ANCESTRAL AFFILIATION AND THE PRODUCTION OF SOCIAL IDENTITY: INVESTIGATIONS OF MORTUARY PRACTICES AMONG PERSISTENT HUNTER-GATHERERS IN ARCHAIC INDIAN KNOLL, KENTUCKY

by

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Ancestral Affiliation and the Production of Social Identity: Investigations of Mortuary Practices among Persistent Hunter-Gatherers in Archaic Indian Knoll, Kentucky

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DEDICATION

For those that are always there in my darkest moments. My mom, whose unwavering love and warmth are a human triumph. My dad, whose bright mind and encouragement fostered my love of learning from the beginning. To Richard. Your constancy, strength, and dedication inspires me every day. And, finally, to double fudge brownie ice cream, whose indulgence I would never have finished this thesis without.

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ABSTRACT

ANCESTRAL AFFILIATION AND THE PRODUCTION OF SOCIAL IDENTITY: INVESTIGATIONS OF MORTUARY PRACTICES AMONG PERSISTENT HUNTER-GATHERERS IN ARCHAIC INDIAN KNOLL, KENTUCKY

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This thesis explores the utilization of the Archaic cemetery at Indian Knoll (ca. 4600-3500 BP) in Kentucky as a persistent mortuary landscape. Reconstructing mortuary practices and population structure among hunter-gatherers helps explain the formation of persistent places through identities affiliated with the ancestral dead. Grave good presence and absence as well as burial location within the midden was recorded. To analyze population structure, buccolingual and mesiodistal measurements were collected for each permanent tooth present for the sample. An R-matrix evaluated within-group phenotypic variation for the full sample and within temporal layers of the midden. Mantel's partial correlation tests were employed to evaluate the relationship between biological and spatial distance within the total cemetery and between occupational layers. Phenotypic variation increased between the Deep (oldest) and Mid-Shell (intermediate) midden layers and decreased between the Mid-Shell and Low Shell (youngest) midden

layers. Grave good usage became more inclusive between the Deep and Mid-Shell midden occupation, then decreased between the Mid-Shell and Low Shell midden. There were no significant correlations between biological and spatial distances. These results suggest that the social structure of the site moved from a more restricted, closely related group to a more diverse population, with a contraction in this diversity during the latest occupational phase. Burial proximity was likely a symbolic social strategy aimed at preserving the site as a persistent landscape through maintenance of social memory via adjacency to ancestral occupants.

CHAPTER ONE: DECIPHERING MORTUARY PRACTICES IN ARCHAIC KENTUCKY AND AN EXPLORATION OF PERSISTENT HUNTER-GATHERER STUDIES IN BIOLOGICAL ANTHROPOLOGY

Personal and social identity plays a key role in the constructive mechanisms of many societal practices. These kinds of identity become involved on the individual and communal level, expressions of which intertwine with behaviors and actions shaping societal movement and structure. Critical expressions of identity become intrinsically connected with social meaning generated through embodied memories and experiences, an embodiment expressed through the ritual mortuary practices of hunter-gatherers. Research into changing perspectives on hunter-gatherers from material deterministic views of subsistence to biobehavioral models allows for more comprehensive future research viewing hunter-gatherers as complex, resilient populations. Adapting this lens into a biocultural model have initiated the renewed analysis and utilization of mortuary practices among hunter-gatherers to decipher the cosmologies and ideologies motivating these populations. Particularly, the use of persistent landscapes in the mortuary practices of complex Archaic hunter-gatherers in Kentucky exposes the ritual creation, (re)negotiation, and recognition of social identity and memory through continuous interaction with the ancestral dead.

This thesis focuses on the Indian Knoll collection derived from Archaic hunter-gatherers in the Green River Valley region of western Kentucky. Methods of biodistance

and mortuary analysis are employed to demonstrate how social identity is produced at the persistent mortuary landscape of the shell mound where living populations continuously affiliate with the ancestral dead. The findings of this work firmly push the scope of past conceptualizations of hunter-gatherers and represent mobile, hunting and gathering groups in Archaic North America as multifaceted and nuanced populations whose embodied patterns of phenotypic variation are impacted by socially, symbolically, and environmentally derived factors.

The organization of this thesis will follow a purposeful structure. The following chapter reviews the ideas, concepts, and research behind the study of mortuary practices among hunter-gatherers and the rising theories informing new interpretations of ritual behavior among these populations. Chapter Two will discuss the primary method of biodistance utilized to structure the presented findings. These discussions delve into the historical development of the technique on a broad and regional level, reasons behind the technique's high levels of accuracy, applications to bioarchaeology and hunter-gatherer studies, ethical tensions, and potential limitations. Chapter Three provides a description of the materials gathered from the Indian Knoll site, reviewing the burial distribution, methods of data organization, and explanations of statistical testing applied to investigate the correlation of biological and spatial relationships. Chapter Four includes results from statistical analyses on these distances, outlining the organizing structure present at the cemetery as well as presenting changes in phenotypic patterns of variation over time. Chapter Five provides a discussion of results and associated meaning for symbolic

behaviors of ancestral affiliation at the site while Chapter Six provides a comprehensive review and conclusion of the work.

Conceptualizations of Hunter-Gatherers in Anthropology

The production of social identity within populations influences the construction and portrayal of various behavioral, cultural, and ecological mechanisms. Identity, or the individual construction of one's self that influences the distribution of individual rights and duties to others, has multiple facets (Goodenough 1965). Identity can be differentiated into numerous forms, including social identity and personal identity. Social identity deals with the rights and duties of individuals while personal identity involves the diverse modes or expressions of individual action (Goodenough 1965). Both social identity and personal identity influence individual thoughts and actions through the assignment of rights and duties in individually idiosyncratic ways.

The formation of identity revolves around various culturally specific elements, but one particularly profound element influencing identity development relates to social memory. Social memory, or memories created amongst a group through shared experiences, integrates the expression of individual identities into a collective representation of social perceptions and worldviews (Cannon 2002; Hawlbachs 1925). Collective memory is structured within groups in multiple forms, transmitting social memories between individuals and generations on culturally institutionalized and unformalized levels (Assman 2008; Hawlbacks 1925). The production of social memory occurs through everyday practice, both in daily minutiae and, especially, in ritual behaviors responding to social activities. Ritual behaviors function to establish and

support social norms and customs, making such behaviors ripe for producing social memory (Connerton 1989). Some of the most apparent examples of social memory appear in the anthropological study of cemeteries and mortuary practices of past populations. Cemeteries contain key information on the processes involved in the genesis of social identities of the dead through mortuary practices, reflecting past beliefs, social structures, and value systems through the ritual treatment of individuals. Therefore, the analysis of mortuary practice through research in biological anthropology and archaeology are essential to discovering the structures of thought influencing interment presentations and behaviors.

Hunter-gatherer studies in archaeology and biological anthropology have initiated a key shift to portray these communities as complex, nuanced, resilient, and persistent populations (Cannon 2011; Temple and Stojanowski 2019). Moving beyond a research model placing hunter-gatherers into a binary classification of social structure as either "simple" or "complex," current studies have begun to move past limiting, materialistic perspectives based on a hunting and gathering subsistence system to reveal the deep ideologies motivating these communities. The complex revelation of these ideologies can be successfully viewed through systematic analysis of the ritual practices and mortuary landscapes utilized in the treatment of the dead. Engagement in a community consciousness through the persistent occupation of particular landscapes reaffirms the status of participating individuals and adds to the generation of social memories and identities (Gamble 2017; Thompson and Pluckhahn 2010). Identity formation corresponds to time, the synthesis of which is produced by memory (Assman 2008).

Institutionalized cultural memories embodied in symbolic objects engrain past beliefs, traditions, and knowledge into physical substances, such as landscapes. Such objects trigger remembrance, transferring memories across generations (Assman 2008). Behavioral strategies attempting to maintain ancestral affiliations through the repetitive interment of individuals into particular cemeteries continually negotiate and renegotiate social memories through the preservation of persistent landscapes (Gamble 2017; Thompson 2010).

Methods and perspectives in biological anthropology lend crucial insight into mortuary practices of past populations. Renewed investigations into the nature of complex hunter-gatherers employing a framework viewing past actions as structured, not only through socioecological or evolutionary motivators, but through perceptions, cosmologies, values, and interpersonal relations allows for new understanding of ancient mortuary practices. Fishing hunter-gatherers in the Archaic North American midcontinent portray behaviors that suggest involvement with ancestral populations utilizing persistent places. Investigations in bioarchaeology and biological anthropology serve to prove the connection between the cosmological and ideological beliefs of these populations and hunter-gatherer mortuary practices. This work endeavors to review past hunter-gatherer studies and mortuary practices to dissect the role of persistent places in the burial rituals of complex hunter-gatherers in Archaic Kentucky to produce and (re)negotiate collective social identities and memories.

Early Hunter-Gatherer Studies

Early research on hunter-gatherers subscribed to limiting perspectives focusing on elements of hunting and gathering subsistence strategies as structuring all other elements of life amongst practicing populations. These studies fell victim to many problematic assumptions, considering hunter-gatherer populations at the early phase of an evolutionary framework that destined these groups for eventual entrance into more developed, agricultural landscapes (Bettinger 1991; Fitzhugh 2003; Morgan 1877). Early anthropological postulations of a unilineal evolutionary progression of human culture relegated hunter-gatherers into a socially arrested "savage" category, a categorization intrinsically tied to practices of food acquisition and environmental constraints (Darwin 1890; Morgan 1877).

In addition, other investigations regarded existing hunter-gatherer populations as proxies for ancestral subsistence behaviors practiced before the transition to agriculture. These portrayals represented contemporary groups as "living fossils" directly reflecting past socioecological systems because of an arrested cultural state, a retention highly impacted by a reliance on a hunting and gathering food procurement strategy (Bettinger 1991; Jordan 2011). Such studies either applied materialistically deterministic models to the study of hunter-gatherers or fetishized these populations as "modern noble savages" with ideal economic systems (Jordan 2011; Rousseau 1754; Sahlins 1972). Western perspectives applied onto these populations led to diminishing studies attempting to decipher levels of "complexity" and trace the propagation of humanity's history towards the ultimate goal of progress: civilization.

Cultural evolutionist perspectives on hunter-gatherers were critiqued by historical evolutionists and cultural ecologists, prompting the consideration of local histories, context-specific knowledge, and human adaptations to environment as contributors to the construction of cultural traditions in these groups (Boas 1911; Steward 1955). These developments led to the volume *Man the Hunter*, in which Laughlin (1968) put forth ideas on the importance of hunting as a practice in the study of human behavioral patterns. Moving beyond views of hunting and gathering existing as a mere subsistence strategy, this work recognized the critical, influential role of the practice in integrating biobehavioral developments amongst participating groups. The nature of behaviors outside of food acquisition influencing biological developments introduced a concept moving away from a stark division between theory and science to portray hunter-gatherers as innovative populations. This new position in hunter-gatherer studies, infused with a life history model, led to the investigation of adaptive behavioral strategies and social constructions motivated by surrounding ecological environments (Hawkes et al. 1989). Early hunter-gatherer studies lacked exploration of questions unrelated to subsistence and socioecological motivations for behavior. As such, discussions did not acknowledge the intentional, interactive, and purposeful elements of practicing a hunting and gathering lifestyle, elements reflecting individual and cultural perceptions of the environment as well as belief systems (Cannon 2011; Ingold 1988; Temple and Stojanowski, 2019). By doing so, these early studies left the connections between ideological thoughts structuring ritual action in a mortuary context to later analysis.

Hunter-Gatherers in the Archaic Period

Investigations into the lives of Archaic (10,000-3,000 BP) hunter-gatherers have followed broader trends in hunter-gatherer studies from general investigations of subsistence practices to studies of complexity and further biobehavioral models. Research into subsistence patterns in the North American midcontinent of central Kentucky led to discoveries of mounds containing dietary materials like hickory nuts and shellfish as well as the skeletal remains of humans and dogs. The occupants of Green River shell mound locales represented groups gathering in seasonal patterns. These groups aggregated for longer periods of time to invest in regional resources and participate in feasts, trading, ritual activities, and burial of the dead (Marquardt and Watson 1983, 2004, 2005). The settlement preferences of these communities developed alongside subsistence strategies, shifting prioritization to resource rich river shoals and increasing persistent settlement near riverbanks and wetlands during the mid-Holocene, although inland hunter-gatherer habitation did occur (Jefferies et al. 2005).

Stable access to seasonal resources produced the continual negotiation of communal rights, developing a veneration for the subsistence-rich areas. Shell middens represented products of social labor, social activities such as feasts, mate exchange, and burial of the dead, and became continued sites of importance (Crothers 1999; Herrmann 2002a; Marquardt and Watson 1983). Occupation of various Archaic midden sites spanned a considerable amount of time, with the most intense shell midden use across various sites from approximately 6,500-4,500 BP. Hunter-gatherers exercised diverse life practices across the Green River Valley over time as economic risks reinforced by ritual

and social behaviors became engrained in Archaic communities, exhibiting a diversity central to hunter-gatherer adaptation on a regional scale (Morey et al. 2002). Social structure responded to ranging behavioral adaptations and changing subsistence strategies, with varying degrees of egalitarian treatment (Rothschild 1979). The increasingly rooted settlement pattern amongst these diverse hunter-gatherer groups also instigates the implementation and extension of territorially bounded social networks. The extension of these networks lead to modified levels of social interaction dramatically affecting the population biology and biological relationships between these groups (Jefferies 1997). Biological distances of Green River Archaic hunter-gatherers indicate a geographically influenced structure, suggesting the presence of a local mate exchange network between sites (Herrmann 2002a). A further review of the population structures and patterns of phenotypic variations constituting the region will be discussed in Chapter 2.

For Green River Valley sites in the North American midcontinent there are conflicting interpretations of cemetery site distribution and maintenance. Arguments include thoughts on sites as part of mobility patterns within annual subsistence cycles moving towards sedentary occupation (Jefferies et al. 2005), intentional sites of aggregation for rituals and feasts (Crothers 1999), and sites playing a role in a "foraging mode of production" allowing increased mobility (Crothers and Bernbeck 2004). In the further development of hunter-gatherer studies in North America, these perspectives have been informed by a view of sites functioning as emergent loci integrating ecological history, ideology, and worldviews in the construction of monumental landscapes

(Thompson and Pluckhahn 2010). This integration is reflected in the creation of monumental landscapes and mortuary sites as persistent places with flexible functions adhering to short- and long-term timescales (Thompson 2010). Reflections of acting adaptive strategies within hunter-gatherers through the social behaviors and actions influencing mortuary landscape development can benefit from the synthesis of field practices from mortuary archaeology into biological anthropology perspectives.

Mortuary Archaeology and Theory: A Framework for Hunter-Gatherer Studies

The study of mortuary practices has deep anthropological, sociological, and psychological histories. Early developments in mortuary archaeology sourced perspectives from developments in anthropological theories pertaining to the roles and impacts the dead have on living societies as well as rituals of transformation. These conceptualizations involved the recognition of rites of passage as processes that regenerate energy through processes of transmission (Turner 1967; van Gennep 1909). These processes transmute the "sacred" into the "profane" of everyday life, with the presence of ambiguous, ritually charged, and alienating liminal phases dissolving and transforming identity between states (Bennedict 1934; Turner 1967; van Gennep 1909). The ambiguous nature of the liminal phase during these transformative rites countered structuralist views in sociology, with the focus on the dynamic nature of ritual opposing scientific positivist considerations of more rigid "social facts." This shift established the flexible role of the autonomous individual within periods of transformation to analyze and change cultural patterns essential to ritual transitions (Durkheim 1916; Thomassen 2009; van Gennep 1960). In addition to recognizing the transformative power of rites

transferring one social state to another, patterns and practices involving the deposition and disposal of the dead were linked to the onset of powerful social responses enacted in the face of death. These responses constituted and embodied social theory through patterns of behavior conditioned within societies and not developed spontaneously or necessarily mechanically responsive to the same sets of variables as other cultural traits (Childe 1945; Hertz 1907; Kroeber 1927). The perspectives comprising this theoretical backdrop laid the basis for early studies in mortuary archaeology as burial practices and associated grave materials were connected to the cultural ideologies of the living.

Processual Theory in Mortuary Archaeology

The study of mortuary practice began to gain traction during the days of early processual archaeology which interpreted burial contexts and associated material culture as reflecting social complexity of populations (Binford 1971; Saxe 1970). These investigations deployed such understandings as evidence in larger arguments involving a social evolutionary framework. Processualists began identifying elements of mortuary practice through information from ethnographic models and descriptions of grave goods as well as grave good types, body position and orientation, cemetery location, and burial or interment location. Application of this information with funerary archaeology methods was then used to infer organizational type of the culture being studied and interpret the symbolic representation of an individual's social identity. Subsequently, these applications then inaccurately linked changes within social organization and complexity seen in mortuary practices with social structure (Binford 1971; Saxe 1970). With this association made, subsistence strategies and social roles could be extrapolated from the

burial and associated grave goods as well as the differential distribution of energy invested in individual burials (Tainter 1981). This method delineated hunter-gatherer groups into, by contemporary standards, highly flawed "simple and egalitarian" structures through burial practices and agriculturalists into "complex and hierarchical" structures. Limitations of this approach were noted and expanded to discern the need for efficient, quantitative methods as well as reference to ethnographic mortuary systems required in mortuary archaeology. This expansion led to the increased use of objective methods of analysis and recognition of how the complex factors comprising mortuary practices reflect social phenomena (Carr 1995; Tainter 1981). These developments in processual archaeology were eventually directly challenged by postprocessual critiques, identifying the ritual events surrounding mortuary deposition and infusing an anthropological perspective into archaeological analysis.

The Postprocessual Structural-Symbolic Critique

Postprocessual critiques identified issues in representationalist approaches to archaeological mortuary analysis. This theoretical shift emphasized the rituals and actions surrounding mortuary practices, distinguishing social systems, and the functional relationships comprising social roles apart from inherent social structure, or the societal rules which organize and imbue meaning into social systems (Ekengren 2013; Hodder 1982). These critiques identified processual misuse of systems theory. Systems theory does not recognize the permeation of symbolic principles into individual and daily practices or cultural patterning as being produced through a framework that action and adaptation function within to create, reproduce, and negotiate meaning (Hodder 1982). In

addition to a lack of consideration of the structure of ideas instilled into the material culture found in mortuary sites, processual methods utilized arbitrary separations of cultural agents comprising these systems into distinct, artificial dualities. The application of these dualities left subsequent analyses bereft of the potential material symbols have in misrepresenting, inverting, or concealing social relations present during life (Shanks and Tilley 1982). A better approach views these dualities instead as dynamic relational entities within social constructions involving the continual reproduction or transformation of social forms resulting from daily practices, revealed in mortuary practices through the powerful legitimation of social structures present in life (Shanks and Tilley 1982).

These theoretical oppositions to representationalist arguments often surrounded the distinction between social systems and social structures. This distinction impacted studies in mortuary archaeology by enhancing considerations of burial practices as important ritual events functioning beyond simplistic representations of social systems and ranking behaviors. Postprocessual discussions in mortuary archaeology and theory developed these ideas, emphasizing the ritual nature of mortuary events as acts maintaining cultural institutions through interactions with collective memory that reference past populations through longstanding symbolic behaviors (Buikstra and Charles 1999; Connerton 1989). Factors external to functional social structures and potential impacts on burial behaviors and presentation, such as philosophical-religious beliefs, are presented as well, calling for more holistic, multidisciplinary approaches in the interpretation of mortuary remains (Carr 1995). These theorists introduced emerging

important considerations of agency and symbolism identifiable through mortuary practices and behaviors.

Postprocessual theory in mortuary archaeology expanded farther with bioarchaeological considerations of living – dead interactions, interactions marked by burial practices directly involving continuous affiliation with the bodies of the deceased (e.g., Rakita and Buikstra 2005). Building off of the implementation of archaeological methods enhancing studies of ritual contexts, more coherent cultural analyses of mortuary sites are created by investigating relationships between the living and the dead through anatomical, spatial, and organizational approaches to skeletal remains within burials. Rituals bridge the past with the changing world through physical interactions between the living and the dead in mortuary ritual (Beck 2005; Klaus and Tam 2015; Weiss-Kreijci 2013). These approaches clarify the circumstances surrounding funerary deposits and allow for added understanding of socially adaptive strategies through the analysis of relationships between living and the dead reflected in the reconstruction of deathways.

Integration of Mortuary Studies and Practice: Synergisms with Bioarchaeology and Field Anthropology

The development of archaeological methods for excavating remains have been progressing since the early to middle twentieth and early twenty-first centuries. These methods have advanced to include the careful recording of the human skeleton *in situ*. The salient refinement of methods comes from meticulous considerations of skeletal elements, grave goods, taphonomic changes, and the relationships between the body and burial features as well as context and biases surrounding burial placement (Buzon 2012).

The integration of bioarchaeological methods into mortuary analysis is recognized as being imperative for holistic, comprehensive understandings of past populations, as the expansion of bioarchaeological methods to develop rigorous, systematic procedures for field analysis of human remains has been key to the advancement of comprehensive mortuary archaeology.

Developed in French field anthropology, the advent of the archaeothanatological approach, or *anthropologie de terrain*, aided in creating an encompassing perspective in the analysis of human remains *in situ.* An approach focused on studying the articulation, placement, and positioning of skeletal remains as well as adjacent elements and structures within the funerary context, archaeothanatology infused funerary analysis with a consideration of spatial relationships and biological processes by incorporating taphonomic knowledge (Duday 2009). This form of study reviews the biological and social components of death through detailed interpretations of human decomposition processes through skeletal analysis, relying heavily on notations of body placement and orientation, positioning, method of deposition, present and absent skeletal elements, associated grave goods, and relevant features. Intrinsic to this method is the collaboration of archaeological methods with anthropological perspectives, integrating biological and social considerations into field interpretations. This approach and the incorporation of taphonomic knowledge dynamically increases understanding of biological, social, and cultural constructions surrounding death.

