1991; Prufer and Brady, 2005; Lau, 2013). Ancestral veneration among Andean groups often emphasized characteristics such as fertility and life, and therefore caves were prominent locations for burials since they are linked to many Origin myths – the birth of specific cultural groups including the Inca.

Within several Andean societies there are clear distinctions in mortuary practices between individuals of different social statuses. For example, the Lambayeque (750 CE- AD 1375) culture of the north coast of Peru constructed dozens of monumental mounds that were either covered or surrounded by tombs (Shimada et al., 2004). On the top of these mounds were impressive temples, decorated extensively with polychrome murals and the site of offerings. The burials of the most elaborately decorated individuals were located in the highest and most central locations, indicating a social hierarchy and observed material variation reflecting these differences (Shimada et al., 2004). The Moche, one of the most studies complex societies in the prehistory of the Peruvian north coast (ca. AD 200-800) also exhibited a significant range in mortuary practices. Pit burials were the most common forms, often with few accompanying offerings, while more elaborate tombs such as those found at Sipán and San José de Moro held larger chamber tombs and were very complex, containing a principal figure, presumptively sacrificed individuals, and a wealth of artifacts (Donley, 2004). Boot tombs, a vertical shaft that ends in a small horizontal chamber, most likely represented mortuary structures of the middle class, as they are intermediate between pit tombs and high status chamber tombs, in terms of the effort that was invested in the construction of these structures and the quality of grave goods associated with each type (Donley, 2004). These examples demonstrate the variability present in Andean mortuary practices, highlighting that differences in construction and location were often attributed to social status.

Chachapoya Mortuary Practices

Chachapoya mortuary contexts include above ground *chullpas*, anthropomorphic sarcophagi, burial in natural contexts such as caves, as well as burials within structure walls. The most prevalent and visual forms of Chachapoya mortuary architecture include large communal *chullpas,* which are found mainly in the southern region of Chachapoyas and anthropomorphic sarcophagi that are clustered primarily in the northern region (Nystrom et al., 2010).

Chachapoya *chullpa* structures included houses and tombs were often built with limestone, a hard and sharp substance ideal for building because it is easy to cut and shape and is found readily in the bedrock of the Chachapoya province. Stone structures were often created with irregularly sized stones that are not consistently rectangular, which retained a natural appearance with an imprecise fit, and mortared with mud and plaster finished, and decorated externally with geometric designs (Figure 6) (Schjellerup, 1997). Notable absence of pre-

Hispanic quarrying sites in the Chachapoya archaeological landscape indicates that occupation sites may have been built directly on sites of rock extraction, a further indication that the Chachapoya had a great knowledge of their physical environment (Schjellerup, 1997). Chachapoya and other pre-Hispanic central Andean societies built funerary structures and occupation sites in high areas with far reaching vantages and rocky prominences of land and within view of special features such as rivers, lakes, caves, springs, and rocky outcrops that were considered places of origin (Doyle, 1988; Isbell, 1997; Fabre et al., 2009; Nystrom et al., 2010; Lau, 2013).

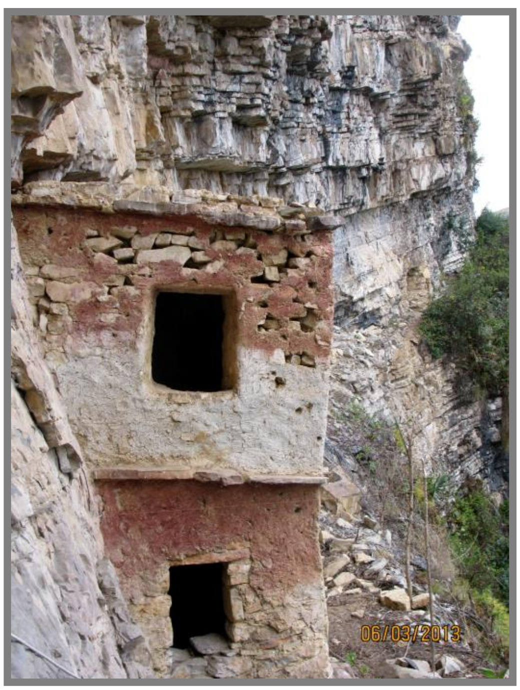


Figure 6 Chullpa at La Petaca in the province of Chachapoyas.

Some structures are set in rows on natural rock ledges with overhangs that protect from the elements, like those at Laguna de los Cóndores, Revash and La Petaca. Others are single constructions that are located in difficult to access locations, such as those at Kuelap. These areas seem ideal since they provide natural protection from rainfall, which enhanced the preservation of funerary items and textile wrapped and prepared bodies.

Radiocarbon dates indicate that Chachapoya *chullpas* were utilized well into the Inca occupation and perhaps as late as 1657 AD (Nystrom et al., 2010). While this does not necessarily indicate their dates of construction, it implies continued access and use of these spaces even through periods of significant cultural change.

Muscutt (1998) observed that many burial sites were located in sheltered areas under overhanging cliffs and at cave entrances, and in some cases the entrance was walled in with large cut stones. Chachapoya populations may have selected these dry spaces specifically to preserve their dead, sometimes even altering the natural state of the cave for the mortuary practice (Ruiz Estrada, 2008). Others argue that ancestors were deposited in these places where they could look out upon the world, and be visited by their descendants (Knutson, 2006).

Preliminary investigations in the area indicate that the Chachapoya also had an understanding of the subterranean environment, using deep crevices and underground chambers to house their dead (Knutson, 2006). Spelunking explorations demonstrate that the subterranean world mirrored the above ground world, and that the Chachapoya utilized both environments as funerary contexts (Bigot, 2006; Knutson, 2006; Fabre et al., 2009). Despite observations that suggest caves play a significant role in central Andean mythology, most of these studies are based on surface observations. A more comprehensive investigation of cave burials both subterranean and high on the cliffs is necessary in the Chachapoyas region in order to further understand how these spaces were incorporated into the cultural landscape (Knutson, 2006; Ruiz Estrada, 2008; Fabre et al., 2009).

Chachapoya anthropomorphic sarcophagi, more commonly identified in the northern portion of Chachapoyas, have long attracted the attention of scholars (and looters), however there remains a great deal still unknown about these constructed mortuary structures (Figure 7). They were individual tombs, with bodies placed in the flexed seated position. Composed of plaster and sticks, sarcophagi were constructed around the seated body *in situ*. Kauffmann Doig et al. (1989) grouped this mortuary architecture into six classes of differential complexity, with a large range in size and decoration. They were often individually decorated, and many had false stylized heads. A large majority of these tombs have been extensively looted.

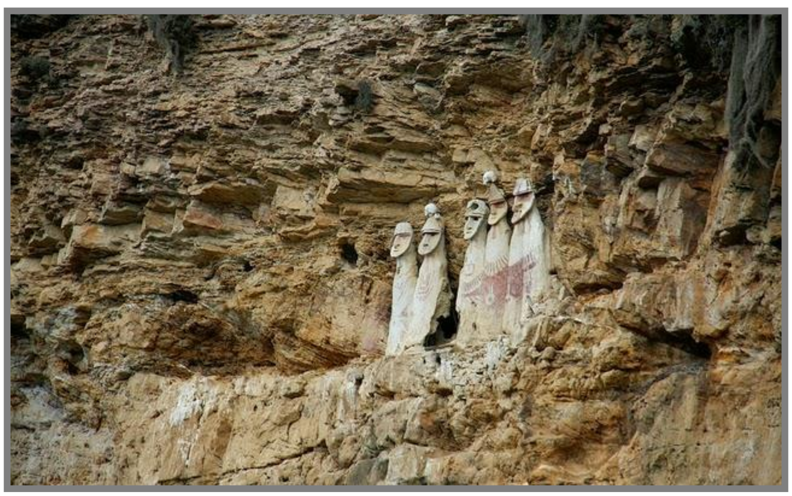


Figure 7 Sarcophagus complex of Karajia. Photo adaptation courtesy of panamericanworld.com.

It has been suggested from studies of other pre-Hispanic Andean societies that only the elite were entombed within sarcophagi and *chullpas* based on the amount of energy expended in their creation and the assumption that the amount of energy expended would correlate to status of the individual (Langlois, 1934; Binford, 1981; Vreeland, 1998). Chachapoya specific references indicate that the *ayllu* of Chuquimis "placed their most important dead" in the cliffs (Espinoza, 1967), and the large amount of Inca style ceramics found at Los Pinchudos (in the southern region) suggests that the individuals interred in the mausoleums were members of a local elite *ayllu* politically aligned with the Inca (Nystrom et al., 2010). Currently, however, there has not yet been enough research to support these ideas, nor is it clear if these differences in mortuary practice correlate to sociopolitical differences between the northern and southern region of Chachapoyas, or rather variations in social status or chronology.

The treatment and preparation of bodies changes within and between Chachapoya populations, likely due to Inca occupation. Body processing of individuals was observed in several Chachapoya mortuary contexts, which often included some form of mummification and a secondary internment of skeletal material (Nystrom et al., 2010). The type and coloration of external woven textiles and internal wrappings varied, as did the positioning of the arms, hands and feet (Nystrom et al., 2010). Though forms and processes of mummification vary between and within sites (further indication of the diversity of Chachapoya mortuary ritual), individuals were most commonly placed in a tightly flexed seated position, wrapped in vegetal fiber cords and some type of woven textile (Guillén, 2002, 2003; Nystrom et al., 2010).

Due to the nature of mortuary offerings, including gold, fine ceramics, and especially well-preserved textiles around mummies, this has created a voracious black market for these valuables and thus a mining effort across the Andes to loot tombs in search of all types of mortuary artifacts. As a result, *huaqueros* will dig or climb great heights in order to take anything they can find. Unfortunately, this has resulted in many archaeological sites being extensively disturbed. For example, at the nearby Chachapoya site of Laguna de los Condores, cattle ranchers from Leymebamba found red painted funerary structures located on the cliffs above the lake (Bjerregaard and Von Hagen, 2007). With machetes, they slashed mummy bundles, and rummaged through the tombs, searching for metal artifacts and others they could sell (Bjerregaard and Von Hagen, 2007). This created a great deal of disturbance, the primary provenience is lost, and materials were destroyed (Bjerregaard and Von Hagen, 2007). While a great deal of information is lost as a result of these actions, this thesis emphasizes that there is still much information that can be recovered from these contexts.

Summary

This chapter provided an overview of the Peruvian central Andes, divided into three sections. The first section describes the basic Andean chronological development, and then discussing the environment and ecology of the Central Andean Highlands. Next this section described the Chachapoya region, and explored the cultural development of the pre-Hispanic cultural group, the Chachapoya with archaeological and ethnohistoric evidence. The next section of this chapter discussed the La Petaca mortuary complex, identifying the location and dimensions of the complex, as well as the types of mortuary contexts present. In order to analyze the archaeological data presented in this chapter, the third section presented mortuary analysis as the guiding framework for a bioarchaeological interpretation of this research project. It began with a basic overview of mortuary analysis as a theoretical approach, and then described the current understanding of ancient Andean burial practices and Chachapoyas specific mortuary variation. Next, Chapter Three presents the methods utilized to explore the hypotheses and research questions developed in previous chapters.

CHAPTER THREE: METHODS OF ANALYSIS

To test the hypotheses discussed in previously, demographic and spatial analysis will be employed to estimate the demographic categories present in SUP CF-01 and the spatial relationship between paired skeletal elements. First this chapter will provide a brief summary of the methods used in the excavation, documentation, and recovery of the skeletal remains. This chapter then describes the methods employed in the osteological analysis of the materials recovered, including the inventory, summary counts, and estimations of sex and age used to reconstruct the demographic composition of the burial population. Demographic methods will also be applied to the remains retrieved from SUR CF-01, a less accessible cavern also used as a collective burial. Finally, this chapter will discuss the methods employed to record, illustrate and analyze the elements within a Geographic Information System (GIS). The demographic analysis focuses on reconstructing whose remains were recovered from SUP CF-01, and the spatial analysis will contextualize the commingled remains within this cave context.

Methods of Excavation, Documentation and Collection

The excavation and collection procedures of all skeletal and archaeological remains were impacted by the methods used to record the spatial location of major elements. Using traditional archaeological methods of excavation and artifact recovery (Renfrew and Bahn, 1991), the cave was divided into 7 roughly 1x1 meter units, labeled numerically (with the exception of the Entrance Unit), and further subdivided into 50 x50 cm quadrants designated with alphabetical labels (Figure 8). Due to the irregularity of the cave, units were not uniform in size, but instead adjusted to best divide the space in a way that would allow for easy access to the units. The unique shape of the cave also impacted the way elements were recorded. A level horizontal line was stationed across the entrance of the cave from the permanent datum location (WGS84 UTM 18S 189683 9244170) to be used as a line of reference from which we were able to measure depth in all locations of the cave.

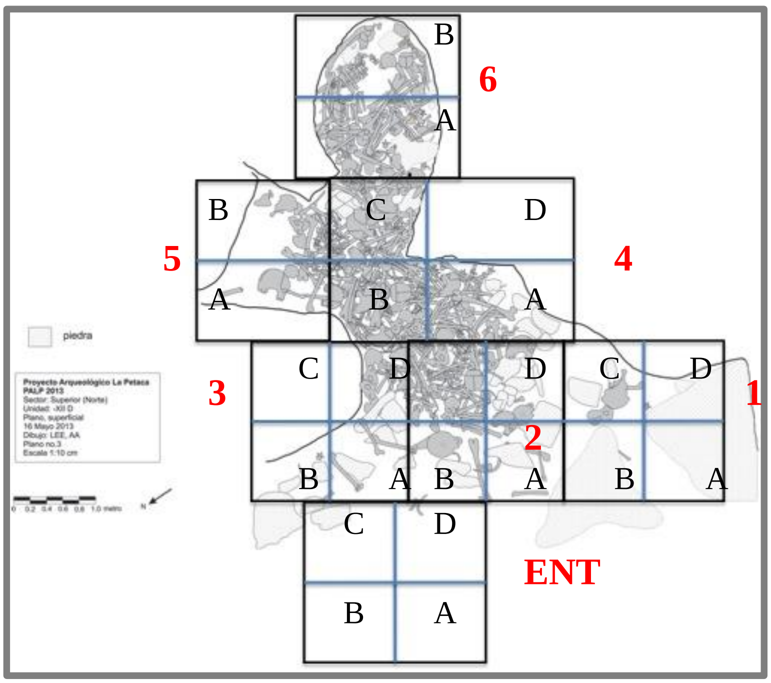


Figure 8 Plan map of SUP CF-01 illustrating the locations of units and quadrants.

The collection method was by quadrants, which increased the degree of provenience, and facilitated the subsequent spatial analysis of all elements collected. The top stratigraphic level observed was identified as “superficial”, and a plan view drawing recorded the 2D context of each visible element using traditionally archaeological methods, including taking depth measurements. The total station then recorded the 3D location of each element after the 2D context had been recorded as an illustration. Each skeletal element recorded in plan view drawings was labeled in permanent black marker with identification numbers and placed into corresponding plastic bags. Each bag was labeled with the unit and quadrant. A paper tag was placed within each bag, identifying the contents and the specific location they were collected from.

Once the surface remains were collected to a consistent level, which was arbitrarily defined based on the exposure of a new layer of skeletal remains (Level 1), a new drawing was prepared, new total station points taken on the exposed remains, and the collection process began again. Because the deposit of skeletal remains was commingled and some large remains such as whole femora and tibia were buried fairly deep (>30 cm), an infinite number of strata could have been artificially created. It was decided that two strata could accurately represent the commingled unit, without straining time or resources. Trowels and brushes were employed to carefully remove the dirt around each element prior to exhumation. In some cases the density of the deposited remains was so thick that bones were manually removed from the loosely packed soil matrix with little resistance and without the assistance of a trowel or brush. Once complete, a 60 cm wide trench was excavated with hand trowels through quadrants 2b to 6b to sterile soil (Figure 9 and 10). The remains were collected according to their quadrant location within the trench in order to maintain a more precise provenience.

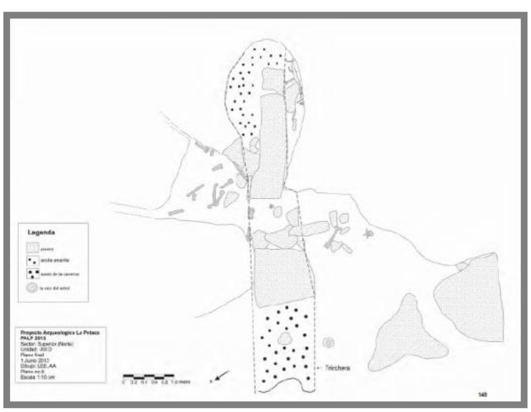


Figure 9 Plan view of SUP CF-01 illustrating the context after excavation, and the location of the excavation trench.

Figure 10 Photographic image of SUP CF-01 prior to excavation or documentation and after excavation and collection.

Each bag was transported to the lab for inventory and further analysis. Bones were first allowed to dry, and then cleaned dry with toothbrushes and dental picks. Then, each bag was individually laid out on a table, grouping elements by type and side. An inventory was created in Microsoft Excel® by bag, where each bone was assigned a general inventory total number, an element number based on bag, and if bones were documented within the plan map, a specific identification number that referenced their spatial location within the mortuary environment. The inventory recorded each bone by element, side, and segment if a fragment of a long bone (See Figure 11 for illustration), percent present for each elements, age estimation, sex estimation, and general descriptors including classification of condition, taphonomic modification and paleopathological characteristics.

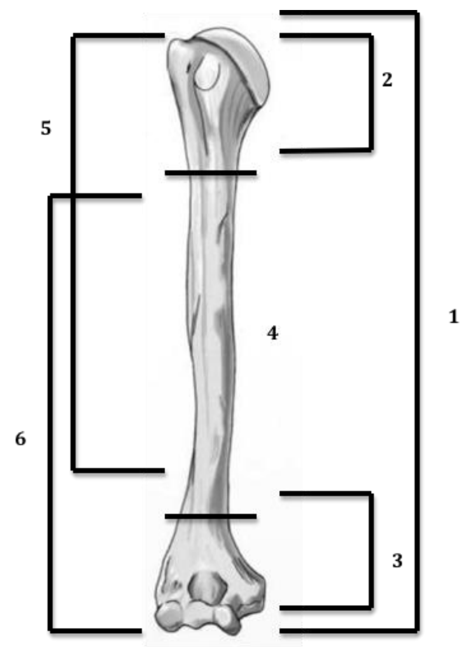


Figure 11 Depicts the system used to estimate the segment of long bones present, which was used in the inventory process. 1=complete; 2=proximal fragment; 3=distal fragment; 4=shaft; 5=proximal element; 6=distal element; 7= not present (7 was not used in this analysis).

The inventory included a record of metric measurements in millimeters of complete long bone and cranial elements, also including the calcaneus and second metacarpal, but excluding small bones such as carpals, tarsals, metacarpals, metatarsals and phalanges. Measurements were based on landmarks and techniques recommended by the Standards volume (Buikstra and Ubelaker, 1994) for postcranial elements, and an adaptation of cranial measurements recommended by Standards (Buikstra and Ubelaker, 1994). While Standards was the guiding framework, more information was added to the inventory from Bass (1994), White and Folkens (2000), and Ubelaker (1989). An osteometric board was used to record the length of larger elements and digital sliding calipers and spreading calipers were used to record all other metric data. Metric data was consistently recorded to the nearest millimeter. In cases where elements were slightly damaged, measurements were still taken, and an asterisk was used as an identifier on the recording form.

Estimation of Sample Demography

Demographic statistics are the most basic descriptors of human populations upon which all other analyses are based, therefore the first step in an analysis of an assemblage of skeletal remains is to reconstruct the original death assemblage including the total number of individuals and the estimated age at death and sex distributions (Boquet-Appel, 2008). When skeletal assemblages consist of relatively complete individuals, the demographic profile is based on each individual's osteobiography, a term coined by Saul and Saul (1989) describing an approach to the interpretation of populations by illustrating the composite lives of the public. The assemblage at SUP CF-01 was quite disturbed and commingled, and therefore the individual skeletons could not be reconstructed. Thus, the current analysis relied on a different approach, which first necessitated an estimation of the minimum number of individuals (MNI) represented by the skeletal remains, and then the cranium and os coxa were assessed to estimate the age and sex categories present. The materials from SUP CF-01 used various quantification methods beginning with a count of elements (MNE), bone representation index (BRI), minimum number of individuals (MNI), minimum number of likely individuals (MNLI), and osteometric sorting of elements to estimate the sample demography discussed below.

Estimation of Sample Demography: Minimum Number of Individuals (MNI)

The most common method of quantifying the number of individuals present in a skeletal assemblage is MNI, and is most applicable for commingled deposits of human remains, as it does not contain assumptions for how the assemblage was created. There are three separate calculations used for MNI. The first method used to determine MNI is an estimation of the minimum number of elements (MNE) present for each bone type regardless of side. The calculation of MNE is simple, by estimating a total count of each element. All complete elements are then separated into left (L) and right (R) sides, where the largest number is taken as the MNI estimate [Max (L,R)] (White, 1953; Adams and Konigsberg, 2004, 2008). Others may include in the total counts fragments of elements 50% and larger (Buikstra and Ubelaker, 1994), an adaption to the original equation which was used in this analysis.

T.E. White (1953), who first introduced this method as a way to measure the differences in animal species occurrence at archaeological sites on the North American Great Plains, warned that disregarding data on age, sex, antemortes (antemortem condition), occlusion and articulation would result in an estimate underrepresentative of the original assemblage population. Feiller and Turner (1982) highlight another very important shortcoming of this method; the presence of unmatched bones indicates that there will be an underestimation of the number of individuals that comprised the death assemblage. MNI presents the minimum estimate for the number of individuals that contributed to the sample, it does not necessarily correlate to the original death assemblage, which will contribute to an underestimation of individuals unless 100 percent of the skeletal remains are collected and counted (Adams and Konigsberg, 2004; 2008). While MNI cannot estimate the original number of individuals within an assemblage unless each element is collected, in cases of fragmentary and poorly preserved bone, or small bone assemblages, it can be the best quantification method.

Estimation of Sample Completeness: Bone Representation Index (BRI)

Taphonomic processes, burial practices, and postdepositional activities can be reflected in the frequency statistics of present skeletal remains. In archaeological deposits, the absence or emphasis of skeletal elements has been ascribed to cultural and/or social practices (Duday and Masset, 1987; Bellow and Andrews, 2006). Because this excavation did not recover 100% of the skeletal remains from the entire context, as there was only a complete recovery from units excavated by trench, there will be innate differences in frequency and MNI estimations between skeletal elements. However, while there will be a random assortment of missing elements, patterning of emphasized elements or an absence of element categories can contribute information about the creation of the deposit and the relative completeness of the individuals contained within. Following an assessment of MNI, this thesis will estimate the Bone Representation Index (BRI) in order to explore the presence and absence of certain bone categories (Dodson and Wexlar, 1970; Bellow and Andrews, 2006). This method was calculated using the ratio between the number of bones excavated and the number of bones that should have been present based on the calculated MNI (most common bone present in the assemblage for subadult and adult individuals), and followed the equation:

$$BRI=100x\sum(N_{observed}/N_{expected}).$$

Estimation of Sample Demography: Lincoln/Peterson Index (LI) and the Minimum Number of Likely Individuals (MNLI)

The calculation of the Lincoln/Peterson Index (LI) has almost been exclusively applied to zooarchaeological remains (Adams and Konigsberg, 2004, 2008). First developed for population studies of living animals, it was later adopted for application to zooarchaeological assemblages.

LI is considered a better method to use in archaeological samples as it can be derived from assemblages that are biased due to taphonomic processes (Adams and Konigsberg, 2004; Fieller and Turner, 1982; Ringrose, 1993). This method also takes into account some degree of data loss, allowing for a better reconstruction of the number of individuals present in the original death assemblage (Adams and Konigsberg, 2004).

Table 2 Equations for LI and MNLI.

Type	Author(s)	Equation
Lincoln/Peterson Index	Lincoln (1930) Peterson (1889)	(1) $\acute{N} = (L * R)/P$
	Fieller and Turner (1982)	(2) $N = (L+1)(R+1)$
Minimum Number of Likely Individuals (MNLI)	Chapman (1951)	(3) $MNLI= ((L+1)(R+1)/(P+1))-1$

More accurate with higher levels of recovery, LI is based on precise estimations of pair matching elements, useful in situations where the elements are in good condition and researchers are experienced enough to accurately pair match bones (Adams and Konigsberg, 2004). Criteria used in visual pair matching involve size, shape, possible age and sex characteristics, and any distinct morphological traits. Osteometric pairing methods are described below. If pairs can be estimated, (Table 3, Formula 1) can be followed. Fieller and Turner (1982) suggested this modification (2) if no pair matches could be identified. There are multiple other variants to this method, however, those just mentioned can be easily and quickly calculated, and confidence intervals can be estimated.

