A GIS-Based Investigation Into Social Violence and Settlement Patterns in the Gallina Area of the American Southwest

Adam M. Byrd

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A GIS-BASED INVESTIGATION INTO SOCIAL VIOLENCE AND SETTLEMENT PATTERNS IN THE GALLINA AREA OF THE AMERICAN SOUTHWEST

by

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B.S., Anthropology, University of Oregon, 2002
M.A., Anthropology, University of New Mexico, 2008

DISSERTATION

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A GIS-BASED INVESTIGATION INTO SOCIAL VIOLENCE AND SETTLEMENT PATTERNS IN THE GALLINA AREA OF THE AMERICAN SOUTHWEST

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ABSTRACT

The Gallina area is an ideal location for an investigation into social violence using GIS-based methods. Situated in northern New Mexico, the remote Gallina region and the Gallina phase (A.D. 1100–1300) in particular have a clear record of violence that peaked in the latter half of the 13th Century (Borck and Bremer 2015; Constan 2011). Although there is an abundant record of violence, the source of the violence remains unclear. Were the Gallina attacked by an outside group or groups? Did the Gallina turn on each other? Or was some combination of internecine conflict and foreign attacks to blame? The Gallina do not appear to have been restricted territorially by outside groups and there are few indications that they influenced neighboring groups.

The Gallina phase has been characterized as an area of intense conflict, with researchers citing the many defensible sites (towers, cliff houses, and site locations with limited access), burned sites, lack of trade wares, and skeletal evidence of violence throughout the region (Byrd 2010, 2015; Borck and Bremer 2015; Constan 2011, 2015; Dick 1976; Green 1956; Hibben 1939). The construction of defensible structures, such as towers and cliff houses, involved a significant investment of time and resources. Their
specific locations on the landscape were likely the result of careful planning with an inherent concern for defense as demonstrated by location and design. Investigating the placement of these structures on the landscape and their relationship to other settlements (including intervisibility) could demonstrate the existence of alliances between communities, territorial boundaries, potential regional organization, and from where communities most felt threatened. In addition, examining the locations of settlement clusters and the distribution of trade wares can clarify the nature of interactions among settlements. Finally, identifying spatial and temporal patterns of warfare-related sites can be used to help identify both the source and the objective of attacks.

This study specifically investigated how intraregional conflict and interregional conflict result in different spatial trends seen in the archaeological record by comparing spatial datasets to three hypothetical models of tribal conflict. The three models of conflict included conflict between Gallina groups (internal), conflict between Gallina and outside groups (external), and a combination of internal and external (mixed) conflict. Based on ethnographic and archaeological research, the models identify a suite of regional settlement characteristics that have been previously demonstrated as relevant to warfare (Haas 1990; Haas and Creamer 1993; LeBlanc 1999; Solometo 2004; Wilcox and Haas 1993), such as settlement density, defensibility of sites, sites with evidence of violence, and interaction between Gallina settlements. For each model, variations for each of these settlement characteristics are correlated with expected settlement patterns and expected results from different spatial analysis techniques. The settlement data for documented sites within the study area were then compared to the expected results for
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Chapter 1—Introduction

Violence has always been a part of the human story. Ranging from conflicts between two individuals to world wars, violent conflicts have occurred in nearly every cultural context and throughout all periods. It is not inaccurate to state that violence within and between societies is the norm. This assertion is well supported in recorded histories and with archaeological data. An even cursory review of current news headlines also backs up that statement. While the severity and frequency of violence within societies has varied through time (based in part due to environmental, political, and social factors), violence or the threat of it is an ever present part of the human experience. Anthropological investigations into violent conflict are explorations into one of the fundamental aspects of human social behavior.

Warfare can be defined as “organized, purposeful group action, directed against another group that may or may not be organized for similar action, involving the actual or potential application of lethal force” (Ferguson 1984:5). While not all conflicts rise to the level of violence, violence remains as a potential option if a resolution cannot be achieved through peaceful means. Considering that all disputes could potentially lead to violence, the term “warfare” is used throughout this dissertation interchangeably with group conflict.

Warfare has been regarded as a significant factor in shaping many past and present societies (Keeley 1996; LeBlanc with Register 2003). Modern conflicts often occur within a context of tribal societies. Therefore, studying the practices and consequences of tribal warfare in the past could be beneficial in studies of modern conflicts. As discussed in greater detail in Chapter 2, warfare in tribal societies differs in
scale, tactics, and motivations from state-level conflicts. Conflicts in tribal societies are often small-scale and consist of raiding and ambushes not aimed at occupying an opponent’s territory (Otterbein 2004).

One valuable avenue of investigation into tribal conflicts is the analysis of settlement patterns. How humans interact with their environment and the traces that are left on the landscape provide a window into past behavior (Hodder and Orton 1976). In particular, warfare within tribal societies results in specific settlement patterns (Arkush 2006; Haas and Cremer 1993; LeBlanc 1999; Wileman 2009). Observed settlement patterns can reflect variations in the level of social organization, of the scale of conflict, and of the interactions between social groups. While conflict is not always reflected in settlement patterns and some settlement patterns can also be a result of behaviors unrelated to warfare, identifying these settlement patterns and relating them to each other can shed new light on previously murky subjects.

The Gallina area is an ideal location for this type of analysis. Situated in northern New Mexico (see Figure 1.1), the remote Gallina region has been neglected by researchers compared to nearby areas such as Chaco Canyon or Mesa Verde (Cordell 1997) yet thousands of Gallina sites have been documented (see Chapter 7). Despite the dearth of scholarship, the Gallina region holds tremendous promise for research, especially for archaeological studies of tribal warfare. The Gallina area and the Gallina phase (A.D. 1100–1300) in particular have a clearly established record of violence, peaking in the latter half of the 13th Century (Borck and Bremer 2015; Constan 2011). Although there is an abundant record of violence, the source of the violence remains unclear. Were the Gallina attacked by an outside group or groups? Did the
Figure 1.1: The Gallina area and major Ancestral Puebloan sites in the surrounding area
Gallina turn on each other? Or was some combination of internecine conflict and foreign attacks to blame? The Gallina do not appear to have been restricted territorially by outside groups and there are few indications that they influenced neighboring groups. Near the eastern margins of the Gallina area, much of the upper Rio Grande region was not settled in significant numbers until after the Gallina region was depopulated (Crown et al. 1996). On the western boundary of the Gallina area, there is a notable absence of settlements between the Gallina region and the Chaco area (Dew 2003). No significant populations have been identified in the region to the north of the Gallina region. Until the arrival of the Jemez people, the region to the south of the Gallina similarly lacked a sedentary population. Interestingly enough, a Jemez oral tradition describes how the Jemez, en route from the Four Corners region to their current home, encountered the Gallina and eliminated all of them (Roberts 1996:153). Analysis of selected Gallina sites with skeletal evidence of violence does suggest that Ancestral Puebloan group from the Four Corners region may have encountered the Gallina and been responsible for at least a portion of the violence in the region (Borck 2012, 2015). However, many archaeologists have advocated that the Gallina migrated to neighboring regions and were absorbed into existing Pueblo groups there (Stuart and Gauthier 1981; Wiseman 2007). Proponents of the Gallina migration hypothesis often ignore the record of violence or marginalize it as a minor consequence of the underlying factors (such as environmental deterioration and resource stress) which led to the voluntary abandonment of the area (Ellis 1988; Mackey and Green 1979; Mackey and Holbrook 1978).

As was previously stated and as will be discussed in more detail in Chapters 4 and 5, the Gallina phase has been characterized as an area of intense conflict, with researchers
citing the many defensible sites (towers, cliff houses, and site locations with limited access), burned sites, lack of trade wares, and skeletal evidence of violence throughout the region (Byrd 2010, 2015; Borck and Bremer 2015; Constan 2011, 2015; Dick 1976; Green 1956; Hibben 1939). The construction of defensible structures, such as towers and cliff houses, involved a significant investment of time and resources. Their specific locations on the landscape were likely the result of careful planning with an inherent concern for defense as demonstrated by their location and design. Investigating the placement of these structures on the landscape and their relationship to other settlements (including intervisibility) could demonstrate the existence of alliances between communities, territorial boundaries, potential regional organization, and from where communities most felt threatened. In addition, examining the location of settlement clusters and the distribution of trade wares can clarify the nature of interactions between settlements. Finally, identifying spatial and temporal patterns of warfare-related sites can be used to help identify both the source and the objective of attacks.

With advances in the reliability of and the affordability of GPS technology, investigations of settlement patterns increasingly rely on geographic information systems (GIS). Simply stated, GIS connects geographic locations with non-spatial data, but applications of GIS are far-reaching. Spatial analysis techniques can range from simple distance calculations between two points to complex statistical tests, and they have been widely employed by archaeologists. Many researchers have begun to combine multiple spatially-enhanced datasets in the construction of complex spatial models to better identify and/or describe prehistoric behaviors. This study represents such an attempt.
Specifically, I investigated how intraregional conflict and interregional conflict result in different spatial and temporal trends seen in the archaeological record by comparing spatial datasets to three hypotheticals models of tribal conflict. The three models of conflict, to be discussed in more detail in Chapter 6, included conflict between Gallina groups (internal), conflict between Gallina and outside groups (external), and a combination of internal and external (mixed) conflict. Based on ethnographic and archaeological research, the models identify a suite of regional settlement characteristics (discussed in more detail in Chapter 3) that have been previously demonstrated as relevant to warfare (Haas 1990; Haas and Creamer 1993; LeBlanc 1999; Solometo 2004; Wilcox and Haas 1993), such as settlement density, defensibility of sites, sites with evidence of violence, and interaction between Gallina settlements. For each model, variations for each of these settlement characteristics are correlated with expected settlement patterns and expected results from different spatial analysis techniques (discussed in more detail in Chapter 6). The analysis results of the settlement data within the study area were then compared to the expected results for each model.

The end of the Pueblo III period (A.D. 1250–1300) was a time of regional abandonments and major migrations in the southwestern U.S. Large portions of the Mesa Verde region in southwestern Colorado and of the central San Juan Basin in northwestern New Mexico were depopulated and were never reoccupied by Ancestral Puebloans or their descendants. The entire Pueblo III period (A.D. 1100–1300) also saw a marked increase in violent conflict, especially in the latter half of the 13th Century (LeBlanc 1999; LeBlanc and Rice 2001; Nichols and Crown 2008). The Gallina area represents a heightened case of general trends in the greater Southwest. Explaining these trends in the
Gallina area may thus shed light on a portion of Southwestern prehistory that has, in large part, remained a mystery to researchers.

Chapter Summaries

Chapter 2 provides a review of settlement pattern analysis in archaeology. The analysis of settlement patterns has changed much since the pioneering work of Gordon Willey in the Virú Valley of Peru, but the basic premise of regarding an entire landscape as the unit of analysis has not changed. The various approaches and methodologies employed over the years are presented, ending with a discussion of the current state of the field.

Anthropologists have frequently debated the motivations for warfare. Explanations can be grouped into three broad categories: social, materialistic, and evolutionary. Chapter 3 discusses these various motivations and introduces evidence supporting each perspective. This chapter also reviews the conventional methodologies employed in studying prehistoric conflict. These techniques often include settlement data, osteological evidence, weaponry, iconography, and ethnographic analogy (Allen and Arkush 2006; Johannesson and Machicek 2010; Lambert 2002; LeBlanc 1999; Wileman 2009). Each line of evidence is described in detail and assessments are made of each technique’s relative utility. Alliances have always played a significant role in warfare (Ferguson 1990). Evidence for prehistoric alliances is often demonstrated in specific settlement patterns. Those patterns are discussed, including other settlement patterns observed in warfare-related contexts.
There are many examples of conflict in the American Southwest. Chapter 4 reviews the record for conflict in the region, focusing on Ancestral Puebloan groups and their descendants, the modern Pueblo tribes.

Chapter 5 describes the geographic region known as the Gallina area, including the geologic history, the climatic history, and other geographic features of the area. This chapter also provides a summary of previous research in the area. With a few notable exceptions (Borck 2012, Constan 2011, Simpson 2008), much of the culture history of the Gallina area is contained in decades-old theses or dissertations and in dozens of cultural resource inventory reports. An attempt is made to consolidate all of this literature into a coherent narrative describing the Gallina Culture.

Chapter 6 begins by detailing the three models of tribal conflict used as a basis of comparison for this study. The components of each model are presented as are the expected results for each model. The methods utilized in this study lean heavily upon built-in tools with ArcMap (a GIS software application). Some customized scripts were created to aid in data processing and analysis. These methods and others are discussed in detail in the chapter.

The final two chapters represent the final product of this study. Chapter 7 presents the final spatial datasets used in the analysis. Each dataset is described at length before presenting the results of the analysis. Chapter 8 synthesizes the analysis, compares the results to the three models of tribal conflict.
Chapter 2 – Settlement Pattern Studies: Past and Present

The History of Settlement Pattern Studies

Briefly defined, the archaeological study of settlement patterns is an investigation into how the material remains of past peoples are distributed across the landscape (Ashmore and Willey 1981). Alternatively, settlement pattern analysis can be defined as explaining the spatial distribution of archaeological sites in terms of their relation to each other or to the natural environment, or both. The assumption behind such analysis is that human beings do not use the landscape randomly (Hodder 1978; Hodder and Orton 1976). Social and environmental factors are inextricably connected to how humans use a landscape. By examining the patterns of such use we can obtain a better understanding of those factors. Examples of potential environmental factors include the spatial distribution of food resources, topography, fresh water supply, ease of movement, and transportation. Social factors may include competition from other groups, proximity to other members of a society, cultural beliefs about the landscape, and defensibility of an area.

Parsons (1972) traces the modern concept of settlement patterns to two chiefly independent traditions, based in the United States and the other based in England. Working in North America, Morgan (1881) suggested that prehistoric residential architecture was an expression of the social organization of its designers and inhabitants. In the U.S. Southwest a decade later, Mindeleff (1900) used ethnographic analogy to introduce a method for reconstructing habitation chronology and settlement configuration from archaeological remains. The English tradition during the late 19th and early 20th centuries was spurred by an interest in establishing an ethnic identity for archaeological sites. Settlement types were connected to specific ethnic groups and the distribution of
the settlement types across the landscape were associated with the spatial extent and movement of these groups (Parsons 1972). These ideas were not explicitly connected to the concept of settlement patterns until decades later. During the 1930s and the 1940s, several research projects throughout England demonstrated a connection between archaeological sites and environmental variables (Childe 1934; Fox 1933; Grimes 1945; Hogg 1943; Woolridge and Linton 1933), ushering in a new era of settlement pattern research in Europe.

The oft-cited root of current settlement pattern analysis was Julian Steward’s work in the late 1930s (Kantner 2008; Parsons 1972). Steward used prehistoric settlement patterns to infer the developmental processes underlying the social organization of indigenous groups in the American Southwest (Steward 1937, 1938). Steward’s emphasis on entire landscapes rather than individual sites stimulated several important studies in subsequent decades. One such project was Gordon Willey’s (1953) analysis of settlements in the Virú Valley in Peru. Willey’s innovation was to look at the entire Virú Valley as a single analytical unit, rather than focusing on individual sites (Parsons 1972). Willey demonstrated that each settlement was related to the overall landscape and was part of a larger economic, environmental, social, and political system (Willey 1953). (A second significant study, by Phillips, Ford, and Griffin [1951], examined the Lower Mississippi River Valley.) Sanders (1956) expanded on Willey’s work by providing specific definitions for the various scales and scopes of analysis and suggesting ways to identify them archaeologically. He also introduced the idea of a symbiotic region as a description of how agricultural communities within a region were related to each other. Sanders (1965) went on to apply his ideas to a large scale research
project in the Teotihuacan Valley of Mexico. Working in the Arctic, Chang (1958) examined the relationship between social organization and settlement patterns in simple societies. He placed special emphasis on the territory that a community moved across during an annual cycle and the variation in settlement types throughout that cycle.

During the 1960s, the use of quantitative spatial analysis coupled with the emergence of the New Archaeology significantly affected the direction of settlement pattern research (Anschuetz et al. 2001). Archaeologists increasingly borrowed analytical tools from other disciplines, enabling a far greater range of quantitative analysis (Kantner 2008). A greater emphasis was also placed on the improving precision of archaeological data (Anschuetz et al. 2001). Flannery (1968) introduced the ecosystem approach, placing importance on the relationship between human behavior and the surrounding environment. The introduction of the settlement system concept was another key factor in the direction of settlement pattern research. Settlement systems were clearly distinguished from settlement patterns. A settlement “pattern” was simply the observation of where sites were located on a landscape, while a settlement “system” described the proposed explanation for the observed settlement pattern (Flannery 1976; Winters 1969).

As a result of these emerging trends within archaeology, the 1960s and 1970s were a trailblazing era with settlement pattern research being used for prehistoric cultures representing all levels of social complexity. Binford and Binford (1966) employed multivariate statistical analysis to reconstruct Paleolithic settlement systems by detecting patterns in artifact variability in Mousterian tool assemblages. At the Carter Ranch site in Arizona, an examination of stylistic variability in ceramics led to suggested locations of
matrilocal residential groups within that Pueblo community (Brown and Freeman 1964; Longacre 1968). Cowgill (1968) applied factor analysis of artifact assemblages from Teotihuacan to develop settlement systems applicable to complex societies.

The proliferation of new techniques to create detailed environmental reconstructions spawned the development of catchment analysis, which has been used widely to investigate settlement patterns (Flannery 1976; Hunt 1992). Borrowed from the field of biology, the term catchment originally referred to the area where water is collected on a landscape. Archaeologists appropriated the term to refer to the area where resources are collected on a landscape. The size of a particular catchment can be calculated in a number of different ways, depending on the resource being exploited (e.g. hunting and gathering vs. agriculture) and other factors such as size of the group or resource availability. Catchment analysis compares observed settlement patterns to environmental variables within a catchment to identify trends in land usage (Vita-Finzi and Higgs 1970). The basis of this approach is the assumptions that resource availability is affected by distance from a settlement and that sites will be located to maximize resource exploitation (Maschner 1996).

As processual archaeology became the paradigm for archaeological research during the 1970s and 1980s, the utilization of multidisciplinary perspectives and quantitative methods increased in popularity. For settlement pattern studies, this resulted in the use of new spatial analysis techniques relating observed patterns to sociopolitical organization. Central place models, rank-size analysis, gravity models, distance decay models, nearest neighbor analysis, trend-surface analysis, and network analysis were all used to examine settlement patterns within a region-wide social and/or political context.
Central place theory predicts that major centers will be evenly spaced and surrounded by smaller sites (Christaller 1966). A central place model assumes that all communities are integrated into a regional system, that the landscape is featureless (contains no geographic features to constrain settlement), and there are no social or cultural factors that dictate settlement location (Smith 1974). When applying central place theory, researchers expect to find an orderly distribution of large population centers sites surrounded by smaller sites dependent on the larger center (Figure 2.1). Unfortunately, many researchers found that the real world seldom conformed to those assumptions and often abandoned central place theory in favor of other models (Johnson 1977). Related to central place theory, rank size analysis assesses the degree of centralization in a settlement system by assuming that the degree to which a site is dominant is reflected in its size, architecture or some other important attribute relative to the other sites in the region (Blanton 1976; Flannery 1976; Johnson 1977). Originally introduced by Zipf (1941), the rank size rule states that regional populations are distributed among settlements in such a way where a settlement of rank $r$ has a population equal to $1/r$ multiplied by the population of the largest settlement in the system (Berry and Garrison 1958). For example, in a region of four settlements of varying size, the largest settlement could have a population of 500,000, the second 250,000, the third 167,000, and the fourth 100,000. As with central place models, researchers found that the real world did not always conform to the rank size rule, but rank size analysis continues to be useful for some researchers (Drennan and Peterson 2004; Lee 2004; Marzano 2011).
Figure 2.1: Regular central-place-hierarchy from Smith (1974:169)

Used extensively in cultural geography, gravity models described interaction between populations (Johnson 1977; Plog 1976). In Newtonian physics, the force of gravity between two objects is a function of the product of their masses divided by the square of the distance between the two objects. In gravity models, researchers replaced mass with population size to predict the degree of interaction (gravity) between population centers (Yeates 1974). Similar to gravity models, distance decay or fall-off
models were based on the premise that there is a strong inverse relationship between distance and interaction (Johnson 1977).

Nearest neighbor analysis is a statistic that describes a distribution of settlements as random, clustered, or dispersed and has been used to indicate the level of centralization of political authority (Earle 1976). Nearest neighbor analysis typically only identifies relationships between a site’s nearest neighbor and effectively ignores all other locations (Hodder and Orton 1976).

Network analysis visualizes regional interactions as a web of interconnected lines connecting points (representing the unit of analysis) across a region. The unit of analysis and the type of interaction selected can cover a wide range of research topics, including kinship, trade, political organization, war alliances, and religion (Boissevain 1979).

Trend-surface analysis attempts to identify trends at the regional scale for a selected class of archaeological data (Bowe 1981). Using regression analysis, researchers separate large-scale variations from local ones and fit the large-scale trend to a defined function. The resulting function can be represented as lines or a surface (Krumbein and Graybill 1965).

As archaeologists began to increasingly borrow analytical tools from other disciplines, questions were raised about the appropriateness of these methods for archaeological data (Paynter 1983; Ruggles and Church 1996). Issues concerning sampling, defining regional boundaries, proper units of analysis, and appropriate spatial scales confounded many archaeologists (Fish and Kowalewski 1990; Johnson 1980; Thomas 1975). Concerns about units of analysis prompted some archaeologists to advocate for siteless archaeology, an approach that favors using variation in artifact
densities across a region to define boundaries between analytical units (Dunnell and Dancey 1983). The disciplines from which many analytical tools were borrowed from were never confronted with many of these issues.