While these field practices infusing bioarchaeological analysis with mortuary practices are recognized, a need for further communion of the fields is still needed. This

integration requires the consideration of other emergent themes – such as gender, the individual, ethnographic and landscape studies – in mortuary archaeology (Goldstein 2006). The utilization of archaeothanatological and bioarchaeological field practices into archaeological studies of death and human remains can work together to reveal the cultural and biological tenements of experience dictating burial presentation through the lenses of ritual, the body, emotion, and power (Nilsson-Stutz and Tarlow 2013). The continued push to connect these realms of theory, technique, and field practice can work to overcome binary generalizations limiting understandings of hunter-gatherers created by a science/theory divide. Navigating through the constraints and strengths of past approaches in mortuary studies, archaeology, theory, and bioarchaeology broadly can allow for transitions in the analysis of past hunter-gatherer populations, recognizing the complex and resilient nature of these communities enacted through interactions between the living and the dead.

Hunter-Gatherer Mortuary Practices

Although processual studies included hunter-gatherer groups in considerations of functional burial representations of living status, there was largely a lack of focus on hunter-gatherer groups in developing mortuary archaeology as complex communities with deep, integrated belief systems. The postprocessual shift developed a practice-oriented approach considerate of context, understanding mortuary practices as events enacted by living individuals affected by emotions, beliefs, and social strategies to indicate attitudes towards death and the dead. This perspective notes the transformative ability of mortuary rituals to change and further embed power relations into practicing

populations (Ekengren 2013). Applying such an integrative, mindful approach understands mortuary practices as crucial events that increase the solidarity of cultural institutions through an engagement of collective memory, as symbolic behaviors act as referrents to ancestors or past events of social importance through continuous ritual practice (Buikstra and Charles 1999; Connerton 1989).

The practice of ritual ancestral veneration was not only continuously engaged, but became considerably marked on landscapes repeatedly used for mortuary practice. By continually using sites during long-term occupations, landscapes become sites for creation, negotiation, and support for community specific behaviors and practices. Persistent place theory regards repetitively used sites as loci expressing human behavior through landscapes occupied for long periods of time (Schlanger 1992). These landscapes, or persistent places, exhibit attractive characteristics for establishment including formal traits promoting recurrent use (including economic or environmental resources), natural and cultural features encouraging continuous reoccupation, and extended periods of use marked by residence and revisitation (Schlanger 1992). The generation of such sites correspond to temporal rhythms of behavior, rhythms that fluctuate according to the nature of occupation, whether long- or short-term (Thompson 2010).

These persistent places transform the environment as a sacred and cultural landscape, allowing for areas of social negotiation and consideration. The creation of burial mounds and monuments for the Middle Woodland peoples in the Lower Illinois Valley potentially served as markers of the increasing tendency for sedentary occupation

as well as the establishment of regional territories (Buikstra and Charles 1999). The burial mounds amongst these populations can be seen to recreate cosmological beliefs in North American hunter-gatherers, providing a forum to address and reflect on power relations among the living across differentiated regions. Creating these landscapes in service of the living, as well as establishing and reflecting beliefs about the dead, allows human action to create "markers" to influence and structure future behaviors surrounding use of particular environments (Littleton and Allen 2007). Such "markers" were seen in persistent places amongst Australian aboriginals, showing that consistent land use reflected the connection between human populations and the native environment, relating the two in a structured manner that influenced mortuary practices (Littleton and Allen 2007).

The use of these persistent places can add to understandings of adaptive life strategies of hunter-gatherers while also creating socially significant landscapes engaged in systems of identity creation through mortuary practice, both on the individual and communal level. These systems of creation become visible in the bioarchaeological record through the mapping of spatial elements of mortuary archaeology, elements that express personal and social memories of the dead (Cannon 2002). Social memory can be seen through mortuary practice as the historical and spatial dimensions of death become linked to memory (Cannon 2002; Hawlbachs 1925). The link between memory and space becomes central to the historical and spatial dimensions surrounding death and allows for an integrated approach to mortuary archaeology.

The placement and positioning of individuals within a cemetery, burial pit, or interment site can represent the continuing presence of the dead amongst the living, as spatial occupation is ritually associated with the creation of memory and social identities defined through communal action (Cannon 2002). The continuous interment of individuals in communally venerated landscapes exemplify the expansion of social identity through the creation of social memory during individual integration into a collective ancestral cemetery. Such practices in the archaeological record reveal that hunter-gatherer belief systems were structured with exceptionally complex and nuanced consideration to social relationships, experiences, values, and cosmologies (Cannon 2011). Such cosmological considerations counter a materialistic view of hunter-gatherer behavior being driven by solely economic or ecological factors.

In fact, mortuary practices express motivations beyond solely socioeconomic or ecological motivations to employ multidimensional adaptive ritual behaviors creating and enforcing cultural resilience through the use of persistent places. With the emergence of various types of social formations in more sedentary late Archaic hunter-gatherers, such as the mounds in Mississippi, the shell rings in Georgia, and the shell middens of the Green River Valley, a macroregional approach highlights how environmental changes interact with larger cultural dynamics in persistent landscapes (Thompson 2010). These interactions are expressed through the erasure of delineations between the worlds of the living and the dead through repeated burials in particular areas, creating a symbolic link to the past that serves to reinforce cultural values (Nilsson-Stutz et al. 2013). Among hunter-gatherers in Japan, burials in the Yoshigo Shell Mounds reveal a maintenance of

ancestral affiliation through mortuary rituals interring the dead in a persistent landscape, ensuring the production and maintenance of memories in living populations through spatial placements motivated by biological relationships (Temple 2019).

Funerary rituals reinforced social relationships with the dead but also provided a unification of populations that ensured the persistence of the practicing culture into future generations. This cultural resilience was facilitated through the transmission of contemporary rights and responsibilities onto the next generation while strengthening social bonds (Letham and Coupland 2019). This framework of resilience should not be limited to the boundaries of ecological systems and expands to include the enduring capacity of culture. In this capacity, cultural resilience provides a path to investigate the role of persistent practices in human social behaviors as occurring either independently or in conjunction with the evolution of socioecological systems (Justice and Temple 2019). The perpetuation of meaningful social action in hunter-gatherer populations provides a basis for considerable thought on the resilience of said communities for which subsistence economies and social interactions create reciprocal relationships through hunting and gathering (Justice and Temple 2019). The use of the bioarchaeological mortuary record can aid in deciphering the way persistence of hunter-gatherer culture works, exploring the relationships between socioecological and cultural systems as mortuary practices are inextricably linked to deep belief systems surrounding symbolic and natural worlds (Cannon 2002; Gamble 2017; Nilsson-Stutz 2013; Thompson and Pluckhahn 2010).

Techniques in the Bioarchaeological Context

Studies surrounding the creation of social memory through mortuary practices and the incumbent cultural and structural functions of such adaptive behavioral strategies gleans much information from the integration of bioarchaeological and anthropological techniques (Buikstra and Charles 1999; Littleton and Allen 2007; Nilsson-Stutz 2013; Temple and Stojanowski 2019). Analytical biological anthropology theories applied in bioarchaeological contexts begin to reveal data for later interpretation of cultural significance (Buikstra 1977; de la Cova 2019; Geller 2008; Goodman 2013; Martin et al. 2013; Temple and Stojanowski 2019). Standard demographic analysis of individuals through estimations of sex and age at death via morphological features of the *os coxae*, tooth emergence, and epiphyseal fusion create a basis for investigation surrounding the influences of age and sex on deposition (Buikstra and Ubelaker 1994). Investigating placement of individuals by geographically mapping interment position alongside grave good location, body orientation, situation within the cemetery, nature of deposition as having single or multiple individuals, and analysis of biological relationships can reveal information on social personas and ritual motivations for specific treatment based on relationships (Binford 1971; Carr 1995; Gamble 2017; Goldstein 1981; Justice and Temple 2019).

Biodistance analysis utilizing tooth measures of the buccolingual breadth and mesiodistal length of teeth can relate individuals to one another through phenotypic presentation of teeth, a highly heritable characteristic (Buikstra et al. 1990; Dahlberg 1956; Goose 1967; Pietruwesky 2008; Stojanowski 2013a, b; Stojanowski and Buikstra

2004; Stojanowski and Schillaci 2006). Tooth size in permanent teeth remains largely unaffected by environmental influences and has been seen to reflect a heritability of approximately 90% within dental biology (Garn et al. 1965; Larsen 1983; Rizk et al. 2008; Stojanowski 2007; Turner and Scott 2000). The genetic conservation of tooth size makes permanent teeth applicable as a source of data for information on population structure and relationships. Analysis of observable phenotypic variance across various locations in the cemetery can identify potential correlations between spatial and biological distances, a correlation that can indicate social strategies surrounding a continuous relationship with ancestors through mortuary practices (Temple 2020).

Problems in Mortuary Studies

The integration of biological anthropology and archaeology are important for deciphering the significance of human skeletal remains and *vice versa* (Konigsberg and Buikstra 1995). The analysis of grave goods is often used to investigate the emergence of ranked or hierarchical societies, creating differentiated levels of social importance amongst the deceased (Binford 1971). However, mortuary rituals present in regionally specific ways and should be analyzed within the context of localized histories, histories that respond to changes in ecology, human demographics, developing interregional relationships, cultural perceptions and belief systems, as well as other historically contingent factors (Letham and Coupland 2018).

Hunter-gatherer studies in anthropology previously adopted perspectives of historical materialism, noting the cause of increasing complexity amongst hunter-gatherers arising from solely evolutionary or environmental factors (Brown 1981;

Sassaman 2004). Classifications of hunter-gatherers in binary, deterministic categories produce shallow, one-dimensional analyses, falling short of detailed explanations of patterns of action visible in archaeological studies (Cannon 2011). These pursuits should integrate ideas of subsistence, human behavior, and belief systems along a circuitous feedback system of reciprocity that intersects within a population's historical and regional context (Temple and Stojanowski 2019a, b). These perceptions of hunter-gatherers harken back to tendencies in biological anthropology to commit to essentialized categories and taxonomies, placing human groups into types along a spectrum or "primitive" to "advanced." Preconceptions of hunter-gatherers as groups constrained from moving towards civilization coordinated with typological thinking in biological anthropology in the nineteenth century (Darwin 1896; Hrdlička 1918; Morton 1849).

This view also places hunter-gatherers in a position as supposed "precursors" or "transitional" groups to contemporary agricultural practices. Prescribing to such a view is seemingly incorrect and overlooks considerations of hunter-gatherer communities as cultures exhibiting resilience, adaptation, and developments in coordination with cultural and environmental influences (Larsen 1995; Temple and Stojanowski 2019). Separating hunter-gatherers from cultures with agricultural subsistence strategies, as well as delineating past hunter-gatherers as distinct from present hunter-gatherers, avoids deterministic viewpoints assuming past population behaviors are similar to current populations. Such a separation also prevents the inherent discounting of community specific evolutionary responses to lifeways surrounding hunting and gathering and can be subject to biases based on current worldviews or interpretations of the past. Differences

between research strategies and objectives in archaeology should be maintained as the projection of contemporary worldviews, symbolic interpretations, and theories based on sedentary lifestyles onto the past ignores the cultures created by ancient peoples (Charles and Buikstra 1999; Littleton and Allen 2007).

The application of methods previously associated with scientific racism and classificatory attempts to segregate people in bioarchaeology based on skeletal differences must be infused into a biocultural perspective that recognizes the damaging history associated with the method. These histories of racism and attempts to essentially group people must be thoroughly rejected in favor of inclusive analyses recognizing the clinal patterns of human variation (Relethford 2009). Past studies identified races through cranial measurements, although such studies frequently fell victim to the application of a priori conclusions to false data failing to recognize the plasticity of the human cranium (Boas 1912; Gould 1981; Gravlee et al. 2003; Morton, 1849). Biodistance analyses, which currently can be used to explore the connection between spatial and biological relationships contributing to the repeated invigoration of social memory through mortuary practice, is associated with past racist pursuits. However, application of a biocultural model following a move into practice theory accepts a view that human actions are motivated and constructed in accordance with values, perceptions, worldviews, and histories.

In this format, biodistance analysis moves away from descriptive analyses investigating typological classifications of past populations or the establishment of human origins to explore social identity. The dark history of biological anthropology and

the association with scientific racism arising from skeletal measurements should be recognized but firmly denied in future ethical research (Armelagos and Van Gerven 2003; Marks 2012). While associated with these roots of prejudice, biodistance analyses have been useful in bioarchaeological studies, being used to investigate variation within cemeteries (Schillaci and Stojanowski 2003), the migratory patterns of populations (Herrmann 2002a; Konigsberg 1988), population structure within cemeteries (Konigsberg and Buikstra 1995), and motivating factors hosting ethnogenesis (Klaus 2013; Stojanowski 2013a, b). In these instances, biodistance went beyond reviews of simple biological relationships for classification to aid in the further understanding of the cultural construction of past populations important in the field (Stojanowski and Buikstra 2004). When applied to research in mortuary practices and ritual behavior, these kinds of developments allow for research outside of historically particularistic or descriptive studies for a use of skeletal biology that understands problems of social and cultural relevance. Developments can analyze the social creation of structures based on biological affinities or as ritual strategies.

This addition of biocultural models and life history theory to previously essentialized and typological modes of thinking make biological anthropology robust through the consideration of cultural and behavioral influences on physical adaptations and energy expenditures outside of ecologically and environmentally deterministic research. These perspectives introduce comprehensive analysis of the interconnected relationship between the physiological constraints and cultural influences involved in life stress events through mortuary contexts (Temple 2019).

Discussion

Hunter-gatherer studies have developed in accordance with broader trends molding the field of archaeology and biological anthropology. The trajectory of mortuary studies and archaeology have directly impacted perceptions and understandings of hunter-gatherers arising from theories made based on earlier processual and postprocessual trends. Moving away from generalizations produced from positivist-derived universals explaining the relationships between social agents and material remains, emphasis shifts to roles and social personae being encapsulated in practices enacted by individuals with agency and social strategies. This practice-oriented approach integrates the anthropological conceptions of the *emic* and *etic* into understandings of mortuary behavior (Hodder 1982; Parker Pearson 2006). In this way, human experience is seen to reflect interactions between ritualized and profane life interpreted and enacted daily in the world (Parker Pearson 2006). Integrating perspectives acknowledging the symbolic systems of power, belief, identity creation, and resilience constituting behavioral practices creating mortuary landscapes are crucial for application to hunter-gatherer studies to avoid past misrepresentations of these populations (Cannon 2002; Carr 1995; Shanks and Tilley 1982). The entrenchment of processual and postprocessual fields of mortuary archaeology and need for further infusion with methods of bioarchaeology should be further developed largely and within the confines of hunter-gatherer studies.

Incorporating considerations of these past developments in biological anthropology into studies of hunter-gatherers in the Archaic will allow for effective, ethical research that portrays the nuanced, complex nature of hunter-gatherer populations.

Past communities in Archaic Kentucky transitioning from more mobile groups to increased sedentary patterns near resource-rich areas display elements in mortuary practices reflecting the ritual interment of the dead in persistent places. The ritual accretion of social memory through repetitive action and interaction with the dead in specific locations reflects the cosmologies and values structuring the behaviors of these populations. Archaeological pursuits accumulating data on Archaic hunter-gatherer sites in Kentucky have provided vast amounts of information on demographics, temporality, subsistence strategies, mobility patterns, resulting cultural behaviors such as feasting and interregional relationships (Crothers 1999; Herrmann 2002a; Marquadt and Watson 1985; Morey et al. 2002; Webb, 1974). However, further research into the beliefs and values structuring human mortuary behavior needs to be further investigated through biological methods in anthropology, including biodistance analysis. These analyses can portray the processes involved in the embodiment of worldviews as well as social rights and responsibilities through ritual behaviors encouraging communal solidarity (Charles and Buikstra 1999; Schillaci and Stojanowski 2003; Stojanowski 2003a). These types of events transcribe personal and social identities into collective, social memory through the extended placement of the dead in persistent landscapes.

Conclusion

Personal and social identity become expressed on individual as well as communal levels through actions and behaviors that reflect, create, and negotiate social values and structure. Of interest to biological anthropology, the expression of identity and connections with social meaning become embodied through collective experiences that

generate social memories, an embodied experience visible in the bioarchaeological contexts of hunter-gatherer cemeteries. Paradigm shifts in materialistic perceptions of hunter-gatherers as mere products of subsistence strategies to biobehavioral models frame these populations more effectively as complex, resilient, and adaptive populations. Current frameworks infusing spheres of bioculture and life history are beginning to be embedded in analyses of the mortuary practices of hunter-gatherers to uncover the ideologies and cosmologies driving behavior in these populations. Theories in archaeology and biological anthropology, such as the concept of persistent places, creation of sites according to short- and long-term temporal rhythms, links between social identity and spatial relationships within funerary contexts, and ritual mortuary practices as forms of cultural resilience create a functional framework for investigating mortuary practices of complex Archaic hunter-gatherers in Kentucky. The engagement in persistent landscape use in these populations as sites of continuous funerary treatment reveal the ritual creation, recognition, and negotiation of social identity and memory through prolonged interaction with the ancestral dead.

CHAPTER TWO: METHODOLOGICAL CONSIDERATIONS OF BIODISTANCE ANALYSIS IN HUNTER-GATHERER STUDIES

In studies of past Archaic North America, biodistance analysis has been a method with rising utility in bioarchaeology that can explore previously under-evaluated lines of inquiry surrounding complex hunter-gatherer populations. This chapter reviews and critically examines the history of biodistance studies in biological anthropology, the genetic basis of heritability, conservation of tooth form between generations, and tensions between intrinsic and extrinsic factors encountered in such studies. More importantly, biodistance analyses are uniquely positioned to deciphering questions surrounding the complex, organized social behaviors and rituals both constructing and preserving hunter-gatherer societies, ideologies, and cosmologies over time. These elements of social organization and symbolic expression in persistent hunter-gatherer communities are visible in the skeletal record and reveal patterns of communal, social identity production through the continuous mortuary interment of individuals into collective burial contexts.

The Utility of Biodistance Analysis for Reconstructing Hunter-Gatherer Lifeways

Investigations of relationships in bioarchaeology at the population level have produced theoretical foundations for methods applied to studies of human traits across ecogeographically specific regional groups. Moving past initial research in biological anthropology mired in racial classification and typological categories, contemporary studies have developed methods in biological distance analyses interested in techniques

that more accurately represent the spectrum of human variation. While early physical anthropologists utilized biodistance to study variability, these pursuits were limited by a descriptive, historically based framework that produced less substantial results than processual, functional hypothesis testing incorporating developments in multivariate model-bound quantitative approaches (Armelagos et al. 1982; Armelagos and Van Gerven 2003; Relethford and Blangero 1990; Stojanowski and Buikstra 2004; Washburn, 1952). One more meaningful mode of analysis is achieved through the lens of evolutionary adaptation, mechanisms of genetics, and the role of these processes in producing human phenotypic variation within and between groups.

With this shift in focus to observations of trends in variability, biological distance analysis has been developed as a quantitative method to reconstruct past population structures, interactions, patterns, and movements using the objective measures of continuous and discrete metric and non-metric traits, the most useful of which comprise tooth size, shape, and form (Buikstra et al. 1990; Dahlberg 1956; Pietruwesky 2008). Through the employment of dental metrics consisting of continuous variables of tooth measures, the conservative nature of a series of dental traits provide the ability to analyze populations over broad regions as well as within sites to a large degree of accuracy because of the high level of genetic control over such traits (Goose 1967, 1971; Jernvall et al. 1994; Jernvall and Jung 2000; Jernvall and Thesleff 2000). Though highly heritable, tooth size and shape can be influenced by early life stress encountered during fetal development but remains generally resistant to environmental impacts (Garn et al. 1965; Larsen 1983; Rizk et al. 2008; Stojanowski, 2007; Turner and Scott, 2000). However,

tensions in biodistance studies must be considered. Potential influences affecting the interpretations of metric results include phenomena such as genetic drift, fluctuating asymmetry, environmental variation, local adaptive transitions, and other contextually specific factors remain essential for comprehensive, accurate analysis.

The applicability of this approach extends from reconstructions of phenotypic variation to reconstructions of sociocultural and political worlds. A synergy between biodistance data and mortuary analysis creates a robust way to understand past sociocultural networks and ritual behaviors, such as those involved in the production of social identities and memories. The expression of collective behavior can be seen at the population level and reflect the multiple interactions comprising both evolutionary and ritual processes affecting genetic variation. These methods provide evidence for the cultural resilience of lifeways, the events preceding and resulting in events of ethnogenesis, and ritualistic affirmation of communal relationships.

A thorough examination of studies of biological distance and the direct application in hunter-gatherer populations and samples is necessary. Such an examination will provide approaches that consider findings of contemporary hunter-gatherer studies, the potential influence of complex thought and behavioral patterns on presentations of phenotypic variation, and limitations generally associated with nomadic, semi-nomadic, and persistent groups. In turn, these perspectives should aim to create comprehensive, ethical representations of past hunter-gatherer communities that intertwines understandings of subsistence strategies with unique expressions of social and cultural

cosmologies visible through the deciphering of biological relationships and physical organization in mortuary contexts.

Biological Distance Studies: Conceptual Bases and Biocultural Applications

Within bioarchaeological studies, the utility of biological distance analyses is indisputable and has been widely developed (Buikstra et al. 1990; Scott and Turner 2000). Biological distance analysis provides information based on the concept that observable morphological traits in the human skeleton (phenotypic variation) are a result of underlying genetic composition (genotypic variation). Inferences on relatedness assume that more closely related individuals will have higher frequencies of shared traits whereas less closely related individuals will have lower frequencies, as heightened exchange of genetic information results in more phenotypically similar groups and allows for the measurement of biological distance calculations based on these similarities (Stojanowski and Schillaci 2006). These inferences allow investigations of past patterns of inheritance and microevolution, evaluating genetic drift, gene flow, migratory patterns, and levels of mate exchange using morphometric and qualitative traits to compare allele frequencies between groups (Campbell 2016). On this basis, broad and contextually specific patterns of the composition, relationships, and movements of human groups can be revealed through the analysis of discrete nonmetric and continuous metric datasets (Kieser 2008; Scott and Turner 2000).

