# Social Memory of Violence and Enduring Colonialism: The Bioarchaeology of Resilience Among the Ancestral Puebloans

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by

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## DEDICATION

I dedicate this thesis to my number one supporters: my mother, my loving boyfriend, and my emotional support tortoise.

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I would like to thank the many friends I have amassed through the years for being there for me emotionally. This thesis would not have been possible without my massive support system to whom I owe it all. Additionally, I would like to thank my advisor at George Mason University, Daniel Temple, for the continual support and understanding of my needs throughout my graduate career. His input was integral for the creation and development of this thesis. I would also like to thank my Committee, Dr. Klaus, and Dr. Clark, for their fantastic input and help refining this work.

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## LIST OF ABBREVIATIONS

Cranial Depression Fracture ..... CDF
Millimeters ..... mm
Musculoskeletal Stress Markers ..... MSM
Blunt Force Trauma ..... BFT
Bone Mineral Density ..... BMD

## ABSTRACT

SOCIAL MEMORY OF VIOLENCE AND ENDURING COLONIALISM: THE BIOARCHAEOLOGY OF RESILIENCE AMONG THE ANCESTRAL PUEBLOANS

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Recent explorations of resilience theory and violence within bioarchaeology have provided new insight into the continual Indigenous struggle against colonialism by studying the recent and deep past. This study seeks to demonstrate how analysis of traumatic injuries in the skeletal record elucidates evidence of flexibility, rigidity, resilience, and persistence of cultural identities using mitigation techniques during periods of socioecological changes. By examining published analyses of skeletal samples from the Ancestral Southwest sites of Pueblo Bonito (800-1200 CE), Point of Pines (400-1450 CE), Hawikku (1300-1680 CE), and San Cristobal (1300-1680 CE), this study explores risks and likelihoods for experiencing trauma in reaction to various socioecological relations and colonialism. Pueblo Bonito and Point of Pines represent two extremes, where Pueblo Bonito's use of violence as social control created a rigidity trap and Point of Pines provides evidence for successful mitigation techniques. Hawikku and

San Cristobal exhibit higher likelihoods of experiencing traumatic injuries, relating to increased Spanish taxation and negative interactions with the Great Plains and Ute or Comanche communities. Uniquely, these colonial sites did not show an increase in lethal cranial trauma, providing evidence for resilience in the Ancestral Puebloan community via social memory of previously successful mitigation techniques and small-scale changes to the social adaptive system. The results demonstrate an increase in the experienced violence due to the biologically transformative event of colonialism while also suggesting evidence for cultural resilience and endurance that continues today amongst the descendent communities of the Ancestral Southwest.

# CHAPTER ONE: ANTHROPOLOGY OF VIOLENCE

Classical evolutionary anthropologists envision violence as an inherent aspect of being human and hypothesize that this behavior increased access to mates and resources through direct competition or costly social signals. On this basis, evolutionary perspectives often hypothesize that violence has been present for the duration of human evolution. In contrast, sociocultural anthropologists often suggest violence is associated with institutions of inequality and elevated levels of sociopolitical power and authority. Some sociocultural emphases hypothesize that violence is socially conditioned and is found as greater levels of complexity emerge. In contrast, resilience theory suggests that under circumstances where increased levels of rigidity characterized by low environmental productivity and high degrees of connectedness may exacerbate violence. This approach establishes contexts where violence may increase without assumptions regarding levels of sociopolitical complexity or ascribing inherent behavior to human communities. Bioarchaeological research documenting violence under conditions of increased rigidity suggests that this behavior has deeply contextual roots in cultural and socioecological systems.

## Definition of Violence

Violence exists throughout history and the modern era as a global phenomenon. The World Health Organization defines violence as “the intentional use of physical force

or power, threatened or actual, against oneself, another person, or against a group or community, which either results in or has a high likelihood of resulting in injury, death, psychological harm, maldevelopment, or deprivation" (WHO, 2002, p. 4). This definition of violence not only encompasses interpersonal violence through physical harm but also acknowledges the wide range of acts that are beyond physical interactions. Violence is experienced through threats, intimidation, psychological harm, deprivation, and maltreatment endured by individuals through the actions of economic, political, and social spheres (WHO, 2002).

## Classical Biological and Cultural Perspectives on Violence

Evolutionary perspectives of violence assume this behavior is an inherent component of human behavior. These ideas were developed in conjunction with Hobbes's *Leviathan* (1651), which hypothesizes that populations are in a constant struggle for survival and that early human communities, lacking governmental institutions, were reduced to violent behavior to satisfy conflicts and attain their basic needs. These ideas were incorporated into Darwinian perspectives where violence is used as a direct form of competition or costly signal in attracting mates or accessing resources (Darwin, 1890). Sociobiological perspectives draw on this approach by emphasizing the presence of violence across animal communities, including primates, and suggest that violence has deep roots in the human evolutionary story. Individuals being valued or associated with kinship groups, creates ethnic oppositions where violence can emerge sporadically among local cooperative groups as a social control mechanism or as an expression of competition over mates (Knauft et al., 1991). The idea comes from

understanding great apes as associating increased benefits by forcefully defending resources and property, as well as forcefully obtaining them from other groups (Knauft et al., 1991). Conflict then revolves around self-interest and cooperation as an assumed aspect of early human social organization and evolution (Otterbein, 1999; Knauft et al., 1991). Marriage, mating, and indicators of masculinity are frequently protected. Therefore, the severe violence that occurs ultimately relates to mating competition among males. This aspect of the evolutionary perspective created a comparison between great apes and early human societies that suggests violence is an inherent aspect of our species.

Others have suggested that direct violence is rare in long-lived primate communities, owing to the high cost of mortality risk in populations with reduced reproductive output and longer lifespans. Here, body size, canines, and calling act as signals that deter violence through competitive display while simultaneously increasing access to mates and resources. Laland and Brown (2002) present the genes-eye view, which advocates for group selection based off of the social behavior of animals. Uniquely, humans could be paying attention to the limitation of population growth by restraining reproduction (Laland and Brown 2002). This could be achieved through highly ritualized disputes between groups. Competition then becomes the ability of the individuals to determine who had earned the right to breed and who should withdraw. This decision-making aspect of competition for mates is also considered an evolutionarily stable strategy (Laland and Brown 2002). The evolutionary stable strategy suggests that in deciding whether to engage in a fight over a resource, an individual may adopt the strategy of always attack, never start a fight, or always attack when challenged.

Sociobiologists then consider that once this strategy is adopted by all members of the population, no other strategy could replace it (Laland and Brown 2002). Once a decision is made in terms of which type of aggressive action to take in response to competition over resources or mates, it is not to be undone by the relating kinship group.

Some emphases on an evolutionary perspective further assume that violence or phenotypic signals of violence are successful strategies for attracting mates or accessing resources. Sociobologists pull from this evolutionary perspective and explore the sex difference in homicidal aggression amongst humans. Across all sexual species, the sex that makes a greater parental investment tends to become the crucial resource which limits the fitness of individuals of the less investing sex. This idea supports that males in human societies need to be more aggressively competitive in order to have greater fitness as they are the less invested parental unit (Laland and Brown, 2002). Therefore, successful males have many partners and offspring, where there are big rewards for competition between males for access to females. This suggests a history of male behavior that favors higher risk strategies (Laland and Brown, 2002).

Some genetic studies have attempted to identify "violent genes" in human communities and demonstrate how these traits represent evidence for the inherently violent nature of the species (Moosajee, 2003). Contemporary studies attempt to assess the validity of and evidence for genetic influences on violent behavior. Analyses are based on the premise that in all civilizations over time, violent behavior was a necessity for survival and thus natural selection chose to favor more violent and aggressive traits (Moosajee, 2003). Therefore, the capacity for violence is needed for the survival of a

species. Moosajee (2003) provides an overview of research into this genetic predisposition for violence by surveying results for the mutation of the monoamine oxidase A (MAOA) structural gene. Their analysis asserts that it is a combination of environmental and genetic factors contributing to the undesirable conduct of violent behavior. With the mounting evidence that violent behavior has a pathological basis and a strong correlation to the Y chromosome, the evidence points towards males being predisposed to violent actions (Moosajee, 2003). This allele evolved within the last 40,000 years; however, anthropological approaches to genetic analysis suggest that these genes have been evolving in conjunction with hominin evolution all along. These studies espouse a deterministic approach to violence in human communities by assuming violence is an inherent adaptation to early hominin environments that persists in modern populations.

Sociocultural perspectives on violence are often drawn from Romantic-era interpretations of behavior. Romantic arguments pushed for a return to a pastoral past that was free from the corrupting influences of industrial capitalism, land ownership, and political authority (Rousseau, 1754). This approach was seized upon by some cultural anthropologists who argued that violence was associated with institutions of increasing power and inequality. Examples from early ethnographers of the Boasian school show deliberate deemphasis of the importance or frequency of violent interactions in isolated or "small-scale" Indigenous communities. Benedict (1934) described the Zuni as a peacefully Apolloian people that distrust authority, value moderation, as well as pliant personalities. She explains the warrior society and the importance of the war chief and

war priests in the ceremonialism and dances performed by the Zuni. However, she considered them uniquely peaceful by comparing them to the western Plains groups that seek out visions through "hideous tortures" involving the skinning and mutilation of their opposition (Benedict, 1934, p. 58). Benedict positions the Zuni people as untouched and a homogenous continuation of their ancestors. She goes so far as to say, "they have a romantic history" (Benedict, 1934, p. 41).

Benedict (1934) attempted to utilize cultural relativism by focusing on the ceremonial aspect of Zuni life, painting a picture of an enduring untainted group that represents the ancient Puebloan world. This romanticization clearly shows determinism regarding the destruction of culture due to colonialism and the warfare practice of scalping being integral to rain making by the warrior society. She admits that the Plains groups are violent in nature yet denies and ignores other instances of violent interactions seen within the Zuni group, in order to perpetuate the peacefulness of the Ancestral Puebloan Southwest. Considering the Zuni as "untouched" is placing them within a time where their ancient lifestyle was not influenced by industrialization and this makes them less violent, continuing the use of an evolutionary typology.

This perspective relied on the romanticization of Indigenous communities, where the goal of salvaging fading cultures was emphasized in the ethnographic perspective (Otterbein, 1999; Accomazzo, 2012). Synthetic work that addresses the history of violence in human communities highlight this point by suggesting that the documentation of violence in early human communities was ineffective, not serious, and unprofessional (Keely, 1996). The practice of cultural relativism and romanticizing nonliterate people

went hand-in-hand; however, not every anthropologist at the time followed this tradition of being blind to violence. An example of differing opinions on the same observed culture can been seen on Margaret Mead's (1935) classic work, *Sex and Temperament in Three Primitive Societies*. Field work was done in conjunction with her husband at the time, Reo Fortune. While Mead wrote about both men and women being naturally unaggressive and gentle among the Arapesh, Fortune (1942) conducted further investigations into Arapesh warfare, later publishing a war leader's speech to provide evidence of violent practices. Mead clearly makes mention of war-related rituals and weaponry but claims they were uncommon and there were no formal or organized expeditions of war (Mead, 2001). The mountain Arapesh are considered a warring community and have been assessed by many anthropologists since the conclusions of Mead and Fortune. This deliberate removal of Indigenous power by suggesting the Arapesh are a nonviolent community had negative repercussions in the Arapesh community (Roscoe, 2003).

Another component of the Rousseauian perspective revolves around over emphasizing the role of colonial activities in the increase of warfare among Indigenous groups. Researchers proposing the Tribal Zone Theory emphasized the predatory actions of colonial powers and how these affected the intensity, frequency, and the nature of warfare in "small-scale" societies (Hames, 2019). The colonial process of displacing groups into territories of other Indigenous communities is suggested as having led to the increase in intertribal warfare (Ferguson and Whitehead, 1991). Several examples from the California coast and the Great Plains communities are used to explain peaceful

societies that were corrupted by colonialism into becoming more bellicose (Secoy, 1953; Brown, 1967). These perspectives are coupled with the technique of deemphasizing the complexity, frequency, and intensity of warfare prior to colonial interactions. Comparing this romantic perspective, researchers address the hypothesis of pacification by elucidating trends in warfare or violent interactions that are actually decreasing with colonial interactions, with the highest frequencies of warfare occurring prior to "pacification" (Ember and Ember, 1997). While these studies sought to privilege Indigenous lifeways by emphasizing a peaceful past, the works still engaged in linear, typological assumptions surrounding human behavior. Specifically, that violence can be placed within a category that reflects stages of social organization.

## Multidisciplinary Perspectives of Violence

Violence is a complex, multi-faceted experience involving participants, recipients, and witnesses. In this sense, violence holds a high performative quality. Violent acts within a culture are efficient because they have staging power and legitimacy. The performative quality of violence is observable in public rituals, in which they show the antagonistic relationships as staged and produced. These performed qualities of violence show a structure of "we" versus "they," as well as the identification of the "us" side as being related to the struggle for survival (Schroder and Schmidt, 2001; Perez, 2012b). These violent imaginaries, however, do not always turn into violent practices on their own, as they need to be implemented through human agency. Structure does not always compel violence, as there are alternative paths of action (Krohn-Hansen, 1994; Corbin, 1976).

Participants, recipients, and witnesses all have unique, yet integrated experiences within violence. For instance, performances such as human sacrifice reflect deeper social practices that are legitimized by a ruling elite as practitioners, yet the behavior involves recipients and witnesses to grant agency to these acts by acting as vessels for violence and witnessing the rituals associated with these behaviors. (Klaus and Toyne, 2016; Bentley and Klaus, 2016). However, they are considered legitimate and ordinary by members of the practicing culture. Violence is seen as never completely senseless or senseful to the actor, and it is certainly not meaningless to the recipient or observer (Perez, 2012a). One can never completely disassociate social action from rationality. Violence is a historically situated practice and is informed by the material constraints and incentives of a cultural memory (Krohn-Hansen, 1994; Schroder and Schmidt, 2001; Perez, 2012b; Farmer, 2004). Violence is highly visible and concrete and therefore an efficient way of transforming the social environment and staging a specific ideological message in front of an audience (Farmer, 2004). A society's cultural perspective mediates conflicts by giving specific meaning to the situation, and it is based in the historical social memory.

The community's experiences are inscribed on any form of cultural archive and are socially recalled and recreated through collective memory. Part of this relationship needs to be explained historically in the community's social memory, in which long-term confrontations typically explode in violent clashes. These events then take place within well-defined locales and a recognizable time frame. No violent act can be understood without viewing it as a link in the chain of a long process of events which then refer to

the cultural and material structure as compared to similar structural conditions elsewhere. Violence is a unique experience that is culturally mediated and stored in the society's collective memory. It also produces tangible and empirical results. Limiting our view of violence to its functional properties in conflict, one cannot grasp this nuanced nature of violence. It is important to consider when violence is used as a legitimate cultural resource, as it presents itself as recreating social ideas or models from the past that have a strong sense of social closure based on previous experiences of superiority or suffering (Krohn-Hansen, 1994; Schroder and Schmidt, 2001; Perez, 2012b; Farmer, 2004).

Violence as a cultural resource is examined through the interpersonal relations of everyday cultural reality as conflict and as warfare. Violence within specific cultures is an identified strategy that is generated by competition over resources and becomes a means of overcoming critical situations for survival of a given population. They can establish violence as a long-term strategy for group maintenance and for the population's physical and social reproduction. Violence can also offer short-term benefits of material gain, social recognition, and socially defined goals, such as revenge. These goals are viewed as an expression of long-term cultural adaptation to a social reality that is characterized by competitive interactions. This collective repetitive response in the social memory shows that violence is an appropriate solution to conflict. The communicative aspects of violent interactions combine the perspectives of a functional evolutionary aspect as well as a socially functional usage (Krohn-Hansen, 1994; Schroder and Schmidt, 2001; Riches, 1986).

In conclusion, violence is a highly complex phenomenon and cannot be reduced to either an inherent human condition, consequence of social organization, or resource availability (Corbin, 1976). Acts of violence hold substantive social meaning and reflexivity. In the future anthropological approaches to violence should consider the integration of biological and sociocultural perspectives that provide context for these behaviors.

## Resilience Theory

Resilience theory provides a new perspective that relies on the context rich record of human behavior to predict violence. Resilience theory attempts to identify the underlying causes, effects, sources, and roles of change in an ecological adaptive system (Redman and Kinzig, 2003). It is a theory of cycles of change that occur across various spatial and temporal scales. At the core of resilience theory is the adaptive cycle, which is symbolized by the "figure eight" (Figure 1).

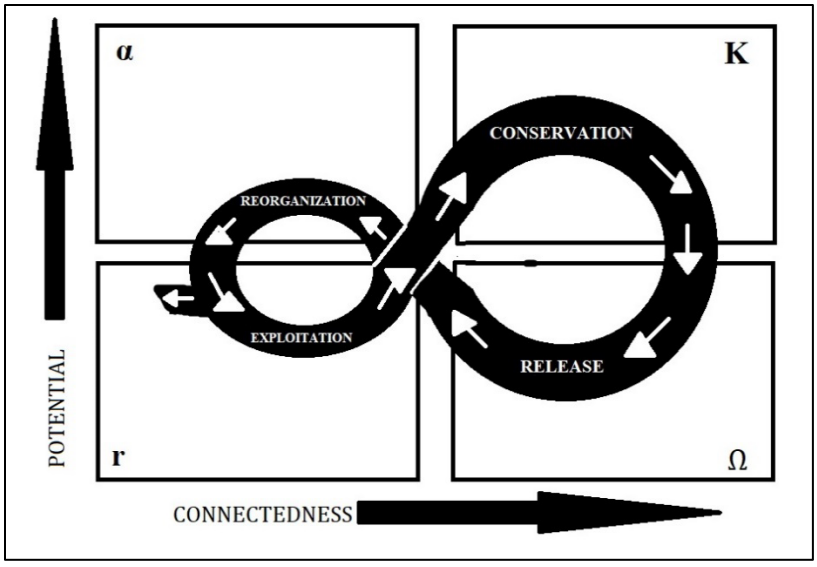

Figure 1: Model of Adaptive Cycle Modified from Holling and Gunderson (2002)

There are four phases in the adaptive cycle reflecting ecosystem succession. This model of ecosystem succession and has been integrated into anthropological analysis of socioecological resilience. First, the release phase, or Ω phase, is where the tightly bound accumulation of organisms in the ecosystem becomes too fragile and thus is released suddenly by external agents. The second function, growth, or the r phase is the use of the land for natural resources. Conservation of the ecosystem in the K phase is the next function, which includes the building up of natural resources from the previous land release. The final phase added on by resilience theorists is the α phase, which represents the reorganization of resources to take advantage of new opportunities and returning to or a building of new forms of interaction (Redman and Kinzig, 2003). Individual components of the adaptive cycle are characterized as nested hierarchies. These hierarchies may have a stabilizing effect, as they represent the memory of the past and the ability to recover after a change occurs. These nested hierarchies may also be

destabilizing if they become “over connected” or “brittle” (Redman and Kinzig, 2003). Small-scale change can drastically affect rigidity, triggering revolt and subsequently creating large-scale transformation. This combined theoretical approach is termed “panarchy” (Redman and Kinzig, 2003). Panarchy is a framework that is meant to account for these contradictory characteristics of complex adaptive systems, such as the duality and necessity of stability and change.

Ecologist C. S. Holling introduced resilience as the capacity for flexibility regarding change, and thus shows the ability to adapt and absorb dramatic changes within an ecosystem (Folke, 2006). Resilience emphasizes that rigidity creates vulnerability within socioecological systems—elevated levels of interdependence and reductions in productivity portend transformation during the reorganization phase of the adaptive cycle. Resilience theory implies that the maintenance of diversity and individuality avoids vulnerability in an ecosystem. “Hence, a complex adaptive system consists of heterogeneous collections of individual agents that interact locally, and evolve in their genetics, behaviors, or spatial distributions based on the outcome of those interactions.” (Folke, 2006, p. 257).

Destabilizing and stabilizing forces are integral within an ecosystem for various reasons. To maintain diversity, flexibility, and opportunity, destabilizing forces are crucial (Redman and Kinzig, 2003). Inversely, stabilizing forces maintain productivity, fixed capital, and social memory (Redman and Kinzig, 2003). Finally, systems that attempt to manipulate their ecosystem by applying fixed rules to achieve constant yields of production lead to a reduction in flexibility. With low flexibility in the system,

disturbances can affect the system more drastically, when previously they would have been able to be absorbed.

These new systems can either be fundamentally the same as the originally released system or represent something entirely new. This inevitable change occurs on various spatiotemporal scales, which range from slow-and-large to fast-and-small (Redman and Kinzig, 2003). The memory imposed by the overarching slow and large cycle can still guide change on the small and fast scale. These small changes would then reenter the large adaptive cycle. If enough of the small-and-fast cycles exhibited tight connections and shared a spatiotemporal shift, then a "revolt" can occur that ultimately affects the large-and-slow cycle (Redman and Kinzig, 2003). Collaboration with archaeologists in this ecological system theory can provide explanations for change, collapse, transformation, and resilience of human populations over time. The focus here is that collapse is not necessarily the end of the breaking of the complex adaptive system, especially if there is some maintenance of cultural identity and plasticity that permit survival in this constantly changing landscape.

The maintenance of livelihoods that satisfy moral and cultural needs in the face of major environmental perturbations defines cultural resilience (Crane, 2010). Cultural resilience can also grant flexibility to the socioecological system and can interact with the way that these will produce new socioecological resilience. One way that cultural resilience can interact with socioecological systems is through cultural memory (Redman and Kinzig, 2003). Archaeology provides this deep time perspective when looking at the use of social memory, particularly regarding persistence and transformation. Cultural

resilience may interact with the socioecological conditions by legitimizing the transformations and behavior that can demonstrate flexibility through the collective action and agency of the community. An enduring nature of specific cultural practices can represent proof of resilience in past populations across transformative events occurring to the socioecological system.

Contemporary studies on social resilience focus on analysis of the dichotomy of collapse and resilience. This dichotomy is not necessarily real as both collapse and resilience are a part of the same phenomena, the same adaptive cycle, and interpretations of these binary points are influenced by time scale (Faulseit, 2016). Trends in prehistory are visible over a large temporal and spatial scale and this exposes cultural diversity at various macro and microcosmic levels. This analysis can avoid these foils, and instead of providing a contrasting analysis of resilience and collapse, one can then assess how the two concepts can provide a holistic understanding of the complex relations between both.

The archaeological record can inform on a collapse in the central administrative organization, disappearance of an elite class, collapse of a centralized economy, and a settlement shift and subsequent population decline. These can manifest in the record as an abandonment of public buildings or palaces, reduction of elite grave goods, and a shift to smaller settlements (Faulseit, 2016). These archaeological processes can reflect a transformation rather than a collapse of a population. Instead of analyzing a site for collapse, the analysis of the site for evidence of societal transformation can then expose the full extent of outcomes, including collapse but also reorganization and revitalization of the culture and population (Faulseit, 2016).

To quantify the degree of severity of a societal transformation, Hegmon et al. (2008) discussed the capacity of human agency to maintain a certain level of conservation in the K phase that leads to long-term degradation of the ecosystem. This cycle of producing robustness to maintain stability also produces vulnerability in its inability to adapt to changes. Human ingenuity thus produces negative outcomes for the future of society if there is no maintenance of flexibility. The manifestation of this process is termed the "rigidity trap," where growth capacity is high and manages to surpass the ecosystem's equilibrium point (Hegmon et al., 2008). However, these seemingly positive situations surrounding the rigidity trap have undesirable outcomes in response to the repetitive actions that reproduce the desired stability structure. Rigidity increases the vulnerability of socioecological and cultural systems to collapse or drastic transformation.

Rigidity, as the idea of "squeezing out diversity" creates hierarchies and class distinctions (Hegmon et al., 2008). They consider various parameters that contribute to rigidity. Integration of social and political systems, groups of people, ceramic styles, or architectural components can produce a decrease in diversity and increase vulnerability (Hegmon et al., 2008). Interconnectivity may produce strength on some scale but can also lead to violent outcomes when quality of life is degraded during periods of drastic transformation or collapse. When confronted with environmental challenges, this interconnectivity will require a transformation of the entire system, rather than small adjustments related to flexibility and adaptability as small changes require massive downstream shifts in socioecological and cultural practices. Hierarchy, which establishes

small and large-scale social factors, can foster inequality and discrepancies between classes, seen in burial treatment, social control, or resource disparities (Hegmon et al., 2008). Therefore, the degree of rigidity seen suggests a correlation to the severity of suffering experienced because of societal transformation.

Relationships between humans and their environment are a component not only in the ecosystem itself but also in the socio-political world. Populations have the capacity to manipulate the ecosystem and contribute to the overall adaptive cycle. Human interactions with their environment never quite reach equilibrium due to constant change on both scales. There develops an interdependence of the ecosystem as it has been modified by the human population and vice versa. If external factors then cause a depopulation of an area, the ecosystem and the human group will be drastically affected (Redman, 2005). Previously stored social memory of how to respond to drastic external factors may no longer be viable due to the sociopolitical pressure on the landscape, and other factors associated with the rigidity trap, that reduced the adaptive capacity and thus the society's resilience (Redman, 2005). As seen in previous research, a lack of alternative options in the face of drastic change often provokes violent outcomes within communities forced into drastic transformation or collapse of the socioecological system. In this sense, violent outcomes may be viewed as having deep roots within the flexibility or rigidity of a community, which is measured based on interacting contextual factors including inequality, interconnectedness, and population density and resource availability.

## Archaeology of Violence

Archeology contributes to the study of human warfare in several ways. The first emphasizes the ability of archaeology to look into the distant past and examine an area over a vast temporal context, thus providing insight into the origins and evolution of war. The second, using the temporally extensive archaeological record, provides evidence for the causes and effects of war. Though the archaeological record is incomplete, utilizing this method of material remains reduces biases inherent in historical literature. Dispelling the dichotomous notion of either a peaceful or violent past, the archaeological record provides empirical evidence for fluctuating frequencies of violence prior to emergence of state level polities (Haas, 2001; Keely, 1996; Ferguson, 1997). Furthermore, modern literature and material theory in archaeology provide evidence to refute the Hobbesian view of humans as residing in a constant state of "ware." They have also established the record of warfare into the Neolithic, refuting the Rousseauian notion of a peaceful past being corrupted by agencies of government.

Contemporary archaeological studies search for models of causes and consequences of war and violence. Archaeological perspectives rely on the notion that expressions of war and violence vary depending on the societal structure of the community, such as tribal, chiefdoms, and state-level hierarchies. Material factors are posited as the cause of violence, such as economic, political, or environmental stress, as well as gains for each in the form of land, prey animals, labor, power, prestige, or mates (Nielsen and Walker, 2009). Subsequently, the consequences of war are just as diverse as the causes, where there is just as much possibility of one outcome as for the other.

Violence can be cyclical and cultural events such as population redistribution, material factors, economic intensification or political fragmentation may exacerbate violent behavior.

These perspectives from contemporary studies of archaeology of war tend to negate or lack a consideration of agency and cultural diversity. These two concepts make generalization and standardization of the study of violence quite difficult. While the existence of subjective motivations for violence, such as revenge, fear, power, religion, are more than present in historical context, the material record does not directly allude to them and therefore they are often pushed aside as causes and motives (Nielsen and Walker, 2009).

Material conditions that reflect war in the archaeological record, such as environment, demography, technology, and economics, elucidate long-term evolutionary patterns of social conflict (Haas, 2001). These patterns and manifestations of violent events tend to occur in clusters and not as isolated events. The material perspective presents empirical data relating to technology, subsistence, and settlement patterns, which used in context can help infer information on social structure, political organization, and ideology as relating to violence (Haas, 2001). Material remains, which are considered direct manifestations of war, can be identified from skeletal remains, weaponry, and settlement destruction. Material theory regarding analysis of violence in the archaeological record relates to identification of defensive structures, mass graves, burned communities, specialized weapons, artistic, and ideological representations of war in rock art or ceramics (Haas, 2001).

Material theory further pulls from population densities, storage structure of resources, and cultural diversity in assessing the causes of warfare. Locating and identifying stability within these sources can elucidate further external conflicts arising from those on the outskirts of the established villages and communities. Material theory relies heavily on surrounding context as pulled from the environment, subsistence, and religious systems to conclude on a holistic view of the causes of warfare and violence. Religious iconography or artistic representations of identity are also strongly associated with the identification of violence in the past. Iconography and markers of identity can be seen in the material record on rock art depictions, glorifications of warriors and war, and as ritual legitimization of the actions of the military or elites.

A bridge between cultural anthropological theory and archaeological material theory, the practice approach is characterized as culturally informed and historically contextualized insight into action. Utilizing material theory and structural regularities, practice theory considers clearly unique depositions, proximate causation, and agency in the analysis of violence (Nielsen and Walker, 2009). The materiality of violence (architecture, skeletal remains, iconography, and landscapes) provides empirical evidence for the multiplicity in meanings of violence, and gives a more holistic understanding of its cause, consequences, and impact upon society (Ralph, 2012). Context is immensely important to consider as these events and activities of violence do not happen in a vacuum. Context creates a means of interpreting evidence to understand why and where an event took place, and who was involved. The practice approach can refute the previous notions of environmentally deterministic explanations by applying the material record

and agency and discovering the frequency of war correlates more to resource unpredictability than to chronic environmental stress (Haas, 2001; Nielsen and Walker, 2009). The social processes associated with this environmental finding are suggested to be the fear of resource scarcity causing a socialization of mistrust.

It is the intersection of objective and subjective conditions that provide the historical context and provide a culturally informative insight into causes and consequences of violence. Where materialistic accounts of war and violence create analytical categories of infrastructure-superstructure, a practice approach avoids these concrete preconceived notions. The materialist approach suggests that warfare is a nested hierarchy of constraining factors giving causal priority to infrastructure, then structure, and rarely takes into account superstructural variables (Nielsen and Walker, 2009). Wars are based on cost and gain associated with material interests, according to the materialistic perspective.

The practice approach focuses on not dividing these systems into artificial subsystems as they seek to understand the patterns of system, structure, and culture as a reference to practice itself (Nielsen and Walker, 2009). There is a continuous flow of acts, material, and ideas on the actors themselves, as seen through culturally specific historical contexts that are intertwined with armed confrontations. These concepts attempt to infer agency by understanding the complex ways that interests and motivations develop in practice and specific contexts regarding conflict. Taking archaeological methods of studying prehistoric war beyond the mechanical application, practice theory demands use of thick contextualized analysis to assess the role of conflict in historically

constituted fields of action (Nielsen and Walker, 2009). With all of this in mind, the materiality of practice (places, objects, time, bodies) provides archaeological evidence of experience and context of violent events and actions, historically situated for specific and general cross-cultural comparisons.