In part as a consequence of these issues, new approaches to settlement pattern research were developed during the early 1990s. These approaches were based on classic analytical techniques but were designed to address the challenges of archaeology (Ruggles and Medyckyj-Scott 1996; Zubrow 1994). The application of historical ecology encouraged viewing the interaction of people with the environment over an extended period and connecting it to regional change (Crumley and Marquardt 1990). The advent of postprocessualism increased the acceptance of qualitative techniques for evaluating past landscapes, leading to the emergence of landscape archaeology (Kantner 2008). Landscape archaeology, which has become increasingly popular in Europe, attempts to understand how people perceived, constructed, and experienced their prehistoric environments (Knapp and Ashmore 1999).

These developments in settlement pattern studies took place amidst a number of technological innovations. The power available to a typical computer user increased at an exponential rate, enabling researchers to design and implement complex settlement models. Visualizing and analyzing multidimensional prehistoric landscapes became possible for anyone with access to a personal computer. The emergence of geographic information systems (GIS) software supporting spatial analyses turned many operations from time-consuming, labor-intensive calculations to simple button clicks. More than any other factors, these developments have shaped how current settlement pattern analysis is conducted and signaled the start of modern settlement pattern studies.
Current Trends in Settlement Pattern Studies

Settlement pattern analysis is evolving at an ever faster rate (Kantner 2008). The ubiquity of GIS, the increasing affordability and ease of collecting precise spatial data, the availability of high-resolution, digital environmental data, and the incorporation of GIS data in archaeological site registries has opened the door for analyses that would not have been possible previously. The past few years have witnessed an explosion in the number of regional settlement pattern studies often adopting innovative methods and techniques (Kowalewski 2008). The following review of current settlement patterns research is by no means exhaustive but provides a summary of the various research topics addressed and the analytical methods employed in such research.

Spatial Clusters

Identifying spatial clusters is a fundamental part of settlement pattern studies. Determining the existence of spatial clusters through statistical analysis is a common approach. Each of the following techniques employ a different algorithm to identify spatial clusters and are affected by common issues with spatial analysis, such as edge effect, shape effect, and often produce slightly different results. Edge effect refers to potential estimation errors of spatial patterns for data located near the boundaries of a study area, while shape effect refers to potential errors due to irregularly shaped study areas (Haining 2003). Researchers often run preliminary analysis using the different techniques and will compare the results to select the most beneficial technique for their research.

The analysis of datasets usually begins with determining whether the observed results are consistent with a random distribution (Kvamme 1990). Probably the most
common such method is nearest neighbor analysis (NNA), which examines the distance between each point and the closest second point, then compares observed distances to expected values for a random sample of points (Wheatley and Gillings 2002). One limitation of NNA is that it only detects patterning based on closest points. Although NNA can be applied to the 2\textsuperscript{nd}, 3\textsuperscript{rd}, and n\textsuperscript{th} neighbor, it cannot be statistically validated (Hodder and Orton 1976). In contract, Ripley’s K function (Ripley 1981) operates on multiple scales by identifying clustering or dispersion at user-defined intervals. Ripley’s K-function requires a defined number of random simulations. The average values for those simulations are computed and observed values are compared to those averages. This method allows for the identification of clustering at different distances but can result in unreliable results at larger distances due to edge effects.

Another method of determining the existence of clusters is Moran’s I autocorrelation analysis, which measures the similarity between point values and their proximity to each (Griffith 1987). The advantage of Moran’s I lie in its ability to compare multiple spatial patterns identified using different calculating parameters but does not evaluate the semivariance of data points (Huo et al. 2012). The final statistic yields a value ranging from -1.0 (dispersed pattern) to +1.0 (clustered pattern) (Kvamme 1990; Mitchell 2005; Wheatley and Gillings 2002).

Another spatial cluster analysis technique employed by archaeologists is K-means analysis, which is applied to two-dimensional spatial data. The goal of the analysis is to assign each data point into one of a specified number of clusters. A maximum number of clusters is defined by the analyst. The algorithm is first run to define the location of two clusters, then is rerun for three clusters, then for four clusters, on up to the maximum
number of clusters that the user defined. This analysis produces a graph that helps researchers identify at what points (in this context, how many clusters) spatial clusters occur (Kintigh 1990; Simek 1987). K-means is especially useful in efficiently identifying globular clusters but is less useful identifying non-globular clusters or in situations when the number of clusters (the value of K) is difficult to predict (Kim and Yamashita 2007).

Other techniques to identify spatial clusters include discriminant analysis and Getis’s Local Gi*. One of the advantages of discriminant analysis includes identifying the differences between two or more groups of data relative to several variables simultaneously and then groups data based in part on designations of dependent and independent variables. Outliers can skew results dramatically, so discriminant analysis is inappropriate for some datasets. Getis’s Local Gi* identifies the location of cold and hot spots among a spatial data set (Wheatley and Gillings 2002). Getis’s Local Gi* includes a measure of statistical significance for identified cold and hot spots but results can be skewed by a small sample size.

**Surface Interpolation**

Surface interpolation is “the prediction of exact values at control points within the same area” (O’Sullivan and Unwin 2003:220). Kriging is a surface interpolation technique that examines the spatial composition of data to determine appropriate parameters for interpolation. Kriging can be much more sensitive to the organization of the original data set and can produce results much more appropriate than any other interpolation techniques. It is a reflexive type of analysis that can be constantly altered to better suit the data and to produce more meaningful results. It is particularly useful for
compensating for spatial clusters and provides an estimate of interpolation error. The potential downside of kriging are its assumptions (stationarity and normal distributions) which are rarely met in real world data sets (Largueche 2006). The complexity of the underlying algorithms often render results difficult to interpret and explain.

Geographically weighted regression (GWR) is contrasted to a standard regression. A standard regression finds a single solution for the intercept term, the coefficients that weight independent variables, and the model’s goodness of fit. GWR estimates those three components separately at each sampled location. These estimates are applied locally within an area defined by a spatial kernel, whose size and shape is defined by the analyst. The results can be compared to a global model to assess the variety of spatial relationships within the data set (Fotheringham et al. 2002). GWR can be useful by improving model performance by analyzing spatial variation to modify model parameters but collinearity and errors defining model parameters could lead to unreliable results. Both kriging and GWR have been used to create interpolated surfaces that could be used to predict the presence of artifacts in unexcavated regions. Cokriging is an interpolation technique that allows one to fine tune a kriging interpolation when there is a secondary variable that has been more intensively sampled (compared to the primary variable).

Cost Distances and Cost Path Analysis

Cost path analysis is a method for measuring distance that factors in the cost associated with travel. Costs can refer to anything that may impact a decision to travel from one location to another, including factors such as travel time, financial expenses, environmental impacts, energy, or construction costs. Cost distance is often contrasted to Euclidean distance, which measures the straight-line distance between two points
(Wheatley and Gillings 2002). In cost path analysis, the various route options between two points are evaluated in terms of their cost distances. The least cost path, the route with the lowest associated costs, is the most common application of this analysis but determining the highest travel costs can also be done. Before calculating cost distances in GIS, a cost raster must be created that assigns a cost factor for each cell. The cost factor can be defined based on a single characteristic or on multiple weighted criteria. To determine the least cost path, the cost to travel to each neighboring cell to the starting point is calculated with the path advancing to the cell with the lowest cost. This process is repeated until the starting point and destination are connected by the generated path. To calculate the highest cost path, the same process is completed but the highest associated cost for each cell is selected when defining a path.

One significant advantage to this type of analysis is its ability to factor in real-world costs for travel. Calculating cost paths and cost distances in GIS also provides a way to efficiently calculate optimal routes across long distances that would be extremely time-consuming if done manually. One potential disadvantage is that the final travel costs for any particular route are dependent on the user-defined cost factor. Any issues with the cost factor will be reflected in the final result.

Viewshed

A viewshed is the area that is visible from a specific point on a landscape. Calculating the viewshed for a location using digital elevation models (DEM) is a built-in function for most geospatial software packages. As commonly applied in most GIS software packages, a viewshed is calculated from the elevation value of each cell of a DEM. Factors such as the height of the observer, the curvature of the Earth, and the limit
of the viewshed calculation are available in most GIS software options (Wheatley and Gillings 2002).

The accuracy of any viewshed is tied to the accuracy of the DEM used. DEMs have an inherent margin of error and can vary dramatically depending on source quality, terrain relief, land cover, and other variables. The USGS reported a vertical error of less than 3 meters for 95% of the National Elevation Dataset (Gesch et al. 2014). The horizontal level of precision for DEMs is a significant factor in determining viewsheds. In addition to the margin of error of DEMs, the reliability of prehistoric visibility assessments are also limited by the same issues that potentially hamper prehistoric catchment studies. In lieu of developing a sophisticated prehistoric reconstruction, modern DEMs are typically used for calculating prehistoric viewsheds and any potential differences in vegetation or ground cover that may impact visibility are noted.

Modeling

Complex settlement models typically involve multiple dimensions of archaeological and environmental data used to predict, simulate, or describe prehistoric settlement behavior. Predictive modeling has been used effectively for over 20 years by cultural resource managers and academics (Verhagen and Whitley 2012). Many predictive models relate environmental and social variables to known site locations and then use those identified relationships to predict the locations for undiscovered sites. Many archaeologists have also developed simulation models in which agents interact with each other and their surrounding environment. The simulation is run over many generations allowing researchers to make observations about social interactions and environmental conditions at a regional scale (Kantner 2008).
Applications of Spatial Analysis Techniques in Archaeology

Regional Systems

Analysis of how settlements are distributed and differentiated across a region and identifying potential interactions can be indicative of the underlying social organization of prehistoric groups. K-means analysis was used to identify settlement clusters among Late Bronze Ages city-states in the Near East (Savage and Falconer 2003). Settlement clusters identified through spatial analysis were then compared to historical records and found to be in agreement. Bevan and Conolly (2006) employed Ripley’s K function to identify settlement clusters of varying scale on the island of Kythera, Greece and was highly effective investigating settlement organization on multiple scales. Winter-Livneh and others (2010) identified settlement clusters on multiple scales to assess levels of social organization during the Chalcolithic period in the northern Negev, Israel. They first determined that the distribution of settlement locations were clustered by applying Moran’s I autocorrelation analysis. They then applied Ripley’s K-function to determine multiple scales of settlement clustering along wadis in the region.

Crema et al. (2010) used spatial tests, such as Getis’s Local Gi* and Ripley’s K-function to look at the distribution of pit houses in prehistoric Japan. In this study, the point data represented the location of pit houses during the Middle to Late Jomon in the Chiba New Town area of Japan. Getis’s Local Gi* analysis identified the location of pit house cold spots and hot spots in the area. In a study reminiscent of classic central place theory research, Smith (2010) used some less statistically-rigorous methods for defining neighborhoods and larger districts in ancient cities.
Settlement pattern studies on the Middle and Upper Paleolithic in Greece have shed light on the respective social systems of those periods (Bailey et al. 1997). In the American Southwest, there are many examples of researchers identifying regional social organization based on settlement patterning. Fish and other (2007) made various arguments for placing the trincheras sites of southern Arizona and northern Sonora within a regional system of mutual defense or agricultural cooperation. Hohokam communities clustered in large settlement groups separated from each other by 5 to 6 km and participated in different exchange networks that varied by commodity (Harry 2002). The nature of the Chaco System has received considerable attention, including research based on attributing the distribution of Great House communities and prehistoric roadways to a regional system of ritual and exchange (Gilpin 2003; Kantner and Mahoney 2000). Combining historical and archaeological data, Jordan (2004) explained changes in Seneca-Iroquois settlement patterns in terms of the introduction of economic opportunities among the Seneca. Variations in the scale of architecture across the landscape have been related to social hierarchy in the Casas Grandes region (Whalen and Minnis 2001) and in Venezuela (Spencer and Redmond 1998).

Siart and others (2008) presented a study using least-cost analysis, land cover grids, remote sensing, and DEM analysis to reconstruct the prehistoric landscape of Bronze Age Crete and create a model for settlement location. Slope and contour grids were created from DEMs. These grids, along with land cover grids, were used to calculate least-cost paths to identify the potential existence of prehistoric roads. The details of the methodology were not discussed in the article, but least-cost analysis usually entails factoring the slope in determining distances between locations. In this
context, cost is time, so paths were determined that minimized the amount of time to traverse a landscape. The slope grid, derived from the DEM, was used to determine the cost distance between sites on the landscape. The authors concluded that the lowest cost paths between sites were likely locations for prehistoric roads. The present land cover grid was used to create grids representing land cover from the past. All of these data were combined into a model that accurately depicted the prehistoric landscape of the region. The modern contour grid was used to cross-check the landscape model.

McMahon (2006) used settlement locations and kernel density estimation (KDE) to look at interactions between Pueblo communities in southwestern Colorado. KDE provides a method for smoothing out the variation in a function and allows researchers to estimate the value of a variable at all points within the range of a function. Using KDE in spatial analysis provides a method to estimate the value of a variable across a surface. McMahon’s model incorporated topography, cost distances, and kernel density estimates to examine relationships between population centers and smaller communities. Other predictive models have been created for Neolithic settlements in Scotland (Graves 2011) and rural Roman villae (Rua 2009); predictive models have been developed for nearly all archaeological research areas (Kowalewski 2008).

Kohler and others (2000) used agent based modeling to determine the causal factors related to observed changes in the archaeological record. They simulated the location and population of communities through time, based on agricultural potential estimates derived from paleoclimatic data. Their model also factored in potential human impacts on the environment. A different agent-based model used simulations to improve battlefield excavations (Campillo et al 2012). Griffin and Stanish (2007) created an
agent-based model for the Lake Titicaca Basin to examine pre-state societies between 2500 B.C. and A.D. 1000. Prehistoric behavior has also been simulated for the Long House Valley of northeastern Arizona (Axtell et al. 2002; Dean et al. 2000; Gumerman et al. 2003), the Mesa Verde region (Varien et al. 2007), and Mesopotamia (Christiansen and Altaweel 2006; Wilkinson et al. 2007).

**Activity Areas**

Many researchers have applied spatial cluster analysis to archaeological data to help explore the relationships between space and past behavior within sites. Bradbury and others (2008) applied the K-means method to surface collection data from two prehistoric sites in Kentucky and was useful in defining activity areas at one site and determining site use and identifying a component at the other site.

Merrill and Read (2010) proposed a method using spatial similarity and cohesion among artifact types to interpret activity areas within archaeological sites. The researchers begin by calculating a probabilistic measure of spatial similarity between each pair of artifact types. This probabilistic measure was based on the average distance between artifact pairs within a particular artifact type. The probabilistic measure was converted to a matrix which shows the pattern of spatial similarity between artifact types. In this matrix, the artifact types are compared and their spatial relationship is described by a 0 or a 1. This matrix of 0 and 1 was then represented as a graph with each artifact type as a node in the graph. If the matrix value for a pair of artifact types is 1, a line was drawn between the two nodes. This was repeated for all possible artifact pairs. In the opinion of the researchers, the resulting graph presented the relationships between artifact.
types in a novel way that tremendously benefitted their analysis of activity areas within archaeological sites.

**Prehistoric Landscape Reconstruction**

Reconstructing prehistoric cultural and environmental landscapes is tremendously useful for settlement pattern studies. Surface interpolation is a commonly used technique for landscape reconstructions. Contreras (2009) reported on the use of cokriging to model a prehistoric land surface using unevenly distributed point data. In this case, the primary variables are the sampled data points representing prehistoric artifacts. The secondary variables are the estimated courses and elevations of the rivers of the region in the past. Kriging was first used to create an interpolated surface representing the prehistoric land surface in the Chavín de Huantar region of Peru. Point-located artifact locations were the data points used for kriging. Once an initial interpolated surface was defined, Contreras introduced estimated prehistoric paths and elevations of the area’s rivers to adjust various aspects of the surface. The resulting surface was deemed to have produced a much better approximation of the prehistoric landscape. The prehistoric landscape surface was then compared to the modern surface to assess the amount of change through time. Bevan and Conolly (2009) utilized kriging and geographically weighted regression to develop a model addressing artifact distribution across a landscape. Using survey data and various environmental variables from the Greek island of Antikythera, they created a digital surface that can be used to estimate artifact densities in non-surveyed areas. Another study on the Early Neolithic period in Thessaly recreated the prehistoric landscape to help detect the location of Neolithic settlements (Alexakis et
Goings (2003) created an interpolated bedrock surface for southeastern Iowa to assist in predicting the location of prehistoric lithic resources.

**Resource and Land Use**

Settlement pattern studies are ideal for examining how prehistoric groups exploit resources across the landscape. Catchment analysis continues to be performed but has been greatly expanded with the aid of new techniques (Hamilton 2000; Hunt 1992). Researchers often employ two-dimensional modeling of site boundaries, using Thiessen polygons or overlapping site catchments based on a fixed radius from the center of a site, to determine interactions zones on the landscape (Renfrew 1986; Ruggles and Church 1996; Wheatley and Gillings 2002). These methods fail to account for how topography can affect the utilization of the landscape and has led to the use of models that factor in the physical costs of traveling from one place to another (McCoy et al. 2011; Ullah 2011; Varien 1999; Wheatley and Gillings 2002).

The creation of cost surfaces and defining related least-cost paths is a tremendously helpful in suggesting how prehistoric people traversed across the landscape (van Leusen 2002). The mobility of prehistoric groups is also often assessed in settlement pattern studies. Inherent uncertainties in prehistorical landscape reconstruction do present challenges to utilizing cost surfaces for resource use studies, but they still are a useful tool. Topography is generally assumed to change minimally through time, so modern-day cost surfaces are often used in prehistoric land use studies. Studying Neanderthals in Bavaria, Richter (2001) found that groups in that area followed a seasonal mobility pattern similar to that of local Upper Paleolithic populations.
Social Use of Landscapes

Visibility is a key component of constructed landscapes and a significant factor in archaeological studies of landscapes (Bongers et al. 2012). Locating a site in a highly visible location affects how individuals experience their social and physical environment (Wheatley and Gillings 2002). The reasons for establishing highly visible sites include asserting territorial claims, enabling communication networks, and providing defensive lookouts. Calculating line of sight, cost surface, associated least cost paths, and network analysis can be used to examine interaction between groups and how people perceived their environment (van Leusen 2002).

Swanson (2003) used viewshed analysis to quantitatively test whether or not a communication network could have existed among hilltop sites in northern Mexico. Howey (2007, 2011) used cost surface analysis and the creation of least cost paths to investigate ritual activity and social interaction in the Northern Great Lakes from A.D. 1200 to 1600. Viewshed analysis supported claims that *chullpas* (above-ground funerary structures) were used to establish social boundaries between groups in the central Andes (Bongers et al. 2012; Mantha 2009). Wernke (2012) used spatial network analysis to simulate patterns of foot traffic to examine interactions between prehispanic and early colonial settlements in the Andean highlands. Line of sight and cost surface analysis help clarify the relationship between hill forts during the Celtic Iron Age in the Burgundy region of France (Madry and Rakos 1996).

Environmental Change

Relating trends in settlement patterning to environmental changes provides unique insights to what factors influence settlement decisions. Boone and Worman (2007)
attributed the abandonment of rural villages in southern Portugal during the mid-12th century to wide-spread erosion and soil loss. Many studies in the American Southwest point to environmental stress as the key factor in significant settlement pattern change (Dean et al. 1994; LeBlanc 1999; Schollmeyer 2009). Examining the variability of water availability during the Upper Paleolithic and Epipaleolithic in southwestern Syria, Bretzke and others (2012) correlated changes in land use patterns to the distribution of water. The appearance of fortifications during the late Holocene in East Timor was related to significant climate change (Lape and Chin-Yung 2008). Many other studies have related climate change to settlement patterns (Cremaschi and di Lernia 2001; Madsen 2002; Przywolnik 2005).

**Demography**

Changes in regional populations through time (whether due to disease, migration, war, environmental changes, or other factors) can be addressed using spatial and statistical techniques. Jones and DeWitte (2012) used surface interpolation to estimate depopulation for Native American populations in northeastern North America. Examining the early 17th century, they created an interpolated surface using kriging analysis that predicted depopulation rates across their study area. Bamforth and Grund (2012) attempted to discern Paleoindian population trends by statistically simulating demographic processes. Applying data from 12,000 to 9000 B.C., they used summed probability distribution analysis to discern statistical trends and to correlate those trends to Paleoindian populations in North America. In the American Southwest, archaeologists have attributed regional migrations to environmental deterioration, change in resource
availability, and warfare (Bernardini 1998; Duff and Wilshusen 2000; LeBlanc 1999; Wilshusen and Ortman 1999).

Throughout the history of settlement pattern studies, researchers have used a wide range of analytical techniques and continue to do so. Innovations continue to raise the bar for settlement pattern analysis. Given the continuing technological advances in spatial data collection and spatial statistical software, the future of regional settlement studies is promising.
Chapter 3 – Archaeology of Warfare

Motivations for Warfare

The roots of theories of warfare lie in the philosophical debate about human nature. Thomas Hobbes argued that humans were inherently violent. In their natural state they would lead lives that were “nasty, brutish, and short.” Without social controls, people would become violent savages, in a “war of all against all” (Hobbes 1651). At the other extreme, Rousseau (1750) offered his concept of the “noble savage,” maintaining that humans are inherently peaceful and only compelled to act violently if corrupted by their experiences in society.

The word “warfare” is a loaded term. It often evokes images of trench warfare or large armies clashing on a battlefield. Within anthropology, it has been used to describe battles between states, raiding between tribal groups, and violence between hunter-gatherer groups. The literature on warfare reflects this wide range of the term’s applications. For those who appreciate explicit definitions and specific usage of terms, it has created a somewhat messy situation. Warfare has been defined as “organized, purposeful group action, directed against another group that may or may not be organized for similar action, involving the actual or potential application of lethal force” (Ferguson 1984:5). Rather than getting bogged down in determining when conflict has escalated to the level of warfare, I have expanded the meaning of the word to include all behaviors related to conflict between groups, regardless of scale, frequency, or duration. Warfare is used interchangeably with the phrase “group conflict” and is intended to include behaviors that occur as a response to violence between groups. This can include (but is not limited to) armed combat between two groups, the suppression of minority groups by
dominant groups, and defensive responses to the threat of violent conflict. Group conflict is defined as a disagreement between groups that either include violence or the threat of it. Competition between groups refers to situations where two or more groups are attempting to acquire the same resource. Although competition can lead to conflict, it does not always do so. Aggression, when used, refers to the overt intention of violence of one group toward another.