The serviceability of biodistance studies to bioarchaeology are profound. The techniques and perspectives associated with the subdiscipline create a framework for answering questions relating to the evolutionary trajectories of past populations. Patterns

of post-marital residence, mate exchange networks, temporal and spatial associations between biologically related and distinct groups, population movement, and connections to paleodemographic and paleopathological analysis are all visible within the broader scope of biodistance analysis (Buikstra et al. 1990; Konigsberg 2006; Pietrusewsky 2008; Stojanowski and Schillaci 2006). Additionally, studies of social organization, cultural practices, socioeconomic relationships, and cultural or biological instances of ethnogenesis can be evaluated by exploring biological relatedness, providing an effective method of analysis for studies of social identity production, multifaceted cultural relationships, and past adherence to culturally relegated understandings of kinship (Klaus et al. 2018; Schillaci and Stojanowski 2003, 2006; Stojanowski 2013; Temple 2020).

These biological relationships are best understood using multivariate statistical analyses considering various traits and interactions at once, applying analytical models such as components analysis, canonical axes, discriminant function analysis, and model-free perspectives including cluster analysis or multidimensional scaling (Larsen 2015). Considerations of metric versus nonmetric data have created different statistics applicable to each, including the Mahalanobis D^2 statistic for continuous population data and Mean Measure of Divergence for discrete data. However, nonmetric discrete data sets as well as the Mean Measure of Divergence statistic have been criticized for lack of consideration for correlations occurring between variables (Konigsberg 2006). The infusion of quantitative and population genetic models have further developed understandings of population structure with the development of R-matrix population models (Konisberg 2006; Relethford 2012; Relethford and Blangero 1990), providing an analytical method

for deciphering the genetic variation of populations using the F_{ST} statistic and relationship matrices to uncover genetic distances. These models view allele frequencies in relation to phenotypic data to estimate the amount of mate exchange or gene flow occurring across and within populations (Larsen 2015). Applying these multivariate statistical analyses tends to be more effective when analyzing dental metrics derived from buccolingual breadth and mesiodistal length measures. These measures, approximating tooth shape and form, have a high degree of heritability and are less susceptible than other sources of scorable morphological data (Dahlberg 1956), such as craniometrics or craniofacial measures, to environmental factors.

While biodistance analysis is widely applicable in various bioarchaeological contexts, results become problematic when disentangling the roles of intrinsic (genetic) and extrinsic (environmental) factors in generating skeletal and dental traits. The multifaceted nature of morphological traits comprising skeletal phenotypes creates complex associations comprising the genotypic causality of phenotypic expressions. Traits more prone to plastic responses resulting from extrinsic factors provide results that are not as significantly associated with biological relatedness and can skew subsequent analyses. The role of heritability in the continuation and distribution of traits within related populations provides a solid basis for biodistance analysis, especially when considering dental traits and metrics whose morphogenesis are highly genetically controlled.

Uncovering the layers of interactions involved in translating the relationship between genotype and phenotype is immensely complex. Studies of dental biology in

both humans and primates have elucidated insights to better understand and accurately evaluate the genetic basis of morphological traits viewed in archaeological contexts. These studies analyze genetic effects of dental variation identifying high correlations in tooth measures within morphological groups (Hlusko et al. 2007), the macro- and microevolutionary processes decipherable through genetic analyses of dental variation (Jernvall and Jung 2000; Kavanagh et al. 2007), the level of genetic control involved in tooth development (Jernvall et al. 1994; Jernvall and Jung 2000; Jernvall and Thesleff 2000; Rizk et al. 2008), and the significant heritability of these traits (Garn et al. 1968; Goose 1968; Townsend and Brown 1978). Family and twin studies provide a historical basis establishing the heritability of tooth size and tooth form as resultant of additive genetic effects with heritability estimates for crown size being between 0.80 and 0.90 (Garn et al. 1968; Goose 1968; Townsend and Brown 1978).

Molecular understandings of tooth development allow for the identification of dental traits as reliable characters for study as the production of tooth shape from the interaction between the epithelium and neural crest-derived mesenchyme are regulated by molecular signaling centers differentiating and regulating morphogenesis (Dempsey and Townsend 2001; Jernvall and Jung 2000; Kavanagh et al. 2007; Nanci 2018). These molecular signaling centers are controlled by conservative signaling families (FGF, Hh, Wnt, Msx, and BMP) and result in a cascading pattern of development (Jernvall and Jung 2000; Nanci 2018). The identification of this cascading pattern allows for a greater conceptual continuity between genetic basis to phenotypic expression and allows predictive studies of evolutionary patterns in certain ecological environments (Kavanagh

et al. 2007). While additive genetic variance impact tooth crown size and shape, ontogenetic and environmental experiences of stress can impact dental morphogenesis, resulting in an impact in tooth size in association with reduced body size, placental insufficiency, and early life nutritional or pathological strains (Garn et al. 1968; Larsen 1983; Stojanowski et al. 2007). However, these effects are slight when compared to overall, genetic contributions. While these experiences of stress can affect crown size, dental traits remain a suitable data source, being both relatively resistant to environmental factors due to a conserved morphological nature and high level of genetic control (Dahlberg 1956; Garn et al. 1968; Kavanagh et al. 2007; Rizk et al. 2008; Turner and Scott 2000).

Moving Past Typologies: History and Current Tensions

The roots of biodistance analysis, similarly shared with the entire field of biological anthropology, are mired in typological and racial classifications of human groups derived from supposedly characteristic traits based on skeletal morphology (Morton 1849; Relethford 2009). The broader part of the twentieth century saw a methodological and theoretical focus on ascertaining human "types" using limiting historical and descriptive frameworks (Armelagos et al. 1982; Armelagos and Van Gerven 2003; Marks 2012). Even with the advent of the New Physical Anthropology for more process-oriented, functional studies using hypothesis testing, these issues remain a concern within studies of biological relatedness. These issues result from an analytical focus on the migration, diffusion, racial history, and interactions of groups based on phenotypic traits in a way that hearkens back to a descriptive form of analysis

(Armelagos and Van Gerven 2003). While there is belief that moving past these perspectives may be too difficult to overcome (Schindler et al. 1981), current advocations for biodistance analysis present these studies as biocultural enterprises. Investigations into population structure via biodistance can, successfully, offer insights on various patterns of behavior by comparing observed and expected phenotypic distributions and emphasizing patterns of variability to contrast typological, and descriptive mean-based approaches (Relethford 2009; Stojanowski and Buikstra 2004). The implementation of model-bound quantitative genetic approaches is crucial to this argument, stating that these studies consider the genetic structure of populations and adaptations in regional and intracemetery contexts to evaluate both evolutionary and cultural processes through interpretive analysis (Stojanowski and Buikstra 2004).

Moving past articulations of racial groups or "types," interest goes beyond categorizing to investigate biological structures existing within and between ecogeographic settings (Buikstra et al. 1990). While regionally-focused studies are still conducted, the interest no longer remains simply with large scale demographic movements to identify origins of human groups but incorporates the roles of evolutionary mechanisms, adaptive strategies, and intrasite levels of genetic variation (Buikstra et al. 1990; Powell and Neves 1999). Modified approaches to assessments of morphological variation within cemeteries have been meticulously outlined to provide information on past kinship and cemetery structure, postmarital residence patterns, temporal microchronology, age-structured phenotypic variation, and sample aggregate phenotypic variability (Stojanowski and Schillaci 2006). By utilizing these standard analytical

approaches to biodistance studies, phenotypic data allows the retrieval of a wide set of answers interesting to bioarchaeology using a biocultural application of a variability framework aiding in the elimination of typological and descriptive studies. This shift allows for understandings of the ecogeographic origins and distribution of traits along with variation in tracing the evolutionary trajectories influencing present and past compositions of genotypes and phenotypes.

In addition to these typological underpinnings haunting the discipline, biodistance remains problematic because of the multifactorial nature of the skeletal and genetic traits being studied. Inheritance of these traits is incompletely understood and so biological population models that assume the genetic control of traits is directly representative of genetic frequencies that is hard to ascertain from past human populations and bioarchaeological samples (Konigsberg 2006; Stojanowski and Schillaci 2006). Hence, the emphasis on the high degrees of heritability ascertained from genetic data in family studies using dental measures (Turner and Scott 2000). Heritability and the development of dental morphology is instrumental in understanding odontometric variation in past populations.

Biological Affinity and Phenotypic Variation in Archaic Period Hunter-Gatherers

Past studies of native populations have looked extensively at the biological construction of groups during the Archaic. Broad trends in morphological and phenotypic data show these peoples consisted of small groups subject to genetic drift and population bottlenecks contributing to the genotypic and phenotypic expressions present in contemporary groups (Powell 1995; Powell and Neves 1999; Wang et al. 2007). Current

DNA analysis is limited to samples from the later Holocene but the patterns of genetic diversity reflect the occurrence of gene flow in the Southeast allowed for the retention of haplogroups A to D in Mississippian samples (Bolnick and Smith 2003). While comparatively more homogenous, native populations of small, mobile hunter-gatherer groups exhibited between group heterogeneity, with cultural and genetic differentiation of groups occurring prior to the Early Archaic period (Sassaman 2010). Migratory events in conjunction with networks of interaction and exchange motivated by kinship and alliance developed in the Middle and Late Archaic period created a complex, multifaceted, and dynamic series of cultural organizations in the Southeast (Campbell 2016; Crothers 1999).

Recent work on Archaic period hunter-gatherers note the geography of the Green River Valley region of Kentucky maintained these groups as distinct and cohesive entities (Herrmann 2002a; Sciulli 1979). Higher amounts of variation in cranial nonmetric traits amongst females in these groups indicate patrilocal postmarital residence patterns and possible mate exchange networks constructed locally (Campbell 2016; Herrmann 2002a). Archaeological evidence for Archaic period groups in the Green River and surrounding regions also support participation in networks of exchange with the movement of copper, bone, and shell artifacts into Indian Knoll, Barrett, and Carlston Annis from surrounding areas, with dissemination preferentially moving out of the region southward (Brown 2004; Jefferies 2004; Marquardt and Watson 1983). However, biological exchanges and gene flow patterns do not identically match the pattern of material distribution. Groups in western Kentucky remain distinct in comparison with other populations in the mid-South,

with greater biological affinity evident between southern Illinois and central Tennessee populations than between central Tennessee and western Kentucky. This trend occurs even though cultural connections between central Tennessee and western Kentucky would suggest higher affinity (Campbell 2016). These patterns indicate an isolation by distance model where either cultural isolation or a separate population history suggests a different biological lineage in the Green River ecological system (Campbell 2016; Herrmann 2002a; Konigsberg 2006).

Regional exchange networks of goods or mates may have been utilized as conflict reducing mechanisms as well as tools to mediate identity creation or definition and alliance construction with rising population sizes and sedentary behavior beginning in the late Middle and Late Archaic (Crothers 1999; Jefferies 1996; Kidder and Sassaman 2009; Sassaman 2010). Such exchanges were patterned, with Green River groups avoiding trade north and west across the Mississippi and Ohio Rivers and groups in southern Illinois and Indiana exchanging with one another. Cultural manifestations of these differences also present in temporally and regionally distinct mortuary practices in the Middle to Late Archaic. As sedentism increased, the more inconsistent burial patterns of highly mobile Early Archaic groups gave way to more repetitively used burial sites such as in burial mounds in continuously used locations (Charles and Buikstra 1983). Variations in body position in Middle and Late Archaic sites of Black Earth in southern Illinois contrast those in western Kentucky Shell Mound Archaic sites, with the former interring individuals in extended positions and the latter in flexed positions (Milner et al. 2009; Webb 1974).

The development of approaches to bioarchaeological studies of hunter-gatherers have been applied for Archaic period samples and include the documentation of biological relationships in Ohio, Florida, and southern Illinois (Powell 1995; Sciulli 1990; Sciulli and Schneider 1985). Some previous studies of Late Archaic samples showed a significant correlation between biological and geographic distances between subpopulations in nonmetric cranial traits in Ohio Archaic and Woodland samples (Sciulli 1990; Sciulli and Schneider 1985). Analyses of the Green River site at Indian Knoll found the metric variability of the skeletal sample to be quite low and, in conjunction with a nonmetric distance result supporting an isolation by distance model, indicates lower rates of morphological variation within the site (Herrmann 2002a; Long 1966; Steele 1948). While a relatively homogenous biological construction of the site corresponds to an isolation model, instances in hunter-gatherer studies also show that patterns of ancestral affiliation and cultural resilience can influence the genetic makeups of cemeteries and serve as motivations for maintaining persistent landscapes as ritual mortuary sites (Temple 2020; Thompson 2010). The role of cultural processes of cemetery construction in combination with the evolutionary mechanisms should be considered for comprehensive interpretations of biological affinity within site specific contexts.

Problems with Biodistance Analysis

Biodistance studies broadly and within hunter-gatherer investigations suffer from a multitude of theoretical and methodological issues. Theoretical issues begin with the application of contemporary views of ancestry and kinship to past populations. While

contemporary views of biological relatedness are heavily oriented around genetics and direct biological ties, past understandings of these concepts may not conform to such rigid, genetic definitions (Johnson 2019; Lozada 2011). The incorporation of multiple external lines of evidence, such as ethnohistoric and ethnographic data, material culture assessments, and oral and historical narratives can aid in these investigations. However, general small sample sizes associated with hunter-gatherer communities as well as lack of these ethnohistoric materials presents issues for the accurate representation of past ideological constructions surrounding affinity and kinship as well as motivations for the organization of mortuary contexts. While archaeological remains are suggestive of varying cultural expressions in materials during different historical phases of occupation at Indian Knoll (Rolingston 1967), past speculation on understandings of hunter-gatherer perceptions of what qualifies and quantifies relatedness or kinship is difficult to ascertain. Cultural interpretations of biological relatedness matter in shaping concepts of identity as well as resulting phenotypes empirically observed from human remains. In addition to theoretical considerations of kinship, continued infusion and application of social theory to hunter-gatherer studies will continue to elucidate the ways behaviors are constructed by complex ideologies present in these communities (Cannon 2002).

Juxtaposed with these theoretical issues, methodological concerns associated with studying past populations subscribed to a hunting and gathering subsistence strategy are also pertinent to studies in biodistance. Small sample sizes, increased effects of genetic drift, and high levels of dental attrition amongst these past populations limit data availability and integrity. Late Archaic populations in southern Illinois and the Green

River Valley of Kentucky experienced high levels of subadult mortality as well as severe levels of dental wear and poor oral health. This poor health was reflected in high rates of chronic periapical infection and antemortem tooth loss amongst the adult population (Ward 2005). Acquired pathological conditions of the permanent dentition in these populations reveal changes in food processing technologies and cooking strategies, such as hot-rock cooking and stone-grinding, triggering increased incidences of extreme dental wear unassociated with food related abrasion (Nealis and Seeman 2015; Ward 2005). These limitations in the study of nomadic and semi-nomadic groups require the development of methods apt for the elimination of these issues associated with data lost from these populations. Missing data can be estimated using statistical models, such as maximum likelihood estimations of the estimation maximization algorithm (Allison 2002). The utilization of buccolingual, mesiodistal, and cervical measures of less plastic primary teeth of each tooth class are key datasets that should be used in multivariate analyses for low-density hunter-gatherer skeletal samples (Luna 2015).

Addressing Tensions in Biodistance for Hunter-Gatherer Studies

To better service the bioarchaeological study of hunter-gatherers, added parameters to biological distance studies need to be applied for the accurate representation of these past communities. While the utility of biodistance analysis for the study of hunter-gatherers and bioarchaeology broadly is unmistakable, there are still caveats to the method in need of consideration. Issues such as small sample sizes, lack of implemented social theory, pathological conditions limiting datasets, the mobile nature of these groups, and past typological fascinations with identifying characteristic and

historical traits of different native groups all potentially hamper robust understandings of hunter-gatherers. Engagements in social and cultural behaviors outside of subsistence practices should be considered within the framework of biodistance to decipher the underlying social adaptive strategies involved in the maintenance of past groups, associated behavioral practices, and the potential responses to life events seen in shifts present in phenotypic data (Klaus 2013; Stojanowski 2013a, b). Data derived from hunter-gatherer sites can provide information on patterns of cultural changes and events precipitating the formation of new identities. Contextualization of biodistance methods in a biocultural approach integrating archaeological context, local oral and narrative histories, regional and intrasite perspectives, and the applications of social theory are essential to the continued ethical use of biodistance analysis in bioarchaeology.

Conclusion

Biodistance analysis provides a framework of rising applicability in bioarchaeological investigations of past Archaic period hunter-gatherers in North America. With contemporary research in hunter-gatherer studies beginning to acknowledge the cultural complexity and capacity for resilience amongst these past populations (Cannon 2002; Temple and Stojanowski 2019b), biological distance studies can elucidate patterns in the past that not only investigate relationships and interactions between groups, but can also identify mortuary contexts as intrasite loci of identity production and negotiation. This chapter discusses the typological roots of biodistance studies as well as the conceptual basis of heritability of highly genetically conservative tooth forms between generations. The effects of both extrinsic and intrinsic factors on

tooth form and the potential complications these have on studies of biodistance are considered as well as the genetic basis for why dental matrices still remain an appropriate dataset for biodistance analyses.

Past studies in the biological affinities of Archaic North America are reviewed, noting how the former focus on deriving native populations from an original Asian "type" are somewhat problematic. Biodistance has the potential to answer questions comprising the structures underlying complex social behaviors and rituals comprising and maintaining hunter-gatherer societies, ideologies, and cosmologies. These studies hold the potential for synergisms with mortuary analysis to better understand the construction, production, and (re)negotiation of social identity and memory in persistent hunter-gatherers visible in the skeletal record. Current Archaic and hunter-gatherer studies should continue moving forward past focuses on comparisons and impacts on broader scales to better apply concepts of social theory, identity production, and ethnogenetic processes to better understand underlying constructions of phenotypic variation. Defining these relationships through human and environmental interactions, microevolutionary processes occurring between and within groups, as well as adherences to cultural identities constructed in accordance to those interactions and regional temporal rhythms.

CHAPTER THREE: MATERIALS AND METHODS

This research seeks to expand bioarchaeology through the osteological analysis of Archaic hunter-gatherers occupying the persistent landscape at the Indian Knoll site (ca. 4600 and 3500 BP) and the incumbent social strategies associated with its long-term occupation. This work evaluates the repetitive nature of interment in these communities and reviews the spatial relationships between individuals to understand whether burial clustering is biologically or socially motivated and how such placement affects the creation of social memory. Contributions of biological affinities to the organization of spatial patterns and such connections in consideration of intrusive versus non-intrusive burials has been previously unexplored. Prior investigations into the biological affinities at Green River sites can be expanded further (Herrmann 2002a; Long 1966; Wyckoff 1977). Biological affiliations and distances at the site can extend to elucidate patterns of meaningful biological relationships, local histories of ritual mortuary practice, regional interactions of groups through symbolic burial of the dead, as well as programs of social memory creation through the use of shell middens as persistent places.

This project aims to observe the role social memory held in the creation of Indian Knoll as a persistent landscape. To do this, research was structured to assess the persistence of symbolic ritual by accounting for archaeological mortuary practices through the documentation of body positioning and grave goods. Secondly, a

Figure 1. Regional map denoting the primary area of Shell Mound Archaic sites in western Kentucky in the Green River Valley region (Rodan 2020).

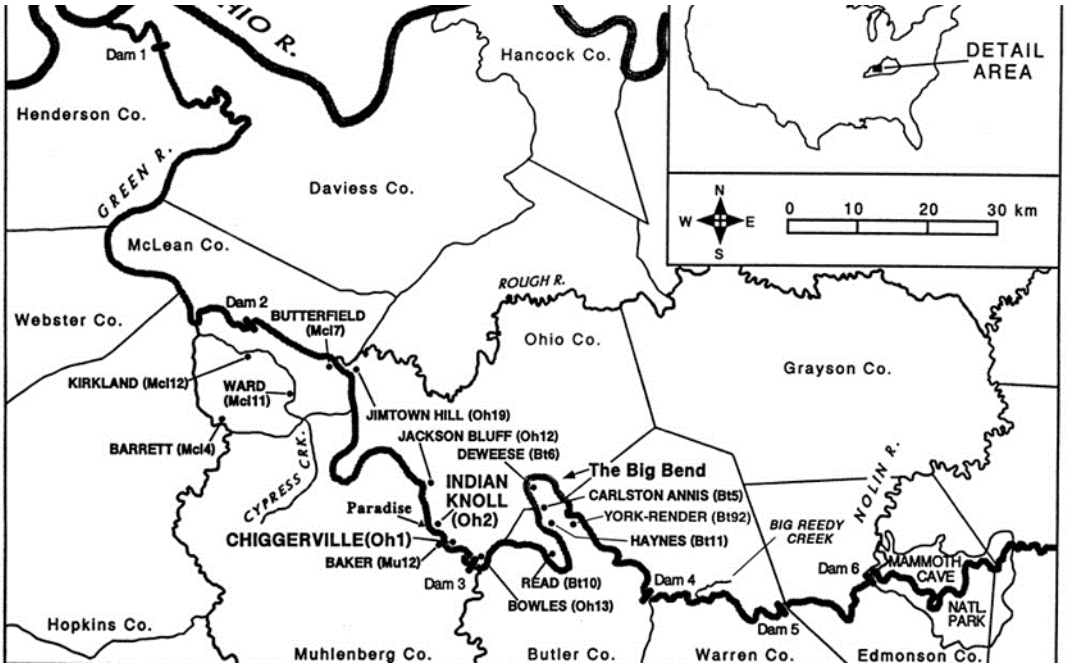

Figure 2. Map denoting the Green River Valley and Indian Knoll site (Webb 1974; Marquadt and Watson 1983)

comprehensive analysis of the human skeletal remains to find both spatial and biological distance were performed to derive whether individual placement of the deceased in the cemetery corresponds to social affiliation or if proximity in burial reflects biological relatedness. Such forms of analysis, in conjunction with an understanding of the temporal distribution of the site, can ignite insight into the ways persistent mortuary land use in these long-term occupational sites and shifts to the consolidated inhabitation of resource rich environments potentially affect one another. These observations will help demonstrate how this population utilized both the persistence of ritual and social strategies to continually occupy this landscape over an extended period of time.