The study of war and violence has grown in recent decades. Violence has become synonymous with warfare, and vice versa, making a single definition of violence difficult and impractical (Ralph, 2012). Approaching the subject of violence from one single definition is just as constraining as approaching it through only a single discipline, and it does not allow for interaction of temporal, spatial, and cultural diversities.

Contemporary studies on war have established a powerful association between violence and social identity (Fibiger et al., 2013; Ralph, 2012). The emergence of specialized warrior classes can assess creation of identity through use of violence in the archaeological record. Violence can also act as a means through which to define the other in relation to the difference between "us" and "them." Both aspects clearly establish powerful identities, either of the individual or the community, in association with or through using violence. This is further elaborated with the relationship between religion and violence. As most violence in cultural communities requires some sort of justification and legitimization, religion provides a strong basis of support. These acts can be evident in the archaeological record through iconography, architecture, burial goods, skeletal remains, and purposeful destruction of human figurines. If performative acts of violence or sacrifice are seen as legitimate in the context of religious beliefs, this can clearly

become sanctified violence and seen as necessary for transformative process (Ralph, 2012; Perez, 2012b).

Utilizing a materialist, practice, contextual, and interdisciplinary approach provides the ability to move beyond descriptive analysis of physical evidence of violence. These approaches elucidate the causes and consequences, both long and short-term, of violent interactions and the implications of the perpetrators, victims, and witnesses involved.

## Bioarchaeology of Violence

Bioarchaeology is the study of human skeletal remains within the context of the archaeological record. In this sense, bioarchaeology provides a direct line of evidence to violent encounters in the human past by marshalling the human body as a primary locus point of study. Human remains are a direct link to how violence is used in the past to shape and control our behavior as a species. Some forms of violence leave permanent marks on the body, creating an inscribed history on bones. The individual body is a playing field, as described by Lovell (2008), a terrain where truths and contradictions in the social world are acted out, putting on display social and personal struggle and resistance. Cultural processing and display of dead bodies present the ability to understand the way people perceive death and how they make sense of violence acts (Perez, 2012a). Evidence of trauma in the past is not only anatomically vital but provides information on an individual's or population's interaction with its socio-cultural and physical environment (Lovell, 2008; Perez, 2012a). Evidence of trauma and violence allows the bioarchaeologist to study the behavior of a population under extreme

environmental or socio-political stress. In this sense, bioarchaeological research provides an embodied perspective on violence, contexts for violence, and individual perceptions of violent events.

Walker (2001) argues bioarchaeologists are best qualified to analyze the cause of violent conflict in nonindustrial societies and to assess its social and economic significance. Historical studies of the bioarchaeology of violence have focused on males and the warfare surrounding densely populated regions (Kohler et al. 2014; Kuckelman et al. 2000; Kuckelman et al. 2002; Allen et al., 1985). In addition to these cases of institutionalized violence on a large scale, there is budding research into the small-scale interpersonal violence that can occur when the need for social control is primary among smaller groups (Baustian et al., 2012; Martin, 1997; Martin, 2016; Fleming and Watson, 2018). However, many bioarchaeological studies of violence have focused on binary approaches to these behaviors that contrasted an inherent component of the human condition versus practices that reflect deterministic relationships with social institutions.

The bioarchaeological study of violence has been used to demonstrate the inherent nature of this behavior in human communities and has resulted in racist, deterministic understandings of the human past. For example, Dart (1925) documented a series of puncture wounds in australopithecine crania in South Africa. These findings were interpreted to reflect evidence that the earliest human ancestors were involved in violent confrontations reflecting competition for mates and resources. Later studies by Broom (1936) suggested that these puncture wounds represented injuries sustained when humans were consumed as prey to large-bodied felids and aves. Evidence for cannibalism

and violent death has also been documented in early members of the genus *Homo* and used to support similar claims of an inherently violent past (Fernandez-Jalvo et al., 1999; White et al., 1991).

Turning to North America, traumatic injuries in ancestral remains from the Early Holocene have been used to further argue for an inherently violent condition in human ancestors, including outrageous and racist accusations of domestic violence some 10,000 years ago in Indigenous Americans (Chatters, 2014). These analyses were done with the goal of presenting the information from an etic perspective to remain as objective about the subject matter as possible, without integrating important cultural context. Assertions of cannibalism and warfare have further sought to support these claims by documenting violent behavior in populations with a supposedly peaceful past (Turner and Turner, 1999; Zimmerman and Bradley, 1983; Zimmerman et al., 1981).

In contrast, fetishization of the pastoral past is also documented in bioarchaeological research. For example, the low frequency of traumatic injuries in skeletal remains from the Jomon period in Japan has been used to support arguments that suggest violence did not occur in cases of "egalitarian" social organization or abundant access to resources (Nakao et al., 2016). Numerous studies also document increasing violence during the agricultural transition and greater inequality, arguing that social conditions related to modern lifestyles have been a primary driver of violent behavior (Glencross and Boz, 2014; Keeley, 1997; Smith, 2014; Otterbein, 2011). Finally, images of the pastoral past may be disrupted, though these cases appear refined to circumstances where sudden environmental change increases competition for territory and resources

(Walker, 1989). In this case, cranial depression fractures increase in frequency and severity in males though these injuries were sustained across both sexes and all age groups.

As noted, violence is a complex, multi-faceted experience and must be understood using perspectivism that is rooted in the identities and experiences of participant, recipient, and witness. Studies of human sacrifice and structural violence exemplify evidence for this complex interaction, demonstrating behaviors involved in this practice, while also emphasizing the deeper ideological purposes and life experiences of individuals involved in the events. This approach allows for a deeper appreciation for violence as an event that may be institutionalized through ideology. Violence as performance is also important to consider as this approach further captures the experiences of communities.

Human sacrifice is a complex form of religious or supernatural ritual, where cultural ideology translates into a form of performative communication with entangled links to many actions prior, during, and after the ceremonial event (Klaus and Toyne, 2016). Cross-culturally, sacrifice is seen as an ultimate means of communication between humans the supernatural forces (Girard 1977[1972]; Hubert and Mauss 1964[1898]; Oestigaard 2000). Ritual violence could present elites in a complex hierarchy the ability to monopolize over life and death by maintaining power through enculturation of sacrificial practices (Klaus et al., 2010; Klaus and Toyne, 2016). Contextual studies of ritual violence in the Ancient Andes provides multidisciplinary approaches into understanding the personhood, social constructions of the individual, and group identities

relating to the changes in sacrificial violence over time (Klaus and Shimada, 2016; Gaither et al., 2016; Klaus et al., 2016). Various violent pathways appeared and changed with the transferring of power occurring between various cultural groups, such as the Moche practicing decapitation and their successors, the Sicán and Chimú empires, practicing strangulation and throat slitting (Klaus and Toyne, 2016). These changes reflect and correspond to cultural identity shifts of the elites in power within the region, as well as the ritual needs changing in response to environmental or ecological transformations (Klaus et al., 2010).

Structural violence, which involves the participants, recipients, and witnesses of violence in a hierarchical scale, is considered structural because these types are less obvious and may or may not result in bodily harm, such as manipulation through fear (Farmer, 2004). First coined by Sociologist Johan Galtung, "structural violence" describes social structures that suppresses individual agency while also preventing individuals, and groups from reaching their potential (Klaus, 2012). Bioarchaeologists are trained primarily to assess structural violence through contextual empirical studies of health in concert with evidence of interpersonal trauma (Klaus, 2012). Through new advancements in the standardization of descriptive protocols and thematic and theoretical advances focusing on population-level contextual lifestyle studies, the bioarchaeology of violence can transcend past black and white evolutionary or romantic perspectives. Multidisciplinary approaches involving social theory and medical anthropology can provide insight into structural violence in the past, which is typically seen as invisible in the skeletal or archaeological record (Klaus, 2012).

Perez (2012b) further offers a perspective of structural violence through the theoretical framework of politicization of the dead. The body, in this case, is both a social concept and socially shaped by the actions of the group itself. Therefore, the manipulation of a corpse then holds significance for both the participant of the violence and the community to which the deceased belongs. Violent acts within and outside of a community can not only create stability, unity, or maintain progress towards goals, they also have just as equal a change to create the antithesis of these positive forces (Perez, 2012b). Mass graves full of burned and disarticulated individuals can be coupled with traditional prepped burials present in the same site, suggesting the capacity for multidimensional perspectives of mutilated remains and their symbolic place in the community (Akins, 1986; Morris, 1924).

Though it is evident that many forms of violence are inherent in our past, the reasons behind their presence are far more nuanced than previously established. Various instances of trophy taking are assessed by Schwitalla and colleagues (2014) and included in a meta-analysis of southern California archaeological sites. Important trends of note revolve around the peak of all types of trophy taking being represented in central California before any serious economic investment and intensification began. This metanalysis provides substantial evidence that violence is not contingent on political structure, nor does it often produce a linear based increasing or decreasing trend over time. Rather evidence of violence in the past presents in waves, and irregular temporal trends with relations to various aspects of the social system and is not contingent on the ideas of past evolutionary or romantic perspectives.

The application of resilience theory to bioarchaeological studies of violence may further advance understandings of context surrounding violence. First, resilience theory makes no assumptions regarding cultural complexity or evolutionary staging in relation to violence and instead develops predictions based on connectivity and productivity. Next, bioarchaeological research engages directly with human bodies, where evidence of violence may be directly observed. Finally, bioarchaeological research may merge these theoretical and methodological perspectives to longitudinal and contextually rich portrayals of human behavior in the past to understand how violence interacts with periods of socioecological and cultural transformation.

Recent studies in California provide a useful approach to contrasting resilience theory with socially and ecologically deterministic models that find evidence for warfare following climate change and resource dearth (Bartelink et al., 2019). The Medieval Climatic anomaly is dated to around 1000 CE and the Meganos cultural migrations into the San Francisco Bay region are dated to around 200 CE. Cranial depression fractures and projectile injuries do not correspond to the Medieval Climatic Anomaly, even in regions where zooarchaeological assemblages document resource depression. Instead, these populations intensified consumption of acorns as a matter of flexibility within the socioecological system to withstand these challenges to local resources. In contrast, Meganos migrations into the region introduced a sociopolitical and ideological system that transformed local belief structures and social organization, specifically moving towards greater inequality and prestige seeking behaviors. These events are directly associated with increasing rigidity within the socioecological and cultural system.

Increases in violence are therefore attributable to reductions in flexibility and increases in rigidity within this region.

Rigidity was measured in the Mimbres region of the American Southwest using rock art, ceramics, diet, population density, and institutional inequality (Hegmon et al., 2008). This work demonstrates that as population rigidity increases, drastic transformation is documented in response to drought. These drastic transformations are associated with increased frequencies of violence. Another case study from the American Southwest reported similar findings (Harrod and Martin, 2014). Here, climatic fluctuations including severe drought were nearly constant in the region. These challenges were met with both socioecological and ideological structures that were integrated to form a broader system of survival in response to these environmental challenges (Harrod and Martin, 2014). However, the study of violent interaction between regions shows that communities with lower inequality, greater trade networks, and higher migration had lower rates of traumatic injury, quite possibly due to greater flexibility in accessing vital resources.

Taken as a whole, these studies provide support for the hypothesis that flexibility offsets violent encounters by increasing socioecological and cultural diversity. This then reduces interdependence between systems and vulnerability to drastic transformation and collapse. In contrast, greater rigidity within a system may be associated with a greater likelihood of collapse or drastic transformation under circumstances of declining productivity as each component of the system is mutually dependent.

## Colonialism

The use of resilience theory in concert with examination of trends in violence allows for in-depth, holistic, and complex analysis of the impact of colonialism on Indigenous lives and cultures, before and during this process. Colonialism represents both a drastic internal and external transformation, as well as both a long-term and short-term drastic event as experienced by the interacting cultures. Examining published studies of the archaeology and bioarchaeology of colonialism can place its devastating effects into perspective for further analysis, utilizing resilience theory.

Contemporary studies in the archaeology of colonialism focus on the hardships of colonialism, but also work on establishing how the Indigenous societies persist in various ways. Colonialism and the interactions between different cultures and societies became a complicated world of entanglement and a long term biological and cultural transformation that are still underway (Murphy and Klaus, 2017). The timing, mode, and degree of colonial changes vary drastically due to the preexisting interrelationships between pre-colonial patterns of health, disease, ecology, population density, and sociopolitical complexity in the relationships between the colonizers and the colonized. Following initial interactions, many Indigenous populations did not drastically decline, therefore, it is important to question how people compensated, adapted, or transformed under these new disjunctive and stressful conditions (Murphy and Klaus, 2017; Leibmann, 2021). Contemporary research continues to acknowledge active persistence of Indigenous peoples who negotiated, contested, and articulated their needs in relation to colonial projects and the successive waves of colonists that they encountered (Panich and

Gonzalez, 2021). The current approach is to address the Colonial period's focus on not just a rupture of the past, but a long-term Indigenous history and ongoing colonial struggle.

Early historical archaeology focused on defining site types, classifying European introduced material culture, and determining the extent of economic features at sites that were founded by European colonists. This early archaeological perspective utterly fails to address the Indigenous side of European colonialism (Panich and Gonzalez, 2021). Early uses of European accounts of the precolonial Indigenous past by ethnohistorians and archaeologists unfortunately deduced the impact of colonialism not on evidence but rather on the biased interpretations of the Europeans (Liebmann, 2021). Contemporary research now focuses on collaboration with Native scholars and descendant communities. It is important that these collaborations emerge as settler societies have long mobilized archaeology to erase the continued presence of native peoples. Not only did colonialism affect these native and Indigenous populations of the past, but it is an ongoing colonization. The importance of the bioarchaeology of colonialism is to discuss the implications of how and for whom the past is studied and written to address issues of representation, power, and inequality in the present day (Murphy and Klaus, 2017).

Advancements in archaeological methods are well suited to address the social aspects of colonialism, which then exacerbated the effects of disease and environmental degradation of the Indigenous societies. Spanish colonialism was an invasion, a colonization effort, a social experiment, a religious crusade, and a highly structured economic enterprise (Panich and Gonzalez, 2021). This, along with the archaeology of

colonialism, supports the evidence of drastic and dramatic effects of colonialism on the Indigenous peoples of the area. Colonialism happened on a global and temporally variable scale, and colonialism itself does not entirely equate to colonization (Stojanowski, 2017). While colonialism did indeed destroy or effect every aspect of Indigenous life, a comparative framework can discuss the broad patterns of Indigenous persistence and their survival across geographic regions.

Colonialism affected Indigenous lifeways through warfare, violence, forced labor migration, disruption of social and political institutions. Settler colonialism promoted disturbances manifesting as malnutrition, poverty, warfare, violence, dislocation, and famine. This disruption made Native Americans vulnerable to further troubles of disease and violence. Indigenous peoples were increasingly made vulnerable to subsistence change, residential change, labor intensity, and mobility patterns during the colonial era (Liebmann, 2021). The combined pressures of forced migration, malnutrition, subsistence stress, disease, and violence caused Indigenous populations of the Americas to plummet in the mid to late 17th century. Utilizing complex mitigation techniques, Native populations were not destined to be destroyed by colonialism, but unfortunately, experience a massive reduction in flexibility through the policy choices and behaviors of the settler colonists.

Important considerations of Indigenous history in terms of understanding the contrast to colonial interactions occurs with knowing how individuals interacted with their environments that could have made settler colonialism particularly devastating. Landscape in the past was extremely important to the Indigenous homelands, as they

were critical hubs of economic, spiritual, and political autonomy during the Colonial period. One sees the devastation of colonialism in the intentional destruction of these centers of Indigenous power. Current archaeological studies of colonialism set out to breakdown the dichotomy of European and Indigenous, between colonizer and colonized, and focus more on the century-long process of cultural entanglement (Panich and Gonzalez, 2021).

Colonialism is studied in various parts of the globe for its many drastic impacts on the Indigenous populations. Colonialism has caused massive disease epidemics and pandemics, cultural destruction, mass genocide, and much more (Scheper-Hughes and Bourgois, 2004; Ferguson, 2005). The clash of languages, cultures, technologies, and more certainly would have had massive impacts on both sides (Accomazzo, 2012). Studying the effects of colonialism and cultural interactions on the health of all parties involved creates a unique holistic image (Stojanowski, 2017). Colonialism itself is not a one way process of cultural exchange and is not a passive or static experience. Bioarchaeologies of colonialism can uniquely offer a study of identity, hybridity and ethnogenesis on a global and cross culturally comparative scale (Stojanowski, 2017).

One of these drastic impacts from colonialism is violence, but to what extent? How does colonialism influence preexisting cultural expressions of violence? Does colonialism force new violent expressions towards not only the foreign invaders but also neighboring groups? Colonialism has enormous impacts on all groups involved, via not just physical violence but also with socially oppressing ideas and actions. Colonialism has the capacity to destroy possible socio-cultural outlets for violence as well as

preventative measures that are in place in order to avoid violent interactions. These expressions of violence and the violent reactions to colonialism can help elucidate the impacts of colonialism on the Indigenous population's economics, politics, culture, subsistence strategies, and cultural buffering systems (Scheper-Hughes and Bourgois, 2004; Ferguson, 2005; Accomazzo, 2012). Violence as a line of evidence of these drastic transformative events is best understood from a bioarchaeological and resilience perspective. The study of human remains, the bodies of the people themselves from transformative Colonial periods, can show what violent effects colonialism had on the Indigenous population and enlighten scholars to the Indigenous struggles of persistence.

"As colonialism itself is a constant "work in progress," and so too must be its study" (Stojanowski, 2017, p. 412). Integration of multifocal approaches to the collective human past provide exciting opportunities to illuminate the ways that resilience, violence, and the social situations experienced can directly impact and imprint on the human skeleton. Based on these findings, the goal of this thesis is to explore colonialism and violence and the reduction of resilience in the marginal environment of the American Southwest.

# CHAPTER TWO: ANCESTRAL PUEBLOAN LANDSCAPES

This chapter presents an overview of the various cultures and regions under study for this thesis. It presents the overall site descriptions and regional environmental setting in order to understand temporal and cultural contexts. Previous archaeological studies have raised many questions that can be addressed through skeletal analysis and give background knowledge of the daily life and health trends of the Ancestral Puebloans of the American Southwest.

## Regional Context

The North American Southwest is a cultural area defined geographically by all of Arizona, most of New Mexico, southern Colorado and Utah, a small portion of Nevada and the state of Chihuahua, Sonora, and Sinaloa in Mexico (Cordell and McBrinn, 2012). Topographically, the Southwest encompasses low basin in the Sonoran Desert to higher wooded mesas of the Colorado Plateaus and even higher wooded and forested mountain masses of central Arizona, New Mexico, and Chihuahua. Culture in the Southwest is unique in its use of agriculture, maize agriculture, digging sticks, metates, manos, finely made pottery, and compact multi-room villages, with dispersed settlements in other areas (Cordell and McBrinn, 2012). The region of northern New Mexico exhibits a long occupation period, starting with Paleoindian and Archaic times. Discovery of stone spear points associated with now extinct bison at Folsom, New Mexico, characterizes early

occupation of the region (Cordell and McBrinn, 2012). The Ancestral Puebloans, situated in northern New Mexico, spoke six different languages, and originated out of the Tewa, Tiwa, Towa, Zuni, and Keres traditions. Early settlements consisted of thermally efficient pithouses, grey pottery, and finely woven baskets and sandals. Later, traditional Pueblo villages were composed around an open plaza consisting of contiguous rectangular rooms. They used both stone and adobe in construction of these room blocks.

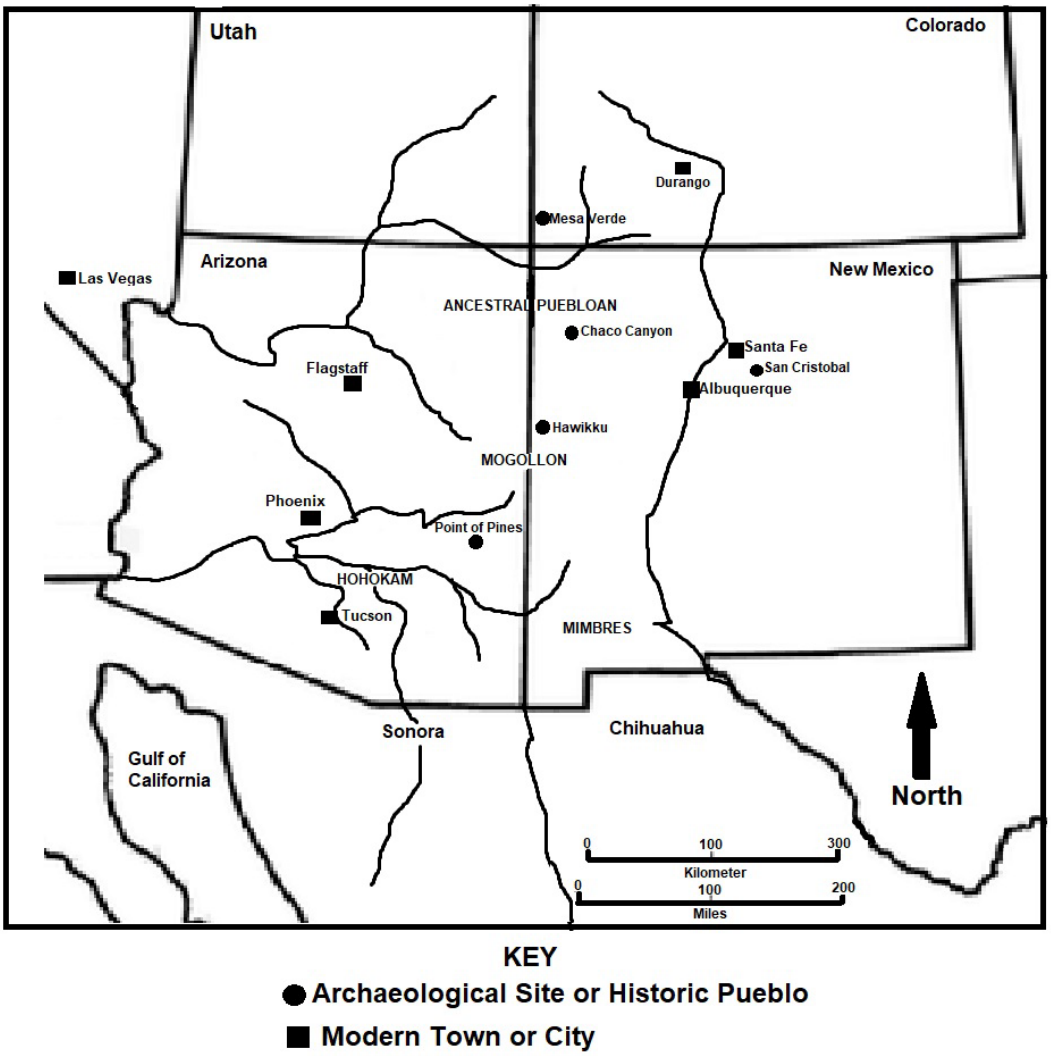


Figure 2: Map of the Southwest.

Archaeologists established chronology of the region through use of tree-ring dating and ceramic styles. The first Pecos conference in 1927 attempted to lay a foundation of dates for the entire Southwest region (Cordell and McBrinn, 2012). Alfred Kidder (1924) spearheaded the creation of centralized terminology and the Pecos Classification of cultural stages, each uniquely characterized by diagnostic traits or elements. A centrally defined set of cultural periods for the entire Southwest was created by combining the tree-ring chronology from Andrew E. Douglass (1929) and the ceramic seriation of Kidder. Ancestral Puebloan chronology follows the Pecos Classification. Basketmaker II (ca. 1500 BCE-300 CE) to Basketmaker III (ca. 500-700 CE) represents the earliest cultural stages, agriculture is known but not used and most dwellings are pithouses (Cordell and McBrinn, 2012). Ceramics are plain ware, without decoration, and cranial deformation was not used. The Pueblo I period (700-900 CE) introduced cranial deformation, increased decorations of cooking vessels, and above ground contiguous rectangular masonry rooms. Pueblo II (900-1100 CE) is characterized by small villages occurring over large spatial areas. Pueblo III (1100-1300 CE) represented a change in larger communities and an increase in elaboration and specialization of crafts. The Pueblo IV period (1300-1600 CE) exhibited a decline in the northern San Juan region, reduction of artistic elaboration, and plain wares replaced utility wares. The most recent period in the Ancestral Puebloan past is the Pueblo V period, which represents the 17$^{th}$ century to the modern era (Cordell and McBrinn, 2012).

Table 1: Pecos Classification Chronology

| Period | Date Range | Characteristics |
|---|---|---|
| Basketmaker II | 1500 BCE-300 CE | Atlatl is used. Pottery is not present. |
| Basketmaker III | 500-700 CE | Pithouses. Pottery is made. Cooking ware is plain. |
| Pueblo I | 700-900 CE | Cranial Deformation. Above ground, rectangular masonry rooms. |
| Pueblo II | 900-1100 CE | Small villages over a large geographical area. |
| Pueblo III | 1100-1300 CE | Large communities. Artistic elaboration, and craft specialization. |
| Pueblo IV | 1300-1600 CE | Northern San Juan region depopulated. Plain ware replaces corrugated utility ware. |
| Pueblo V | 1600 CE to present | Includes modern Pueblo descendants. |

Ancestral Puebloans had a unique relationship with their environment. Dean et al. (1985) explored the paleoclimate of the Ancestral Puebloan regions using tree-ring data to elucidate overall regional trends in fluctuating climatic conditions. Three general variables in the Ancestral Puebloans adaptive systems include environmental and population variation, and behavioral classes. Any drastic change to one of the three classes could cause an adaptive system to exceed its capacity and create a new situation where the system is not adapted. There are low-frequency environmental processes that occur over longer than a human generation (ca. 25 years) and high-frequency environmental processes that are in shorter cycles (Dean et al., 1985). The high-frequency processes are typically where the system adapts, as the low frequency processes are seen as stability. While both play an important role, each affects carrying

capacity in different ways and is only drastic when carrying capacity is either too high or too low to support the population. Population size can be controlled via voluntary means, such as infanticide, or involuntary means such as starvation (Dean et al., 1985). These episodes of low and high-frequency environmental variability in the American Southwest would have provided various adaptive problems and opportunities for the inhabitants of the region. Mitigation techniques used by these populations included high spatial mobility and interaction and exchange with local and nonlocal populations. This could have lessened the degrees and kinds of subsistence stress occurring from constant climatic fluctuation. A consistent precipitation regime after 1000 CE, which combined with high spatial climatic variably from 1050 to 1150 CE, would have increased growing populations and interaction among groups in the southern Colorado Plateaus (Dean et al., 1985). The increase in population around 1150 CE would have also heightened the impact on the environment, thus lowered the adaptive capacity of both the populations and the environment. As Dean and colleagues explore through tree-ring data, the Great Drought of 1275 CE to 1300 CE created constraints on the Ancestral Puebloans in the form of falling water tables and rapidly expanding arroyo systems. Long-term climatic persistence returned at 1500 CE with rising water tables and aggrading floodplains (Dean et al., 1985).

Complex social networks in the American Southwest provided high mobility and cultural diversity in mitigating environmental stress (Borck et al., 2015). Data from the western US Southwest during the late Pueblo III to Pueblo IV period 1200-1450 CE shows characteristic aggregation, depopulation of areas, and large-scale migrations.

Corresponding with one of the mega-droughts in 1273-1297 CE, this mass migration marks the depopulation of the Four Corners region (Borck et al., 2015). An external orientation in the social relationships between Ancestral Puebloan groups provided successful resistance to environmental crises during this period (Borck et al., 2015). These embedded regions within the extensive social networks did better during drastic social transformative periods. Zuni is an exception for its lack of integration into the overall social networks in the region but contained a large population and high resilience (Borck et al., 2015). These social network trajectories diverged after 1300 CE as the southern network continued to grow, leaving the northern network behind to become more fragmented (Mills et al., 2013).

Even with the use of various agricultural technologies and mitigation against environmental stress techniques, punctuated events that lasted for hundreds of years characterized the history of the Ancestral Puebloan region of the Southwest. Summer floods and increases in salinities of floodplain soils made reliable maize farming difficult from year to year (Benson and Berry, 2009). Benson and Berry (2009) explored evidence of resilience against these droughts and climatic fluctuations. Tree-ring data shows construction continued during times of stress, suggesting continued timber harvesting when the population was static. Two megadrought intervals occurred between 1130-1177 CE and 1273-1297 CE, with two wet periods occurring in between at 1040-1129 CE and 1193-1269 CE (Benson and Berry, 2009). These wet periods experienced an increase in building activity. During the last megadrought in the late 13$^{th}$ century, the Four Corners area was largely abandoned, and populations aggregated into newly built Pueblos

(Benson and Berry, 2009). This aggregation led to disease and increased mortality, either due to poor sanitation or increased violence. For the history of the Ancestral Puebloans in the Southwest, disease frequencies and mortality rates fluctuate similarly to the changing environment.

**History of the Ancestral Puebloans: Health and Disease**

Though occupation of the American Southwest is extensive and dates back to the Paleoindian-Clovis period (9500 BCE), sites at this age are rare and therefore paleopathological health analysis is limited to more recent temporal contexts. Expanding the knowledge of daily living conditions of the past through population-level analyses is integral for archaeologists, bioarchaeologists, and paleopathologists. Paleoepidemiological studies shed light on the health of ancient societies through frequencies and patterns of disease between and within populations. (Martin and Goodman, 2002). Assessing spatial variability of diseases can be done successfully with the arid landscape and migrations in the North American Southwest. With maize agriculture playing an important role in the diet of the Ancestral Puebloans before Spanish colonial interactions, emphasis on nutrients in the diet can provide insight into health conditions in the region. Skeletal tissue is highly sensitive to the severity, duration, and chronological course of general physiological disruptions. Understanding the presence or absence of these stressors on skeletal remains elucidates the health status and functional impairment of individuals in the past (Martin and Goodman, 2002) and provides a holistic view of socioecological constraints and adaptations.