Anthropological discussions of warfare often assess the relationship between conflict and social complexity. Some have considered violent conflict over limited territory as a key factor that spurred societies towards statehood (Carneiro 1970; Haas 1990; Otterbein 2004; Webster 1975). Others, such as Service (1975), viewed warfare as a consequence of increasing social complexity, rather than the cause. More recent studies have shown that warfare in hunter-gatherer populations was sometimes just as prevalent as in state-level societies (Keeley 1996). Current theoretical discussions of warfare have concentrated on explaining motivations for war. Most of these explanations can be grouped into three broad categories: economic, social, and evolutionary.

**Economic Models**

Economic models present explanations in terms of competition over resources. The scarce-resources model argues that subsistence resources were limited and people fought to claim these scarce resources (Durham 1976). Scarcity could be due to decreases in the abundance of resources, distribution of resources over large areas (as opposed to resource concentrations), or decreases in the overall returns of subsistence resources. Implicit in this model is the notion that if environmental or climatic conditions deteriorate and lower the carrying capacity of a region, groups engage in warfare to
secure the remaining resources (Allen and Arkush 2006; Wileman 2009). It should be noted that even within these models, conflict is seen as one choice among many others that groups make to alleviate resource stress. Agricultural intensification, territorial expansion, changes in subsistence strategies, migration, and warfare are common responses to scarcity and are not mutually exclusive. The potential economic benefits of warfare include the acquisition of additional resources, the elimination of competitors for resources, and a decrease in the demand for resources within the group when casualties occur. The costs of warfare include the loss of life and the amount of energy and resources expended in its exercise, and those costs can be compared to the potential gains of investing a similar amount of resources in non-violent behaviors. Although originally intended to address competition over land, the fundamental concept (people fight over scarce resources) can be expanded to include land, labor, exotic goods, access to women, or even information (LeBlanc 1999). In some cases, warfare is viewed as a violent form of exchange. Groups engage in warfare to forcefully acquire goods (Spielmann 1991). In a cross-cultural ethnographic study of 183 preindustrial societies, Ember and Ember (1992) found that resource unpredictability, or uncertainty about the future availability of resources, was the factor most strongly correlated with conflict between groups.

Many archaeological and ethnographic case studies connect demographic factors to rates of warfare (Keeley 1996; Nolan 2003; Wileman 2009). Population growth, increasing population density, or changes in access to resources for communities creates subsistence and social stresses. Conflicts ensue as groups attempt to lessen those stresses by securing resources, by denying access to resources for others, or simply by eliminating competition for resources. When confronted with resource stress due to increasing
population, the New Zealand Maori would choose either agricultural intensification or warfare (Kirch 1984). Sometimes they cleared more forest for farmland but other times they would attack other groups to take already cleared land. In protohistoric Korea, the desire to achieve a surplus during a period of environmental stress and population pressure prompted groups to engage in warfare to acquire a labor source to produce food, goods, and services (Kang 2000). Rich polities also engage in conflict to protect valuable trade commodities, including slaves (Wolf 1987).

Social Models

Social models see warfare within a context of status-seeking behavior, retribution, or ritual behavior (Allen and Arkush 2006). Researchers who view warfare primarily as status-seeking behavior point out that warfare creates opportunities for individuals to improve their status. Social and materialistic motives for warfare are not mutually exclusive, but social motivations are seen as the primary mechanism driving the behavior. In support of this view, there are numerous ethnographic examples in the American Southwest of the special status given to warriors (Ellis 1951; Solometo 2004, 2006; Titiev 1944; White 1935). Socialization for war plays a significant role. Children are taught to value fierceness and to avenge slights, with one’s proficiency in battle considered an all-important characteristic of masculinity (Chagnon 1983; Ferguson 1999; Robarchek and Robarchek 1998). Vengeance models describe warfare as simply an attempt to even the score for a real or perceived grievance (Ferguson 1984). In the American Southwest, demands for vengeance from Apache women played a role in decisions to execute raids on other groups (Basso 1971). Ritual warfare represents an attempt to resolve conflicts through symbolic contests where formalized rules limit
casualties for the combatants (Meggitt 1977). Ritualized conflicts also allow participants to display their abilities as warriors while minimizing the frequency of injury or death (LeBlanc 1999). While ritualized warfare is more appropriately regarded as a response to violent conflict rather than a cause of it, it can play a significant role in the duration of conflicts. Conflicts that might eventually end due to attrition can be prolonged indefinitely. In these cases, by limiting casualties, ritualized warfare creates a sustainable option, albeit violent, for groups to resolve conflicts.

War can also be viewed as a strategy to relieve internal social pressures (Mercer 1989; Vayda 1968). Within regional systems with pronounced social, ecological, economic, or demographic inequalities, war can become an established method for groups to attempt to rectify these inequalities (Ferguson 1997). High-status individuals may also encourage lower-status individuals to engage in warfare with other groups. Not only would the higher-status individuals reap the benefits of any resources gained through conflicts, potential aggression towards the higher-status individuals is redirected to other groups (Boone 1983). Evidence from Tonga suggests this motive for the encouragement of attacks on group on other islands (Aswani and Graves 1998). For lower status individuals, the security of the group and the possibility of achieving greater status result in a tacit acceptance of the situation (Boone 1992). Alternatively, warfare could take the form of witchcraft persecution, where groups attempt to relieve internal social pressures by executing extremely violent acts on particular members or groups of a society (Walker 2008, 2009).
Evolutionary Models

Evolutionary perspectives on warfare see both materialistic and social explanations as manifestations of underlying evolutionary forces (Ferguson 1990; Wileman 2009). Under an evolutionary framework, warfare creates conditions where natural selection operates on both groups and individuals. Groups that succeed in their attacks are selected over less successful groups. Successful attacks require careful planning and organization under the direction of a war leader, so natural selection also works to select the best leaders for a group (Webster 1975). On the individual level, a successful warrior can improve both his social standing and his access to mating opportunities while eliminating some of his competitors. Other researchers view human aggression and coalition formation within a larger context of evolved primate behaviors (Wrangham and Peterson 1996). The propensity for violence has been regarded as playing a crucial role by some researchers in the evolution of Homo sapiens (Bigelow 1975). Corning (1975) identifies a number of potential evolutionary advantages related to aggressive behavior, including larger brains, bipedalism, inventiveness, and physical stamina. Violent conflict over territory could have been the cause of the extinction of Homo neanderthalensis at the hands of Homo sapiens sapiens (Pettit 2000).

An alternative theory contends that humans are predisposed to form groups and to compete with other groups for resources (Alexander 1979). This trait, the theory suggests, evolved in ancestral environments to provide humans an adaptive advantage against other species that were competing with humans for resources (Melotti 1986). Once humans became the dominant species, the only remaining competitors were other groups of humans. As a result, humans acquired predispositions to be cooperative within
their groups and to be wary and even hostile towards outside groups (Goetze and James 2001). Social psychologists have conducted a large volume of research documenting examples of these in-group/out-group behaviors in humans (Billig 1976; Billig and Tajfel 1973; Melotti 1986).

Explaining the existence of warfare from an evolutionary perspective presents a conundrum to researchers. The casualties of war are typically young men who could have potentially fathered more children. The members of a group who may benefit from warfare may not be related to the warriors risking their life. Selection within a group should discourage warfare since it entails a very high risk of death. Increasing the level of participation within a group could lead to greater success for the group and could increase the spread of genes that encourage participation in warfare, but such arguments require that there would be virtually no gene flow between groups. Otherwise, genetic variation between groups would not be sufficient to overcome selection within groups against warfare. Migration and the capture of women during war contribute to reducing genetic variation between groups. Yet warfare persists. One potential explanation for the perseverance of behavioral traits when there is not a high degree of genetic variation between groups is cultural selection (Boyd and Richerson 1985; Henrich 2004; Richerson and Boyd 2005). Group cultural selection could explain how behaviors that are beneficial to a group of unrelated individuals, such as warfare in some contexts, may persist despite the high personal costs for individuals. Group cultural selection is also useful in explaining variation in the manifestations of warfare (Zefferman and Mathew 2015).
The Conduct of War in Tribal Societies

Although many questions remain about the social organization of Gallina Culture, evidence indicates that there was not a centralized authority, and its society was likely similar in many ways to other tribal groups (Borck and Bremer 2015; Constan 2011; Dick 1976; Green 1956; Hibben 1939). Solometo (2004, 2006) identifies various factors for the study of war in noncentralized societies. These factors include social distance, scale, frequency and predictability, and duration. In varying degrees, each of these factors results in distinct patterns of conflict. These factors do not occur in isolation and often significantly affect each other. For example, ethnographic data from many non-centralized societies indicates that degree of social connectivity between groups largely dictates the form of conflicts between those groups (Boehm 1984; Meggitt 1977; Otterbein 1968; Turton 1979). Conflicts are conducted based on how groups define the identity of their opponent, along with other factors (scale, frequency, predictability, and duration).

Social Distance

Social distance plays an important role in the conduct of tribal warfare and refers to the nature and strength of relationships between groups (Solometo 2004, 2006). Groups can be related by kinship, by economics, or by general concepts of identity (such as ethnicity or shared religion). The strength of the relationship between groups can be measured by the number of connections between individuals of each group and the importance placed on those connections. Different types of ties might be weighted more heavily than other types. Solometo explains: “For instance, agnatic ties may be perceived as more important than relationships of trade and exchange” (Solometo 2004:20). Strong
relationships between communities may decrease the severity of conflicts or prevent them all together. People are less likely to engage in costly and destructive conflicts if there is the risk of harming relatives, jeopardizing trade relationships, or disrupting shared religious activities (Koch 1974; Meggitt 1977). When conflicts do arise, community leaders will encourage and even compel disputants to resolve their dispute before it has a chance to escalate. Even when conflicts escalate to battles, opposing groups with some degree of shared experience will refrain from collecting war trophies, mutilating bodies, or committing other disrespectful acts. When the ties between communities become weaker (i.e., social distance increases), the motivations and mechanisms to end conflicts become less frequent. In the absence of connections between warring groups, groups may dehumanize their opponent, leading to extreme amounts of killing, property destruction, and severe treatment of warriors and captives (Bohannan 1958; Karsten 1923; Meggitt 1977). Among the Jalé of western New Guinea, cannibalism is restricted to opponents who are socially and physically distant (Koch 1974). In northern Nigeria, cutting the ear from a corpse indicated the end of an alliance between Kofyar villages (Netting 1974).

**Frequency, Scale, and Duration of Conflicts**

The frequency or expected frequency of attacks dictates how groups defend themselves. The frequency of conflicts within tribal societies can be extremely variable (Solometo 2006). Attacks can occur every month or week while in the midst of intense hostilities (Heider 1997). Ethnic conflicts or trophy hunts can occur several times per year or once every several years. Their frequency is often dictated by the ability to mobilize allies or religious and ritual factors (Redmond 1994; Zegwaard 1959). When
attacks are infrequent or absent, very little effort is put into organizing defenses. When
groups expect attacks to occur frequently or in a predictable pattern (e.g. after harvest
time or during winter months), they devote energy in preparing their defense. The latter
can take the form of fortifications, the placement of settlements in defensible locations, or
conducting military drills. In a cross-cultural study of societies classified as bands and
tribes, Otterbein (1970) found that there was a direct relationship between the frequency
of attacks and the use of fortifications. He found that most groups that experienced
attacks at least once a year fortified their settlements. When attacks were less frequent,
no group established fortifications. The societies in Otterbein’s sample with frequent
warfare and that did not construct fortifications were either highly mobile, established
settlements in defensible locations but without formal fortifications, or some combination
of the two.

Social ties between groups can also help them anticipate and prepare for attacks
(Solometo 2004). Groups that are socially close, such as the Mae Enga of highland New
Guinea, are often aware of the threat of war by knowing which of their neighbors are
coveting more land or seeking revenge for some grievance (Meggitt 1977). Groups with
little or no contact may be taken completely by surprise by their enemies. Long-distance
raids, prompted by internal cultural objectives, rather than grievances known by both
parties, are far more likely to achieve the element of surprise (Solometo 2006).
Predictable annual or seasonal raids (e.g. after harvest or specific points in cycles of
exchange) from distant groups provide an exception to this pattern (Rappaport 1968;
Titiev 1944). Pueblos along the Rio Grande, for example, expected visits from the
Comanche every year during trade fairs and after the harvest (Ford 1972). These visits took the form of raids just as often as they involved peaceful exchange.

Tribal conflicts occur at several scales, ranging from a few warriors to groups of thousands (Ferguson 1984). When stealth is desired, a small war party may be preferred, but the outcomes of most conflicts are usually determined by which side has more warriors. Groups can increase the size of their forces for offensive or defensive action through alliances or settlement consolidation. Alliances are often drawn from existing social ties (Ferguson 1990). Would-be allies may decline to join either side of a conflict if they are connected through kinship (or other reasons) to groups on both sides of a conflict. This can help keep conflicts from escalating and developing into larger wars. When there are no such conflicting interests for potential allies, they are considered more likely to join in, increasing the severity of destructive impact for the conflict.

While hostilities and feelings of enmity may last generations, the duration of individual attacks between tribal groups are typically brief. War parties generally lack the logistical infrastructure and resources to support lengthy sieges (Turney-High 1949). Tribal groups also lack the hierarchical structure to compel warriors to maintain costly (in terms of time and resources) sieges. Even if these difficulties are overcome, sieges can be easily broken by alerting allies through various modes of communication (runners, signal fires, etc.). The duration of many conflicts are often influenced by the degree of social connectivity between groups. Groups with close ties are incentivized to resolve conflicts rather than jeopardize the long-term integrity of trade or family relationships. When conflicts do occur between groups with common social or economic bonds, they typically alternate between periods of war and peace (Kelly 2000). Groups without any
common bonds are likely to exist in states of constant war. Clearly identifying the opposition as a people vastly different than oneself commonly occurs in these contexts. Examples of this include the Mohave and Pima (Stewart 1947), the Shuarä and Achuarä Jívaro (Bennett Ross 1984), and tribes of the Great Plains (Biolosi 1984).

Alliances

The formation of alliances is a critical aspect of tribal warfare (Helbling 2006). In a tribal context, an alliance is the joining of efforts or interests between individuals, families, communities, or any other groups. Allies provide warriors, intelligence, material support, refuges, and secure flanks, and alliances were often built on existing social ties, such as trade, kinship, and marriage (Ferguson 1990). Among the Yanomamo, marriage alliances were often called upon during the formation of war parties, and marriages were used to prevent or mitigate conflict (Chagnon 1966). Alliances among Northwest Coast tribes were based on kinship ties (Ferguson 1984). In the Guianas of South America, trade was the impetus for the formation of alliance among tribal groups (Riviere 1984). Alliances among Upper Amazon Xingu villages were dictated by both trade and intermarriage (Gregor 1990). Historic Pueblo groups in the American Southwest were known to have formed war alliances, often following linguistic or kinship ties (Ellis 1951; Haas and Creamer 1997). Success in war is often a matter of outnumbering one’s enemy, so the ability to form a larger alliance than one’s foe was of great importance (Ferguson 1990; Helbling 2006).

The scale of alliances also varied greatly among cultures and even within cultures, depending on the circumstances. On the Great Plains, groups of several hundred warriors would unite to contest territory or seek revenge. At other times, Great Plains groups
would come together in small numbers to raid for horses (Biolsi 1984). The Mundurucu from central Brazil formed war parties of hundreds of warriors from several villages to execute raids up to 500 miles (800 km) away (Murphy 1957). While the scale of Ancestral Puebloan alliances is unknown, groups are believed to have formed alliances at different times in the northern Southwest (Plog 1984). The Pueblo ability to form alliances on a regional scale, albeit for a short duration, was clearly demonstrated by the Pueblo Revolt of 1680 (Roberts 2004).

**Ambushes and Line Battles**

Warfare in tribal societies differs in scale, tactics, and motivations from state-level conflicts. While warfare between states often occurs for political reasons and consists of large-scale operations such as set piece battles and sieges, conflicts in tribal societies are often small-scale and consist of raiding and ambushes not aimed at occupying an opponent’s territory (Otterbein 2004). Otterbein (2004) states that tribal warfare consists of ambushes and line battles. Line battles, where opposing forces arrange themselves on a battlefield across from each other, typically have low casualty rates. Line battles serve the function of allowing each side to test the strength of the enemy without incurring heavy losses. Casualties in ambushes, on the other hand, are extremely high (Gat 1999). Among the Tiwi of North Australia, line battles provided the opportunity to size up opponents prior to the execution of ambushes (Pilling 1988). The testing of strength in line battles followed by ambushes is also well documented with the Dani, a tribal group in Highland New Guinea (Heider 1997). The Dani would organize line battles that resulted in very few casualties followed by large-scale dawn raids on
enemy villages that would kill hundreds. Both groups would engage in line battles and raids until one side succumbed through attrition.

Establishing an alliance with another group and conducting an ambush or raid would often break a stalemate between adversaries (Otterbein 2004). A Dani group might also enlist the aid of a neighboring group to join forces and completely eliminate their enemy. The Yanomamo of the Amazon frequently conducted raids on each other but were rarely successful due to fortifications surrounding villages (Chagnon 1983). To overcome the obstacles that the fortifications presented, attackers would commonly strike a secret deal with an ally of their enemy. The betraying ally would invite their oblivious friends to a feast, and the guests would be attacked as they left the feast. The males would be killed and the women would be captured and divided between the two attacking groups.

The pattern of line battle and ambushes is not applicable in all situations. When war parties vastly outnumbered their opponent and were intent on the complete destruction of their adversary, neither stealth nor the establishment of formal battle lines was employed. While these types of attacks could still be considered raids, the defenders were not likely to be taken by surprise, so the attacks should not be considered ambushes. Attacks on fortified settlements can involve both direct and indirect assaults. Among the Maori, attackers would disguise themselves to infiltrate their enemy’s villages or to get close to the village before launching their offensive (Vayda 1967).

**Objectives of Tribal Warfare**

The aims of a particular tribal conflict are often reflected by how it is conducted. In some cases, the goal of the attacking group is the complete elimination of their
adversary. These types of assaults involve a large number of warriors, requiring a high degree of organization, leadership, and planning. The acquisition of resources becomes a secondary concern in favor of the general destruction of the settlement. In the American Southwest, examples of these types of assaults include massacres at Sacred Ridge (Potter and Chuipka 2010), Castle Rock Pueblo (Kuckelman et al. 2002), Rattlesnake Ridge (Bahti 1949), Sityatki (Malotki 1993), and Awatovi (Brew 1949). In contrast to these types of conflicts, a large volume of archaeological and ethnographic evidence points to conflicts of a much smaller scale with lower loss of life, less settlement destruction, and a greater emphasis placed on resources acquisition. The objectives of these kinds of tribal raids can include wife-stealing, retribution, limited resource acquisition, territorial expansion, discouragement of other groups from inhabiting an area, and the general destruction of an enemy’s resources (Chagnon 1990; Ferguson 1984; Meggitt 1977; Service 1975). Attacks seeking revenge or prestige often result in limited fatalities and occur away from settlements (Solometo 2006). In some cases, ideological reasons for conflicts, such as political, religious, or ethnic differences, may obscure the materialistic ones.

Archaeological Study of Warfare

While some have argued that the only conclusive evidence for warfare is found in skeletal trauma (Cordell 1989b), identifying warfare in the archaeological record typically relies on multiple lines of evidence: settlement patterns, burned sites, osteological evidence, weaponry, iconography, and ethnographic analogy (Allen and Arkush 2006; Johannesson and Machicek 2010; Lambert 2002; LeBlanc 1999; Wileman 2009). Except for osteological evidence, these are categories of indirect evidence. While
each category is presented separately below, they should not be considered in isolation, but in terms of other lines of evidence and the greater cultural context. Archaeological evidence falling into each of these categories (with the exception of skeletal trauma) may have multiple explanations that have nothing to do with conflict. Researchers should remain cognizant that each line of evidence represents only part of the picture and their ultimate meaning must be informed by other lines of evidence. In some ways, it is analogous to a prosecutor building a murder case with only circumstantial evidence. Only by using multiple lines of evidence can one assert that warfare exists in the archaeological record. When building a case, researchers should consider alternate explanations for each potential indicator of warfare without accepting a priori a war-related cause. Identifying attacks among tribal groups is especially difficult since it usually entails small scale battles that are often archaeologically invisible and the absence of evidence should not be taken as proof that it did not occur. How a group responds to the threat, real or imagined, of an attack is what is often the most archaeologically visible.

**Settlement Patterns**

Settlement patterns are a commonly mentioned type of archaeological evidence indicating warfare (Lambert 2002; LeBlanc 1999; Wilcox and Haas 1994). They constitute an extremely broad category and encompass information gathered from site configuration, site location, settlement distributions, and inter-settlement relationships. In addition to habitation sites, the term settlements encompasses agricultural features, resource procurement areas, and special-use sites. This information can also be used to identify changes in settlement patterns over time, allowing researchers to form conclusions about the scale, frequency, duration, and aims of conflicts. When
chronological resolution is too coarse to discern changes through time, the presence of settlement clustering and buffer zones can still be used to help define territorial boundaries and potential alliances (LeBlanc 1999). As previously stated, (in the absence of osteological evidence of violence) it is often a group’s response to the threat of an attack that is the most archaeologically visible.

Specific changes in settlement distributions over time can provide evidence for warfare. Following the logic that there is safety in numbers, increasing settlement size is a common response to conflict within a region. Large communities may not need to employ fortifications if their size is enough to deter attackers. Within a region, people may abandon smaller settlements and begin aggregating into larger settlements. People living in small villages or isolated homesteads are easy prey to raiding parties, so during periods of frequent raiding, they often migrate to larger communities. Larger communities are also able to form large attacking parties, which might prompt neighboring communities to aggregate as a response. Over time, the smallest settlements within a cluster should be abandoned first as people begin to aggregate into larger communities. Likewise, the smallest clusters within a region should be abandoned first.