Recently, this method has been adapted slightly to improve accuracy and better compensate for sampling bias, labeled as the Minimum Number of Likely Individuals (MNLI) (3), which is also heavily reliant on accurate pair matching. LI and MNLI are argued to create more accurate reconstructions of population statistics in comparison to MNI, however accuracy is contingent on an experienced osteologist making correct pair matches (Adams and Konigsberg, 2004). Therefore, researchers often used a combination of these methods to estimate the number of individuals present.

Osteometric Sorting

Based off of traditional sorting methods developed by C. Snow in 1947, the method of osteometric pair matching depends on the underlying principle that two of the same skeletal elements of different proportional sizes than seen in most human populations are most likely commingled and from different individuals (Byrd, 2008; Byrd and Adams, 2003). Statistical analyses of proportionality are based on general patterns that exist in reference populations (Byrd, 2008). These parameters are then used to formulate a null hypothesis of a typical size relationship. A rejection of the null hypothesis estimates the probability that two elements may have come from the same individual.

Methods are constructed from the reference data available, using measurements that are present in both the reference sample and the commingled sample in question, and kept as simple as possible (Byrd, 2008). By using simple measurements and equations, issues such as over fitting are avoided, and it can be used by analysts in any field or lab setting using a standard osteometric board (Byrd and Adams, 2003; Byrd, 2008).

Byrd (2004, 2008) proposes three methods of osteometric sorting: (1) pair matching based on the relationship between shape and size, (2) articulating bone portions where methods are calculated by estimating the difference in sizes of adjoining portions, and (3) by grouping other bone portions based on a regression formula (Table 3). This research employed the first pair match method of osteometric sorting.

Table 3 Equations for osteometric sorting (Byrd, 2008).

Methods	Equation
1. Pair Match	$D = \sum (a_i - b_i)$,
2. Articulating bone portions	$D = c_i - d_j$,
3. Grouping bone proportions	$t = \|y\hat{} - y_i\| / [(S.E.) \times \sqrt{[1 + (1/N) + (x_i - x)^2/(N \times S_x^2)]}]$.

Models based on left and right-paired elements were developed with an emphasis on size and shape, using metric data and estimate regressions from the archaeological sites of *Kuelap* as a local reference population. Measurements from both the length and girth of long bones were used for this method to pair match elements. Measurements of the Anterior-Posterior (AP) and Medial-Lateral (ML) diameters of the bone taken at midshaft defined approximate girth in this research (Buikstra and Ubelaker, 1994). According to Byrd (2008) a pair match model will be based on an estimated maximum difference in size between left and right elements of the same individual. Within the equation (See Table 3), *a* represents the right side bone measurement *i*, and *b* represents the left side bone measurement *i*. The null hypothesis is tested by replacing *D* with "0", and by using the standard deviation of *D*. The deviation from "0" divided by the reference data standard deviation is compared against the t-distribution to obtain a p-value (Byrd, 2008). It is recommended that a 0.10 significance level is used for most applications of this method; however, this may be adapted based on specific parameters of the research in question.

Compared with other methods for pair matching, osteometric pair matching is advantageous when working with a large amount of data, as it is suitable for computer automation. In cases where time constraints restrict the amount of access anthropologists have to the skeletal material such as in the research project at La Petaca, osteometric pair matching is a useful method for estimating MNI and MLNI, a second method of analyzing the number of individuals represented in a deposit.

Age and Sex Estimation

The next step of this analysis is estimating the demographic categories present in the sample. After elements are identified to a specific bone type, the element may be classified as either an adult or juvenile based on morphological characteristics of size, epiphyseal fusion, or patterns of age-related changes. The accuracy of age estimation is increased when multiple methods are employed using as many skeletal elements as are present in the individual (Lovejoy et al., 1985). The commingled remains at La Petaca, however, prevented the multivariable, multi-element approach advocated by Lovejoy et al. (1985). In most cases, only one indicator was present to estimate age. Because it was not possible to assign more than one element to a single individual in most cases, a traditional demographic profile would be misleading for this assemblage other than general differentiation between mature and immature skeletal remains.

Broad age categories were used for this context (Table 4). The first step was based on indicators of skeletal maturity. Age categories of juveniles were adapted from Scheuer and Black (2000). Juvenile elements were estimated based on standard methods for measurement of long bones and dental eruption patterns, as well as approximated timing of epiphyseal fusion (Buikstra and Ubelaker, 1994). Postcranial measurements were recorded for complete elements according to methods developed by Fazekas and Kosa (1978), Hoffman (1979), and recommended by Standards (Buikstra and Ubelaker, 1994). Age methods based on dental eruption patterns are based on charts developed by Ubelaker (1978) and Moorrees et al. (1963).

Table 4 Definitions of Age Categories.

Category	Age Range
Infant (INF)	Birth-1 yr
Early Child (EC)	2-4 yrs
Late Child (LC)	5-10 yrs
Adolescent (ADO)	10-19 yrs
Young Adult (YA)	20-35 yrs
Middle Adult (MA)	36-50 yrs
Older Adult (OA)	50+ yrs

The primary methods of adult age estimation were cranial suture closure, and pubic symphysis and auricular surfaces of the os coxa. The cranial suture composite technique was based on methods developed by Meindl and Lovejoy (1985) for both vault and lateral-anterior sutures. The auricular surfaces and symphyseal face of the pubic symphysis was also used to estimate age (Todd, 1920; Lovejoy et al., 1985; Brooks and Suchey, 1990). In some cases, osteoarthritic changes of the joint articulations or advanced dental attrition and tooth loss were used to suggest an older aged individual.

Estimations of sex were only attempted for the adult skeletal elements of the cranium and os coxa, as there is not yet a reliable method of sex determination for juvenile bones. Methods were based off of Standards (Buikstra and Ubelaker, 1994) including the following cranial features: size and shape of the mastoid process, brow ridge prominence, supraorbital margins, and mental eminence, as well as pelvic features including: shape of pubic bone, subpubic concavity, ventral arc, subpubic angle, and sciatic notch. This research employed a multivariate approach, incorporating many of the aforementioned features to estimate the sex of the skeletal remains. It was clear that sexual dimorphism is consistent with other estimates from other Chachapoya sites (Toyne, personal communication), but size differences alone cannot be used to estimate sex of isolated elements due to overlap in variation.

Spatial Analysis of Commingled Context

The analysis of spatial relationships between artifacts, features, and sites has been an integral part of archaeological investigation since its inception (Wheatley and Gillings, 2003). Traditionally, collective burials are stratigraphically recorded through precise documentation and mapping of the context where each exposed horizontal strata (layer) would be recorded through detailed photography and paper mapping techniques (Adams and Byrd, 2008). Recently, archaeology has turned to a geographical information system (GIS) to capture, analyze and display complex archaeological data and deposits since archaeology often involves a spatial analysis of human behavior over time (Aldenderfer and Maschner, 1996).

GIS largely emerged in the field of archaeology in 1990 with the publication of a collection of papers entitled *Interpreting Space* (Gillings and Mattingly, 1999). When GIS was first introduced and incorporated into archaeology, a focus on large-scale regional based analysis seen in other disciplines and public sectors was mirrored in early archaeological analysis. Soon, it was realized, however, that a GIS was not restricted to large regional based studies, and could be could be useful in intrasite analysis as well. Theoretical approaches have changed considerably, and Llobera (1996) was responsible for shifting the focus to a structuralist approach, arguing that GIS could be used to study social space and meaning from practice based approaches of smaller spatial distributions. Now accepted as a science and not merely a tool, GIS can be applied to a multitude of anthropological questions, and used as an interpretive environment (Gillings and Mattingly, 1999).

A GIS Based Approach

GIS can provide a medium for the documentation of commingled remains by creating a customizable environment for an element specific spatial analysis of recovered elements (Herrmann and Devlin, 2008). The method employed in this current investigation was influenced by Herrmann's (2002) analysis of commingled remains in Honduran caves. Herrmann (2002) focused on the applications of a GIS to facilitate an estimation of MNI; however, this thesis will incorporate the method employed to compare attribute data and measure the distance between related skeletal elements. Once attribute data is imported into a GIS geodatabase for La Petaca, descriptors can be easily searchable through a query and comparable spatially. Although attribute data within a GIS can be unlimited, this study included skeletal element, completeness, side, pair matches, pathological data, age, sex, and condition both as a spreadsheet, and more importantly, as searchable field within each digitized shape element. This will allow for an analysis of the distribution of elements, providing a way to quantify the measure of distance between related elements.

Analysis began with recording 3D GPS points of elements and the cave feature, for which a total station was employed. A total station is an electronic instrument that is a transit integrated with an electronic distance meter, which reads slope distances from the instrument to a particular point by maintaining a direct line of sight. Able to be used in either prism or non-prism mode, this project utilized the laser feature of the instrument to measure distance points (x,y,z coordinates) on skeletal features of the bones from the fixed datum at WGS84 UTM 18S 189683 9244170 3330. The total station was positioned at the opening of the cave at the beginning of each work day, placement contingent on the location of the elements that will be mapped, and the angled needed by the total station to accurately measure these points with a direct line of sight. Once manually adjusted to an acceptable height and precisely leveled, crew members recorded a calibration point of a pre-specified marking, which was consistently used throughout the investigation. Each point was both saved and numbered in the total station, as well as in handwritten notes and documented in a plan view map of the unit. This method maintained provenience, and affixed qualitative descriptors to each point. Preference was given to large complete bones, as fragments would have been difficult to identify and there was limited field time for this project. Each total station point was referenced in a site map drawn at a scale of 1:10 centimeters, which allowed for a visual representation of each bone and recorded into an Excel spreadsheet. Inventory data was then transferred from an Excel spreadsheet into Arcmap®, a computer program used for analysis of coordinate and variable data.

ArcView® extension Edit Tools were employed to digitize the plan field drawings into spatially referenced polylines, which were later converted into polygons. Total station points were imported from Microsoft Excel® using the imported x, y, z coordinates and fixed to the digitized field map. Then, the Project tool located within Data Management tools > Projections and Transformation > Feature toolset was used to transform the total station points to WGS84 UTM 18S. Next, each bone polygon was assigned a specific specimen number, which paralleled the general inventory number sequence and the polygon theme was linked to the La Petaca Specimen Inventory database and the location of elements were adjusted with the recorded total station location. Once the tables were joined, the context could be queried to examine specific elemental, taphonomic or demographic patterns in the commingled context. Each quadrant was then randomly populated with the remaining elements retrieved from each square, in order to expand the interpretive environment to all elements collected during excavation. This means that the analyses conducted on the deposit were approximate, and that the position of each element within the quadrant is random and not the original position or orientation.

Next, pair matched elements estimated by osteometric sorting were queried using the Select by Attribute tool located within the Table Options, and exported and merged into bone category shapefiles. The symbology tab was used to designate unique symbols for each pair of elements in order to easily and visually differentiate related elements within the context. All elements from the superficial layer were bordered in black, and those collected from level one were outlined in light grey (Grey 40%). These data will be presented in a series of map illustrations, visually displaying the distance and dispersal of related elements within SUP CF-01 (Appendix).

Spatial Analysis and Distance of Dispersal

Following the paleodemographic analysis of excavated material from SUP CF-01 and SUR CF-01, this thesis explored the spatial relationship between bone categories and related elements in SUP CF-01. It was the purpose of this analysis to evaluate the disturbance of this deposit by measuring the distance and noting depth differences between paired elements, following the example set forth by Marean and Bertino (1994) that explored the effect of carnivore consumers on the spatial distribution of bone elements. While the study by Marean and

Bertino (1994) did not specifically explore the spatial distribution of paired elements, the methods used for statistical analysis of disturbance and distance traveled were applicable to this study. First, bone categories were highlighted within the database in order to elucidate if there was a pattern in the ways that bone categories or certain aged individuals were deposited.

Data gathered using tools in Arcmap® were then used to explore the spatial distribution of related elements, assuming that a normal dispersal from natural decomposition processes of a fleshed individual would restrict related elements within a one meter area if the body and limbs had originally been placed in a tightly flexed body position and the body placed in a seated, upright position. Paired adult bone elements were separated by bone category, and the measurement of distance traveled characterized the dispersion of related elements. The measure tool was used in Arcmap® to estimate the distance between each related pair of elements. However, because the majority of elements were spatially located according to quadrant, these measurements were approximate, and were rounded to categories of 25 cm (Category 1: 0-25 cm; Category 2: 26-50 cm). These data were then entered into SPSS, where descriptive statistics associated with the distance of dispersal measured in Arcmap® were used to explore these relationships between bone categories, and calculate the significance of the differences between element categories through an ANOVA test, following Marean and Bertino (1994). Next, the percentages of bone pairs located within and outside the expected one meter area were calculated, and a Chi-square analysis was employed to determine the significance of these results.

If the remains were fleshed when deposited in this location, and not disturbed by external agents, processes of decomposition and disarticulation result in a slumping of various elements

(Roksandic, 2002). These dislocations would include the collapse of the thoracic cage, rotation of vertebral elements, and/or disjunction of the coxo-sacral articulation. However, they would not cause large elements to travel large distances, nor become jumbled within the deposit (Roksandic, 2002). Therefore, in addition to analyzing the spatial differences between pair matched elements, it is also relevant to highlight variations in depth between paired elements as further indication of disturbance.

This section ends with an exploration of the space needed to house the estimated MNI, by gauging the space available in the natural cave context as well as approximating the space an average complete adult and juvenile individual would take up seated in an upright seated flexed position. The area of an average adult was calculated by measuring an averaged size living human, seated in the flexed position, and recording the sitting height, maximum width of the horizontal plane and maximum length of the transverse plane with a hard meter stick, all measurements recorded in cm. These three dimensions were then multiplied, which provided an estimation of the average area of an adult individual, which was then halved to represent a juvenile individual. In order to measure the area of the cave itself, total station points and hand measurements were imported into the 3D GIS software Arcscene. The tool 3D editor was activated to connect each point in order to form an approximate 3D polygon of the cave. The cave dimensions were calculated by using the measure tool in Arcscene to measure the area of the 3D polygon.

Summary

This chapter discussed the demographic and spatial methods used in the analysis of mortuary practices at SUP CF-01. The methods employed in the excavation, documentation and recovery of skeletal elements were described, including the methods of inventory. This chapter then presented the methods utilized in the osteological analysis of the sample, which served as the framework for an analysis of the demography present. Then, the methods utilized in the spatial analysis of this context were described, including an assessment of the degree of distance traveled for related elements and comparison of the estimated MNI and space available. Next, Chapter Four will present the results of this investigation, following the sequence of methods outlined here.

CHAPTER FOUR: THE RESULTS

This chapter follows the Methods Chapter and is divided into three sections. The first presents the results of the excavation, detailing the material collected from the excavation unit SUP CF-01. It begins with a description of the unit excavated, as well as a taphonomic evaluation of the material, evaluating both cultural and natural processes modifying the bone. Lastly, this section presents other cultural material excavated, including ceramic, lithic and faunal remains. The second section presents a demographic analysis of SUP CF-01 as well as SUR CF-01 as comparative material, presenting the results of MNI, BRI, MNLI and LI, osteometric pair match sorting, and age and sex analyses. The third section presents the spatial analysis of the unit within the context of the archaeological complex and the cultural material excavated. It will first discuss the overall interpretations of the linear and depth distribution of element categories. Next, this section will present the spatial distribution of bones by bone element and age category, and then display distance measurements between paired elements within SUP CF-01 by bone category, and the result of an ANOVA statistical test that measured the significance of these results. Then this section will explore the general patterns of distance between related categories devoid of categorical separation, and present Chi-square results indicating the significance of these data. Finally, this chapter will explore the number of individuals that could have been deposited in the cave space with the cave dimensions available.

Excavation Summary

This section presents data from the excavation of SUP CF-01. It begins with a description of the mortuary context, highlighting the size and shape of the cave as well as the environment and taphonomic factors identified. The following unit summaries break down the excavation by unit, and include data from field notes of the La Petaca site excavations of SUP CF-01 (See Chapter 4, Figure 8 for illustration of the unit locations). Because there were no natural or cultural stratigraphic layers identified, the summaries do not differentiate between levels, nor between surface collection, excavation or trench excavation. The following summaries are defined by the excavation units and quadrants excavated, and therefore are only a sample (approximately 90%) of the entire unit. Only two small areas were left completely unexcavated. Included within the summary of each unit are descriptions of bone frequency, condition and morphological characteristics. All skeletal remains are human unless otherwise noted.

Context, Environment, and Taphonomy

SUP CF-01 is a natural limestone rock overhang of irregular triangular shape, with floor dimensions approximately 3 meters at its widest, across the entrance of the cave, and 3 meters at its longest, from the entrance to the back chamber of the cave (Figure 10). The height of SUP CF-01 averaged around 1 meter at its entrance under a horizontal shelf, and opened up to 2 meters in height at the back portion enclosed within an ovular chamber and convex roof. A small crevice located in the roof of the back oval chamber ran what appears to be an additional meter upwards into the bedrock, and there was a thick bluish green botanical growth on the back cave walls. Excavations revealed no evidence of stone construction.

Figure 12 Photo of the superficial layer of SUP CF-01, prior to excavation.

The environment within the overhang maintained a constant ambient temperature of 50-60°F, however was noticeably humid. The location of this context within the monteo-tropical zone influences this humidity, as rainfall is abundant. Mosquitoes were abundant, and there were several species of arachnids present. A loose soil matrix covered some of the remains, most likely a natural byproduct of geological and taphonomic factors, which facilitated extensive root growth. In the front and central portion of the context, excavation exposed a loosely compacted, medium-brown, silty-clay soil. The thick deposit of bone did not reveal any animal created features within the soil such as burrows or tunnels. A damp, deep reddish-brown, damp, clayey-silt soil matrix was identified in the back chamber. This damp soil matrix impacted the associated skeletal remains. Many were wet and fragile, which contributed to significant warping, water damage and mold spores staining the outer cortex of the bones. Material recovered from this context was primarily human bone, with only a small amount of animal bone, mate and ceramics also collected.

The irregular shape and depth of the cave contained the large deposit under the overhang; however, it is possible that some elements have been lost by animal-related processes including trampling, chewing and digestion, and by other physical factors including diagenic movement, and gravity or fluvial processes that may have moved skeletal elements outside of the overhang on to the exposed horizontal ledge. The ledge outside of the cave is only approximately one meter at its widest, therefore it is possible that through the aforementioned post-depositional processes, elements could have been moved to the adjacent ledge and eventually lost by falling off of the cliff. Both animal gnawing and chewing were observed on many elements, indicating that there was animal disturbance of this deposit. Moreover, a similar pattern of dispersal and data loss was observed at SUP CF-02 located 2 meters south of SUP CF-01 on the upper ledge. SUP CF-02 was a much smaller natural crevice that was once enclosed with a rectangular stone block structure. However, the structure was destroyed and the human skeletal remains once deposited within were scattered irregularly across the ledge. Some elements were observed caught in the vegetation growing off the side of the ledge, and therefore it can be assumed that over time, many skeletal elements from this context and likely SUP CF-01 were lost over the ledge.

There was observable bone breakage noted on many elements recovered from SUP CF-01 context, which may have resulted from several post-depositional processes and environmental conditions. Rocks were excavated throughout SUP CF-01, often located directly on top of skeletal elements. Varied in size, the dislocation of pieces of the rock chamber overhead could have crushed the materials beneath, accounting for some of the damage and postmortem fracture patterns observed on several elements. Additionally, animal chewing often produces fracture patterns, which may have contributed to the damage of skeletal remains. The damp humid environment softened the bone cortex, which would have contributed to the extent of damage to several elements.

Soil staining of elements and extensive intact root growth indicates that these remains have not been disturbed recently. In some cases, root activity grew completely through elements, cutting through the cortical and trabecular bone, damaging the remains in the process. Uniform soil stating of elements in the back chamber of the cave indicate that the remains were not extensively disturbed in modernity. Radiocarbon ($^{13}C/^{12}C$) dating of bone recovered from Layer 1 in Unit 6 produced a radiometric date of Cal AD 1190 to 1200 (Cal BP 760 to 750)/Cal AD 1210 to 1270 (Cal BP 740 to 680) with a conventional age of 800 +/- 30 years BP (Beta-369478), indicating this context was used at some point during the Late Intermediate Period.

Unit 1

Unit 1 is located at the southeastern-most portion of the cave entrance. There are several large rocks in this location and a low density of skeletal elements. A total of 37 skeletal elements were collected from Level 1 of this quadrant including complete and fragmented remains (See Table 5). Most elements exhibited soil staining and root activity on the cortical surfaces (Figure 13). Water damage caused cortical flaking and warped several elements including the femur and cranial elements. No non-human modification such as gnawing or scavenging was present.

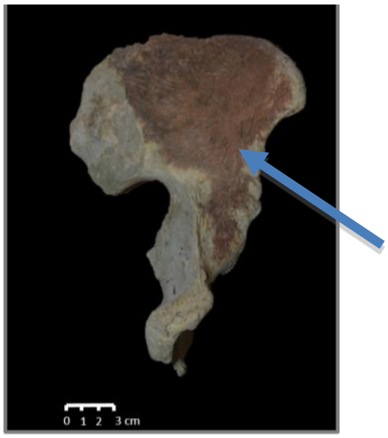


Figure 13 Example of taphonomy present in Unit 1 of excavation, note the dark staining due to soil staining on the medial aspect of the left ilium.

Table 5 Summary of skeletal elements recovered from excavation Unit 1.

Element	Complete	Fragmentary	Subadult	Total
Cranium	1	4	1	**6**
Femur	1	3	0	**4**
Humerus	1	0	0	**1**
Metacarpal	1	0	0	**1**
Os Coxa	1	5	0	**6**
Phalanx	1	0	0	**1**
Rib	1	1	0	**2**
Tibia	0	1	0	**1**
Teeth	1	0	0	**1**
Ulna	0	0	1	**1**
Vertebra	1	0	0	**1**
Bone Fragments	0	13	0	**13**
Total	**9**	**27**	**2**	**38**

Unit 2

Unit 2 is located at the most southern central portion of the mouth of the cave, underneath the overhang. A total of 566 elements were recovered including: 13 elements from adult crania, 379 from adult postcranial skeletons, 145 from unidentified fragments, and 28 from subadult remains (Table 6). Several elements showed signs of animal scavenging (restricted primarily to long bones), as well as cortical erosion and flaking. Soil staining varied from a light to dark brown. Many elements were fragmented postmortem. Subadult elements ranged in age from infant to older juvenile, and most exhibited evidence of animal scavenging.

Two complete crania were collected. Both were from young adult female skeletons and showed minimal signs of animal scavenging. Weathering and cortical erosion was present on the surface of both elements; however, only one cranium exhibited associated warping.

Table 6 Summary of skeletal elements recovered from excavation Unit 2.

Element	Complete	Fragmentary	Juvenile	Total
Cranium	2	5	1	**8**
Clavicle	1	2	0	**3**
Carpal	12	0	0	**12**
Femur	2	5	1	**8**
Fibula	3	1	1	**5**
Humerus	5	4	4	**13**
Hyoid Body	2	0	0	**2**
Mandible	2	0	0	**2**
Manubrium	3	0	0	**3**
Metacarpal	14	0	0	**14**
Metatarsal	32	0	0	**32**
Os Coxa	2	3	2	**7**
Patella	4	0	0	**4**
Hand Phalanx	21	0	0	**21**
Foot Phalanx	30	0	0	**30**
Radius	2	7	0	**9**
Rib	-	75	4	**79**
Sacrum	2	3	0	**5**
Scapula	1	5	0	**6**
Sternum	2	0	0	**2**
Tarsal	36	0	2	**38**
Tibia	5	4	3	**12**
Teeth	30	0	3	**33**
Ulna	4	4	1	**9**
Vertebra	57	0	7	**64**
Fragments	0	145	0	**145**
Total	**137**	**263**	**29**	**566**

As Table 7 shows there were a large number of smaller skeletal elements collected from this Unit, including carpals, tarsals, metatarsals, ribs and phalanx. One incomplete ulna and four incomplete juvenile humeri were also collected from this quadrant.