Cultural patterns and influences can demonstrate the effects of buffering systems to mitigate stressful environments or external factors. Cultural contexts can also clarify disease-promoting customs or traditions. The development of maize agriculture in the American Southwest produced negative impacts on the populations due to increased population density, increased labor, and social inequalities (Martin and Goodman, 2002). Agricultural intensification increased disease and significantly decreased health. Examples of morbidity associated with dietary changes and population aggregation include porotic hyperostosis and cribra orbitalia. The increase of these pathological processes indicate that a maize-dependent diet does not provide the necessary nutrients, as it is low in iron (Martin and Goodman, 2002). Other general indicators of decreased health and increased stress loads are seen in the frequency of osteoarthritis in joint locations relating to biomechanical wear and functional stress. Though a myriad of diseases were prevalent in the region prior to Spanish colonial interactions, health disparities, infectious diseases, and increased workload did proliferate during and after colonial contact (Martin and Goodman, 2002).

At the site of Arroyo Hondo, climatic fluctuations and the human remains document chronic nutritional deficiencies associated with the instability of an uncertain diet. Paleopathological evidence at the site is seen with ten cases of porotic hyperostosis, eight cases of endocranial lesions, and five cases of cribra orbitalia, out of the 108 individuals analyzed. Adaptive strategies of diverse diets became starvation diets during droughts, increasing morbidity and mortality rates (Palkovich, 1984). Migration strategies used to mitigate these increased costs on the populations of the region slowly became

impossible to employ. As such, morbidity, and mortality drastically increased due to reduced flexibility (Palkovich, 1984).

Hypoplasias are exhibited in a high prevalence from populations of the American Southwest even before European interactions. To assess the prevalence of childhood stress during the Pueblo II (900-1100 CE) period in southwestern Colorado, Malville (1997) analyzed permanent dentition samples from Mesa Verde and Montezuma Country. Results show that 90% of individuals exhibited hypoplasia defects on at least two anterior teeth. Age and sex division did not reveal any significant differences. Though the peak age of hypoplasia occurrence remained constant at 3-3.5 years through all time periods and regions, each temporal and spatial location does show other significant differences (Malville, 1997). Pueblo I (700-900 CE) period showed an increase in childhood stress compared to the Basketmaker III (500-700 CE) period. However, the greatest evidence for growth disruptions is the Pueblo II period at Mesa Verde and Yellow Jacket. The Pueblo III (1100-1300 CE) period showed a decrease in stress compared to Pueblo I and II. Factors that contributed to the overall prevalence of chronic undernutrition are posited as infectious diseases, parasitic diseases, nutritional deprivation, increased population density, and poor sanitation (Malville, 1997).

Stress not only manifests itself in the skeletal record as imprints of growth disruption but also can increase frailty of the individual and thus their relative risk of morbidity and mortality compared to others in the group (O'Donnell, 2019). Though porotic hyperostosis and cribra orbitalia manifest in childhood, evidence of healed lesions relating to the two is often present throughout adulthood. Ancestral Puebloan sites were

chosen by O'Donnell (2019) to test the hypothesis that frailty increases with porotic hyperostosis and cribra orbitalia presence from early childhood stresses. The time span for the southwestern sites is one of upheaval, regional abandonment, and population aggregation. These factors add to disease prevalence and possible resource disparities. With an increase in hierarchical social structures, unequal access to resources produced class distinctions in terms of health. O'Donnell (2019) discovered significant differences between age classes in cribra orbitalia prevalence but there was no significant association between age, class, and presence/absence of porotic hyperostosis. However, there was a higher probability of mortality for those with porotic hyperostosis lesions (O'Donnell, 2019). The survival analysis results demonstrated that hidden heterogeneity in risks associated with cribra orbitalia and porotic hyperostosis lesions are different throughout members of the group. Those with healed lesions had a higher survival rate than those with or without lesions (O'Donnell, 2019). Results of this study showed that not only is the presence or absence of healed lesions important in differential risk, but also the cultural restrictions surrounding resources (O'Donnell, 2019).

The American Southwest provides clear and expansive examples of violence during its extended history of occupation by Ancestral Puebloans, from around 12,000 years ago until today. Specifically, this kind of violence prevailed in precolonial interactions, and among the communities active in trade and expansion in specific regions during the early agricultural period, (2100 BCE- 50 CE). There are many ways of observing violence in the archeological record. These can range from violent trauma in the skeletal remains to an analysis of spatial, environmental, and architectural materials in

determining the overall socio-political stability of certain regions. The literature on violence in the Southwest centers on the bioarchaeological data which documents a wide variety in ante-mortem and peri-mortem traumas to individuals, and the subsequent treatment of the deceased. There are many models of behavior postulated to explain the way Ancestral Puebloans conducted intentional and calculated peri-mortem processing of the dead (Martin, 2016). While the literature on this behavior greatly overestimates the overall occurrences of these practices, site specific and case specific examples show many of these intentional peri-mortem processing traditions and spontaneous decisions to be true.

Kuckelman et al. (2000) charted an increase in violence, in the San Juan region, later in early history. In the Southwest and the San Juan region, the increase occurs during the period 900 CE- 1300 CE. Kuckelman et al. (2000) utilized the evidence of extreme perimortem processing to reveal violent trauma. Violence includes perimortem trauma, specifically disarticulation and burning, followed by abnormal burial of the victims. The first case is dated to the Basketmaker period, at the site of Cave 7 in southeastern Utah. The site shows evidence for a single massacre event. There were around 90 individuals all buried in the relatively small cave. This suggests they went there to flee from violence and yet found their ends. They only used the cave for internment, which suggests a decent number of survivors of the event to have properly buried the victims. The only other evidence found during this period revolves around the complex structure of stockades surrounding a small Basketmaker period settlement. In this earlier period, these are the few signs of violence budding in the area. Kuckelman et

al. (2002) suggested that the selection of defensible locations for habitations was a sign of increasing warfare in the region of Castle Rock Pueblo. There is also evidence of aggregation of people at a specific location for access to resources. Bioarchaeological analysis at Castle Rock Pueblo showed a high amount of peri- and ante-mortem trauma. However, there was evidence that almost all the individuals that violently died with indications of peri-mortem trauma did so at a single event in time. This event also ended the occupation of the site.

Walker and colleagues (2009) further addressed the high prevalence of porotic hyperostosis and cribra orbitalia in Ancestral Puebloans by arguing that anemia was most directly linked to vitamin $B_{12}$ deficient diet and gastrointestinal infections. Archaeological evidence for the deficient diets of the Ancestral Puebloans shows an increase in maize dependency and overhunting of large game resulting in reduced animal food access (Walker et al., 2009). Severe drought in the area would disrupt the typical nutrient-adequate diet, and over-exploitation of plant resources and animals would reduce the number of sufficient nutrients. A shift towards small game and the domestication of the turkey helped increase food resources. Diet changes due to over-exploitation and drought would not solely explain the high prevalence in porotic hyperostosis and cribra orbitalia. Sanitation problems with domesticated turkeys and agricultural intensification, coupled with nutrient deficiencies could influence higher frequencies of porotic hyperostosis and cribra orbitalia (Walker et al., 2009).

Sanitation issues leading to parasitic infections could also spread from the mothers to nursing infants. Additional factors for lacking proper nutrients are assessed

through social inequalities. Established hierarchies at various sites in the southwest would have limited food access by class and further exacerbate nutritional problems (Walker et al., 2009). The presence of elites and ruling classes at Pueblo Bonito elucidates the impact of social hierarchy on health disparities between classes. However, these elite individuals still exhibited a high prevalence of dietary inadequacies, suggesting that social and subsistence strategies were not enough to buffer serious climatic fluctuations (Palkovich, 1984). Factors produced by drought and social inequalities led to violence and warfare throughout the region. The shift from food production to defensive purposes would have only added to the nutritional deficiencies. Both resource reallocation and aggregation of people into compact areas for defense would pose additional problems for sanitation and water contamination adding to the prevalence of parasite diseases (Walker et al., 2009). These factors combined would create difficult conditions for obtaining sufficient nutrients and thus provides evidence and support for the increase in porotic hyperostosis and cribra orbitalia found on Ancestral Puebloan remains (Walker et al., 2009).

Periods of increased stress in the American Southwest did not affect everyone equally. Cultural buffering occurred on a variety of levels, though not necessarily in equal amounts towards all members of society. The hierarchical and complex societies of the American Southwest provide evidence not just of health issues related to drought or increased violence, but also unequal access to resources (Harrod, et al., 2017). Harrod and colleagues (2017) studied the relationships between social disparities, health, and violence at Pueblo Bonito and La Plata. The increased hierarchical complexity within

these communities on the periphery of the political centers is thought to have lead to adverse health outcomes (Harrod et al., 2017). A combination of variables such as site settings, funerary treatments, trauma, and stress indicators can elucidate an individual's place in the hierarchy and social controls employed. The importance of this contextual analysis of skeletal remains is to increase the understanding of health relative to the socio-political and cultural world individuals reside. Though violence and cooperation are both employed in complex political systems, cooperation is preferred. Direct violence as manifested in fractures and other injuries to the body and structural, as manifested in health disparities are useful in determining cultural responses to stress whether external or internal in origin (Harrod, et al., 2017).

Tegtmeyer and Harrod (2017) defined warfare as practiced among prime-aged males between two different cultural groups. However, there is an emphasis on not viewing warfare only through the lens of combatants and non-combatants, as non-combatants experience a wide array of violence not necessarily directly from being involved in the battle. The authors explain "for the purposes of this study, the term "combatants" refers to primarily males engaged in, or targeted during, warfare, while "noncombatants" refers primarily to women and children who affected by the intergroup conflict" (Tegtmeyer and Harrod, 2017, p. 72). Their areas of study were along the Chaco meridian, including Chaco Canyon, Aztec Ruins, and Paquime. They hypothesized violence and warfare to be strategies for survival in the Southwest. Whether it was a time of "peace" or not, evidence of violence as related to warfare is present. The sample from Chaco Canyon includes seven sites and 271 individuals, with a diverse set of ages and

equal distribution of each sex. Remains from Aztec Ruins are somewhat limited and include those with known mortuary context and those without. The Paguime sample includes individuals from multiple time periods and a total of 576 individuals.

Results showed that the prevalence of violence at Chaco Canyon ranges from 21.5% to 63%. Non-lethal trauma was recorded as cranial depression fractures (CDF) which are healing or fully healed. Highest rates of non-lethal trauma were seen amongst the males at Pueblo Bonito Room 33 and the females at Kin Bineola. These data, coupled with the presence of anemia among females and children at the sites, showed that violence was likely used among the elite class to enforce social control. Aztec Ruins had a relatively even distribution and low frequency of trauma between males and females. Paquime showed evidence for elite burials with sacrifice victims of children and females. From all the sites, there is evidence of violence present on the male skeletal remains, which relates to them being an elite warrior class, as associated burial goods and positioning also support this role. Males at the site had fewer nutritional health issues than the women and children, signifying that they had more access to these resources. Paquime and Chaco Canyon samples propose inequality, while the sample from Aztec Ruins does not. In conclusion, the study posits that warfare is more nuanced than just male elite warriors fighting, and instead, conflict greatly affects the health of non-combatants within the community as well.

Harrod et al. (2017) used stature, enthesopathies, porotic hyperostosis, and cribra orbitalia to address overall health disparities in the population, coupled with archaeological evidence of migration events in response to environmental conditions.

Population and depopulation of sites such as Chaco Canyon, Aztec Ruins, and Mesa Verde, include higher resource insecurity and fear of warfare (Harrod et al., 2017). This underlying fear throughout the region could have helped develop social hierarchies and perpetuate health disparities. Increased resources in the defensive social structure would have also reduced the availability of resources. Class distinctions and health disparities are seen in the analysis of the elite burials of Room 33 in Pueblo Bonito as compared to the women of La Plata.

In a specific case in the La Plata river valley, this type of social reaction took the form of violence against women more so than any other group in the community. Martin (1997), conducted a study on two different sites representing two extremes in ancient Puebloan society, revealing the contrasting role of violence in each community. La Plata, located in northwestern New Mexico, is a site with a permanent river allowing for plenty of agricultural production. The valley was occupied from 200 CE- 1300 CE. Several complex political centers surrounded the valley community, with Mesa Verde to the north and Chaco Canyon to the south. Black Mesa in northeastern Arizona, in contrast, is in a marginal and isolated area. It was occupied for several centuries until people later abandoned the site as the residents migrated elsewhere. The site's inhabitants had a high dependence on maize (Martin, 1997). Due to the high occurrence of nutritional diseases and hardship, Black Mesa shows little evidence of interpersonal violence. In contrast, the resource abundant site of La Plata shows a high prevalence of violence against females, possibly to instill fear and social control. Martin (1997) provides this evidence to support the hypothesis that abundance of resources and a complex socio-political environment

can lead to an increase in interpersonal stresses, causing violence. This shows the contrast of Black Mesa site, that due to being outside the dominant political sphere and with little resources operated with a more egalitarian structure that produced little need for violence in the community.

The elites showed signs of trauma but less severe health issues. The women of La Plata, deemed lower class based on the evidence of hard physical labor, demonstrated increased cranial headwounds and declined health (Harrod, et al., 2017). Though the elites at Pueblo Bonito did show less severe health conditions, they were not culturally buffered from early childhood growth disruptions. Harrod and colleagues' (2017) conclusions supported evidence for chronic warfare, increased hierarchical disparities, and climatic variability in population health as complex factors that need to be addressed through archaeological and paleopathological avenues. This study provided support for the conclusion that cultural factors can disrupt an individual's health at the same level of climatic variability. If the system in which the individual lives is well buffered for all members, then all individuals can mitigate external stress. If the social disparities and ranking carry into the access of resources by all members of society, the lack of cultural buffering will affect members of society drastically and unequally.

Martin's (1997) study fits into a trend of examining the socio-political conditions for interpersonal violence in the Southwest. The incidences of interpersonal violence are reported more frequently in the literature now that there is new focus on communities during extremely volatile times when economics or politics are changing the social landscape (Martin, 1997, 2006; Baustian et al., 2012; Kohler, 2014). Substantial degrees

of migration due to extreme warfare in other areas can also contribute to intra-community stress that can cause violence to increase and become a norm.

Social stress relating to increasing population size and resource instability is a prominent population-related situation often inferred as a key driver of any case of increasing secular in violence within a society. Social and resource stress probably increased as a variety of people joined certain communities and with resource stress, and population pressure, competition for power and survival could have evolved. These aspects have influenced an increase in violence among other sites in the Southwest (Kuckelman et al, 2000; Walker, 2001). As well, it is the unpredictability of resources, not just their reduction, that can also cause social stress, conflict, and possibly contribute to an intensification of violence in growing communities.

The capacity of the archaeological record to illuminate societal changes on drastic and tragic scales has been established through contemporary studies in the American Southwest (Hegmon et al., 2008). How much did social transformation contribute to human suffering? Severity of change on human populations can be seen in several parameters, demographic scale, population displacement, the degree of cultural change, and physical suffering (Hegmon et al., 2008). Cultural change and physical suffering both refer to lifeways, where physical suffering is specific to bodily injury or death as a result of poor health or violence. Archaeological analysis of population density and depopulation of a site provide evidence of demographic changes.

Bioarchaeological data can provide an individualized and population component to quantifying change. Differential health problems and traumatic injuries conceptualized

through empirical evidence from skeletal stress indicators, and evidence of defensive architecture in the Mimbres, Mesa Verde, and Hohokam regions, suggests the threat of violence was region wide (Hegmon et al., 2008). The utilization of developed methodologies to assess the severity of social change are demonstrable through Hohokam morbidity and mortality patterns and rapid depopulation and massacres throughout Mesa Verde (Hegmon et al., 2008). Hierarchy which directly shapes small- and large-scale social norms, can foster inequality and discrepancies between classes, burial treatment, social control, or resource disparities.

Non-lethal interpersonal violence used to contribute to the resolution of a problem without lethal side effects can reveal more about the socio-political and economic aspects of society than warfare. Baustian et al. (2012) illustrated that this interpersonal violence is usually culturally sanctioned, relating to environmental stress and social reorganization. Baustian and colleagues focused on the Mogollon site of Grasshopper Pueblo during the period 1275 CE- 1400 CE. As migrants came in growing numbers to the area an increased tendency to segregate newcomers to the pueblo via roomblocks is present in the archaeological record. Spatial divisions, in turn, segregated certain social interactions which created social inequality. This major effect on the social health environment of the pueblo led to violence as a tool for social control Connection between occipital bone injuries and defenselessness or surprised victims contrasts with facial injuries probably representing mutual physical engagements. Interpersonal violence is often seen in an evenly distributed pattern of injuries found throughout the population, with no pattern amongst ages and sexes. Many of the individuals at Grasshopper Pueblo

expressed multiple cranial depression fractures over time. This can have a pronounced effect on an individual's behavior if the injury was severe and thus creates a predisposition of the individual to behavior that causes more injuries to occur. Most CDFs were present on the front and sides of the cranium, indicating face-to-face violence. Conclusions of the non-patterned, well-healed, and evenly distributed trauma indicated that they did not use this in a social context to maintain social stratification. A pattern in the types of individuals receiving the majority of the violence, such as those in lower economic standing, would be a sign of violence used for social control. However, these could be traces of violence on an individual scale in order to solve resource disputes from the large influx of migrants entering the site, and a lowered number of resources available.

El-Naijar et al. (1975) analyzed a total of 539 crania from southwester Anasazi populations within a 120 miles radius to assess differences between canyon sites and plains sites. Porosity in the skull was scored based on presence and size. Porotic hyperostosis was present in 34.3% of all skulls in the sample. When comparing sites present in the plains area versus sites in the canyon bottom, porotic hyperostosis was more common in the canyon bottom sites. Sex differences were not statistically significant. El-Naijar and colleagues (1975) attributes this high frequency in porotic hyperostosis to marrow hyperplasia, further associated with iron deficiency. Contemporary studies found evidence of blood loss from hookworm infestations and parasitic infections in the American Southwest. This is another factor contributing to the high prevalence of porotic hyperostosis (Walker et al., 2009; Stodder, 1990; Angel,

1966). El-Naijar and colleagues (1975) suggests the low iron diet due to maize producing an insufficient amount though consideration of animal proteins is not as addressed. When assessing his hypothesis that iron deficiency anemia accounts for the porotic hyperostosis presence, El-Naijar found the sage plains group showed fewer frequencies of porotic hyperostosis due to mixed subsistence strategies including maize and a variety of animal foods. he canyon bottom groups had a high dependency on maize and experienced higher rates of porotic hyperostosis as a result. Thus, the high predominance of porotic hyperostosis in children from certain ecological sites, (i.e., canyon bottom sites), compared to plains locations supported El-Naijar's hypothesis that porotic hyperostosis was caused by iron deficiency anemia.

The combined effort and contribution of all these studies demonstrate patterns and prevalence of porotic hyperostosis, cribra orbitalia, linear enamel hypoplasia, and musculoskeletal stress markers (MSM) in the American Southwest. These stress-marking conditions all point to a time of difficulty in adapting to a constantly fluctuating environment in terms of agriculture, social hierarchy, migration, and mitigation techniques failing or succeeding. Due to its long occupational period and intricate social networks, the American Southwest provides insight into the health and cultural buffering techniques of the Ancestral Puebloan people in prehistory. These techniques used to adapt to the fluctuating environmental and social factors may have been successful prior to European interaction, but as the following studies show, stress events only increased from the impact of the Spanish colonists invading the area.

**European Interactions and Health**

Mills (2008) analyzed colonial interactions' impact on Zuni Pueblo and provided substantial evidence for a transformative period prior to European interactions. The 1400s CE exhibited a period of reorganization in the history of the northern Southwest, as identified in evidence of mass migrations and regional aggregation. Depopulation of vast areas of the Southwest was coupled with settlement pattern changes and evidence of new groups arriving at Zuni as distinguished through material culture and burial patterns. Cremations, common to the Hohokam of southern Arizona, become a significant part of mortuary practices within the Zuni area at Hawikku and Kechiba:wa. Analysis of ceramic styles provides evidence of intermingling in the production of the Salado polychromes, previously not seen in the Zuni area. Late 15$^{th}$ and 16$^{th}$ century changes include depictions of shields on rock art and ceramic vessels as well as a high frequency of conflict and disease in the pre-colonial landscape. This massive cultural transformation during the 15th century precluded the presence of Europeans and saw them entering the area on the heels of a major population reorganization (Mills, 2008).

Eckert (2005) analyzed Zuni demographic structure in response to Spanish colonial interactions over the period 1300 CE-1680 CE. The study focused specifically on the largest Zuni population at Hawikku. This site was initially contacted indirectly through trade and directly through missionary conversion and construction. The common misconception that precolonial peoples in the area were relatively healthy is not necessarily true. Though, archaeologists posit malnutrition and immune system weakness wee preconditions that helped spread European diseases (Eckert, 2005).

While life expectancy data from Zuni was similar to other sites in the area, there was a prevalent increase in mortality during the Colonial period (Eckert, 2005). This increase reflected a dramatic change in Zuni demographics after missionization, not at the moment of colonial interactions. This massive loss of individuals, especially the elderly, would have had a profound impact on the culture, oral traditions, and inherited knowledge passed down within the Zuni culture (Eckert, 2005).

Chapman (1997) evaluates the use of musculoskeletal stress markers (MSMs) in ancient Puebloan remains to address the impact of the Spanish on activity patterns. Pecos Pueblo was occupied from 1200 CE to 1838 CE; however, they were quickly subjugated by the Spanish when they established a settlement in the region around 1598 CE. Before the Spanish arrival at Pecos Pueblo, labor was highly gendered, as the inhabitants practiced a sexual division of labor (Chapman, 1997). There is no evidence to suggest that the Spanish changed this division of labor, and thus the analysis focused on gender-specific behavoirs. Intensification of upper shoulder and arm muscle attachment sites in males are manifestations of morphological changes caused by the intensification of labor from the Spanish on the Puebloan inhabitants. Comparatively, females exhibited upper arm development of muscle attachment sites from processing maize on manos and metates (Chapman, 1997). The final evidence of intensification through weaving is seen in the muscle development of the hands, wrist flexors, and forearm supinators and pronators of Pecos males.

Chapman (1997) collected data from 185 adult individuals, 18 years of age and older, both from pre- and Colonial periods. Differential diagnosis of pathological

conditions leading to abnormal levels of muscle activity were excluded from the study. Results showed that the brachialis was the most utilized portion of the upper body during both periods. *Latissimus dorsi* m. and *Anconeus* m. exhibited a statistical increase in MSM expression among the Pecos males. These muscles are attributed to activities including hoeing, chopping wood, and other horticulture activities (Chapman, 1997). There is also a statistical increase in the MSM expression of the conoid ligament, associated with chopping woods and carrying heavy burdens on the shoulders or upper back (Chapman, 1997). Females experienced an increase in the usage of *Pectoralis minor* m. in relation to the increased maize processing. The conclusion revolved around the support that the Spanish had an increased influence on the intensification of labor of both males and females from Pecos Pueblo towards resources output for the Spanish through maize production and processing (Chapman, 1997).

Other studies have also addressed the comparison between pre- and colonial influence on Indigenous population health specifically in Spanish colonial settings. Klaus and Tam (2009) argue that colonial interaction between Spanish and Indigenous peoples was a "total biocultural phenomena affecting every possible aspect of human life" (Klaus and Tam, 2009. p. 356). The accumulation of data regarding this drastic and transformative change suggests a pattern in Native health that is associated to the duration and intensity of interaction with European settlers. Utilizing MSM and malnutrition analysis suggests a drastic biological impact on the lives and bodies of the Ancestral Puebloans due to interactions with the Spanish.

**Health Differences Between Precolonial and Colonial Periods**

Compromised health and disease adversely impact performance, participation in sociopolitical systems, adaptability, flexibility, and sustainment of population health (Stodder and Martin, 1992). Precolonial and Colonial period sites in the American Southwest exhibit an increase in overall health and disease disparities from Spanish colonial contact. Adaptation and emphasis on agriculture in the precolonial era contributed to disease prevalence. Mixed subsistence strategies provided limited increase in diet diversity and flexibility to reduce health problems. Abundant evidence exists for the mitigation of environmental stressors through migration, site abandonment, and shifting settlement patterns (Stodder and Martin, 1992). Precolonial Puebloan diets relied heavily on maize and hunted animals, such as rabbits and deer (Stodder and Martin, 1992). Stable isotope analysis of Black Mesa showed heavy reliance on plants, such as maize and amaranth. These plants would have been drastically impacted by drought and climatic fluctuations (Stodder and Martin, 1992).

Cultural identity can be uniquely assessed through cuisine. The archaeological record provides evidence for food serving and storage vessels, preparation facilities and finally the food themselves (Mills, 2008). Precolonial aggregation at Zuni pueblo shows a redefining identity of Zuni culture through its changes in foodstuffs. New styles of ceramic called Mataski Buff Ware replaced preceding diversity in ceramic wares. This change in food vessel style is in contract to the unique and diverse burial practices remain separate by migrant communities. This newly created style of food vessel remained prevalent during Spanish interaction, suggesting an intentional avoidance of colonial

foods, institutions, and practices. Zuni cooks intentionally avoided wheat and continued to make hewe or paper bread. Archaeological evidence of this resistance to colonial food is seen in the absence of Spanish style domed bread oven and the prevalence of hewe stones in living rooms at Hawikku (Mills, 2008).

Rates of dental caries are high, mainly due to the type of diet but also the intensification of agriculture. Dental pathologies are especially frequent in Chaco Canyon burials, which also exhibit a crude prevalence of antemortem tooth loss at (~ 63% of adults). Porotic hyperostosis and cribra orbitalia suggest an endemic problem throughout the precolonial and colonial eras. There are no overarching temporal trends; however, bioarchaeologists suggest that porotic hyperostosis and cribra orbitalia intertwine with a diet, infectious disease load, hygiene, and ecology variables (Stodder and Martin, 1992). Groups in the upland accessed more game, while those in the canyon bottom sites had more restricted dietary diversity. Cliff dwellings would have increased infections due to aggregation and hygiene practices.

The introduction of prolonged and sustained colonial interactions with Europeans began in 1598 CE, with the first Spanish establishment in the Rio Grande valley (Stodder and Martin, 1992). A myriad of factors contributed to Pueblo health decline during the initial colonial era included drought, environmental instability, site abandonments, violent interactions, and epidemic diseases. Diet change for the Puebloans increased due to demands of tribute through of labor and food by the Spanish (Stodder, 1994). Overall, these factors drastically contributed to declining nutrition and health (Stodder and Martin, 1992). While the western Puebloans were removed for the main European activity, raids

from other non-pueblo groups brought disease and destroyed supplies of resources. Infectious diseases were endemic and widespread, in part due to increased interactions with outside groups and the domestication of the turkey spreading parasitic diseases. Trade routes either north-south with the Spanish, or east-west with Puebloan and non-Puebloan groups would have spread diseases region-wide (Stodder and Martin, 1992). Further evidence to support widespread disease is in the change to cremation burial practices. Previously mitigation practices such as migration would not have been sufficient to survive the drastic transformative changes during the Colonial period.

Biological impacts on Native populations from increased interactions with European settlers through colonialization were severe. However, visualizing Ancestral Puebloan communities as healthy is inaccurate. The osteological picture of precolonial communities in the American Southwest is that of long-term chronic health issues, as seen by increased frequencies of anemia and dental pathologies (Stodder, 1994). Chronic health issues were prevalent in the hundreds of years before interaction with Europeans. Unfortunately, increased colonial contact only exacerbated the phenomena and increased infections and traumatic injuries (Stodder, 1994). During the period of intermittent contact between the Pueblo people and Franciscan missionaries, food was demanded and obtained by force if not willing given by the Indigenous population. Documentation of the Colonial period was destroyed during the violent interactions of the Pueblo revolt of 1680 (Stodder, 1994). Spanish rule eliminated the possibility of maintaining continuity in religious practices and increased the disconnect between Plains hunters and Pueblo farmers.

Analysis of two multicomponent sites during the Colonial period, Hawikku and San Cristóbal, were studied by Stodder (1994) to assess health impacts from European interactions. Evidence of anemia through the presence of porotic hyperostosis and cribra orbitalia showed a frequency of 90% at San Cristobal and 84% at Hawikku (Stodder, 1994). Stodder (1994) suggested that the lesions are a result of iron deficiency anemia due to decreased nutritional status and infections relating to local ecology and hygiene. Enamel hypoplasias suggest inter-site differences in which Hawikku subadults show a higher rate of morbidity. In terms of non-specific infections, there were frequencies of 23% of San Cristobal and 36% at Hawikku. Stodder (1994) concluded that the evidence for a health decline is driven by demographic, economic, and political instability due to the increased confrontations with the Spaniards and hostility between Pueblo and non-pueblo groups.

Ham and colleagues (2020) established an analysis of linear enamel hypoplasia in northern New Mexico, ancient Puebloan sites as a response to early life environmental stressors. Studying linear enamel hypoplasia frequencies can provide info on the profound impacts of European colonization on Native groups as well as the impacts of drastic environmental changes on Native populations. In the Ancestral Puebloan Southwest, the desert environment is prone to climatic fluctuations that can result in short and long-term drought conditions (Ham et al., 2020). These droughts can drastically impact precolonial Puebloan farming and resource acquisition.

Strong dendroclimatic evidence correlate to ecological strain from 1150 CE to 1200 CE and 1275 CE to 1475 CE (Ham et al., 2020). Both time periods are reflected in

Pueblo Bonito and Hawikku, respectively. General health in the Ancestral Puebloan region likely decreased relative to food shortages resultant of the economic and social policies from the Spanish. The western burial sector of Pueblo Bonito dates from around 1020 CE to 1150 CE. These remains show a high frequency of nutritional stress through evidence of porotic hyperostosis and cribra orbitalia, despite these individuals' high status (Ham et al., 2020). Hawikku shows a turbulent occupational history, ranging from 1300 CE to 1680 CE during the Pueblo Revolt (Ham et al., 2020). The arrival of the Spanish in 1540 CE caused episodic site abandonment. The burials of the site date from the early Colonial periods. Colonial sites in the area show a higher prevalence of infection rates than the pre-colonial sites.

Pueblo Bonito and Hawikku, though part of the same region and cultural area, reflect unique temporal, social, and ecological contexts. These differences can help explain the mitigation of physiological stresses in an individual and must be taken into consideration in the final analysis of the effects of stress on the population. The Pueblo Bonito group represents elite individuals and even though they have a high prevalence of linear enamel hypoplasia, there may have been enough cultural buffering to help support a longer survival rate after the initial stress event. The use of resilience theory in the American Southwest has demonstrated that rigidity and flexibility will influence the severity of the demographic responses to drastic environmental and social changes (Ham et al., 2020). The prevalence of linear enamel hypoplasia supports the conclusion that among other factors, environmental climatic changes affecting the resource availability

and social transformation from Spanish influence significantly impacted Puebloan populational health (Ham et al., 2020).