When settlement clustering is seen in the archaeological record, its occurrence seeks an explanation. Highly concentrated settlements distribute people unevenly across the landscape, leading to overexploitation of nearby resources and underutilization of more distant resources (Wilcox 1981). These settlement clusters also tend to reduce the range of habitat available to a community. When a drought, flood, insect plague, or other catastrophic event strikes, a cluster of communities is more likely to have its entire utilized habitat severely affected. If a farmer does not live within a clustered community,
in contrast, he or she can plant crops in a number of diverse zones over a wide area, increasing the likelihood that at least some fields would be productive every year. Collecting wood for fuel and construction, foraging for wild plants, and hunting would also have been affected by people concentrating in small areas. While settlement clusters and intervening empty zones are often found within a context of war (LeBlanc 1999), they are not exclusively due to warfare. Environmental, climatic, and social factors are critical in where people decide to locate their settlements. When present, conflict is usually inextricably tied to these factors, so caution should be exercised before attributing a warfare-related cause to settlement clustering.

Outside a context of violence, settlement clustering can be explained by a behavioral ecology model, the ideal free distribution (IFD). When applied to an archaeological context, IFD predicts that aggregation (up to a point) is the most efficient strategy if agriculturalists are unconstrained by other factors such as competition or conflict (Kohler et al. 1986; Orcutt et al. 1990). When found with other evidence of violence, such as burned structures, defensible sites, or skeletal trauma, aggregation is more likely due to conflict (LeBlanc 1999). In the prehistoric U.S. Southwest, settlement aggregation and settlement clustering seen throughout the Pueblo III period have been attributed to an increase in warfare (Haas 1990; Haas and Creamer 1993; LeBlanc 1999; Wilcox and Haas 1993). Preliminary research in the Gallina area has identified at least five settlement clusters that conform to this model (Upham and Reed 1999).

Aggregation is a temporal process, however. When chronological control is not fine enough to differentiate settlements into different periods, the presence or absence of aggregation cannot be evaluated. Yet settlement clustering (regardless of whether it
changes over time) has a number of benefits during warfare and can provide insights into how communities were organized on a regional scale. Settlements located near each other can provide support to their neighbors when the latter are attacked. If attacked suddenly, people can alert others within a settlement cluster, allowing their neighbors the opportunity to prepare their defenses, come to their aid, or both. Nearby communities also serve as refuges for people whose villages have been attacked or destroyed. Settlements within a cluster should be located near enough to provide these benefits but also far enough away to minimize economic competition. The minimum distance between settlements within a cluster is undoubtedly a calculation unique to each region based on topography, travel time, resource availability, strategic value of site locations, social connections, and perceived threats. In non-state societies experiencing warfare, a settlement’s nearest neighbor generally should be within a few miles (LeBlanc 1999).

During conflict, spacing between communities was extremely important. Since each community needs to be close enough to provide defensive support if an allied community was attacked, if an allied community is located too far away, reinforcements would arrive after the outcome of a conflict was determined. Following a similar logic, allied settlement clusters tend to be located farther away from potential attackers. As a result, buffer zones (areas between settlement clusters that remain unpopulated despite being favorable land for settlement) develop. Ethnographically, buffer zones have been identified as a response to warfare among the Achuara in the Upper Amazon, where productive hunting land was avoided due to its proximity to enemy territory (Ross 1984). The existence of buffer zones has been documented throughout the prehistoric American Southwest, ranging from 15 to 75 km in width (Doelle and Wallace 1991; Haas and
Creamer 1993; Kohler et al. 2004; Rohn 1989; Upham 1982). No one has previously investigated buffer zones within the Gallina region, but a potential buffer zone may exist between the Gallina region and the Chaco region (Dew 2003). The location of settlement clusters and buffer zones can help define territorial units, or groups of allied communities.

Examining the degree of interaction between communities is useful in evaluating the existence of alliances in a region. Since close proximity is a likely and often obvious indicator of interaction, settlement clusters themselves imply some level of interaction between communities within a cluster. Increased exchange between villages and decreased trade with outside villages could indicate the presence of an alliance (Haas and Creamer 1993). If settlements are part of a mutual defense network, allies could be alerted of attack by transmitting visual messages across long distances. A number of examples of site intervisibility in the American Southwest demonstrate this possibility.
The Tsegi phase includes site intervisibility (Haas and Creamer 1993). Intervisibility was reported among sites in Chaco Canyon (Windes et al. 2000), in west Texas (Turpin 1984), and in Sonora, Mexico (Doolittle 1988). Using a GIS-based intervisibility analysis, Swanson (2003) determined that a series of hilltop sites in the Paquimé area as ideally situated for fire signaling. It should be noted that intervisibility between sites can only establish the potential for a communication network. Other potential purposes for intervisibility, such as observing hostile neighbors or non-conflict related communications, must also be considered. Ethnographic examples of signaling networks, using smoke and fire, have been documented in the Galisteo and middle Rio Grande/Rio Jemez basins of the American Southwest (Ellis 1991). The location of
defensible sites on the landscape can be used to make inferences about the source of a perceived threat and may imply some level of cooperation between communities to coordinate their defenses against a common enemy.

Defensive sites are often the easiest to spot in the archaeological record. Walls, fences, or stockades surrounding a settlement could be evidence for defense. Alternatively, walls or fences could be constructed to contain domesticated animals or to keep out wild ones, to restrict public access to parts of sites, or to even keep children safely within a settlement. Moats surrounding access points to a site can also be used for other purposes, such as irrigation. Examples of these alternative explanations are rare, and these settlement features are often found with other indicators of conflict. Moats surrounding defensive walls, a design seen regularly with medieval castles in Europe, have the dual advantages of increasing the effective height of defensive walls and making it more difficult for attackers to approach the walls. A structure’s construction method may confer inherent defensive advantages. The defensive capabilities of walls could also be reinforced with bastions and redoubts, constructed at strategic points along a defensive wall. While probably intended to mitigate the effects of climatic extremes and to integrate multiple households into single social units, the room blocks of many Pueblo settlements of the Southwestern U.S. formed contiguous outer walls that served as fortified walls. Early Spanish accounts describe how the Pueblos would pull up the ladders on the outsides of the structures, effectively turning their villages into forts (Hammond and Rey 1940). The construction of towers and keeps augment the defensive capabilities of a settlement. They serve as another line of defense once attackers breach through the initial defenses and allow defenders to concentrate their resources. While
this may provide an advantage when attempting to repel an attack, if a tower or keep is overrun, the defenders will be trapped, virtually ensuring that no one will escape. Towers also may provide the opportunity for defenders to see the approach of attackers from farther away and can be used to communicate with allies in other communities. Towers can be constructed for a myriad of reasons (storage, ceremonial, etc.), all of which may have nothing to do with warfare.

The existence of fortifications at a site indicates at least the threat of an attack (Allen and Arkush 2006). The scale and elaboration of the fortifications may indicate how large of an attacking force defenders are expecting (Solometo 2004). Using natural features on the landscape to serve the same function as fortifications or to augment the effectiveness of fortifications is often a very efficient defensive strategy. Locating settlements on hilltops, on mesas, or along canyon walls restricts access to sites without the need of completely encircling palisades or stockades, but locating a site in such a way often places the settlement further away from water, fuel, and other necessities. Other than the obvious defensive advantages of locating sites in such a manner, researchers have cited conservation of farmland, avoidance of pests, or ceremonial reasons as explanations for these site locations (Cordell 1997, LeBlanc 1999).

The location of defensive sites has been used (with other lines of evidence) to define alliance boundaries within a region (Wilcox and Holmlund 2007). A fortified site (or network of fortified sites) is often located along interaction zones between two cultures or political units. During the late Bronze Age, fortified sites in the Trans-Ural region formed a frontier against nomadic Savromatian-Sarmatian tribes, while other fortified sites in the Ural-Siberian region formed a frontier against tribes that were being
pushed north due to climatic factors (Borzunov 2002). During the Protohistoric period in northern British Columbia (A.D. 1700 to 1830), defensible sites were found in an interaction zone between Northwest Coast groups and groups from the interior (Prince 2004).

The locations of sites can often confer inherent defensive advantages by limiting access, increasing visibility of the surrounding area, or keeping a site hidden from unfriendly eyes. Situating sites on top of hills is a defensive strategy employed for thousands of years around the world. Occupying the high ground in any conflict is a basic precept of warfare. Attackers are more exposed while climbing up hills and are less able to defend themselves or to launch effective attacks. Defenders benefit from extended range for projectiles and can even roll large boulders down at attackers. Many hilltops and mesas can only be approached from one direction or path, creating natural bottlenecks for any groups attempting to reach the top. Limiting access to a site can often be a double-edged sword. If defenders are overwhelmed, their options for retreat may be severely limited. Hilltop sites often possess commanding views of the surrounding landscape, reducing the likelihood of a hostile force taking a community by surprise. The defensive advantages of cliff dwellings and caves lie primarily in restricting access to the site and limiting its visibility from potentially hostile groups. Cliff dwellings and caves can also offer protection from harsh weather conditions or from the constant glare of desert sun, so strategic implications of their locations may not have been considered when established.

Settlement distributions can be used to distinguish internal and external conflict. Internal conflict refers to conflicts between settlements within the same larger community.
while external conflicts refer to conflicts between groups from different larger communities. The delineation of internal and external conflict is an arbitrary one depending on the scale of analysis and how the territorial units are defined. How territorial boundaries are defined can indicate the scale and scope of conflicts. Given a context of internal warfare, each settlement or group of allied settlements will seek to protect its residents, its water source, farmland, and stored food. Internal conflict should result in a relatively dispersed settlement pattern with buffer zones separating agricultural fields of individual villages (Haas and Creamer 1993). Within a context of external conflict, some communities respond to threats by constructing centrally located refuges where critical goods are stored. Defenses are often focused on these central places so people can evacuate to them during times of threat. Buffer zones should be much wider than those seen during internal warfare and should surround clusters of allies (Haas and Creamer 1993). Defensive construction could also display a concern for defending an entire region, seen in a wide network of fortified sites or a regional perimeter wall.

Evidence for these two scenarios has been observed in both the ethnographic and archaeological record. During the pre-colonial period among the Wosera Abelam of Papua New Guinea, internal warfare and rapidly shifting alliances resulted in fortified sites being located across the entire landscape (Curry 1997). On the Fiji island of Viti Levu, intensive competition and conflict between groups on the island resulted in a patchwork of fortified and defensible sites creating territories specific to ancestral lineage groups (Field 2005; Nunn 2012). On the Pacific island of Palau, both internal and external warfare are seen. During the Terrace Era (ca. 600 B.C.), ridge-top settlements are defended by massive earthworks that formed defensive boundaries for groups of
During the Stonework Era (ca. A.D. 1000), construction of these massive earthworks ended while construction of stone walls, causeways, and platforms controlling access to individual villages increased. This shift in defensive alignment has been interpreted as a change from conflict between polities to conflict within polities (Liston and Tuggle 2006).

**Human Remains**

The most direct evidence for warfare comes from skeletons with embedded weapons or signs of mutilations, and from mass graves (LeBlanc 1999; Osgood et al. 2000; Wileman 2009). While typically the best indicator of violence, data from human remains are often the most difficult to acquire. Human remains are typically only encountered during excavations, which entails a level of effort beyond many investigations.

Examples of osteological evidence includes defensive wounds (such as parry fractures on the forearm, from someone attempting to ward off a blow), scalping cut marks, and skeletal trauma suggesting intentional mutilation provide direct evidence of violent behavior (Johannesson and Machicek 2010; Martin et al. 2008). Smashed skulls, broken jaws, and other damage consistent with the use of a clubbing weapon also indicate violent death. The demographic profiles of the victims, including information on age and sex, can provide valuable information about the nature of violence (Lambert 2002; LeBlanc 1999). These profiles may also show population-level impacts from conflicts, such as deaths of young males or the capture of women (Hurst and Turner 1993; Willey 1990).
Indirect evidence of conflict comes from finding bodies that were not formally buried. Bodies left in a structure that was not subsequently destroyed would likely be scattered or consumed by scavengers (LeBlanc 1999). Bodies found interspersed with structural debris (but not formally buried) may indicate that a conflict took place. These remains are often referred to as unburied but are in actuality secondary or disturbed burials. When occurring with the abandonment and burning of a site, the likelihood of a violent event to explain the evidence increases. These burials could also represent secondary or disturbed burials that are not connected to violence, so other lines of evidence for violence must be present to attribute a violent cause to their disposition.

**Burned Sites**

Burning is one of the most archaeologically visible ways in which attackers can destroy a site. It is a commonly employed during attacks, but sites burn for other reasons. Accidental fires can be frequent when building materials consist of wood, thatch, or other easily combustible material. In these cases, people would have been able to save (at most) only the most valuable artifacts or those easiest to transport. Large objects and stored foodstuffs would be consumed in the blaze. If a fire is accidental, burned structures should be dispersed within settlements, settlement clusters, and regions under most circumstances.

Sites and individual structures are often intentionally burned after they are abandoned. Salvageable items would tend to be removed from the structures before burning, and human remains should not be associated with the burned structures. In the U.S. Southwest, there are many examples of kivas being burned as part of the abandonment process (Anyon and LeBlanc 1980; Van Keuren and Roos 2013; Walker et
In that region, there has been speculation that burning of structures with bodies was the result of communities attempting to rid themselves of witches (Darling 1995; Walker 1995, 2008).

In contrast, burning of sites due to warfare should result in the burning of most or all structures. Human remains would often be found if residents were taken by surprise or if they were taking refuge in structures. Attackers may also force surviving defenders into a structure before setting fire to it. By eliminating any survivors, the attackers would be free to carry off as many of the spoils as they desired without fear of a retaliatory strike. Attackers can also set fire to structures during the first phase of an attack to drive defenders out into the open where they can be dispatched. Sites can also be burned as the last step of an attack to destroy all of the remaining resources.

The Tower Kiva at Salmon Ruins in northwestern New Mexico illustrates some of the difficulties with interpreting burned sites. Most of the structures at Salmon Ruins were burned, including Tower Kiva (LeBlanc 1999). Excavators found the human remains of 40 to 50 individuals (mostly children) among the burned structural remains of the tower kiva (Akins 2008). Initial interpretations were that people sought refuge on the roof of the tower kiva during an attack and where subsequently burned when the tower kiva was set on fire (LeBlanc 1999). More recent analysis indicates that the individuals found at Tower Kiva were dead prior to the firing of Tower Kiva and the skeletal evidence for violence was minimal (Akins 2008). Evidence does indicate that Salmon Ruins was attacked in a raid, but the circumstances that led to the archaeological record appear to have been complicated and subject to debate.
Weaponry

Information from weaponry can sometimes be ambiguous because many weapons (such as knives, axes, or bows) have more utilitarian purposes. Relating these artifacts to other lines of evidence or to the larger cultural context is essential when demonstrating their military use (LeBlanc 1999; Milner 1999). Less ambiguous examples of warfare-related artifacts includes armor, shields, long swords, or caches of sling stones (Wileman 2009). The appearance of new weapons, like bow and arrow, may signal changes in tactics or aggression (Blitz 1988). The sudden appearance of a new weapon may indicate an increase in conflicts between groups. The size and shape of weaponry can also be matched to the size and shape of injuries to skeletons (Lambert 2002).

Iconography

War iconography, including imagery found in murals, on ceramics, in rock art, or on artifacts, often depicts mythological people and events and cannot be assumed to represent events contemporary with the art. They do provide some indication of the ideology of a society (Arkush 2006, 2009; Crotty 2001; Schaafsma 2000). Violent imagery can also indicate a culture where warfare is common or was common in its past. The use of specific tactics, such as skirmishing lines or flanking maneuvers, can be demonstrated in imagery. Paintings in murals, rock art, and ceramics may show scalping, decapitation, or the acquisition of other war trophies, suggesting that these practices were used in battle.

Ethnographic Analogy

The cautious use of ethnohistory, oral history, and ethnography can be a valuable tool in interpreting archaeological evidence (Allen and Arkush 2006; Haas and Creamer
Oral histories and ethnographies give archaeologists valuable insights into the goals and tactics of groups waging war. They also help contextualize much of the archaeological evidence of conflict and can fill in the gaps when attempting to reconstruct the past from the archaeological record alone. Ethnographic data is extremely useful in identifying motivations for violence or understanding the cultural meanings of some archaeological data.

Concluding Remarks

Warfare is a common theme found within all types of social organization throughout human history and prehistory. Unfortunately, archaeologists have spent a great deal of effort arguing over its existence in the archaeological record rather than investigating what the manifestations of war can tell us about a culture. How groups conduct war or how they respond to attacks can tells us a great deal about its social organization and its interactions with other groups. Granted, establishing that warfare occurred in the archaeological record is a necessary step, but it is only the first step. By looking further and identifying the patterns of conflict, the rich potential of the archaeological record can be realized.
Chapter 4 – Social Violence in the American Southwest

Warfare and other episodes of socially sanctioned violence were common in the prehistoric and early historic American Southwest. Once sedentary life began in the region, the archaeological evidence indicates that the frequency and scale of aggression ebbed and flowed over time. The trend continued after European contact, as the earliest Spanish accounts demonstrate that indigenous warfare was not just part of the distant past. This chapter concentrates on evidence from Ancestral Puebloan societies and on the regions those societies inhabited. The data are organized in terms of periods, which generally follow the Pecos Classification for Pueblo chronology (Table 4.1).

Table 4.1 – Periods of Conflict in the Southwest

<table>
<thead>
<tr>
<th>Period</th>
<th>Dates</th>
<th>Pecos Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early Period</td>
<td>Before A.D. 900</td>
<td>Basketmaker II to Pueblo I</td>
</tr>
<tr>
<td>Middle Period</td>
<td>A.D. 900–1250</td>
<td>Pueblo II to Early Pueblo III</td>
</tr>
<tr>
<td>Late Period</td>
<td>A.D. 1250–1600</td>
<td>Late Pueblo III to Pueblo IV</td>
</tr>
<tr>
<td>Post-Contact</td>
<td>A.D. 1600–1900</td>
<td>Pueblo V</td>
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</tbody>
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The Early Period (Basketmaker II to Pueblo I, Before A.D. 900)

The idea that warfare is primarily caused by resource stress does not appear to work for early sedentary life in the American Southwest. The introduction and adoption of agriculture in the American Southwest began by 2000 B.C. (Merrill et al. 2009). The regional population was relatively low and one might expect agriculture (and the ability to store crops) to have resulted in a period of low resource stress and general peace. On the other hand, considering the unpredictability of environmental conditions in the Southwest (Dean et al. 1994), a reliance on agriculture could have led to periods of greater resource stress for populations that had abandoned more diverse foraging...
strategies. In support of the latter argument, there is evidence suggesting that plant
cultivation in the Southwest is better viewed as only one component of complex
subsistence strategies (Phillips 2009; Vierra 2008; Vierra and Ford 2006, 2008; Wills
1992). Whether or not agriculture increased or alleviated resource stress, the bulk of the
archaeological evidence suggests that as agriculture became more and more prevalent in
the Southwest, violence was ever present. The occurrences of violence during this period
are primarily small in scale, with a notable exception, and are likely attributed to raids
from other groups.

**Human Remains**

Located in southeastern Utah, Cave 7 was originally excavated by the Wetherill
family in the 1890s and has been suggested as the most striking example of Basketmaker
violence. Ninety-seven Basketmaker individuals appear to have been placed in the cave
at one time, with many showing signs of traumatic death (Hurst and Turner 1993). Six of
the bodies were found with spear points in them, and in several cases the points were
embedded at least an inch into bone. The Wetherills mentioned finding an extraordinary
number of bifacial blades with many of the burials, and many bodies were riddled with
projectile points and had broken arms and skulls. As part of the Wetherill-Grand Gulch
Project (Atkins 1993), Hurst and Turner reassessed the available data from Cave 7. Hurst
and Turner corroborated the Wetherills’ descriptions and presented evidence for the
possible taking of scalps, ears, and heads. Of the sixty-one individuals that Turner
examined, forty were male, fifteen were female, and six could not be assigned a sex.
Nine out of the sixty-one were subadult. Twenty-nine individuals showed signs of
perimortem trauma. Considering the osteological evidence, the abundance of weaponry
associated with the burials, and the disproportionate sex ratio of the victims, Hurst and Turner maintained that the entire assemblage most likely resulted from the violent destruction of a group. In other words, Cave 7 represented a tribal-level massacre. Most males of fighting age were killed, while most of the women and children were captured and taken away.

More recently, Coltrain and others (2012) reassessed the evidence from Cave 7. They re-examined the skeletal remains and extracted collagen from whole bone fragments for isotopic analysis and radiocarbon dating. If the remains from Cave 7 were the result of a single massacre, the radiocarbon dating for all samples should yield similar results. Instead, Coltrain and others found that their sample of 96 individuals formed a sequence of dates from 205 B.C. – A.D. 536 with no more than a decade separating most dates (Figure 4.1). They also found a lower number (20) of individuals with evidence of perimortem trauma than did Hurst and Turner. Coltrain and her colleagues found that 41% of the individuals were adult males compared to Hurst and Turner’s 66%. In addition, no adult females or individuals under the age of 12 showed signs of trauma. Coltrain and others concluded that the remains at Cave 7 represented episodic acts of violence between males within the same society, rather than a single massacre.

Skeletal remains indicating violent death have been found at other Basketmaker sites. Skulls from adults found at Green Mask Cave and Red Canyon in southeastern Utah exhibit signs of lethal head wounds (LeBlanc 1999). During their Grand Gulch expedition, the Wetherills reported finding the remains of many arms, hands, legs, and feet ostensibly cut off before burial in Cut-In-Two Cave (Blackburn and Williamson...
Figure 4.1: Calibrated AMS radiocarbon dates on 96 Basketmaker burials recovered by Richard Wetherill in 1893 from Cave 7 in southeastern Utah from Coltrain et al. (2012).