Unit 3

Unit 3 is located at the north westernmost portion of the cave (Chapter 3; Figure 8). There were several large rocks in this area and a low density of skeletal elements. Some skeletal elements were located beneath the rocks (10 cm). A total of 162 elements were collected from this quadrant, including 4 cranial, 134 post-cranial, 9 juvenile elements, and 15 unidentifiable fragments. Non-human modification such as animal chewing and gnawing was present on many elements in this quadrant, primarily restricted to long bones and vertebral elements. Medium to dark brown soil staining was also commonly identified on many skeletal elements as well as localized green algae staining. Many juvenile bones were damaged postmortem, and impacted by cortical erosion and flaking. Animal chewing was also identified on several juvenile skeletal elements.

Table 7 Summary of skeletal elements recovered from excavation Unit 3

Element	Adult: Complete	Adult: Fragmentary	Juvenile	Total
Cranium	1	3	0	**4**
Clavicle	1	2	1	**4**
Carpal	6	0	0	**6**
Femur	1	6	1	**8**
Fibula	2	0	0	**2**
Humerus	2	0	0	**2**
Hyoid Body	0	0	0	**0**
Mandible	1	1	0	**2**
Manubrium	1	0	0	**1**
Metacarpal	2	0	0	**2**
Metatarsal	11	0	1	**12**
Os Coxa	1	3	0	**4**
Patella	0	0	0	**0**
Phalanx	13	0	0	**13**
Radius	1	1	1	**3**
Rib	0	34	1	**35**
Sacrum	3	1	0	**4**
Scapula	0	2	0	**2**
Sternum	0	1	0	**1**
Tarsal	13	0	0	**13**
Tibia	3	1	2	**6**
Teeth	0	0	0	**0**
Ulna	0	1	0	**1**
Vertebra	20	0	2	**22**
Fragments	0	15	0	**15**
Total	**82**	**71**	**9**	**162**

As Table 7 shows, there was a relatively even distribution of skeletal elements, with higher frequencies of ribs, vertebrae, metatarsals, phalanx and tarsals. One complete middle-aged adult cranium was collected from this quadrant. The other three cranial elements were small fragments in poor condition. Very few juvenile elements were recovered from the Unit, and many were fragmentary.

Unit 4

A total of 1728 skeletal elements was collected from the centrally located unit 4, including 63 cranial elements, 1479 postcranial skeletal elements, 186 subadult remains, and 287 unidentifiable fragments. A 60 cm wide portion of this unit was excavated as part of an exploratory trench, and elements were collected 50 cm in depth until the natural cave floor was revealed. There were several large fallen rocks naturally distributed within this quadrant, and a very dense distribution of skeletal remains. Many elements exhibited characteristics of post-mortem modification in the forms of animal chewing and postmortem fragmentation. Soil staining ranged from a light to dark brown, with some elements stained a reddish brown color (Figure 14a). Water damage was also present, contributing to cortical flaking and erosion of many elements, in addition to warping of many long bones (Figure 14b). Many juvenile elements showed signs of animal scavenging and light brown staining.

Figure 14 Range of taphonomic staining observed on os coxa elements collected from unit 4 (a) and fibula that exhibits severe warping of shaft (b).

Table 8 Summary of skeletal elements recovered from excavation Unit 4

Element	Adult: Complete	Adult: Fragmentary	Juvenile	Total
Cranium	3	60	8	**71**
Clavicle	17	5	2	**24**
Carpal	46	0	0	**46**
Femur	15	29	7	**51**
Fibula	11	24	3	**38**
Humerus	12	23	0	**35**
Hyoid Body	3	0	1	**4**
Mandible	4	17	1	**22**
Manubrium	11	1	1	**13**
Metacarpal	75	0	4	**79**
Metatarsal	87	0	6	**93**
Os Coxa	12	15	8	**35**
Patella	16	1	2	**19**
Phalanx	55	0	1	**56**
Radius	8	13	0	**21**
Rib	81	237	10	**328**
Sacrum	4	4	5	**13**
Scapula	7	15	2	**24**
Sternum	5	6	2	**13**
Tarsal	156	0	10	**166**
Tibia	20	21	2	**43**
Teeth	90	0	24	**114**
Ulna	12	16	0	**28**
Vertebra	136	90	34	**260**
Fragments	0	287	0	**287**
Total	**886**	**864**	**133**	**1728**

As Table 8 shows, there was a large deposit of skeletal elements recovered from this Unit, with a large frequency of vertebra, tarsals, ribs, metatarsals, metacarpals, crania elements, and long bones such as tibia and femora. Three complete crania were collected from this unit, each cranium from a middle-aged individual; two were consistent with an adult female skeleton and one with an adult male.

All three crania were in fairly good condition, with only minimal postmortem damage to the inferior portions and minimal water damage to the cortical surfaces. Eight juvenile cranial fragments were recovered, four from an infant skeleton. Of the 21 collected mandibular elements, three originated from middle-aged skeletons, three from older-aged adult skeletons, and at least one from a young adult. One complete juvenile mandible was recovered, which came from a child approximately seven years of age (Moorrees et al., 1963; Ubelaker, 1978).

Unit 5

Unit 5 is located in the eastern central portion of the cave, a triangular niche which projects into a thin crevice deep into the cliff structure. This section did not have a high density of skeletal remains, except for the area that was adjacent to Unit 4 (30 cm). A total of 117 elements were collected from this quadrant, consisting of 24 unidentified fragments, 3 cranial, 82 postcranial remains, and 10 subadult elements. Many adult elements were in fair or good condition, soil stained medium to dark brown, with some root activity, cortical erosion and algae staining (Figure 15). Juvenile elements were in good condition, with some animal activity and cortical surface erosion.

Figure 15 Example of algae staining (bright green coloration) on the medial aspect of the ilium and pubis of this right os coxa.

Table 9 Summary of skeletal elements recovered from excavation Unit 5.

Element	Complete	Fragmentary	Juvenile	Total
Cranium	0	3	0	**3**
Clavicle	0	1	0	**1**
Carpal	1	0	0	**1**
Femur	7	2	0	**9**
Fibula	5	2	0	**7**
Humerus	3	3	1	**7**
Hyoid Body	0	0	0	**0**
Mandible	0	0	0	**0**
Manubrium	0	0	0	**0**
Metacarpal	1	0	0	**1**
Metatarsal	2	0	0	**2**
Os Coxa	2	3	0	**5**
Patella	0	0	0	**0**
Phalanx	0	0	0	**0**
Radius	1	1	0	**2**
Rib	17	0	2	**19**
Sacrum	2	2	0	**4**
Scapula	1	0	0	**1**
Sternum	1	0	0	**1**
Tarsal	1	0	0	**1**
Tibia	1	3	1	**5**
Teeth	1	0	0	**1**
Ulna	1	1	0	**2**
Vertebra	12	0	2	**14**
Fragments	0	24	0	**24**
Total	**59**	**45**	**6**	**117**

As Table 9 shows, the majority of bones collected from this unit included large long bones, ribs, and vertebra, with few associated small hand or foot bones, and few subadult elements.

Unit 6

This Unit was located in the deepest portion of the cave, with elements commingled to a depth of approximately 80 cm. The exploratory trench ran the length and a majority of the width of this unit, and ended when the natural cave floor was exposed. A total of 4,986 skeletal elements were collected from this quadrant, including 982 unidentifiable fragments, 225 cranial elements, 232 juvenile elements, and 3547 postcranial elements (Table 10). The majority of elements exhibited dark reddish brown soil staining, and postmortem modifications including some animal scavenging and postmortem fracturing. Root activity was less frequently observed on elements from this quadrant.

Table 10 Summary of skeletal elements recovered from excavation Unit 6.

Element	Complete	Fragmentary	Juvenile	Total
Cranium	6	219	8	**233**
Clavicle	21	39	6	**66**
Carpal	221	0	2	**223**
Femur	15	45	8	**68**
Fibula	8	60	3	**71**
Humerus	22	40	13	**75**
Hyoid Body	4	0	0	**4**
Mandible	10	34	3	**47**
Manubrium	5	8	1	**14**
Metacarpal	216	0	17	**233**
Metatarsal	156	0	12	**168**
Os Coxa	9	44	15	**68**
Patella	52	3	0	**55**
Phalanx	612	0	10	**622**
Radius	20	45	10	**75**
Rib	616	0	17	**633**
Sacrum	10	17	4	**31**
Scapula	5	59	12	**76**
Sternum	8	12	5	**25**
Tarsal	259	0	12	**271**
Tibia	19	47	9	**75**
Teeth	254	0	5	**259**
Ulna	24	44	6	**74**
Vertebra	485	0	53	**538**
Fragments	0	982	0	**982**
Total	**3057**	**1698**	**231**	**4986**

Six complete crania were recovered from this quadrant: two exhibiting morphological characteristics consistent with a middle-aged adult female skeleton, and two with morphological characteristics consistent with a middle-aged adult male skeleton. Of the 44 mandibular elements recovered from this unit, elements exhibited morphological characteristics consistent with a variety of demographic categories including older adult males, middleaged adult males and females, and young adult males and females.

Unit Entrance

This area extended 50 cm longitudinally out of the mouth of the cave and 60 cm wide, bisecting the large mound that bordered the cave entrance, and was excavated as part of a trenching exploratory excavation. Excavation of this unit exposed a portion of the natural cave floor devoid of cultural material. A thick root matrix transected a great deal of the soil excavated, and the soil composition itself was primarily a silty-loam that graded into dense yellow clay approximately 20 cm below the surface. The elements recovered from this unit were scattered. A total of 250 skeletal elements were recovered, divided into 67 unidentified fragments, 23 juvenile, and 160 postcranial skeletal elements. Elements in this quadrant were primarily soil stained a dark brown, and the majority exhibited animal scavenging and postmortem damage.

Table 11 Summary of skeletal elements recovered from excavation Unit Entrance.

Element	Complete	Fragmentary	Juvenile	Total
Cranium	0	0	0	**0**
Clavicle	1	0	3	**4**
Carpal	11	0	0	**11**
Femur	1	1	2	**4**
Fibula	0	3	0	**3**
Humerus	0	1	2	**3**
Hyoid Body	1	0	2	**3**
Mandible	0	1	0	**1**
Manubrium	0	0	1	**1**
Metacarpal	14	0	1	**15**
Metatarsal	11	0	0	**11**
Os Coxa	0	0	2	**2**
Patella	0	2	0	**2**
Phalanx	47	0	6	**53**
Radius	0	0	0	**0**
Rib	16	0	0	**16**
Sacrum	0	0	0	**0**
Scapula	0	1	0	**1**
Sternum	1	0	0	**1**
Tarsal	4	2	0	**6**
Tibia	1	1	2	**4**
Teeth	25	0	0	**25**
Ulna	0	0	0	**0**
Vertebra	15	0	2	**17**
Fragments	0	67	0	**67**
Total	**148**	**79**	**23**	**250**

As Table 11 shows, the majority of elements recovered from this Unit were small bones, including phalanx, teeth, vertebrae, metacarpals and metatarsals.

Additional Cultural Material Recovered

In addition to human bone, other cultural material such as animal bone, ceramic sherds, lithic fragments and personal adornments were collected from SUP- CF 01. A total of 229 grams of fragmented and complete animal bones were collected from SUP CF-01, which consisted of primarily small rodent bones. A small (2 grams) fragment of textile was recovered, decorated in blue and red stripes, as well as 115 grams of fragmented lithic material and 1 diagnostic lithic flake that appeared to be a scraper. A total of 35 ceramic sherds were recovered from SUP CF-01; however, only one was diagnostic, a rim sherd from a small, red, polished pot (*olla*). Ceramic material was primarily recovered from the entrance of the cave, in Units 1, 2 and 3. One bone needle, possibly a grave good, was recovered from the back chamber of the cave, in Unit 6.

Paleodemography of SUP CF-01

Paleodemographic reconstruction of the cave sample population was based on an analysis of the elements collected within each Unit. The first step was to count, side and differentiate between adult and subadult for each element. From these data, this study estimated the MNI. In order to better assess the number of individuals present in this sample, this study then employed osteometric sorting to pair match elements based on size and shape. After pair matches were estimated, this thesis then assessed LI and MLNI, thought to be a more representative estimate than MNI in archaeological contexts. Lastly, age and sex categories were estimated from the elements collected. Paleodemographic analyses were performed on SUP CF-01 as well as another natural cave in the La Petaca mortuary complex, SUR CF-01, based on the skeletal inventory collected from remains recovered.

Initial Element Count

Prior to demographic analyses, the elements were counted and sorted according to bone, completeness, side, age and sex This method of inventory facilitated later estimations of the number of individuals present. Table 12 presents the counts of each identifiable element collected, separated between adult and subadult remains.

Table 12 Inventory of identifiable elements collected from SUP CF-01.

ELEMENT	SUBADULT			ADULT		
	Left	Right	UNK	Left	Right	UNK
Capitate	0	0	1	15	24	0
Carpals	0	0	0	0	0	26
Cranium	32		-	303		-
Clavicle	10	8	0	38	51	0
Calcaneus	2	5	0	37	45	0
Cuboid	1	0	0	38	32	0
Cuneiform #1	1	1	0	28	26	11
Cuneiform #2	0	1	0	14	14	0
Cuneiform #3	0	1	0	17	21	4
Femur	11	11	8	57	59	4
Fibula	3	3	5	53	54	11
Hamate	0	0	0	26	20	0
Humerus	9	12	8	45	64	7
Lunate	1	0	0	26	28	0
Mandible	5		-	78		-
Manubrium	3		-	29		-
Metacarpal #1	0	0	1	31	33	5
Metacarpal #2	1	2	0	32	38	0
Metacarpal #3	3	1	0	33	25	0
Metacarpal #4	2	1	0	34	25	8
Metacarpal #5	1	2	1	18	37	3
Metacarpal UNK	0	0	4	0	0	0
Metatarsal #1	2	2	0	27	32	0
Metatarsal #2	0	0	0	29	29	0
Metatarsal #3	3	2	0	24	29	0
Metatarsal #4	0	2	0	28	27	0
Metatarsal #5	0	1	0	28	34	0
Metatarsal UNK	0	0	6	0	0	8
Navicular	0	0	0	41	42	0
Os Coxa	19	8	3	47	49	3
Patella	2	0	0	34	42	3
Pisiform	0	0	1	5	3	0
Phalanx	0	0	38	0	0	860
Radius	8	8	3	48	46	1
Rib	15	19	0	497	473	74
Sacrum	13		-	49		-
Scaphoid	1	0	0	23	24	0
Scapula	8	4	0	44	52	1
Sternum	8		-	37		-
Trapezium	0	0	0	14	22	0
Trapezoid	0	0	0	7	4	0
Triquetral	0	0	0	8	14	0
Tarsal-UNK	0	0	6	7	12	0
Talus	2	5	0	42	43	0

ELEMENT	SUBADULT			ADULT		
	Left	Right	UNK	Left	Right	UNK
Tibia	9	5	5	60	59	6
Tooth			35			396
Ulna	4	9	2	48	56	6
Vertebra-Atlas	0		-	19		-
Vertebra-Axis	2		-	23		-
Vertebra-Cervical	13		-	216		-
Vertebra-Thoracic	47		-	347		-
Vertebra-Lumbar	24		-	169		-
Vertebra UNK	8		-	65		-

MNI Estimation

Estimates of MNI included both complete and fragmented elements. Fragments of 50% completeness and larger with identifiable skeletal landmarks were incorporated into this analysis, and overlapping portions of bone were considered to be from separate individuals.

MNI estimated that there were a minimum of 43 adults (78% of sample) in this skeletal deposit and 12 juveniles (22% of sample) with a total estimation of 55 individuals present in this sample (See Table 13). MNI of adults were based on the distal portion of the left tibia, right humeral shaft and right femur. While long bones provided the largest MNI estimation, several smaller elements estimated a similar MNI, as exampled by the right patella, right talus, right calcaneus and right clavicle. In addition, small tarsals also provided similar MNI estimations, as exampled by the left cuboid and right navicular. However, there was a significant range of MNI, some small carpal and tarsal elements also provided the lowest MNI estimations such as the left trapezoid right triquetral and left second cuneiform. Similar to adult MNI estimations, long bones consistently had high MNI estimations for subadults. While the humerus provided the highest MNI estimation of 12, the right femur provided an MNI estimate of 10, and the left femur and left clavicle provided an MNI estimate of 9. Juvenile patella, fibula and calcaneus provided the lowest MNI estimations, 2, 4 and 4 respectively.

Table 13 MNI summary estimation of adults and juveniles (Max (L,R)) in SUP CF-01.

ELEMENT	SIDE	JUVENILE ESTIMATE	SIDE	ADULT ESTIMATE	TOTAL ESTIMATE
Capitate	*ind*	1	*right*	24	**25**
Cranium	*n/a*	6	*n/a*	28	**34**
Clavicle	*left*	9	*right*	41	**50**
Calcaneus	*left and right*	4	*right*	39	**43**
Cuboid	*left*	1	*left*	37	**38**
Cuneiform #1	*left*	1	*left*	28	**29**
Cuneiform #2	*right*	1	*left*	14	**15**
Cuneiform #3	*right*	1	*right*	21	**22**
Radius	*left and right*	5	*left*	33	**38**
Femur	*right*	10	*left*	43	**53**
Fibula	*right*	4	*right*	34	**38**
Hamate	*n/a*	0	*left*	26	**26**
Humerus	*right*	12	*right*	43	**55**
Lunate	*ind*	1	*left/right*	28	**29**
Mandible	*n/a*	4	*n/a*	38	**42**
Manubrium	*n/a*	3	*n/a*	27	**30**
Metacarpal #1	*ind*	1	*right*	33	**34**
Metacarpal #2	*right*	2	*right*	40	**42**
Metacarpal #3	*left*	3	*left*	33	**36**
Metacarpal #4	*left*	2	*left*	34	**36**
Metacarpal #5	*right*	2	*right*	35	**37**
Metatarsal #1	*left*	2	*right*	34	**36**
Metatarsal #2	*n/a*	0	*left/right*	29	**29**
Metatarsal #3	*left*	3	*right*	29	**32**
Metatarsal #4	*right*	2	*left*	28	**30**
Metatarsal #5	*right*	1	*right*	34	**35**
Navicular	*n/a*	0	*right*	42	**42**
Os Coxa	*right*	6	*right*	36	**42**
Patella	*left*	2	*right*	42	**44**
Sacrum	*n/a*	5	*n/a*	29	**34**
Scaphoid	*left*	1	*right*	24	**25**
Scapula	*left*	8	*right*	33	**41**
Sternum	*n/a*	7	*n/a*	31	**38**
Trapezium	*n/a*	0	*right*	22	**22**
Trapezoid	*n/a*	0	*left*	7	**7**
Triquetral	*n/a*	0	*right*	14	**14**
Talus	*right*	5	*right*	42	**47**
Tibia	*left*	6	*left*	43	**49**
Ulna	*right*	8	*right*	40	**48**

SUR-CF-01 was a cavern located in Unit IF of the SUR sector of La Petaca, and as discussed earlier, was only accessible by repelling techniques. This cave was large and triangular shaped, with three separate entrances, and a deposit of bones located in the northern portion of the cave. A total of 1607 elements were collected from this deposit (421 subadult, 1186 adult).

When compared to SUP CF-01, the MNI of SUR CF-01 (Table 14) was smaller, estimating a minimum of 33 individuals, including 25 adults (75.7% of the sample) and 8 juveniles (24.3 % of the sample). Both femur and tibia estimates are consistent with a minimum of 25 adult individuals, and cranial elements similarly estimated a minimum of 22 adult individuals. Patella, sacrum and calcaneus elements, smaller in size, were underrepresented compared to the aforementioned larger elements, approximating a MNI of only eight adult individuals.

Juvenile cranial elements provided the highest MNI estimation, indicating a minimum number of eight juvenile individuals deposited in this context (Table 14). Femur and tibia elements both approximate a total of seven juvenile individuals. Comparatively, no juvenile patella bones were present and juvenile fibula and sacral elements estimated a minimum number of three individuals. For both adult and juvenile elements, larger bones and crania were more than twice as common as smaller elements.

Table 14 MNI summary estimation of adults and juveniles (Max (L,R)) in SUR CF-01.

ELEMENT	SIDE	JUVENILE ESTIMATE	SIDE	ADULT ESTIMATE	TOTAL ESTIMATE
Capitate	*ind*	0	*right*	6	6
Cranium	*n/a*	8	*n/a*	22	30
Clavicle	*left*	5	*right*	11	16
Calcaneus	*left and right*	4	*right*	8	12
Cuboid	*left*	0	*right*	5	5
Cuneiform #1	*left*	0	*right*	3	3
Cuneiform #2	*right*	0	*right*	2	2
Cuneiform #3	*right*	0	*right*	2	2
Radius	*left and right*	6	*left*	13	19
Femur	*right*	7	*left*	25	32
Fibula	*right*	3	*right*	13	16
Hamate	*n/a*	0	*left*	6	6
Humerus	*right*	5	*right*	17	22
Lunate	*ind*	0	*left*	6	6
Mandible	*n/a*	5	*n/a*	7	12
Metacarpal #1	*ind*	-	*right*	7	7
Metacarpal #2	*right*	-	*right*	6	6
Metacarpal #3	*left*	-	*left*	4	4
Metacarpal #4	*left*	-	*left*	6	6
Metacarpal #5	*right*	-	*right*	6	6
Metatarsal #1	*left*	-	*left*	5	5
Metatarsal #2	*n/a*	-	*left/right*	4	4
Metatarsal #3	*left*	-	*Left/right*	4	4
Metatarsal #4	*right*	-	*Left/right*	2	2
Metatarsal #5	*right*	-	*right*	4	4
Navicular	*n/a*	0	*left*	3	3
Os Coxa	*right*	6	*right*	12	18
Patella	*left*	0	*right*	8	8
Sacrum	*n/a*	3	*n/a*	8	11
Scaphoid	*left*	0	*right*	10	10
Scapula	*left*	5	*right*	11	16
Sternum	*n/a*	1	*n/a*	6	7
Trapezium	*n/a*	0	*right*	4	4
Trapezoid	*n/a*	0	*Left/right*	3	3
Triquetral	*n/a*	0	*left*	4	4
Talus	*right*	1	*right*	5	6
Tibia	*left*	7	*left*	25	32
Ulna	*right*	5	*right*	15	20

Bone Representation Index

Counts for left and right bones were then combined, and grouped into element classes. Because of the complex nature of commingled skeletal deposits, a Bone Representation Index was calculated (BRI) (Figure 16). BRI was scored for adults and juveniles separately, and plotted. BRI scores for adults and juveniles follow different patterns, suggesting that factors other than depositional patterns or taphonomy may play a role in the creation of SUP CF-01. By count data alone, there was clearly an underrepresentation of some adult elements within this context including carpal bones, and a clear underrepresentation of carpal, tarsal and patella juvenile elements.

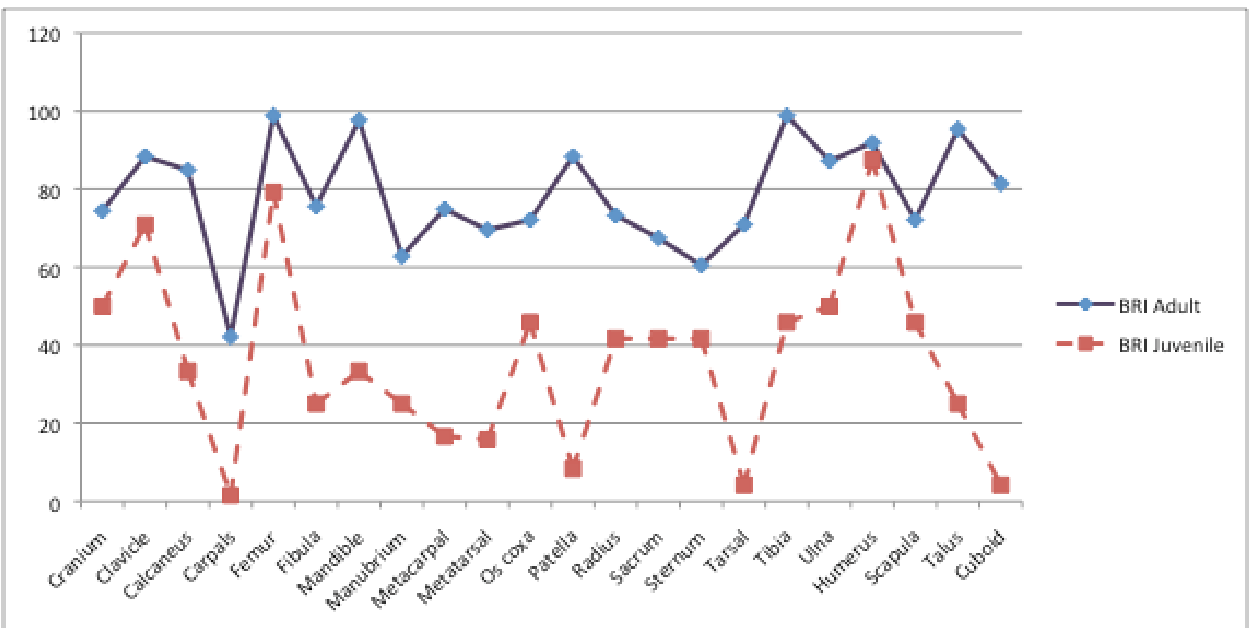


Figure 16 Plot distribution of BRI for both adult and juvenile skeletal remains from SUP CF-01.