Important considerations of the study are the application of resilience theory and age-specific conceptions of personhood as buffers for metabolic distributions from future stress episodes (Ham et al., 2020). These direct comparison studies provide ample evidence of a constant struggle among the people of the American Southwest. Fraught with health issues, disease, violence, social control, and hierarchy myriad strategies were employed to mitigate drastic social changes. Strategies that supported previous lifestyles did not buffer after Spanish colonial rule. Not only did the fluctuating climatic environment cause social change, but so too did inter-polity relations and Spanish maltreatment of the Ancestral Puebloans.

## Colonialism and Health

Paleopathological studies of the American Southwest illuminate fluctuating pictures of temporal health changes throughout the region's prehistory. These drastic social changes are accompanied by the aggregation of sites, and thus an increase in negative sanitary conditions and health deficiencies. The intensification in maize agriculture and the introduction of the domesticated turkey provided a prime environment for malnutrition and disease. Importantly, these temporal changes are also spatially variable and dependent on class membership within a population. Cultural buffering systems worked for only specific members of the community, and thus reinforced a complicated hierarchical system which facilitated class-based health disparities.

Spanish colonial contact created a more dramatic stress increase because cultural buffering systems failed to work. The introduction of untreatable and unknown diseases caused drastic social transformation. These transformations towards child health, increased elder mortality, and drastic bodily decline from increased labor, forced social transformations to ensure community survival. These variables all point to fluctuating temporal health trends throughout the precolonial and colonial American Southwest. The paleopathological analyses of porotic hyperostosis, cribra orbitalia, linear enamel hypoplasia, and musculoskeletal stress markers, insist on more work to be done when assessing the human costs of these drastic social transformations. Violence can provide another line of evidence of resilience, rigidity, stress, revolt, and social buffering to contextualize these temporal trends and further introduce ideas of resilience and embodiment in the face of great changes.

Scholarship over the decades regarding the impacts of colonialism on Native populations of the American Southwest has held that the cultural practices drastically differ from those prior to Spanish invasions. This idea reduces the importance of Native narratives in understanding the cultural resilience against colonial oppression through the maintenance of traditional lifeways and cultural perspectives. Current archaeological perspectives on the Ancestral Puebloan region are working towards better understanding the biological and cultural impacts of the Spanish colonial interactions with the Indigenous people of the area. The focus of current research is through the perspective of Native populations instead of placing Spanish colonialism as the driver for Indigenous cultural change. The effects of the direct and indirect contact of foreign people, goods,

and biological agents are currently not well understood but are slowly being elucidated through the use of bioarchaeology and archaeology of Colonial period sites and peoples.

Oppression of the Indigenous populations by the Spanish focused on native labor for missions, mines, and secular ranches, and resource tributes by the Indigenous population (Pavao-Zuckerman and Jenks, 2017). Further oppression occurred through the attempts of conversion of religious beliefs, destroying the use of traditional cultural practices. Atop increased physical labor and religious oppression, epidemic diseases ravaged Indigenous populations. While this tragic depopulation from disease was widedspread, it should not take away from the violent realities of colonialism and native resistance to colonial oppression (Pavao-Zuckerman and Jenks, 2017). Previous mitigation techniques to reduce these drastic social transformations, usually migration, could no longer be employed by the Native groups. Further analysis of colonial-era migrations may provide more insight into the extent of success with these techniques (Pavao-Zuckerman and Jenks, 2017).

Liebmann (2021) utilized the Ancestral Puebloans as an example of population decline associated with European interactions and sustained contact. With the period directly before colonial interactions being associated with mass migrations, aggregation, and cultural diffusion, there is a decrease in trade routes and social networks (Mills et al., 2013; Liebmann, 2021). The robust Mesoamerican-Pueblo trade began to fade near the end of the 1100s CE and was no longer maintained in the late 1500s CE. Archaeological evidence of the violence extending from the Coronado expedition is present in broken daggers, chain mail, crossbow bolts, arrowheads, and burned structures at the Pueblos

(Liebermann, 2021). After several sporadic and violent interactions, there occurred nearly four decades of no foreign invaders present in the New Mexico area. Then, after the arrival of settler colonists, tree-ring studies indicate the Pueblos were still harvesting wood for new construction and cooking. The first decades of the 17th century show no increase in pueblo population decline, or evidence of mass graves. This independence changed when the Spanish increased their harsh tribute demands of the Pueblo people. An increase in antelope hunting at Pueblo Blanco during the colonial era likely relates to the Spanish increase in hide tribute. The faunal assemblage at Gran Quivira records an increase in hide processing during the same period (Leibermann, 2021). Archaeological evidence supports a Pueblo population decline during the early 17th century with the expansion of Franciscan missionaries.

Increasing tensions not only between Native groups and Spanish colonizers but also between Plains groups and Ancestral Puebloans culminated in the Pueblo Revolt of 1680 CE (Pavao-Zuckerman and Jenks, 2017). The revolt was successful in both political and symbolic respects and granted victory to the Pueblos who destroyed missions and reconquered the capital, expelling the Spanish colonizers for around a decade (Pavao-Zuckerman and Jenks, 2017). Many Pueblos, however, were intentionally left out of the Pueblo Revolt, unfortunately, creating more instability instead of community in the region.

## Research Hypotheses

The time of colonial interactions was one of instability, disease, tension, warfare, violence, oppression, and climatic fluctuations. This period in Ancestral Puebloan history

needs to be further explored to understand Native resilience, resistance, and continuation of many traditional ideals, worldviews, and communities persisting until today. Indigenous diversity and agency, as seen through the archaeology of the past, are integral to understanding modern-day tensions of colonial impacts on the Native populations of the American Southwest.

The current anthropological knowledge of Ancestral Puebloan history brings about several pressing questions. Considering the cultural buffering systems utilized in this marginal environment and their subsequent disruption by colonialism, was there an increase in rigidity due to colonialism in the Ancestral Puebloans? Did colonialism destroy the Ancestral Puebloans cultural buffering and mitigation systems, thus creating more rigidity? Was such rigidity reflected in an increase of interpersonal violence? Is this violence a reflection of stress (i.e., is it interpersonal, and non-sanctioned, non-warfare, and non-ritual/ political)? These questions inform and create three hypotheses to be assessed in this study.

Hypothesis 1 attempts to assess the increased interconnectivity of a social adaptive system in reaction to drastic transformative change, which squeezes out diversity and leads to a rigidity trap. Chaco Canyon's use of violence as social control provides evidence of a system with a decrease in diversity and flexibility. As such, for hypothesis 1, I expect to see high frequencies of lethal cranial trauma among adult males at Pueblo Bonito.

Hypothesis 2 attempts to assess the precolonial mitigation techniques utilized in buffering against drastic transformative change to the socioecological system. The site of

Point of Pines Pueblo experienced a massive influx of Kayenta migrants to the region after the Great Drought. This increased aggregation at the site provides an opportunity to assess the mitigation techniques utilized to buffer against an increase in population density and an influx of individuals with a diverse identity during a time of socioecological stress. As such, for hypothesis 2, I expect to see no increase in the frequency of traumatic injuries specifically targeting incoming migrants to the Point of Pines Pueblo.

Hypothesis 3 attempts to assess the destruction of social mitigation buffering techniques as a result of drastic changes created by colonialism. These drastic changes affected all aspects of life, reducing diversity and flexibility in the mitigation and buffering techniques that were stored in the social memory of the Ancestral Puebloans. As such, I expect to see an increase in lethal cranial trauma, with even sex distributions at the colonial sites, Hawikku and San Cristobal.

# CHAPTER THREE

## Materials and Methods

To test the hypothesis that European interactions with Ancestral Puebloans destroyed Indigenous social networks and buffering systems, a meta-analysis of overall trends in violence throughout the Southwest region is conducted by this thesis. Here, overviews for each site's environment, culture, architecture, subsistence patterns, and chronologies are provided, along summaries of the skeletal samples from each site. Finally, data being used in this study, as obtained from the published record, is described for the number of individuals and methods of analysis of sex and age.

### Pueblo Bonito

The Hyde Expedition began excavations in Chaco Canyon in the late 1800s, focusing on Pueblo Bonito. Neil Judd followed this initial excavation in the 1920s, and excavations in the region continued to spread from Pueblo Bonito (Akins, 1986). Chaco Canyon, located in northwestern New Mexico, had an expansive region associated with its cultural influence, as seen in architectural styles and ceramics. Geographically, a large amount of the Colorado Plateau is identified as part of the Chacoan cultural system during the $10^{th}$ and $12^{th}$ centuries (Mills, 2002). Regional roads, great houses, and great kivas informed the boundaries of the Chaco area. Chaco Canyon's architecture also shows a high degree of planning, shown by the distinct masonry and circular

semisubterranean kivas. The roads are different from other trails, as they are straighter and more expansive, ranging from 8 to 12 meters (m) in width (Mills, 2002). The construction included raised borders, bridges, gates, stairways, and ramps, to name a few.

Chaco Canyon sits at an elevation of 1890 m above sea level, with an average annual precipitation of 225 mm, and temperatures that range from -29 to 100 degrees Fahrenheit (Crown and Wills, 2018). The canyon is carved from Cretaceous sandstones, which formed vertical cliffs on the north and south margins of the floodplains. Pueblo Bonito encompasses about 600 masonry rooms up to four stories in height (Crown and Wills, 2018). The site also includes around 37 semi-subterranean masonry-lined kivas.

Pueblo Bonito was built on a site occupied during the Basketmaker III period (ca. 450-750 CE) (Crown and Wills, 2018). Between 100 BCE and 1000 CE, the valley bottom in Chaco was a flat seasonally wet flood plain where mesa top run-offs pour over the edge on the north side of the canyon. These runoffs create temporary pools and small channels that flow into the floodplain. This combination of convergent water was critical for farming during the Basketmaker III period at Chaco. Canal systems, masonry dams, and headgate systems harnessed these high-velocity surface runoffs which channeled water into the floodplain field systems (Plog et al., 2017). Though Chaco Canyon showed high agricultural successes and technology, the late 12$^{th}$ century had drought events from 1130 to 1180 CE, reducing the stability of the Chacoan irrigation farming (Plog et al., 2017).

The construction of Pueblo Bonito during the 10$^{th}$ century is characterized by dispersed household structures surrounding a large masonry building. Between 850-925

CE masonry rooms varied between one to four stories (Crown and Wills, 2018). Plaza-side postholes supported ramadas, with additional walls added later. A variety of masonry techniques suggests a lack of unified architectural style in the early construction period. This diversity suggests multiple households built individual sections of the complex (Crown and Wills, 2018). A hiatus in building at Pueblo Bonito occurred during 975-1040 CE, as indicated by tree-ring dates. Construction resumed in the 1000s CE as wind-blown sand caused the west court's surface to rise. Tree-ring dates estimated the construction of another 80 rooms from 1040-1050 CE, 24 rooms between 1050-1070 CE, and 160-170 rooms from 1070-1100 CE (Crown and Wills, 2018). At the time of abandonment, multiple fires were set in several rooms as a part of the termination rituals. This ritual closed the rooms from further use and removed power from objects. Though the Ancestral Puebloans likely abandoned Pueblo Bonito in the 14$^{th}$ century, Chacoan influence is evident throughout outlying regions.

The Bonito phase (920-1220 CE) is generally attributed to the time of great house construction and covers the entire Pueblo II period, and parts of Pueblo I and Pueblo III (Mills, 2002). Though portions of the San Juan Basin are arid and desolate the availability of seasonal runoff could create a patch environment. Long and short-term climatic fluctuation trends are present in the paleoclimatic record (Mills, 2002; Dean et al., 1985; Benson and Berry, 2009). The north and south were clearly distributed to agricultural fields, and all the great houses are located at the confluence of large tributaries with Chaco Wash. The use of stream entrenchment and irrigation techniques has been suggested for farming in the Chaco Canyon region. A downturn in the

environmental conditions took place during 1130-1180 CE, which corresponds to the end of great house construction and may have contributed to a reorganization of the regional system (Mills, 2002).

The size of the population occupying Chaco Canyon is highly debated. The types of residential rooms and public architecture suggest possibly around 2000-3000 persons. Bernardini (1999) assessed the population numbers at Pueblo Bonito based on evidence of hearths and residential areas. Understanding population fluctuations at the site can help to explain stressors in the form of resource availability and predictability. For the various stages of construction at Pueblo Bonito, Bernardini (1999) utilized a residential suite-based model to attempt to identify residential and nonresidential rooms and the population estimates that come with them. He concluded that the population of Pueblo Bonito never exceeded 12 households or 70 people. The non-residential rooms in the area greatly outnumber the residential ones. The outlying sites around and within Chaco Canyon could also have held the residential population, while Pueblo Bonito was for the elites. After initial construction in stage one (850- 930 CE), there was a great house construction hiatus throughout Chaco Canyon for around a hundred years. Furthermore, there is no evidence for the construction of additional residential suites at Pueblo Bonito after 1085 CE, which was around 40-50 years before the last cutting date in the canyon. Bernardini concluded that Pueblo Bonito was not a primarily a residential site but instead reflected the scale of social events hosted at the site and possibly represented a center of elites living within the walls.

The political structure of Chaco Canyon suggests a complex social hierarchy. The hierarchical structure suggests multiple competitive leaderships during periods of high productive climate (Mills, 2002). Archaeologists believe the center of Chaco Canyon was empty with increased aggregation at the site during ceremonial events. The distribution and trade of highly valuable exotic goods from Chaco's center, suggests the need for organized hierarchy and elites. These elites held power throughout the region utilizing a combination of economic and military authority.

The economics of Chaco Canyon centered on high numbers of exotic trade goods passing through the great houses (Mills, 2002). Nonlocal ceramics and other non-subsistence goods are attributed to being crafted in Chaco Canyon, in addition to evidence of complex agricultural technology is also present in the form of dams, gardens, ditches, and gates. Storage access is an archaeological example of social hierarchy. Greater consumption of high utility parts of deer was evident at Pueblo Alto (Mills, 2002). Wood for building construction is traced to the Chuska mountains and Mount Taylor (Mills, 2002). Trees from both locations are present in the same rooms and built at the same time, suggesting a stockpile for the region that contributed to all the construction. Though a large amount of craft production and trade did occur at the great house sites, the most important produced goods are in the form of ritual knowledge and ceremonial materials (Mills, 2002).

Further evidence of social inequalities is manifested in skeletal samples, indicating individuals from the great houses having a high average adult stature. Two distinct burial populations correlate with spatially different burial groups in the oldest

areas of Pueblo Bonito. Analysis of sex-specific phenotypic variation showed females with higher variation, providing evidence counter to a matrilocal residence pattern (Mills, 2002). These distinct burial clusters contain multiple individuals similar to family crypts. While the pattern of burial clusters and burial goods does suggest a make dominated gender hierarchy, the evidence also suggests the presence of hierarchies in both male and female burials (Mills, 2002).

A wealth of information exists for context and burial goods documentation at Chaco Canyon. Four (or five) burials excavated from Pueblo Bonito are paramount to the current analyses of the region. Akins and Schelberg (1984) referenced one room where fourteen to fifteen individuals were placed on top of wooden planks. Underneath these wooden planks, two adult males lay in a bed of wood ashes and yellow sand. Both males exhibited chopping and percussion trauma to their heads. Each individual had associated turquoise and shell beads within their contexts. The other paramount burials were not well documented. This included an extended burial of a man with turquoise beads wrapped around his forehead (Akins and Schelberg, 1984). This individual was surrounded by thirteen female skeletons with no ornaments. Judd describes a large room in Pueblo Bonito with a mummified woman, and turquoise. Clusters of burial rooms may represent distinct cemeteries at Pueblo Bonito. All individuals with burial status markers were dated to between 1050 CE to 1130 CE (Akins and Schelberg, 1984).

Ninety-six percent of the great house burial clusters were found within structures (Akins and Schelberg, 1984). Within each burial cluster, there were differences between status object frequency. Children in these cases were found associated with status

markers. Pueblo Bonito's burials were on the floors, suggesting the rooms were closed for that specific purpose. Burial positions included around 76.5% extended, and 82.3% on the back, and often the head was directed to the east at about 60% of the excavated burials (Akins and Schelberg, 1984). Nuclear DNA analysis demonstrated possible grandmother-grandson and mother-daughter relationships between individuals buried in Room 33 (Plog et al., 2017).

Chaco Canyon's influence can be seen through four distinctive characteristics as described by Plog and colleagues (2017). Firstly, Chacoans produced a wide variety of exotic and elite materials focusing on turquoise, jet shell, bone ornaments, and material associated with ritual ceremonies. Secondly, expansive trade networks between Chaco and surrounding regions including Mexico brought in a wide variety of material such as macaws, cacao, and copper bells. Thirdly, the architectural style of Chacoan great houses spread throughout the northern Southwest, where around 200 of these great houses were constructed in outliers after 1025 CE. Finally, the road pathways cleared of stone were up to 10m in width extended to about 50-60 (km) out from the Chaco great houses.

Many archaeological studies suggest that Chaco Canyon held significant sacred importance as an Ancestral Puebloan landscape. This does not mean that the center was largely unused as the important interconnectivity of ritual, economy, and sociopolitical relations is a huge dimension of Pueblo life. This multi-usage component of the site is seen in its diverse architecture where there are residential sites, workshops, ritual repositories, public spaces, and burial crypts (Plog et al., 2017). From the mid to late 1100s CE, the Chaco system developed new great houses at the end of 1130 CE (Mills,

2002). This event is associated with a drought in the San Juan Basin. Sociocultural shifts also influenced the great house architecture, unroofed kivas, and road development in the post-Chacoan period (1150-1250 CE).

Harrod (2013) collected data from human remains in the Greater Southwest region to assess how violence and social inequality maintained regional control between 850 CE to 1300 CE. He addressed several research questions utilizing the skeletal collections. The main goal of the study revolved around identifying elite individuals through mortuary data and skeletal analysis. The high-status individuals should show evidence that social control was utilized for the mitigation of stress on the surrounding communities during period of drought, and uncertainty. To supply sufficient social control, Harrod argued that the Chaco people established a system of coercion maintained through violence.

Harrod's (2013) study merged bioarchaeological data with theoretical concepts of control and violence performance. The hypotheses tested included: 1) does the archaeological and bioarchaeological record support the presence of both elites and low-class individuals? 2) Was there a Pax Chaco where violence increased before and after the prominent years of Pueblo Bonito's regional influence?

Harrod (2013) studied human remains from the late Pueblo I through the Pueblo III periods, totaling 271 individuals. The skeletal collection is currently housed at the American Museum of Natural History (AMNH), and the National Museum of Natural History (NMNH). He analyzed remains based on the completeness of the skeletal elements present, alongside those identified with the burial data. He collected empirical

data on biological and cultural identity to provide information on socioeconomic and political identity.

Harrod (2013) generated a bioarchaeological profile for site location, burial position, grave goods, age, and sex. The concept of biocultural identity incorporated stature, robusticity, porotic hyperostosis, cribra orbitalia, and anti/peri mortem trauma. The study showed clear hierarchical divisions and violence in Pueblo Bonito.

Burials used in the meta-analysis of this thesis project included the best preserved burials originating from Pueblo Bonito-West and Pueblo Bonito Room 33 (Table 2). Subadults are not included in this study as they are not distinguished by sex. Harrod chose burials based on skeletal completeness and association with burial documentation. He estimated age based on the pubic symphysis (Brooks and Suchey 1990; Todd 1920), closure of cranial sutures, and dental wear (Buikstra and Ubelaker 1994). He estimated sex using the pelvis and differences in morphology on the cranium for isolated elements (White, et al. 2012). Individuals identified as male or female and assigned an estimated age class of late adolescent/young adult (aged 12-35), middle adult (aged 35-50), and old adult (age 50+) are included in this study. Harrod did not include postcranial trauma, as He deemed it not reliable for evidence of violence, therefore only cranial trauma from identified individuals of Pueblo Bonito-West and Room 33 are included in this analysis.

**Point of Pines**

The next sample for this current project comes from the Point of Pines region, in modern-day southern Arizona on the San Carlos Indian Reservation. South of the Black River, this area lies on an intermontane plateau known as Circle Prairie, at 6,000 feet in

elevation (Rodrigues, 2008). The Willow Mountains in the north, the Nantack Ridge in the south, and streams to the east and west, surround these sites. The streams later flow into the tributaries of the Gila River (Bennett, 1967).

The surrounding forests are characterized by ponderosa pine, oak, and juniper, with the ridges giving way to tall grasses and shrubs that cover the floor of the plateau (Bennett, 1967). Indigenous plant species include blue grama grass, bee weed, thistle poppy, and herbaceous plants (Rodrigues, 2008). Weather in the region included an annual precipitation at point of pines around 18 to 19 inches (Bennett, 1967). Dry periods lasted from April to June, with downpours in the subsequent months. Little evidence exists of water storage due to the rapid runoff. This makes farming difficult, not unlike other marginal environments in the southwest (Bennett, 1967).

The University of Arizona Field School, established in 1976 and spearheaded by Emil Haury, conducted the first excavation on the Point of Pines. Excavations lasted each summer through 1960. The architectural styles and material differences are assigned to the distinctive Mogollon culture, separate from Hohokam and Ancestral Pueblo (Rodrigues, 2008). Habitation of the area of the Mogollon tradition began around 200 CE, with the early period being defined as 200 CE-1000 CE. Before 1000 CE, the sites adhered to the Mogollon tradition. Over time, many cultures from the north moved into the area creating a population now known as the Western Pueblo (Bennett, 1967). After 1000 CE architecture shifted from pithouses to above ground masonry pueblos. Cultural changes after 1000 CE include cradle boarding, three-quarter groove axes, construction of kivas, and inhumation of the dead in a fully extended supine position (Rodrigues,

2008). The middle period is marked by the Reserve and Tularosa phases from 1000-1265 CE. The Pueblo III period (1250-1300 CE) saw a transition from pithouses to cobble surface room and various sized masonry pueblos. The final part of the Mogollon chronology is the late period from 1150-1450 CE, characterized by the Tularosa to the Point of Pine phases (Bennett, 1967). The most significant human migration across the Mogollon highland was seen in 1350 CE, with the dispersal of around 11,000 individuals into the area. Maximum population density occurred in the late 14$^{th}$ century, with abandonment of the area in the early 15$^{th}$ century (Bennett, 1967).

Agricultural dependence began in the Early Pithouse Period, identified with the presence of agricultural features and the pattering of faunal remains, grinding technology and pollen data (Rodrigues, 2008). Wild game and plant variance decreased with population aggregation in the 14$^{th}$ and 15$^{th}$ centuries. Despite the availability of land, most of the area became underutilized for agriculture. This is especially true for periods of great stress, such as the Great Drought in the late 1970s (Rodrigues, 2008). Water was critical in such a harsh environment, exemplified through walk-in wells and rainwater runoff near streams. Reservoirs developed later in 1350- 1400 CE (Rodrigues, 2008).

The Point of Pines Pueblo represents migration trends in the Mogollon Highlands. There are several arguments for potential causes of these mass migrations, revolving around competition for resources, warfare, or the influence of the Kachina religion (Rodrigues, 2008). Climatic influences on the surrounding environment played a role in the migration frequencies in the Kayenta area during the late 13$^{th}$ century. The archaeological evidence of the migrations is abundant through architectural studies,

ceramic style influences and changes, as well as a change in cultigens, including a northern corn (Rodrigues, 2008). The drastic social migrations and diffusion into the settled local community at Point of Pines shows a unique mixing of cultural material. While there is evidence of separate cultural communities from the Kayenta region at Point of Pines, the burial practices had migrants and locals intermixed in the local cemetery (Rodrigues, 2008).

Burial patterns from the Point of Pines region indicated an increase in cremations from the early period to the late (Bennett, 1967). The largest village at Point of Pines, Arizona W:10:50, makes up 66 percent of the 321 cremations (Bennett, 1967). There are multiple documented numbers of excavated inhumations, but these vary depending on the publications due to issues with preservation, cataloging errors or unqualified staff mixing burials (Bennett, 1967). Inhumations were mostly extended and in concentrated areas around the village at the beginning of the Reserve phase (Bennett, 1967). Late period inhumations at Point of Pines Pueblo were typically in a supine extended position, with the heads facing east (Rodrigues, 2008). Burial assemblages were typically ceramic offerings though bone, stone and shell artifacts were also present (Rodrigues, 2008).

Rodrigues (2008) assessed potential relationships between human behavior and social change in the Point of Pines region. The study examined 518 individuals from 10 archaeological sites that span over 1000 years (400 CE to 1450 CE). The goal of the study was to determine if individuals from the Mogollon Highlands exhibit patterning of traumatic lesions indicative of changes in subsistence patterns as well as interpersonal conflict. Point of Pines has a well-established room block that was distinctively founded

by migrants of the Kayenta region around 1265 CE. Her hypothesis considered that increased reliance on farmed crops led to an increase in traumatic lesions associated to the subsistence related occupational activities. The hypothesis continued that population aggregation in the middle period intensified violent competition for prime agriculture and foraging lands amongst males. She posits that degraded environmental conditions in the final period and an increase in migrants at the site would increase interpersonal and domestic violence, including migrants, males, and females, and children. Rodrigues's (2008) analysis of traumatic injuries distinguished between occupational trauma, interpersonal conflict, and warfare. This was assessed by mapping the locations of fractures, interpreting weapon wounds, comparing antemortem and postmortem trauma, and separating population demographics.

Rodrigues (2008) initially analyzed skeletal remains from the Point of Pines region dating over a span of a thousand years. A total of 514 inhumations are housed at the Arizona State Museum. The individuals included in this study were identified as being from the late period (1200-1450 CE), and three distinct sites (AZW:10:50 (ASM), AZW:10:51 (ASM), AZW:10:52 (ASM)). A total of 215 individuals were from all three sites, though only the adults with associated sex and age, as well as burial documentation, are included in this study. Rodrigues (2008) estimated age and sex utilizing the methods outlined in Standards (Buikstra and Ubelaker, 1994) for the pelvic indicators, and cranial morphological features. Age classes include late adolescent/young adult (aged 12-35), middle adult (aged 35-50), and old adult (age 50+). For comparisons of locals and migrants present in the skeletal assemblage, migrants were identified by accompanying

burial artifacts that were archaeologically associated with the Kayenta culture or the Ancestral Puebloans. Lines of evidence include architectural styles, ceramic wares, and strontium isotopes (Price er al., 1994). All traumatic lesions were recorded by element, side, aspect, and segment using the coding system presented by Buikstra and Ubelaker (1994). All burials included in this thesis, are described in Rodriguez's (2008) study and date from the late period with documented sex, age, residency status, and burial documentation (Table 2).

**Hawikku**

Limited research exists on the region surrounding the contemporary Zuni Indian Reservation during the late pre-Hispanic period (ca. 1300-1540 CE) (Peeples et al., 2017). In general, the great Cibola region is a large and geographically diverse area extending across the southern Colorado Plateau and into the mountains of Arizona and New Mexico. Precipitation, temperature, and growing seasons differ dramatically across the region and influence farming capabilities. As with the rest of the Southwest, climatic variability remained unpredictable and promoted interactions with populations residing in various ecological zones.

Settlement into the Cibola region began around 250 BCE to 900 CE with the gradual occupation of small settlement clusters and regional population growth (Peeples et al., 2017). Pithouses characterized seasonal and short-term settlements. A rapid transition from pithouses to multi-room masonry pueblos corresponded with population increase after 900 CE. Chaco-style great houses and great kivas populated the region's architecture around 1050 CE and 1150 CE. Between the mid-1200s CE to 1300 CE, 30 to

40 nucleated pueblos spanning 100 to 400 rooms developed alongside population aggregation (Peeples et al., 2017). Architectural construction marked well-integrated social communities previously established in the area. Migration was a common mitigation technique against external factors and a common component of site formation by the Zuni people. With the rise of aggregated communities around mid- 1200 CE, clearly marked social and political boundaries between members of society are elucidated. Political distinctions are evident in the separation of Western pueblos over vast open spaces (Peeples et al., 2017).

Hawikku is located at the top of a ridge, and the bottomland at the base of the ridge. The pueblo, located about 24 km southwest of modern Zuni pueblo in northern Mexico, had been occupied for 340 years (Howell and Kintigh, 1996). The site overlooks the Zuni River junction with Plumasana wash. Plant communities in the area are of grassland and the ridge top is covered in juniper-pinyon woodlands (Kintigh, 1985). Hawikku is a ruin of irregular shape. It is a multistory pueblo on the top of and down the slope of a hill with seven major room blocks constructed of red and tan sandstone (Kintigh, 1985). Inhumations were found in room fill though the rest, nearly a thousand burials, were found in clusters located to the north, west, and south of the pueblo. Remains of an adobe church and monastery, established in 1629 CE are also present at the site, around 370 rooms were excavated (Kintigh, 1985).

Hawikku is known as one of the so-called fabled cities of Cibola and thus exhibits the first location of colonial interactions between the Spanish and the Puebloan peoples in 1539 CE and 1540 CE. Frederick Webb Hodge conducted excavations in the early 1920's

working in conjunction with the Museum of the American Indian, and discovered around 1000 burials (Howell and Kintigh, 1996). Precolonial remains found underneath the pueblo show continuous occupation of the site from the Pueblo IV period to the late 1600s CE (Kintigh, 1985). The period of prolonged European colonial interaction exhibits a haphazard growth of room blocks with no preplanning involved. Despite the lengthy occupation period at Hawikku, its growth and construction phases are undocumented.

The population peaked in the precolonial Zuni area around 1200 CE when groups dispersed into small to medium-sized sites of about five to 20 rooms (Stodder, 1990). Population decline, aggregation, and settlement shifts created larger settlements around 200-1400 rooms in the 1300s CE. Annual rainfall is highly variable with an average of 11.9 inches and the growing season averages 150 days a year that are frost-free. Long-distance trade between the Zuni and Mexican and Gulf people included exotic goods and commodities. European colonial interaction in the area began with De Niza's emissary traveling to the so-called "Golden City of Cibola" and being killed by the Zuni in 1539 CE (Stodder, 1990). This prompted Coronado to siege the city for several months in 1540 CE but was successfully repelled by the Zuni (Stodder, 1990).