1997). In Battle Cave in Canyon de Chelly, Earl Morris and Ann Axtell Morris found the remains of thirteen individuals (mostly adult males) in a storage cist, including a mummified body with an embedded projectile point (McDonald 1976; Morris 1933). Ann Axtell Morris described a large number of broken and cracked skulls, damage she believed to have been made by heavy stone axes. In the Kayenta area, twenty individuals, all without skulls, were found in Woodchuck Cave (Lockett and Hargrave 1953). Excavations at Broken Flute Cave in northeastern Arizona uncovered an adult male with a lethal head wound (Morris 1980). Six unburied bodies were found at the
Cerro Colorado site in the Petrified Forest area, dating to the Basketmaker III period (Burton 1991).

A handful of preserved scalps have been found dating to this period. Scalps and the practice of scalping have a well-documented history in Pueblo societies, often in association with warfare (Haas and Cremer 1997; Schaafsma 2000). Their meaning in prehistory is less clear, but at minimum, they likely represent acts of violence. Kidder and Guernsey (1919) found an intact human face and scalp sewn together and painted with various colors at Cave I, Kinboko Canyon in northeastern Arizona, dated to around A.D. 400 (Figure 4.2). Other preserved scalps include a collection curated at the Museum of Peoples and Cultures at Brigham Young University. Two of these scalps, reportedly from the Nine Mile Canyon region of eastern Utah, were stretched over basketry disks (Howard and Janetski 1992). Five more scalps, with basketry disks, were found southeast of Moab, Utah. One of the scalps from the Moab area was radiocarbon dated to A.D. 1 to 359 (Howard and Janetski 1992). Unfortunately, the context in which these scalps were originally found is unknown.

Osteological indicators of violence continue to appear throughout the Basketmaker-Pueblo transition, but the overall body of evidence remains sparse compared to later periods. At Bancos Village (A.D. 850 to 950) in the Navajo Reservoir region, seven individuals were found unburied within two separate pit houses (Eddy 1966). At Sambrito Village, also in the Navajo Reservoir area, at least fifteen individuals were found unburied in one location at the site. An additional twenty-nine individuals may have also been unburied but it is unclear whether or not they were formal burials.
Figure 4.2: Scalp and face recovered from Cave I, Kinboko Canyon in northeastern Arizona from Kidder and Guernsey (1919).

subjected to prehistoric disturbance. At sites in southwestern Colorado, Roberts (1930) uncovered at least one unburied body in a structure. He also found two male crania and few cervical vertebrae with ceramic bowls, perhaps representing trophies taken during battle. There are many examples of unburied bodies throughout the Dolores area as well (Wilshusen 1991). Seven unburied bodies were found at the Duckfoot site, a Pueblo I site, near Cortez, Colorado (Lightfoot and Etzkorn 1993). During this period, three claims of cannibalism have been made for the Cottonwood Wash site in southeastern Utah, the Ram Mesa Pit house along the Rio Puerco near the Arizona-New Mexico border, and the Robert’s Small House in Chaco Canyon (Bustard 2008; Turner and Turner 1999).

The bulk of the skeletal evidence supporting warfare during Basketmaker and Pueblo I periods either represents small-scale events or appears ambiguous when subjected to scrutiny. A notable exception to this is the Sacred Ridge Site. Located 8 km
southwest of Durango, Colorado, the Sacred Ridge Site, was a multiple habitation site containing 22 pit house structures (Potter and Chuipka 2010). Tree-ring dates from the site indicate a continuous occupation of the site from around A.D. 700 to 803, with three distinct building phases (Potter and Chuipka 2007). About A.D. 810, all structures were burned and Sacred Ridge was completely abandoned. Within three of the structures, excavators found processed human remains dating to the last phase of occupation. At one structure, a jumble of broken and disarticulated bones, representing less than 50% of a 45 to 49 year old female was placed near the vent. Cut marks consistent with scalping were found on skull fragments along with fractures indicating blows to the side of the head. Multiple chop and cut marks were found on many of the long bones and vertebrae. The floor of the structure did not contain any human remains, but a jar and an axe found on the floor tested positive for human blood (Marlar 2010). These findings led the investigators to conclude that the processing of human remains probably was done on the floor of the structure (Potter and Chuipka 2010). In a second pit structure, highly fragmented and burned human bones representing an unknown number of individuals were found along with human blood residue on artifacts. The investigators concluded that remains from multiple individuals were most likely processed in this structure. A third structure contained the largest amount of human remains, totaling 14,882 bone fragments from at least 35 individuals. Both males (5) and females (7) were identified, ranging from infant to adult in age (Ezzo 2010). Among the entire assemblage, only two articulated body parts were recovered. Several individuals had scalps, noses, and ears removed. Other commonly observed damage to skulls included the smashing of front teeth, disarticulation of lower jaw, and blunt force trauma. Teeth from the assemblage
were analyzed and compared to 173 individuals from 18 Pueblo I sites in the general vicinity. McClelland (2010) found that the victims from Sacred Ridge differed significantly from all other groups in the general vicinity. A comparative analysis of 26 skulls from sites in the area found a similar trend (Douglas and Stoddard 2010). Isotopic analysis from tooth enamel indicated that the Sacred Ridge victims were local inhabitants for at least a generation rather than recent immigrants to the area (Ezzo 2010). Based on the evidence, the researchers concluded that the Sacred Ridge site represented a case of ethnic violence (Potter and Chuipka 2010).

Fortifications and Defensible Sites

There are many examples of possible fortifications and defensive site locations during the Basketmaker and Pueblo I periods. The most common type of identified fortification during this period was stockades. Stockades were typically made from large wooden posts, sometimes hundreds of them (LeBlanc 1999). It was common for only portions of a community to be protected by a surrounding wall. Stockaded settlements are probably much more common than published reports might indicate because most excavators do not strip the surface far enough away from structures to find evidence of fortifications (Rohn 1975).

That being said, investigators have identified Basketmaker III stockades at Knobby Knee Stockade (Fuller and Morris 1991), at Cloud Blower Stockade (McNamee 1992), at Yellow Jacket (Rohn 2008), at Vinegar Hamlet (McNamee and Hammack 1992), and at Palote Azul Stockade (McNamee et al. 1992). Several sites, dated to A.D. 850–950, in the Gobernador area of northwestern New Mexico were surrounded by stockades (Hall 1944). Bancos Village and the Sanchez site, both Pueblo I sites in the
Navajo Reservoir area, were surrounded by post stockades (Eddy 1972). Stockaded houses were also found along the Animas River near Durango, Colorado (Carlson 1963).

During this period in the Southwest, three different types of site locations (hulltops, cliff dwellings, and caves) were selected for specific defensive purposes (LeBlanc 1999). The Rock Island site (Basketmaker II period) in southeastern Utah is an example of a hilltop site (Matson 1994). Large Basketmaker III settlements, such as Shabik’eschee (Roberts 1929) and 29SJ423 (Wills and Windes 1989) in Chaco Canyon were on mesa tops, providing increased visibility and limited access from some directions. Cliff houses, smaller than those found later in the Mesa Verde region, were found in the Prayer Rock District of northern Arizona (Morris 1980). Cave sites were extremely common in southeastern Utah during Basketmaker periods (Kidder and Guernsey 1919; Morris 1938) but other than Broken Flute Cave (Morris 1980), they do not seem to be defensive sites.

**Burned Sites**

Burned sites are common during the Early Period and were noted by some of the earliest researchers in the Southwest (Morris 1939; Roberts 1930). In New Mexico, these include Basketmaker II sites near Zuni Pueblo (Roberts 1939; Varien 1990). In Arizona, there were Basketmaker III sites in the Petrified Forest area (Burton 1991), and several cliff shelter and cave Basketmaker III sites in the Prayer Rock District (LeBlanc 1999). At Broken Flute Cave, several structures were burned with large amounts of food and artifacts along with the previously mentioned adult male with a lethal head wound (Morris 1980). In Colorado, there were many burned Basketmaker III sites near Durango.
(Carlson 1963) and several Basketmaker III sites elsewhere in southwestern Colorado (Lancaster et al. 1954; Lange et al. 1988).

The frequency of site burning increased sharply during the Pueblo I period (LeBlanc 1999). In southern Colorado, the list of burned sites and regions includes Blue Mesa and the surrounding Durango area (Carlson 1963; Fuller 1988), the Duckfoot site near Cortez (Lightfoot and Etzkorn 1993), Grass Mesa Village (Lipe et al. 1988) and McPhee Village in the Dolores area (Kane and Robinson 1988), and the Stollsteimer sites in southwestern Colorado (Roberts 1930). Many areas in northwestern New Mexico were burned as well, including the Governador region (Cater and Shields 1992) and the Navajo Reservoir area (Eddy 1972). Nearly all of the surface structures of Site 13 at Alkali Ridge in southeastern Utah were destroyed by fire (Brew 1946). A majority of the structures at the Turkey Foot Ridge village in the Mogollon area were burned, perhaps as part of a successful raid (Martin and Rinaldo 1950).

**Middle Period (Pueblo II to Early Pueblo III, A.D. 900–1250)**

The Chaco phenomenon, with its sphere of influence stretching across northern New Mexico and southern Colorado, was one of the most significant developments in Southwestern prehistory and has generated a great deal of scholarly interest (e.g. Crown and Judge 1991; Doyel 1992; Lekson 2006; Neitzel 1989; Wills 2000). There was a pronounced decrease in evidence for warfare, leading Lekson to coin the term “pax Chaco” for this period. Even after the collapse of the Chaco System, the Pueblo world still experienced a degree of peace and stability until the latter half of the 13th Century (Lekson 2002). Although violence on the scale seen in the previous period is absent, there is evidence for violence on a smaller scale that does not appear to be the result of
raiding or warfare. There are few examples of site burning and of fortified sites, but there are notable examples of osteological evidence of violence, including the processing of human remains.

To account for this pattern of violence, a number of theories have been put forth. Turner and Turner (1999) proposed that an elite group of warrior priests with Mesoamerican ties established and maintained a ceremonial system, involving human sacrifice and cannibalism, primarily at Chaco Canyon and in other Chaco Great House communities. This system, they suggested, was used to control local farming communities through a combination of fear and shared religious belief. A second theory is that a subset of the Chaco population, primarily women, possessed significantly lower status and was treated extremely poorly (Martin et al. 2001). There is evidence from burial assemblages that raiding for women may have occurred during this period. Females are disproportionately represented in 11th Century assemblages in Chaco Canyon and other parts of the Chaco World (Kohler and Turner 2006). A third explanation for the pattern of violence during this period was that it represents witchcraft persecution (Walker 2008). Although a definitive behavioral explanation for violence during this period is still lacking, the archaeological record does indicate that the violence was likely the result of internal social phenomena. Violence was within communities, not between them.

**Human Remains**

The burials of apparently two high-status individuals in Pueblo Bonito are perhaps the best-known burials from this period (Pepper 1909; Wilcox 1993). Two individuals were laid to rest on a prepared bed of sand and covered by planks. The
skeletons of twelve other individuals were found above the planking, suggesting that they were sacrificial victims (Wilcox 1993). Thousands of turquoise beads and other rare items were buried with the two individuals (Frisbie 1978). Most of the grave goods were associated with one of the individuals, identified as male, whose death probably resulted from a blunt force wound to the head (Pepper 1909).

Other incidences of violence have also been found within Chaco Canyon. Pepper (1920) found many broken and burned human bones in two other rooms within Pueblo Bonito. Judd (1954) found the disarticulated remains of more than 20 individuals in Room 330 of Pueblo Bonito. At Chetro Ketl, a formal burial contained an adult male with a projectile point embedded in his ribs (LeBlanc 1999). At Site 1360, a small site within the canyon, six individuals were found within a pit house that was purposely destroyed while in use. One of the individuals had two projectile points within his or her body cavity (McKenna 1984). At Bc51, near Casa Rinconada, scattered human bones were found throughout the site (Kluckhohn 1939). Burned and broken human remains were reportedly found within Peñasco Blanco during 1898 excavations (Bustard 2008). Pueblo del Arroyo contained disarticulated human remains with evidence of violent death (Turner and Turner 1999). Throughout the canyon, evidence suggests that many individuals were either buried hastily with minimal effort or left unburied. Data from excavations of seven sites in Chaco Canyon indicate that 23% of all human remains were gnawed by carnivores (Akins 1986).

In all, more than 20 Great House communities display mistreatment of human remains (LeBlanc 1999). One example is the Far View group at Mesa Verde. An unburied adult was found in a kiva with a bone awl in its chest cavity, its back bent
backwards, and its head facing backwards (Lister 1964). Some researchers have suggested that many bone awls should more appropriately be described as daggers and their associations with some burials indicates the presence of a murder weapon (Hurst and Turner 1993; LeBlanc 1999). At another nearby site, the disarticulated remains of several individuals were found mixed in with structural debris placed there after the abandonment of the structure (Lister 1966). At a small site near Teec Nos Pos Great House, the incomplete remains of an adult and a child were found on the floor of a burned room (Turner 1989). Two bone awls were found in association with the adult. At sites near the Sanders Great House in Arizona, incomplete skeletons were found, including a skull within a ventilator shaft (Fletcher 1994). Other Great House communities with similar evidence include Guadalupe Ruin (Pippen 1987), the La Plata River Valley (Martin et al. 2008; Morris 1939), Yellow Jacket (Malville 1989), Houck K (Turner and Turner 1999), Ram Mesa (Ogilvie and Hilton 2000), and Village of the Great Kivas (Roberts 1932).

Evidence of skeletal trauma was also found at smaller sites in the region. Flinn and others (1976) found the dismembered and charred remains of 11 individuals at a small early Pueblo II site on Burnt Mesa in northwestern New Mexico. One of the more well-documented cases of perimortem trauma comes from a small pueblo site in Mancos Canyon in southwestern Colorado (White 1992). Dated to between 1100 and 1150, the fractured and charred remains of 30 individuals were found in several bone beds throughout the site. Bone fragments from the same individuals were found in different bone beds. Investigators also found the dismembered remains of more than 20 individuals at Rattlesnake Ruin (A.D. 1050–1100), near Blanding, Utah (Baker 1994).
At Cowboy Wash in southwestern Colorado, excavators found the disarticulated human remains of seven individuals, including two children (Billman et al. 2000; Lambert et al. 2000). Researchers found butchered human remains at other sites in southwestern Colorado, including Hansen Pueblo (Morris et al. 1993), Grinnell (Luebben and Nickens 1982), and Marshview Hamlet (Wilshusen 1988). Turner and Turner (1999) identified several other sites throughout the Southwest with evidence of skeletal trauma.

Other Evidence

During the Middle Period, there is little evidence for warfare. There are few incidences of burned sites and sites that are burned are very small. Most sites do not appear to be fortified and site locations do not confer any defensive advantages (LeBlanc 1999). One exception to this trend is Chimney Rock, located on a narrow ridge with a commanding view of the surrounding landscape (Eddy 1977). Other defensively located sites include Guadalupe Ruin (Pippen 1987), Escalante Ruins (Hallasi 1979), and Bis sa’ani (Breternitz et al. 1982). The vast majority of all Chaco sites in this period were single-story room blocks without interior rooms. The room blocks themselves were not arranged to maximize any defensive advantages. An argument can be made that the Great Houses themselves were defensive structures (LeBlanc 1999); they were often multiple stories with access limited to specific rooms (especially kivas) within the structure. In fact, restricting access or controlling how rooms were accessed seems to be inherent in the design of the structures (Rautman 2001; Schachner 2001; Van Dyke 2002), but attributing a defensive reason rather than ceremonial or social one seems ill advised. Also worth noting is the occurrence of stockades surrounding some farmsteads in the northern San Juan region (Kuckelman et al. 2000). Toward the latter half of this
period, there was an increase in enclosing walls that may have served a defensive purpose for communities (Kenzle 1997). During this period, towers began appearing in the Four Corners area and in the Gallina area (LeBlanc 1999; Mackey and Green 1979; Schulman 1950; Van Dyke and King 2010). The Gallina area, which will be discussed in more detail in Chapter 5, was settled during this period. The majority of Gallina communities are on defensible positions and towers have been documented at 136 sites.

**Late Period (Late Pueblo III to Pueblo IV, A. D. 1250 to 1600)**

As the Chaco World began to dissolve, the Ancestral Puebloan world was immersed in turmoil. Evidence of violence increased dramatically, including a rise in defensive sites and site burning. The scale and scope of the pattern was consistent with tribal warfare (LeBlanc 1999). At the beginning of the period, many communities were entirely destroyed, with some regions being abandoned until modern times. The entire Southwest underwent massive social and geographic reorganization at a time when the region experienced a prodigious amount of resource stress due to declining environmental conditions (Dean et al. 1994; Doyel and Dean 2006). Populations aggregated into large communities, consisting of multi-storied pueblos with hundreds of contiguous room blocks. Smaller sites were almost universally fortified, or were located at defensible locations, or both. Evidence for violence varies from region to region, suggesting that as many groups migrated they either came in conflict with other groups during migrations or supplanted them entirely.

Large sites during this period were configured in two main styles (LeBlanc 1999). The first style was that of the inward-facing town (Roney 1996). Room tiers were highest along outer walls and there were large central plazas (Stein and Fowler 1996).
Examples of this style include Aztec Ruin and Awatovi. The second style consisted of a large number of connected rooms without large plazas and without a clear overall settlement design. Historical Taos Pueblo is an example of this style. Regardless of style, many sites contained more than 1000 rooms. The differences in the styles may have reflected differences in settlement formation process or in internal social organization (LeBlanc 1999).

Near the beginning of this period, there are examples of massacres and the complete destruction of sites. Rock art and murals from this period also indicate an increase in conflict (Crotty 2001; Schaafsma 2000). The frequency and intensity of direct evidence of violence decreased after A.D. 1300 but the organization of societies and sites seem to reflect an ever present concern for conflict (LeBlanc 1999; Lekson 2002). The clearest evidence comes from the radical changes in settlement patterns over time. The information presented here represents a small sample of the overall evidence and seeks to summarize the different regions of the Pueblo world during this period.

**The Colorado Plateau**

The Colorado Plateau underwent the most dramatic settlement change during this period. Many areas on the Plateau (such as Mesa Verde, the Kayenta area, and the Four Corners area) were abandoned by A.D. 1300, involving the migration of tens of thousands of people, in most cases to regions along the Rio Grande (Adler 1996; Dean et al. 1994). Large numbers of people from the Kayenta area also migrated to the San Pedro Valley in southeastern Arizona and were incorporated into local populations (Clark et al. 2012; Huntley et al. 2010). Communities in other areas, including portions of the Rio Puerco (of the West) and the Little Colorado, were abandoned sometime in the 14th
Century. In fact, only three settlement clusters (Hopi, Zuni, and Acoma) survived on the Colorado Plateau until the arrival of Europeans in the 16th Century.

**Mesa Verde District**

Prior to the abandonment of the Mesa Verde region, large groups lived in open-air sites and cliff dwellings, including a network of cliff dwellings at Mesa Verde (Rohn 1977). Many of the cliff dwellings were very difficult to access, suggesting a defensive function. Unburied remains, including several isolated skulls, were found at kivas at Long House with one of the kivas burned while in use (Cattanach 1980). Excavators found skulls in the ventilator shafts in three kivas at Spruce Tree House (Fewkes 1909). Square Tower House also contained human skeletal fragments (Fewkes 1922).

Evidence from nearby Castle Rock and Sand Canyon Pueblos was far more dramatic. Both villages were occupied from about A.D. 1250 to 1285 (Bradley 1992; Kuckelman et al. 2000). At Castle Rock Pueblo, researchers found the highly fragmented remains of at least 41 individuals in kivas, in towers, and within extramural features throughout the site (Kuckelman et al. 2002). There was clear evidence of lethal skull fractures, cut marks, chop marks, decapitation, scalping, face removal, and burning of human remains. The ages of the victims ranged from infant to over 50 years. The sex of the individuals could not be determined in most cases, but five males and three females were identified among the remains. Contextual evidence from the site indicates that all individuals died during a single event. Analysis of the skeletal remains of 33 individuals at Sand Canyon Pueblo determined that at least eight individuals showed signs of violent death (Kuckelman et al. 2002). Evidence of lethal skull fractures, cut marks, scalping, and decapitation was present among these remains. Those eight individuals were all
discovered on top of other cultural layers at the site, perhaps indicating that they died during one event at the end of occupation. Both villages appear to have been abandoned soon after the violent attacks occurred (Kuckelman 2010). Disarticulated remains of at least 11 people were found in a tower at Charnel House, a nearby site in the region (Martin 1929). Many sites in the region, including Castle Rock Pueblo, Sand Canyon Pueblo, and Charnel House, were burned (LeBlanc 1999).

Towers were built throughout the northern San Juan Basin, including the well-known tower complexes of Hovenweep National Monument, Canyon of the Ancients National Monument, and Mesa Verde National Park. Towers in the greater Mesa Verde region may have been used for line-of-sight communication (Ellis 1991; Wilcox and Haas 1994), as watch towers (Johnson 2003; Wilcox and Haas 1994), as defensive strongholds (Kuckelman 2002), for agricultural storage (Winter 1981), or even for astronomical observations (Williamson 1978). No one explanation for the functions of towers fit all instances, but these explanations need not be mutually exclusive (Van Dyke and King 2010). Towers may have served multiple purposes at different times.

**Kayenta District**

While home to much smaller populations, the Kayenta area of northeastern Arizona was similar to the Mesa Verde region in a number of ways. Communities in the Kayenta region were abandoned at roughly the same time as communities in the Mesa Verde area (Haas and Cremer 1993). A large number of cliff dwellings were built along canyons in the Kayenta area. Evidence suggests that many sites were intervisible and that buffer zones may have existed between settlement clusters (Dean 1996; Haas and Cremer 1993). Despite examples of skeletal trauma (including an embedded
arrowpoint), a handful of incidences of site burning, and a disproportionate burial sex ratio at a few sites, the overall evidence for violence in the region is limited. Haas and Creamer (1993) attribute the low frequency of violence to successful defensive strategies employed by the local communities. Locating sites in highly defensible and extremely inaccessible locations allowed inhabitants to successfully fend off or discourage attacks. Additionally, an extensive communication network across the region would have enabled people to mobilize defenses or seek refuge when an attacking force was spotted.