Osteometric Pair Matching

Osteometric pair matching was necessary for this analysis because the number of remains was so large that within the time allotted, there was no ideal way to pair match bones during the inventory process. This method facilitated an estimation of LI and MNLI, which is considered to be more representative of the original deposit than MNI, and osteometric pair matching also provided distance relationships between single elements that will be discussed in the third section of this chapter. This method was based on the assumption that one can exclude pairs based on differences in size and shape, where the size analysis incorporated only length measurements. The number of pairs estimated using this first method is provided in Table 15. The second shape analysis used multiple length and width measurements, as indicated in the previous section, and estimated matches are provided in Table 16. Table 17 identifies the pair matches that were used in this research, and provides the raw p-value data that was used to determine successful pairs using this method, as well as the pair matches used in the demographic and spatial analysis.

Table 15 Pair matches estimated for each skeletal element based on length, bold values indicate matches that were estimated using both methods.

SKELETAL ELEMENT	NUMBER OF PAIR MATCHES	MATCHES
HUMERUS	11	ID 1418 & ID 197 ID 148 & ID 198 ID 149 & ID 424 ID 1933 & ID 1 ID 301 & ID 801 **ID 423 & ID 506** **ID 504 & ID 1265** ID 193 & ID 1777 ID 182 & ID 2246 **ID 199 & ID 2247** **ID 1497 & ID 2316**
RADIUS	9	ID 384 & ID 294 ID 169 & ID 702 ID 703 & ID 827 ID 168 & ID 1180 ID 826 & ID 1456 ID 2463 & ID 1524 ID 2464 & ID 1630 ID 2585 & ID 2309 ID 1633 & ID 2584
ULNA	10	ID 204 & ID 819 ID 1769 & ID 298 ID 64 & ID 299 **ID 297 & ID 428** ID 461 & ID 696 **ID 1523 & ID 821** ID 1345 & ID 1182 ID 1618 & ID 1270 ID 1461 & ID 1537 **ID 2234 & ID 1798**
FEMUR	6	ID 1603 & ID 75 ID 1984 & ID 166 ID 1261 & 412 ID 163 & ID 1109 ID 2750 & ID 1626 ID 1987 & ID 1988
TIBIA	14	ID 217 & ID 160 ID 2747 & ID 191 ID 1247 & ID 213 ID 1599 & ID 214 ID 2748 & ID 503 ID 1994 & ID 867 **ID 281 & ID 868** **ID 1244 & ID 1243** ID 1995 & ID 1525 ID 502 & ID 1526 ID 236 & ID 1598 ID 189 & ID 1790 **ID 1919 & ID 2553** **ID 2057 & ID 689** ID 2183 & ID 1422 **ID 1790 & ID 189**
FIBULA	6	ID 188 & ID 158 ID 159 & ID 372 ID 499 & ID 406 ID 2059 & ID 871 ID 405 & ID 1527 ID 70 & ID 1628 ID 2208 & ID 1920
CLAVICLE	12	ID 511& ID 52 ID 842 & ID 53 ID 2010 & ID 54 ID 1552 & ID 354 ID 1958 & ID 512 ID 2422 & ID 1083 ID 355 & 1678 ID 2727 & ID 2890 ID 356 & ID 2960 ID 1538 & ID 2151 ID 2286 & ID 2424 ID 2419 & ID 2425
CALCANEUS	20	ID 2302 & ID 562 ID 743 & ID 1313 ID 409 & 1396 ID 2705 & ID 1702 ID 2067 & ID 2835 ID 324 & ID 85 ID 2436 & ID 211 ID 873 & ID 251 ID 1625 & ID 326 ID 741 & ID 674 ID 2784 & ID 877 ID 556 & 1624 ID 1398 & ID 2834 ID 558 & ID 2066 ID 1641 & ID 2192 ID 742 & ID 2300 ID 744 & ID 2435 ID 874 & ID 2576 ID 3027 & ID 2700 ID 325 & ID 2701

Osteometric sorting using only length measurements provided more numerous pair match estimations (See Table 15) than those elements that were analyzed a second time with both size and shape measurements (See Table 16). This was not unexpected, for many elements were fragmentary, and incorporating more elements into an analysis should hypothetically make the estimations more accurate, but also more selective. Femur estimates created six matched pairs for each analysis; however, no pair matches directly overlapped. Conversely, although the number of pair matches for the tibia was reduced significantly when using shape and length measurements instead of only length, 5 sets of pair matches were consistently selected during each analysis. Similarly, of 6 ulna pair matches using both length and girth (with girth defined as anteroposterior and medial-lateral measurements), three overlapped with pair matches estimated using only length.

Table 16 Pair matches estimated using both length and shape measurements.

ELEMENT	NUMBER OF PAIR MATCHES	MATCHES
HUMERUS	9	ID 149 & ID 1419 ID 1774 & ID 1 ID 182 & ID 801 **ID 423 & ID 506** **ID 504 & ID 1265** ID 1933 & ID 2952 ID 148 & ID 1629 **ID 199 & ID 2247** **ID 1497 & ID 2316**
ULNA	6	**ID 297 & ID 428** **ID 1523 & ID 821** ID 1927 & ID 1269 ID 1739 & ID 1799 **ID 2234 & ID 1798** ID 1461 & ID 1926
FEMUR	6	ID 2751 & ID 1426 ID 1757 & ID 2850 ID 456 & ID 2327 ID 207 & ID 1109 ID 1987 & ID 1305 ID 684 & ID 1601
TIBIA	7	ID 1599 & ID 191 ID 2747 & ID 867 **ID 281 & ID 868** **ID 1244 & ID 1243** **ID 1790 & ID 189** **ID 1919 & ID 2553** **ID 2057 & ID 689**

Table 17 Pair matches used for LI/MLNI and spatial analysis of distribution of related elements.

ELEMENT	NUMBER OF PAIR MATCHES	PAIR MATCHED ELEMENTS
HUMERUS	12	(A) ID 149 & ID 1419 (B) ID 1774 & ID 1 (C) ID 182 & ID 801 (D) ID 423 & ID 506 (E) ID 504 & ID 1265 (F) ID 1933 & ID 2952 (G) ID 148 & ID 1629 (H) ID 199 & ID 2247 (I) ID 1497 & ID 2316 (J) ID 1418 & ID 197 (K) ID 149 & ID 424 (L) ID 193 & ID 1777
RADIUS	9	(A) ID 384 & ID 294 (B) ID 169 & ID 702 (C) ID 703 & ID 827 (D) ID 168 & ID 1180 (E) ID 826 & ID 1456 (F) ID 2463 & ID 1524 (G) ID 2464 & ID 1630 (H) ID 2585 & ID 2309 (I) ID 1633 & ID 2584
ULNA	A	(A) ID 297 & ID 428 (B) ID 1769 & ID 1799 (C) ID 1523 & ID 821 (D) ID 2234 & ID 1798 (E) ID 1927 & ID 1269 (F) ID 1461 & ID 1926 (G) ID 204 & ID 819 (H) ID 1345 & ID 1182 (I) ID 461 & ID 696 (J) ID 1618 & ID 1270 (K) ID 64 & ID 299
FEMUR	10	(A) ID 2751 & ID 1426 (B) ID 1757 & ID 2850 (C) ID 456 & ID 2327 (D) ID 207 & ID 1109 (E) ID 1987 & ID 1305 (F) ID 684 & ID 1601 (G) ID 1603 & ID 75 (H) ID 1984 & ID 166 (I) ID 2750 & ID 1626 (J) ID 1261 & 412
FIBULA	6	(A) ID 159 & ID 372 (B) ID 499 & ID 406 (C) ID 2059 & ID 871 (D) ID 405 & ID 1527 (E) ID 70 & ID 1628 (F) ID 2208 & ID 1920
TIBIA	12	(A) ID 1599 & ID 191 (B) ID 1244 & ID 1243 (C) ID 2057 & ID 689 (D) ID 2747 & ID 867 (E) ID 1790 & ID 189 (F) ID 281 & ID 868 (G) ID 1919 & ID 2553 (H) ID 217 & ID 160 (I) ID 2748 & ID 503 (J) ID 502 & ID 1526 (K) ID 236 & ID 1598 (L) ID 2183 & ID 1422
CLAVICLE	12	(A) ID 511& ID 52 (B) ID 842 & ID 53 (C) ID 2010 & ID 54 (D) ID 1552 & ID 354 (E) ID 1958 & ID 512 (F) ID 2422 & ID 1083 (G) ID 355 & 1678 (H) ID 2727 & ID 2890 (I) ID 356 & ID 2960 (J) ID 1538 & ID 2151 (K) ID 2286 & ID 2424 (L) ID 2419 & ID 2425
CALCANEUS	20	(A) ID 2302 & ID 562 (B) ID 743 & ID 1313 (C) ID 409 & 1396 (D) ID 2705 & ID 1702 (E) ID 2067 & ID 2835 (F) ID 324 & ID 85 (G) ID 2436 & ID 211 (H) ID 873 & ID 251 (I) ID 1625 & ID 326 (J) ID 741 & ID 674 (K) ID 2784 & ID 877 (L) ID 556 & 1624 (M) ID 1398 & ID 2834 (N) ID 558 & ID 2066 (O) ID 1641 & ID 2192 (P) ID 742 & ID 2300 (Q) ID 744 & ID 2435 (R) ID 874 & ID 2576 (S) ID 3027 & ID 2700 (T) ID 325 & ID 2701

LI and MNLI Estimation

Estimations of LI and MLNI were dependent on osteometric pair matching and the establishment of paired elements (thus unpaired skeletal elements such as cranium are not included in these analyses), and was estimated by first counting the number of unpaired left and right elements. Adapting the method of MNI, only fragments with a completeness of 75% and larger with identifiable skeletal landmarks were included in the analysis. Overlapping fragments were considered to be from separate individuals. Estimates for left and right were then entered into the equations for LI: Ń = (L * R)/P and MLNI: MNLI= ((L+1)(R+1)/(P+1))-1, incorporating the number of pairs estimated for each element from the osteometric statistical pair matching. Table 18 compares the results between MNI, LI and MLNI based on each major element observed. It is noted that for some elements, the LI and MLNI estimations are higher than MNI, such as in the humerus, radius, and ulna. For the calcaneus, clavicle, and femur; however, there is a noticeable underestimation of individuals. Table 19 and 20 show the results for the Chi-square test examining the relationship between the method of determining the number of individuals present and the estimated number. These results indicate that for each cave context, there was not a statistically significant relationship between methods and the estimate they provided. Symmetric Measures for each Chi-square test also indicate that there was no statistically significant relationship between the methods tested.

Table 18 Comparison of MNI, LI and MLNI estimation for adults, of elements in both SUP CF-01 and SUR CF-01.

	SUP CF-01			SUR CF-01		
Element	**MNI**	**LI**	**MLNI**	**MNI**	**LI**	**MLNI**
Humerus	43	96	92	17	40	32
Radius	33	96	92	13	77	47
Ulna	40	76	74	15	70	43
Femur	43	159	151	25	323	179
Tibia	43	140	134	25	247	139
Fibula	34	125	114	13	X	69
Clavicle	42	45	73	11	15	15
Calcaneus	39	57	58	8	X	64

Table 19 Results of the Chi-square test for the relationship between MNI, LI and MNLI for SUP CF-01.

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	48.000[a]	38	.128
Likelihood Ratio	52.733	38	.056
N of Valid Cases	24		

a. 60 cells (100.0%) have expected count less than 5. The minimum expected count is .33.

Symmetric Measures			
		Value	Approx. Sig.
Nominal by Nominal	Phi	1.414	.128
	Cramer's V	1.000	.128
N of Valid Cases		24	

Table 20 Results of the Chi-square test for the relationship between MNI, LI and MNLI for SUR CF-01.

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	42.000[a]	36	.227
Likelihood Ratio	46.142	36	.120
N of Valid Cases	24		

a. 57 cells (100.0%) have expected count less than 5. The minimum expected count is .33.

Symmetric Measures			
		Value	Approx. Sig.
Nominal by Nominal	Phi	1.323	.227
	Cramer’s V	.935	.227
N of Valid Cases		24	

Sex Estimations

Estimations of sex were limited to a few specific elements due to the commingled nature of the remains. Based on skeletal characteristics of the os coxa, there were at least 11 adult females and 12 adult males in SUP CF-01, indicating that of the sample where sex was able to be determined, 39% of the sample was male and 35% was female, 53% of the total adults recovered (Table 21). This small sample cannot be considered representative of the entire sample collected from SUP CF-01, as many elements were fragmented, and morphological characteristics consisted with sex were unavailable for identification; however, it does indicate that both males and females were present in the assemblage, in roughly equal proportions. Additionally, based on os coxa skeletal elements, five individuals were estimated to be possibly female and one individual was estimated to be possibly male (Table 21). This raises the total distribution of sex to at least 14 females and 13 males, where 45% of the sample population was female and 42% of the sample population was male. Sex was unable to be estimated from five cranial and two os coxa elements.

Table 21 Estimation of sex for both the os coxa and cranium elements from SUP CF-01 and percentage.

Element	Total	M	F	?M	?F	Total Male	Percentage of Male	Total Female	Percentage of Female	IND (?)
Cranium	25	6	11	1	2	7	28%	13	52%	5
Os coxa	31	12	11	1	5	13	42%	14	45%	2

Comparatively in the other cave context (SUR CF-01), based on skeletal characteristics of the cranium there were at least 3 adult females and 6 adult males present (Table 22). Based on skeletal characteristics of the os coxa, there were at least 3 adult females and 4 adult males and an additional 3 elements are estimated to be possibly female and 2 elements are estimated to be possibly male (Table 22). The distribution of sex within this context is estimated to be 6 females and 6 males, where 35% of the sample was female and 35% of the sample was male. Again, this small sample cannot be considered representative of the sample collected from SUR CF-01, as many elements were fragmented, and morphological characteristics consisted with sex were unavailable for identification. However based on the elements recovered during excavation, both males and females were present in the assemblage, in relatively equal numbers.

Table 22 Estimation of sex for both the os coxa and cranium elements from SUR CF-01.

Element	Total	M	F	?M	?F	Total Male	Percentage of Male	Total Female	Percentage of Female	IND (?)
Cranium	22	5	3	1	2	6	27%	5	23%	11
Os coxa	17	4	3	2	3	6	35%	6	35%	5

Age Category Estimation

Due to the commingled and fragmented nature of this context, it would not have been representative of the sample to create a traditional population demographic profile, however age categories were considered useful as they show the range of biological age categories of individuals included in this mortuary context. This study was able to estimate age categories present in SUP CF-01 from both cranial and os coxa adult elements, as well as long bone lengths and dental eruption patterns of juveniles (Tables 23, 24 and 25). Only two infants were identified, a possible byproduct of biased sampling or taphonomic factors influencing preservation (Table 24). The most common age categories in this sample were young and middle-aged adults. There was also a fair distribution of older adults in this assemblage (n = 9). While this is only a sample of the possible 43 adults included in SUP CF-01, this analysis indicates that both males and females of each adult age group were included in this mortuary context.

Table 23 Estimation of adult age based on skeletal elements and differentiated by sex in SUP CF-01, and below a summary of the results.

	Male	Female	Possible Male	Possible Female	Total Male	Total Female	Unknown	Total
Cranium	**6**	**11**	**1**	**2**	**7**	**13**	**5**	**25**
YA (20-34)	1	2	1	0	2	2	2	6
MA (35-49)	3	5	0	2	3	7	2	12
OA (50+)	1	3	0	0	1	3	0	4
UNK	1	1	0	0	1	2	1	4
Os Coxa	**14**	**11**	**1**	**5**	**15**	**16**	**2**	**33**
YA (20-35)	6	3	0	2	6	5	0	11
MA (36-50)	5	4	0	2	5	6	1	12
OA (50+)	3	4	1	1	4	5	0	9
UNK	1	0	0	0	1	0	1	2

Table 24 displays the distribution of subadult age by skeletal element in SUP CF-01 as several long bones were incorporated into this analysis. There is a variation in MNI for each age category between skeletal elements. Ulna remains indicate that there were two infant skeletons deposited in this cave, while the infant age category (0-1 yrs) was not represented in any of the other bone categories. Young child (2-4 yrs) MNI estimate at least three individuals based on ulna elements, while humerus elements estimate a minimum of two small child individuals in SUP CF-01. MNI estimates at least four older child and adolescent individuals based on recovered humerus skeletal elements from SUP CF-01. Based on the age distribution of juvenile elements, the overall MNI for juveniles is 12. Table 25 displays the summary MNI statistics for SUP CF-01, where it appears that the majority of the individuals included in this assemblage were aged 16 to 50 (43.6%).

Table 24 MNI age categories of subadults displayed per skeletal element, SUP CF-01

Humerus	Number	Fibula	Number
Infant (0-1 yrs)	0	Infant (0-1 yrs)	0
Young Child (2-4 yrs)	2	Young Child (2-4 yrs)	1
Older Child (5-10 yrs)	4	Older Child (5-10 yrs)	1
Adolescent (11-19 yrs)	4	Adolescent (11-19 yrs)	0
Radius		**Mandible**	
Infant (0-1 yrs)	0	Infant (0-1 yrs)	0
Young Child (2-4 yrs)	0	Young Child (2-4 yrs)	0
Older Child (5-10 yrs)	1	Older Child (5-10 yrs)	1
Adolescent (11-19 yrs)	1	Adolescent (11-19 yrs)	0
Ulna		**Clavicle**	
Infant (0-1 yrs)	2	Infant (0-1 yrs)	0
Young Child (2-4 yrs)	3	Young Child (2-4 yrs)	2
Older Child (5-10 yrs)	1	Older Child (5-10 yrs)	2
Adolescent (11-19 yrs)	0	Adolescent (11-19 yrs)	1
Femur		**Cranium**	
Infant (0-1 yrs)	0	Infant (0-1 yrs)	1
Young Child (2-4 yrs)	1	Young Child (2-4 yrs)	0
Older Child (5-10 yrs)	1	Older Child (5-10 yrs)	1
Adolescent (11-19 yrs)	3	Adolescent (11-19 yrs)	1

* Adapted Standards (Buikstra and Ubelaker, 1994) juvenile age categories to better represent the distribution of juveniles in this population.

Table 25 MNI summary statistics for SUP CF-01

	0-19	20-35	36-50	50+	"Adult"	Total
Male	0	7	5	4	1	**17**
Female	0	5	7	5	1	**18**
Indet.	12	2	2	0	4	**20**
Total	12	14	14	9	6	**55**

This study also estimated adult age categories present in the other cave context (SUR CF-01) from both cranial and os coxal adult elements (See Table 26). There was a difference in age estimates between cranial and os coxal elements in this other context. The most common age categories of cranial elements are of young and middle-aged adults. Comparatively, older adults were more common among os coxal elements in this small sample from SUP CF-01.

Table 26 Summary estimation of adult age based on skeletal element and differentiated by sex in SUR CF-01.

	Male	Female	Possible Male	Possible Female	Total Male	Total Female	Indeterminate	Total
Cranium	**4**	**4**	**0**	**2**	**4**	**6**	**5**	**15**
YA (20-34)	2	2	0	1	2	3	2	**7**
MA (35-49)	2	2	0	2	2	4	2	**8**
OA (50+)	0	0	0	0	0	0	0	**0**
UNK	0	0	0	1	0	1	3	**4**
Os Coxa	**3**	**3**	**2**	**2**	**5**	**5**	**1**	**11**
YA (20-35)	1	0	0	0	1	0	0	**1**
MA (36-50)	0	1	1	0	1	1	0	**2**
OA (50+)	2	2	1	1	3	3	0	**6**
UNK	0	0	0	1	0	1	1	**2**

Table 27 displays the distribution of juvenile age by skeletal element in SUR CF-01. There is a variation in MNI for each age category between skeletal elements as seen in the other cave context. Both juvenile ulna and humerus elements indicate that there were two infant skeletons deposited in this cave. MNI estimates at least four young children based again on the radius. MNI of older children estimates four individuals based on mandible elements from SUR CF-01, however all other skeletal elements suggest a lower estimate. Finally, MNI estimates two adolescent individuals based on both mandible and cranial elements. The overall MNI of subadults from SUR CF-01 is estimated to be eight individuals, however based on the distribution of age categories, MNI could have been at least 10 individuals. Table 28 shows the MNI summary for both adults and juveniles, including individuals from a range of age categories.

Table 27 MNI Age categories of juveniles displayed per skeletal element, SUR CF-01.

Humerus	**Number**	**Fibula**	Number
Infant (0-1 yrs)	2	Infant (0-1 yrs)	1
Young Child (2-4 yrs)	1	Young Child (2-4 yrs)	1
Older Child (5-10 yrs)	0	Older Child (5-10 yrs)	1
Adolescent (11-19 yrs)	1	Adolescent (11-19 yrs)	0
Radius	Number	**Mandible**	Number
Infant (0-1 yrs)	1	Infant (0-1 yrs)	1
Young Child (2-4 yrs)	4	Young Child (2-4 yrs)	0
Older Child (5-10 yrs)	0	Older Child (5-10 yrs)	4
Adolescent (11-19 yrs)	1	Adolescent (11-19 yrs)	2
Ulna	Number	**Clavicle**	Number
Infant (0-1 yrs)	2	Infant (0-1 yrs)	1
Young Child (2-4 yrs)	3	Young Child (2-4 yrs)	2
Older Child (5-10 yrs)	0	Older Child (5-10 yrs)	2
Adolescent (11-19 yrs)	1	Adolescent (11-19 yrs)	0
Femur	Number	**Cranium**	Number
Infant (0-1 yrs)	0	Infant (0-1 yrs)	1
Young Child (2-4 yrs)	3	Young Child (2-4 yrs)	0
Older Child (5-10 yrs)	0	Older Child (5-10 yrs)	1
Adolescent (11-19 yrs)	1	Adolescent (11-19 yrs)	2

* Adapted Standards (Buikstra and Ubelaker, 1994) juvenile age categories to better represent the distribution of juveniles in this population.

Table 28 MNI summary for SUR CF-01.

	0-19	20-35	36-50	50+	“Adult”	Total
Male	0	2	3	3	0	**8**
Female	0	3	4	3	1	**11**
Indet.	8	2	2	0	2	**14**
Total	8	7	9	6	3	**33**

Spatial Distribution of Related Elements

Analysis of the location of bone elements and demographic categories of age indicated that there was not an overabundance of a certain category of bone element in any portion of the cave (Appendix: Map 1- crania, Map 2- upper limbs, Map 3- lower limbs). While elemental categories tended to be more densely located in the back chamber of the cave that area is where the deposit was deepest, at approximately 70-80 cm deep. Maps 4 and 5, which demonstrate the spatial distribution of age categories of both adults and juveniles, also do not indicate any emphasis on the location of specific aged elements.

Osteometric sorting estimated pair matches under the assumption that two paired elements from the same individual would be similar in both size and shape. Table 17 provides a list of the pair matches estimated using both methods (size and shape) of analysis. The maps included in the Appendix highlight each pair's spatial and depth distribution. Bones are separated into upper and lower limbs to simplify analysis. As discussed previously, two arbitrary levels were distinguished during the excavation of this unit: superficial (top level) and level 1 (bottom level). All elements excavated from the Superficial level are designated with a black border within the map illustrations, and those recovered from Level One are bordered with light grey. While these were not cultural or natural stratigraphic layers, they indicate differences in depth between related elements, and therefore were included as part of this analysis. It was expected that large elements such as the femur and tibia would be concentrated within the expected one meter perimeter, as it would take a larger force than gravity to transport these elements far distances. Conversely, it was expected that smaller elements, such as the calcaneus, may have traveled further distances, and tricked down into deeper layers.