Bioarchaeological data from craniofacial measurements and funerary data within the Zuni region suggests an arrival of immigrants into the area around 1400 CE, just prior to interactions with Europeans (Peeples et al., 2017). Resultant transformations following Zuni and European settler interactions include changes in ceramic design and technology, agriculture, and burial practices. The adobe church on site was burned in 1632 CE and

Hawikku was abandoned for more defensible sites. Reoccupation of the town and the mission prompted several more burnings and uprising following to around 1680 CE when the pueblo revolt occurred. The final return of the Zuni consolidated the area into Halonowa, due to the population having been reduced to half (Stodder, 1990).

Inhumations were largely concentrated in area 9 west of house C. Due to poor excavation reports the burials cannot be dated, other than those in the church. Flexed burials located in houses were oriented north or south and comprise the characteristics of early Hawikku inhumations (Stodder, 1990). East-oriented burials became more common after 1475 CE. Some 79% of Matsaki wares were associated with cremations. More broadly, cremations in general ceased in the 1630s CE, probably due to Spanish Catholic influence (Stodder, 1990).

Hawikku burials were distributed in spatially discrete clusters and cemeteries. Around 40% of these burials and cemetery clusters dated to one of three time periods. Howell and Kintigh (1996) provide temporal context for the burials, including the Pre-Mataski period (1300-1375 CE). These correspond with various types of polychrome ceramics and constitute 56 burials. The Mataski period (1350-1630 CE) constitutes about 260 burials. Finally, the historic period, ca. 1630-1680 CE, includes all burial containing historical artifacts which represents 70 burials. Analysis of these clusters attempted to identify distinct kin groups, using dental morphology to assess group affinity.

Multiple burials, involving one adult female and one or more children, are present at Hawikku. These results correspond with the expected kinship relations of an exogamous clan, characteristic of Zuni (Howell and Kintigh, 1996). Dental morphology

also showed small kin-based units that could be matrilines, which is also present in ethnographic Zuni findings (Howell and Kintigh, 1996). Grave goods further helped to distinguish between individuals and groups. Several males were buried exclusively with war clubs, compared to more common burials with bows and arrows. High diversity burials of females showed a prevalence of domestic items constituting most of the burial goods. The conclusion of their study supports the idea that these specific clusters do indeed indicate kin groups buried together (Howell and Kintigh, 1996).

Stodder's (1990) study of Hawikku explored the overall demographic and health status of Ancestral Puebloan populations at the end of Southwestern prehistory. To understand adaptation in the Southwest, her analysis considered the events during 16th and 17$^{th}$ century New Mexico. Stodder's data used by in this thesis represents the Hawikku sample includes a total of 168 skeletal individuals. These samples from the National Museum of Natural History were analyzed by Stodder for dental pathology, abscesses, traumatic injury, and skeletal infections.

Stodder estimated age through use of pubic symphysis morphology (Todd, 1920; Brooks, 1955) and dental wear. Sex was analyzed based on pelvic and cranial morphology (Krogman, 1962; Bass, 1971). All individuals identified by Stodder (1990) with associated age and sex estimation that were scored for traumatic postcranial and cranial injuries are included in this thesis (Table 2). All traumatic injuries are presented in Stodder's analysis, including those of inferred to be of traumatic and accidental origin. There is no current way to remove possible cases of accidental trauma from this analysis, and so, all traumatic injuries are included.

**San Cristobal**

The Pueblo San Cristobal excavation in the early 20th century was the first systemic study of the large Tano ruins in the Galisteo Basin. This ancient and historic site is about eight miles southeast of Lamy, New Mexico and six miles east of Galisteo. Pueblo San Cristobal sites on the banks of the Arroyo San Cristobal and exhibits a viewshed open to the south and with a limited extent west (Nelson, 1914). Elevation ranges from 6000 feet to 6500 feet, with the higher range housing ponderosa pine stands, and the lower range housing cottonwood, and oak within the canyons (Stodder, 1990). The environment surrounding the sites hosts water, tillable soil, timber, and building stone.

Nels Nelson (1914) mapped twenty masonry and adobe structures that encompass the site, including eight refuse heaps, and two stone reservoirs (Stodder, 1990). San Cristobal was founded in the early 1330s CE and abandoned around the time of the 1680 CE Pueblo Revolt. Continued aggregation from the Classical through the early historic period, attributed to the construction of communal structures, including three story buildings, clustered room blocks, and kivas (Stodder, 1990). San Cristobal shows archaeological evidence for being a local trade center for ceramics, specifically glaze ware. Around 2400 acres of land within three miles of the Pueblo is useful for dry farming, and 80 to 100 acres of agricultural and irrigation. The average precipitation is 14.32 inches annually, with intermittent flow to the San Cristobal and Galisteo Creeks (Stodder, 1990). Fauna in the region included pronghorn antelope, hare, rabbits, and mule deer.

Nelson (1914) first excavated the buildings and middens from the American Museum of Natural History in 1912 and established regional chronologies through the stratigraphic sequencing of ceramic wares (Stodder, 1990) Louis Sullivan exclusively excavated skeletal remains in 1923, from middens D and E (Stodder, 1990). Robert Lang's 1977 report on the archaeological survey of the upper San Cristobal drainage is the only subsequent large-scale excavation (Stodder, 1990).

Nelson and Sullivan recorded the human remains from the San Cristobal totaling 492 burials. One hundred and eight individuals were from structures and while 384 are from middens (Stodder, 1990). At the northeast and north ends of the site, Middens E and D resulted in the most excavated burials. While the social implications of midden versus structural burials are hard to assess, the burial assemblages had little to no associated artifacts. Though the precolonial population size of the site is estimated to be around 1084 individuals, the historic section of the skeletal population yielded more collected burials (Stodder, 1990).

Stodder (1990) undertook a paleoepidemiological examination of two large pueblos occupied during initial interactions with Europeans and Puebloan populations. The study posed to understand the overall demography and health status of Ancestral Puebloan populations at the end of Southwestern prehistory. Analysis emphasized adaptation in the Southwest in light of events during 16$^{th}$ and 17$^{th}$ century New Mexico. Stodder (1990) analyzed a sample of 268 skeletal individuals, from the San Cristobal excavations. These samples curated at the American Museum of Natural History were analyzed for dental pathology, abscesses, traumatic injury, and skeletal infections. High

crude prevalance of anemia and dental pathology are present in both the colonial and precolonial samples, and Stodder (1990) inferred this demonstrated a continuity in subsistence patterns. Colonial samples displayed more instances of developmental arrest, infections, and traumatic injuries than the precolonial sample. Colonization disrupted local trade networks and economies for both sites despite difference circumstances between the communities (Stodder, 1990). Stodder compared the high frequencies of traumatic injuries at San Cristobal to other Pueblos experiencing European interaction. Other colonial era Pueblos experienced high frequencies of trauma as well, supporting Stodder's conclusion that endemic warfare in the colonial era amongst the Ancestral Puebloans was intensified following European arrival.

Stodder estimated age through use of pubic symphysis morphology (Todd, 1920; Brooks, 1955) and dental wear and sex based on pelvic and cranial morphology (Krogman, 1962; Bass, 1971). All individuals identified by Stodder (1990) with associated age and sex estimation that were analyzed for traumatic postcranial and cranial injuries are included in this thesis (Table 2). Stodder presented all traumatic injuries, including those of traumatic and accidental origin. These were not previously distinguished by Stodder, and therefore, are all included in this meta-analysis and reexamination of the skeletal assemblage is not available at this time.

## Methods

This meta-analysis categorizes trauma into several groups and establishes patterns through analysis of anatomical location of trauma, population demographic frequencies, and lethal/ non-lethal trauma.

Different social reactions can occur when a community is facing a serious change in socio-political and economic circumstances. Whether men, women, and children are affected equally depends on difficulties being faced by the community over time. Incidences of interpersonal violence are reported more frequently in the literature with the new focus on communities during extremely volatile times, where economics or politics are changing the social landscape (Martin, 2016; Baustian, 2012; Kohler, 2014). Heavy amounts of migration due to extreme warfare can also contribute to intra-community stress, causing violence to increase and become a norm.

Violence is typically defined as an injury inflicted on others through intentional human actions (Walker, 2001), though determining this intentionality highly depends on cultural context. Injury means damage, or a wound produced by trauma, where trauma is interpreted as an accidental or inflicted injury caused by harsh contact with the environment (Walker, 2001). Trauma may be defined as an injury to living tissue that is caused by an external force or mechanism (Lovell, 1997). Though this description does not consider self-harm, the attempt to standardize a definition utilizing both medical and archaeological classifications is necessary and useful. Warfare, as seen in the bioarchaeological record, can be designated as lethal violence between distinct competing groups. Interpersonal violence can be defined as non-lethal and is between individuals or small groups within the same community. (Martin and Harrod, 2012).

Trauma was classified into blunt-force (BFT) and sharp-force trauma (SFT). Blunt-force trauma in dry skeletal remains can result in lesions like cranial depression fractures, produced by impacts from objects causing radiating fractures and varying

depths of impressions on the cranium (Wakely, 1997). Moritz (1954) describes the effects of injury severity ranging from endocranial fracturing to full displacement of a portion of the cranial vault. Most BFT's are typically non-lethal unless they break through the cranial vault.

Sharp-force trauma injuries are typically penetrating wounds that result in separation or compaction of bone. SFT characteristically is considered non-accidental due to its unique loading and effect on bone. These injuries are commonly asymmetric and show directionality (Wells 1982). If they are post-mortem or from excavations the injuries will have a U-shaped cross section and a random distribution across the body (Wakely, 1997). SFTs can also occur on the cranium in conjunction with blunt force trauma, indicating a loading force from a sharp and large object. This is commonly caused by an axe or otherwise sharp, robust object. This leaves a distinctive combination of elements of a cranial depression fracture with penetration to the inner cranial vault, separating the bone and causes radiating fractures from the impact area.

Location, severity, and stage of healing were recorded for all cranial depression fractures, as documented by the original researcher. The locations of each such defect were then mapped to determine patterns and frequencies. Location was mapped onto drawings of an anatomical skeleton to reconstruct the frequencies of probable right-handed and left-handed attacks. If individuals are right-handed then injuries are expected to be located on the left side of the cranium for frontal assaults. In addition, location can be indicative of accidental falls or objects falling on top of the cranium. Severity and stage of healing were identified to facilitate the comparison of lethal and non-lethal

injuries. Post-mortem damage was identified if breaks were crumbly and brittle with very little soil staining (Wakley, 1997).

The same method was applied to the postcranial skeleton to distinguish between violent and accidental trauma (Martin et al., 2013). Falls can be indicated by a linear and radiating fracture occurring on the distal radius (Guvomarc'h et al., 2010). Whereas blows, seen commonly with the ulna for parrying fractures, are comminuted and depressed (Guvomarc'h et al., 2010). Accidental trauma is more likely to have a random distribution across the body, where violent trauma is more common on the left side of the body from right-handed blows. Most perimortem injuries are identifiable by their sharp, clean fracture lines as well as radiating fractures. Postmortem fractures will exhibit none of these characteristics and be lighter in color than the rest of the bone as it will not have been stained by the soil (Galloway, 1999).

In addition, population demographics were recorded to assess patterns in sex and age distributions and consider its potential underlying cultural significance. Population demographics contextualize sex, age, burial practices, ritual practices, ethnographic material, and archaeological context. This system provides a biocultural approach, to interpret statistical analysis as well as the cultural context for the interpretation of those statistics.

Statistical analyses include common odds ratio and likelihood ratio, as calculated using SPSS 28.0 for Windows (SPSS, Inc. 1999). The Mantel-Haenszel common odds ratio estimate is used to describe the strength of association between two variables. If it is greater than 1.0 an association between two variables is inferred, with significance being

present at a p value greater than 0.05. The test is used to detect differential risk for a particular condition, (i.e., individuals experiencing trauma, within a sample). The odds ratio results provide a probability that a condition can be associated with a particular population, in this case violence as associated with colonial sites. This allows comparisons across multiple sites with various sample sizes. General descriptive statistics can allow for the identification of patterns in the frequency of location of trauma, sex, age, and antemortem or perimortem incidences comparatively between and within each site. As Waldron (2007) and Klaus (2014) both argued, odds ratios are probably the best statistical tool yet developed to compare prevalence between skeletal samples.

The sample from Point of Pines consists of a total of 140 individuals from the late period (1285-1450), with 60 males and 80 females. Only adults with an identified sex were included in the analysis. The sample includes both migrants and locals from sites AZ W:10:50, AZ W:10:51, and AZ W:10:52. The late period represents a major influx of migrants into the Point of Pines region, with 24 individuals inferred previously as representing the migrant population of 15 females and nine males (Table 2). Only adults were chosen and are presented for analysis. Data in Table 2 is represented by individual not number of injuries. Analysis considered both cranial and postcranial trauma as evidence of violence. Rodrigues assessed each traumatic injury for its potential to be accidental or of violent origin, only those marked as violent were considered in this study. The sample from Pueblo Bonito includes a total of 60 individuals, 47 individuals are from Pueblo Bonito-West and 13 individuals are from Room 33. The sample from

Hawikku includes a total of 121 individuals, with 50 males and 71 females. The sample from San Cristobal consists of 155 individuals, with a total of 74 males and 81 females.

**Table 2:** Data Available from Original Observers Used for This Thesis.

| SITE | SEX | CRANIAL TRAUMA | POSTCRANIAL TRAUMA | LETHAL TRAUMA | TOTAL TRAUMA | ORIGINAL OBSERVER |
|---|---|---|---|---|---|---|
| ***POINTOF PINES*** | **MALE** | 8/60 (13.3%) | 4/60 (6.7%) | 2/11 (18.2%) | 11/60 (18.3%) | Rodrigues 2008 |
| | **FEMALE** | 14/80 (17.5%) | 2/80 (2.5%) | 0/15 (0%) | 15/80 (18.8%) | |
| | **TOTAL** | 22/140 (15.7%) | 6/140 (4.2%) | 2/26 (7.7%) | **26/140 (18.6%)** | |
| ***POINT OF PINES MIGRANTS*** | **MALE** | 1/9 (11.1%) | 0/0 (0%) | 1/1 (100%) | 1/9 (11.1%) | |
| | **FEMALE** | 3/15 (20%) | 1/15 (6.7%) | 0/3 (0%) | 3/15 (20%) | |
| | **TOTAL** | 4/24 (16.7%) | 1/24 (4.2%) | 1/4 (25%) | **4/24 (16.7%)** | |
| ***PUEBLO BONITO WEST*** | **MALE** | 3/15 (20%) | 0/0 (0%) | 0/3 (0%) | 3/15 (20%) | Harrod 2013 |
| | **FEMALE** | 4/32 (12.5%) | 0/0 (0%) | 0/5 (0%) | 4/32 (12.5%) | |
| | **TOTAL** | 7/47 (14.8%) | 0/0 (0%) | 0/7 (0%) | 7/47 (14.8%) | |
| ***PUEBLO BONITO ROOM 33*** | **MALE** | 5/8 (62.5%) | 0/0 (0%) | 3/5 (60%) | 5/8 (62.5%) | |
| | **FEMALE** | 1/5 (20%) | 0/0 (0%) | 0/1 (0%) | 1/5 (20%) | |
| | **TOTAL** | 6/13 (46%) | 0/0 (0%) | 3/6 (50%) | **6/13 (46%)** | |
| ***HAWIKKU*** | **MALE** | 7/50 (14%) | 8/50 (16%) | 0/14 (0%) | 14/50 (28%) | Stodder 1990 |
| | **FEMALE** | 4/71 (5.6%) | 11/71 (15.5%) | 1/15 (6.67%) | 15/71 (21.1%) | |
| | **TOTAL** | 11/121 (9.1%) | 19/121 (15.7%) | 1/29 (3.4%) | **29/121 (24%)** | |
| ***SAN CRISTOBAL*** | **MALE** | 13/74 (17.5%) | 17/74 (22.9%) | 2/26 (7.6%) | 26/74 (35.1%) | |
| | **FEMALE** | 7/81 (8.6%) | 19/81 (23.5%) | 2/24 (8.3%) | 24/81 (29.6%) | |
| | **TOTAL** | 20/155 (12.9%) | 36/155 (23.2%) | 4/50 (8%) | **50/155 (32.3%)** | |

Previous archaeological analysis of Pueblo Bonito presents evidence of systemic stress and unequal access to resources among its populous. Elite individuals have also experienced nutritional deficiencies and lethal cranial trauma. Established literature provides evidence for the use of violence as social control amongst elite males within the region under Chaco Canyon's expansive influence. Violence as social control produces

an interconnectivity of the social adaptive system by squeezing out diverse mitigation options and ultimately breeding a rigidity trap. This rigidity trap led to Chaco Canyon's release and reorganization. As such, for hypothesis 1, I expect to see high frequencies of lethal cranial trauma among adult males at Pueblo Bonito. Hypothesis 1 will be tested by comparing frequencies of traumatic injuries amongst individuals in the Pueblo Bonito sample, presented by Harrod (2013), using the Mantel-Haenszel common odds ratio to assess patterns in the data.

Point of Pines Pueblo and its religious and social network systems successfully integrated a large aggregation of Kayenta migrants into their community. This successful integration of the migrant community suggests that their buffering systems maintain diversity and flexibility in the face of possible transformative change. Based on the archaeological context and resilience theory, for hypothesis 2, I expect to see no increase in the frequency of traumatic injuries specifically targeting incoming migrants to the Point of Pines Pueblo. Hypothesis 2 will be tested by comparing frequencies of traumatic injuries between local and migrant populations in the Point of Pines Pueblo sample, presented by Rodrigues (2008), using the Mantel-Haenszel common odds ratio, and mapping the location of injuries on an anatomical figure.

Established literature assessing Pueblo IV and Pueblo V period sites provides evidence for the closing off of alternative pathways that once help mitigate against transformative change. The drastic and massive event of colonial interactions in the region created turmoil in the form of outside factors such as violent colonial interactions, taxation practices, newly introduced agriculture, problematic relations with Plains groups,

and drastic change in the socioecological environment. All together, these external and internal transformative changes are not easily buffered against because of the removal and destruction of previously used pathways amongst the Ancestral Puebloans. As such, for hypothesis 3, I expect to see an increase in frequencies of lethal traumatic injuries evenly distributed amongst adult males and females at the colonial sites, as compared to the precolonial sites. Hypothesis 3 will be tested by comparing frequencies of traumatic injuries between the precolonial and colonial sample, presented by Stodder (1990), using the Mantel-Haenszel common odds ratio, and mapping the frequencies of injuries on an anatomical figure.

## CHAPTER FOUR: RESULTS

### Pueblo Bonito

Individuals from Pueblo Bonito show a total of 13/60 (21.7%) experiencing overall trauma. Rates of trauma for males in the Chaco region are highest amongst individuals from Room 33, 5/8 (62.5%). The inverse is true for females from Room 33, 1/5 (20%). The entire site, including Room 33 and the remainder of the samples includes a high frequency of male trauma, 8/23 (34.8%), with a comparatively lower frequency amongst females at Pueblo Bonito, 5/37 (13.5%) (Figure 3).

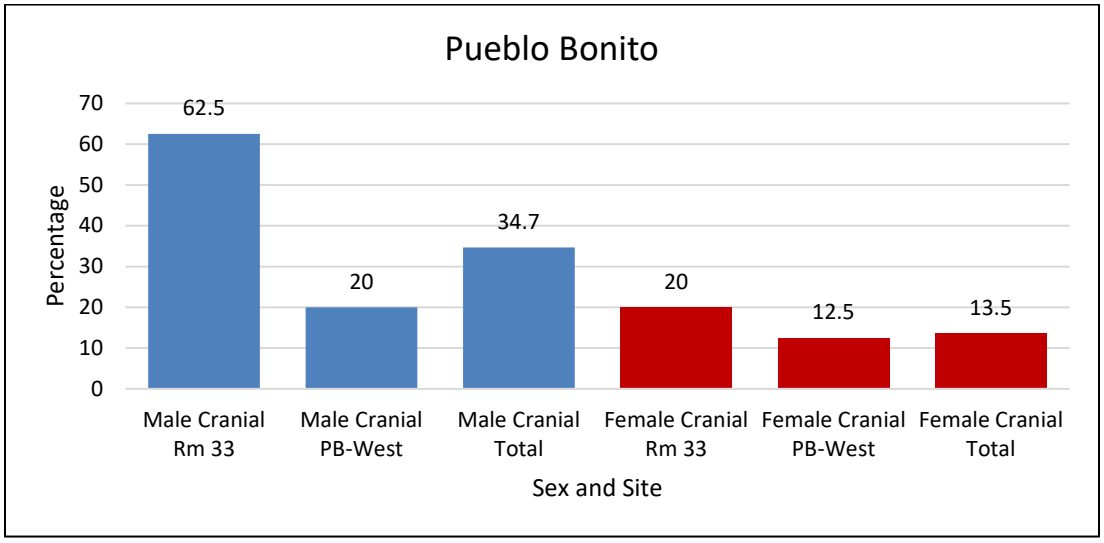


Figure 3: Pueblo Bonito Trauma Frequencies

Harrod (2013) provides only cranial trauma for the individuals from Pueblo Bonito-West and Room 33. Individuals from Pueblo Bonito exhibit 21.7% of the sample had cranial trauma, or 13/60. Of the individuals with cranial trauma, or 23.1% of the sample, experienced perimortem trauma, and all of them were from Room 33 – the elite burial (H/3661, H/3668, and H/3672). These individuals experience severe panfacial fractures, involving multiple facial bones, the cranial vault, and the mandible (Harrod, 2013). H/3361 and H/3668, both individuals date from (1023-1185 cal CE). While individual burial H/3672 has one of the oldest mean dates (690-940 cal CE).

Harrod provided very little specific anatomical location data for all individuals with cranial trauma. Statistical analysis was based purely on the brief description provided by Harrod and the numbers presents. Males from Pueblo Bonito are 2.5 times more likely to experience cranial trauma than females from Pueblo Bonito, as seen in Table 3.

Table 3: Pueblo Bonito Comparisons

| Comparison for Pueblo Bonito Sample | Likelihood | Odds Ratio | p Value |
|---|---|---|---|
| Pueblo Bonito Male Vs Female Cranial Trauma | 2.574 | 3.413 | 0.059 |

Hypothesis 1 argues that for the precolonial sites, Pueblo Bonito will show a higher frequency of male lethal cranial trauma, as violence as social control amongst males was utilized to buffer against environmental stressors. Females from Pueblo Bonito demonstrate a lower frequency of trauma when compared to their male peers, suggesting that males were the main actors in this form of violence. The common odds ratio

presented based on cranial trauma for both Room 33 and Pueblo Bonito-West provides support for Hypothesis 1.

## Point of Pines

Point of Pines during the late period shows 26/140 (18.6%) individuals experienced trauma. A total of 18.3% (11/60) of all males from the sample experienced overall trauma, while 18.8% (15/80) of females from the samples experienced overall trauma, showing very little difference. The sample exhibited 15.7% (22/140) of individuals with cranial trauma, comprising eight males and 14 females. Only two cases of perimortem cranial trauma were present in the sample. Both perimortem cases were male (one migrant and one local individual) who each exhibited a perimortem cranial depression fracture. Burial 70 from AZ W:10:50 was a male migrant aged 30-35 who experienced an oval depression fracture on the posterior-lateral quadrant if the right parietal. The CDF included radiating fracture lines, with the exterior depression measuring 17.51 mm x 10.53 mm. The second case of perimortem trauma was burial 24, a local male from AZ W:10:50 aged 40 years or older. This individual had three cranial depression fractures on the left frontal near the coronal suture. This local male also had over 30 cutmarks throughout the exterior cranial vault.

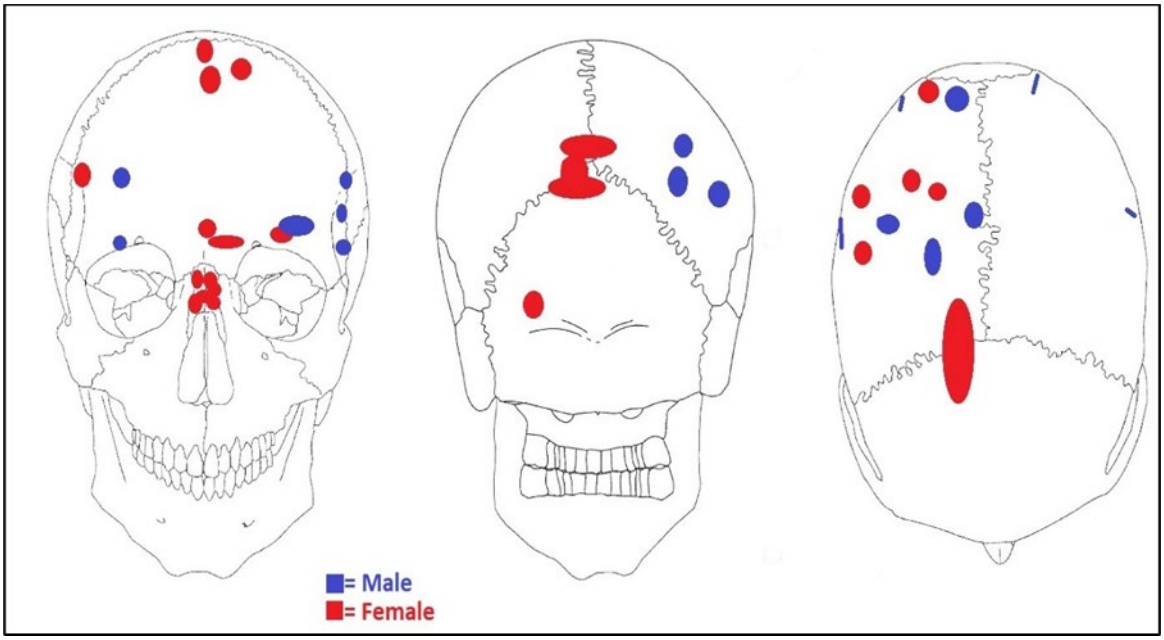

Figure 4: Point of Pines Cranial Trauma

All cranial injuries with provided information from Rodrigues (2008) are mapped in Figure 4, with postcranial injuries mapped in Figure 5. A total of four females exhibited broken nasal bones, possibly consistent with an isolated violent pugilistic event (Burials 260, 258, 065, 256 from AZ W:10:50). Individuals ranged from 20 to 40 years of age at death, each showing healed fractures of the left and right nasals with nasal thickening.

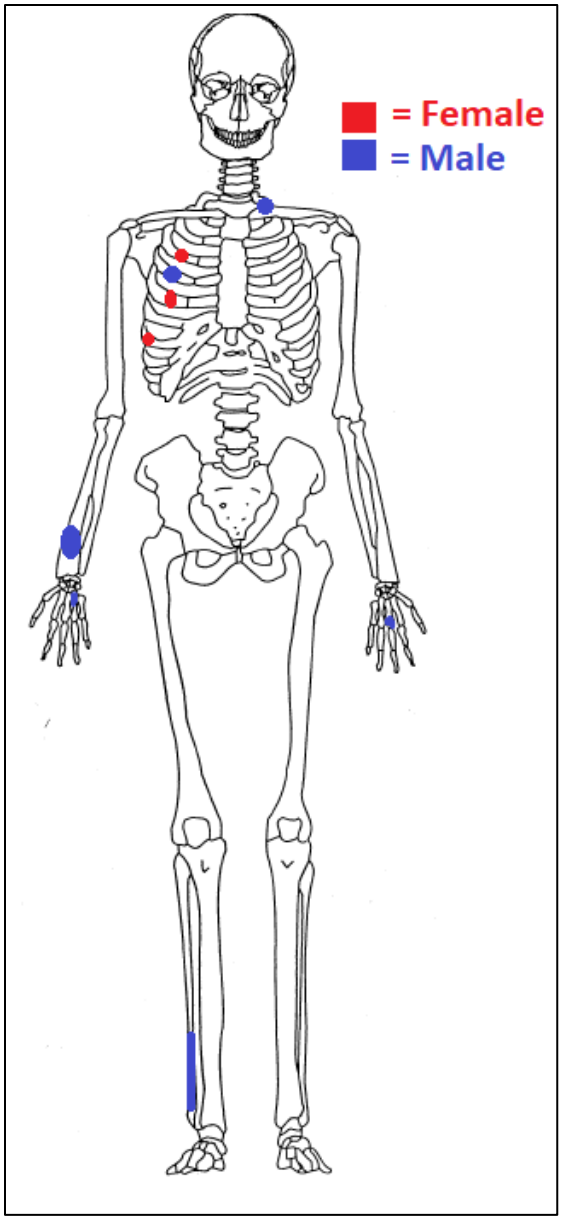

Figure 5: Point of Pines Postcranial Trauma

Four males and two females experienced postcranial trauma (Burials 88, 60, 249, 245, 251, and 263 from AZ W:10:50). Burial 88, a local male aged 20-25 years, experience a fracture of the third left metacarpal. Burial 60, a male aged 30-35, exhibited both cranial and postcranial trauma, with a depression fracture of the right frontal, a

fracture of the distal shaft of the fibula with the bone callus having fused to the tibia (side not mentioned) and a fracture of the left first rib. Burial 249, a local male aged 25-30, had a fracture of the distal shaft of the right radius. Burial 245, a local male aged 30-35, also shows a fracture metacarpal, affecting the proximal diaphysis of the fourth right metacarpal. This individual also has a fracture of a right rib. One female with postcranial trauma, Burial 251, aged 40 years and older, exhibited three right rib fractures with signs of healing. Burial 263, a female aged 18-20 years shows a traumatic compression fracture to T9 and T10 vertebrae.

Statistical analysis shows several trends in the likelihood of certain individuals experiencing more traumatic injuries than others. Utilizing a common odds ratio analysis and the Mantel-Haenszel common odds ratio estimate with asymptotic significance (2-sided, $p \leq 0.05$), several patterns are observed. Males from Point of Pines are 2.6 times more likely to experience postcranial trauma than females from the Point of Pines sample, and though this result is not significant, it does show a strong trend, nonetheless. Another large likelihood shows female migrants are 4.3 times more likely to experience postcranial trauma than local females. This result is not significant and could be this high likelihood due to the small sample size and that only one female migrant and one female local experiencing postcranial trauma. No other large or significant differences between males and females, and migrants and locals emerged in the statistical analysis (Table 4).