**Totah District**

Located 50 km southeast of Mesa Verde, the Totah area of northwestern New Mexico was similarly abandoned sometime in the late 13th century, but with relatively few examples of violence. A notable exception to that trend comes from Salmon Ruin. The bodies of more than 40 individuals, mostly children, were found among the charred remains of a tower kiva and other structures at the site (Akin 2008; Shipman 1983). As previously discussed in Chapter 3, the remains at Tower Kiva represented individuals who died before the structure was burned and contained minimal signs of violence. At Aztec Ruins, excavations uncovered the skeleton of an adult female with a shattered pelvis and forearm, four children and an adult male within a burned kiva, and an elderly woman impaled by a sharpened stake (Lister and Lister 1987). There is also evidence of site burning and osteological evidence of violence at sites in the La Plata Valley (Morris 1939), including an unusually high frequency of females with skeletal trauma (Martin 1997; Martin et al. 2001; Martin et al. 2008).
Southern San Juan Basin and Eastern Rio Puerco

Throughout the southern San Juan Basin and the eastern Rio Puerco, many small sites were established by groups moving from Mesa Verde to the area during the first half of the 13th century (Roney 1996; Stein and Fowler 1996). Many of the sites were defensive. Nearly all sites on Mesa Portales were located on ridgelines and burned (Lally 2005; Anthony Lutonsky, 2011 personal communication). Located along the Chuska slope, Crumbled House, in particular, was located on a mesa spur with a defensive wall and a moat (Marshall et al. 1979). Crumbled House, containing 300 rooms, was the largest site in this area, but most sites in this area were small and dispersed. By A.D. 1300, all sites within this area had been abandoned (Stein and Fowler 1996).

Lower Little Colorado River and Western Rio Puerco

Several site clusters occur along the Puerco (of the West) and the Lower Little Colorado River (Kintigh 1996; Stein and Fowler 1996). Along the upper Rio Puerco, small clusters of sites with defensive layouts were abandoned before A.D. 1300 (LeBlanc 1999). Farther down the Rio Puerco, in the Petrified Forest area, were two large sites, Puerco Ruin and Stone Axe, 7 km from each other. Between the large sites was a small (12 room) site that could have provided a visual link between the two large sites (LeBlanc 1999). Puerco Ruin was extensively burned and abandoned about A.D. 1350, while the Stone Axe site continued to be occupied for a short time afterwards (Burton 1990).

Hopi District

Adams (1996) identified early Hopi site clusters, along the Middle Little Colorado River, along the washes that feed the Little Colorado, and among the mesas and buttes.
that overlook the river. With the apparent arrival of immigrants from the Four Corners region, populations within the Hopi region swelled dramatically after A.D. 1250. The overall body of evidence for violence is scant, but there are a few indications of conflict in the region. Some sites were burned, such as Kin Tiel (Haury and Hargrave 1931), Wide Reed (Mount et al. 1993), Sikyatki (Fewkes 1898a), Awatovi (Fewkes 1898b), Homolovi II (Walker 1996), and Chevelon (Andrews and Ambler 1982). Informally buried bodies were also found within kivas at Kin Tiel and at Homolovi II. According to oral history, the village of Sityatki was destroyed by warriors from the Hopi village of Qootsaptuvela (Malotki 1993). All of men from Sityatki were killed and the village was set on fire. Over time, some settlements and settlement clusters were abandoned while others become larger and denser (LeBlanc 1999). Sites on the margins of the Hopi area, such as Kin Tiel and Wide Reed were abandoned before A.D. 1300. Sites in the Hopi Buttes area and along the Middle Little Colorado were abandoned in the late 14th Century while settlements at the Hopi Mesas persisted until after contact with the Spanish to present day (Adams et al. 2004).

Zuni District

Beginning about A.D. 1285, small sites in the Zuni area were abandoned in favor of larger village communities (Kintigh 1985). By the mid-14th century, this shift in settlement strategy was completed, leaving only large villages in the region (Kintigh 1996). The villages were concentrated along the Zuni River and along the Ojo Caliente Wash, with most surviving into historic times (Huntley and Kintigh 2004). There is little direct evidence for conflict for the region (LeBlanc 2001), but there are some incidences of site burning during the latter half of the 13th Century, including the Scribe S
community in the El Morro area (Watson et al. 1980), a community near Heshotauthla (Zier 1976), and communities in Shoemaker Canyon (LeBlanc 1999).

**Acoma District**

By the end of the Pueblo III period, many communities in the Acoma area were abandoned, and the pattern of aggregation seen elsewhere began to play out around Acoma (Roney 1996). By A.D. 1350, only the communities of Acoma, Shumatzutstya, and Cubero still survived (with Acoma the only one to persist until European contact). The body of archaeological evidence supporting violence for the region is sparse, but the area itself is not well-known archaeologically. The Newton site is the only case of site burning to have been identified (Frisbie 1973).

**Rio Grande Valley**

While most of the Colorado Plateau was being depopulated during the latter half of the 13th century, the Rio Grande Valley region, including portions of the Upper Pecos River Valley and the Chama River Valley, witnessed a dramatic increase in population. It seems likely that several large groups from the Colorado Plateau migrated to the region at this time (Cordell 1989a). With the notable exception of the communities in the Gallina region, many sites were founded at the beginning of this period and populations would swell considerably in the following centuries (Crown et al. 1996). People settled in clearly defined site clusters and over the subsequent centuries began aggregating into a smaller number of extremely large sites (Snead et al. 2004). Many of the site clusters were defined by language groups that lasted until historic times. The distance between each settlement cluster and its nearest neighboring cluster ranged from 10 to 20 miles (16 to 32 km) (LeBlanc 1999). Wilcox (1991) suggests that the areas between clusters were
left as buffer zones. For most of the region, the strongest evidence for conflict for this region is found is settlement data, consisting of defensive site configurations, defensible site locations, and changes in settlement patterns over time. The Gallina area is again an outlier within the Rio Grande region and represents some of the strongest evidence of violence (including skeletal trauma, defensible sites, and site burning) in the entire Southwest (Upham and Reed 1989).

**Galisteo Basin and Upper Pecos River Area**

Several large sites were occupied between A.D. 1275 and 1550 in the Galisteo Basin, including some of the largest and most complex Pueblo IV sites in the Rio Grande region (Snead et al. 2004). Although smaller sites existed before then, large settlements in the Galisteo Basin were not established until after A.D. 1325. In the Upper Pecos, small sites tended to possess some defensive value in support of very large, aggregated sites (LeBlanc 1999). Pecos Pueblo was an extremely large site with more than 1,000 rooms and was the only site in the area to survive upon the arrival of Europeans. There is no osteological evidence of violence found in the Pecos area, but the Arrowhead site was burned (Holden 1955).

**Albuquerque District**

Sites dating to the 1200s along the middle reaches of the Rio Grande were predominantly small (Eckert and Cordell 2004). Large sites of over 50 room blocks began to appear during the 14th century. Over the following centuries until the arrival of the Spaniards, sites became fewer in number but larger. Evidence for violence is sparse, but the ancestral Tiwa site of Kuaua was burned and mostly destroyed (but not abandoned) during a raid around A.D. 1350 (Dutton 1963). A kiva was also burned at
Tijeras Pueblo (not the rest of the site) sometime during the 14th century but was likely not the result of an attack (Cordell 1977).

**Jemez District**

Nearly all sites in the Jemez area have been dated to a range of A.D. 1300 to 1600 (Elliot 1982). Populations peaked in the 15th and 16th centuries within the area and lived in a small number of very large sites (Crown et al. 1996). In general, small sites were more defensively located than large sites, but even some large sites were defensively located and were able to resist the Spaniards upon their arrival (LeBlanc 1999). There is little direct physical evidence of conflict in the Jemez area, but the presence of large aggregated sites and defensive sites suggests the possibility of competition with neighboring groups.

**Pajarito Plateau and Santa Fe District**

Encompassing portions of the Rio Grande and the Rio Santa Fe between the Jemez and Pecos areas, the Pajarito Plateau and the Santa Fe area were sparsely populated until the late 13th century (Crown et al. 1996). Following the same trend in most other parts of the Rio Grande Valley, population size and site size increased dramatically after A.D. 1250. On the Pajarito Plateau, overall population decreased from A.D. 1325 to 1400 but the settlements that did exist grew larger (Kohler 1993; Orcutt 1991). The peak occupation took place after A.D. 1400. In Frijoles Canyon a series of “guard pueblos” were situated to monitor and control access to larger sites within the area (Snead et al. 2004). In the Santa Fe district, population and aggregation reached their peak between A.D. 1250 and 1400. The strongest evidence for violence in the Santa Fe area comes from Arroyo Hondo. During one phase of occupation the site was burned
prior to its abandonment. Eleven unburied bodies were found along with 25 human skulls not associated with bodies (Palkovich 1980).

**Taos District**

By A.D. 1250, the entire population of the Taos District had aggregated into two or three large multi-story pueblos (Crown et al. 1996). At Pot Creek Pueblo, a large influx of immigrants about A.D. 1310 prompted a rapid increase in construction, lasting until the site’s abandonment 10 years later (Crown 1991). The reasons for this abandonment are unclear but the site was extensively burned and the remains of at least two individuals were found unburied at the site (Wetherington 1968). The remaining pueblos in the district were highly aggregated and would have conferred defensive benefits due to their high outside walls.

**Chama District**

The earliest permanent habitation sites in the Chama Valley were established after A.D. 1250 (Crown et al. 1996). Initial settlement sizes were modest but increased rapidly after A.D. 1350, increasingly exhibiting site planning (Hibben 1937; Peckham 1959; Wendorf 1953). Many of the sites were very large, with hundreds of rooms, and were located on mesa tops or ridgelines (LeBlanc 1999). Sites on valley floors were nearly exclusively large with a nearby site on a hilltop. Immigrants from other areas of the Southwest continued to swell the population in the Chama until about A.D. 1500 (Crown et al. 1996). Major construction ceased by A.D. 1550 but the region continued to be occupied on a limited scale until the Pueblo Revolt of 1680 (Ramenofsky and Feathers 2002). Several sites were burned in the Chama Valley, including Palisade, Riana, Kap,
Te’ewi, Poshu, Tsama, Ku, and Pesede, with unburied human remains or mass burials found at some sites (Beal 1987).

Gallina District

As previously stated in this chapter, the Gallina District possesses some of the strongest prehistoric evidence for conflict in the Southwest. The specific incidences of violence will be discussed in more detail in Chapter 5, but the overall view is one of endemic violence prior to its abandonment sometime before A.D. 1300 (Upham and Reed 1989). Human remains displaying evidence of skeletal trauma, including embedded projectile points, are found in high frequencies throughout the area (Chase 1976; Mackey and Green 1979). Many Gallina sites are burned, with one study reporting a third of all sites showing signs of intentional burning (Mackey and Green 1979). The vast majority of settlements are found on ridgelines, cliff edges, and hill tops, often providing commanding views of the surrounding landscape (Muceus and Lawrence 1990). Towers, most possessing line-of-sight contact with other towers, have been identified at 136 sites. Near the end of the 13th century, all occupation sites in the region were abandoned (Bremer and Burns 2013). The region was not occupied again until centuries later, when Navajo groups began settling in the northwestern portion of the region.

Post-Contact (A.D. 1600 to 1900)

The arrival of new groups in the region dramatically altered patterns of conflict. Athabaskan groups first moved into the Southwest in the centuries before European contact. As their numbers steadily increased, these groups became both allies and enemies of the Pueblos. Although the ethnographic record indicates that warfare between Pueblos was far more prevalent in the distant past (Bayer 1994; Benedict 1931; Fewkes
1893; Lomatuway’ma et al. 1993; Voth 1905), almost all of the historical evidence involves conflict between Pueblo and non-Pueblo groups.

The first sustained appearance of Europeans in the U.S. Southwest was the Coronado expedition beginning in 1540. The expedition described encountering fortified Pueblos with hundreds of warriors, painting a picture of a people accustomed to warfare (Hammond and Rey 1940). In his chronicles of the expedition, Pedro Castañeda de Náxera specifically mentioned the Pueblos of Acoma, Matsaki, and Pecos. Castañeda was impressed by Acoma’s location atop a steep-sided mesa, stating that “no army, however powerful, could reach the top” (Hammond and Rey 1940:218). Castañeda also describes seven-story towers that served as fortresses at the ancestral Zuni pueblo of Matsaki. Pecos was apparently “feared throughout the land” and would “dominate the pueblos they wish” (Hammond and Rey 1940:256–257). At that time, conflicts appear to have been primarily between Pueblo communities.

The later colonization effort spearheaded by Oñate in 1598 provided the Spaniards with direct evidence of Pueblo proficiency at warfare. Warriors from Acoma killed more than 20 Spaniards, leading to a bloody reprisal. Spaniards executed many warriors and cut off a foot of many of the remaining men (Hammond and Rey 1953). Using such drastic methods, the Spaniards were able to establish some measure of control over the Pueblos. The Spaniards compelled the Pueblos to provide food and lodging to the colonists and appear to have been surprised that these demands chafed the local populations (Hammond and Rey 1953). Europeans believed their arrival was a benefit to the Pueblos and accounts describe tribal chiefs expressing gratitude for the Spaniards maintaining a regional peace. Despite Spanish accounts describing their beneficial effect
on the Pueblos, Spanish rule was often brutal (Kessell 1987). Tensions between the Europeans and the Pueblos would mount until the Pueblos temporarily threw off the Spanish yoke in 1680 (Roberts 2004).

While seemingly maintaining a “peace” among Pueblos, the Spaniards were not able to prevent raiding by the Navajo, Apache, and other groups. Navajos were first noted living in the Chama River Valley in the early 17th Century (Zárate Salmerón 1966). After acquiring horses in the 17th Century, Navajos began raiding Pueblo and Spanish settlements along the Jemez River and the northern Rio Grande (Bartlett 1932). The Spaniards were aware of Apache groups as well, who ranged the mountains north of Taos and along the Rio Grande Valley (Kessell 1987). In addition to engaging in periodic raids on Spanish and Pueblo settlements, the Apaches formed alliances with various Pueblos in unsuccessful plots to overthrow the Spanish (Hackett 1942).

During the Pueblo Revolt of 1680, the Pueblos united to drive the Spaniards out of New Mexico (Roberts 2004). Soon after the Europeans were forced out, the Pueblos reverted to the earlier pattern of internecine conflict (Haas and Cremer 1997). Fighting among the Pueblos opened the door for the Spanish reconquest twelve years later. After the Spanish reconquest, there are numerous reports of conflict between the Pueblos and the Navajo, Apache, Comanche, Ute, and Kiowa (Hill 1982; Parsons 1929; Simmons 1979; Thomas 1940; White 1942).

Although conflict after the arrival of the Spaniards was predominantly between Pueblo and Athabaskan or Plains groups, one notable exception is the destruction of Awatovi in 1701 by other Hopi villages. Oral histories recount that the village chief of Awatovi asked other villages to destroy the cancer of Christianity that had taken root in
Awatovi (Brew 1949). In support of the oral history, archaeologists discovered a mass burial several kilometers from Awatovi (Turner and Morris 1970).

**Warfare in Modern Pueblo Society**

A rich historic and ethnographic record documents the prominent role of warfare among cultures in the American Southwest (Haas and Creamer 1997). Commenting in 1889, Bandelier explained, “Although the Pueblos have been at peace since the Navajos were repressed, war still remains theoretically their chief duty and occupation, and the war organization is kept up carefully” (Bandelier 1890:285). The ethnographic record also clearly demonstrates the importance of warrior societies within Pueblo communities. While the initial impetus (warfare) for the organization is absent, the traditional status, authority, and organization are maintained (Ellis 1951; Haas and Creamer 1997; Solometo 2006).

Each of the modern Pueblos retains some form of the traditional war societies, war chiefs, or war priests. Bow Priests at Zuni were traditionally in charge of war parties, oversaw scalp societies, and also governed the pueblo during times of conflict (Bunzel 1932). In Hopi society, a War Chief is in charge of the warrior and scalp societies (Stephen 1936; Titiev 1944). Authority in Keresan Pueblos was shared among four societies, with warriors and war priests figuring prominently within those societies (Bandelier 1890). At Acoma, three war priests are chosen each year and during times of war assumed complete authority of the Pueblo, relying on the O’pi (Warrior Society) to assist them (White 1932a). Reports from Laguna indicate a similar organization (Eggan 1950). War priests and the O’pi held similar importance at Santa Ana Pueblo (White 1942). It was reported that war captains at San Felipe were involved in all important
events at the pueblo (White 1932b). War chiefs, war captains, and war priests organized secret dances, maintained customs, consulted on important decisions at Santo Domingo and Cochiti (Goldfrank 1927; Parsons 1920; White 1935). Two War Captains, who were responsible for tribal hunts and war, were appointed annually at Zia by the War Priest and the cacique (Stevenson 1894). According to Ellis (1951), aspects of Tanoan culture indicate a greater emphasis on warfare than the Keresan Pueblos. War officers at Jemez formed a council to perform religious duties and were responsible for the security of the pueblo. The leader of the war officers was the War Chief and was expected to be vigilant against enemies of the pueblo, witches, and informants (Ellis 1951). At Taos, Parsons (1936) reported on the importance of scalps to fertility and the defense of the pueblo. The War Chief was charged with the responsibility of preparing scalps prior to the four days of singing and dancing that ensued after a scalp was brought to the pueblo. A Bow Chief and the Kumpa society were expected to stand guard during wars, presiding over important ceremonies, and were in charge of scalps which were sealed within the walls of the kiva (Parsons 1932). War captains were elected by general vote and collected food for the chiefs, punished witches, and guarded ceremonies.

Given the ubiquity of war societies and the leadership roles of war leaders among the modern Pueblos, warfare remained an integral part for their societies even in the absence of violent attacks. As the archaeological evidence can attest to, violence was commonplace over the centuries of Puebloan prehistory and left in indelible mark on Pueblo societies.
Chapter 5—Gallina Region

**Gallina Boundaries**

Researchers have generally defined the spatial extent of the Gallina Culture similarly (e.g. Anschuetz 2004; Crown et al. 1996; Dick 1976; Seaman 1976; Simpson 2008). The eastern boundary falls along the Continental Divide near the New Mexico-Colorado state border and continues south along the Divide to El Vado Reservoir, then along the Chama River (Dick 1976), but seasonal Gallina sites have been found east of the Chama in the Canjilon Mountains (Ellis 1988). The southern boundary follows the north edge of the San Pedro Mountains, follows the Rio Puerco upstream to the Continental Divide, and ends at Sisnathyel Mesa (Sleeter 1987). The western boundary extends north along the east side of Sisnathyel Mesa and continues northeast to the Colorado-New Mexico state line. The northern boundary is formed by a wide arc along the state line, skirting the east and south sides of the San Juan River (Seaman 1976; Simpson 2008). Based on the misidentification of many Rosa sites as Gallina, the northern extent of Gallina sites is often drawn incorrectly. The actual northern boundary roughly follows US 64, between NM 537 and the western boundary of the Jicarilla Ranger District of Carson National Forest (Peter McKenna, personal communication, 2014).

Based on the results of the current study, the boundaries for Gallina occupation sites are somewhat more restrictive (Figure 5.1). The western edge of the Gallina area follows the western edge of the Jicarilla Ranger District, continues south for roughly 16 km (10 miles), and then arcs toward NM 96 roughly 8 km (5 miles) north of the town of
Figure 5.1: The Gallina area boundaries
Cuba. Gallina sites farther south are found with a 25 km (15 miles) wide north-south corridor following US 550 and NM 96. This corridor of Gallina sites extends roughly 16 km (10 miles) south of the town of Cuba. The highest frequency of occupation sites are found in the Llaves Valley.

The Gallina area is a patchwork of federal, state, and private lands stretching across Rio Arriba, Sandoval, McKinley, and San Juan counties. Federal lands include Carson National Forest, the Jicarilla Apache Reservation (with federal trust responsibilities managed by the Bureau of Indian Affairs), lands of the Bureau of Land Management, and Santa Fe National Forest. State lands within the Gallina area are managed by the State Land Office and the Department of Transportation. Gallina sites on private lands are found primarily on in-holdings within federal land and in the region between the southern extension of the Jicarilla Apache Reservation and Santa Fe National Forest; the private lands include the small rural communities of Ojito, La Jara, Lindrith, Regina, Gallina, and Coyote.

**Physical Environment**

**Topography**

The Gallina area covers portions of the Colorado Plateau and the Southern Rocky Mountain Provinces (Fenneman 1931; Hunt 1974). The portions of the Colorado Plateau within the Gallina region mostly consist of mesas and cuestas with broad valleys between them (Hunt 1974). The southern reaches of the Gallina region encompass areas of past volcanic activity as demonstrated by the presence of lava flows, volcanic necks, and other igneous formations (Fenneman 1931). Generally, the Southern Rocky Mountain Province consists of a series of north-south trending mountain ranges and intermontane
basins with the highest ranges defining the Continental Divide (Hunt 1974). Within the Gallina area, this province is represented by the San Pedro Mountains, the Sierra Nacimiento, and the Canjilon Mountains. The San Pedro Mountains and the Sierra Nacimiento were created from uplifting of a granite mass by volcanic activity associated with the Jemez Mountains (Fenneman 1931; Wilks 2005).

The topography of the Gallina region can be categorized by the landforms of either side of the Continental Divide. The area west of the Divide consists of mesas cut by deep canyons. Canyons give way to valleys with the relief more extreme when moving from south to north. West of the divide, elevations generally increase from north to south (Dick 1976). East of the Divide is a rugged series of mesas and ridges (up to 2,700 m [9,000 ft.] in elevation) with north-south trending hogbacks that rise up to 180 meters (600 ft.) above the surrounding valleys and canyon floors. The hogbacks extend north from the San Pedro Mountains (Baltz 1967).