These investigations into biodistance amongst the hunter-gatherers at Indian Knoll are based upon a biocultural perspective investigating the role of biological affinities in the placement of individuals within the cemetery and potential correlations such placement has on the creation of social systems expanding, initiating, and renegotiating social memory at the site. This form of biodistance research does not prescribe to descriptive analyses investigating typological classifications of populations from the past or the establishment of human origins. This resulting data will evaluate the persistence of mortuary practice and ritual within the Indian Knoll community while evaluating the role of spatial distance and whether placement is biologically motivated or a social strategy utilizing contiguity in death to create an intimate social affiliation with ancestral populations.

Background

Investigations into Archaic Period (10,000-3,000 BP) hunter-gatherers glean large quantities of information from populations occupying the southeastern United States, including groups in the Mississippian River Valley and the Green River in Kentucky. The region of Kentucky associated with the Green River Valley is characterized by multiple shell mound sites of prehistoric occupancy, including Carlston Annis (15Bt5), Haynes (15Bt11), and DeWeese (15Bt6). The largest and most well-known amongst the Green River sites is Indian Knoll (15Oh2), a prominent shell mound located along the southwestern boundary of Ohio County in western Kentucky.

Past Excavations of the Indian Knoll Site

The excavation efforts of Indian Knoll have produced an extensive and well-preserved set of material samples on Archaic hunter-gatherers in the midcontinent, providing important collections for archaeological, bioarchaeological, and anthropological studies of prehistoric populations. Clarence B. Moore (1916) conducted initial excavations for the Academy of Natural Sciences in Philadelphia, uncovering 298 burials and a myriad of associated artifacts. While providing exciting new reports on a new cultural complex in Green River, the lack of standardized archaeological methods or organization of data led to successive excavations by the Works Progress Administration (WPA). William B. Webb supervised these excavations in the 1930s and 1940s, pursuing previously uncovered materials in a statewide archaeological overview of shell middens and mounds in Kentucky. These excavations led to the majority recovery of the site, discovering 880 unexcavated human burials and approximately 55,000 artifacts. Webb added to a developing definition of the Archaic Period in North America and contributed the first professionally organized consolidation of information of the Green River shell middens, publishing a monograph *Indian Knoll* (1946) that remains a classic in the archaeological literature of the region.

The release of this foundational work for the Indian Knoll site was succeeded by investigations of the Shell Mound Archaeological Project (SMAP) by William Marquardt and Patty Jo Watson during the 1970's. Focusing on the Carlston Annis site, the Shell Mound Archaeological Project served as an expansion of previous projects investigating the presence of horticultural practices in Mammoth and Salts caves in Kentucky sites of

Woodland cave explorers. The research into the subsistence patterns at these sites led to an expansion west to the Archaic shell mounds of Green River, mounds consisting of past dietary materials of hickory nuts and shellfish as well as a cemetery for humans and dogs. The occupants of Green River shell mound locales represented groups gathering in seasonal patterns, aggregating for longer periods of time to invest in regional resources and participate in feasts, trading, ritual activities, and burial of the dead (Marquardt and Watson 1983). The endeavors of SMAP were continued into the 1980's and 1990's by George Crothers and C. K. Hensley, instigating test excavations of previously unexcavated midden sites by the WPA, including the York-Render (15Bt92), Haynes (15Bt11), and DeWeese (15Bt6) sites.

Occupation of various Archaic midden sites spanned a considerable amount of time, with the most intense midden use across various Green River Valley sites from approximately 6,500-4,500 B.P. and 5,590-4,530 cal B.P. at Indian Knoll specifically. Dates available for the dictation of such boundaries stem from original radiocarbon dates from burials at the site (C-254 5320 ± 300 B.P., C-740 4282 ± 250 B.P., and C-741 3963 ± 350 B.P.) (Arnold and Libby 1951; Libby 1951). These primary dates were sourced from bulk antler and animal bone samples derived from burials at the site and exhibit large standard errors between 250 to 350 years as well as inverted age determinations in comparison to stratigraphic context (Herrmann 2002b; Rolingston, 1967). The questionable validity of these dates for research led to subsequent updates using radiocarbon dating from the rib bones of two individual burials (Burial 827 and 612)

from the top and bottom layers of the midden (Herrmann 2002b) as well as from soil samples gleaned from auger holes.

AMS determinations made by dating charcoal samples from soil in a series of auger holes identified “shell free” and “shell midden” segments at the site. These layers were defined by the differing levels of organic matter and carbonate present in the samples, as shell is characterized by high percentages of organic matter and carbonate. Conversely, the shell free midden has high organic but low carbonate values (Stein, 1980; Morey et al., 2002). The four dates determined by these samples provided an uncalibrated temporal range from 4670 ± 70 B.P. to 4230 ± 80 B.P., potentially indicating a period of approximately five hundred years of occupation.

However, in conjunction with original AMS dates from the midden deposit, derived from human rib bone samples of two burials (827 and 612) situated at the top and bottom of the cemetery and associated temporally specific projectile points, estimated a total chronological span of midden use approximating a one thousand year span of time. Burial 827, located close to the top of the midden, was associated with seven Late Archaic stemmed projectile points, consistent with AMS determinations for points located at various sites in central Kentucky and was dated 3500 ± 60 B.P. Burial 612, located at the bottom of the midden, was associated with four Benton cluster projectile points and was dated 4570 ± 75 B.P. The dates on these artifacts are consistent with Middle to Late Archaic Benton cluster points located across Kentucky and Tennessee at the time (Justice 1987). These provide a temporal range of 4570 ± 75 B.P. to 3500 ± 60 B.P. for the midden from Burial 612 and 827, respectively. This range establishes a

timeframe for the burial data specifically and a combined range of 4670 ± 70 B.P. to 3500 ± 60 B.P. between both skeletal and soil samples. Such determinations fall within previous estimates but reveal a 1000 to 1500 year span of use of the Indian Knoll site.

The Distribution of Indian Knoll and Adaptive Subsistence Strategies

The Middle to Late Archaic Period (6,000-2,500 BP) site was constructed by complex fishing hunter-gatherers with multifaceted life strategies. During occupation, those at Indian Knoll practiced intricate systems of political, ecological, and economic strategies, lacking an apparent social hierarchy and pursuit of horticultural practices (Crothers 1999; Marquardt 1985; Marquardt and Watson 1997). The location of the raised shell mound, positioned near the bank of the river, most likely served as a natural levee preventing flooding of the river and water locking a two mile span of land between Green River and Pond Run, a small creek bed prone to rising water levels during heavy rains or flood events. Enclosing the area in this way created a large area of plains relatively safe from flooding, making the stretch an ideal location for occupation by fishing hunter-gatherers as the knoll provided a high ground that remained dry during wet seasons in the region (Webb 1974). From the Early to Middle Archaic Period, hunter-gatherer mobility and life patterns went through significant changes in the Southeastern United States, particularly in the Green River Valley, as mobile groups with smaller numbers began to trend towards more stationary groups settling in resource-rich areas with location specific cultural practices (Crothers 1999; Jefferies et al. 2005). The establishment of more major settlements resulted in large accumulations of midden, comprised of various organic matter and shell deposits.

Alterations in settlement preference adhered to developing subsistence strategies prioritizing proximity to abundant resources. Long-term occupational commitments resulted in increased persistent settlement near riverbanks and wetlands during the mid-Holocene, although inland sites marked by hunter-gatherer habitation did occur (Jefferies et al. 2005). This increased preference may have corresponded with warmer, dryer regional temperatures from the Climatic Optimum. The placement of shell midden accumulations corresponds continually with resource-rich river shoals along the Green River. River shoals held food in the form of mussel beds, fish, and other subsistence opportunities. Such ecological zones attracted Archaic hunter-gatherers for habitation and transitioning from mere settlement areas to aggregation points for economic and social purposes (Hensley 1994; Hoffman 1986; Morey et al. 2002; Winters 1974). Harvesting shellfish from the main river encouraged Indian Knoll residents to settle on a more permanent basis by the river. Stable access to seasonal resources produced the continual negotiation of communal rights, developing a veneration for the subsistence-rich areas as shell middens represented products of social labor, social activities such as feasts, mate exchange, and burial of the dead, and became continued sites of importance (Crothers 1999; Herrmann 2002a; Marquardt and Watson 1983).

The Archaic midden site of Indian Knoll was occupied for a considerable amount of time, providing a long-term temporal framework for the establishment of complex, symbolic lifeways. Hunter-gatherers practiced diverse life practices over time across the Green River Valley as economic risks reinforced by ritual and social behaviors became engrained in Archaic communities, exhibiting a diversity central to hunter-gatherer

adaptation on a regional scale (Morey et al. 2002). Transformative social structures types responded to ranging behavioral adaptations to changing subsistence strategies. The increasingly rooted settlement pattern amongst these diverse hunter-gatherer groups also instigates the implementation and extension of territorially bounded social networks, leading to modified levels of social interaction dramatically affecting the population biology and biological relationships between these groups (Jefferies 1997). Biological distances of Green River Archaic hunter-gatherers indicate a geographically influenced structure, suggesting the presence of a local mate exchange network between sites (Hermann 2002a). While analysis into broader regional patterns establish shell mounds, such as the one present at Indian Knoll, as continuously creative regions of social behavior affecting biological relationships, subsequent understandings of site-specific relationships, burial placement patterns, and the resultant nature of landscape use are limited. These factors make Indian Knoll an appropriate site for the investigation of symbolic landscape use and the impact of persistent ritual behaviors on producing social identity in mortuary cemeteries.

Materials

This research drew from skeletal samples in the Indian Knoll (15OH2) collection at the William S. Webb Museum in association with the University of Kentucky in Lexington. This collection is prudent for analysis because of the large number of individuals retrieved from excavations as well as the provision of high levels of preservation due to burial deposition into a high shell environment. These environments have characteristically low levels of acidity, slowing bone destruction over time (Morey

et al. 2002). Original site reports and maps from the initial excavations (Marquadt and Watson 2005; Snow 1948; Webb 1974) as well as updated materials detailing more accurate representations of the excavation block and geographical distances between individuals (Herrmann 2002a; Nicholas Herrmann, personal correspondence 2019) were used to structure the investigations of burial placement, grave good presence, grave good types, body position and orientation, relative interment depth, and relative temporal categorization of individuals.

Dental measurement data were collected from a total of 250 individuals. Dental metrics are appropriate for this study for multiple reasons: dental metrics are highly heritable (Dempsey et al. 1995; Townsend and Brown 1978; Townsend et al. 1986), more resistant to environmental influences and ontogenetic variation than other morphological sources such as craniometrics or craniofacial measures (Dahlberg 1956), and have been historically used for various evolutionary studies (Kieser 2008). Certain dental dimensions, such as the buccolingual dimensions of anterior tooth types, give information adequate for identifying variation using a continuous distribution, one which easily functions in statistical models while remaining less frequently impacted by dental attrition (Relethford et al. 1997; Scott and Turner 1997). Using these measures for biodistance studies provides results that are more highly significantly associated with biological relatedness than morphological traits susceptible to high levels of plasticity in the presence of extrinsic factors.

Methods

This project began by including the recording of all evidence of mortuary practices from the original site records located at the museum in association with the University of Kentucky. All data from the mortuary site reports from previous excavations was organized into an Excel spreadsheet, with the following recorded according to individual and burial number: age-at-death estimates, sex estimates, presence of grave goods, corresponding good types and positions of material placement, depth of interment, body position, and spatial orientation ascertained from the original site reports (Marquadt and Watson 2005; Webb 1974). Lab analysis of human skeletal remains were performed in accordance with standardized, non-destructive methods (Brickley and McKinley 2004; Buikstra and Ubelaker 1994) and estimations of age and sex were drawn from previous studies made for individuals at the site (Marquadt and Watson 2005; Snow 1948; Webb 1974).

Investigations into biodistances at the site focused on the use of standard methods to gain insight into the potential underlying motives involved in burial placement. Spatial and biological distances were determined and tooth measurements made according to standard protocols utilizing dental phenotypic data to map biological relatedness (Buikstra and Ubelaker 1994).

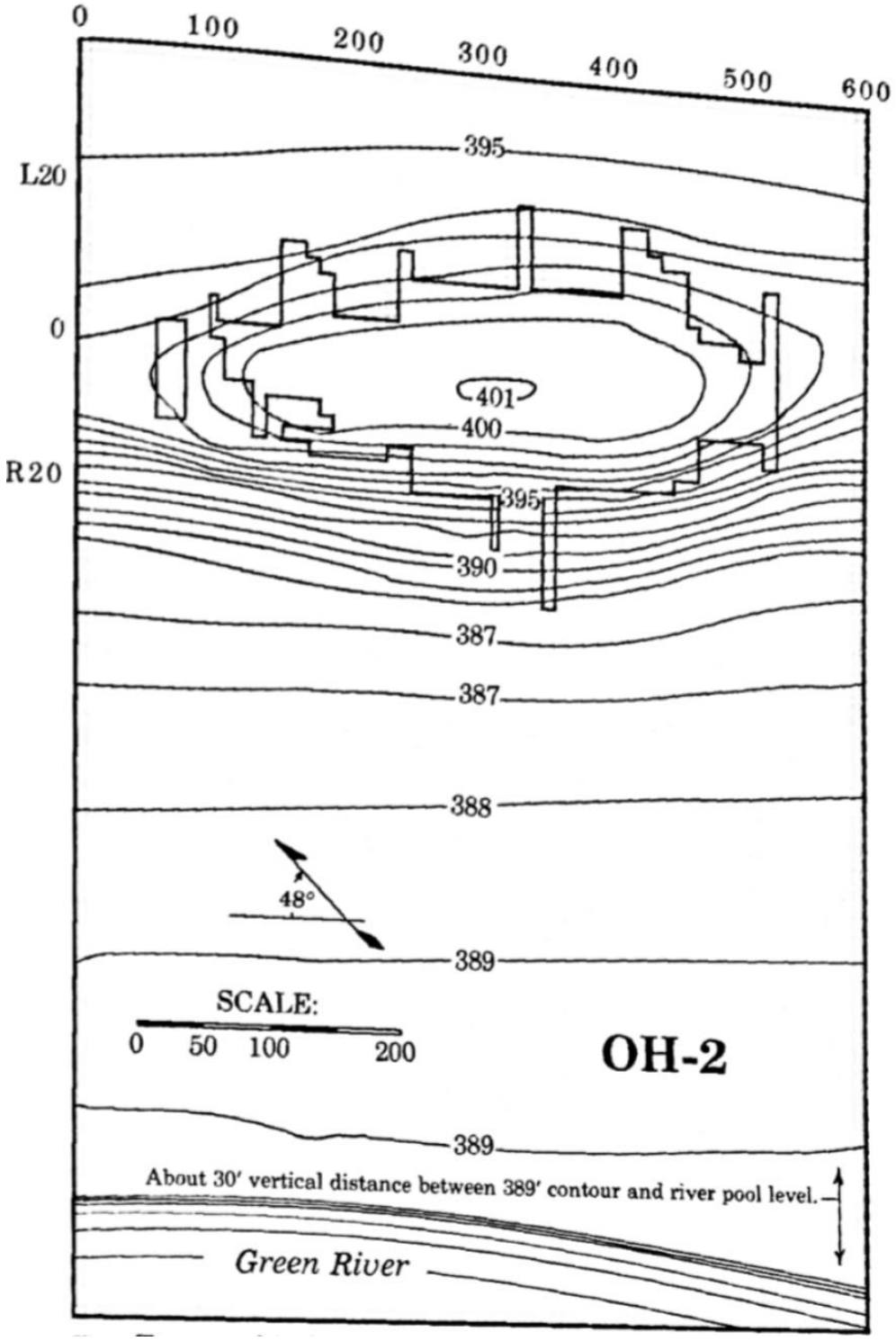

Figure 3. Topographic map of the Indian Knoll excavation block from the original site report. (Webb 1973).

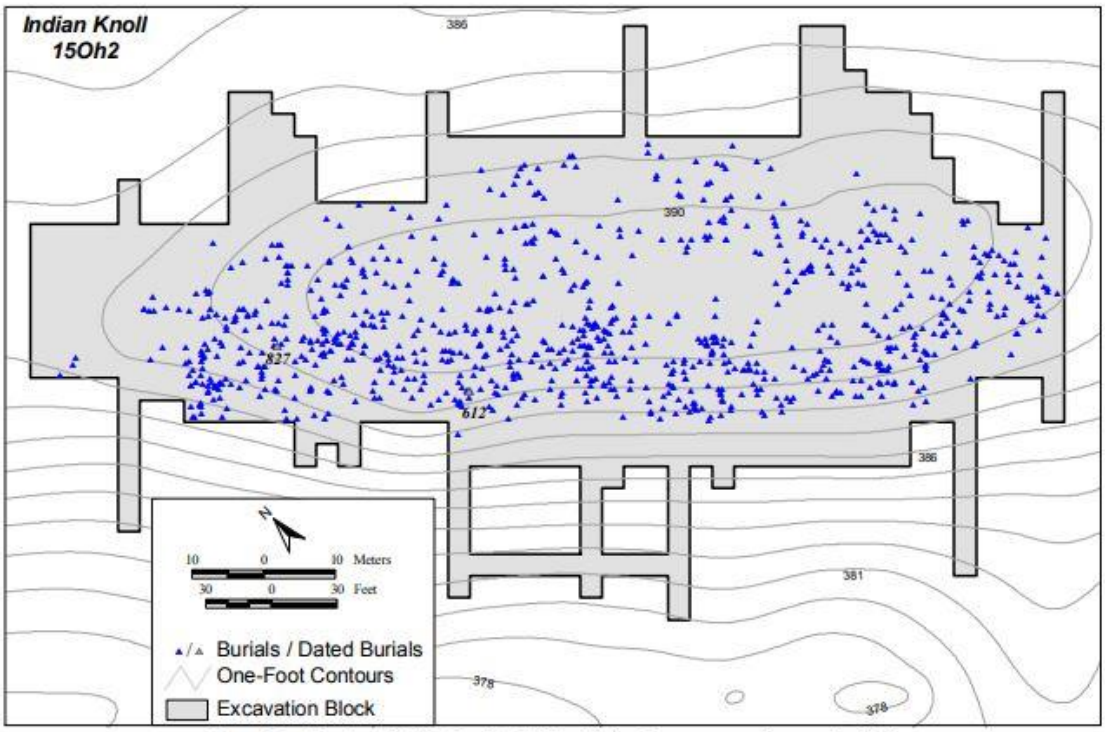

Figure 2-4. Planview of Indian Knoll (15Oh2) with burials, contours and excavation block.

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Figure 4. Topographic map of the Indian Knoll (15OH2) archaeological site denoting burial locations within updated boundaries of the excavation block (Herrmann 2002a).

Biological Distance Estimates

Dental inventories were taken for all 250 individuals according to standard protocols (Buikstra and Ubelaker 1994). Individuals included were those with complete teeth for measurement and those with severe dental attrition or tooth loss excluded from study. In addition, all individuals identified under the biological age of 20 years had the status of tooth emergence and eruption noted for each tooth and categorized into groups of unerupted, erupted past the alveolus, and emerged into occlusion. For these

individuals, age-at-death was estimated using tooth formation and eruption. Standard protocols were used to document the stages of tooth formation and eruption in deciduous and permanent dentition as well as to estimate ages based on reference standards for each tooth (Bass 1971; Buikstra and Ubelaker 1994; Liversidge and Molleson 2004). Tooth presence and absence was recorded as well as all notable dental pathological conditions.

Once inventories were taken, measurements of teeth were performed for measures of mesiodistal length and buccolingual breadth. These measurements were made using sliding digital Mitutoyo needle point calipers to the nearest 0.10 of a millimeter. For incisors, the buccolingual measures were taken from the cingulum to the labial surface of the tooth. Data on mesiodistal and buccolingual diameters were recorded for the maxillary and mandibular arcades, using maximum diameters of the crown (not between contact facets). Measures were taken on three separate cases to reduce interobserver error, with the average measure being recorded.

Once all measures were recorded, left-side measurements were taken from 139 of the original 250, with 111 individuals being excluded for a lack of 75% tooth presence. This exclusion removed individuals with heavy tooth damage, dental disease, or extensive tooth loss from the study. Data were collected from the polar teeth present within each tooth class, encompassing a total of 16 tooth measurements per individual. The polar teeth include the first maxillary molar (M^1), the first maxillary premolar (P^3), the maxillary canine, the first maxillary incisor (I^1), the first mandibular molar (M_1), the first mandibular premolar (P_3), the mandibular canine (C), and the second mandibular incisor (I_2). The data from the polar teeth are used because of high levels of intertrait

correlation, the genetically reiterative nature of teeth within the same tooth class, the resistance to extrinsic factors, and the minimization of error contributed by alterations of tooth form and shape resulting from attrition or environmental impacts (Bateson 1894; Butler 1939; Dahlberg 1945; Stojanowski 2003a). Once individuals with 75% presence were organized, a maximum likelihood estimation (MLE) model of expectation maximization algorithm was applied to data through SAS 9.3 software to estimate any missing buccolingual or mesiodistal measures (Alison 2002).