As the Appendix demonstrates, the majority of pair matches were located within the expected one meter area and collected from the same excavation level. However, it was consistently noted that for each group of elements, a small subgroup of pair matches was located greater than one meter away and collected from different levels. For example, of the twenty calcaneus pair matches estimated through osteometric pair matching, three pairs were separated by a distance of more than one meter: pairs G, K, R (Map 6 and Figure 36 a) and four were collected from different layers: pairs G, M, L and B. Conversely, femur pair matches (Map 8) were more closely distributed, concentrated primarily towards the back portion of the cave and only two of the six estimated pair matches (C and D) were located at a distance further than one meter. Interestingly, three femora pair matches were located at different depths: J, F and A. Fibula pair matches were less concentrated towards the back portion of the cave; however, most were located within the one meter area and the majority of elements were collected from the same excavation level (Map 9). Interestingly, of the twelve tibia pair matches, six were distributed outside of the one meter area (Map 12).

Upper limbs had a similar spatial distribution to lower limbs (Map 10, 11 and 13). Half of the humerus and radius pair matches were located outside of the one meter area, and several of each bone category was recovered from different excavation layers. Of the eleven total ulna pair patches, only two were located at a distance further than one meter apart from its respective mate and three pair matches were recovered with elements found in different excavation layers as illustrated in Map 8.

Juvenile pair matches were not estimated through osteometric sorting, as there was a much smaller sample size of elements that were non-fragmentary and measured. Map 14 illustrates the distribution of juvenile pair matches for each element. Paired juvenile elements were primarily distributed within a half meter area; however several paired elements were recovered from different depths. The next section displays the statistical results of this analysis, presenting the distance of dispersal between paired elements.

Distance of Dispersal

The distances measured in ArcMap using the Measurement Tool allowed for an analysis of the space between related elements. Table 29 shows the summary data broken into respective bone categories. The mean and metric distance of the juvenile and adult femur categories are smaller, and the mean and distance of the adult humerus and ulna are larger than the other bone subsets. Additionally 27 % of pair matched elements were recovered from different excavation levels indicating disturbance including large and small elements. The results of the One-Way ANOVA test (Table 29), F=0.829 and p=0.579 indicates there is no statistical relationship between the bone category and the distance traveled.

Table 29 Descriptive and One-Way ANOVA test results testing the relationship between the distance of elements (mm), adult bone category, and combined juvenile elements.

Element	N	Mean	Different Depth	Std. Dev.	Std. Error	Minimum	Maximum
Calcaneus	20	68.75	6	49.25	11.01	25	200
Clavicle	12	64.58	2	40.53	11.70	25	125
Femur	10	52.50	3	29.93	9.46	25	125
Fibula	6	66.66	2	43.77	17.87	25	150
Humerus	12	87.50	2	56.90	16.42	25	175
Tibia	12	81.25	3	48.99	14.14	25	200
Radius	9	80.55	4	51.20	17.06	25	175
Ulna	11	90.90	3	86.79	26.17	25	275
Juvenile	7	46.42	2	22.49	8.50	25	75
Total	**99**	**72.22**	**27**	**51.617**	**5.18**	**25**	**275**

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	17918.516	8	2239.814	.829	.579
Within Groups	243192.596	90	2702.140		
Total	**261111.111**	**98**			

A visual inspection of Figure 17 and 18 shows that the pair matched elements tended to be dispersed within the expected one meter area for adults and half meter area for subadults.Smaller elements such as the calcaneus and fibula tended to be moved more than larger more dense bones such as the femur and humerus; however one can see from Figure 17 that tibia tended to be a larger distance apart than other elements similar in size. While all bone categories of adults and juveniles had pair matches located within a 25 cm area, ulna paired elements appeared to travel the farthest distance (Figure 17). The overall visual pattern of bone distribution indicates that paired elements were on average within the expected one meter area (Figure 18), and elements that were a distance further than one meter apart tended to be average 101-125 cm apart.

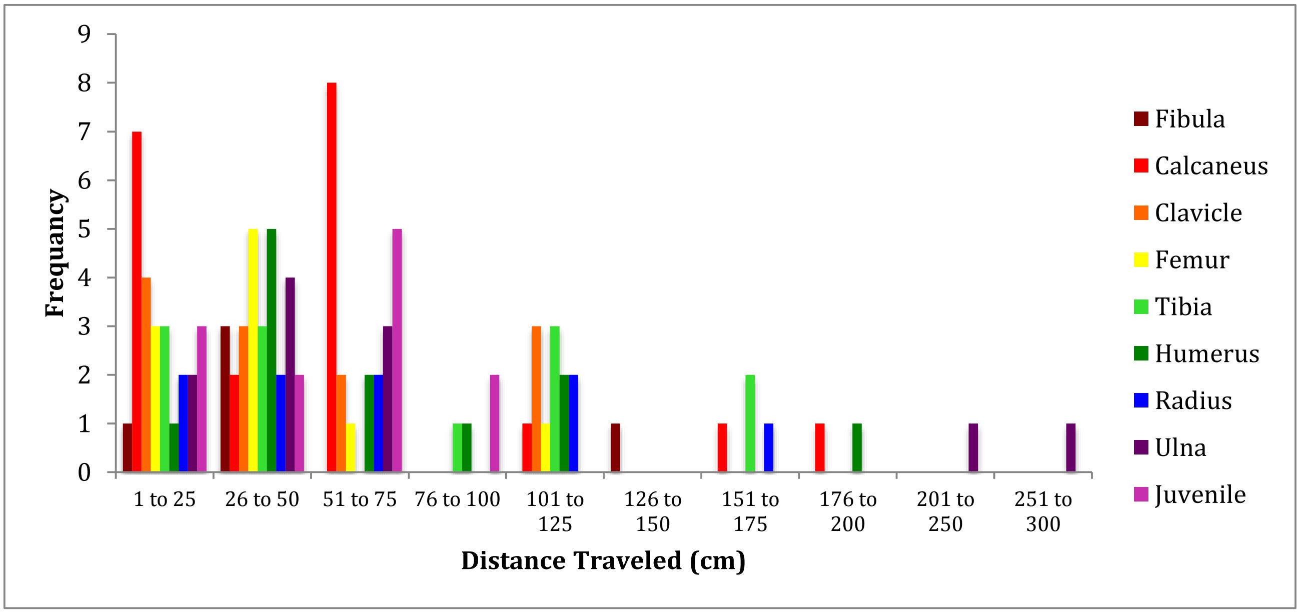


Figure 17 Frequency histogram of distance measurements for each bone category.

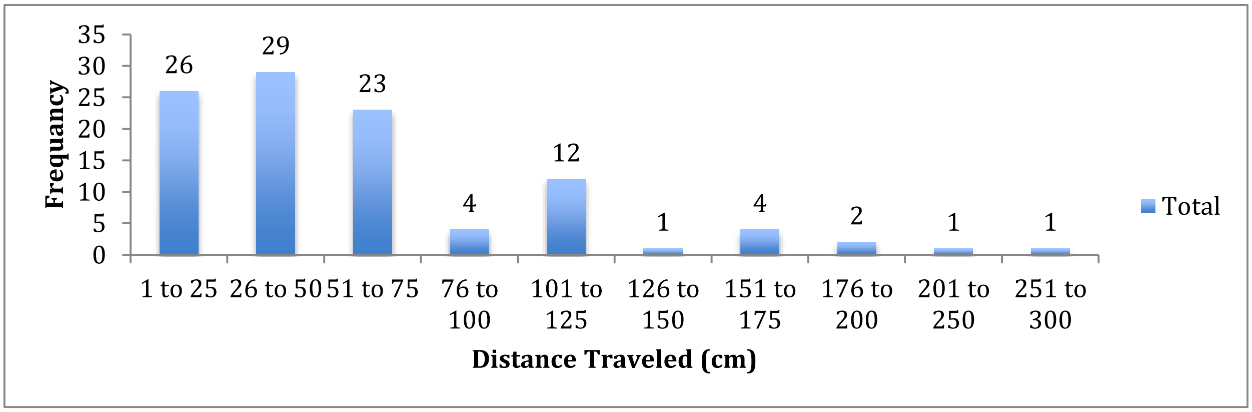


Figure 18 Frequency histogram of distance measurements for the total of pair matches estimated.

Size of Mortuary Space in Relation to MNI

With the skeletal remains representing so many individuals deposited in this location, one question becomes *how* and *why* were they deposited? While we may not be able to answer the first question in its entirety, it can be assumed that the bodies would have been placed in the traditional Chachapoya seated flexed position (Guillén, 2002; 2003). The high presence of small elements indicate that these remains were most likely fleshed at the time of deposition, therefore this model will assume that the individual was a completely fleshed dead human, wrapped in a basic shroud textile with an average standing height of 167 cm for males, or 147 cm for females (based on estimates from Kuelap – Toyne, personal communication), seated in a tightly flexed position – with an average 80 cm sitting height. On average, an adult would take up an minimum approximate area of 161,000 cm^3 and an average smaller child around 3-5 years old juvenile would take up a minimum approximate area of 77,500 cm^3 . The cave in its entirety is approximately 5,430,000 cm^3. With these estimated dimensions, the space available could potentially house on average 33 fleshed adults seated in the flexed position, which is significantly less than the minimum number of adult and juvenile individuals estimated to have been deposited in SUP-CF01 (Figure 18). In order to house the complete and articulated estimated 43 adults and 12 juveniles at one time, the available space would have needed to total around 7,900,000 cm^3, indicating that a singular group burial event would not have been possible.

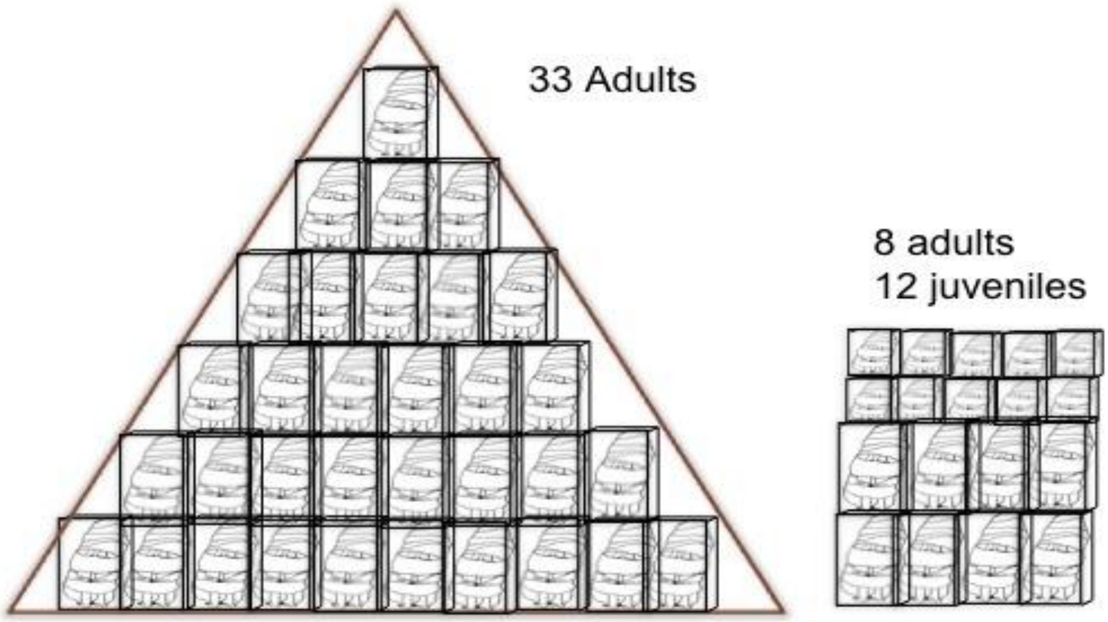


Figure 19 Spatial Model of the number of individuals that could have been deposited in this cave context according to the calculated spatial dimensions of the cave and adult and juvenile complete bodies.

Summary

This chapter detailed the results of both a paleodemographic and spatial analyses. It began with a count of elements recovered from SUP CF-01, which led to an estimation of MNI and calculation of the BRI. Osteometric pair matching utilized both length and shape measurements to estimate pair matches of several long bone elements. This facilitated additional LI and MLNI estimations, which were compared against MNI analysis. Then, this chapter explored the demographic categories present in SUP CF-01, contrasting these findings with the alternative cave context SUR CF-01. The third section of this chapter presented the spatial analysis of SUP CF-01, first identifying the distribution of related elements in the mortuary deposit and then presenting an analysis of the space available to hold the estimated MNI. The data presented in this chapter will be integrated into the discussion and interpretation of this context in Chapter Five.

CHAPTER FIVE: DISCUSSION

This chapter discusses the results presented in Chapter Four, and is divided into four sections that follow the questions posed in Chapter One of this thesis. This chapter first explores the notion of excavating disturbed, looted contexts, and the possibility of reconstructing mortuary practices from these assemblages. This thesis argues that by incorporating a GIS to the methods of recording and analysis, it is possible to explore complex questions concerning depositional and post depositional mortuary practices. Then this chapter presents evidence of the demographic categories incorporated into this assemblage, highlighting why this context is interpreted as a collective burial by comparing bone counts calculated and the demographic categories represented in SUP CF-01. These data were then compared with the estimates and demographic categories represented in SUR CF-01, a similar mortuary context that was less accessible in the La Petaca mortuary complex than SUP CF-01. The next section explores the measured disturbance among pair matched elements, discussing what this could mean about the depositional and post depositional processes thus reconstructing aspects of the funerary process. Lastly, this chapter will conclude with a discussion exploring the Chachapoya mortuary landscape, defining the evidence for practices of revisitation and ancestor veneration at SUP CF-01 and the mortuary complex of La Petaca.

Reconstruction of Mortuary Practices from Disturbed Contexts: A GIS Application

Despite the common assumption that disturbed mortuary contexts are not worth extensive investigation due to the difficulty of their interpretation, this thesis shows that excavation of looted funerary spaces can provide a great deal of information about past populations. Recovered osteological material allowed this study to estimate the MNI and biological details about the individuals included in this mortuary practice. The noted absence of material culture recovered during excavation allowed this study to interpret post depositional processes that may have impacted the assemblage. Moreover, a spatial analysis of the assemblage and cave space, which resulted from careful documentation methods in the field, allowed for this study to explore questions of why and how this context was created.

Previous research by Gerdau-Radonic and Herrera (2010) similarly argues that looted disturbed contexts are important contexts and warrant careful excavation and analysis. Resources prevented a 3D record of the exact position of each skeletal element recovered, as was the case in this study, however this thesis expanded upon the methods proposed by Gerdau-Radonic and Herrera (2010) by introducing a GIS to the analysis of the excavated material. While this constituted an approximate analysis devoid of the original orientation and placement of each element, this study could further explore depositional and post depositional processes that together created this commingled assemblage. An analysis of the spatial distribution of these elements, as well as the overall distribution of bone types, demonstrated the random distribution of bone types, and a small degree of disturbance. Whereas excavation provided bone counts and recorded the location of elements recovered, the GIS software presented a framework where interpretative questions could be asked, and patterns could be analyzed. Through the use of careful and systematic excavation techniques, the data recorded was entered into a GIS where demographic distributions of bone types, age and sex characteristics, as well as distance measurements were evaluated. The random distribution of identified bone elements suggested that post depositional practices of rearranging the cave for successive burials did not include moving certain elements to specific locations within the cave. Instead, statistical analyses indicate it was a random dispersal. Additionally, by introducing a novel method of measuring the available area of the mortuary context itself, this analysis was also able to posit the type of depositional pattern that would have been necessary to create the MNI within this context, which is discussed in further detail later in this Chapter.

By excavating looted and disturbed tombs as if they had not been disturbed, e.g. systematically, researchers can establish an empirical base for future interpretations. These contexts can provide data on the people that were deposited in these contexts, and depending on the level of disturbance, how they were initially buried (Gerdau-Radonic and Herrera, 2010). It was policy of the *Extirpacion* campaigns to extract and destroy the osteological contents of Andean funerary space, or dispose of them in a secluded space in order to offset the deep-seated practices of ancestor veneration. Therefore, one would expect mortuary structures to be devoid of the majority of their original contents, making it difficult to recognize mortuary space without archaeological excavation (Gerdau-Radonic and Herrera, 2010). Additionally, looting that is encouraged by the modern illicit antiquities market has contributed to the ongoing destruction of ancient funerary contexts. Valued for their funerary goods and elaborately decorated spaces, looters will often destroy the original context of the funerary space in search of precious goods for sale. Methods of looting goods are contingent on the space available within tombs. In some contexts looters may have dragged bones or other cultural materials outside (Gerdau-Radonic and Herrera, 2010). The excavation of the entrance of SUP CF-01 revealed that 250 bone elements, the majority of which were smaller bones such as phalanx and teeth, were located within or external to the mouth of the cave, supporting this theory of moving elements. As no cranial maxilla or mandibular elements were recovered from this entrance location, it is logical to assume that cranial elements were once located here and the teeth became loose and disassociated from the cranium, indicating disarticulation and movement of the skeletal remains.

This analysis, while preliminary in nature, allows for an exploration into past depositional and post depositional practices, which are important to the overall interpretation of the creation and use of mortuary space. Therefore, this study suggests that if disturbed tombs are studied with the realization that they have a long history of intentional and unintentional processes that have influenced the current assemblage, a great deal of information can be learned. By incorporating new methods of analysis such as a GIS, future studies can explore more advanced questions, expanding our understanding of mortuary practices. This careful and systematic approach to excavation and analysis is particularly applicable to populations whose mortuary sites have been extensively disturbed and looted such as the Chachapoya.

Demographic Profile: Collective Primary Burial Site

Archaeological evidence suggests that SUP CF-01 is a primary collective interment context, supported by a careful comparison of the percentage of the bones present and the number of individuals estimated to be deposited in this mortuary context. There were a large number of bones and bone types, as well as a large number of individuals preserved in SUP CF-01, clearly demonstrating that this space was used as a collective burial site. Osteological sorting indicated that both large and small elements were present in similar frequency, and pairs were identified within the SUP CF-01 mortuary context, supporting the interpretation that this was a primary internment context once containing complete, articulated bodies.

This research utilized MNI estimates for this deposit instead of LI or MLNI. While analyses recommend multiple methods of analysis to determine the number of individuals present in a skeletal deposit, LI and MLNI can only useful if the elements are in good condition and mostly complete in order to establish pairings (Adams and Byrd, 2008). Many elements in SUP CF-01 were fragmentary or in poor condition, preventing osteometric pair matching from analyzing a large sample of the collected remains. This led to large discrepancies between MNI and LI and MLNI estimations, and statistical testing did not support a relationship between the methods for this context. Because MNI is the recommended method in cases of very fragmentary material, this thesis chose to only use MNI estimations during a discussion of the recovered skeletal elements.

When comparing the MNI results in terms of number of individuals present, it appears that selective large and small elements had similar estimations. The humerus, femur and tibia all estimated a minimum of 43 adult individuals, while the patella, talus and navicular estimated a minimum of 42 individuals. There was a large range in variation, however, with some carpal and tarsal elements also estimating the lowest minimum number of individuals. This may point to differential preservation, or perhaps a result of the incomplete recovery of the context.
SUP CF-01 BRI scores demonstrated a high level of representation for most elements, with emphasis placed on both large and small elements including tibiae (BRI=99), humeri (BRI=92), patellae (BRI=88), femora (BMI=99), and tali (BRI=71). There was no indication of selectivity in the adult bones that were deposited, and a large proportion of the expected skeletal material based on the estimated MNI of 43 adult individuals is present. These counts indicate that some if not all individuals were complete when deposited (Roksandic, 2001). Overall, adults were not

likely being deposited as fragmentary bundles or incomplete remains, and these results do not support that certain elements were being selectively deposited or removed from the context afterwards.

Conversely, it appears that was placed on deposition of juveniles in SUP CF-01 towards ulna (BRI=50), cranium (BRI=50), clavicle (BRI=71), femur (BRI=80), and humerus (BRI=87) elements, with all other element scores falling below 50. Carpals, tarsals, patellae, metacarpals and metatarsals are the least represented juvenile elements, and are often underrepresented in secondary burials (Roksandic, 2001). This could indicate that juveniles were deposited as secondary and not primary assemblages, that excavation and inventory practices may have overlooked small juvenile remains, or that differential preservation led to an underrepresentation of smaller and less dense juvenile remains (Roksandic, 2001). It is possible that those five aforementioned overrepresented juvenile element categories were selected for, or that juvenile skeletal material was not as well preserved in this humid environment, often cited as common reasons for the underrepresentation of subadult elements in archaeological assemblages (Angel, 1969; Moore, 1975; Wood et al., 1992). Taphonomic processes of water damage and root growth noticeably affected the composition of many large adult bones. It is possible that the combination of extreme humidity, water damage, the extensive root growth identified throughout the cave, and animal scavenging noted on the ends of many juvenile bones had affected the preservation of the smaller, less dense juvenile skeletal elements.

The pattern of MNI estimation of the remains recovered from the other cave context, SUR CF-01, appears to be noticeably different. The highest adult MNI estimations, similar to SUP CF-01, were estimated from large bone elements such as the left femur and left tibia (adult

MNI = 25); however, there was not a similar large estimation of MNI from smaller elements as seen in SUP CF-01. Instead, smaller elements were underrepresented such as the patella which estimated a MNI of eight, fourth metatarsal which estimated a MNI of two, talus which estimated an MNI of five, and the calcaneus which estimated a MNI of eight. Even long bones such as the radius and clavicle were notably underrepresented, with MNI estimations of 13 and 11 respectively. This suggests a different depositional pattern than that of adults deposited in SUP CF-01. It must be acknowledged; however, that there was not a complete excavation of SUR CF-01. It is possible that these elements were present and not recovered due to restricted time and resources.

The pattern of juvenile MNI estimation of the remains recovered from the other cave context SUR CF-01 presents a similar pattern to those recovered from SUP CF-01. Interestingly, the cranium presented the highest MNI estimation, indicating that eight juvenile individuals were deposited in this context. Expectedly, the right femur and left tibia both estimated a MNI of seven, indicating they were well represented in this assemblage. Other larger elements such as the right os coxa, right ulna, left scapula, and right humerus were equally well represented, estimating an MNI of six, five, five, and five respectively. Smaller bones, however, were similarly underrepresented when compared to SUP CF-01, with no metacarpals, metatarsals, or carpals recovered. Only one right talus was recovered from a juvenile individual. This could suggest, again, that this was a secondary burial context, or that because of limited excavation time, they were not recovered.

Several post-depositional taphonomic factors may have influenced the preservation of skeletal material and MNI estimation of SUP CF-01 as suggested earlier. Animal scavenging was identified on the ends of many adult and juvenile elements, suggesting that some elements may have been carried off or ingested by scavengers. Additionally, notable cortical erosion and water damage identified on many skeletal elements, especially those from the back portion of the cave, may have adversely impacted bone preservation, and some more fragile elements from this location may have disintegrated and disappeared. Both processes that affect preservation and dispersal of elements may have contributed to an underrepresentation of the number of individuals that were once deposited in this context. Additionally, due to the fact that this context is located on the side of a cliff, along a very narrow ledge, it is possible that due to natural and animal dispersal processes, some elements were lost to the valley below. The presence of bone elements outside and along the entrance of the cave indicates that some elements were moved to this location, either by human, animal, or natural dispersal processes, suggesting that it is possible other elements were also moved outside of the cave entrance, which have since been lost.

In terms of differential burial practices of adult and juvenile individuals, currently there is not yet evidence of specific secondary juvenile deposits in Chachapoya mortuary practice. However, research by Nystrom et al (2010) at the mortuary Late Intermediate site of Laguna Huayabamba indicated differential treatment of juvenile skeletons. While adults were transformed into intentional mummy bundles during Inca times, children were placed at the site with little or no postmortem processing. An analysis of the remains at Laguna Huayabamba did not find any evidence that they had been wrapped with either cordage or textiles at any point. This could indicate differential treatment in Chachapoya mortuary practice of juvenile remains, where they may have been processed differently than adults. Differential mortuary treatment may account for the differences noted in the bone representation index.

Although the remains were disarticulated, fragmented, and commingled, skeletal characteristics of isolated elements indicated that there was a range of demographic categories present in this deposit, pointing to a community mortuary complex. The funerary context at SUP CF-01 contained adult female and male skeletal elements, with morphological characteristics consistent with adults from all age categories, and juveniles ranging from infant to late adolescent. As stated earlier, a demographic reconstruction would not have accurately represented this context due to the commingled nature of the deposit; however, it appears from the sample collected that there was no singular demographic category overly represented. Similarly, the context at SUR CF-01 also contained elements from both males and females, with skeletal characteristics indicative of a range of age categories. Analyses of skeletal remains from inventoried mortuary mausoleums demonstrate that different demographic categories were present in these contexts as well, including males, females, adults and subadults. With an estimated total of approximately 120 structures housed in this complex, the size and complexity of the use of vertical space indicates that it may have been used over a long period of time, and is indicative of a large regional community where it is possible that many families buried their dead in collective familial tombs. Demographic analysis of the sampled remains further indicates that a range of community members were included in this mortuary practice.