Geology

The Gallina area sits across four tectonic features: the San Juan Basin, the Nacimiento Uplift, the Gallina-Archuleta Uplift, and the Chama Basin (Bingler 1968; Constan 2011). The San Juan Basin contains sand, gravel, clay, and volcanic ash sedimentary deposits on top of igneous and metamorphic bedrock (Baltz 1967). The Nacimiento and the Gallina-Archuleta Uplifts cut north-south across the middle of the Gallina region. The north end of the Gallina-Archuleta Uplift is capped by Jurassic formations. The hogbacks found throughout the region were formed from the uplift of Cretaceous formations. The Chama Basin consists of sedimentary shale, sandstone, and
limestone ranging in age from the Mississippian to the Tertiary (Bingler 1968). These four tectonic features converge along the Llaves Valley (Fassett 1977).

Stream erosion of the shale layers has formed valleys and steep slopes across the region (Baltz 1967). The mesas and benches of the area are composed of more resistant sandstones and contribute to the sharp relief in the region. Due to their granitic composition, the San Pedro Mountains and the Sierra Nacimiento have been more resistant to erosion and contain the highest peaks in the area.

Water

The only perennial stream in the Gallina area is the Chama River, but summer storms and snowmelt periodically fill other drainages, including the Rio Gallina, Rio Puerco, Largo Canyon, and Lleguas Canyon (Seaman 1976). West of the Continental Divide, intermittent streams flow into Largo Canyon, which in turn flows northwest into the San Juan River. East of the Divide, all water eventually drains into the Rio Grande. Seasonal streams and washes empty into larger drainages, such as the Rio Gallina or Archuleta Canyon, before connecting to the Chama River. In the far southern part of the Gallina area, water drains into the Rio Puerco which eventually joins the Rio Grande. Surface water is rare in the region but can be found along with springs near the surface in many places (Dick 1976).

Surface Soils

Soils within the region are predominantly mollisols, alfisols, and entisols (Morain 1979). Common in semi-arid grasslands and forest areas, mollisols have deep soil horizons with a high organic content. These soils retain moisture moderately well and are well-suited for agriculture. Alfisols have clay-enriched subsoil and typically formed
beneath forested areas. Clay content enables high levels of mineral and moisture retention that can present problems for plant cultivation due to soil compaction (Morain 1979). Entisols do not contain soil horizons, typically due to active erosion. Their ability to support plant growth varies based on the composition of the parent material (Maker et al. 1974). Two other soil orders occur in the region but have limited fertility. Inceptisols are found in the highest elevations and have weakly developed soils horizons. Aridisols are accumulations of carbonates and salts and appear in areas with limited access to water (Morain 1979).

Climate

Annual precipitation in northern New Mexico is generally low, highly variable, and unpredictable (Bennet 1986). Moisture levels follow the regional seasonal pattern of strong late summer thunderstorms and winter snows. Topography and elevation partly dictate the amount of precipitation on a local scale, but precipitation can fluctuate dramatically through time. In general, annual precipitation increases by approximately 100 mm for every 300 m increase in elevation (Maker et al. 1973). Modern precipitation data for the region ranges from 300 to 460 mm for rainfall and between 635 and 1880 mm for snowfall each year (Constan 2011).

Temperatures in the Gallina region vary greatly. Mean average temperatures recorded at Dulce reach their highest point in July, at 30 degrees C (86 degrees F) with the lowest occurring in January at 2 degrees C (36 degrees F) (Maker et al. 1973:5). The higher elevations have cooler summers and colder winters than adjacent lower areas. Canyon and valley bottoms provide some of the most fertile and moist soil in the area but reach freezing temperatures more often than elevated areas, limiting their use for farming.
The greater Gallina region experiences between 60 and 120 frost-free days per year, with most of the area enjoying 90 to 120 frost-free days per year (Bennet 1986). Some native strains of maize can mature within 90 to 120 days (Muenchrath et al. 2002).

Data from corn, pollen, and microfaunal samples indicate that between A.D. 1059 and 1300, the environment shifted from conditions favorable to dry farming to significantly drier conditions, possibly contributing to the abandonment of the Gallina region (Fiero 1978; Holbrook and Mackey 1976; Mackey and Holbrook 1978). Decreases in precipitation were coupled with a shift from winter precipitation to summer thunderstorms (Holbrook 1977). Flash flooding during summer rains and the clearing of fields accelerated the rate of erosion, although it was tempered in some degree by the construction of check dams and terraces (Mackey and Holbrook 1978). The Great Drought that impacted the entire Four Corners region occurred from A.D. 1275 to 1300 (Euler et al. 1979).

**Flora**

The many canyons and mesas of the Gallina region provide a wide variety of ecological zones that vary with elevation and precipitation. The highest areas support ponderosa pine, aspen, spruce, and fir (Ellis 1988). The flora on the mesa tops include piñon pine, ponderosa pine, juniper, oak, and sagebrush (Seaman 1976). As elevations decrease, most of these species disappear, leaving a habitat dominated by juniper, piñon, and sagebrush (Elmore 1976).

**Fauna**

Modern fauna, found mostly in the lower elevations, include mule deer, elk, pronghorn antelope, black bear, mountain lion, coyote, porcupine, skunk, badger, coyote,
gray fox, bobcat, prairie dog, jackrabbit, cottontail rabbit, and squirrels (Bailey 1931). Various reptiles, amphibians, and migratory birds are also found in the region (Hudspeth 1997). The prehistoric range of the jaguar also included northwestern New Mexico (Constan 2011; Federal Register 2006).

**Gallina Culture History**

**Chronology**

To a large degree, researchers have been unable to establish a clear chronological sequence for the Gallina area. The conventional narrative of the sequence begins with the first sedentary population in the area, the Rosa phase (A.D. 700–850), believed to have migrated to the area from southern Colorado (Ellis 1988; Sleeter 1987). Settling in the northwest periphery of the Gallina area, the people of the Rosa phase built small communities of clusters of pit houses, associated surface structures, and exterior pits or ovens. The immigrants relied on a mix of farming and hunting for subsistence. The Rosa phase also saw the local introduction of the bow and arrow (Eddy 1972). The Piedra phase (A.D. 850–950) is seen as an elaboration of cultural patterns established during the Rosa phase, including the appearance of larger houses and community clusters and movement farther up the San Juan Basin (Anschuetz and Merlan 2004; Eddy 1972). Rosa and Piedra phase villages were often surrounded by stockades and many sites were burned (Hall 1944; Seaman 1976). The Arboles phase (A.D. 950–1050) follows the Piedra phase and was notable for its significant decrease in population and site size (Eddy 1966). By the end of the Arboles phase, the area was abandoned as populations migrated out of the area and to the north.
The period after the Arboles phase and before the Gallina phase is undocumented archaeologically in the Gallina region but the conventional narrative has linked the Rosa-Piedra-Arboles sequence to the Gallina phase. Many researchers have assigned a starting date of A.D. 1050 for the Gallina phase (Bahti 1949; Dick 1976; Ellis 1988; Green et al. 1958; Hall 1944; Lange 1956; Pattison 1968; Sleeter 1987; Stuart and Gauthier 1981), based in large part on the similarities in ceramics and the smattering of tree-ring dates (falling in the early 11th century) from Gallina structures. This early start date for the Gallina phase allows for a convenient linking to the Rosa-Piedra-Arboles sequence, but recent tree-ring studies cast some doubt at the early start for the Gallina phase. Bremer and Burns (2013) conducted a systematic review of the tree-ring dates and have questioned the validity of many of the early occupation dates. They examined 78 dates from 105 sites excavated between 1930 and 1990, and found that 69 of the dates fit best after A.D. 1200. The 9 dates before A.D. 1200 could not be verified through other dating means and could be cases of older wood being used in construction. Based on their results, Bremer and Burns set the starting date for the Gallina phase at A.D. 1175. Preliminary results from more than 2,000 tree-ring samples from the Llaves Valley indicate that the samples primarily dated to the A.D. 1230–1270 range (Towner et al. 2015).

One possible link between the Gallina and the Arboles cultures is the Chimney Rock phase of the Chimney Rock area of southern Colorado. Located along the upper reaches and tributaries of the San Juan River, the Chimney Rock phase (A.D. 1050 to 1150) is a continuation of the Rosa-Piedra-Arboles cultural sequence (Parker 2004). Similarities between Gallina and Chimney Rock phase habitation sites have been noted
(Borck and Bremer 2015; Breternitz 1993; Chuipka et al. 2010; Kane 1993). Thus, the culture later identified as Gallina may have been brought to the area fully developed by people from the upper San Juan Basin, putting its start date about A.D. 1150. Once arrived, these people established a similar adaptation to high elevations, including maize agriculture (Borck and Bremer 2015; Bremer and Burns 2013).

The Gallina phase ended sometime before A.D. 1300. At the end of the Gallina phase, the area was depopulated (Borck and Bremer 2015; Constan 2011; Dick 1976; Ellis 1988; Simpson 2008). Some researchers believe that the populations in the Gallina people migrated to the Jemez and Chama areas and were absorbed into existing populations (Ellis 1988; Wiseman 2007). No modern Pueblo groups claim the Gallina region as ancestral, however. A Jemez oral tradition recounted by William Whatley describes how the Jemez, en route from the Four Corners region to their current home, encountered the Gallina and eliminated them (Roberts 1996:153). Analysis of selected Gallina sites with skeletal evidence of violence does suggest that Ancestral Puebloan group from the Four Corners region may have encountered the Gallina and been responsible for at least of portion of the violence in the region (Borck 2012, 2015). Until the area was reoccupied during the Historic period, it saw infrequent use by bands of nomads (Sleeter 1987).

**Material Culture**

The Gallina phase represents a mixture of regional Ancestral Puebloan cultural features and a unique suite of endemic traits (Sleeter 1987). Gallina material culture consistent with contemporary agricultural cultures in the Southwest includes the use of pottery, stone tools, basketry, and tools of animal bone. The unique traits include
distinctive artifacts such as pointed bottom pots, tri-notched axes, basal tanged knives, antler celts, distinctive arrowshaft straighteners, and elbow pipes (Hibben 1938, 1939; Mera 1938). Assemblages at sites range from a handful of artifacts to tens of thousands of items.

**Subsistence**

As was the case with other sedentary cultures in the Southwest, maize was the primary source of sustenance for the Gallina people (Constan 2011; Dick 1976; Ellis 1988; Hibben 1939). Beans and squash were cultivated to a lesser degree. Many wild plants, such as seeds, nuts, berries, amaranth, and ragweed, were gathered and stored (Fiero 1978; Hibben 1939; Lange 1941). Wild game, including elk, deer, antelope, rabbits, and turkey, contributed significantly to Gallina diet (Hibben 1939). The large volume of the faunal assemblages at many sites demonstrates that hunting was an integral part of Gallina subsistence (Fiero 1978).

**Ceramics**

Gallina ceramics consist of painted and unpainted varieties. Constan (2011) defines two categories of Gallina ceramics: Gallina Gray and Gallina Utility. Gallina Gray encompasses Gallina Black-on-gray, Gallina Black-on-white, and Gallina Plain undecorated types defined by previous researchers (e.g. Ellis 1988; Green 1956, 1962; Hibben 1939, 1949). Gallina Gray paste, light to medium gray in color, is typically fine. Fine crushed sand was used as temper. Bowls and ollas with lug handles are the most common vessel forms, but canteens and effigy pots do occur. Carbon-based decorations, when present, include crosshatching, a series of dots, checkerboards, hour-glass figures, and zoomorphs. Surfaces are smoothed but unslipped. Gallina Utility has a gray to dark
gray paste, ranging from very fine to coarse sand temper. The main vessel forms consist of large, pointed bottom pots, bowls, and jars of various shapes and sizes. The surfaces of the utility wares are often fire darkened and crumbly with a gritty texture. Textured decorations included banding, fillets, smearing, clapboard, washboard, punching, incising, and basket impressing. Vessels forms of both types are created by coiling and then thinned by scraping. The distinctive pointed bottom pots and globular jars were used for cooking while the other vessel forms fulfilled a variety of food storage, preparation, and serving needs. Worked and drilled sherds have commonly been found in ceramic assemblages. Ceramic beads and pendants have been found at some Gallina sites (Constan 2011).

The absence of trade wares in ceramic assemblages is an oft-repeated refrain by Gallina researchers (Green 1956; Hibben 1949; Lange 1956; Mera 1938). Likewise, very few Gallina wares have been recovered outside of the Gallina area (Constan 2011). Exceptions to this trend are found in the Cuba area, where both Pueblo III and Gallina sites contain a combination of Gallina and non-Gallina ceramics at each site (Elyea 2005; Myers 2007). When present at Gallina sites, intrusive ceramic types included Mesa Verde wares, Cibola wares, northern Rio Grande wares, White Mountain Red Ware, and Mogollon brownwares. Other than the Cuba area, exchange is not evident at the vast majority of Gallina sites.

Flaked Stone

The predominant flaked stone tool forms include projectile points, bifaces, drills, scrapers, knives, and edge-modified flakes (Hibben 1939). Among these forms are distinctive basal tanged knives. There are two varieties of basal tanged (also described as
laurel-leaf-shaped) knives (Figure 5.2) (Green 1962; Kleindienst 1956). One variety has parallel sides with a pointed basal tang, the other a straight or convex base. Chert was the primary material type, but obsidian tools also occurred (Ellis 1988). Both material types were locally available with the Jemez Mountains containing several easily accessed sources of obsidian. An obsidian sourcing study of 62 obsidian artifacts from nine sites traced their sources to two quarries in the Jemez Mountains (Shackley 1999).

Projectile points typically came in three varieties: corner-notched, side-notched, and un-notched (Lange 1941; Wilkinson 1958). The side-notched points were small and triangular with square bases and were primarily produced from obsidian (Ellis 1988; Hibben 1939). Corner-notched points could have flat, concave, or rounded bases (Lange 1941). Chert appears to have been the preferred material type for corner-notched points (Hibben 1939). Unnotched triangular points were made from both chert and obsidian (Lange 1941). Middle Archaic points have also been found with a high degree of regularity (Lane et al. 2004; Wyatt 1995), prompting some (Bertram 1988; Wyatt 1996)

Figure 5.2: Basal tanged knife from Green et al. (1962:Fig. 5).
to suggest an association with the Gallina phase.

Ground Stone

Ground stone tools commonly found at Gallina sites include metates, manos, pestles, axes, mauls, palettes, and polishers (Wilkinson 1958). Slab metates and two-hand manos are the most common ground stone artifacts but basin metates and one-hand manos were also common. These grinding tools were primarily made from local sandstones (Fiero 1978). Stone axes, typically made from igneous rock, had a distinctive large blade tapering to a pointed bit, with three notches forming a T-shaped hafting area (Hibben 1938). Shaped sandstone slabs were frequently used as bin covers (Hibben 1939; Lange 1941; Wilkinson 1958). Sandstone discs, described as “capitals” in the early literature (Hibben 1939; Lange 1941), were often found amongst roof debris, but their purpose is unclear (Wilkinson 1958). They could have served as hatchway covers (Green 1962) or as covers for roof bins (Constan 2011). Cylinders made from sandstone, limestone, calcite, and igneous rock have been found at some sites (Fiero 1978). The function of the cylinders is unknown, but possible options include tiponi (corn-mother figures) (Fiero 1978; Lange 1941), pedestals on an altar (Wilkinson 1958), andirons, or props for raised floors (Constan 2011). Tubular and disc-shaped stone beads were recovered from several sites and were primarily shaped from travertine, gypsum, and slate (Constan 2011). Pendants, primarily made from selenite, occur in moderate quantities at Gallina sites (Green 1964; Pattison 1968) and with the selenite perhaps used as signaling lenses (Ellis 1991).
Bone and antler

Bone awls, bone needles, flakers, bird bone whistles, bone beads, spatulas, bone chips, antler celts, antler axes, and antler adzes have all been found at Gallina sites, with awls the most common artifact type (Hibben 1938, 1939; Wilkinson 1958). The spatulas could have been used as scraping or rubbing tools (Constan 2011). Tools were primarily made from deer, elk, gray wolf, bobcat, coyote, and dog bones (Fiero 1978). In general, faunal remains at Gallina sites came from a variety of species, including deer, elk, antelope, bighorn sheep, rabbits, turkeys, gophers, and wood rat (Ellis 1988; Hibben 1939; Lange 1941; Seaman 1976).

Wood, Fiber, and Basketry

Several wooden artifacts, such as digging sticks, bows, arrows, cradleboards, bowls, spoons, spatulas, and knife shafts, have been found at Gallina sites (Hibben 1939; Wilkinson 1958). Recovered wooden artifacts were made from piñon, juniper, ponderosa pine, oak, box elder, mountain mahogany, willow, and cottonwood (Constan 2011). Sandals woven from yucca leaves had corner-notched ties and square heels (Wilkinson 1958). Cordage was created by braiding together yucca fibers, and human hair (Hibben 1939). Yucca leaves were also woven to create bow guards. Baskets were typically made with yucca using a two-rod and bundle technique (Wilkinson 1958). No fabrics have been found at Gallina sites, but potential weaving frames have been identified (Dick 1976; Green 1962; Hibben 1939; Lange 1941). Gallina people were also actively processing and tanning hides (Hibben 1939).
Ceremonial Objects

Regardless of the study area, identifying artifacts with ceremonial value always entails some degree of speculation. This is especially true for the Gallina area, where researchers have a fairly incomplete picture of the culture. That being said, previous researchers have tentatively attributed ceremonial significance to a handful of objects (Ellis 1998; Hibben 1939; Wilkinson 1958). Many of the artifact types previously mentioned (e.g. whistles, cylinders, pendants) could have served some ritual purpose, but a few others deserve special mention. Hibben (1939) recovered medicine bundles containing crystals, clay, fossils, rocks, bones, antlers, and pigments. Caches of minerals, such as kaolin, malachite, azurite, argillite, and calcite, have been found (Fiero 1978). Pieces of shaped quartz, quartzite, and chalcedony stones have been found at several sites, possibly representing lightning stones that glowed when rubbed together (Ellis 1988; Fiero 1978; Hibben 1939). Colored and etched wooden prayer sticks, found in association with feathers, were recovered from Nogales Cliff House (Hibben 1939) but not been found at any other sites. Also, Ellis (1988) has argued for the existence of sipapus within Gallina structures.

Imagery

Murals have been found both on the interior and exterior of Gallina structures (Green 1962; Hibben 1939; Wilkinson 1958). Common design elements include plant and animal motifs, stacked triangles, spirals, concentric circles, and other geometric designs (Green 1962; Hibben 1939; Lange 1941; Wilkinson 1958). Murals were typically drawn with red hematite or black carbon paint on top on a white gypsum
Human Remains

Only a few osteological studies of Gallina collections have been conducted (Bell 1940; Chase 1976, 1978; Lange 1940; Stanerson 2012; Weaver 1976). The average height for adult males was roughly 158 cm, and 151 cm for females (Chase 1976). Life expectancy appears to have been low; the age at death for most individuals was less than 30, with women slightly outliving men (Chase 1976; Stanerson 2012). Living past 50 was exceedingly rare. Lambdoid and occipital cranial deformation, likely from cradle boarding, is common in Gallina collections (Chase 1976, 1978; Lange 1940; Weaver 1976). Obelionic flattening, a rare form of cranial deformation, has been identified at one Gallina site (Nelson and Madimenos 2010). Various conditions, such as pyorrhea, osteomalacia, metopism, have also been noted (Chase 1976, 1978; Lange 1940).

Architecture

Gallina architectural forms consist of pit houses, surface houses, outbuildings, and towers. (Constan 2011; Dick 1976; Hibben 1948; Simpson 2008). Each of these
structural types have been found in isolation or associated with other structural types. Dick (1976), Simpson (2008) and others have suggested that pit houses were more common earlier in the Gallina phase, but the general uncertainty plaguing Gallina chronology has made it difficult to verify any perceived temporal trends in architecture. When pit houses and surface houses co-occur at sites, often they were occupied contemporaneously. It is possible that the two structures conveyed different seasonal benefits and inhabitants would move from pit house to surface house as winter gave way to summer.

**Pit Houses**

Used as habitations, Gallina pit houses are generally circular or rectangular with rounded corners and have a north-south orientation (Simpson 2008). The pit, up to 4 m deep, was dug with the interior walls of the surface forming the interior walls of the structure. Layers of plaster and adobe were often applied to the earthen walls. In his study of Gallina architectural patterns, Simpson (2008) found that the average diameter of pit houses was 5.5 m and the average depth was 2.2 m (but there were tremendous variation between sites). The floors of pit houses were usually laid with large sandstone flagstones (Hibben 1948). The roof was supported by four posts which in turn supported four beams (Green 1956). Access to the habitation was provided through an opening in the roof with a ladder extending to the floor of the structure.

The interior of the structure generally included a hearth, a deflector, a ventilator, wing walls, and a banquette. The hearth was typically in the middle with a U-shaped deflector to its south (Fiero 1978; Simpson 2008). The U-shaped deflector often surrounded an ash pit that held pointed-bottom vessels (Constan 2011). Beneath the
bottom slab of the hearth in many excavated Gallina pit houses was a chamber containing river cobbles, fine ash, and partly burned wood (Dick 1975; Ellis 1988), perhaps serving a role in a house blessing ceremony (Constan 2011). A ventilator shaft for air intake was located on the south wall. The interior space was partitioned into sections by wing walls extending from the east and west walls toward the deflector. A banquette enclosed the northern section of the interior extending from one wing wall to the other. Storage bins, often with small vent holes, could be found throughout the interior or on the roof. Storage niches are found along the walls of the pit. Tunnels connecting the pit house to another pit house or surface structure have been found at four sites (Dick 1976; Ellis 1991; Fiero 1978; Green et al. 1958). The entrance of the tunnels were less than a meter in diameter with the lengths of the tunnels ranging from 8 to over 20 meters (Constan 2011).