R-matrix Calculation. All original present and estimated missing data was used to estimate biological distance between individuals using an R-Matrix test. With heritability set at 1.00, this analysis evaluates residuals between observed and expected patterns of phenotypic variation to document trends at the site based on the Relethford-Blangero technique using quantitative traits to estimate population affinities (Relethford and Blangero 1990). The R-matrix evaluated within-group phenotypic variation for the full sample and within differing temporal layers of the midden. An R-matrix was also performed analyzing within-group phenotypic variance among temporal groups in relation to grave good presence to evaluate shifts in the use of mortuary artifacts and associations with biological affinities.

To assess different microevolutionary forces, this technique utilizes comparisons of observed versus expected phenotypic variation within populations to provide models that analyze patterns of genetic variance in local regions. The expected variation within a population is a function of phenotypic variation for broader areas and the distance of the population from a mean centroid of allele frequencies. Once standardized for population

size, this function uses quantitative traits as additive genetic variance within a population. This additive genetic variance is proportional to phenotypic variation and so expected trends are proportional to the genetic distance from the centroid. Subsequently, comparing observed and expected patterns of phenotypic variation as a proxy for genetic variation can provide insight into effects of differential gene flow in a relationship (R) matrix (Relethford and Blangero 1990). Residuals between the observed and expected phenotypic variances indicate direction and intensity of patterns of variation, with greater residual variance indicating increased intensity of gene flow in a population. Residual variance and significance of an F_{ST} statistic were approximated by dividing these values by the standard error. Once estimated, the resulting values were then evaluated according to a two-tailed t-distribution with n – 1 degrees of freedom (Powell and Neves 1999).

Spatial Relationship Estimates

Site maps of the original excavation block detailing individual burial placement were reviewed in addition to updated materials for an accurate representation of the distribution of individuals across the cemetery. Excel spreadsheets articulating matrices of all the straight-line geographical distances between burials of individuals at the site (Nicholas Herrmann, personal correspondence 2019) were used to create geographical matrices of the individuals for the study sample. These matrices were created for later use in a Mantel's partial correlation tests to investigate the potential relationship between spatial positioning and biological relatedness within the total cemetery and between occupational layers.

Temporal categories were created to differentiate occupational layers at the cemetery over time. These categories were established in the midden layers comprised of high levels of shell material and layers characterized by low levels of shell material closer to the cemetery surface based on the AMS determinations of charcoal soil samples dating the site. Utilizing these determinations, individuals were relegated into three relative temporal categories based on burial depth, in feet: Low Shell (0 – 2.5), Mid-Shell (2.6 – 5), and Deep Shell (>5). These categories utilize stratigraphy to represent general proxies for time differences between individuals. In this sense, Deep Shell correlates to the oldest occupational layer, Mid-Shell to the middle period, and the Low Shell to the youngest layer. The selection of 2.5 foot intervals were chosen arbitrarily, as midden lacking shell material has been seen to permeate to approximately 2 feet (Herrmann 2002a; Morey et al. 2002).

Mantel's Partial Correlation Test. Once teeth were measured, a Mantel partial correlation test was performed to test the correlation between biological affinity among individuals and corresponding spatial relationships at the site. These tests were performed with significance values computed over 9,999 permutations using the Passage 2 software, available online (www.passagesoftware.net). These tests investigate the question as to whether biological relatedness potentially motivates burial placement of the dead. Temporal and spatial relationships have been shown to contribute to biological distances at mortuary sites, with isolation by distance of either as well as gene flow influencing the level of genetic distances between individuals. For these reasons, estimations of the potential degree of correlation between biological, spatial, and temporal relationships

were investigated using Mantel matrix permutation tests (Manly 1986, 1997; Mantel 1967; Smouse et al. 1986; Smouse and Long 1992). Matrices for geographical and biological distances were created for the total sample population as well as for temporally specific matrices for individuals in Low Shell, Mid-Shell, and Deep Shell portions of the midden, correlating with the latest, middle, and earliest periods of occupation. Temporal matrices were compared with measured biological distances to identify transitioning trends in intrusive deposition at the site over time. These measurements were taken from various sections of the shell mound to account for potential intersite variation.

The Mantel test is a statistical test prudent to spatial analysis as it analyzes the relationship between square matrices. The values within each distance matrix (X and Y) represent the relationship between points i and j (Xij and Yij). The Mantel statistic used is a function (Z) comprised of the sum of the products of the corresponding values of the matrices. The Mantel statistic can then be transformed into a t statistic, where the significance of t can be found through t-tests. This basic Mantel test was extended using a partial Mantel test, where the inclusion of a third, or more, matrices remains constant while the correlation between the other matrices is analyzed (Smouse et al. 1986). The partial test creates a multiple regression for additional matrices and inputs the residuals resulting from the regressions into a standard Mantel test, permuting the data within the residual matrices. Mantel permutations compare magnitudes of Z in one-tailed and two-tailed permutation tests.

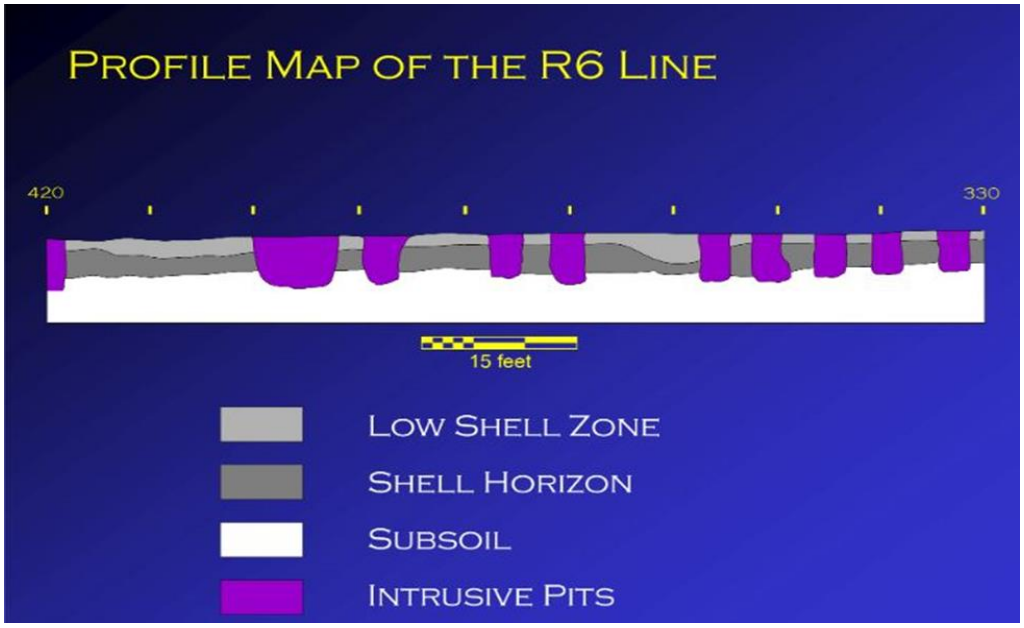

Figure 5. East-west profile map of the R6 line noting areas of low and high shell zones (Nicholas Herrmann, personal correspondence 2019).

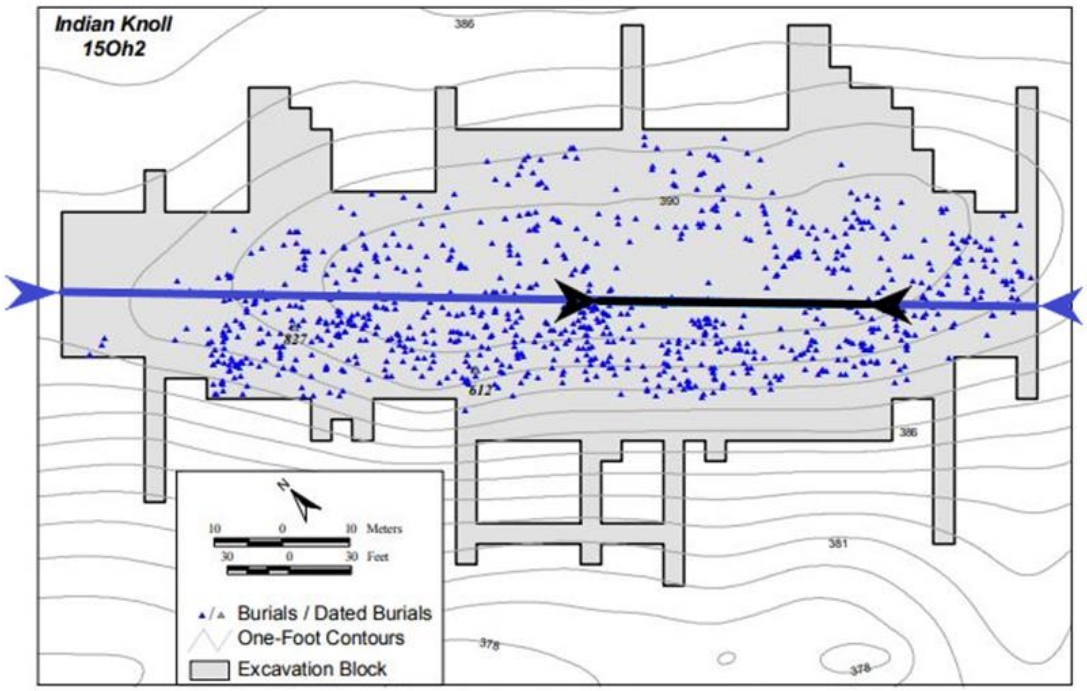

Figure 6. Orientation of the R6 line geographically in the excavation block with the location of the east-west profile of the line highlighted (Herrmann 2002a).

In this case, spatial matrices for the total sample as well as individual occupational layers were compared to biological matrices for the total sample as well as individual occupational layers to find the amount of covariance or correlation present between matrices.

Investigation of Symbolic Mortuary Practices. Interest in broader structures framing perceptions of identity at the site were also of interest outside of more narrow considerations of social identity and memory creation in connection to biological relatedness. Subsequent tests were performed to analyze potential interactions between

age, sex, and associated presence of grave goods. Both binary logistic regression and chi-square tests were performed to investigate these relationships.

Table 1. Sample composition for the biodistance analysis and ranges demarcating temporal groups.

Temporal Group	Sample Size	Burial Depth (in feet)
Low Shell (1)	21	0 – 2.5
Mid-Shell (2)	59	2.6 – 5
Deep Shell (3)	59	5.1+
Cumulative	139	

Table 2. Ranges demarcating age groups.

Age Group	Sample Size	Numerical Age Range
Adolescent	29	12 – 19.99 years
Young Adult	106	20 – 34.99 years
Mature Adult	4	35 – 49.99 years
Old Adult	0	50+ years

Table 3. Categories of body position and orientation.

Body Position		N	Body Orientation		N
D	Disturbed	3	B	On back	58
F	Fully flexed	106	R	On right ride	38
P	Partially flexed	27	L	On left side	28
E	Extended	3	F	On face	12
			S	Sitting	0
			?	Disturbed/Unknown	3

Table 4. Sample burial data utilized for biodistance and spatial analysis.

Burial Number	Age Group	Sex	Grave Good Presence	Body Position and Orientation	Burial Depth	Temporal Category	Age
9	YA	F	N	F,L	3.9	2	27.5
10	YA	F	Y	P,Fa	2.1	1	27.5
13	MA	N/A	N	F,L	2.7	2	32
15	YA	F	N	E,B	2.9	2	27.5
17	YA	F	N	P,B	4.3	2	27.5
30	YA	F	Y	F,R	4.6	2	22.5
34	YA	M	N	F,B	5.8	3	25
39	A	M	Y	F,L	6.7	3	17
42	YA	M	Y	E,B	6.3	3	27.5
44	YA	M	N	F,R	6.2	3	27.5
46	A	M	N	P,R	4.3	2	19
49	YA	F	Y	F,L	2.3	1	21
50	YA	M	Y	F,R	2.3	1	21.5
55	YA	M	Y	P,L	6.3	3	21.5
56	YA	F	Y	F,R	6.3	3	21.5
64	YA	F	N	F,B	2.9	2	22.5
68	YA	F	N	F,B	6.1	3	21.5
69	YA	M	Y	F,B	8.5	3	21.5
70	YA	F	Y	F,R	3.9	2	22.5
73	YA	M	Y	F,R	3.8	2	27.5
75	YA	F	N	F,R	1.9	1	20.5
79	YA	M	N	P,B	1.5	1	23
81	YA	M	N	F,B	3.8	2	23
87	YA	M	Y	P,R	6.7	3	21.5
90	YA	F	N	F,R	5.1	3	22.5
95	A	M	N	F,B	6.5	3	15
97	A	M	Y	F,B	6.6	3	17
103	YA	F	N	F,B	5.5	3	21.5
105	MA	M	Y	F,B	7.1	3	37.5
107	YA	F	N	F,R	5.9	3	21.5
108	MA	M	Y	F,R	8.1	3	37.5
109	YA	N/A	Y	F,L	6.4	3	26
121	YA	M	Y	F,B	6	3	21.5
122	YA	M	N	F,Fa	6.4	3	22
127	A	F	Y	F,R	6.8	3	15

Burial Number	Age Group	Sex	Grave Good Presence	Body Position and Orientation	Burial Depth	Temporal Category	Age
131	A	M	N	P,B	2	1	19
133	YA	F	Y	F,B	3.1	2	21.5
134	YA	M	N	F,L	3.5	2	23.5
135	YA	M	Y	F,B	1.6	1	21.5
140	YA	F	Y	F,R	4.2	2	21.5
146	YA	F	Y	P,B	7.5	3	24
150	YA	F	N	F,L	7.1	3	21.5
168	YA	F	Y	F,L	4.8	2	21.5
169	A	M	N	F,R	5.9	3	15
170	A	F	N	F,B	3.9	2	15
183	YA	F	Y	F,R	2.8	2	21.5
191	YA	F	Y	F,R	4.9	2	22
205	YA	F	N	F,R	5.4	3	21.5
215	A	N/A	Y	F,L	5.7	3	17.5
217	YA	M	Y	P,B	4.8	2	21
220	YA	F	N	F,B	4.5	2	21.5
233	YA	F	Y	P,B	2.6	2	21
234	YA	F	N	F,B	3.3	2	23.5
235	YA	M	Y	P,Fa	3	2	27
236	A	M	Y	F,Fa	3.2	2	15
237	YA	F	Y	P,B	3	2	22
240	YA	F	Y	F,B	3.9	2	21
242	YA	F	Y	P,B	3.8	2	22
247	YA	N/A	N	F,R	4.4	2	32
251	YA	F	Y	F,B	5.9	3	21
256	YA	M	N	F,L	3.7	2	24
261	YA	F	N	F,B	4.5	2	25.5
262	YA	M	Y	F,B	4.3	2	24
263	YA	M	Y	P,B	3.1	2	22
266	YA	M	Y	F,R	6.4	3	32.5
269	YA	F	N	F,R	6.3	3	22
277	YA	F	N	F,Fa	3.2	2	23
280	YA	M	Y	F,R	2.9	2	24
283	YA	M	N	F,R	3.3	2	24
285	YA	F	N	F,L	7.2	3	22
536	YA	F	Y	D,?	4.7	2	21
288	YA	M	N	P,B	7.7	3	25.5

Burial Number	Age Group	Sex	Grave Good Presence	Body Position and Orientation	Burial Depth	Temporal Category	Age
290	YA	M	N	F,L	7	3	22
291	YA	F	N	P,B	7.4	3	21.5
292	YA	M	N	P,B	7.9	3	28
293	YA	M	N	F,R	6.9	3	26
294	YA	M	N	F,R	7.3	3	24
295	YA	M	Y	P,F	1.8	1	22
296	MA	M	N	F,B	6.6	3	52.5
299	YA	M	N	F,L	7.2	3	22
301	YA	F	N	F,B	2.6	2	21.5
305	YA	M	Y	F,B	7.4	3	30.5
306	YA	M	Y	F,B	7.6	3	30
307	YA	M	Y	F,B	7.9	3	21
310	YA	M	Y	F,B	8.3	3	29.5
311	YA	F	N	F,L	7.1	3	21
314	YA	F	Y	F,L	2.7	2	22
322	YA	M	Y	F,L	3.7	2	22
323	YA	M	Y	P,Fa	3.7	2	27.5
324	YA	F	Y	P,L	3.1	2	21
340	A	F	Y	F,L	3.3	2	18.5
637	A	F	Y	F,R	4.6	2	17.5
346	YA	F	N	P,B	8.2	3	21
349	YA	N/A	N	F,L	2.2	1	24
353	A	F	Y	F,B	4.1	2	18.5
364	YA	M	N	F,B	1.2	1	33
366	YA	F	Y	F,B	6.9	3	20.5
368	YA	M	Y	P,B	2.2	1	26.5
374	YA	M	Y	F,B	7.4	3	22
380B	A	N/A	Y	F,L	2.9	2	19
381	A	F	N	F,B	3.1	2	15
391	A	F	Y	F,R	3.9	2	19
398	YA	F	N	F,Fa	4.2	2	21
401	YA	M	N	F,B	6.6	3	21.5
402	YA	M	Y	F,L	1.2	1	23
403	A	F	N	F,R	1.2	1	19.5
409	YA	M	Y	F,B	6.8	3	22
411	YA	F	Y	F,Fa	3.1	2	22
417	YA	F	Y	F,L	4.2	2	22

Burial Number	Age Group	Sex	Grave Good Presence	Body Position and Orientation	Burial Depth	Temporal Category	Age
418	YA	F	Y	P,R	4.2	2	22
423	YA	F	Y	F,R	3.7	2	22
470	YA	F	Y	F,R	5.9	3	21
436	YA	M	Y	F,L	7.1	3	29.5
440	YA	F	Y	F,B	5.1	3	21.5
449	YA	M	Y	F,L	4.8	2	22
454	YA	M	Y	F,R	4.1	2	22.5
462	YA	M	Y	F,R	5.6	3	22
495	A	M	Y	F,B	2	1	18.5
567	A	M	Y	F,L	3.2	2	19.5
596	A	M	Y	P,R	2.2	1	18.5
715	A	F	Y	F,L	2.2	1	19.5
716	A	F	Y	F,B	2.5	1	19.5
756	A	M	Y	F,R	4	2	19.5
758	A	F	Y	D,?	0.8	1	19.5
796	A	M	Y	F,R	2.5	1	18.5
804	A	M	N	F,Fa	7.4	3	19.5
814	A	F	Y	D,?	2.7	2	18.5
835	A	F	Y	E,B	1	1	19.5
836	A	M	Y	P,R	5.6	3	18.5
467	YA	M	Y	P,B	2.6	2	29
473	YA	F	N	F,B	6.2	3	21
474	YA	F	Y	F,B	7.4	3	21
480	YA	F	Y	F,L	7.5	3	22
481	YA	M	Y	F,Fa	7.5	3	22
489	YA	M	Y	F,Fa	6.7	3	30.5
492	YA	M	Y	P,B	8.4	3	31
494	YA	F	Y	F,B	4.9	2	22
496	YA	M	N	F,B	2.1	1	23.5
509	YA	M	Y	F,R	3.6	2	23

CHAPTER FOUR: RESULTS

Biodistance and Mortuary Practices Analysis Results

Phenotypic variances calculated from the R-matrix are shown in Table 5 for the complete sample and in Table 6 for the sample in accordance with temporal zone and grave good presence. For the total sample over temporal layers, the F_{ST} (0.013) value was larger than the standard error (0.003) and represents a statistically significant result ($t = 4.59$; $df = 138$; $P \leq 0.0001$). The residuals between the observed and expected patterns of phenotypic variation seen across temporal categories was statistically significant in the Deep Shell ($t = 44.3$; $df = 138$; $P \leq 0.0001$) and Mid-Shell ($t = 46.9$; $df = 138$; $P \leq 0.0001$) layers but were not statistically significant in the Low Shell layer ($t = 2.39$; $df = 138$; $P \leq 0.0263$). This result suggests that phenotypic variation increased between the Deep and Mid-Shell midden layers ($t = 46.9$, $P \leq 0.0001$) and decreased between the Mid-Shell and Low Shell midden layers ($t = 2.39$, $P \leq 0.0263$).

For the sample over temporal categories and in respect to grave good presence, the F_{ST} (0.033) value was larger than the standard error (0.005) and also represents a statistically significant result ($t = 6.49$; $df = 138$; $P \leq 0.0001$). The residuals between the observed and expected patterns of phenotypic variation seen across temporal categories and in association with grave goods showed a statistically significant result in all temporal categories, those in the Deep Shell layer with grave goods ($t = 41$; $P \leq 0.0001$),

those in the Deep Shell layer without grave goods (t = 3.3; P ≤ 0.0012), those in the Mid-Shell layer with grave goods (t = 48.6; P ≤ 0.0001), those in the Mid-Shell layer without grave goods (t = 6.47; P ≤ 0.0001), those in the Low Shell layer with grave goods (t = 14.4; P ≤ 0.0001), and those in the Low Shell layer without grave goods (t = 24.5; P ≤ 0.0001). This result suggests that grave good usage became more inclusive between the Deep and Mid-Shell midden occupation (t = 41, P ≤ 0.0001), then contracted between the Mid-Shell and Low Shell layers (t = 14.4, P ≤ 0.0001).

Table 5. Residuals of observed relative to expected variation calculated for each sample by population structure over time.

Sample	Sample Size	r(ii)	Observed	Expected	Residual
Low Shell	21	0.000000	0.985	0.993	-0.007
Mid-Shell	59	0.003545	1.127	0.989	0.137
Deep Shell	59	0.000000	0.862	0.993	-0.130

Table 6. Residuals of observed relative to expected variation calculated for each sample by population structure over time in relation to grave goods.

Sample	Sample Size	r(ii)	Observed	Expected	Residual
Low Shell Present	14	0.009272	0.908	0.982	-0.073
Low Shell Absent	7	0.000000	1.115	0.991	0.124
Mid-Shell Present	40	0.010736	1.190	0.980	0.209
Mid-Shell Absent	19	0.000000	0.956	0.991	-0.035
Deep Shell Present	33	0.001585	0.782	0.989	-0.207
Deep Shell Absent	26	0.000000	0.973	0.991	-0.018

Results from the R-matrix and Mantel tests are listed in Tables 5, Table 6, and Table 7, respectively. Mantel tests for correlations between biological and spatial distance were not significant for the cumulative sample ($t = 0.93$; $P \leq 0.350$) or within any individual temporal categories of Deep Shell ($t = 0.24$; $P \leq 0.813$), Mid-Shell ($t = 0.894$; $P \leq 0.371$), or Low Shell ($t = 0.07$; $P \leq 0.942$).