When further considering the question of who was deposited in this context, it becomes pertinent to consider the possible social status of the individuals. The correlation between socioeconomic status and mortuary treatment has not yet been verified in most Chachapoya mortuary contexts (Nystrom et al., 2010). While ceramic evidence from Los Pinchudos and the presence of *khipus* at Laguna de los Condores indicates that the individuals interred in these sites would have been from local elite *ayllu*, this has not been correlated to other Chachapoya specific mortuary sites (Morales, 2002). However, Crandall (2012) suggests that there was a political economy displayed in the placement and management of Chachapoya burial complexes, indicating that not all members of the community would have had the ability to deposit their dead in these elaborate complexes. Using the example of Pueblo de los Muertos and Karajia to support this theory where only a small number of individuals were interred, Crandall (2012) emphasizes that many of the material goods found with these contexts signified prestige, coming from Cajamarca and other areas nearby. As such, Crandall (2012) notes that similar to other pre-capitalist agrarian societies, the rights of land and access to labor in Chachapoya society were maintained through social relationships, and that these complexes solidified and maintained the system of social reciprocity and exchange.

Cultural material recovered from SUP CF-01 included a few ceramic sherds, some small animal bones, one carved bone needle and a few pieces of lithic material. Only one ceramic sherd was diagnostic as a common utilitarian vessel, therefore there was no way to estimate how many ceramic objects were originally placed in this mortuary context. However the caves most likely once held some offerings to the ancestors, a common practice of ancestor veneration, however like many pre-Historic Andean sites, has been looted for these materials. Animal skeletal remains collected from SUP CF-01 were primarily from smaller mammals that most likely lived and died in this deposit, however there were other instances of a llama skull in structures SUR EF-18 and in EF-01 of butchered llama/deer leg bones, with a large presence of llama feet which is a notable difference between natural and constructed mortuary space at this site. The presence of small mammal skeletal remains at SUP CF-01 indicates that possibly food offerings were present.

No textile, cotton or rope remains were recovered from SUP CF-01 like those found in some of the other mortuary structures at La Petaca, which is contrary to the common Chachapoya mortuary practice of depositing their dead wrapped and bundled. This could have resulted from several factors: (1) that these easily perishable items may have not preserved well in this humid cave context, (2) that additional commingling occurred by looters removing them for sale, or possibly, (3) that these remains were deposited without traditional textile wrappings, possibly indicative of a difference in social status than those that were wrapped in other areas of the complex.

As discussed earlier, Tainter's (1973) theory of social identity and energy expenditure suggests that individuals of higher status will have greater group involvement in their preparation after death, resulting in a larger amount of energy expenditure than those of a lower status. Therefore, it would be expected that those deposited within constructed mortuary space at La Petaca (*chullpas*) would be of higher social status than those deposited in natural space that requires less energy expenditure. The importance of rock outcrops, caves and mountains in Andean mythology, however, prevent this from being an accurate measure of labor input for this region. As Gerdau-Radonic and Herrera (2010) argue, burials in natural contexts may have been a way to keep the remains of ancestors in close proximity to rocks or mountains that were associated with special meaning. Therefore, instead of interpreting a difference in status between natural and constructed mortuary space, it is possible that the natural spaces held symbolic meaning and that is the reason for the large deposit of individuals within these small spaces, such as that found in SUP CF-01.

At the nearby Chachapoya site of Laguna de los Condores, which has been slightly less looted than La Petaca, 213 mummies have been recovered, where two level stone mausoleums similar to those found at La Petaca were used to place their mummified dead (Bjerregaard and Von Hagen, 2007). The amount and type of offerings associated with the mummified remains indicate that this burial site was used for and by the elite, which was also supported by the large number of pottery, gourds, carved wooden figures, baskets, and *khipu* offerings that were strewn along the narrow ledge (Bjerregaard and Von Hagen, 2007). Perhaps the structures and caves at La Petaca once held similar offerings, the majority of which have since been looted.

Caves and Tombs

With an estimated total of approximately 120 structures housed in this complex, the size and complexity of the use of vertical space is indicative of a large local community and a unified group collective, where it is possible that many families buried their dead in this complex. The noted disturbance, and relative pilfering of many of the stone structures in comparison to the very disturbed however relatively full cave contexts signifies that there may have been a difference between these contexts. If the complex housed only elites of the local *ayllu*, why would the stone structures have been so disturbed and a majority of the bone elements missing, while the cave contexts while noticeably disturbed did not have a noticeable absence of bone elements? It is possible that the destruction of these structures, through either natural or cultural forces, may have contributed to a loss of cultural material. Cultural forces such as *Extirpación* policies of the Spanish may have called for a removal of skeletal material from the constructed *chullpas*; however again, the question becomes why were the caves not similarly disturbed and emptied of their contents? Conversely, natural forces such as the location of these structures nestled within the natural formation of the cliff face, suggest that it is possible that gravity, water, and other natural processes acted upon the material, and some became lost over the cliff face. However, because of the disturbed and looted nature of this complex, it is difficult to conclude one way or another if cultural policies or natural processes caused the differential preservation of natural and constructed mortuary space at La Petaca. Due to these differences noted between constructed mortuary contexts and natural cave formations, further explorations examining the skeletal remains, as well as more broad studies exploring mortuary complexes as a whole may yield additional information concerning this complex question.

Spatial Analysis: Spatial Dimensions and Disturbance of the Internment Context

While primary contexts commonly include complete, articulated skeletons, disturbance and disarticulation can be caused by a variety of agents to create a commingled primary context. Commingling of skeletal elements can occur in several ways: it can be intentional, it can be a byproduct of looting which causes great disassociation and fragmentation, it can occur as a byproduct of cultural processes such as making room for more bodies or offerings, which often cause minimal damage or disturbance to the context, or it can result from natural processes. While natural processes such as natural decomposition of the body, animal activity, rock fall, tectonic activity, or water movement, can be inferred in many cases, Duday (1979) notes that it does not account for excessive fragmentation and disturbance. He suggests that human activities were often the source of this disturbance, a result of rearranging graves for successive burials or removal of bodies or objects.

Evidence of animal chewing and gnawing supports that natural taphonomic processes played a role in the fragmentation and disturbance of SUP CF-01. Natural decomposition processes of the deposited bodies would have also contributed to the commingled nature of the remains, however the movement of large bones such as femora and tibiae indicate that intentional human activity might have been also a contributing factor. The fact that the distance between large paired elements such as humeri, femora and tibiae was greater than the expected 1 meter area and related elements were distributed between both upper and lower layers indicates that human activity played a role in the creation of this commingled assemblage. While gravity often causes small bones such as carpals and tarsals to filter down to lower layers, only a disturbance could cause larger bones such as femora and tibia to migrate to different depths.

Statistical analysis indicated that the distance of dispersal was not statistically significant for the element categories, or for the deposit as a whole, indicating that it was a more random dispersal. This suggests that elements were not moved to certain areas based on the type of bone. Additionally, Appendix: Maps 1-5 further indicate that there was not a specific patterning to the dispersal of bone elements. No location was emphasized with either bone category or age, indicating that it was a random process.

The size of the mortuary space available further supports that that this context was likely the result of intentional human activity. Based on the size of a fleshed adult human body seated in a flexed position, the area within the cave could not have supported the estimated MNI of 55 adults and juveniles. Therefore, this thesis argues that the only way for the estimated MNI to be deposited in this location would have been from a gradual accumulation of individuals. Processes of accumulation indicate that this space was revisited through time, sometimes with new bodies, other times possibly to accommodate those already deposited. These processes would have served to solidify the dead in the memory of the living and maintaining this memory through the regular and timely maintenance of this space. The sequential placement of individuals in this space, despite the consequence of commingling and fragmenting, points to the sacredness of SUP CF-01. Despite other locations along the complex that could have served as spaces for additional mortuary structures, this cave was chosen time and time again as the location for the internment of bodies. This highlights that the natural space were selected for in this complex, rather than creating additional mortuary space along the horizontal ledges.

These data support the argument that multiple processes, including human activities and natural events, created the commingled context of SUP CF-01 as a result of successive burials where skeletal elements were moved to make room for additional bodies, characterizing this deposit as a diachronic group burial that has since been further disturbed, most likely by looters.

Chachapoya Mortuary Practices: Visitation and Ancestor Veneration

Based on this bioarchaeological analysis we can infer that La Petaca was a space that was visited and ancestors venerated. Through these events of deposition that become formalized with practice and repetition, social memory became ingrained within the body of the deceased, creating and maintaining a communal identity. Through these processes, the individual body is fragmented and transformed into the collective. This signifies the importance of the group in mortuary practice, and emphasizes the transformation from the individual to the collective.

The practiced re-visitation of certain ancestors would have perpetuated the *ayllu* social structure, maintaining a society based on kin relationships and reciprocity with familial ancestors. Re-visitation of ancestors is evidenced by the collection of ceramic and mate fragments form several mortuary contexts at La Petaca, which indicates the presence of offering vessels. On the other hand, the manipulation of the bodies, transforming them from individual bodies to a cohesive group composed of singular elements, emphasizes the importance of group identity over the individual. The commingled context of SUP CF-01 signifies that this context was used and reused, despite its limited size, as a way to maintain this group identity through the continual use of this space over time.

The presence of food offerings, interpreted from the few ceramics and animal remains collected from SUP CF-01, are not naturally occurring at tombs. This suggests offerings were made during, and most likely after, ‘burial’ as part of an ongoing mortuary process. These bodies become agents of memory for those individuals that revisit and reuse this space, and who participate in new mortuary practices and the deposition of bodies into new mortuary space (Crandall, 2012). In the Andean region, bodies are commonly ascribed with their own form of social agency, and it is argued that they embody and become expressions of institutional power (Robb, 2004; Lau, 2013). By the practiced re-visitation and deposition of new internments, these practices become expressions of social memory and visual monuments to collective identity. Practiced re-visitation of certain ancestors perpetuates the *ayllu* social structure, maintaining a society based on lineage based kin relationships and reciprocity with familial ancestors.

This begs the question, why was this particular space continuously used to deposit the dead, despite its size? Because of the relatively difficult accessibility of this space, evidence of revisitation emphasizes the importance of group identity over individual identity, and indicates the sacredness of the physical space. A review of the archaeological evidence demonstrates that many Chachapoya mortuary sites were located on cliff faces, where structures and spaces would naturally be spatially restricted (Crandall, 2012). This indicates that visibility and perhaps verticality was of great importance to Chachapoya funerary rituals, surpassing restrictions of necessity and accessibility. It also suggests that these natural spaces held special meaning, and that by choosing to deposit dead within natural cave formations such as SUP CF-01, the bodies were placed as close as possible to the sacred space. Despite the spatial restrictions, La Petaca, and more specifically SUP CF-01, was chosen as the location for a large and complex mortuary site, signifying that it most likely had some cultural importance.

Summary

This chapter discussed the practicality of reconstructing mortuary practices from disturbed contexts, exploring the ways in which commingled remains can inform us about past mortuary practices. From the data gathered, this thesis was able to reconstruct the demographic profile present at SUP CF-01, and through an analysis of the frequency of bones present, it was determined that this context was likely a primary collective deposit. By considering the spatial extent of the cave, and the spatial distribution of elements, this study was able to interpret that this commingled context was most likely the result of continued visitation to the space, and the purposeful manipulation of bone elements to make space for new bodies. Incorporating cultural material from SUP CF-01 as well as artifactual data from other contexts across this mortuary complex, this thesis explored the role of this collective burial within the La Petaca complex and

Chachapoya culture by specifically considering the processes of visitation, ancestor veneration, and social memory. From these data, it shows that a careful documentation of commingled contexts can allow researchers to consider more complex theoretical questions about mortuary patterns and the role they play within the cultural landscape. In the final chapter of this thesis, conclusions are presented; highlighting the limitations of this research and future considerations.

CHAPTER SIX: CONCLUSIONS AND CONSIDERATIONS

The main focus of this research study was to explore Chachapoya funerary practices at the mortuary complex of La Petaca, which was composed of two related lines of research. The first objective explored demographic characteristics at SUP CF-01, and the second objective explored the spatial relationships between comingled elements in this natural mortuary context. This research hypothesized that by utilizing a careful systematic documentation and excavation of the deposition context, and by employing a total station to record the 3D spatial location of the mortuary space and collected elements, this method could improve the way in which research commonly analyzes commingled contexts. Often overlooked for their applicability in archaeological interpretation, this thesis attempts to demonstrate that disturbed commingled contexts are sources of information beyond simple bone counts. This research employed Geographical Information Systems and osteometric pair matching to address the research questions posed in Chapter One of this thesis.

All expectations were addressed by the spatial and demographic data, which support the original hypothesis. As the results of this thesis show, GIS analysis mapped the location of skeletal elements within an interpretive environment that facilitated a more accurate preservation of provenience data. By doing this, distance measurements were estimated, as well as interpretations of post depositional processes that would have contributed to the distribution of collected elements. Paleodemographic analyses indicated that a range of ages were deposited in SUP CF-01, as well as both males and females, a pattern that was mirrored in SUR CF-01. Analyses of taphonomic conditions proved to be an integral component to the interpretation of

SUP CF-01, and as expectations suggested, there were a variety of taphonomic conditions present. Additionally, both small and large elements were collected, which supported my original expectation that SUP CF-01 was a primary burial context. Lastly, osteometric sorting proved a viable method of pair matching as a result of carefully inventorying skeletal material, which facilitated subsequent analyses of distance measurements and post depositional processes.

The BRI of element types recovered compared to the estimated MNI count of 43 adults and 12 juveniles supports that cave SUP CF-01 was a primary mortuary context where complete and articulated bodies were deposited, and commingled as a result of successive burials in addition to natural decomposition. Conversely, the underrepresentation of smaller elements in SUR CF-01, a cavern much less accessible than SUP CF-01, indicates that differential mortuary practices may have been employed at La Petaca, however a complete excavation of that other cave context would be needed for a more definitive comparison. Spatial analysis of paired elements indicates that while elements were commingled and somewhat distributed distances throughout SUP CF-01, the elements were not extensively disturbed. Measured distance between related elements indicated that most were within the one meter area and elements were for the most part located within the same excavation level. Elements measured outside of that expected area were random, indicating that they were not a result of a specific mortuary practice of moving specific elements to designated spaces within the cave. These lines of evidence suggest that the deposition was constructed by multiple forces, not solely by natural factors, and not by extensive looting, but most notably by the practice of rearranging previously deposited bodies to make room for more individuals.

The data presented in this study help reconstruct cultural practices employed by the Chachapoya to create and transform this visually striking geologic formation into an expression of social memory and identity. By transforming the natural ledges into *chullpas* and utilizing natural caves as mortuary space and depositing their dead within its confines, these actions not only attribute importance to the site, but also indicate that this particular physical space was important to the Chachapoya, indicated by the conscious decision to use and reuse a place despite its spatial limitations and difficult accessibility.

Limitations and Future Considerations

The methods utilized for this research were adapted to environmental and time restrictions. It was not feasible within the field time allotted to record the location of each element collected as originally intended. Instead, the total station was used to record the shape of the cave, and the location of elements on the surface of each artificially created level. The process of collecting elements by quadrant facilitated an analysis of the spatial distribution of elements within an approximate 50x50 cm area; however, the original 3D location was lost for the majority of elements by not documenting the exact location of each collected bone. Perhaps if the context was smaller and elements less numerous, it would have been useful to record the location of each element. Because of the size and deep depth of the deposit (maximum of 80 cm) at SUP CF-01, this would not have been effective with the time available.

Additionally, the verticality of this site proved challenging. The accuracy of the total station is increased when it can remain in the same location for the duration of the project. Environmental, locational, and multiple political factors necessitated that the total station be moved each work day; therefore measurements were taken from a variety of locations from varying heights. In order to account for these issues, mathematical calculations were necessary to standardize all measurements. This method could have resulted in human error depending on the precision and accuracy of the calibration measurement, however care was taken to make sure it is as precise as possible.

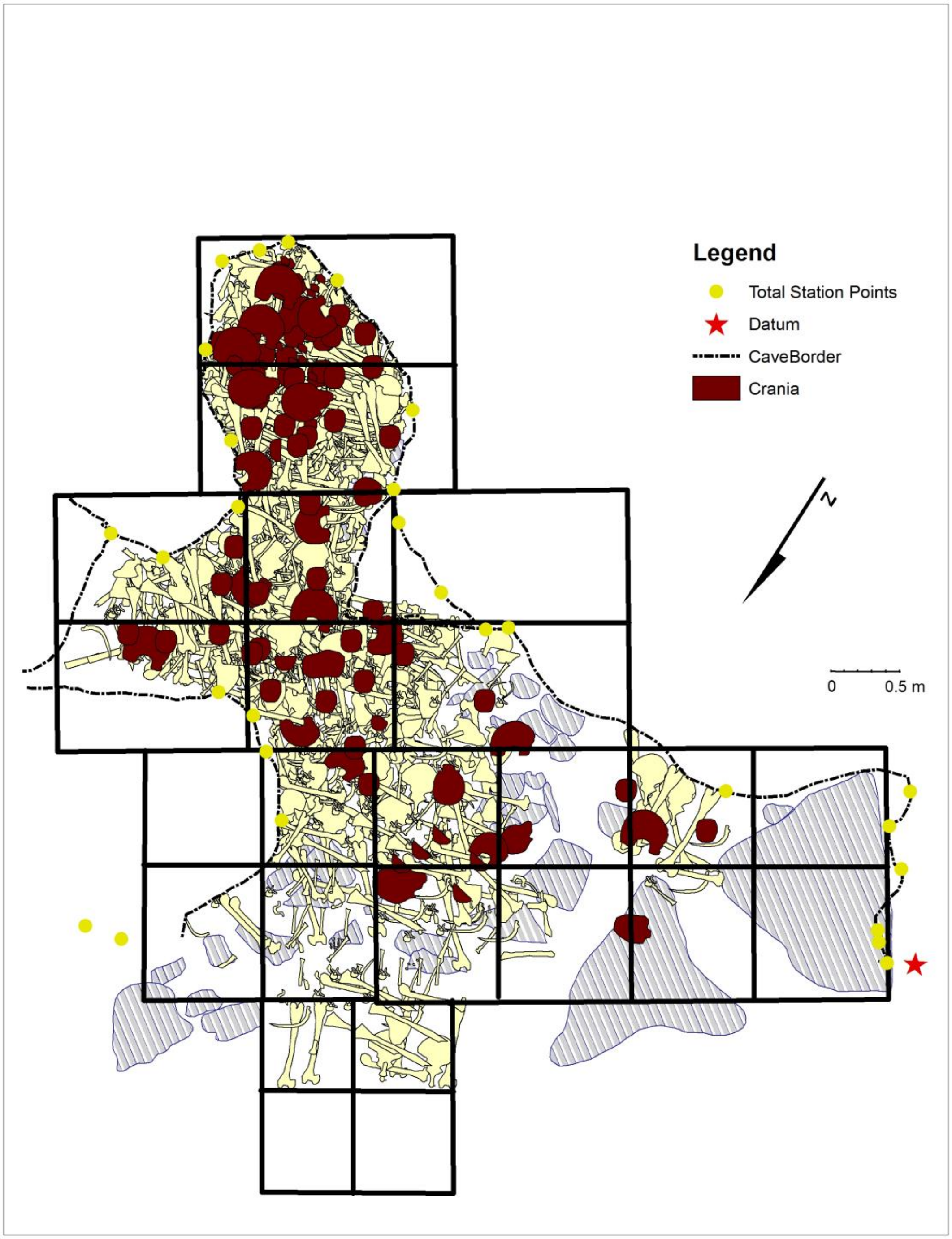
Also, points taken with a total station are most accurate when a prism is used. Unfortunately, the nature of this study required the total station to mark points directly on the skeletal element, rock and cave, preventing the use of target prisms, thereby decreasing the accuracy of the method. Nothing can account for this specific issue; however, researchers made sure that each measurement taken was placed on the element as accurately as possible. While this method of data collection was not error free, the spatial data we were able to record allowed us to explore questions of disturbance of this burial context.

Further research at La Petaca is necessary to explore its role within the Chachapoya mortuary landscape. Additional radiocarbon dating would be helpful to reconstruct diachronic change across the complex, and may elucidate differences between constructed and natural mortuary contexts in this complex. Also, there is a similar mortuary complex two kilometers south from La Petaca referred to as Diablo Wasi that has not yet been archaeologically surveyed. An exploration of that location may provide a better context with which to interpret the mortuary practices at La Petaca.

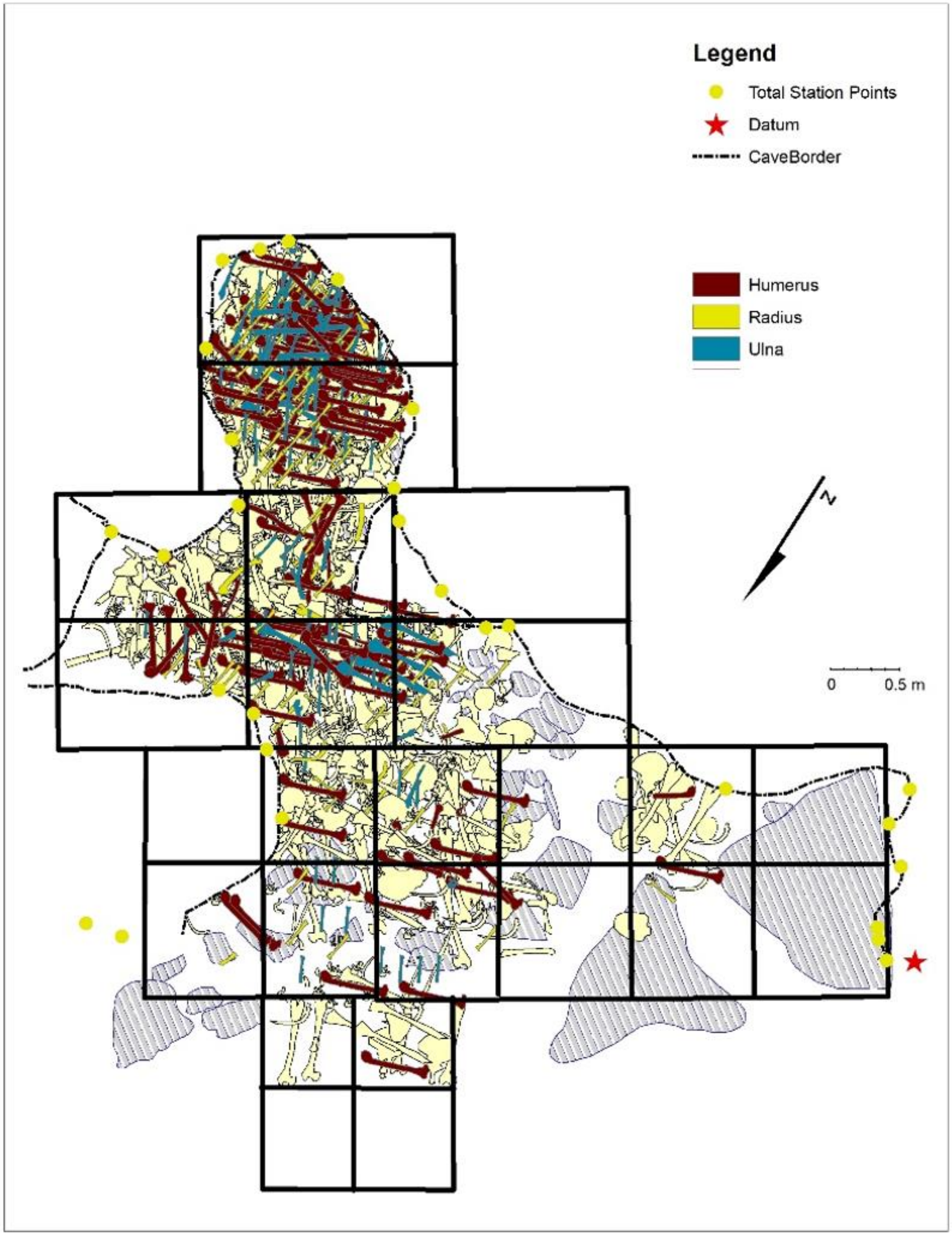
Final Comments

While there is always additional information that can be learned, this research was able to successfully explore questions concerning mortuary practices at the site of La Petaca. As this was the first archaeological investigation at this site, the data learned from this project are a significant contribution to what is currently known about ancient Chachapoya mortuary practices. GIS proved to be an effective tool, helping analyze the measurement of distance between paired elements and exploring the distribution of the commingled elements. The dual approach of this thesis highlights the importance of multiple lines of evidence in a bioarchaeological examination of mortuary practices. Despite the commingled and disturbed nature of this context, careful documentation and novel methods of analysis expanded the realm of interpretation beyond basic MNI counts to more theoretical questions concerning mortuary practices. Overall, this research presented a successful bioarchaeological analysis of SUP CF-01, illustrating the importance of a holistic perspective and methodological innovation for understanding the complex rituals related to Chachapoya social identity and funerary landscape.