Table 4: Point of Pines Comparisons

| Comparison for Point of Pines Sample | Likelihood | Odds Ratio | p Value |
|---|---|---|---|
| Female Vs Male Cranial Trauma | 1.313 | 1.379 | 0.504 |
| Male Vs Female Postcranial Trauma | **2.667** | 2.786 | 0.246 |
| Female Vs Male Total Trauma | 1.023 | 1.028 | 0.95 |
| Local Vs Migrant Male Cranial Trauma | 1.235 | 1.273 | 0.832 |
| Local Vs Migrant Total Male Trauma | 1.765 | 1.951 | 0.55 |
| Migrant Vs Local Female Cranial Trauma | 1.182 | 1.22 | 0.778 |
| Migrant Vs Local Female Postcranial Trauma | **4.33** | 4.5 | 0.293 |
| Migrant Vs Local Female Total Trauma | 1.083 | 1.104 | 0.891 |
| Migrant Vs Local Total Cranial Trauma | 1.074 | 1.089 | 0.888 |
| Local Vs Migrant Total Postcranial Trauma | 1.034 | 1.036 | 0.975 |
| Local Vs Migrant Total Trauma | 1.138 | 1.17 | 0.792 |

For Hypothesis 2 I expect to see no increase in the frequency of traumatic injuries specifically targeting incoming migrants to the Point of Pines Pueblo. Our statistical analysis of the data provided by Rodrigues (2008) supports the lack of an increase of violence towards females, migrants, or children, and indicates flexibility in the site's inclusion of the large influx of migrants.

## Hawikku

Only adults with an identified sex were included in the analysis. A total of 29/121 (24%) individuals from the Hawikku sample experienced trauma. 14/50 (28%) males from the Hawikku sample experienced overall trauma, and 15/71 (21%) females from the Hawikku sample experienced overall trauma. While 11/121 (9.1%) individuals from the Hawikku sample exhibit cranial trauma, a higher frequency of 15.7% (19/121) of individuals from the Hawikku sample exhibit postcranial trauma. Only one individual showed perimortem cranial trauma (NMNH 308755), while all other injuries have signs of healing. A few individuals exhibit multiple extensive injuries (NMNH 308675,

308688), though these all effected individuals show signs of healing and some available function is inferred.

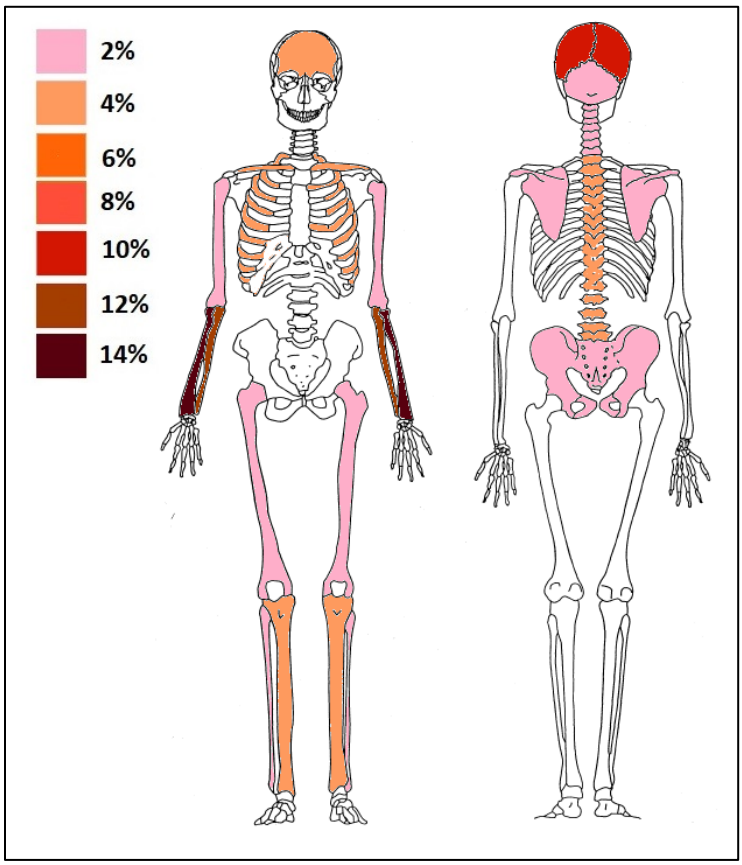

Figure 6: Hawikku Trauma Frequencies by Location

The kind of injuries observed in the Hawikku sample are mapped by frequency of trauma per skeletal element in Figure 6. Cranial fractures are the most common and account for 17.9% (7/39) of all traumatic injuries from the Hawikku sample. The parietal bone is the most commonly affected element. Upper limb fractures affecting multiple elements from both the upper and lower arm account for 17.9% (7/39) of the Hawikku

sample as well. Four individuals from Hawikku have multiple fractures to the arm, and three of them were older females aged 45+, and one male aged 55+ (Stodder, 1990). None of the arm fractures presented features of classical parry fractures. Most of the arm fractures were in the distal portion of the radius and ulna. The third most affected skeletal region is the spine at 15.4% (6/39) of all injuries. Many of the injuries to the lower spine were compression fractures. Stodder (1990) provided this element frequency without mention of side, sex distinction, or specific locations on each skeletal element.

Statistical analysis of trauma frequencies per male and female individuals provides no established trend. Males do show a higher frequency of trauma than females, though when tested with the Mantel-Haenszel common odds ratio estimate no statistically significant interactions arise. Males, however, are 2.4x more likely to experience cranial trauma than females in the Hawikku sample, though, as seen in Table 5, this result is not statistically significant.

Table 5: Hawikku Comparison

| Comparison for Hawikku Sample | Likelihood | Odds Ratio | p Value |
|---|---|---|---|
| Hawikku Male Vs Female Cranial | 2.485 | 2.727 | 0.127 |
| Hawikku Male Vs Female Postcranial | 1.033 | 1.039 | 0.385 |
| Hawikku Male Vs Female All Trauma | 1.325 | 1.452 | 0.384 |

Hypothesis 3 attempts to assess the destruction of social mitigation buffering techniques as a result of drastic changes created by colonialism. As such, I expect to see an increase in lethal cranial trauma, with even sex distributions at the colonial sites, Hawikku and San Cristobal. The frequencies of trauma do not significantly differ

between males and females, and there is indeed a higher frequency of overall trauma at Hawikku, when compared to the precolonial sites. The data support hypothesis 3.

## San Cristobal

Only individuals with identified sex and age were included in the analysis. A total of 50/155 (32.3%) individuals from the San Cristobal sample experienced trauma. 13/74 (17.5%) males from the San Cristobal sample exhibit cranial trauma, and 7/81 (8.6%) females from the San Cristobal sample exhibit cranial trauma. A total of 20/155 (12.9%) individuals from the San Cristobal sample exhibit cranial trauma, with a higher percentage of 23.2% (36/155) of all trauma at San Cristobal affecting postcranial elements. Four adults from the San Cristobal sample have perimortem cranial trauma, which could be a possible cause of death (AMNH 6702, 8583, 8719, 6742). One adult male exhibited an unhealed spiral fracture of the proximal left radius and ulna (AMNH 8747) (Stodder, 1990).

The kinds of injuries observed in the San Cristobal sample are mapped by frequency of trauma by skeletal element (Figure 7). Cranial fractures are the most common, accounting for 28.5% (18/64) of all injuries, with the parietal bone being the most affected element. The upper limb including the humerus, radius, ulna, and scapula, account for 17.2% (11/64) of all traumatic injuries. Compression fractures of the thoracic and lumbar vertebrae also account for 17.2% (11/64) of all skeletal injuries.

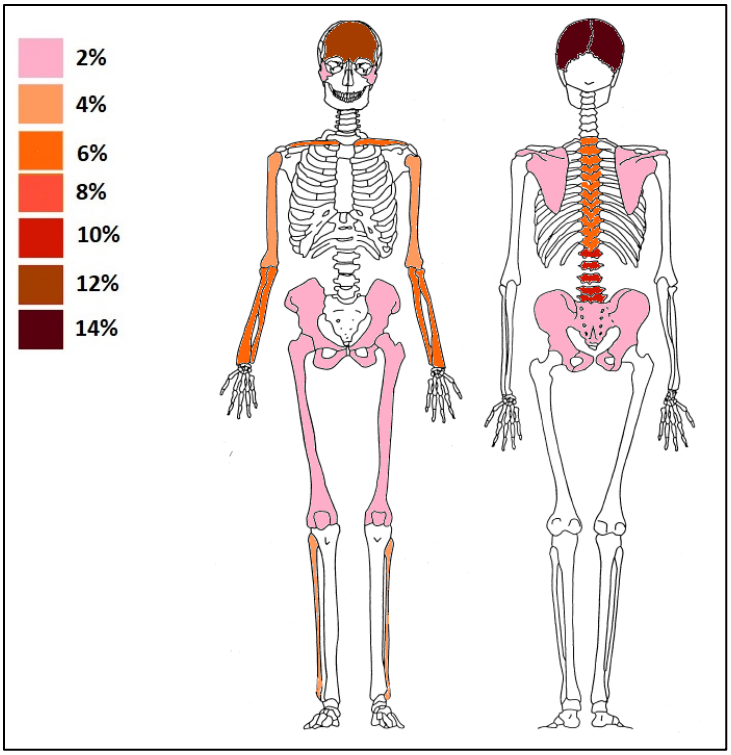

Figure 7: San Cristobal Trauma Frequencies by Location

Statistical analysis comparing likelihoods for experiencing trauma show that males from San Cristobal are 2.03 times more likely to experience cranial trauma than females. As seen in Table 6, none of these comparisons produced statistically significant results.

Table 6: San Cristobal Comparison

| Comparison for San Cristobal Sample | Likelihood | Odds Ratio | P Value |
|---|---|---|---|
| San Cristobal Male v Female Cranial | 2.033 | 2.253 | 0.104 |
| San Cristobal Female v Male Postcranial | 1.021 | 1.028 | 0.943 |
| San Cristobal Male v Female All Trauma | 1.186 | 1.286 | 0.464 |

Hypothesis 3 attempts to assess the destruction of social mitigation buffering techniques as a result of drastic changes created by colonialism. As such, I expect to see an increase in lethal cranial trauma, with even sex distributions at the colonial sites, Hawikku and San Cristobal. The frequencies of trauma do not significantly differ between males and females, and there is indeed a higher frequency of overall trauma at San Cristobal, when compared to Hawikku and the precolonial sites. The data support hypothesis 3.

## Comparisons

### Pueblo Bonito Comparisons

The Mantel-Haenszel common odds ratio estimate provides evidence of significant trends when comparing trauma frequencies at Pueblo Bonito to Point of Pines, Hawikku, and San Cristobal (Table 7). Three comparisons stand out as exhibiting significant interactions. Individuals from Pueblo Bonito are 2.3 times more likely to experience cranial trauma than individuals at Hawikku. Males from Pueblo Bonito are 2.4 times more likely to experience cranial trauma than males from Hawikku. Finally, males from Pueblo Bonito are 2.6 times more likely to experience cranial trauma than males from Point of Pines. There are large likelihoods of males from Pueblo Bonito being at a higher risk of experiencing lethal cranial trauma than San Cristobal and Hawikku.

Table 7: Pueblo Bonito Comparisons to Other Sites

| Pueblo Bonito Comparisons to Other Sites | Likelihood | Odds Ratio | P Value |
|---|---|---|---|
| Pueblo Bonito vs Hawikku Total Lethal Trauma | **6.692** | **8.4** | 0.079 |
| Pueblo Bonito vs San Cristobal Male Lethal Trauma | **4.875** | **7.2** | 0.057 |
| Pueblo Bonito vs Point of Pines Total Lethal Trauma | **3** | **3.6** | 0.195 |
| Pueblo Bonito vs San Cristobal Total Lethal Trauma | **2.885** | **3.45** | 0.14 |
| Pueblo Bonito vs Point of Pines Male Cranial Trauma | **2.609** | **3.467** | **0.032** |
| Pueblo Bonito vs Hawikku Male Cranial Trauma | **2.484** | **3.276** | **0.047** |
| Pueblo Bonito vs Hawikku Female Cranial Trauma | **2.399** | **2.617** | 0.172 |
| Pueblo Bonito vs Hawikku All Cranial Trauma | **2.383** | **2.766** | **0.022** |
| Pueblo Bonito vs Point of Pines Male Lethal Trauma | **2.063** | **2.7** | 0.353 |
| Pueblo Bonito vs San Cristobal Male Cranial Trauma | **1.98** | 2.503 | 0.086 |
| Pueblo Bonito vs Point of Pines Male Total Trauma | 1.897 | **2.376** | 0.116 |
| Pueblo Bonito vs San Cristobal Total Cranial Trauma | 1.679 | 1.867 | 0.113 |
| Pueblo Bonito vs San Cristobal Female Cranial Trauma | 1.564 | 1.652 | 0.42 |
| Pueblo Bonito vs Point of Pines All Cranial Trauma | 1.379 | 1.484 | 0.312 |
| Pueblo Bonito vs Hawikku Male All Trauma | 1.242 | 1.371 | 0.558 |
| Pueblo Bonito vs Point of Pines All Trauma | 1.167 | 1.213 | 0.613 |

The data presented in Table 7, provides trends of support for individuals at Pueblo Bonito experiencing a high risk of lethal trauma among males, both from Room 33 and Pueblo Bonito-West. Pueblo Bonito shows a high prevalence of disease and malnutrition, even among the elites this poor health matches with high frequencies of lethal trauma amongst males (regardless of social status), indicating a failed buffering system and possible rigidity trap, providing support for Hypothesis 1.

**Point of Pines Comparisons**

Using the results of the Mantel-Haenszel common odds ratio estimate, individuals from Point of Pines show only one statistically significant interaction (Table 8). Females from Point of Pines are 3.1 times more likely to experience cranial trauma than females from Hawikku, and this interaction is significant. The data points towards another trend

of Point of Pines exhibiting a higher risk of lethal trauma and female cranial trauma than Hawikku and San Cristobal, though these interactions are not considered statistically significant.

Table 8: Point of Pines Comparisons to Other Sites

| Comparison for Point of Pines to Other Sites | Likelihood | Odds Ratio | P Value |
|---|---|---|---|
| Point of Pines vs Hawikku Female Cranial Trauma | **3.106** | **3.553** | **0.032** |
| Point of Pines vs San Cristobal Male Lethal Trauma | **2.364** | **2.667** | 0.361 |
| Point of Pines vs Hawikku Total Lethal Trauma | **2.23** | **2.333** | 0.5 |
| Point of Pines vs San Cristobal Female Cranial Trauma | **2.025** | **2.242** | 0.101 |
| Point of Pines vs Hawikku Total Cranial Trauma | 1.729 | 1.864 | 0.112 |
| Point of Pines vs Pueblo Bonito Total Female Trauma | 1.388 | 1.477 | 0.486 |
| Point of Pines vs Pueblo Bonito Female Cranial Trauma | 1.295 | 1.358 | 0.45 |
| Point of Pines vs San Cristobal Total Cranial Trauma | 1.218 | 1.258 | 0.491 |

There is a possibility for error, as the Hawikku sample only shows evidence of one incidence of perimortem trauma. This small sample size can drastically affect the statistical analysis.

**Hawikku Comparisons**

Trends exhibited from the Mantel-Haenszel common odds ratio estimate, suggests that individuals from Hawikku have a higher likelihood to experience trauma than Point of Pines and Pueblo Bonito (Table 9). Females from Hawikku are 6.1 times more likely to experience postcranial trauma than females from Point of Pines, and this interaction is significant. This might be due to the small sample size of just two individuals exhibiting postcranial trauma at Point of Pines. Males from Hawikku are 2.4 times more likely to

experience postcranial trauma than males from Point of Pines and this interaction is significant. Finally, individuals from Hawikku are 3.6 times more likely to experience postcranial trauma than individuals from Point of Pines, though this result is not statistically significant. Most importantly, there is an interaction (odds ratio is greater than 1.0) of males and females from Hawikku having a higher likelihood of experiencing trauma than males and females from Point of Pines and Pueblo Bonito.

Table 9: Hawikku Comparisons to Other Sites

| Comparison for Hawikku to Other Sites | Likelihood | Odds Ratio | P Value |
|---|---|---|---|
| Hawikku vs Point of Pines Female Postcranial Trauma | **6.197** | **7.15** | **0.013** |
| Hawikku vs Point of Pines Total Postcranial Trauma | **3.664** | **4.16** | **0.003** |
| Hawikku vs Point of Pines Male Postcranial Trauma | **2.4** | **2.667** | 0.129 |
| Hawikku vs Pueblo Bonito Female All Trauma | 1.563 | 1.714 | 0.337 |
| Hawikku vs Point of Pines Male All Trauma | 1.527 | 1.732 | 0.231 |
| Hawikku vs Point of Pines Total Trauma | 1.291 | 13.82 | 0.288 |
| Hawikku vs Point of Pines Female Total Trauma | 1.127 | 1.161 | 0.715 |
| Hawikku vs Pueblo Bonito Total Trauma | 1.106 | 1.14 | 0.73 |
| Hawikku vs Point of Pines Male Cranial Trauma | 1.05 | 1.058 | 0.919 |

This greater likelihood of experiencing trauma among individuals from Hawikku as compared to the precolonial sites, suggests support for hypothesis 3. Higher frequencies relative to precolonial sites in the region are hypothesized due to the drastic transformative event of colonialism. Thus, an increase in lethal trauma, especially in the cranium, would indicate increased interpersonal conflict in the region, as well as failure of mitigation techniques resulting in the collapse of the adaptive system. While there is no trend for an increase in lethal trauma, there is an established trend of an increase in

frequency of overall trauma and a higher likelihood of experiencing overall trauma among individuals at Hawikku.

**San Cristobal Comparisons**

San Cristobal exhibits the most situations in which there is a higher risk for individuals from the site when compared to others using the Mantel-Haenszel common odds ratio estimate (Table 10). Individuals from San Cristobal have a higher risk of experiencing postcranial trauma than individuals at Point of Pines and this interaction is statistically significant. Individuals from San Cristobal exhibit a 2.3 times likelihood of experiencing lethal trauma than individuals from Hawikku and this interaction is significant. Females from San Cristobal show an increased risk of being 2.1 times more likely to experience trauma than females from Pueblo Bonito. The San Cristobal sample is significantly more likely to experience cranial and postcranial trauma, regardless of sex, than at Point of Pines. The San Cristobal sample is more likely to experience cranial, postcranial, and lethal trauma, regardless of sex, than the Hawikku sample, though this is not significant. Finally, though not statistically significant, individuals from San Cristobal are 1.4 times more likely to experience trauma than individuals from Pueblo Bonito.

Table 10: San Cristobal Comparisons to Other Sites

| Comparison for San Cristobal to Other Sites | Likelihood | Odds Ratio | P Value |
|---|---|---|---|
| San Cristobal vs Point of Pines Female Postcranial Trauma | **9.383** | **11.952** | **0.001** |
| San Cristobal vs Point of Pines Total Postcranial Trauma | **5.4** | **6.75** | **0.0001** |
| San Cristobal vs Point of Pines Male Postcranial Trauma | **3.446** | **4.175** | **0.015** |
| San Cristobal vs Hawikku Total Lethal Trauma | **2.32** | **2.435** | 0.436 |
| San Cristobal vs Pueblo Bonito Female All Trauma | **2.193** | **2.695** | 0.066 |
| San Cristobal vs Point of Pines Male Total Trauma | **1.916** | **2.413** | **0.033** |
| San Cristobal vs Point of Pines Total Trauma | **1.737** | **2.088** | **0.008** |
| San Cristobal vs Point of Pines Female Total Trauma | 1.58 | 1.825 | 0.11 |
| San Cristobal vs Hawikku Female Cranial Trauma | 1.534 | 1.584 | 0.478 |
| San Cristobal vs Hawikku Female Postcranial Trauma | 1.514 | 1.672 | 0.221 |
| San Cristobal vs Pueblo Bonito Total Trauma | 1.489 | 1.722 | 0.128 |
| San Cristobal vs Hawikku Total Postcranial Trauma | 1.4679 | 1.624 | 0.123 |
| San Cristobal vs Hawikku Male Postcranial Trauma | 1.436 | 1.566 | 0.345 |
| San Cristobal vs Hawikku Total Cranial Trauma | 1.419 | 1.481 | 0.322 |
| San Cristobal vs Hawikku Female Total Trauma | 1.402 | 1.572 | 0.233 |
| San Cristobal vs Hawikku Total Trauma | 1.346 | 1.511 | 0.132 |
| San Cristobal vs Point of Pines Male Cranial Trauma | 1.318 | 1.385 | 0.504 |
| San Cristobal vs Hawikku Male Cranial Trauma | 1.255 | 1.309 | 0.597 |
| San Cristobal vs Hawikku Male Total Trauma | 1.255 | 1.393 | 0.405 |
| San Cristobal vs Hawikku Female Lethal Trauma | 1.25 | 1.273 | 0.805 |
| San Cristobal vs Point of Pines Lethal Trauma | 1.04 | 1.043 | 0.962 |
| San Cristobal vs Pueblo Bonito Male All Trauma | 1.01 | 1.016 | 0.975 |

Of the four sites being compared, Table 10 shows more patterns as relating to individuals from San Cristobal experiencing higher risk of trauma than the other three sites in this study, providing support for Hypothesis 3. While there is no trend for an increase in lethal trauma as compared to the precolonial sites, there is an established trend of an increase in frequency of overall trauma and a higher likelihood of experiencing overall trauma among individuals at San Cristobal, as compared to the precolonial sites.

**Diachronic Comparisons**

To create the subset of data relating to the time period of precolonial sites, both Pueblo Bonito and Point of Pines provide a total of 200 individuals. The sample consists of 83 males and 117 females. A total of 19/83 (22.9%) males from the precolonial sample exhibit trauma, while 20/117 (17.1%) females from the precolonial sample exhibit trauma. Combining data from Pueblo Bonito and the Point of Pines samples to create the subset of precolonial data, exhibited a trend of males experiencing a higher risk of traumatic injures compared to females (Table 11). An important note for future comparisons, the Pueblo Bonito sample consisted only of cranial trauma, which may cause errors in comparisons of postcranial trauma for the precolonial sample.

Table 11: Precolonial Comparisons

| Precolonial Comparison | Likelihood | Odds Ratio | P Value |
|---|---|---|---|
| Precolonial Male vs Female Postcranial Trauma | **2.81** | **2.9** | 0.224 |
| Precolonial Male vs Female All Trauma | 1.54 | 1.7 | 0.133 |
| Precolonial Male vs Female Cranial Trauma | 1.187 | 1.232 | 0.578 |

The subset of the colonial sample includes all individuals from the Hawikku and San Cristobal assemblages. The sample consists of 276 individuals, with 124 males, and 152 females. 40/124 (32.3%) males from the colonial sample exhibit trauma, and 39/152 (25.7%) females from the colonial sample exhibit trauma. Fifty-five individuals from the colonial sample exhibit postcranial trauma, as compared to only six individuals from Point of Pines representing the precolonial sample. This difference is certainly due to the exclusion of postcranial traumatic injury data from the Pueblo Bonito sample. Statistical

analysis of the common odds ratio shows trends of males from the colonial sample being more likely to experience cranial trauma than females and this comparison is significant.

Table 12: Colonial Comparison

| Colonial Comparison | Likelihood | Odds Ratio | P Value |
|---|---|---|---|
| Colonial Male Vs Female Cranial Trauma | **2.229** | **2.465** | **0.023** |
| Colonial Female Vs Male Lethal Trauma | 1.538 | 1.583 | 0.626 |
| Colonial Male Vs Female Total Trauma | 1.257 | 1.38 | 0.228 |
| Colonial Male Vs Female Postcranial Trauma | 1.022 | 1.027 | 0.93 |

To test hypothesis 3, that higher frequencies of skeletal trauma in the colonial sample relative to precolonial sites in the region are hypothesized due destructive colonial practices. Table 13 presents common odds ratios between the colonial and precolonial sites.

Almost every interaction assessed with the common odds ratio between the two samples is significant. This provides evidence of important trends when discussing the impacts of colonialism on the Indigenous peoples of the American Southwest. The colonial sample has a significantly higher risk of female postcranial and total trauma when compared to the precolonial sample. The colonial sample also has a significantly higher risk of more postcranial and total trauma, as compared to the precolonial sample. This extends to all individuals from the colonial sample experiencing a higher risk of total and postcranial trauma than the precolonial sample, and this result is significant.

Table 13: Precolonial and Colonial Comparisons

| Precolonial and Colonial Comparisons | Likelihood | Odds Ratio | P Value |
|---|---|---|---|
| Colonial Vs Precolonial Female Postcranial Trauma | **11.546** | **14.139** | **0.0001** |
| Colonial Vs Precolonial Female Total Trauma | **1.732** | **1.985** | **0.025** |
| Colonial Vs Precolonial Male Postcranial Trauma | **4.183** | **4.987** | **0.004** |
| Colonial Vs Precolonial Male Total Trauma | 1.409 | 1.604 | 0.145 |
| Colonial Vs Precolonial Total Trauma | **1.468** | **1.655** | **0.024** |
| Colonial Vs Precolonial Total Postcranial Trauma | **6.643** | **8.47** | **0.0001** |
| Precolonial Vs Colonial Female Cranial Trauma | **2.244** | **2.485** | **0.023** |
| Precolonial Vs Colonial Male Cranial Trauma | 1.195 | 1.242 | 0.559 |
| Precolonial Vs Colonial Male Lethal Trauma | **5.263** | **6.786** | **0.032** |
| Precolonial Vs Colonial Total Cranial Trauma | **1.558** | **1.676** | **0.052** |
| Precolonial Vs Colonial Total Lethal Trauma | 2.026 | 2.176 | 0.243 |

The precolonial sample has a significantly higher risk of experiencing female cranial trauma and total individual cranial trauma than the colonial sample. Finally, the precolonial sample also shows a higher risk of experiencing male lethal trauma than males from the colonial sample, and this result is significant.

These results show trends of higher trauma in both the precolonial and colonial samples in relation to each other. Interactions of note are the higher risk of cranial trauma in precolonial sites, and not in colonial sites, as well as total and postcranial trauma being more prevalent in the colonial sites. This analysis and the significant results from the common odds ratio support hypothesis 3 and suggest high frequencies and greater risk of skeletal trauma in colonial sites as a result of European interactions. However, the differences in cranial trauma frequencies between precolonial sites and colonial sites are unique.

# CHAPTER FIVE: DISCUSSION

Bioarchaeological research into the American Southwest originated with a narrow focus on descriptive analysis of single instances of disease or violence (Stodder, 2012; Stodder, 2017; Buikstra and DeWitte, 2019). Contemporary studies have moved away from this insular perspective and style of analysis, focusing instead on how evidence from individual experiences can create population level analysis and conclusions (Grauer, 2012; Zuckerman et al., 2012). Comparatively little excavation has occurred in the recent decades in the Southwest as compared to over a hundred years ago. These initial investigations and excavations of Southwest sites produced a variety of data points regarding past lifeways. However, mass amounts of data and field notes were destroyed, misplaced, lost, removed from the record, or are not applicable due to changes in archaeological theory and technology (Stodder, 1990; Rodrigues, 2008). The historical shift from description to population studies has drastically allowed an advance in the analysis of the daily lives of the people from the American Southwest, particularly in the face of great adversity.

Bioarchaeological investigations into the history of the Southwest have encountered obstacles due to the increase in repatriation efforts of legacy collections of skeletal remains. This is a necessary and positive contribution to the collaboration between archaeologists and Indigenous communities. However, this also presents a need

for reanalysis of previously published skeletal data through new archaeological, bioarchaeological, and anthropological theoretical lenses. Updated age and sex estimation methods, as well as statistical analyses allows for the expansion of knowledge by integrating updated technological innovations with emerging theoretical paradigms.

This study sought to reassess the analysis of traumatic injuries from individuals at Point of Pines, Pueblo Bonito, Hawikku, and San Cristobal through the lens of resilience theory. Statistical analysis reworked the old data to elucidate new patterns in the previously analyzed skeletal assemblages. This updated analysis of the poorly excavated and documented burials and skeletal assemblages produces new insight into the drastic effects of colonialism in the American Southwest. This chapter provides a discussion and synthesis of the statistical analysis and addresses the conclusions of the previous researchers through the lens of resilience theory.

## Pueblo Bonito Evidence of Violence

Harrod's (2013) analysis of the entire Chaco phenomenon indicates certain groups prospering as elites and others as subordinates, with the height of this cultural complex providing a period of relative peace. Sites differed in trauma frequency, such as Pueblo Bonito and Pueblo del Arroyo in the Chaco Canyon. These two groups of people show a higher frequency of overall trauma among men and a lower frequency of overall trauma among women, which seemed to support a scenario in which men are competing for status and women of higher status were buffered from violence. Males from a higher status burial had greater rates of injury because they were more apt to engage in this face-to-face combat in order to gain status. The fighting would have been highly ritualized and

performed by adult members of both sexes who would have been high-status members of corresponding household groups. Based on the grave goods and the location of the burials, both the men and women that had lethal wounds appeared to have been elite individuals (Harrod, 2013).

While the Pueblo Bonito sample is unfortunately limited and only provides data for cranial trauma, there are still some important trends to be discussed. Within Room 33, the elite burial, 62.5% of males experienced overall trauma. Amongst the females from Room 33, however, only one individual experienced overall trauma, representing 20% of the sample. Including both Room 33 and individuals from Pueblo Bonito West, 34.8% of males experienced overall trauma, while only 13.5% of females at Pueblo Bonito experienced overall trauma. There seems to be a higher prevalence and a higher likelihood of males experiencing cranial trauma than females.

The trauma present among females at the site could represent both high-status females experiencing isolated violent encounters but could also just as likely be participating in competitive fighting similar to the high-status males. When considering the possibility that women can be the aggressors, it is feasible that the one female with trauma from Room 33 was not a victim but an actual participant in this ritual conflict. This system of high-status individuals could represent and intersection between both a hierarchy and a heterarchy in which an individual's status would not be ascribed but achieved. This system could explain the high frequencies of extended periods of stress as a child, even among high-status individuals (Harrod, 2013; Tegtmeyer and Harrod, 2017; Harrod et al., 2017; Stodder and Martin, 1992). The data itself indicates that males were

more involved in the violence, and they buffered the females from this violence, specifically at Pueblo Bonito West and Pueblo Bonito Room 33.

All of the lethal cranial trauma is primarily concentrated in the elite burial from Room 33. The specific types of injuries experienced by the elite males include pan facial fractures, fractures of the cranial vault, and of the mandible (Harrod, 2013). This trend indicates face-to-face fighting occurring competitively amongst elite males and would be further supplemented if there were postcranial injuries indicative of offensive wounds, such as distal metacarpal fractures (Novak, 1999). Harrod (2013) also supplies a general overview of other sites within the Chaco Canyon influential region, where it is clear that females at Pueblo Bonito were the most buffered against this kind of trauma. The trends clearly establish face-to-face interpersonal violence and competitive fighting amongst elite males at the Pueblo Bonito site.