Table 7. Mantel partial correlation testing associations between biological and spatial distance.

Sample	Observed Z	Correlation	t-value	Left-tailed Sig	Right-tailed Sig	Two-tailed Sig
Low Shell	536537.75420	0.00515	0.07248	0.52889	0.47111	0.94222
Mid-Shell	4280943.06340	0.04156	0.89439	0.81444	0.18556	0.37112
Deep Shell	2600170.30200	0.01204	0.23721	0.59375	0.40625	0.81250
Cumulative	20809840.48000	0.02794	0.93426	0.82491	0.17509	0.35017

Results of binary logistic regressions performed to analyze possible functionally dependent relationships between variables of age or sex with grave good presence are shown in Table 8 and Table 9. For age, the -2 Log Likelihood in the performed binary logistic regression analysis was large ($\Lambda = 182.055$), suggesting a large chance of failing to reject the null hypothesis of a functionally dependent relationship between variables (Table 8.1). The coefficient of determination (Table 8.1) showed that only approximately 0.12% of the variation between the variables of grave good presence and age at death influenced overall variance explained by the model ($R^2 = 0.012$). After performing a Wald test to extrapolate the significance of the relationship between grave good presence

and age group (Table 8.2), it was found that there is no statistically significant relationship between the variables and that there is only an approximately 4.2% likelihood of an individual having grave goods based on inclusion in a particular age group ($F = 1.659$; $P \leq 0.436$).

For sex, the -2 Log Likelihood in the performed binary logistic regression analysis was large ($\Lambda = 183.164$), suggesting a large chance of failing to reject the null hypothesis of a functionally dependent relationship between variables (Table 9.1). The coefficient of determination (Table 9.1) showed that only approximately 0.4% of the variation between the variables of grave good presence and sex influenced overall variance explained by the model ($R^2 = 0.004$). After performing a Wald test to extrapolate the significance of the relationship between grave good presence and sex (Table 9.2), it was found that there is no statistically significant relationship between the variables and that there is only an approximately -27% likelihood of an individual having grave goods based on inclusion in a particular sex category ($F = 0.620$; $P \leq 0.431$).

Table 8.1 Binary logistic regression observing potential functionally dependent interactions between grave good presence and age.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	182.055[a]	0.012	0.017

a. Estimation terminated at iteration number 3 because parameter estimates changed by less than 0.001.

Table 8.2 Variables of Age Group included in the binary logistic regression.

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	AgeGroup			1.659	2	0.436			
	AgeGroup(1)	0.544	0.460	1.395	1	0.238	1.723	0.699	4.248
	AgeGroup(2)	-0.421	1.020	0.171	1	0.679	0.656	0.089	4.841
	Constant	0.421	0.199	4.499	1	0.034	1.524		

a. Variable(s) entered on step 1: AgeGroup.

Table 9.1 Binary logistic regression observing potential functionally dependent interactions between grave good presence and sex.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	183.164[a]	0.004	0.006

a. Estimation terminated at iteration number 3 because parameter estimates changed by less than 0.001.

Table 9.2 Variables of Sex included in the binary logistic regression.

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	Sex	-0.270	0.343	0.620	1	0.431	0.763	0.390	1.495
	Constant	0.915	0.541	2.860	1	0.091	2.497		

a. Variable(s) entered on step 1: Sex.

Chi-square tests (Table 10.1) investigating the frequency of grave good presence was seen to be not statistically significantly different between male and female burials ($\chi 2 = 0.983$; $G = 1.321$; $P \leq 0.612$).

Table 10.1. Chi-square tests for frequency of difference in grave good presence between males and females across the total sample

Chi-Square Tests

Value	df	Asymptotic Significance (2-sided)
0.983[a]	2	0.612
1.321	2	0.516
139		

a. 2 cells (33.3%) have expected count less than 5. The minimum expected count is 0.37.

Boxplots portraying the variance in buccolingual measures (Figure 7) of the mandibular polar tooth types across temporal periods are represented for males and females. Distribution of first molar buccolingual measures over temporal periods remain relatively consistent, with overlapping interquartile ranges for both males and females over time (Figure 7.1). A similar trend of distribution is seen for the buccolingual measures of the first permanent mandibular premolar (Figure 7.2), the canine (Figure 7.3), and the primary incisor (Figure 7.4). Median measures of the first permanent mandibular premolar, however, show a slight increase between the earliest phase of occupation (Deep Shell) and latest phase of occupation (Low Shell) among both males and females (Figure 7.2). A slight increase in median measures is seen for the mandibular

first permanent molars, canines, and incisors in males from the earliest to later phases of occupation (Figure 7.1, 7.3, 7.5). Upon visual analysis, these trends could potentially suggest minimally increased phenotypic variation being explained by male members of the population within a greater trend of buccolingual size retention. These observations indicate a general retention of buccolingual measures over temporal periods, with a slight trend towards an increase in size.

Boxplots portraying the variance of mesiodistal measures (Figure 8) of the mandibular polar tooth types across temporal periods are represented for males and females. Distribution of first molar mesiodistal measures over temporal periods also remain relatively consistent, with overlapping interquartile ranges for both males and females over time (Figure 8.1). Mesiodistal measures of the first mandibular premolar also exhibit similarities in median measures amongst males over time, while females show an increase in mesiodistal measures from the Mid-Shell to Low Shell layers and a maintenance of median measures from the Deep Shell to Mid-Shell layers (Figure 8.2). However, canine mesiodistal measures amongst females increased from the Deep to Mid-Shell periods but decreased from the Mid- to Low Shell periods, corresponding with an overall increase in interquartile ranges with the smallest range present in the Deep Shell period, indicating a more genetically inclusive group (Figure 8.3). Alternatively, mesiodistal measures of the canines in males remained relatively consistent over time (Figure 8.3). A similar trend followed amongst males and females for mesiodistal measures of the second incisor, with a stable, constant pattern of measures occurring across temporal periods (Figure 8.5). Increases in the mesiodistal measures of the first

maxillary incisor, however, were seen amongst both males and females, with the largest increase seen in females from the Deep to Mid-Shell periods (Figure 8.4). Males exhibited a slight increase but with consistently overlapping interquartile ranges (Figure 8.4).

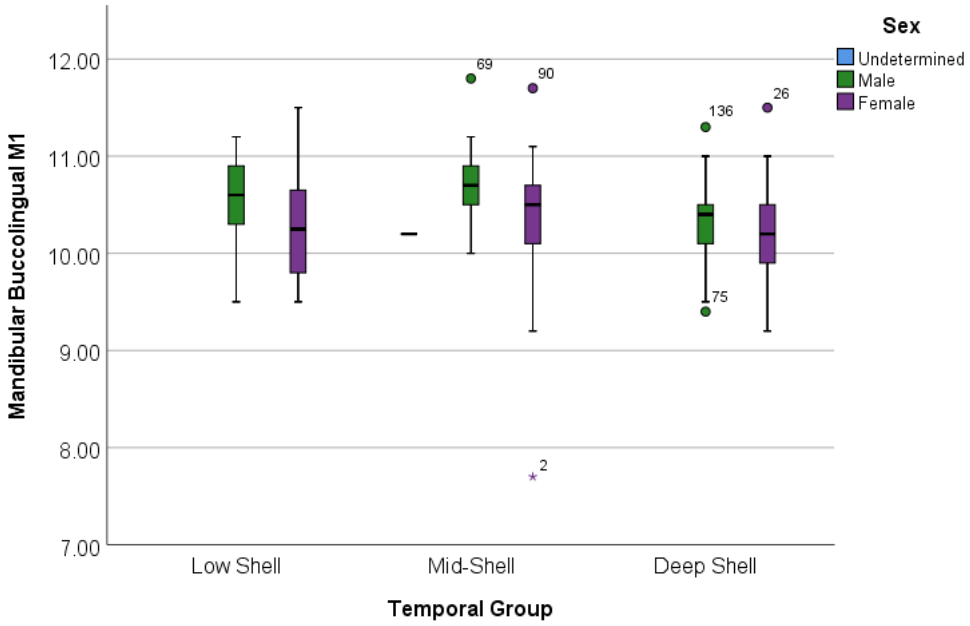

Figure 7.1. Distributions of buccolingual measures for the first permanent mandibular molar.

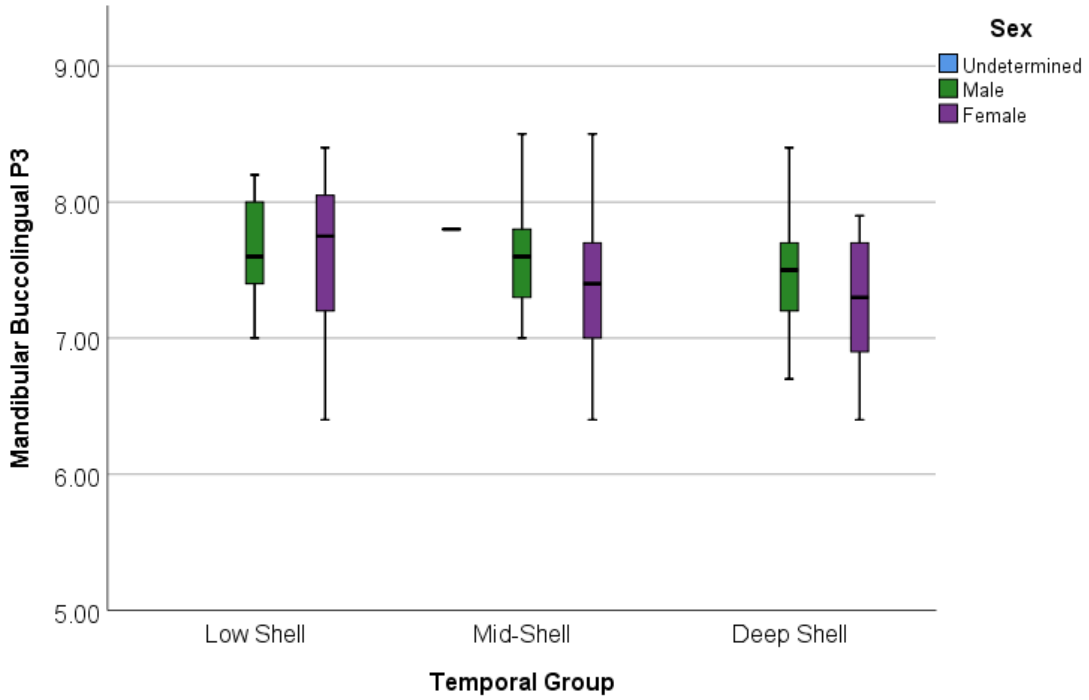

Figure 7.2. Distributions of buccolingual measures of the first permanent mandibular premolar.

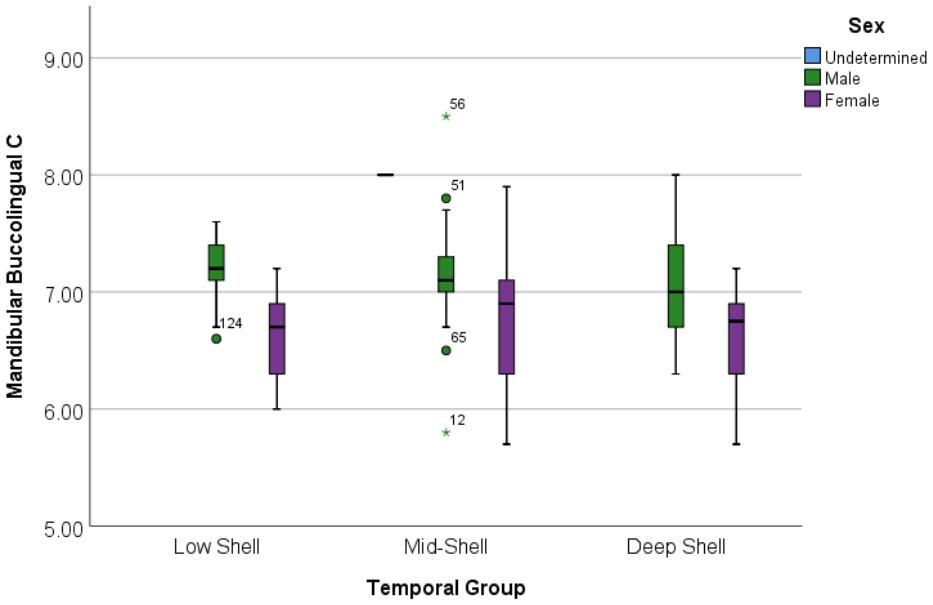

Figure 7.3. Distributions of buccolingual measures of the permanent mandibular canine.

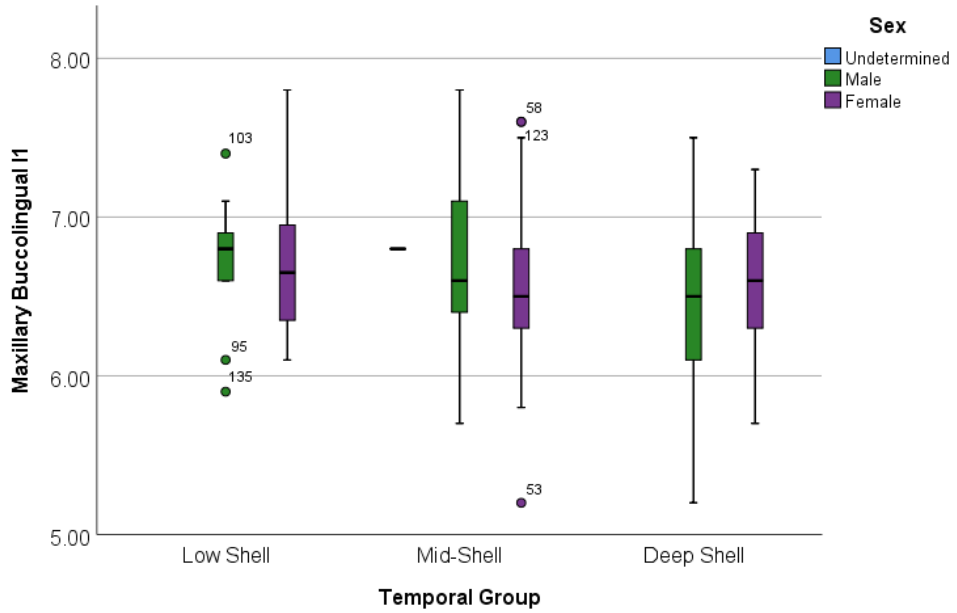

Figure 7.4. Distributions of buccolingual measures of the first permanent maxillary incisor.

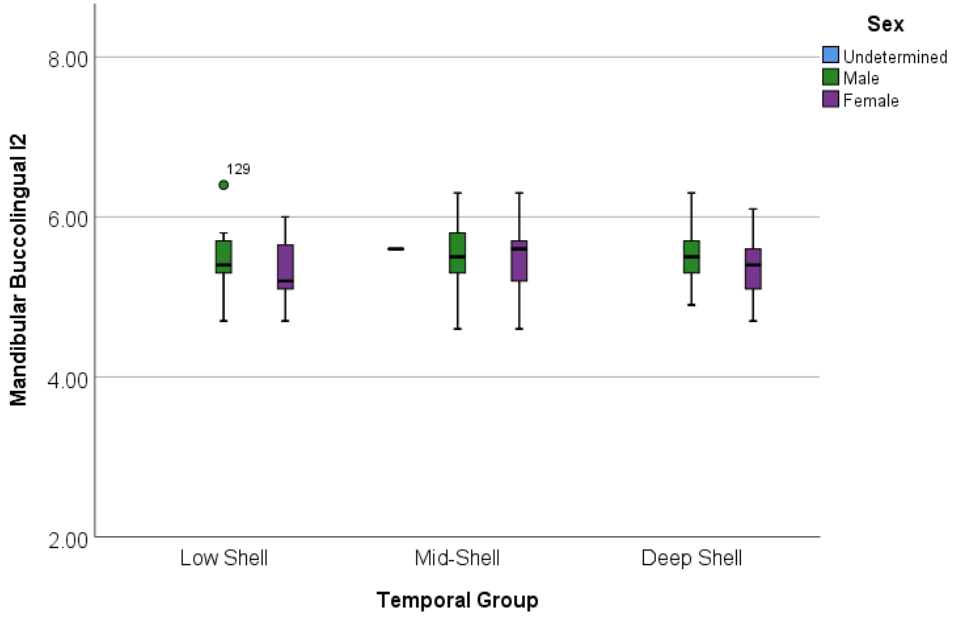

Figure 7.5. Distributions of buccolingual measures of the second permanent mandibular incisor.

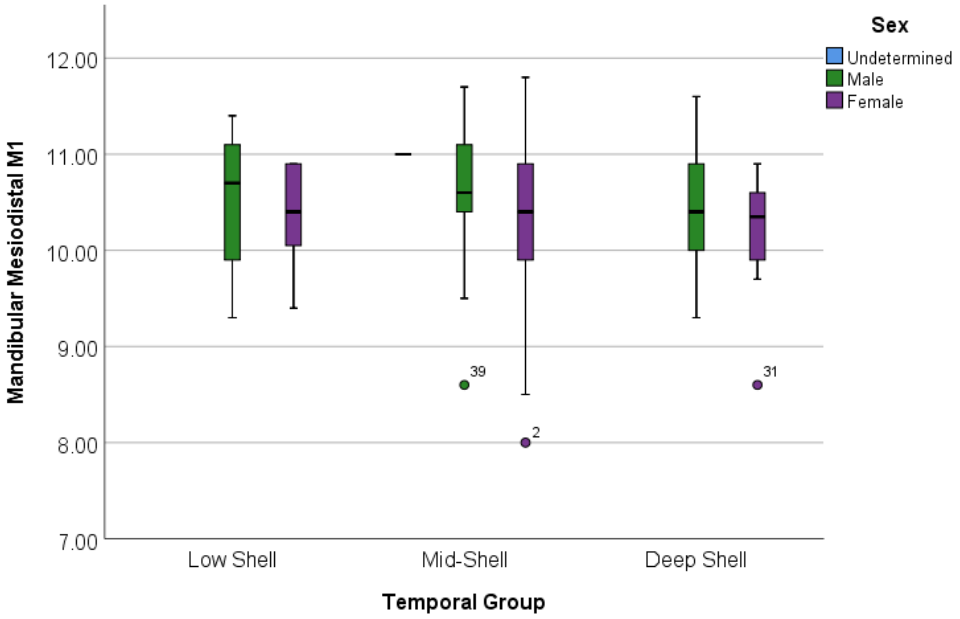

Figure 8.1. Distributions of mesiodistal measures of the first permanent mandibular molar.

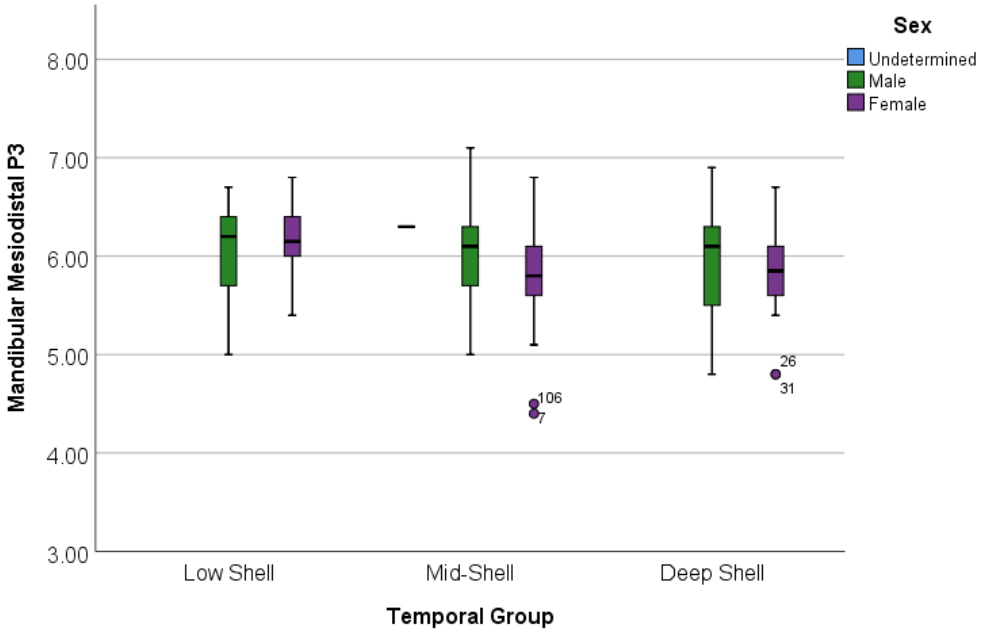

Figure 8.2. Distributions of mesiodistal measures of the first permanent mandibular premolar.