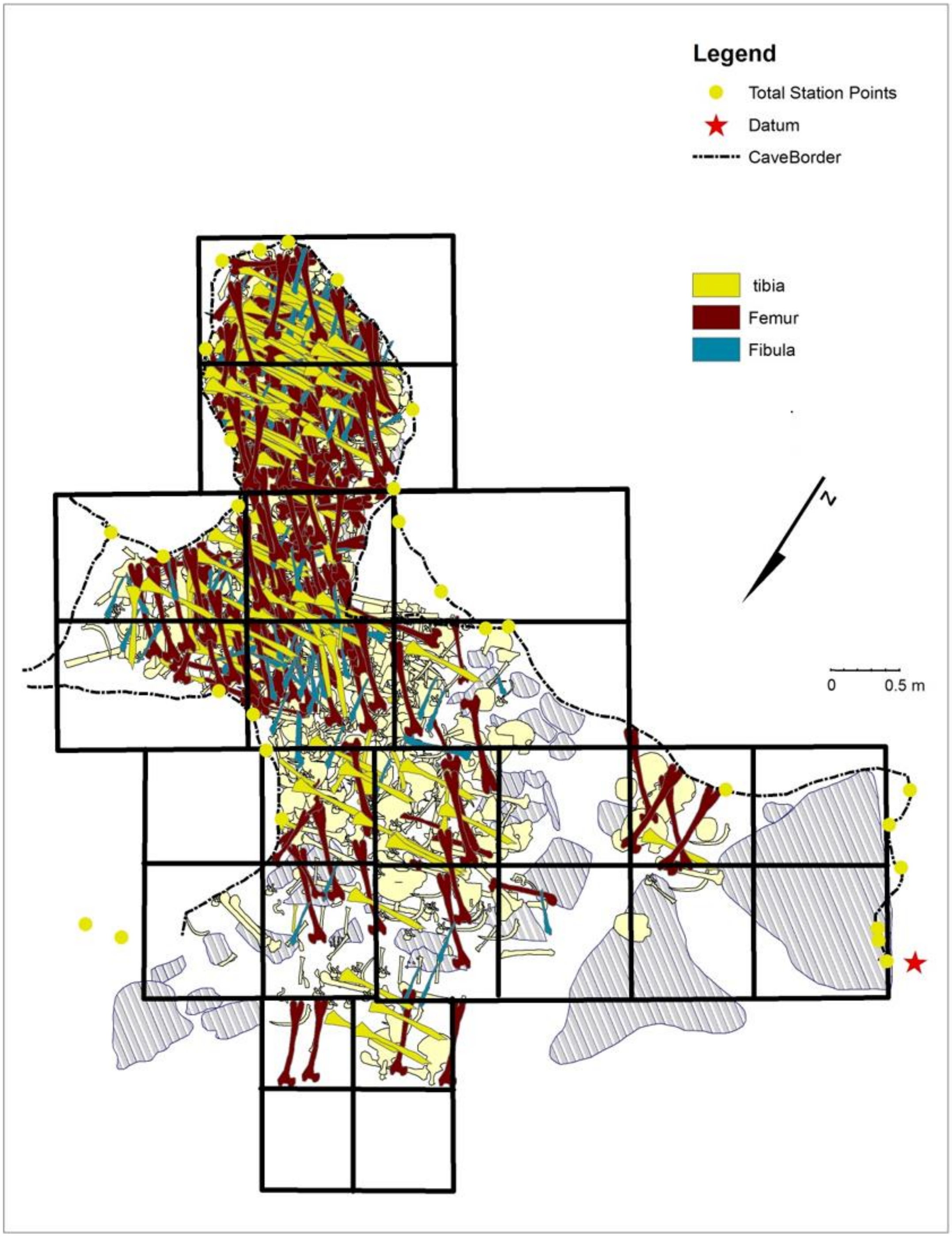
APPENDIX: MAP SERIES ILLUSTRATING THE APPROXIMATE DISTRIBUTION OF SKELETAL ELEMENTS IN SUR CF-01 AND THE DISTANCE BETWEEN PAIRED ELEMENTS



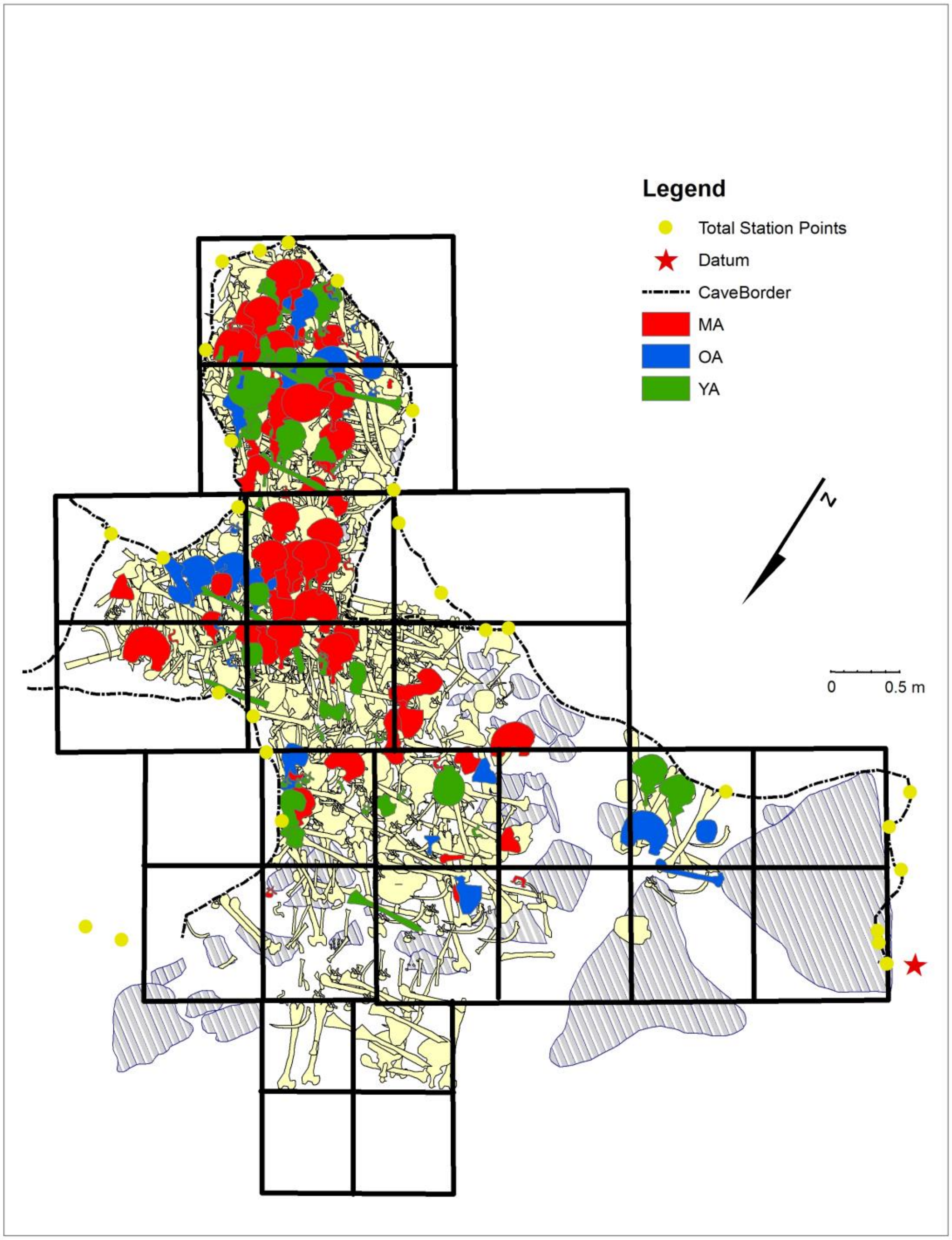
Map 1 Approximate distribution of crania elements displaying their location based on the quadrant of collection, not their original orientation. Note the greater concentration of crania in the back portion of cave and scattered distribution throughout the central and front units.



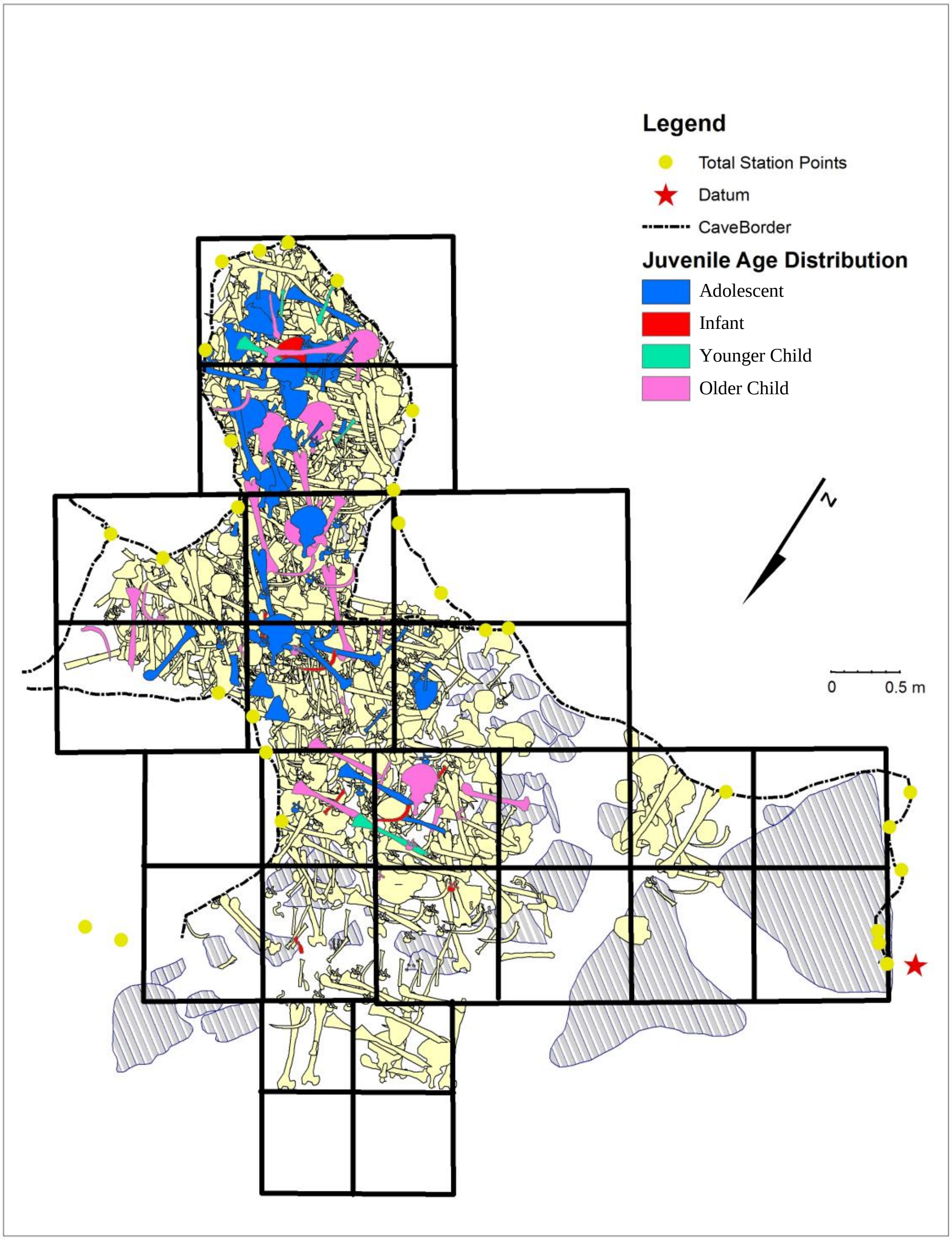
Map 2 Approximate distribution of upper limb elements: humeri, ulnae and radiae. This map displays their location based on the quadrant of collection, not their original orientation. Note the concentration of upper limb elements in the back portion of the cave, and the scattered distribution of humeri, radiae and ulnae in the front and central portion of the cave.



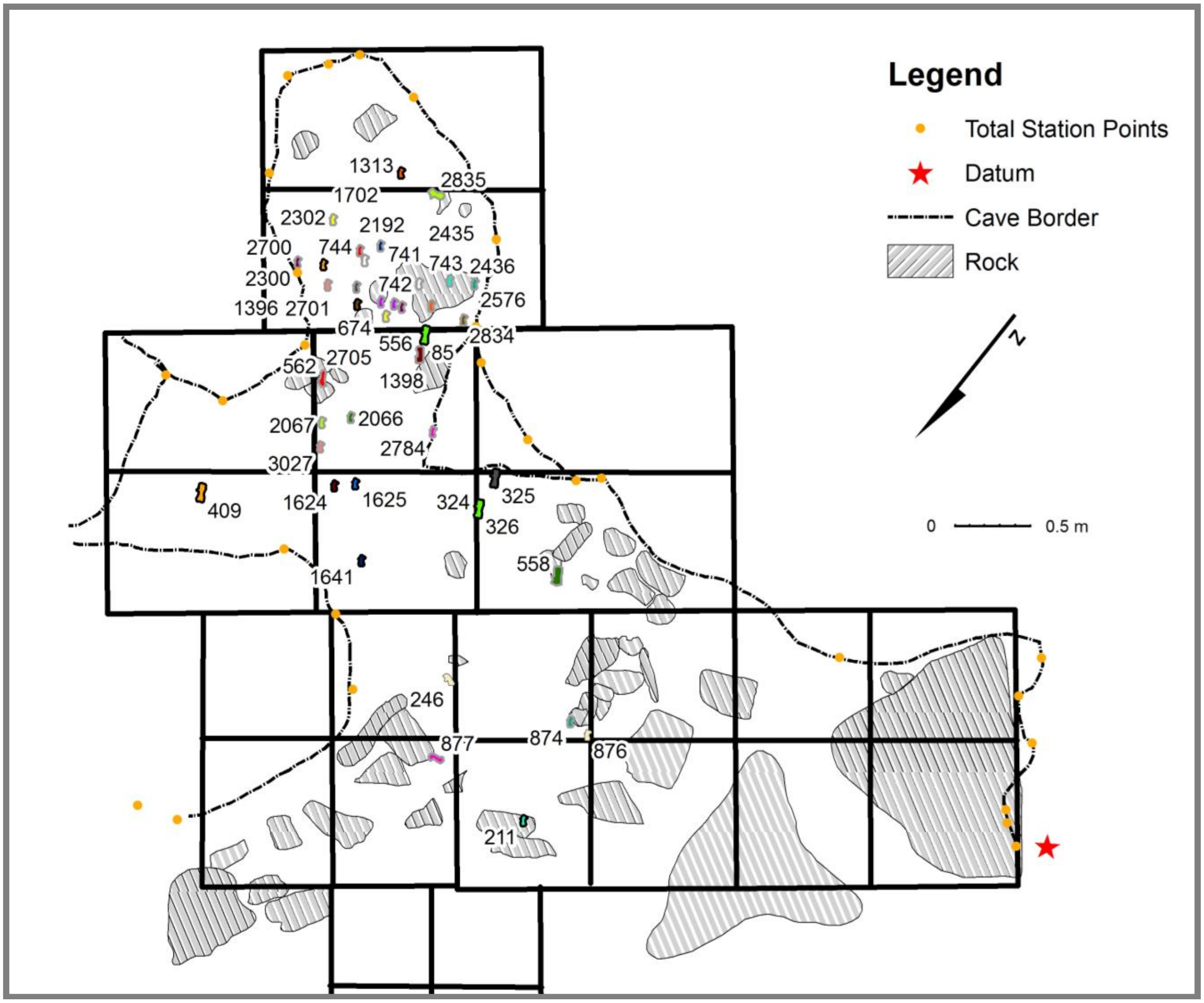
Map 3 Approximate distribution of lower limb elements: femora, tibiae and fibulae. This map displays their location based on the quadrant of collection, not their original orientation. Note the concentration of elements in the back portion of the cave, and the scattered distribution of femora, tibiae and fibulae in the front and central portion of the cave.



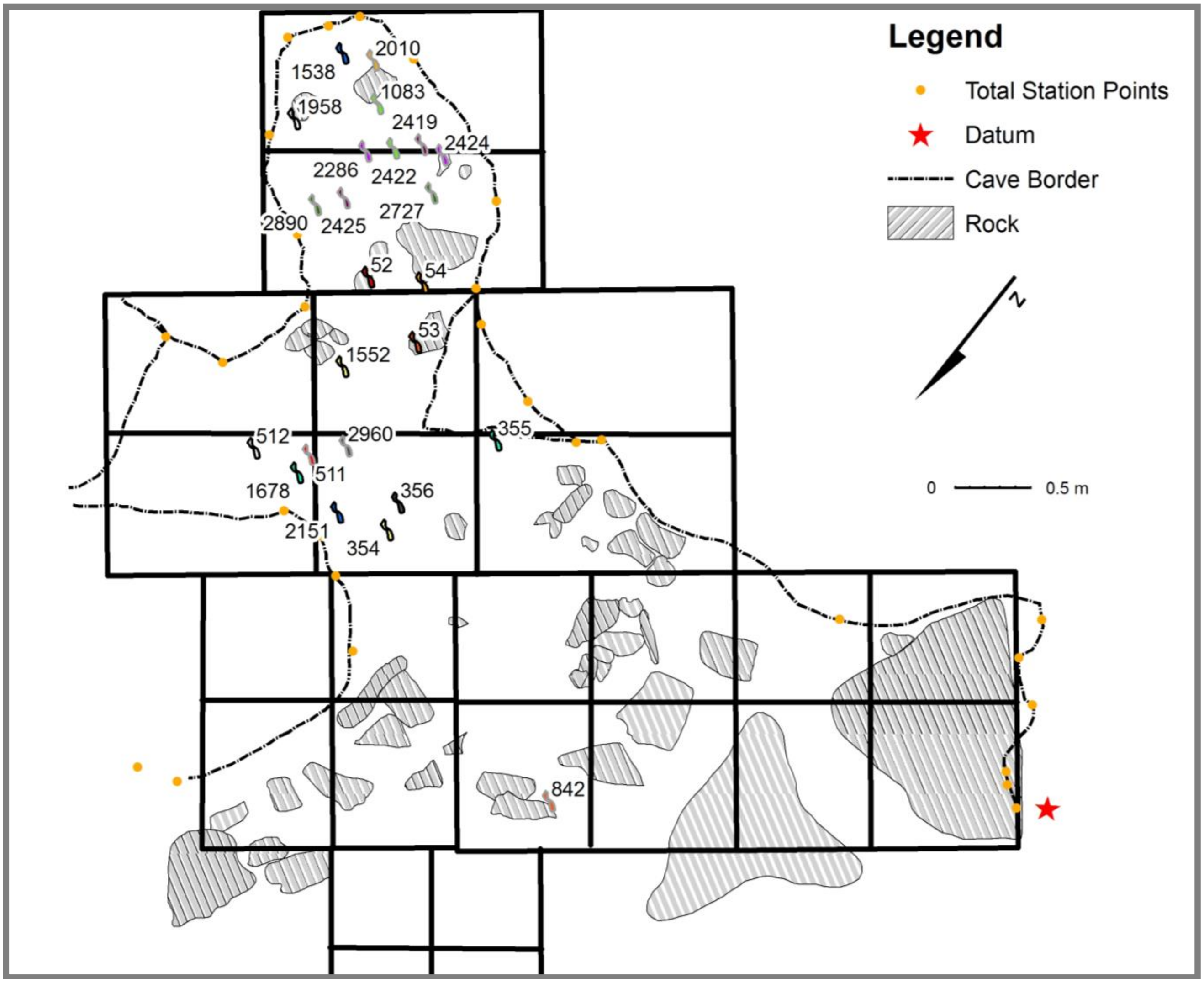
Map 4 Distribution of adult age categories for ossa coxa and cranial elements. This map displays their location based on the quadrant of collection, not their original orientation. Note the scattered distribution of MA (Mature Adult), OA (Older Adult), and YA (Young Adult) elements.



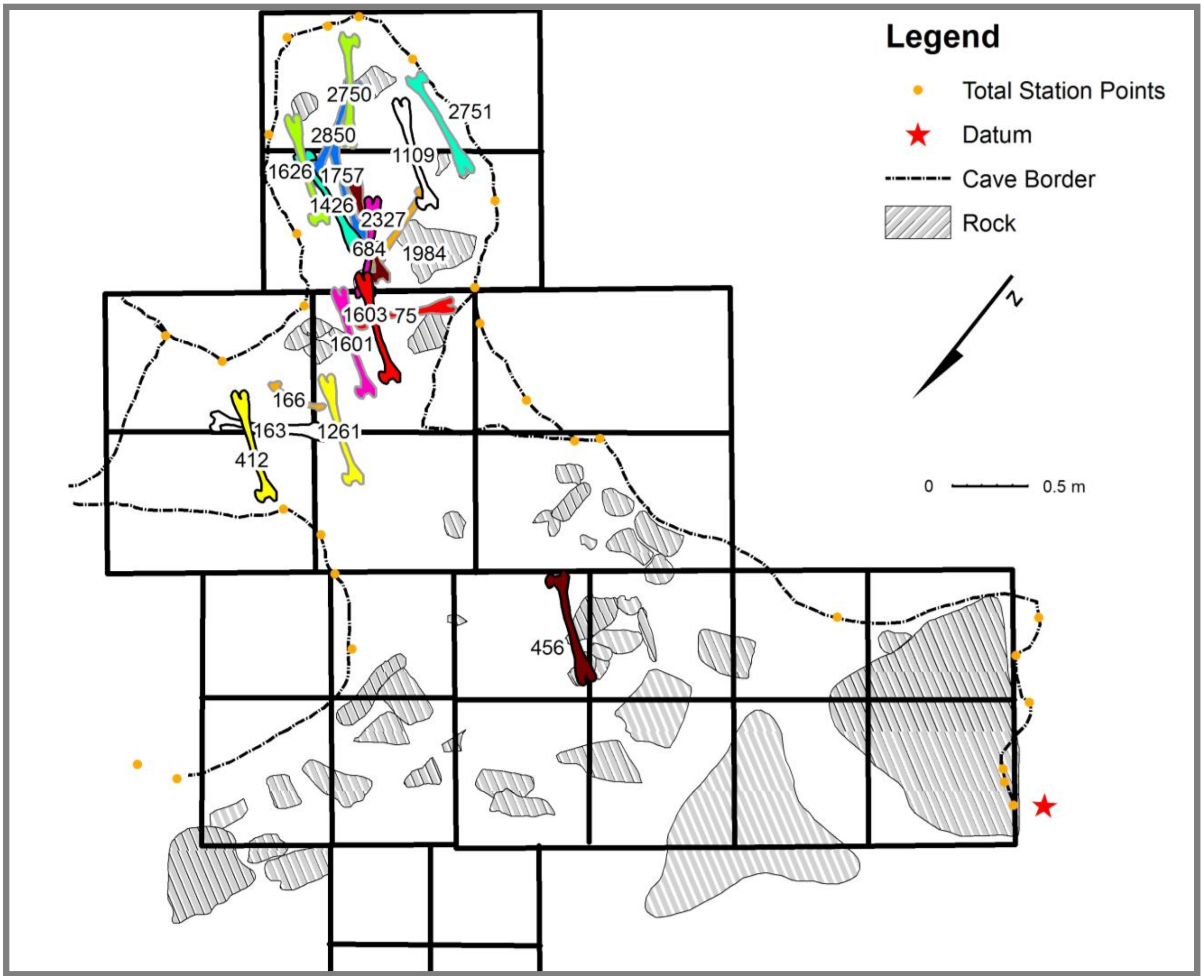
Map 5 Distribution of juvenile age categories. This map displays the location of skeletal elements based on the quadrant of collection, not their original orientation. Note the scattered distribution of Adolescent, Older Child, Younger Child, and Infant skeletal elements.