High prevelance of lethal cranial trauma amongst males certainly support Harrod's conclusions that a rigid hierarchy utilized violence as social control amongst elite males. This rigid social control also, unfortunately, contributed to a lack of flexibility, which can be seen in the nutritional health of the individuals buried at Pueblo Bonito and Room 33 (Harrod, 2013). This conjunction of both poor nutritional health and a high frequency of lethal cranial trauma supports the idea of a rigid system that did not maintain buffering of the people against socioecological hardships.

**Pueblo Bonito and the Chaco Phenomenon**

Rainfall farming, also called dry farming, was the major agricultural strategy in the northern Pueblo region (Cordell and McBrinn, 2012; Plog, 1997). There is no clear

archaeological evidence for investment in canal irrigation, suggesting that rainfall was probably the most important environmental parameter that affected crop production. The use of dry-farming as a subsistence strategy in the American Southwest coexists with constant resource unpredictability. Seasonal variation described by Dean (1996) implies that this was a key factor in the success of dry farming. The entire subsistence pattern relates to rain and, as such, many cultural and ritual components of these communities revolved around rain. Reliance on rainfall is present in Pueblo ceremonialism, which attempts to encourage or ensure rainfall, as evidenced in ethnographies.

Scalping during war was an important aspect of Pueblo communities (Ellis, 1951). Warriors returned these scalps to the community and placed them within the Kivas as an important acknowledgment of the warrior society and a symbol of victory. Scalps specifically were considered effective in rainmaking, in that the rain was required for the agricultural and subsistence strategy of dry farming. In particular, high religious importance surrounded these scalps being returned along with the Warriors from a victorious warfare expedition, as they were considered makers of future rainfall. Specifically, the Warriors themselves were expected to turn this supernatural killing power towards weather control, either through fasting or ceremonies that were considered physically exhausting (Ellis, 1951).

Dean (1996) discusses patterns in environmental variability that roughly correspond to resilience theory's various spatial, temporal scales, which range from a slow and large to a fast and small scale. Periods of high temporal variability, present in tree-ring indices, are rapid and take place over scales of around 1 to 10 years, while

periods of low temporal variability occur over several decades. High temporal variability means rapid short-term oscillations of precipitation, while low temporal variability maintains long-term stable or unstable precipitation regimes. Cultural systems can adapt to either circumstance. This adaptation throughout the Ancestral Puebloans history is seen in new storage technologies, intensification of agricultural practices, and migration to new places (Dean, 1996; Lekson, 2002).

During periods of low temporal variability, subsistence decisions could be made within a reasonable degree of predictability. In the regimes of high temporal variability, change was constant, so any predictive decision making could easily be wrong and, therefore, the risk was considered high (Lekson, 2002). The American Southwest is already a marginal environment where slight variations in rainfall can make enormous differences between subsistence success and failures. However, the rapid and unpredictable oscillations between wet and dry years challenge these traditional mitigation techniques and exceed the existing strategies for subsistence adjustments previously utilized in the social memory of the adaptive system. This challenge to the social memory of responses to extreme environmental conditions correlates with increased resource unpredictability.

The Ember and Ember (1992) model of resource unpredictability refers to non-chronic resource problems related to natural disasters or punctuations of the cycle. The inability to maintain an adaptive system under high temporal variation regimes and a marginal environment breeds an unstable socioecological relationship (Lekson, 2002). Therefore, the unpredictability of resources seems to correlate with high temporal

variability. In Lekson's (2002) analysis of environmental scales and frequencies of violence, periods of high instances of resource unpredictability correlate with high frequencies of violence and warfare. Therefore, high amounts of warfare can fluctuate with times of relative peace, where it is the fear of warfare, or the fear of mistrust, that perhaps creates stability indicated by the lack of high trauma frequencies during these intermediate periods (LeBlanc, 1999). However, it is also possible to respond to the short-term, high temporal variability with raiding and warfare. To assess this correlation, analysis of a ruling polity in which most resources were imported and exported under the watchful eye of an elite ruling class, elucidates reactions to resource unpredictability among the Ancestral Puebloans.

A new form of social violence arises during the "Pax Chaco," characterized by a series of group executions, or extreme processing events, as recognized as occurring in the Northern Pueblo area between the late 900s and the 1250s by LeBlanc (1999). These extreme processing events could have emerged due to the socialization of mistrust and fear. The enculturation of an "us versus them" ideology along with the socialization of fear and mistrust could have made these violent events and outburst more acceptable.

Leblanc's (1999) chronology of violence in the American Southwest places the middle period, 900s to 1250, as a time of considerable peace punctuated with extreme processing events and group executions. This is unique regarding Pueblo Bonito's influence correlating with a majority of this period and subsequent collapse signifying the end of the "Pax Chaco." Either the fear of war or the use of these extremely performative acts of violence, the extreme processing events, were used as a form of social control to

prevent the previous styles of raiding and feuding that plagued the late early period from 700s to 900s CE.

Chaco Canyon, and therefore Pueblo Bonito, arose as a political solution to the raiding and feuding that were prevalent as forms of violence in the late early period. The arrival of Chaco Canyon as a center of political power and the end of this early raiding and feuding era correspond at around 900 CE. However, the period of resource unpredictability does not end until the period of 1000 CE. Therefore, it is thought that Chaco Canyon arose to act as a mitigation technique against this unpredictability of resources and the raiding and feuding that corresponds to it. This use of socialization of mistrust would have resulted from enculturation, where people grew up with this mistrust of others (Lekson, 2002). Therefore, the "Pax Chaco" did exist during the height of Pueblo Bonito.

Pueblo tradition indicates there was considerable anxiety over power that was controlled by both supernatural forces and specific groups of warriors (Ellis, 1951). The Warrior society had a negative social impact when one group incurred the fear and envy of others by showing too much evidence of supernatural power. One can equate the presence of fear and envy to the situation at the height of Pueblo Bonito's power, where there were multiple instances of extreme processing events that have been related to witchcraft and witch killings (Darling, 1999). This time may have been deprived of previous warfare relations, however, the fear and envy of other groups possibly caused outbreaks of violent events.

These events of released aggression and fear were highly performative and highly witnessed acts. High resource unpredictability did not mark the period of 1000 CE to 1250 CE and corresponds to LeBlanc's (1999) peaceful middle period. Therefore, resource predictability and peace co-occurred. Though the middle period is marked with unprecedented peace, extreme processing events and group executions also punctuated this era.

The middle period (1000-1250 CE), mentioned by LeBlanc (1999), constituted the rise of Pueblo Bonito elites and the overall hierarchy at Chaco Canyon. This emerging hierarchical system began the interconnectivity of the various aspects of the Chaco culture, and specifically, how politics became intertwined with social inequality and environmental conditions. Pueblo Bonito's feedback loop with the surrounding landscape enabled the creation of social control through violence as a reaction to the unpredictability of resources. Initially, this would have worked in the short-term, but as is see at the end of the Chaco reign, as well as the results from the analysis of Pueblo Bonito cranial trauma, the mitigation technique did not work in the long-term.

The interconnectivity between parts of the adaptive system created a rigidity trap by not allowing for flexibility in the social memory, as violence as social control was utilized and remembered as the only useful technique. For mitigation against these periods of high temporal variability, the use of this social control through violence and these extreme processing events would have had long-lasting cultural impacts. This period of breeding mistrust, fear, and rigidity would have exacerbated and escalated warfare following the collapse of Pueblo Bonito (Lekson, 2002). These short-term violent

techniques as reactions to the unpredictability of climatic temporal change certainly had drastic effects on the long-term adaptability and flexibility of Chaco Canyon and its outliers.

**Consequences of the Rigidity Trap**

The interconnectivity of these components of the Chacoan system suggests proliferation of a rigidity trap, where sociopolitical and environmental inequality produced a lack of flexibility when reacting to drastic environmental situations. Pueblo Bonito and Chaco Canyon's expansive cultural influence had negative impacts on their environmental flexibility. Pueblo Bonito, as the elite center for exotic trade goods into the rest of the American Southwest, coming from Mesoamerica, required an established hierarchy to maintain control over this exchange. The use of this hierarchy, unfortunately, created inflexible interconnectivity between the sociopolitical world and all the material resources needed at Pueblo Bonito. This system spawned social hierarchy and inequality that added to the interconnectivity between different parts of the system, making a more rigid adaptive cycle. This rigidity is reflected in the use of violence as social control amongst the elite. Pueblo Bonito Room 33 exhibited a high frequency of lethal cranial trauma amongst males when compared to other sites within the Chacoan cultural influence (Harrod, 2013). This use of violence and competitive violence for resources, control prestige, and politics certainly took a toll on the lives of the elite individuals present at Pueblo Bonito.

Chaco Canyon's explicit rules and regulations created inequality between its members and contributing regional networks. Pueblo Bonito's position as a religious,

political, and cultural center reduced the amount of raiding and feuding that occurred throughout the region, while inversely increasing rigidity using violence within the sociopolitical system. This interconnectivity between the sociopolitical and ecological system, unfortunately, created a lack of flexibility and adaptability that, when tested in reaction to high temporal variability, failed in its response to mitigate these environmental stressors (Harrod, 2013; Lekson, 2002; Torvinen, 2016; Sedig, 2016). These previously perceived beneficial conditions of Pueblo Bonito as the elite center and reduction of raiding and feuding through the socialization of fear, unfortunately, had long-term cultural effects. In addition to the failing social system, dry farming no longer worked well enough due to the high temporal variability and release and reorganization occurred.

Chaco Canyon's lack of flexibility and adaptability led to the release and reorganization section of the adaptive cycle. After 1150 CE, the population shifted from the San Juan Basin to northern San Juan, and the Cibola regions. The socialization of fear and mistrust, unfortunately, continued into the post Chacoan era within the Cibola and San Juan regions (Lekson, 2002; Torvinen, 2016; Sedig, 2016). Climatic conditions worsened and people were unable to exploit available resources, perhaps in part due to dangerous locations between these warring and split factions. Reorganization occurred sometime in the first decade of the 13$^{th}$ century, as evidenced by an increase in buildings constructed at Aztec Ruins.

An increase in the rise of cliff-sheltered villages in southwestern Colorado and across the Four Corners area corresponds with the end of Chaco's influence during the

early or mid-12th century (Lekson, 2002). These Cliff dwellings date principally to the late 12th and early 13th centuries. While Aztec Ruins did continue the Chacoan political and belief system, it did not last and ended around 1275 CE, which coincides with the Great Drought of 1275 to 1300 CE, and subsequently ended in the final abandonment of the Four Corners region.

Sedig (2016) postulated that Aztec Ruins became the *de facto* social, political, and ritual capital of the northern Southwest as an attempt to continue Chaco Canyon's cultural influence. Reuse of the failed social and political system corresponded with another collapse and subsequent reorganization of Aztec Ruins. A similar style of reorganization occurred in the Hohokam society of Arizona, where social conformity, intense population density, as well as investment in infrastructure contributed to vulnerabilities and rigidity based on attachment to place (Torvinen, 2016). All of these reorganizations could have been the results of rigidity traps.

The Chaco phenomenon expressed a complex social and political system where social control via violence occupied an important part of Chacoan ideology. Social control and coercion were therefore used to encourage massive building events and maintenance of a large regional enterprise. This elite hierarchy present at Pueblo Bonito exhibited evidence of interpersonal violence and heavy physiological stress, suggesting that the buffering ability of this social control was limited. Harrod's analysis and the data presented in this thesis are unique in that they provide a possibility for exploring variation and complexity through interconnectivity of environmental stress, socio-political integration, stratification, and lethal and non-lethal violence overtime.

## Violence at Point of Pines

Several results presented by Rodrigues (2008) contribute to the potential evidence of resilience and diversity within the locals and migrants at Point of Pines. A subsistence change from the early to middle period did not result in increased frequencies of violence. A lack of corresponding violence in association with agricultural dependency suggests a successful use of mitigation techniques in response to environmental changes. Second, there is a concern that increased aggregation of the population would correspond with violence towards the incoming migrants. While there was indeed a significant increase in violence from the middle to the late period, there was no significant difference found between the number of migrant and local individuals who experienced overall trauma in the late period. A lack of targeted violence toward migrants as compared to locals from our risk assessment also shows no significantly higher risk of violence associated with one group over the other. Rodrigues also assessed possible targeted violence due to increased aggregation and environmental stress using Fisher's Exact Tests. There were no significant differences between early, middle, and late period females, children, or migrants. Migrants, children, and females were not specifically targeted as victims of violence during the late period at Point of Pines, as evidenced by both Rodrigues' study and this thesis.

The statistical analysis of the traumatic injuries present in the Point of Pines sample elucidates a couple of patterns. Firstly, males and females are both experiencing overall trauma at relatively similar rates and no specific sex has a higher likelihood of experiencing overall trauma over the other. When comparing locals and migrants,

migrants do not exhibit a higher likelihood of experiencing overall trauma than the locals. There are a few instances of possible interpersonal conflict amongst females and possible face-to-face conflict amongst males.

Overall, 18.6% of individuals experienced overall trauma during the late period at Point of Pines. There is a relatively even distribution of overall trauma frequencies between males and females within the sample. This denotes that there was no organized warfare going on or competition amongst males for resources, as the trauma did not specifically target one group of individuals. Females experienced more cranial trauma than males, but only males experienced lethal trauma. There is one local male that could have experienced scalping, as evidenced by multiple instances of sharp force trauma on the cranial vault (Rodrigues, 2008). Local females from Point of Pines experienced broken nasal bones and ribs, possibly consistent with isolated violent encounters (Novak, 1999; Allen et al., 2007).

Analysis of the location of the cranial injuries indicates females had 56% of the total cranial injuries located on the frontal or facial region, with 26% of the injuries located on the right parietal bone. The emphasis on the frontal as being the primary recipient of most traumatic injuries on females aligns with the possibility of face-to-face fighting, but also isolated violent encounters occurring. Male cranial injuries are 46% concentrated on the frontal bone and 30% concentrated on the right parietal bone. Once again, there is a higher concentration on the frontal region, indicating face-to-face combat on a small interpersonal scale. This type of violence may be associated with normal skirmishes amongst the Ancestral Southwest, as stated in Ellis's (1951) ethnography.

Though there is evidence of a successful mitigation technique(s), interpersonal violence still occurred. The mapping of the postcranial trauma reveals that males were possibly participating in hand-to-hand frontal conflict. This is also represented by possible offensive wounds, such as the injuries located in the lower wrist and metacarpal skeletal elements. Female postcranial trauma consisted of only three right rib fractures (Rodrigues, 2008). The postcranial trauma expresses the possibility of hand-to-hand conflict between males and possible isolated violent encounters amongst females. Comparisons between the sexes indicate that there are no significant differences in the experience or possible likelihood of experiencing overall trauma. This lack of a clear trend towards a specific group of individuals experiencing overall trauma suggests the possibility that there was no organized target of this violence, and perhaps exhibits resilience in diversity. When examining the departure of the Kayenta migrants, there is evidence for a breakdown in the cultural system that led to another migration out of the area.

**Mogollon Highlands Context**

The Mogollon region experienced an increase in migrant populations in the late 13$^{th}$ century CE related to episodes of drought in the Colorado Plateau. Rainfall, in particular, dry farming became increasingly unpredictable after 1250 CE throughout the region. These populations from the Kayenta region migrated south to the Mogollon highlands in family groups and built their own room block within the Point of Pines Pueblo around 1265 CE (Lindsay 1987; Stone 2000).

Archaeological evidence suggests the immigrants at Point of Pines Pueblo were well integrated within the local population (Stone, 2000; Rodrigues, 2008). Kayenta migrants had established their own separate and private room blocks within the main Pueblo, though their pottery showed a mixing with local styles. Additional evidence of community integration is present in the burial practices of the migrants, as they were interred in the same area as locals. However, the Kayenta room block was burned around 1300 CE, which included the apparent deaths of four individuals (Lindsay, 1987). The burning of the room block is indicative of negative interactions building between locals and the Kayenta migrants. However, there are other possibilities associated with the burning of cultural material.

Communal structures were occasionally created with their intentional destruction in mind. When the purpose of the communal area was served it was either collapsed or burned after the placement of dedicatory items within the walls (Nisengard, 2006). Archaeologists associate these examples of purposeful destruction with various Southwest communities, representing the closing of the space before abandoning a site or moving to a new location. Other sites in the Mogollon highlands show signs of deliberate and ritual retirement of communal buildings (Creel and Anyon, 200; Anyon and LeBlanc, 1984). This ritual destruction is considered a release of the site and signifies its closure to future use. Similarly, Robinson (1958) provided evidence for the breakage of burial artifacts symbolizing the release of the spirit to enable it to accompany the individual to the afterlife. This information provides a possible alternative to the reasons behind the

burning of the Kayenta room block, however, the evidence of burned bodies in the room should not be dismissed.

To address social stress from a nonviolence perspective, Mountain (2013) conducted a study assessing social stress and its correlation to bone loss at the Point of Pines Pueblo during the late period. Her results provide evidence for a community that was not experiencing extreme stress. Females did not suffer greater bone mineral density loss than males and individuals previously identified as migrants did not have significantly lower BMD than locals. Environmental and cultural practices could have buffered females against BMD loss (Mountain, 2013). This lack of significant difference between bone density values of the migrants and the local population is consistent with findings from Rodrigues (2008) that migrants also did not suffer higher levels of interpersonal violence. The conclusion of Mountain's study expresses that either social stress does not induce greater BMD loss or that the population of Point of Pines was not as stressed as other scholars have suggested. Mountain's (2013) results further supply evidence in conjunction with our trauma analysis, that mitigation techniques employed by the individuals at the Point of Pines Pueblo helped reduce social stress as well as interpersonal violence between incoming migrants and locals.

Stone (2000) assessed interactions between the Kayenta migrants and the local community through an analysis of public communal architecture. The Point of Pines Pueblo exhibited a great fragmentation of open space. There is a compound wall with a limited number of openings and a segment of open space that is cut off from the rest of the site via room blocks and walls. The fragmentation of open space hinders the

integration of sizeable groups and facilitates the development of subgroups, which can contribute to a high level of tension (Stone, 2000). Concerning previously autonomous social groups, conflict can arise over communal issues and the renegotiation of space during periods of aggregation. The Kayenta room block was burned in the fall, the migrants then left the Point of Pines region, and the room block was never rebuilt and or reused, though the rest of the site was continually occupied for the next 100 years. This was the conclusion of 35 years of coexistence with their neighbors that ended in the 1300s CE.

The surrounding political and ritual organizations centered around the kivas, where these kivas show a degree of similarity and diversity. Stone's (2002) study of kiva diversity at the Point of Pines region exhibits evidence that kiva's style reflects different social organizations used to adapt to the different microenvironments. There is a relationship between kivas and the adaptive functions of a culture, where these intersect as an area of risk minimization in the subsistence system (Stone, 2002). Kivas housed interactions where the exchange of information concerning resource availability and resource exploitation coincided with food redistributions. These kivas were the centers of political and social action that integrated these largely aggregated communities, despite the factionalism present and the differences in cultural identities. The socio-political connection with the ecological system provided diversity amongst the increased population and the community at Point of Pines, suggesting they employed successful mitigation techniques as a reaction to the incoming migrant communities.

The accommodation of subgroup formation allowed for the migrants to enter the community, while also maintaining their unique identity. It is possible that the migrants entered a system that already promoted and tolerated group differentiation. This social and political system apparently allowed for quicker toleration and integration of the migrants into the Point of Pines community. Factionalism can create a breakdown in communication and alliances between and within villages, however, other instances show factions are accommodating and the village integration is maintained or even strengthened (Stone, 2002). I suggest that this is what is seen at the Point of Pines Pueblo in reaction to the aggregation of Kayenta migrants. The successful integration of the migrants into the community at Point of Pines provides evidence for a high degree of flexibility within the ritual and political organization in the Mogollon Highlands.

Point of Pines exhibited diversity and flexibility in its social units, as well as the community-led and political units, creating resilience regarding socioecological change. The increase in migrants to a marginal environment during periods of drought and resource unpredictability should have prohibited many mitigation techniques and resulted in an increase in violence. However, the Point of Pines region is an exemplary example of a diverse, flexible, and tolerant socio-political culture in which migration was a positive technique against ecological changes and did not result in an increase in violence due to community aggregation. This correlation between aggregation, with no increase in violence or social stress seen in BMD loss, strongly supports the conclusions that Point of Pines exhibits a prime example of successful Ancestral Puebloan religious, political, and mobility techniques in response to socioecological change.

During the late period, at the Point of Pines region, there is a greater dependence and intensification of agricultural technologies. Between 1300 and 1450 CE, there is a severe drop in the water table that is documented along with increased arroyo cutting (Oakes, 1999). The population in the area greatly decreased, and some areas became uninhabitable. There are three major models proposed to explain this drastic population movement involving warfare, climate change, and depletion of available farmland that coincided with this increase in population densities (Oakes, 1999). Factionalism and internal strife surrounding this declining resource could have taken a heavy toll on these large, aggregated sites, ultimately contributing to the decision to leave the area and migrate elsewhere to have better environmental conditions.

A general consensus exists that such a continuation of ethnic identity would be tied to economic and political relationships between individuals and groups within a single community (Stone, 2003). Though these relationships between various ethnic groups can coexist peacefully through long-distance exchange, when this changes to co-residence in a single community, individuals will respond differently depending on the process of the change and their interactions with power relations. While aggregation of distinct cultural groups was present before the Kayenta migrants entered the Point of Pines region, this separation of identity possibly became the axis of conflict between the migrants and the locals. The Point of Pines community chose to emphasize their ethnic separateness and renegotiate the power structure (Stone, 2003). The strategy was successful from around 35 years until this diversity in ethnic identity created a point of conflict and could have ultimately met with a violent end, as evidenced by the burning of

the Kayenta room block and the death of four individuals. This strategy of intense diversity could have become too fragmented and surpassed its usefulness in flexibility by producing an inability to create communal socioecological decisions. Not being able to maintain the type of agriculture or resource productivity needed to increase the carrying capacity of an enlarged society and in the surrounding environment, these groups then utilized the mitigation technique involving migration to various other cultures, groups, and communities within the region.

Evidence presented by Oakes (1999) indicates that before the Highlands were abandoned, the Zuni peoples were exploiting resources in the high peaks of the Highlands in eastern Arizona, utilizing them as sacred areas for retrieval of plant materials and foresting zones as hunting grounds. This interaction would have led to community trading or ties between the Mogollon groups and the Zuni in the area. In conclusion, these large-scale abandonments were likely the result of these densely populated sites inability to maintain a large population within the marginal environment. Though the Mogollon Highlands became depopulated, they brought with them to their new areas a social memory in regard to previously successful mitigation techniques for socioecological decisions. Around 1450 CE, sites from the Mogollon highlands depopulated and aggregated into much larger units in other regions, possibly the Zuni area specifically, creating new ceramic forms, and the Katsina cult is introduced (Oakes, 1999).

While Point of Pines exhibits a prime example of Ancestral Puebloan religious, political, and migratory techniques in response to socioecological change, these techniques may have only lasted on short-term temporal scales. The combination of

population increase, and overutilization of the available agricultural fields could have contributed to a drop in the environmental carrying capacity. Along with more fluctuating climatic conditions and possible interpersonal conflicts arising, the Kayenta migrants could have employed their mitigation technique and left the region, migrating to another community within their social network.

Therefore, the analysis of the traumatic injuries present at the Point of Pines sample from late period indicates that there were evidently no specific targets of these violent skirmishes. Males and females experienced violence indiscriminately, as did locals and migrants. This suggests that there was no large-scale specific targeted violence which supports hypothesis 2 that the combination of tolerance, resilience, and flexibility in the introduction of the migrants into the community did not result in targeted aggression towards the incoming migrants.

## Hawikku and San Cristobal Evidence of Violence

Stodder's (1990) analysis provides evidence that there is an increase in violence from the precolonial populations that reflects a prevalence of warfare and violence in the 16$^{th}$ and 17$^{th}$ centuries. She related the differences between San Cristobal and Hawikku to friendly relations being maintained with non-Pueblo peoples prior to and during Spanish interactions (Cordell and McBrinn, 2012). Stodder concludes that the increase in overall trauma resulted from endemic warfare between the Ancestral Puebloans and the Plains people, which was exacerbated by the presence of Europeans. Our analysis of Stodder's data finds similar results, however, I suggest that warfare was not as prevalent as Stodder inferred due to the lack of lethal trauma and the evenly distributed overall trauma

frequencies demographically. Statistical analysis comparing male and female experiences of overall trauma indicate no clear trend of likelihood in experiencing overall trauma for one sex or the other, for both Hawikku and San Cristobal. 35.1% of all males in the San Cristobal sample exhibit overall trauma as well as 29.6% of all females exhibiting overall trauma. These high frequencies of overall trauma evenly distributed amongst males and females indicate that no one sex was buffered against the current violence. This also indicates that both males and females were possibly suffering from increased workloads, and possibly a change in labored gender roles, as Stodder did not initially distinguish between accidental and violent traumatic injuries. Our analysis suggests more evidence of resilience surrounding these occurrences of trauma.

A relatively evenly distributed frequency of overall trauma amongst males (28%) and females (21%) at Hawikku indicates that no one group was specifically targeted for this violent aggression. When the injuries were mapped, 15.7% of individuals from the Hawikku sample experienced postcranial trauma, which is a higher frequency than the 9.1% of individuals that experienced cranial trauma. Few perimortem injuries were present in the sample, with only one individual exhibiting perimortem cranial trauma. Amongst cranial injuries, the parietal was the most commonly affected skeletal element, however, no side was provided by Stodder in her initial analysis.

The second most affected skeletal region is the upper limb, representing 17.9% of trauma within the Hawikku sample. Uniquely, these upper limb fractures affected individuals of elderly age, from around 45 years of age to 55 and older. These injuries were not classic parry fractures, instead, they were likely due to exacerbated pressure

from repetitive stress. This increased number of elderly individuals experiencing fractures from repetitive stress actions is possibly related to occupations that correspond to increased taxes and tributes implemented by the Spanish and Great Plains groups. Other postcranial injuries revolved around the lower spine at about 15.4% of all trauma. The injuries to the lower spine comprised mainly of compression fractures, which also could indicate higher stress loads on the lower back from increased occupational stressors.

The San Cristobal sample shows a unique trend of 17.6% of males experiencing cranial trauma, with a drastic difference of only 8.6% of females exhibiting cranial trauma. Higher frequencies of 23.2% of all trauma amongst the sample were present in the postcranial skeleton. As for lethal trauma, four adults from the San Cristobal sample have perimortem cranial trauma; however, all other injuries show signs of healing.

When mapped, the frequency of overall trauma by skeletal element indicates that cranial fractures are the most common, accounting for 28.5% of all trauma. The parietal bones were the most affected skeletal element of the cranium. The second most affected area of the skeleton are the upper limbs, accounting for 17.2% of all trauma. Similarly, to Hawikku, the thoracic and lumbar vertebra account for 17.2% of all trauma. The majority of trauma is exhibited in the postcranial skeleton, specifically the upper limb and the lower vertebral column, indicating injuries possibly from increased stress and workloads.

Statistical analysis comparing male and female experiences of overall trauma indicate no clear trend of likelihood in experiencing trauma for one sex or the other. 35.1% of all males in the San Cristobal sample exhibit overall trauma as well as 29.6% of

all females exhibiting overall trauma. These high frequencies of overall trauma evenly distributed amongst the male and female sample indicate that no one sex was buffered against the current violence. This also indicates that both males and females were possibly suffering from increased workloads, and possibly a change in labored gender roles, as Stodder did not initially distinguish between traumatic injuries from accidents vs violence.

Between the two Colonial era sites, individuals at San Cristobal exhibited a higher likelihood of experiencing overall trauma than those at Hawikku. Both males and females from San Cristobal have a higher likelihood of experiencing trauma, both cranial and postcranial, than individuals from Point of Pines and Hawikku. This difference in overall trauma frequencies between the two Colonial era sites could be due to San Cristobal's lack of social networking with the rest of the Ancestral Southwest (Mills, 2008). These individuals also had negative interactions and relationships with the Plains communities as well as with the European settlers (Peeples et al., 2017; Cordell and McBrinn, 2012).

If systems are *too* interconnected, socio-ecological disturbances that could otherwise be contained will propagate throughout the system and require an entire reorganization or transformation instead of minor changes (Torvinen, 2016). Ethnographies provide examples of how diverse subsistence strategies, such as resource storage, collection strategies, field types, social networks, and sharing of resources, help to mitigate various ecological risks (Spielmann, 1986). These examples present themselves with a high degree of diversity and flexibility in a social adaptive system. Recent research focusing on different perspectives has concluded that social diversity can

contribute to resilience, but as well it can contribute to societal problems (Kinzig and Pacala 2002; Levin 1999; Walker et al. 1999; Walker et al. 2006).

It is possible to observe diversity through subsistence strategies, agriculture, architecture, ceramics, household organization, and overall interregional interactions (Hegmon et al. 2008; Torvinen, 2016). The Zuni subregion during Pueblo III and Pueblo IV shows no evidence of interregional ceramics and exhibits little evidence for interaction within the multi-regional social network systems, suggesting the social boundaries at Zuni were focused inwardly (Mills et al, 2013; Mills, 2008). There is evidence that suggests external social practices such as the katsina religion finally infiltrated the Cibola social world as introduced by migrants from the south and west. Despite these decreased external interactions, which could have contributed to an increased vulnerability of the Cibolan residents in reaction to certain disturbances, at Zuni there is evidence that the sociological system continued to persist. For the Cibola region, increases in conformity and social isolation contributed to an increasingly resilient system, where this social configuration likely made it easier for these large, aggregated populations to coexist in nucleated towns (Torvinen, 2016). However, as presented by Stodder and this thesis's analysis, there is evidence of an increase in violence at these two sites during interactions with Europeans.

Archaeologists posit the Cibola region exhibits more flexibility because the social memory from Chaco Canyon did not play a prominent role in the reorganization of the Zuni region (Sedig, 2016; Duff, 2005). Ancestral Puebloans utilized a diverse response to the Chacoan reorganization, which therefore allowed for more flexibility. Inhabitants of

the Cibola region easily spread ideas and mitigation techniques amongst closely aggregated communities. This increased resilience in ancestral Puebloan communities. Therefore, the Cibola region avoided a rigidity trap, even though there were large villages and aggregated Pueblo communities, the people did not fall into the rigidity trap due to this continuity in the community as well as flexibility in its response to these climatic changes (Sedig, 2016; Duff, 2005). Colonialism, however, can drastically affect the established vulnerability of this broad region due to this interconnectivity in the social adaptive system. To understand the severity of these high frequencies of overall trauma in relation to the resilience of these two sites, comparisons to the circumstances of the precolonial Southwest in the periods before European interactions are integral.