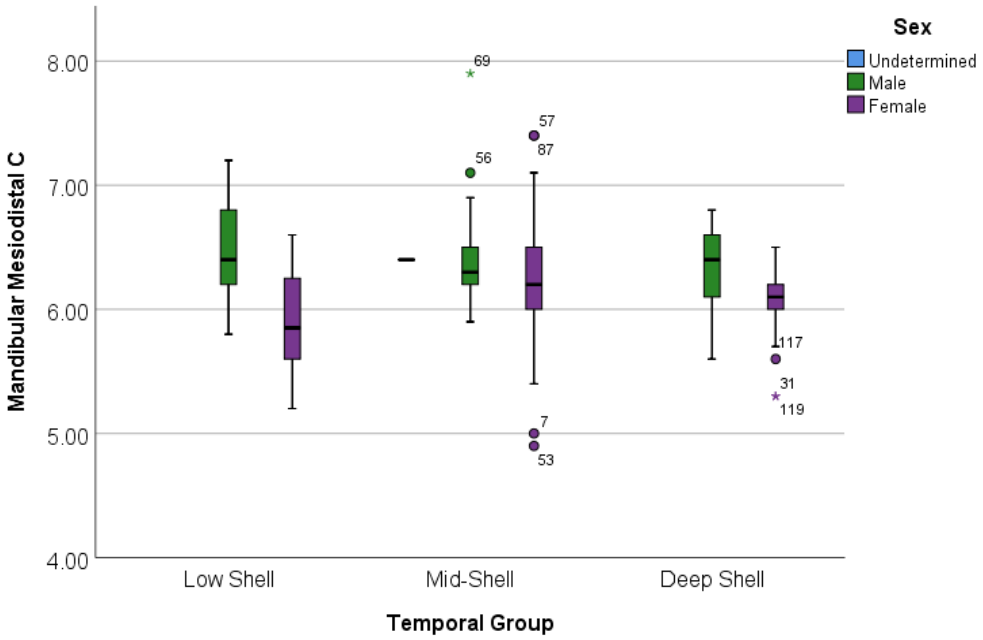

Figure 8.3. Distributions of mesiodistal measures of the permanent mandibular canine.

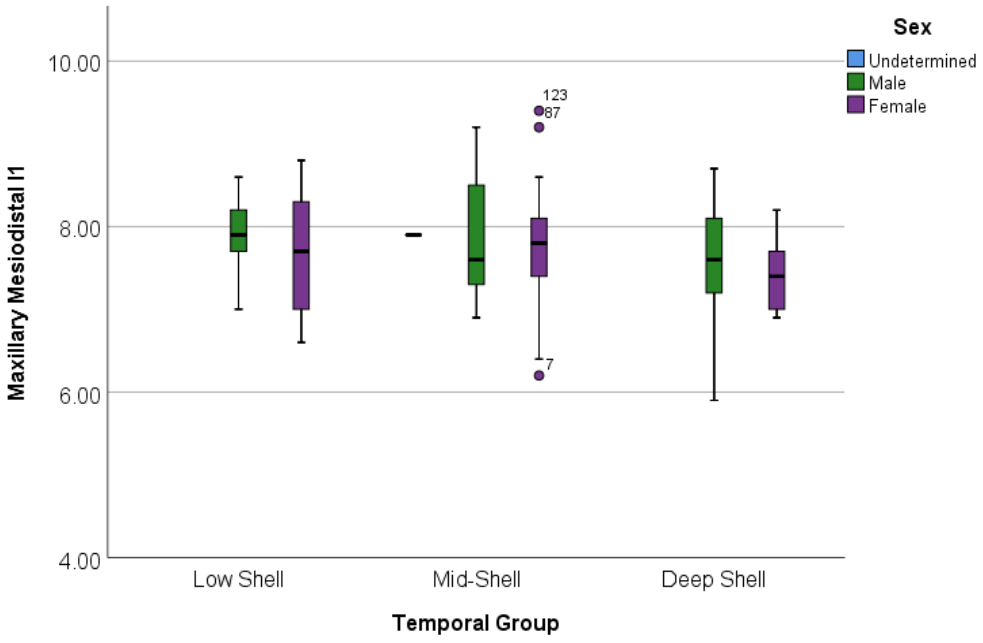

Figure 8.4. Distributions of mesiodistal measures of the first permanent maxillary incisor.

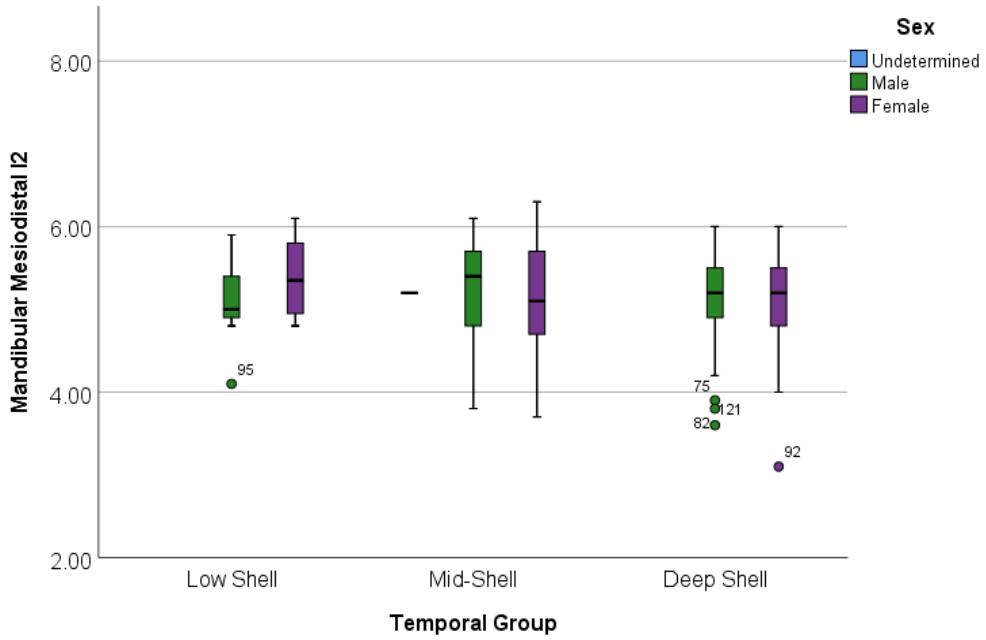

Figure 8.5. Distributions of mesiodistal measures of the second permanent mandibular incisor.

These results suggest that the earliest occupants of the site had the lowest levels of phenotypic variation and the greatest differences between individuals interred with grave goods versus those interred without grave goods. Individuals in this earliest phase of occupation are biologically less variable, indicating a more related original population. This trend inverts over time as the sample becomes more variable, although with a slight reduction in phenotypic variability between the intermediate and final phases of occupation. The distribution of phenotypic variation in regards to grave goods inverts, as individuals with grave goods become more highly variable while individuals without grave goods present become less variable. This trend slightly shifts and then stabilizes

during the final phase of occupation where individuals both with and without grave goods have approximately similar amounts of phenotypic variation.

Table 11. First two eigenvectors for Figure 6 (scaled by the square root of their eigenvalues):

Temporal Category	I	II
Deep	0.0262	0.0299
Low	-0.0945	0.0077
Shell	0.0682	-0.0222

Table 12. First two eighenvectors for Figure 7 (scaled by the square root of their eighenvalues).

Temporal Category	I	II
Deep Shell Absent	0.0426	0.0287
Deep Shell Present	-0.0499	0.0080
Low Shell Absent	0.1102	-0.0800
Low Shell Present	-0.1067	-0.0641
Mid-Shell Absent	-0.0196	0.0316
Mid-Shell Present	0.0234	0.0757

Plot of First Two Scaled Eigenvectors:

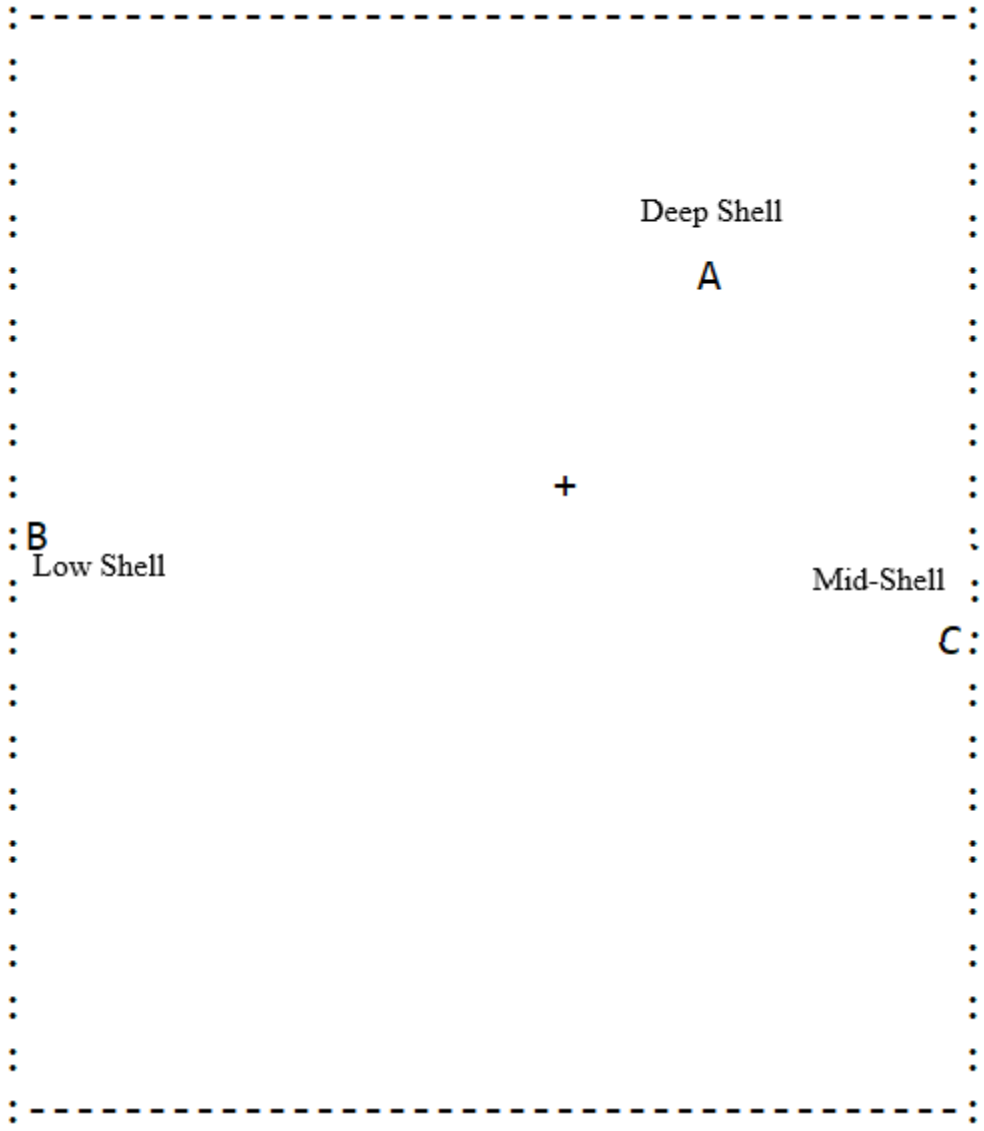

Figure 9. Plot of the population structure according to temporal categories.

Plot of First Two Scaled Eighenvectors:

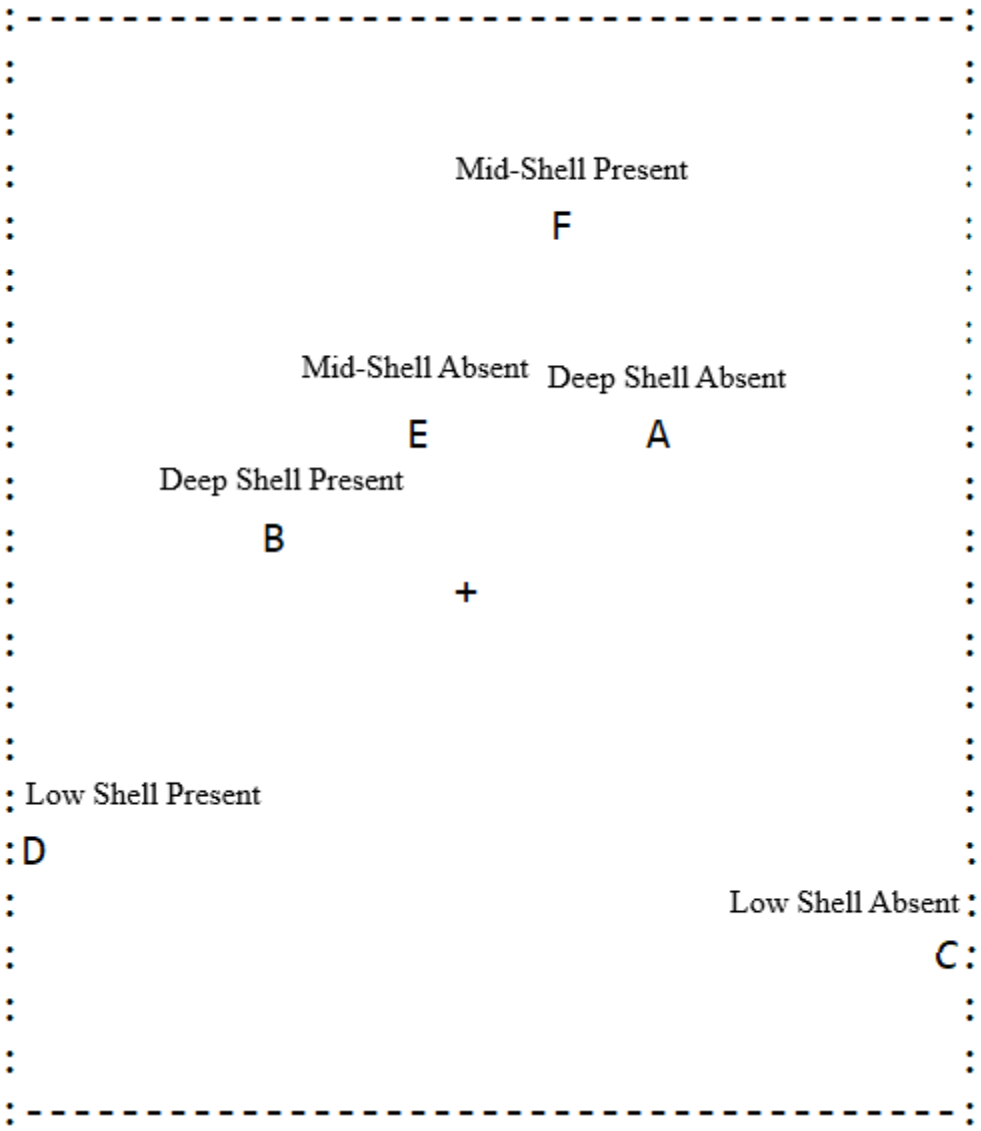

Figure 10. Plot of the population structure according to temporal categories and grave good presence.

CHAPTER FIVE: DISCUSSION

The results of this study present interesting trends for consideration within evolutionary and symbolic mortuary frameworks structuring the maintenance of the site as a persistent place over an approximately 1000 year period. Findings revealed that multiple proposed factors driving mortuary behavior were insignificant, as biological relatedness did not motivate spatial organization at the site and distribution of grave goods was not impacted by independent factors such as age, sex, or temporal category. However, R-matrix tests for the biodistance analysis evaluating patterns of phenotypic variation found a general trend of increased variation within the population happening over time. Variation increased from a highly related ancestral group in the oldest Deep Shell layer to a more diverse descendent group in the Mid-Shell layer, with a subsequent decrease occurring between the intermediate and latest phase of occupation in the Low Shell layer. The residual values represented a significant result for the Deep Shell and Mid-Shell layers. Further R-matrix tests evaluating the levels of variation amongst individuals with grave goods provided interesting results subscribing to a similar trend. The highest levels of differences between individuals who did and did not have associated mortuary materials occurred amongst members of the Deep Shell layer, with the largest levels of homogeneity amongst individuals affiliated with burial goods. This trend inverts from the Deep Shell to Mid-Shell period, as individuals with grave goods

become more variable and those without become less variable, and finally ends with an equalized trend where individuals with or without goods have similar levels of variability. The residual values represented a significant result for individuals with and without grave goods in the Deep, Mid-, and Low Shell periods. These evaluations can be interpreted in support of the concept that hunter-gatherers at the site were utilizing this cemetery as a persistent landscape, creating a resilient social adaptive strategy that reaffirmed communal social identity through collective action involved in continuous affiliative mortuary behaviors connecting the living with the ancestral dead.

Shifts in Patterns of Phenotypic Variation

Multiple thought-provoking outcomes can be considered from these results. While there are no observably present behaviors motivating the organizational structure of the site or particular burial placement in regards to biological relatedness, the landscape remains engaged in continuous, ritual mortuary activity to maintain affiliation with a biologically invariable ancestral population. Differential prioritization of allocating grave goods to individuals primarily in the highly related ancestral group suggests a large, societal veneration for those subscribing to these lineages. The discriminant inclusion of mortuary materials in the Deep and Mid-Shell periods is not as visibly subject to individual social factors such as age or sex category (Rothschild 1979) but rather fluctuates more perceptibly along lines of familial association. These reflect the symbolic behaviors in the form of persistent land use and the incorporation of grave goods marking the site as a place of communal importance and source of social memory, a social memory continuously imbued into the formation of a collective social identity.

Explanation for the patterns of phenotypic variation found comply within the broader context of past studies on the region and in North America. These studies denote the biological distribution of the Early Archaic hunter-gatherers as smaller, homogenized mobile bands that became increasingly integrated socially and biologically with other groups through increased patterns of migration and social networking during the Middle and Late Archaic (Campbell 2016; Crothers 1999; Sassaman 2010). These trends hold within the Late Archaic in the Green River Valley, with hunter-gatherer groups remaining relatively distinct from one another with increased levels of interaction over time, functioning within a general isolation by distance model (Herrmann 2002a; Sciulli 1979).

These results also support previous biodistance analyses conducted for Indian Knoll, specifically, as substantial phenotypic variation based on cranial measures occur within Green River sites with the maintenance of a relatively high level of biological similarity maintained in the cemetery over time (Herrmann 2002a; Long 1966; Steele 1948). Results from different temporal periods at the Indian Knoll site indicating trends towards increased variation add a layer of complexity to these arguments. The homogenous nature of those interred at Indian Knoll has many possible explanations that require additional analysis but allow for considerations on a macroscopic scale. Regional relationships indicate closer biological proximity with Carlston Annis and Read than more western sites like Chiggerville and Eva. Male and female individuals in the population at Indian Knoll contribute similarly to variability in this, and other (Herrmann 2002a), studies. However, contextualizing the general trend of increased variation over

time from the Deep to Low Shell layers within past broad, full sample analyses on multiple Green River sites like Ward, Barrett, Read, Carlston Annis, and Chiggerville support engagement in local mate exchange, with higher levels of female mobility (Herrmann 2002a). While further biological and archaeological data are needed to confirm patterns of residential mobility, the trends seen do not counter such a hypothesis.

While the overall population subscribes to a homogenous structure, the members included in the oldest, Deep Shell temporal category were seen to exhibit the highest levels of biological homogeneity, with the closest positioning to the centroid and lowest residual values. This result suggests a highly related ancestral population, possibly more subject to the effects of genetic drift than later generations. An infusion of extralocal gene flow contributing to the increased variability in the region from the Deep to the intermediate Mid-Shell periods can be seen to result from increased engagement in social and mate exchange networks in the Green River Valley (Herrmann 2002a) and surrounding areas. Archaeological patterns of copper and material distribution in the region promote the understanding of local communal interaction and trade happening within the western Kentucky and eastern Tennessee region (Campbell 2016). This increased participation in social networks, however, does not result in spatial differentiation of burials at the site, maintaining an increasingly variable population within one mortuary cemetery, incorporating all social participants into one collective landscape. These practices continually act as an inclusive, symbolic mechanism to regularly negotiate and reformulate the structure of a collective social identity.

The decrease in phenotypic variation and stabilization of patterns of variability based on grave good presence between the intermediate Mid-Shell and youngest Low Shell layers is intriguing and prompts questioning of the potential societal, symbolic, ecological, or adaptive strategies surrounding this subsequent biological response. The Low Shell layer marks a temporal zone consistent with the approaching end of the Indian Knoll site and, as such, can mark embodied responses occurring prior to drastic social changes, climatic shifts, or new migration patterns. Reasons as to the motivating causes of the demise in Late Archaic monumental burial traditions in North America have been postulated to result from climatic shifts disrupting socioecological systems created during the Early and Middle Archaic Periods, changing the functions of sites on short- and long-term time scales (Thompson 2010).

The end of the Green River Valley sites in 3400 BP (Marquadt and Watson 2005) is not followed by intensive occupation during the Mississippian Period or comparable burial traditions emerging in the subsequent Early Woodland Period (Kidder 2006; Thomas and Sanger 2008; Thompson and Turck 2009). The disruption of sites of importance created by an amalgamation of various short-term events accumulating over deep time suggests the collapse of persistent place usage is systemically related to their long-term construction (Thompson 2010). Changes in socioecological systems (Marquadt and Watson 2005) and long-distance exchange networks (Kidder 1991; Sassaman 1993) have been presented as potential causative agents collapsing persistent places (Thompson 2010).

Investigations into climate data around this time indicate shifts in atmospheric-ocean systems and solar variability between 3000 and 2600 BP (Kidder 2006), potentially resulting in globally cooler temperatures and higher incidences of storm frequency, potentially causing increased flooding along river basins with fluctuating sea levels. The collapse of persistent places and associated interaction networks could have resulted from these changing socioecological systems. The Green River Valley was especially susceptible as networks were constructed based on a riverine resource economy and regional systems of exchange hosted by engagement in ceremony, ritual, and mate exchange networks at particular locations (Thompson 2010). The decrease in phenotypic variability between the Mid-Shell and Low Shell layers within this context can have implications of initial responses to these oncoming shifts, a pattern of increased isolation of the source population, early extrication from local social networks, or increased engagement in adaptive strategies to maintain social identity through mortuary veneration of ancestors. At this point, the direct cause of this shift is unclear and requires further investigation.