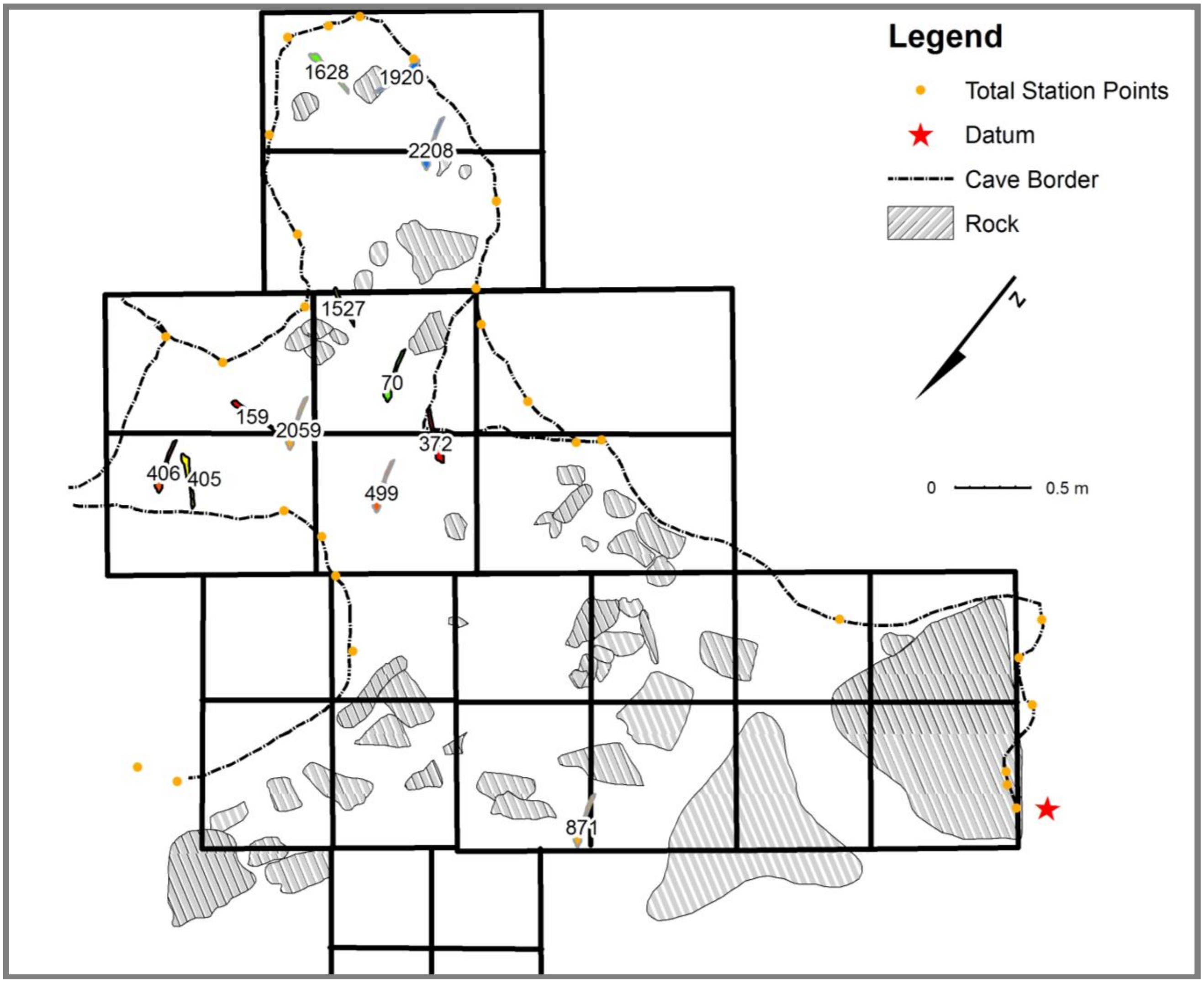
Map 6 Distribution of related calcaneus elements, pair matched elements are indicated by the same color, levels are indicated by the outline border. This map displays the location of skeletal elements based on the quadrant of collection, not their original orientation.



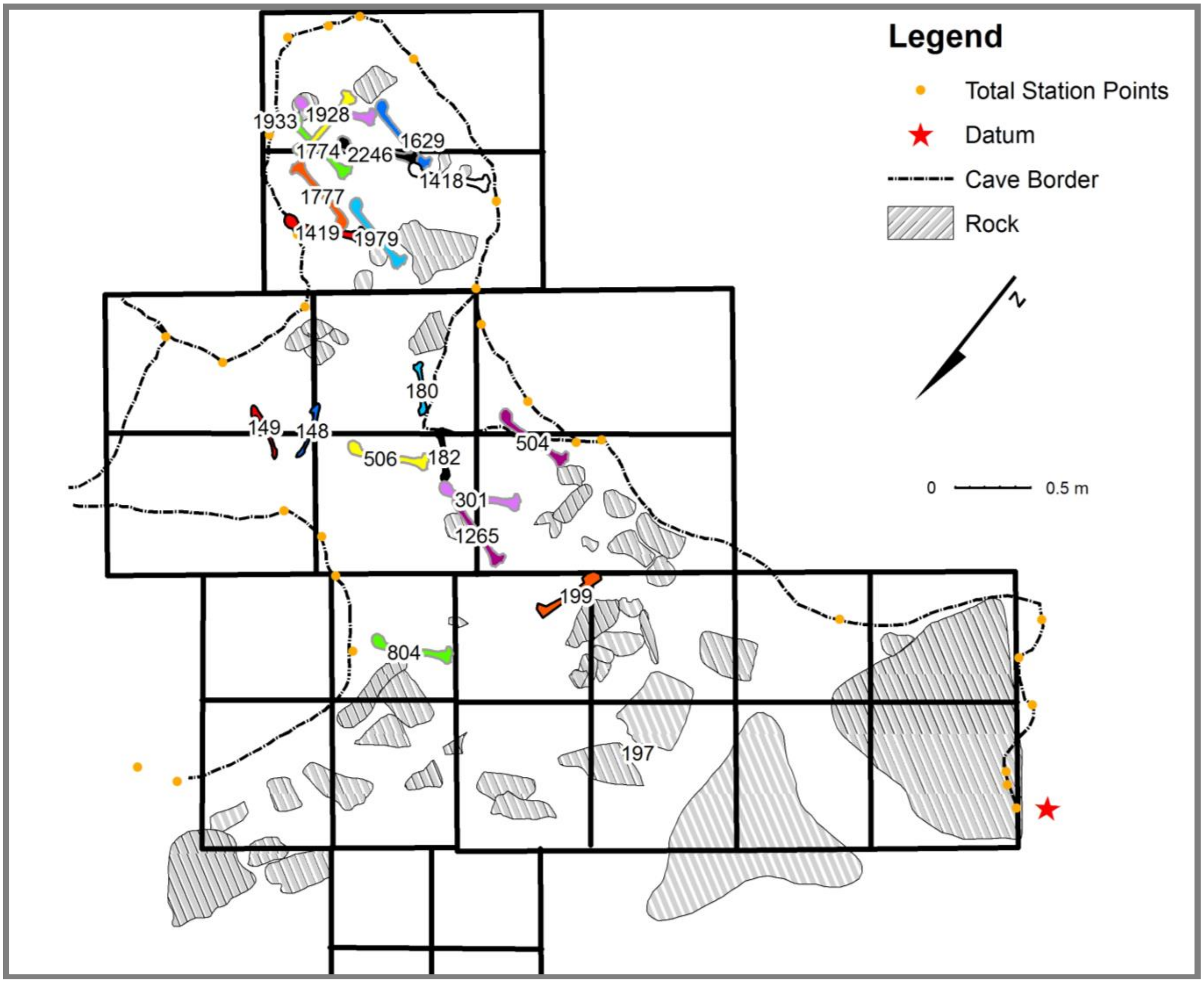
Map 7 Distribution of related clavicle elements, pair matched elements are indicated by the same color, levels are indicated by the outline border. This map displays the location of skeletal elements based on the quadrant of collection, not their original orientation.



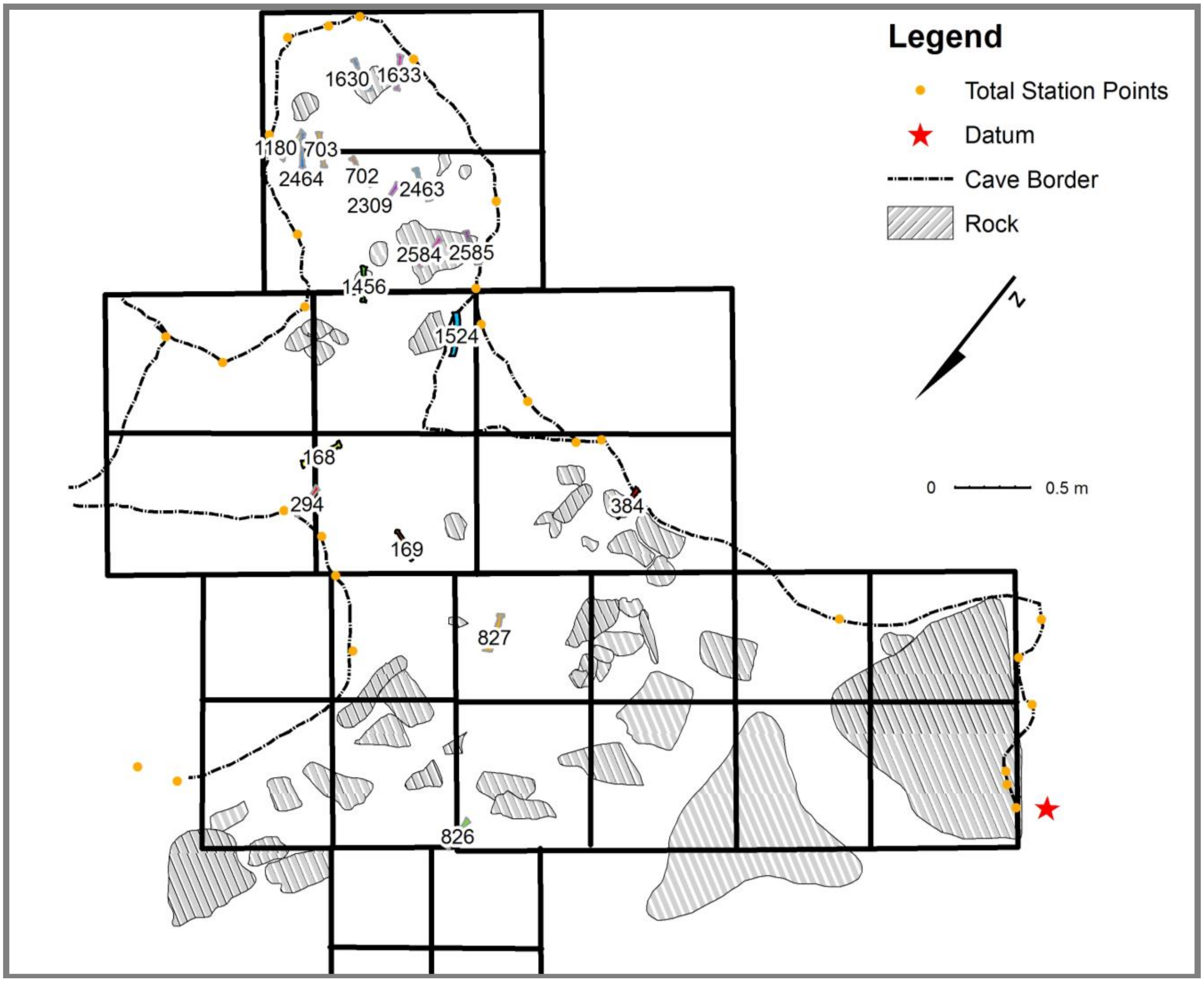
Map 8 Distribution of related femur elements, pair matched elements are indicated by the same color, levels are indicated by the outline border. This map displays the location of skeletal elements based on the quadrant of collection, not their original orientation.



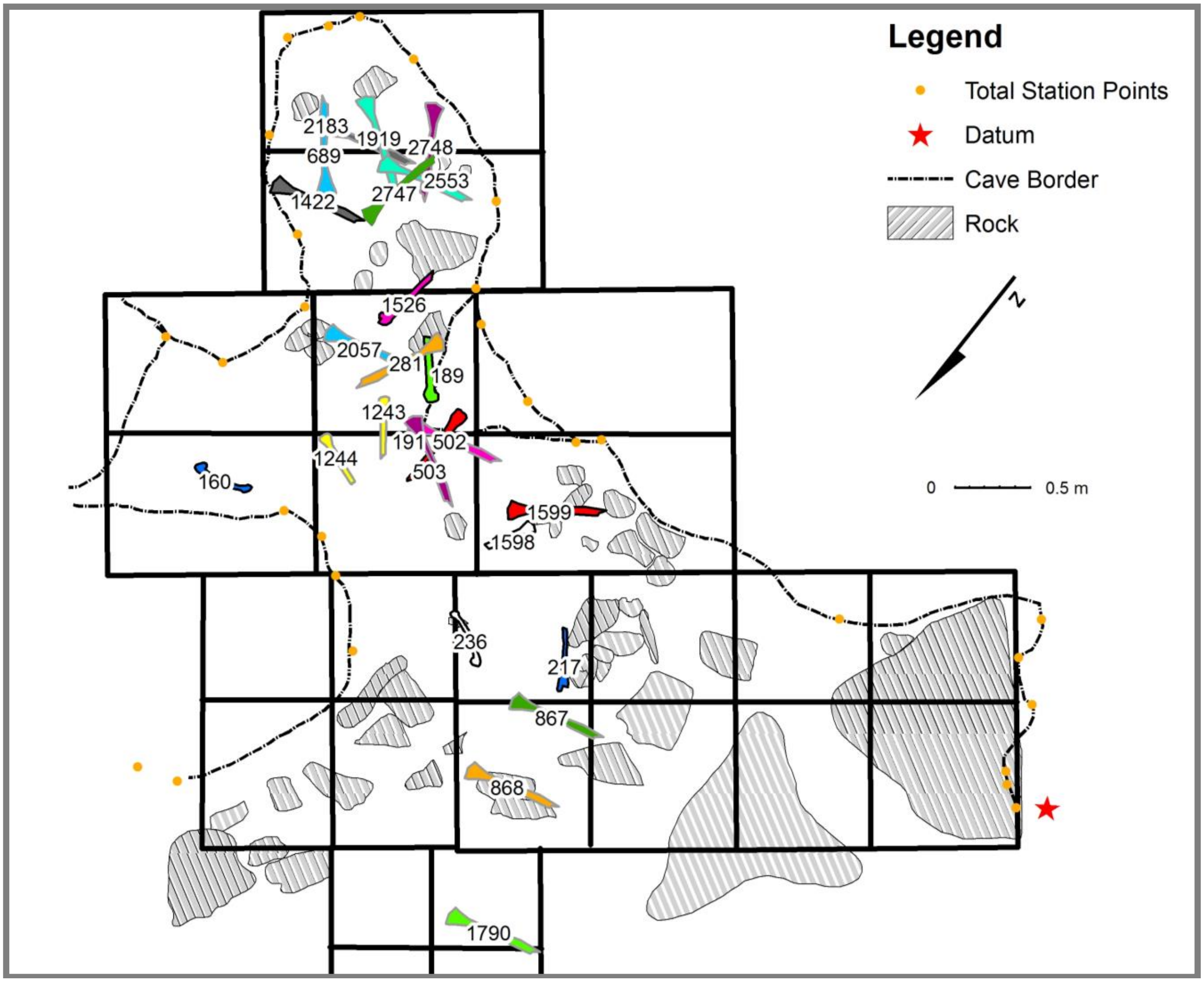
Map 9 Distribution of related fibula elements, pair matched elements are indicated by the same color, levels are indicated by the outline border. This map displays the location of skeletal elements based on the quadrant of collection, not their original orientation.



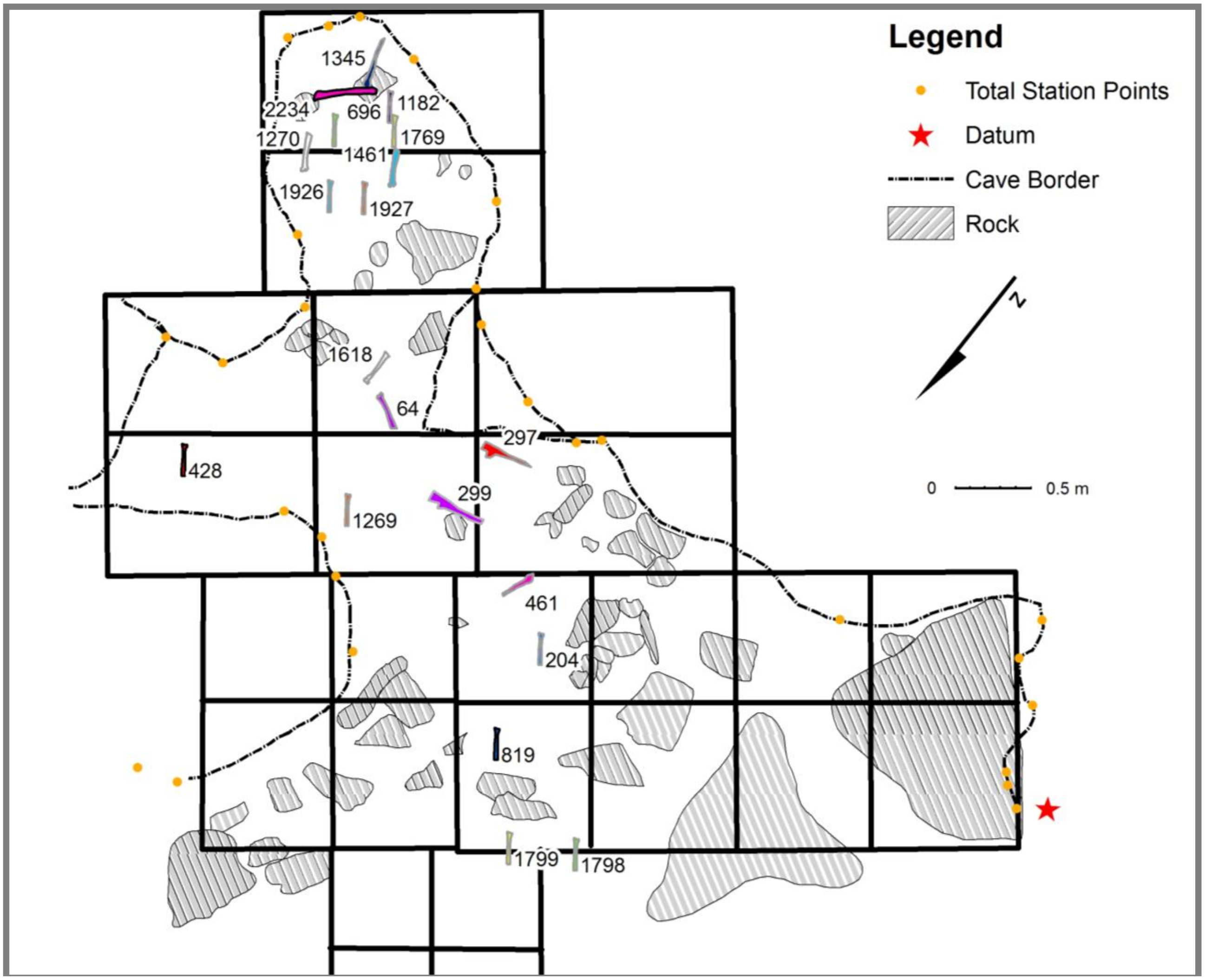
Map 10 Distribution of related humerus elements, pair matched elements are indicated by the same color, levels are indicated by the outline border. This map displays the location of skeletal elements based on the quadrant of collection, not their original orientation.



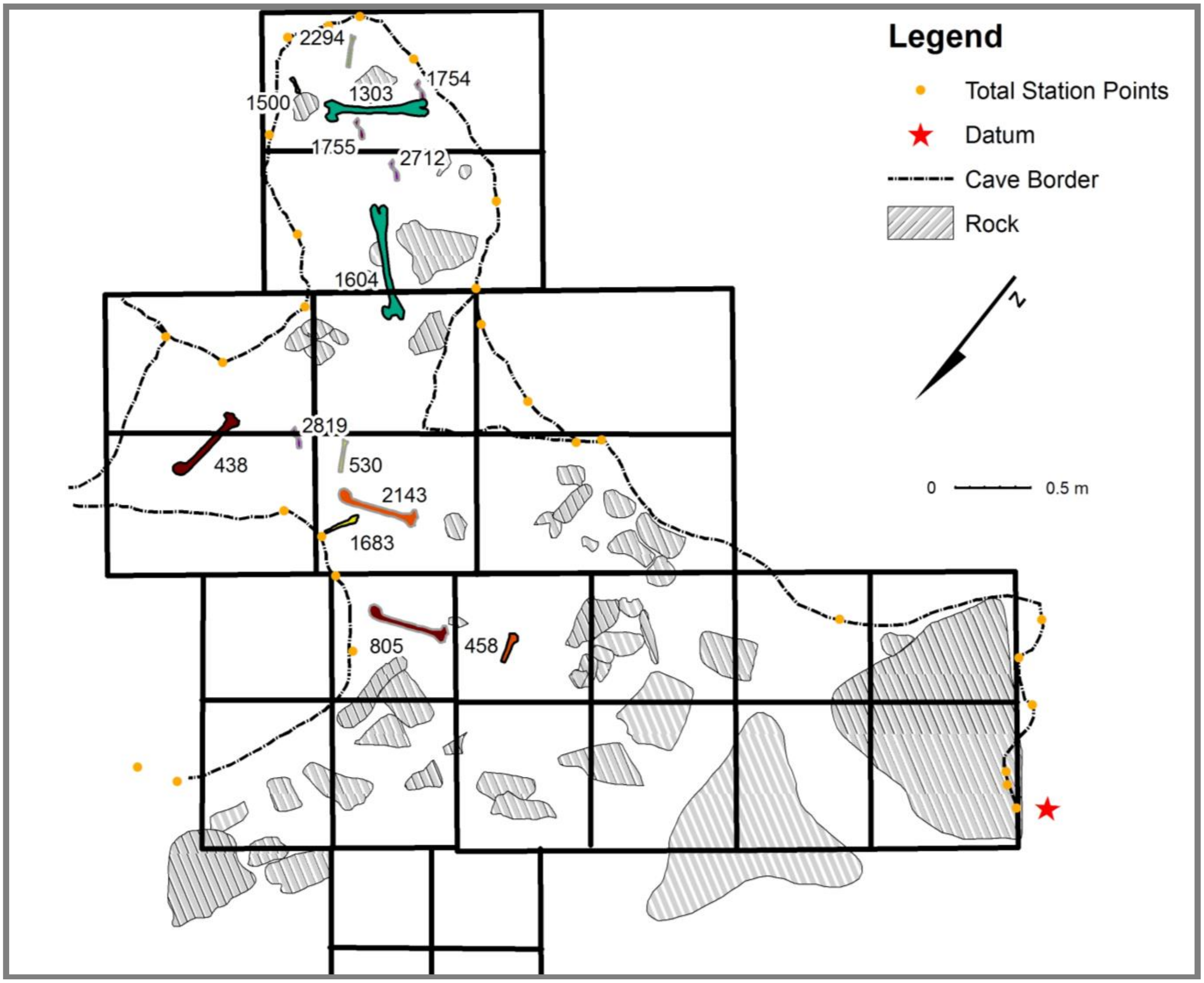
Map 11 Distribution of related radius elements, pair matched elements are indicated by the same color, levels are indicated by the outline border. This map displays the location of skeletal elements based on the quadrant of collection, not their original orientation.



Map 12 Distribution of related tibia elements, pair matched elements are indicated by the same color, levels are indicated by the outline border. This map displays the location of skeletal elements based on the quadrant of collection, not their original orientation.



Map 13 Distribution of related ulna elements, pair matched elements are indicated by the same color, levels are indicated by the outline border. This map displays the location of skeletal elements based on the quadrant of collection, not their original orientation.



Map 14 Distribution of related juvenile elements, pair matched elements are indicated by the same color, levels are indicated by the outline border. This map displays the location of skeletal elements based on the quadrant of collection, not their original orientation.

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