## Evidence of Resilience

Hawikku and San Cristobal were not initially vulnerable in their adaptive systems, as there is a difference between the precolonial era and Colonial subsistence, architecture, politics, and economics. These pillars of society were drastically impacted with the introduction of European settlers in the area, utilizing the same marginal environment as the Ancestral Puebloans. Therefore, the already marginal environment became an area of competition in order to maintain the previous cultural way of life for the Zuni, San Cristobal, and the newly introduced European settlers. The introduction of various diseases, new violence, new cultural adaptation, as well as an increasingly more marginal environment, certainly reduced the previous flexibility of the complex adaptive systems present at Zuni and San Cristobal. Establishing previously successful mitigation

techniques amongst the Ancestral Puebloan prior to European interactions helps elucidate the drastic changes from colonialism that devastated the Puebloan landscape.

**Precolonial Social Networks**

Mills et al. (2013) established the presence of various social networking systems throughout the Ancestral Southwest from 1200 CE to around 1500 CE. The Point of Pines region successfully utilized these migration networks in response to socioecological feedback, as evidenced by the support of hypothesis 2. Hypothesis 2 suggests that the use of migration amongst the Mogollon populations and the Ancestral Puebloans was a successful mitigation technique in harsh social and environmental circumstances and does not correspond with an increase in traumatic injuries during aggregation, specifically targeting migrants at the site. My statistical analysis of the data provided by Rodrigues (2008) supports the lack of an increase of violence towards females, migrants, or children, and indicates flexibility in the site's inclusion of the large influx of migrants. The data examined by the Mantel-Haenszel common odds ratio estimate provides evidence of the successful use of migration by comparing Point of Pines overall trauma frequencies with those of Pueblo Bonito. Pueblo Bonito individuals were 3 times more likely to experience lethal trauma than individuals at Point of Pines, supporting hypothesis 1 that the Chacoan system of social control via violence resulted in a rigidity trap and a failed buffering system. Finally, males from Pueblo Bonito are 2.6 times more likely to experience cranial trauma than males from Point of Pines, signifying the use of violent social control between elite males in the Chacoan system.

Previously established Ancestral Puebloan mitigation techniques revolved around residential mobility. This enhanced the resilience of particular individuals and groups by not staying in one place and incurring negative changes in social or local environmental contexts (Borck et al., 2015; Mills et al., 2013). Migrations, however, are expensive and disruptive to the existing social order and can result in migrants having lower status than the groups in which they join. The use of migration as a tool for resilience also provides an emphasis on the formation, transformation, and dissolution of different kinds of social networks. This sharing of information and resources from diverse environments within the marginal environment could help populations deal with the constant resource unpredictability.

Borck et al. (2015) assessed ways in which people are able to cope with disasters while utilizing their social network's diverse access to external help and resources. This is addressed through the degree of embeddedness of network actors and the population size correlating with population stability and instability. They revealed patterns in which, at the population level, stronger ties were more important for creating internal connections, whereas weaker ties are crucial for external connections. In terms of short-term and long-term mitigation techniques, short-term periods require weak ties to keep a region intertwined in the overall network, while for long periods stronger ties allow for better connection to the network. There is an increase in embeddedness at the network level, indicating an increase in diversity among archaeological sites.

During times of drought, specifically the Great Drought from 1250 CE to 1300 CE, there is a shift in focus from weak external ties to strong external ties as an act of

flexibility and resilience. As communities in multiple regions aggregated, expansion of social connections through the development of this inclusive integration facilitated network embedding. This is evidenced in the archaeological record as migration out of the San Juan Basin and into southern Pueblo regions, such as Point of Pines, housing possible descendants of the failed social system remnants of Chaco Canyon.

By 1450 CE, the northern and southern Southwest regions were maximally disconnected in terms of their social network systems (Mills et al., 2013). The Zuni region persisted in the northern part of the study area, which is represented by two isolated settlement clusters which each have distinctive ceramic assemblages. Due to large-scale aggregation and migrations occurring during the 1400-1450s CE, these connections began to reorient themselves to each aggregated area as populations declined across the region. Zuni, as a unique subregion, persisted during the southern network disintegration in the 15$^{th}$ century and is suggested to have included smaller networks that had become more sustainable in the long-term (Mills et al., 2013).

Zuni is considered a unique case where it persisted with an internally focused social ties over the period of 250 years, presented in Borck and colleagues' (2015) study. Analysis of ceramic styles and trade routes revealed that regions with external relationships that are more embedded in the regional network are more effectively able to show resilience and persist than those with internally oriented relationships. The ability of a group or region to weather a crisis relied not only on external connections, but on strong external connections. However, Zuni does not follow this pattern as it represents an area that was dis-embedded from the larger regional network and yet still maintained

and sustained large populations. The Zuni region's persistence and resilience, as seen through a dominance of internal networks and high regional population, increased the number of potential internal individuals and communities within which to interact. Likely, the Zuni area was a little more spread out geographically than other groups in the region, and thus this ability to migrate short distances to communities within the Zuni culture substituted the need for external connections (Borck et al., 2015; Mills et al., 2013). This high regional population in the Zuni area allowed for a cohesive and long-term social response to environmental adversity. These migrations that constituted the overall population increase into the Zuni area provided the external connections and perspectives necessary to allow for this cohesive and diverse social response to crises. With political power locally held in the Zuni region, leaders of these small, dispersed populations and communities maintained tighter social ties that ultimately resulted in the establishment of large towns that further enhanced the region's resilience through its conformity (Borck et al., 2015; Mills et al., 2013).

Borck et al. (2015) concluded that the inhabitants of some regions strengthen their connections to other regions in an effort to ensure that their support network would be available during precarious times. The Zuni region, however, was already practicing short-term short-distance community mobility to take advantage of the changing niches of productivity in their diverse environmental region. This increased their population's diversity and resilience in response to environmental adversity. Colonialism would have destroyed these abilities to either practice short-distance migrations or long-distance migrations as the established social networks disintegrated into small vulnerable

connections in the late 1450s just prior to European interactions (Borck et al., 2015; Mills et al., 2013).

**The Colonial Era and Resilience**

The precolonial sample itself provides evidence that males have a higher likelihood of experiencing overall trauma than females, though these results are not significant. Within the colonial sample, males also have a higher likelihood of experiencing overall trauma than females. Specifically, males are 2.2 times more likely to experience cranial trauma than females within the colonial sample, and this interaction is significant. The statistical analysis supports the overall distribution of traumatic injuries amongst the colonial samples, where it seems to be indiscriminate of sex in terms of likelihood of experiencing overall trauma, with slight emphasis on male cranial trauma.

Significant interactions between precolonial and colonial samples reveal that the colonial sample suffered from an increased likelihood of experiencing postcranial trauma and overall trauma than the precolonial sample. Uniquely, however, the precolonial sample experienced a higher likelihood of cranial trauma among both males and females and a higher likelihood of lethal trauma amongst males and total individuals. When discussing the frequency of lethal trauma present at the San Cristobal site, only 8% of individuals exhibit lethal trauma. Comparing these frequencies of lethal trauma to the Point of Pines sample, the San Cristobal sample has a less likelihood of experiencing lethal trauma than the individuals at Point of Pines. Further, when compared to the Pueblo Bonito sample, San Cristobal is less likely to experience lethal trauma than the individuals at Pueblo Bonito.

While the prevalence of lethal trauma is low as compared to the precolonial sites, San Cristobal does show trends of a higher frequency of postcranial trauma. Compared to the Point of Pines sample and the Pueblo Bonito sample, there is a higher frequency of postcranial trauma, and these relationships are indeed significant. An increase in agricultural demands on the Puebloans is seen when comparing Hawikku to the Point of Pines sample. Specifically, there is a higher likelihood of experiencing postcranial trauma among females and males than individuals at Point of Pines, and these interactions are significant. Evidence of increased frequencies of postcranial trauma are also present in the San Cristobal sample as compared to the Point of Pines, and all of these interactions are statistically significant. Individuals at Hawikku and San Cristobal are therefore experiencing greater stress, possibly due to the increase in workloads as implemented by the Spanish and the Great Plains groups. An increase in postcranial trauma and a lack of lethal trauma could be indicative of the increased workload imposed on the Indigenous peoples by the Spanish. The lack of lethal trauma also reveals that there was no large-scale warfare, also suggested by an evenly distributed experience of overall trauma amongst males and females. With no increase in large-scale warfare and lack of lethal violence, I suggest there is enough flexibility in the system to create small-scale changes in reaction to colonialism.

Interestingly, the Hawikku sample is experiencing less lethal trauma than the Point of Pines sample and the Pueblo Bonito sample. This surprising contribution could be due to the different types of trauma being experienced during this period of initial colonial interaction. The highest frequency of traumatic injury is present in the

postcranial skeleton and is indicative of an increase in stress and workload. While there are cranial injuries, there was only one that was considered lethal. This lack of lethal cranial trauma present at a Colonial era site has significant implications that colonialism, while having drastic negative effects on the individuals themselves, was possibly buffered against as there is not an increase in lethal trauma.

The higher frequency of postcranial trauma and overall trauma in the colonial sample supports hypothesis 3, indicating that there is a disconnect between previously used mitigation techniques that were destroyed due to aggravated interpueblo relations and the European settlers. However, hypothesis 3 is also rejected in the fact that there is not an increase in lethal cranial trauma at the Colonial sites. This is unique in that it may represent resilience regarding buffering against lethal violence and utilization of new mitigation techniques by changing parts of the system instead of an entire reorganization and transformation.

**The Colonial Landscape**

Massive depopulation in the Four Corners area circa 1450 CE created recently aggregated communities in the western and eastern Pueblos of New Mexico that encountered European settlers. These populations were experiencing a time of transformation and reorganization and an increase in population, and integration of a variety of cultural belief systems into small, densely populated areas reflecting a decrease in overall regional social networks (Borck et al., 2015).

Beckwith (2009) assessed the architectural strategies related to various behaviors regarding incoming migrant communities into the current Indigenous groups within the

Pueblos of the Galisteo Basin. Enclosed or semi-enclosed plaza areas provide space for small groups and community-wide performances. The Pueblos of the Galisteo Basin provided both small and large plazas with distinct visual characteristics that perform different functions in the goal of social integration. Access to plaza spaces and visual access to these spaces represents knowledge as a source of power that is being controlled and limited (Beckwith, 2009).

Specific architectural evidence of occupation at San Cristobal appears to be scattered around the community and not concentrated within any particular room block. In the Pueblo IV period, there was an increasing emphasis on greater control over access to the room blocks. They eliminated specific doorways at ground level, and these doorways soon became holes in the roofs, accessible only through ladders (Beckwith, 2009). This change in the physical accessibility into the room blocks restricted access to storage facilities with the increasing migrant populations. Room blocks would only have been accessible through this roof opening and it would have been more difficult to reach the inner sanctum of each household unit. This once again indicates a greater degree of control over interior space and specifically storage space. These changes to controlled access points within room blocks, the household unit, and storage could have been responses to the population aggregation at the site and possibly could have reduced potential stress (Beckwith, 2009).

Shortly after this period of aggregation, Europeans brought livestock, such as horses, cattle, sheep, goats, and pigs, and crops such as wheat and fruit trees, which permanently changed the Native landscape (Cordell and McBrinn, 2012). This addition to

the current ecosystem drastically changed the socioecological relationship previously established by the Indigenous populations of the area. Much of the land had once supplied edible wild plants. However, many things changed over time due to harsh tribute demands levied by the Spanish and this land now became pasture for farm animals introduced by the European settlers. The harsh tributes are seen in the archaeological record with evidence of increases in hunting for hides as tribute as well as an increase in agricultural production that did not work well with the previously established relationship between the Ancestral Puebloans and the environment (Blanton, 2021). These changes in agricultural and subsistence production strategies certainly would have taken a toll on the environment surrounding the Ancestral Puebloans. Especially regarding not only the current highly populated Pueblos but also the ability to keep up with Spanish tributes which could have surpassed the environment's flexibility and adaptability in regard to this change (Liebmann, 2021; Blanton, 2021).

The Ancestral Puebloans of the American Southwest had specific and unique feedback loops with their environment. These relationships were based on the tenuous fluctuations that constantly happened throughout the marginal environment. These connections with the environment certainly would have been disrupted by missionary and settler colonialism into the area. Landscape was specifically critical for Indigenous homelands, where they were hubs of economic, spiritual, and political autonomy throughout episodes of interaction (Panich and Gonzalez, 2021). In some cases, European settlers worked to violently eliminate these centers of Native power, while others worked to convert Native belief systems to Catholicism (Panich and Gonzalez, 2021). Overall,

increases in violence between the two colonial sites and the two precolonial sites show evidence of these violent interactions.

In addition to the study of violence across time, the study of landscape can provide the archaeological context necessary to analyze the trends in violence as related to colonialism. Landscapes combine space and time by bundling social memory, sensory perceptions, and the space as constructed by earlier generations (Gallivan, 2021). Indigenous peoples retained these linkages to the ancient places and constructed new settlements during the precolonial past. This movement, reconstruction, and abandonment continued during the colonial era using these mobility practices drawn from the past social memory to respond to the colonial structures of authority (Gallivan, 2021).

When looking at previously used mitigation techniques by the Ancestral Puebloans, one can look into trade routes as a prime example of a downturn in the availability and utility of these techniques just prior to European interactions. The regional social network systems that had been necessary for survival prior to interactions with Europeans broke down due to massive population losses and habitat destruction brought on by this introduced livestock (Cordell and McBrinn, 2012). The Mesoamerican Pueblo trade began to fade at the end of the 1100s CE and these connections were no longer maintained by the 1500s around the time of initial European interaction (Liebmann, 2021). During the first two decades of the 17$^{th}$ century not only was there not a direct population drop as a result of European interactions, but there is also resilience seen in the harvesting of wood for new construction, as well as heating and cooking. There is evidence that migration was no longer used as a mitigation technique where the

large, aggregated communities prior to Spanish interactions were not abandoned during the era of European interactions (Liebmann, 2021). The pressure on the environment from the colonial settlers drastically changed the socioecological relationships that were previously employed in the region by the Indigenous people.

In addition to the environmental changes, cultural relationships between various Indigenous groups drastically changed. The weather pattern that previously consisted of two different annual precipitation regimes reestablished itself after a long absence of about 200 years (Dean, 1988). Places that had for two centuries supported farming without streambed irrigation, specifically, the Galisteo Basin, became marginal for that kind of agriculture (Cordell and McBrinn, 2012). After many years of drought, this reestablished precipitation regime allowed for grasslands and herds of bison to become reestablished on the southern plains. This increased the population of specialized bison hunting people migrating into the area (Cordell and McBrinn, 2012). As new relationships were being forged in the region due to population aggregation into the western and eastern New Mexico Pueblos, the arrival of the Europeans destroyed these relationships. No longer could the previous technique of migration be used to find a new area to reorganize as the Spanish destroyed many interconnections and relationships not only with other Indigenous groups but also in the ability for these groups to travel (Liebmann, 2021).

Considerable trade and exchange took place between Apache and the Ancestral Puebloans. Individuals that came into the northern San Juan River, known now as the Ute Indians, entered the Ancestral Puebloan landscape as well. Ute Indians lived as hunters,

gatherers, and fishers with impermanent settlements and polygamous households (Cordell and McBrinn, 2012). This is in stark contrast to the Ancestral Puebloan world, where largely aggregated and permanent communities existed on agricultural farming and unique household units. Relationships of trading and raiding characterized the new social landscape, especially after the arrival of the Great Plains communities as well as the Ute and Comanche. Complicated entanglement of Spanish explorers, new foods, new diseases, climate regimes, and new Indigenous communities created a time of much turmoil.

The use of warfare and scalps as relationships between different indigenous groups was no longer allowed under the reign of the Spanish colonizers (Ellis, 1951). A reduction in the ability to utilize the Warrior Society to produce the required and desired results with the environment (producing rainfall for dry farming), certainly could have taken a toll on traditional social memory in regard to a fluctuating environment. This also would affect the expression of violence towards other communities and its place as a part of the integration of cultural identity through traditional violent actions (Ellis, 1951). The evenly distributed frequencies of violence between both sexes, rather than among young adult males, can signify a reduction of the warrior society.

Colonialism occurs similarly to high temporal and low temporal variability, as mentioned by Dean (1996), within the local environment, in which case colonialism represents both high and low scale temporal variability. Initial reactions to colonial expeditions in the Zuni area could have created a violent social memory as the appropriate response (Lightfoot et al., 2021; Cordell and McBrinn, 2012). The

adventurers with Coronado carried too few supplies to feed themselves, and so plundered Pueblo villages as they came across them. This set the social memory amongst the Indigenous Puebloans to be violent in reaction to incoming Spanish individuals. These strategies and tactics that were initiated by the Indigenous groups certainly proved successful in these early encounters, where their violent responses deterred the colonial expeditions from coming into their area (Lightfoot et al., 2021). This could have created a social memory that would have been drawn upon for future European interactions, even if they occurred between larger groups of people. While this is an example of a mitigation technique working in the short-term, the duration of colonialism and the fluctuation of interactions and events did not support violent responses as an overall flexible and sustainable strategy. The reliance on the social memory of violence towards European settlers could have led to rigidity where more negative outcomes resulted as opposed to advantageous ones. Additionally, there were large variations in regional sociopolitical relationships among Indigenous groups at the time of European interactions. Several distinct autonomous polities amongst the Indigenous peoples of the area had antagonistic relationships in which they chose to create alliances with colonial regimes to maintain an upper hand on their Indigenous neighbors (Lightfoot et al., 2021).

In the Rio Grande region, the Spanish imposed taxes in the form of labor and tribute, and at the same time, the nomadic plains tribes began demanding European products such as horses, guns, and iron tools (Lightfoot et al., 2021). The Pueblo communities could not produce enough food to pay themselves, pay tribute to the Spaniards, and maintain their obligations of trade with their Plains neighbors (Cordell

and McBrinn, 2012; Blanton, 2021). Rogers (2020) also provides evidence that occupational related injuries are consistent with greater intensification of labor, especially in females, where biomechanical analysis of humeri suggest higher intensities of grinding.

The relationship that was later established by the Spaniards and the Plains groups also deteriorated the relationship between the Spanish, the Indigenous Pueblo, and the Plains groups (Lightfoot et al., 2021). The eastern Pueblos of New Mexico developed factions that were composed of high-status leaders versus everyone else in the attempt to mitigate these new stresses (Cordell and McBrinn, 2012). These Pueblo leaders acted as middlemen for the Spanish, both in collecting tribute and coordinating the trade of Pueblo goods for the Plains groups. Unfortunately, this technique did not work against the failing socioecological relationship where the Pueblos could not meet their trade obligations, and the situation deteriorated into armed conflict between the Pueblo and the Plains peoples culminating in the Pueblo Revolt of 1680 (Cordell and McBrinn, 2012; Lightfoot et al., 2021).

Religiously, the Plaza-oriented community of San Cristobal allowed for ritual specialists to perform publicly and interact with the symbol of origin, as well as move between the upper and lower walls. Not only were these plazas community spaces for sharing of knowledge of agricultural technologies, exploitation of resources, and sharing of resources, but they also provided religious public performances (Beckwith, 2009; Cordell and McBrinn, 2012). These places fostered such intertwined relationships between politics, religion, and ecological systems allowed for diversity and flexibility,

while also possibly creating rigidity traps due to increasing interactions with European colonists.

Beckwith's (2009) study shows that San Cristobal uniquely exhibits broken spaces into many small Plaza areas with no specific large community wide ceremonial space. However, the kiva that was found within a specific room block had no external visibility at all. This lack of visibility from the outside could be an attempt at having privacy from the Spanish mission that was adjacent on site. This could have been an attempt by the individuals at San Cristobal to regain power over their religious beliefs from the interference of the Spanish Mission church by eliminating visual access (Beckwith, 2009).

These sites did not initially depopulate, instead, they continued to have a constant struggle between the Indigenous populations and the European settlers. Colonial interactions occurred both on a short-term and a long-term scale which drastically affected the socio, ecological, and sociopolitical systems of Hawikku and San Cristobal. Previous social memory utilized to react to drastic fluctuations in climate as well as fluctuations of relationships to external companies could no longer be employed due to the impact of colonialism. Settler colonialism specifically contributed to malnutrition, poverty, warfare, violence, dislocation, and famine (Liebmann, 2021). Ancestral Puebloans were originally not vulnerable to a drastic change in their environment as seen previously through the use of successful mitigation techniques (Liebmann, 2021). However, it is this combination of aggressive short-term change as well as enduring long-term change that was presented by colonial expansions into the area and into the

environment that rendered the previous social memory useless in this newly composed environment. This change in the sociopolitical system of both the Zuni and San Cristobal could have had drastic impacts on the previous social memory that was utilized in situations where the environment was becoming more marginal.

Social cohesion is retained by Native communities through the centuries of colonial disruption (Gallivan, 2021). Maintaining ties to deep traditional aspects of life allowed for cultural continuity despite the violent and disruptive efforts of colonists. Colonial efforts for some areas of the American Southwest indeed destroyed mitigation techniques previously employed. However, it is important to note that continuity in modern descendent communities and the Ancestral Puebloans is present due to this resilience, negotiations, and flexible mobility of past communities in the face of colonial missionary efforts.

The longer perspective of historical ecology situates the relationships between Indigenous peoples, their ancestors, and their interactions with the European settlers into a socioecological perspective (Mathwich, 2021). Colonialism, by definition, is an extractive, unequal, social and economic relationship, that had drastic effects on the Indigenous populations of the area. Historical accounts of colonialism in the Americas create the assumption that there is little evidence of resilience in the Indigenous cultural landscape. This is not necessarily true as there is evidence of flexibility and adaptation to the new colonial landscape. While evidence of increasing frequencies of violence corresponds to negative interactions with Plains people and European settlers, various parts of the adaptive system persist in the new violent world.

Discussions of persistence by Lightfoot et al. (2021) and cultural resilience are seen in the analysis of quality and size of the structure, landscape management practices, as well as regional sociopolitical relationships. Important considerations should discuss that Indigenous populations did not confront one standard form of colonialism, but instead were engaged by a variety of different pathways. They consider polity size a way to highlight a crucial dimension of Indigenous groups and the way in which they sustain themselves as autonomous political entities during extended periods of warfare. Evidence of increased aggregation into Hawikku and San Cristobal corresponds with increased resilience and flexibility, as mitigation techniques worked with the current socioecological feedback loop prior to European environmental perturbations. However, there is still evidence for an increase in violence corresponding to European environmental changes and cultural interactions with the Puebloans.

The totality of these Indigenous struggles and pathways towards reestablishing identity and previous social network, culminated in a massive violent event the Pueblo Revolt of 1680. The resilience of these communities allowed for adaptation to missionization, however, the skeletal record is consistent with the narrowing of lifeways and squeezing out of diversity related to colonial violence. Interpersonal violence was likely abated by some resilient lifeways and ideologies into colonial times, however, the violence and the complete biologically disruptive event of colonialism culminated in this horribly violent event that is not observable in human skeletal remains (Cordell and McBrinn, 2012). The final outburst of violence seen in the Pueblo Revolt suggests a "rigidity wave," where all aspects of life experienced a foreclosure, despite the lack of

lethal violence suggesting resilience. In this sense, hypothesis 3 is supported by the evidence for a "wave of rigidity" culminating in the final violent event of 1680, which is not seen in the skeletal record.

## Conclusions

This chapter has provided a discussion on the results from Chapter Four through the anthropological, bioarchaeological, archaeological, ecological, and operational lenses presented in Chapters One and Three. The study denoted statistically significant results regarding greater likelihoods of experiencing violence at precolonial, Point of Pines and Pueblo Bonito, and at the Colonial sites San Cristobal and Hawikku. Overall trauma frequencies showed an increase in violent trauma present at the colonial sites as compared to the Point of Pines Pueblo. Pueblo Bonito exhibited high frequencies of lethal cranial trauma in relation to its use of violence as social control. Hawikku and San Cristobal showed higher likelihoods of experiencing postcranial trauma as associated to colonial impacts on the Pueblos. Additionally, this chapter provides surrounding context from each site, from political, social, religious, architectural, ecological, environmental, subsistence, and social network systems, considering evidence for flexibility and rigidity. The next chapter summarizes the evidence demonstrated for each hypothesis and suggests future directions.

# CHAPTER SIX: CONCLUSION

The evidence provided for each hypothesis helps to better explore and characterize the mitigation techniques employed in the Southwest by the Ancestral Puebloans. Using analysis of violent interactions between groups, the results elucidate successful mitigation techniques through flexibility and diversity that correspond to low instances of violence. Inversely, high instances of lethal violence targeting specific demographics corresponded with evidence for rigidity within the adaptive system. Resilience theory successfully elucidates contexts where violence increased due to social system rigidity or decreases with successful diversity in mitigation techniques. Finally, the results regarding colonial expansion into the American Southwest reveal evidence of violent interactions, but also, longevity, resilience, and persistence in cultural traditions, despite the massive obstacles faced by the Indigenous populations.

## Hypotheses Results

Hypothesis 1 assessed the increased interconnectivity of a social adaptive system in reaction to drastic transformative change, which squeezes out diversity and leads to a rigidity trap. Chaco Canyon's use of violence as social control provides evidence of a system with a decrease in diversity and flexibility. As such, for hypothesis 1, I expected to see high frequencies of lethal cranial trauma among adult males at Pueblo Bonito. Pueblo Bonito shows a high prevalence of disease and malnutrition, even among the

elites. The presence of poor health matches with high frequencies of lethal trauma amongst males (regardless of social status), indicating a failed buffering system and possible rigidity trap, providing support for hypothesis 1. Females from Pueblo Bonito show a smaller frequency of overall trauma when compared to the males, suggesting that males were the main actors in this structural violence. The common odds ratio presented based on cranial trauma for both Room 33 and Pueblo Bonito-West provides support for hypothesis 1.

Hypothesis 2 assessed the precolonial mitigation techniques utilized in buffering against drastic transformative change to the socioecological system. The site of Point of Pines Pueblo experienced a massive influx of Kayenta migrants to the region after the Great Drought. Point of Pines Pueblo and its religious and social network systems successfully integrated a large aggregation of Kayenta migrants into their community. This successful integration of the migrant community suggests that their buffering systems maintain diversity and flexibility in the face of possible transformative change. As such, for hypothesis 2, I expected to see no increase in the frequency of traumatic injuries specifically targeting incoming migrants to the Point of Pines Pueblo. Evidence for the support of hypothesis 2 is seen by comparing frequencies of traumatic injuries between local and migrant populations in the Point of Pines Pueblo sample, presented by Rodrigues (2008), using the Mantel-Haenszel common odds ratio, and mapping the location of injuries on an anatomical figure. Statistical analysis showed there was no increase in traumatic injuries towards the Kayenta migrants during the period of aggregation.

Hypothesis 3 assessed the destruction of social mitigation buffering techniques as a result of drastic changes created by colonialism. These drastic changes effected all aspects of life, reducing diversity and flexibility in the mitigation and buffering techniques that were stored in the social memory of the Ancestral Puebloans. All together, these external and internal transformative changes are not easily buffered against because of the removal and destruction of previously used pathways amongst the Ancestral Puebloans. As such, for hypothesis 3, I expected to see an increase in frequencies of lethal traumatic injuries evenly distributed amongst adult males and females at the colonial sites, as compared to the precolonial sites. The frequencies of overall trauma do not significantly differ between males and females, and there is indeed a high frequency of cranial trauma at Hawikku. The greater likelihood of experiencing overall trauma among individuals from Hawikku as compared to the precolonial sites, suggests support for hypothesis 3. While there is no trend for an increase in lethal trauma, there is an established trend of an increase in the frequency of overall trauma and a higher likelihood of experiencing overall trauma among individuals at Hawikku. Of the four sites compared, individuals from San Cristobal experienced a higher risk of overall trauma than the other three sites in this study, providing support for hypothesis 3. However, data relating to increased lethal cranial trauma does not follow the expected patterns. Hawikku and San Cristobal experienced less lethal trauma than the precolonial sites, suggesting possible buffering against lethal violence. This lack of lethal violence may show evidence for resilience and flexibility in certain parts of the Zuni and San Cristobal sociocultural and ecological systems in response to the Spanish intrusions and

inter-Pueblo strife. Therefore, I rejected the hypothesis that hostile interactions with the Spanish and the Plains communities resulted in an increase in lethal trauma. However, the massive violent event of the Pueblo Revolt suggests a rigidity wave, where all aspects of life were heavily restricted and experienced a violent release of the system. The culmination of the squeezing out of diversity provides support of hypothesis 3. Finally, there is a significant increase in postcranial trauma experienced at colonial sites that could be associated with imposed taxes, tributes, and new gender roles on the Ancestral Puebloans.

## Limitations and Future Directions

This study was significantly limited due to global pandemic conditions restricting access to museum collections. The analysis was based on the published archival record for skeletal assemblages from the American Southwest. Various observers analyzed this material at different stages of theoretical thought in anthropology, archaeology, and bioarchaeology. Detailed descriptive analysis of each individual and their burial were missing in most cases, and the Pueblo Bonito sample did not provide an analysis of the postcranial skeleton. Subadults were excluded, however analysis of specific age groups could not be done due to a lack of individual data correlating ages to individuals with trauma. The Mantel-Haenszel common odds ratio estimate was employed successfully to account for the drastic difference in sample size between sites.

It is important to acknowledge the ability to utilize data from the published record to explore new theoretical perspectives and updated analytical techniques, while emphasizing the importance of repatriation of these legacy skeletal collections. This

study brings together violence analysis and resilience theory on previously analyzed and published remains from the American Southwest to present new perspectives in the continual Indigenous struggle against colonization. Future considerations for this type of study should include collaborations with Indigenous scholars, updated ethnographies, and further development of injury mapping techniques to understand the implications of trauma types. A baseline for what normal kinds of culturally sanctioned violence occurred at these sites throughout the Pueblo I to Pueblo IV could further provide evidence of cultural continuity over release and reorganization of the adaptive system. An understanding of what is normal will help to elucidate what is abnormal and allow for future analysis of cultural change in reaction to socioecological systems and colonial interactions.

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