Perception, Environment, and Hunter-Gatherer Response in Mortuary Practices

The human and ecological interface embodied in particular landscapes represent marked sites reflecting adaptive patterns of biological and cultural responses to facilitate survival. Natural environments can contribute substantially to constructions of social organization and development of institutions, impacting systematic changes to cultures as forms of adaptation are embodied through shifting technologies, practices, and beliefs (Steward 1955). With considerations of cultural ecology and the role of the environment

in constructing cultural worlds, an inherent separation arises when attempting to decipher the relation of humans to lived environments and the role of subsistence. This division allocate naturalistic relationships with food procurement, resources, and the environment apart from cultural processes involved in worldview creation (Ingold 1988; Jordan 2011). However, the delineation of natural and cultural worlds and inherent constructions does not encapsulate the synergy hunter-gatherer occupants have with ecological systems (Ingold 1988). Comprehensive cultural and behavioral ecology models move past materialistic perspectives applied to hunter-gatherer studies in the past to contextualize symbolic dimensions of culture from considerations of the formation of social worlds within the larger spheres of ecology and adaptation (Jordan 2011; Palsson 1991). Such considerations acknowledge the social and sensory knowledge shaping and shaped by perceptions of the lived environments of hunter-gatherers, embedded in human practices engaging the surrounding world and visible within the material record when infused into ethnoarchaeological frameworks (Ingold 1988; Jordan 2011).

These ecological responses, imbued perceptions, and subsequent cultural adaptations impact socioeconomic systems of power and wealth distribution in societies. In groups of the Pacific Northwest Coast, potlatch ceremonies engaging in systems of exchange utilize large displays of wealth to facilitate the transfer of property and reaffirm power dynamics between regional groups (Letham and Coupland 2019). Studies have identified shell mound sites in the Green River Valley region as cultural loci for socioeconomic exchange and centers for ritual action (Crothers 1999; Herrmann 2002a; Marquadt and Watson 2005). The significant association between ancestral burials in the

Deep Shell layer and grave good presence, as well as maintenance of the landscape over such a long period of time, reflects a pattern of high, symbolic investment into the shell mound at Indian Knoll as one of these cultural and socioeconomic locations. The connection of these sites to resource rich marine environments providing the basis for socioeconomic practice and survival in these environments establishes these ritually charged environments as areas apt for fostering the production and processes involved in adaptive responses. Low variability and high levels of association between burial artifacts and biological relatedness amongst the ancestral population responsible for the genesis of the cemetery marked the initiation of the site as a point of human-environment interface. The establishment of this interface was constructed by perceptions of everyday and mortuary ritual engagement in the persistent landscape of the shell mound, inherently influencing population structures and maintaining a communal identity over generations.

The potential drivers of biological relationship structures can impact intracemetery organization and, while placement is not associated with biological relatedness at the site, inclusion in the cemetery as an ancestral landscape is purposeful, symbolic, and socially adaptive. While the creation of such mortuary landscapes have linked spatial organization to genetic lineages amongst hunter-gatherers in southeastern Australia and southern California (Gamble 2017; Littleton and Allen 2007), the participation in cycles of ritual interaction with the dead continue to involve past populations in the construction of symbolic systems of the living (Thompson 2010). This level of participation is clearly present amongst the occupants of Indian Knoll. The factors motivating cemetery organization at these ancestral landscapes can vary according

to the specific processes involved in the production and maintenance of those sites across deep time and reflect changes in practices and social strategies (Littleton and Allen 2007; Thompson 2010). In Indian Knoll, shifts in practices can potentially be seen with the fluctuating presence of grave goods within individual burials as mortuary materials became more inclusive over time. These changes ultimately relate to shifts in the ritual behaviors involved in maintaining an intimate relationship between the living and the ancestral dead through physical proximity and practices manipulating persistent mortuary landscapes.

This social strategy preserving a connection to previous generations through ritual behavior and practice imbued onto mortuary landscapes has been seen extensively in various studies, denoting the utility of the framework. The construction of monumental mortuary landscapes in the form of burial mounds amongst Hopewell populations reflect these behaviors, enhancing ancestral affiliation through ritual engagement with the dead that subscribe to an adaptive social strategy maintaining a persistent collective social identity through social memory (Buikstra and Charles 1999; Cannon 2002; Carr 2005; Charles and Buikstra 2002). However, Hopewellian mounds and cemeteries were constructed as three-dimensional representations of a defined cosmology through vertical and horizontal differentiation, a level of structured differentiation in material mortuary remains not seen at Indian Knoll. Instead, burials at the site were seen not to subscribe to factors of organization such as space, instead prioritizing ancestral veneration by including occupants into a collective, corporate space and, consequently, identity. This practice of integration reinforces the resilience of past traditions and memories over time

as grave good presence becomes more and more inclusive over subsequent generations from the Deep to Low Shell periods, regardless of biological relatedness.

Hunter-gatherer burial practices have demonstrated spatial organization and incorporation of past mortuary ritual behaviors structuring the way living populations affiliate with the dead in the Latvian site of Zvejnieki (Nillson-Stutz et al. 2013; Nillson-Stutz and Larson 2016). Hunter-gatherers at this site continuously disturbed earlier burials in the cemetery, maintaining persistence through direct contact and spatial connection with ancestral populations, with the purposeful infusion of soil from earlier graves into newer ones. This level of direct contact with ancestral individuals through consistent, mortuary engagement at a specific, persistent location is comparable to practices visible at Indian Knoll, indicating continuous affiliation through repetitive, physical involvement with the dead.

In Japan, Jomon period hunter-gatherers at the Yoshigo Shell Mounds displayed changes in temporal rhythms constructing earlier and later interments, identifiable with a shift to extended burial positions in newer burials, but with persistence maintained through the continuation of ritual mortuary practices using hip ornaments and animal implements as grave goods (Temple 2020). A close, spatial relationship was found between the early and late occupations, suggesting the preservation of the prehistoric cemetery as an ancestral landscape showing how the site was created and practices changed over time (Temple 2020). Spatial affiliation of later burials near earlier ones and the situation of Deep, Mid- and Low Shell individuals within the confines of the same

space indicates purposeful behavior, revealing a strategy intentionally enacted by the living to interact spatially with ancestral populations (Carr 1995).

The construction of a persistent, mortuary landscape subject to such temporal rhythms can be seen at Indian Knoll as well as an emphasis on physical proximity to earlier burials for the preservation of the cemetery and social practices over time. However, while portions of the Jomon burial site exhibited correspondence between biological and spatial distance in the east section of the cemetery, the consideration of particular biological lineages does not seem to be motivating placement at Indian Knoll, considering the lack of correlations found. Temporal rhythms responsible for constructing the Indian Knoll shell mound involve a collection of short-term responses to events compiled over a long-term occupation of the site, combining an amalgamation of various populations and historical events. These events can influence interpretations of changing variation and grave good inclusion over time at the site and reflect shifting perceptions and processes involved in negotiating and producing social identity in response to external socioeconomic and ecological factors.

Situated within the context of these studies, later occupation burials at the Indian Knoll shell mound may have been constructed according to differing temporal rhythms then earlier occupants. With the increase in overall variability, grave good presence is not as restrictive as in earlier occupations where highly related individuals are more likely to have associated grave implements. While the inclusion of mortuary materials shifts, body position maintains a pattern of being flexed or partially flexed upon interment, suggestive of wrapping of the body before deposition (Webb 1974), a practice that remains

consistent from the earliest to latest occupational layers. Changes in body position, orientation, and grave implements can indicate shifting temporal rhythms constructing mortuary practices in populations produced through ethnogenesis, such as seen in fluctuating interment trends of subadults in Tigara and Ipiutak Arctic hunter-gatherers of Point Hope, Alaska (Justice and Temple 2019). While differing temporal rhythms are not expressed through diverse body positions over time, grave good inclusion at the site can be a good marker of these transitions, especially when considering the contraction of variability from the Mid- to Low Shell layers of occupation. Regardless of the shifts in patterns constructing the site, later occupants were included into the ancestral landscape to maintain physical proximity to a venerated source population as well as through the continued reproduction of ritual burial practices. This evidence suggests that members of later occupational phases prioritized ritual affiliation with ancestral populations through mortuary practices and physical proximity conducted on a persisting cemetery landscape.

Important Considerations

The results of the study indicate that the intensification of landscape use during times of increasing population density and variability were part of a strategy to maintain a cohesive population identity, structured without correlating spatial placement with biological relation. Hunter-gatherer mortuary practices can reflect lived experiences of ethnogenesis occurring across generations. Ethnogenetic processes were embodied in the skeletal remains of Arctic Circle hunter-gatherers from Point Hope, Alaska, as a maintenance of cultural conceptualizations of social age between Tigara and descendant Ipiutak populations was bioarchaeologically visible (Justice and Temple 2018).

However, while biological relatedness is not structuring spatial organization at the site, the consideration of differing social understandings of kinship structures in past populations is of important note. The application of modern ideas on ancestry and kinship that rely on direct genetic associations, inclusion into family structures of hunter-gatherers may not have subscribed to these genetically deterministic categories (Johnson 2019; Lozada 2011). To further understand these structures of kinship at Indian Knoll, further investigations into the material culture at the site and ethnographic data would be required. Adding this layer of theoretical consideration of differing kinship structures of past hunter-gatherers will allow more comprehensive understanding of the deep ideological systems in these communities (Cannon 2002).

The integration of analyses of mortuary behavior with archaeological study is a site of potential when infused with frameworks of social theory and a biocultural perspective. Processual and postprocessual mortuary archaeologists need to continue conversations combining the salient points of each to achieve comprehensive understandings of hunter-gatherer groups in the bioarchaeological record, as both sides have become relatively entrenched and lack production of new, radical perspectives. Important theoretical concepts arising with increased applicability in anthropology, generally, should act as a contextualizing bridge framing bioarchaeological and mortuary studies. The multifaceted consideration of identity and identity construction gained from concepts of intersectionality, feminist theory, resilience, and others are crucial additions to the frameworks constituting analysis of skeletal remains in mortuary contexts.

The utilization of these approaches generate a necessarily holistic perspective important for implementing ethical bioarchaeological studies of past populations, especially for the study of Native American or historically socially marginalized groups. In regards to the Native American population at Indian Knoll, this study represents more than a sheer analysis but an attempt at a comprehensive reflection of how complex personhood and cultural integrity of these populations is seeded within ancestrally deep histories. The arbitrary binary classifications of "simple" and "complex" subscribed to hunter-gatherer groups based on a hunting and gathering subsistence strategy have stunted understanding of the wealth of intricacy that formulated the belief systems of these populations in the past, and such perspectives also impact the historical presentation of the worth of socioeconomically marginalized groups. Biodistance analysis, a technique with a problematic history of unethical use for the construction of typologies, expands within the biocultural framework utilized in this study to observe patterns of phenotypic variation and answer more important social questions pertaining to population structure, social identity, and resilience. Bioarchaeology has the capacity to unearth the oppressive treatment and conceptualizations of marginalized groups, moving past the historical infantilization of ethnic identities used to excuse the defamation, destruction, and mistreatment of groups by legitimizing the suffering and complex histories of these populations.

Conclusion

While the findings of this study resulted in significant results, limitations potentially hampering subsequent interpretations should be considered. As noted in previous chapters, extrinsic and environmental factors affect the collection of complete dental measures from the entire collection. Nutritional status and impact on resulting tooth size from processes like fluctuating asymmetry are potential influencers for dental measures, especially when, ultimately, measures from the left side of the dental arcade comprise the reconstruction of missing measures. Lack of tooth presence resulting from a variety of causes reduce sample size and skew results to a generally younger age group, excluding salient trends of mortuary treatment or biological structures potentially involved in the interment of elder members.

The review of individual burials within spatial quadrants of the cemetery also represents an area for subsequent study, examining the potential relationship between directionality of space and burial placement. Due to a lack of access, the cemetery map including the distribution of individual burials across the cemetery was unable to be reconstructed for these investigations of symbolic, mortuary behavior at the site. This spatial distribution has been previously reconstructed for reconstruction of population structure at the site (Herrmann 2002a), however could be further applied to the symbolic use of persistent landscapes, loci embodying a human-environment interface for the continuous production of a collective social identity from affiliation with ancestral occupants.

Bioarchaeological studies need to continue seeking comprehensive approaches to exploring past hunter-gatherer populations, recognizing the complexity and densely interactive symbolic social strategies embodied in the daily practices of these groups. The application of biodistance analysis, when applied as a tool for reconstructing patterns of phenotypic variation and interpreting socioeconomic, sociocultural, and migratory behaviors, provides a technique ripe with opportunity for the study of skeletal remains. The infusion of mortuary archaeology and theory with the biocultural approach necessary for holistic evaluations of burial landscapes and human remains is essential for responsible, salient analysis of these groups. The lack of complete integration of these fields in the construction of research designs leave them open to substantial pitfalls misrepresenting past behaviors, social structures, and presumed ethnic relationships.

CHAPTER SIX: CONCLUSION

This study sought to analyze skeletal remains of persistent Archaic hunter-gatherers occupying the Green River Valley shell mound of Indian Knoll (15OH2) in Kentucky and the adaptive social strategies affiliated with the long-term occupation of the site. Guided by the theoretical frameworks of persistent place, resilience, practice, and mortuary studies, a comprehensive review of past hunter-gatherer studies in biological anthropology, both generally and within the context specific region of Kentucky, was conducted. Methods and utility of biodistance analysis for bioarchaeology were reviewed and the techniques were applied to reconstruct the population structures of the hunter-gatherer population at Indian Knoll, reviewing patterns of phenotypic variation over time and potential correlations with spatial organization at the site. A mortuary analysis was also conducted to pinpoint symbolic patterns expressed through the placement, orientation, and inclusion of material items within burials. Based on these findings, the functioning hypothesis for this thesis postulated that the population structures of hunter-gatherer groups interring ancestral dead in the mound would reflect lived behaviors and social processes creating a communal, social identity by tapping into a collective memory produced through the continuous affiliation with ancestral populations at persistent mortuary landscapes.

The discussions presented were based upon multiple theoretical considerations, namely the concepts of persistent place, resilience theory, and practice theory, and salient applications of these for hunter-gatherers. The continuous use of the shell midden at Indian Knoll as a mortuary landscape characterizes the site as a persistent place, an area functioning as a site where human behavior intersects with the environment throughout prolonged periods of occupation and revisitation subscribing to particular temporal rhythms. These places become loci for the production and (re)renegotiation of communal social behaviors, practices, and values. These persistent environments can reflect the resilient, complex nature of hunter-gatherer communities, groups that have historically been relegated into arbitrary dichotomous categorizations of social structure complexity based on a hunting and gathering subsistence strategy. These arbitrary, binary classifications, fueled by a science and theory divide as well as the application of processual concepts from the beginnings of mortuary archaeology, fail to incorporate fully the postprocessual ideas central to practice theory or considerations of social adaptive strategies to changing environments. Hunter-gatherers should not and cannot be accurately represented by such categorizations, as the social worlds and beliefs structuring behavior in these groups are deep, adaptive, interconnected, and nebulous constructs that can be reflected in mortuary practice.

Persistent mortuary landscapes, and incidentally bioarchaeological studies, are in a unique position to reveal potential worldviews and adaptive social strategies of past hunter-gatherers by analyzing the spatial organization of individuals in cemeteries, potential biological affiliations motivating organization, the presence of meaningful

biological relationships, local histories of ritual mortuary practice in patterns of body positioning and grave goods, and regional interactions of local groups through symbolic burial of the dead. The increased interaction between the fields of biological anthropology, bioarchaeology, and mortuary studies can provide comprehensive frameworks for investigations of these landscapes and the past agents responsible for creating these sites. Using these methods in conjunction with reviews of past studies in the region can produce a comprehensive image of how the site was created, maintained, and reproduced over time.

Within this context, biodistance arises as a method with increased utility for bioarchaeological studies and for elucidating the complex, resilient nature of hunter-gatherer communities. Biodistance reconstructs population structures through the analysis of relationships present between measures of heritable traits across individuals. Although biodistance analysis historically has been related to a typological framework that frequently seeded essentialist, and racialized portrayals of populations, the infusion of the biocultural perspective allows for the use of the method for appropriate and important discoveries. By shifting focus from the determination of "types" or racial comparisons to the investigation of patterns of phenotypic variation and population structure, biodistance analysis can be applied ethically to address interesting and important questions about past populations such as those surrounding identity, symbolic behavior, resilience, and ethnogenesis. This method can stem from measures of craniometric, craniofacial, and dental metrics. However, dental metrics provide the most effective data source for these analyses as tooth shape and form is highly genetically controlled with minimal

susceptibility to environmental impacts. The use of these measures with a biodistance approach presents opportunities for revealing answers to questions surrounding the intricate, structured social behaviors and rituals constituting and maintaining hunter-gatherer societies and belief systems.

Previous explorations in the Green River Valley region have identified the adaptive subsistence strategies motivating the increased distribution of occupational zones to resource-rich riverbanks and wetlands (Jefferies et al. 2005) and the resulting increase in shell midden accumulations and more permanent settlements. Shell midden sites were increasingly used as loci for social gatherings (Hensley 1994; Hoffman 1986; Morey et al. 2002; Winters 1974), and developed into marked areas of importance used for continuous negotiation of communal rights, social activities such as mate exchange, feasting, and burial as well as social labor (Crothers 1999; Herrmann 2002a; Marquardt and Watson 1983). The increased permanence in the settlement patterns of these hunter-gatherer groups sparked an expansion of social networks regulated by territorial boundaries. The expansion of these social networks lead to changing levels of interaction between groups, resulting in modifications to the overall population biology and the biological relationships between and within these groups (Jefferies 1997).

Understandings of the evolutionary mechanisms comprising these shifts in biological relationships have been attempted for the region, finding that prior to the Early Archaic, relatively more homogenous, native populations of small, mobile hunter-gatherer groups were marked by cultural and genetic differentiation between groups (Sassaman 2010). The Middle to Late Archaic period in the Southeast was characterized

by the presence of a variety of cultural presentations resulting from migratory events and social networks of exchange and interaction based on kinship and alliances (Campbell 2016; Crothers 1999). Recent investigations into the trends of phenotypic variation during the Late Archaic show hunter-gatherers of the Green River Valley region as groups functioning as distinct, cohesive units (Herrmann 2002a; Sciulli 1979), with biological distances at Indian Knoll indicated a geographically influenced structure shaped by the presence of a local mate exchange network between sites (Herrmann 2002a). Higher variation in cranial nonmetric traits amongst females in these groups indicate local mate exchange, but lower expected affinity between Tennessee and western Kentucky based on distribution of cultural materials propose an isolation by distance model where the presence of a distinct population history or cultural isolation results in a different genetic lineage of groups from the Green River Valley region (Campbell 2016; Herrmann 2002a; Konigsberg 2006).

This study expanded on these past studies, analyzing the population structure at the Indian Knoll site by taking dental measures and performing mortuary analyses on 139 individuals from the collection at the William S. Webb Museum in Kentucky. Tooth measures were taken for all individuals with teeth present and final inclusions comprised of individuals with 75% tooth presence. Burial information for each individual was recorded, including age and sex estimates, body position and orientation, grave good presence, and relative burial depth. Geographic matrices were created denoting the space between burials to exhibit the positional relationships present. This information provided the basis for R-matrix and Mantel's Partial Correlation tests reconstructing patterns of

phenotypic variation over time and investigating the relationship between biological and spatial affiliation. Subsequent tests on the scope of interactions between age, sex, and temporal period on the distribution of grave goods were also performed but were found to have no significant impacts.

These tests found that there was no correlation between spatial and biological relationships at the site, indicating that relationships based on genetic relatedness were not motivating burial placement. Patterns of phenotypic variation reveal a highly related ancestral population that becomes more variable over time, with a slight reduction in variability in the latest period of occupation. Phenotypic variation as related to grave goods shows that individuals associated with having grave goods are less variable in the initial source population, exhibiting higher levels of relatedness amongst individuals with grave goods in the most ancestral population. This pattern was seen to invert over time, with higher levels of variability amongst individuals with grave goods in the intermediate phase of occupation shifting to a more uniform paradigm as individuals with and without grave goods exhibited similar amounts of phenotypic variation during the latest period of occupation.

Trends in the phenotypic variation of tooth form and size probes the question of motivating factors for shifts in population heterogeneity. The transition from a highly homogenous source population to an increasingly variable one over time has many potential explanations. Within the context of archaeological evidence and past studies of genetic structures contributing to the site, these results support claims that earlier, more mobile groups of hunter-gatherers were comprised of relatively homogenous bands.

These results also agree with ideas of subsequent changes in mobility behaviors impacting patterns of extralocal gene flow increased from engagement in new networks of exchange across the western Kentucky region. While generally subscribing to a isolation by distance model, the contraction in phenotypic variability seen in the latest phase of occupation is interesting. When contemplated within a resilience framework, this shift could potentially be related to turbulent environmental conditions surrounding the terminal phase of the Archaic, as changes to socioeconomic systems and networks of interaction which resulted in the eradication of persistent places built over long-standing, deep periods of time (Kidder 2006; Thompson 2010). The reduction in variability could then be seen as a socially adaptive response to maintain the integrity of the collective memory at the site, reducing engagement in local behaviors constituting social interaction or exchange. However, this would require further exploration into the temporal boundaries constituting this later phase, the climactic conditions specific to those included within it, and if similar trends of variability reduction are seen in neighboring Green River Valley sites such as Carlton Annis.

The processes involved in the construction, and eventual end, of persistent landscapes in the Archaic are just beginning to be understood. Consideration of the collective social identities constructed by populations engaging in these landscapes mark important, practiced symbolic behaviors embodied in daily practices. Mortuary landscapes provide significant loci that constitute the production, negotiation, and maintenance of communal values, beliefs, and social structures formulating group as well as individual identities. The Archaic shell mound site at Indian Knoll represents a

persistent landscape created and maintained through engagement over deep time, subscribing to long-term temporal rhythms essential for the site's continual use. Investigations into the patterns of phenotypic variation and mortuary patterns comprising the living populations interring deceased members at the site utilize a multivariate approach to gain an exhaustive understanding of the actions comprising everyday life and mortuary practice in this region of Kentucky. These explorations reveal the socially adaptive strategy present amongst these populations, as engagement with ancestral occupants in the persistent mortuary landscape of the shell mound serves to maintain, develop, and negotiate a collective social identity over deep time.

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