Surface Houses

Surface houses were above-ground masonry structures and served as habitations (Hibben 1948). The most common form was a single square room, but contiguous room blocks of up to 20 rooms also existed. Individual rooms were 6 to 8 m long and were up to 3 m tall (Simpson 2008). The walls consisted of large sandstone blocks, with mud filling the gaps between blocks. Mud was also used to coat the exteriors of structures (Constan 2011). The interiors of surface houses mirrored the layout of pit houses. Access to the surface houses was similarly provided through the roof. The four roof supports rested on the banquette and the wing walls. The interior walls and the floor were plastered with a mixture of mud and clay, often with large flagstone around the hearth.
Outbuildings

Outbuildings were built with thin stone walls, jacal, adobe, or some combination of the three techniques (Constan 2011). They typically consist of one to four rectangular rooms but can occur in arcs of up to 27 rooms (Bahti 1949; Fiero 1978). The length of walls generally ranges between 1 and 5 meters. Outbuildings often have raised floors but no fire pits or doorways (Green et al. 1958). They were used as granaries, turkey pens, mealing rooms, storage room, and even for burials (Constan 2011). These structures were typically associated with habitation structures (Green 1956; Lange 1956) and tended to be more strongly associated with pit houses rather than surface houses (Dick 1976). In contrast to other outbuildings, granaries were built with heavy walls and connected to surface houses (Mohr and Simopoulos 1976). Large granaries have been discovered at a few sites and appear to have served as central storage facilities for many habitations (Simpson 2008). Ramadas are also found throughout the area and consist of a roof and supporting posts without enclosing walls (Mackey and Green 1979). Some ramadas were enclosed with brush walls (Constan 2011). Other simple structures, including sun shades and windbreaks, have been found in the region (Bahti 1949; Ellis 1988; Fiero 1978).

Towers

Gallina towers were typically built with double coursed masonry walls, which often displayed a level of craftsmanship far superior to that of other masonry structures in the region (Seaman 1976). They were circular in plan, but at least one rectangular surface house was converted into a tower (Constan 2011). The heights of the remnant walls of the towers range from 0.25 to 2.0 meters, but the original height of the towers has been estimated to be between 8 and 10 meters (Hibben 1948; Seaman 1976; Dick
Diameters ranged from five to nine meters. Towers were accessed through the roof or through tunnels and often contained hearths with ventilators (Constan 2011). Internal domestic features are often absent (Mackey and Green 1979) but storage bins, murals, and banquettes have been found (Fiero 1978; Hibben 1948; Schulman 1950). Floors were typically smaller than in residential structures and only occasionally contain flagstones (Fiero 1978; Hibben 1948; Mackey and Green 1979). Towers are mostly found with residential structures but occur as isolated structures (Dick 1976). Excavated towers have yielded evidence of burning, human remains, and defensive features (Green 1962, 1964; Hatch et al. 1994; Holbrook and Mackey 1975; Mackey and Green 1979).

Most towers have been found on ridgelines and other high points on the landscape and even in their current state often provide commanding views of the surrounding landscape. In their original state, towers would have been taller than many surrounding trees, creating an unobstructed view in all directions (Upham and Reed 1989). The initial interpretation of the function of the towers was that they were defensive structures (Schulman 1950). Based on finds of large amounts of grain in excavated towers, Mackey and Green (1979) concluded that storage was a secondary function for at least some towers. They found little or no evidence to support the hypothesis that the towers were used for ceremonial purposes or prolonged habitation.

The exact function of Gallina towers remains an open question but there are indications that they provided line-of-sight communication between communities. The existence of a communication network was proposed by Ellis (1976), who suggested that as the primary purpose of the towers. Many towers in the Gallina area were located
between 5.3 km to 10.1 km (3.3 to 6.3 miles) from another tower (Sleeter 1990; Baker and Langenfeld 1990). A visual message from one site to the other could have been delivered in a matter of seconds as opposed to the several hours it would take a messenger to travel that distance over rugged terrain.

Line of sight between two towers on nearby ridges was first demonstrated by Page (1986). Researchers at Gallina tower sites attempted to signal each other using selenite reflectors and determined that the resulting flashes could be seen at distances of up to 7.6 km (4.7 miles) (Ellis 1991). Ireland (1984) attempted to demonstrate a line-of-sight communication network for the Gallina sites on the northern portion of the Jicarilla Apache Reservation. He found that many sites were visible from each other and while it was not proof of a communication network, one could have existed in that area. Sleeter (1987, 1990) conducted an intervisibility assessment of a small sample of tower sites in the central Gallina area. He used topographic maps and various statistical tests to determine intervisibility between some of the tower sites. Sleeter concluded that within his small sample, intervisibility did exist for 15 of the 18 samples, supporting the suggestion that the towers served as part of a signaling network. He concluded that the existence of a signaling network demonstrated an inherent concern for defense that dictated the location of the towers in the region (Sleeter 1987, 1990). More recently, a study assessing the intervisibility of 90 tower sites found that 74% of the towers were visible from at least one other tower (Byrd 2010).

**Interaction**

The Gallina culture has traditionally been viewed as living in isolation from other groups in the greater Southwest (Cordell 1997; Ellis 1988; Stuart and Gauthier 1981).
This conclusion is supported by the absence or extremely low frequency of foreign ceramics in most Gallina ceramic assemblages and the equally low frequency of Gallina ceramics at most non-Gallina sites. In contrast to this general pattern, Gallina people on Mesa Portales appear to have interacted with neighboring Ancestral Puebloan groups, as indicated by mixed assemblages of Gallina and non-Gallina ceramic types (Myers 2007). The non-Gallina ceramics are mostly White Mountain Red Ware and Rio Grande and Cibola white wares, but they include types from even farther abroad (Elyea 2005). Non-Gallina sites have been discovered on the mesa. Mackey excavated several of the non-Gallina sites and described them as either Chacoan or Mesa Verdean (Holbrook and Mackey 1976). Survey data further indicate the presence of large non-Gallina communities on the mesa (Baker and Durand 2003, Anthony Lutonsky, personal communication, 2011). This apparent coexistence of Gallina and other Ancestral Puebloan populations does not occur anywhere else in the Gallina region. The Mesa Portales region represents one of the most complex and diverse cultural landscape in the Southwest during this period, but the nature of the interaction between Gallina and non-Gallina peoples is currently unclear and requires further research.

**Settlement Patterns**

Gallina communities of about 10 households were organized into “dispersive villages” (Dick 1988). The dispersive settlement type consists of scattered habitations that retain some degree of spatial association (Dick 1980). These villages were built on mesas, ridge tops, cliff edges, along streams, and cliff overhangs (Hibben 1948; Sleeter 1987) and are most commonly found along high points on the landscape (Muceus and Lawrence 1990). Typical Gallina villages would support a population of about 40 people.
Isolated homesteads tend to be found on valley floors or along slopes and low ridges (Simpson 2008). In general, pit houses are the most common site type (Dick 1976; Elyea 1994).

**Violence**

Many Gallina phase sites—especially towards the end of the phase—display evidence of conflict. Excavators have found skeletal remains with evidence of perimortem trauma at multiple sites, often in mass burials (Bahti 1949; Blumenthal 1940; Green 1962; Mackey and Green 1979; Mackey and Holbrook 1978; Turner et al. 1993). Evidence of trauma include fractured crania, parry fractures (caused as a victim attempts to ward off a blow from a weapon), projectile points lodged in bones, and scalping cut marks (Bahti 1949; Hibben 1939; Turner et al. 1993). Overall rates of violence at Gallina sites appear to be high, but many sites remain unexcavated so we have an extremely incomplete picture on the scale of violence in the region. Constan’s (2011) literature review found that of the 29 sites where human remains have been recovered, evidence of skeletal trauma was found at 11 of them. The remains of 91 of the 159 (57%) individuals recovered from those 29 sites displayed evidence of violence. An osteological study of remains from 142 individuals from various Gallina sites determined that 52 (36.6%) presented traumatic injuries (Stanerson 2012). Earlier studies (albeit with small sample sizes) suggested that the rates of violence were appreciably lower than the literature review suggests. Based on remains excavated by Herb Dick in the Llaves Valley, Chase (1976) determined that 6 out of 16 individuals (37.5%) exhibited signs of violence in the form of fractures and an embedded projectile point. In another osteological study, only two of eight individuals displayed signs of violent trauma (Weaver 1976).
Of the aforementioned 91 individuals showing signs of violent death, 78 came from five sites. At Cuchillo House (LA22861), Hibben (1939) found the remains of 16 individuals distributed indiscriminately about the floor of a burned structure. One individual apparently died crouching in the ventilator, in an attempt to survive the blaze. Based on the orientation of the remains, Hibben concluded that some individuals were alive when the room was set on fire. The remains of one individual were found draped across a storage bin with an arrowhead among its ribs. The victims appeared to have been adult men and women (Stanerson 2012). The remains of nine individuals in a room at Nogales Cliff House (LA649) were similarly found unburied (Hibben 1939; Pattison 1968). The skeletal remains at Nogales showed signs of blunt force trauma and cutting marks (Stanerson 2012).

Thirty-five of the 37 individuals found at Rattlesnake Ridge (LA35648) showed signs of violence. In one pit house at the site, the skulls of 10 adults all showed signs of perimortem fracturing (Bahti 1949). Projectile points were found directly associated with the remains and several individuals were missing hands and feet. The remains of an infant were found at the bottom of a ventilator shaft. Within a nearby two-room structure, excavators found the remains of 25 individuals (Hatch et al. 1994). In the east room, the badly charred skeletons of three adults, one adolescent, and one child were found (Purdy and Shipley 1985). In the west room, the burned remains of 11 individuals were found associated with roof fill (Hatch et al. 1994). Eight more bodies were found on the floor of the structure and the remains of a child were discovered in a storage bin; perhaps the child attempted to hide from attackers. The orientation and condition of the
remains suggests a scenario where most of the structure’s inhabitants were killed prior to the structure being set ablaze (Hatch et al. 1994).

The remains of two adult males, three adult females, one young child, and an infant were found at the Cañada Simon I site (LA48387), eroding from a road cut. All of the individuals displayed evidence of lethal violence, including blunt force trauma and cutmarks (Stanerson 2012). Despite the absence of osteological signs of violence for the infant, the likelihood of a natural death is slim. One individual, an adult male, showed signs of extensive beating prior to death. At Bg88 (LA 61568), the remains of nine individuals were found interspersed with roof fill (Mackey and Green 1979). One skeleton was draped over a storage bin while another was found behind the storage bin. The “positions of interment” for these individuals suggested a violent end to their life (Figure 5.4) (Mackey and Green 1979:147).

The vast majority of Gallina sites were on defensible landforms such as ridges, mesa tops, buttes, and cliffs (Ellis 1988; Mackey and Holbrook 1978; Sleeter 1987). Stockades, towers, and other potentially defensive structures have been found at many Gallina phase sites (Ellis 1991; Hall 1944; Mackey and Green 1979; Seaman 1976). Many sites shared lines of sight visibility with neighboring sites (Byrd 2010; Ellis 1991; Sleeter 1987). Although burned sites do not necessarily imply violent conflict (Creel and Anyon 2003; Lally 2005; Wilshusen 1986), they are common in the Gallina area (Dick 1976; Hibben 1939; Mackey and Green 1979). Almost all structural sites on Mesa Portales, both Gallina and non-Gallina sites, are burned (Anthony Lutonsky, personal communication, 2011).
Previous Research

The earliest archaeological reports of the Gallina area come from the 1874 Wheeler survey, which described a community later identified as the Porcupine Ridge complex (Cope 1879). Following a 1916 survey of the Rio Gallina region, Douglas identified a culture he called the “the small house people” (Douglas 1917). The next significant research on the Gallina area was begun in 1932 by the Laboratory of Anthropology under the direction of H.P. Mera (1938). Mera described the culture he found as the Largo phase (Mera 1935). In 1933, the University of New Mexico began the Navajo Project, a large survey project intended to discern the origins of the Navajo people in the Southwest (Hibben 1938). It became apparent that areas of early Navajo
settlement were previously inhabited by an Ancestral Puebloan group that did not fit within any known phase. This group was given the name Gallina to distinguish it from Navajo sites.

The continued discovery of Gallina sites prompted the establishment of the University of New Mexico’s Gallina Project in 1934, under the direction of Frank Hibben (Hibben 1938). Hibben concluded that the Gallina phase was identical to Mera’s Largo phase. The Gallina Project lasted until 1956 and was responsible for numerous excavations and a number of published articles, masters’ theses, and doctoral dissertations (e.g. Bahti 1949; Blumenthal 1940; Green 1956; Hibben 1939, 1948; Kleindienst 1956; Lange 1956; Schulman 1949; Wilkinson 1958). Even after the conclusion of the Gallina Project, the bulk of the published Gallina literature from the 1960s and 1970s was produced by veterans of those field schools (e.g. Green 1962; Green et al. 1958; Pattison 1968).

The 1970s saw the start of four major projects on the Gallina area. James Mackey and Sally Holbrook conducted joint archaeological and paleoecological investigations of the Gallina area (Holbrook and Mackey 1976; Mackey and Holbrook 1978). In 1971, the Ghost Ranch Museum began its investigations of the Gallina Culture with a study focusing on hunting and gathering camps in the Canjilon Mountains (Ellis 1988). The Ghost Ranch Museum then began a series of field schools in the Llaves region, lasting from 1971 until 1988. Field work in the 1980s focused on the Rattlesnake Ridge Community (Bice 1980; Hatch et al. 1994). In 1972, Adams State College began conducting field schools in the Llaves region under the direction of Herbert Dick (Dick 1975, 1976, 1978). The fourth institutional research project during the 1970s was by the
University of Toronto, Erindale, under the supervision of Laetitia Sample. Starting in 1972, the University of Toronto sponsored several seasons of field schools in upper Largo Canyon (Mohr and Simopoulis 1976, Sample and Mohr 1975). In addition, the University of South Carolina sponsored archaeological research on the Gallina during the decade (Constan 2011). While salvage archaeology and CRM survey projects conducted in the past 50 years have been helpful in identifying hundreds of sites throughout the Gallina region, the 1970s research projects represent the last large-scale investigations in the Gallina area.

The first non-academic efforts were two salvage archaeology projects in the 1960s (Bussey 1963; Hammack 1965). These were followed in the 1970s by large excavation projects focused on sites on federal land (e.g. Fiero 1978; Seaman 1976). Primarily prompted by timber sales or oil and gas exploration, CRM work continues in the Gallina area. These projects have varied greatly in size and scope and have been performed by a variety of CRM firms and federal agency archaeologists. The result has been a large volume of data that, for the large part, has never been integrated to produce a coherent synthesis. Connie Constan (2011) addressed this issue in her dissertation and has created a thorough review and valuable synthesis of the existing Gallina literature.

While most of the fieldwork in the Gallina region since the 1980s has been the result of CRM projects, there have been a handful of university-sponsored field schools in the region. In 1993 the University of New Mexico field school, under the direction of Robert Leonard, conducted pedestrian surveys on Tapicitos Plateau (Hudspeth et al. 1994). The University of Texas at El Paso performed surveys in the Wild Horse Canyon area as part of the 1997 field school session (Peterson et al. 1998). In the 2000s, Eastern
New Mexico University conducted multiple seasons of field work on Mesa Portales. Under the guidance of Stephen Durand, the ENMU field schools were a mix of survey and excavation.

Despite the relative absence of large institutionally-sponsored projects in the region, several recent theses and dissertations attest to a growing interest in the Gallina culture. Joe Lally’s (2005) dissertation from the University of New Mexico investigated the causes of structural fires including a case study from a Gallina site. Based on data collected during the Eastern New Mexico University’s field schools, Nate Myers (2007) master’s thesis presented an analysis of ceramic assemblages from selected sites on Mesa Portales. Erik Simpson (2008) master’s thesis from Prescott College compared architectural traits of Gallina structures to examine the question of Gallina origins and possible migration. Paula Massouh’s (2009) dissertation from American University investigated Gallina society at the scale of a single household. Connie Constan’s (2011) dissertation from the University of New Mexico explored the relationship between ceramic resource procurement and social violence at two Gallina sites, Nogales Cliff House and the Davis Ranch Site. Lewis Borck’s (2012) master’s thesis from the University of Arizona used a GIS-based analysis to discuss whether the source of violence in the Gallina region was internal or external. Finally, Vlisha Stanerson’s (2012) master’s thesis from Colorado State University examined the skeletal remains of 142 individuals from Gallina sites, focusing on evidence of violence from the remains.
Chapter 6—Methods

Primarily based upon a comprehensive dataset of architectural sites from the Gallina region, this study used a GIS-based analysis to investigate the spatial pattern of these sites to investigate the source of violence in the Gallina region. Rather than use spatial analysis to describe existing patterns, three spatial models were developed with the intention of comparing the final analysis results to these models. The record of violence in the Gallina region has been definitively established (Bahti 1949; Blumenthal 1940; Green 1962; Hibben 1939; Mackey and Green 1979; Mackey and Holbrook 1978; Turner et al. 1993) yet the lack of fine chronological resolution presents difficulties when attempting to apply traditional archaeological methods to questions about the source of violence. This study represents an approach to tackling this problem without relying on the existence of better dating of sites for the region.

The analysis itself employed a variety of spatial clustering techniques, including nearest-neighbor analysis, Ripley’s k-function, and kernel density estimation (KDE). Viewshed analysis and least cost analysis were employed and incorporated into the clustering results. The results from this analysis were evaluated with respect to four critical factors: clustering, connectivity, defensibility, and violence. The clustering, connectivity, defensibility, and violence results were then visualized into a series of maps that were qualitatively compared against the spatial models.

Three Models of Tribal Conflict

Generally defined, a scientific model is an intellectual construct that assists in describing, measuring, visualizing, or simulating any type of phenomena. Within archaeology, models have been developed to address a wide range of cultural and
behavioral situations. Model building in archaeology is best viewed as a continuing process rather than as the construction of a static tool. Effective models benefit from constant calibration. The availability of new datasets, the introduction of new analytical techniques, or the emergence of different perspectives may all necessitate a revision of a model. That being said, the models presented below are a good-faith attempt to construct interpretative frameworks based on the current state of the relevant datasets and analytical techniques.

Archaeological models can be grouped into a few general categories: predictive models, simulations, and descriptive models. The models used in this study might best be considered predictive models. Rather than being used to predict the location of cultural materials or phenomena, they represent potential patterns for three types of tribal warfare. Specifically, the models depict expected patterns of tribal conflicts where the sources of violence come from within the region, from outside the region, or from both inside and outside the region.

These models should not be construed as representing the only three possible scenarios. Instead, these models represent points on a continuum with internal (from within the region) and external (from outside the region) sources as end points of a continuum and mixed (internal and external) conflict in the middle. These models also represent the three most often suggested scenarios for violence in the Gallina region. Proposed motivations for conflict, such as competition over resources, status-seeking behaviors, vengeance, and witchcraft persecution, could occur within all three contexts. Motivations for tribal warfare are also not necessarily mutually exclusive. Understanding the motivations for violence is a critical aspect to the study of prehistoric warfare, but any
speculation about motives is fraught with difficulty without first establishing the primary agents in any conflict. Considering that the primary objective of this study is to establish the geographic source of conflict, the possible causes of violence were not incorporated into the three models.

The models themselves build off Haas and Creamer’s (1993) study of the Kayenta Anasazi. According to Haas and Creamer, physical boundaries between tribal groups are often indicated by the spatial separation and isolation of a group or by the construction of defensive walls, lookouts, and fortifications. With respect to the spacing of communities, allied settlements would need to be located near enough to each other for allies to arrive quickly enough when alerted to make a difference during an attack. Buffer zones, or areas with little or no settlements, often develop between antagonistic communities (LeBlanc 1999). The distribution of defensible sites can also be used as an indicator of territorial boundaries (Borzunov 2002; Curry 1997; Field 2005; Nunn 2012; Prince 2004; Wilcox and Holmlund 2007). The existence of fortifications at a site indicates at least the threat of an attack (Allen and Arkush 2006) while their distribution, scale, and elaboration of the fortifications may indicate how large of an attacking force defenders are expecting and from what direction (Solometo 2004). Social boundaries between groups can be seen in the archaeological record by examining the distribution of trade goods (Haas and Cremer 1993). The existence of a communication network also implies some degree of social connection (Ellis 1991; Ireland 1984; Swanson 2003). When warfare exists in tribal societies, it plays a pivotal role in defining these boundaries and social connections (Haas and Cremer 1993). Tribal warfare can occur with varying scales and scopes (Solometo 2004, 2006), so different patterns are seen in the
archaeological record. The following three models illustrate these different patterns with respect to the varying degrees of clustering, connectivity, defensibility, and violence that is seen in the archaeological record. These four criteria in different amounts inform on how territorial boundaries were defined in the region, to what degree Gallina communities may have been unified, which communities were the most vulnerable to attacks, and how the incidents of violence were distributed across the region.

The first model (Table 6.1) proposes that during the Gallina phase the record of violence was due to antagonism among settlement clusters in the Gallina region. If such a situation existed during the Gallina phase, one would expect to find little evidence for alliances between site clusters (Haas and Cremer 1993). Antagonistic communities should maintain a buffer zone between each other (LeBlanc 1999). In a context of

<table>
<thead>
<tr>
<th>Characteristics of internal conflict</th>
<th>Expected pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>The existence of several small dispersed settlements.</td>
<td>Several dispersed settlement clusters will be clearly identified with discernible buffers between each cluster (Figure A.1).</td>
</tr>
<tr>
<td>Settlements are fortified to resist attacks from neighbors. Defensible sites are located to defend small parts of the region.</td>
<td>Defensible sites will be distributed across the region, situated to defend smaller areas within the region (Figure A.2).</td>
</tr>
<tr>
<td>Lookouts or guard posts are situated to defend small areas of a region. Peaceful interactions occur between other Gallina communities will be limited to the immediate vicinity of communities.</td>
<td>Observation sites, such as towers, will be found with line-of-sight connections between a few site clusters, rather than the majority of sites in the region. Similar trade ceramics will be found at a small number of nearby communities (Figure A.4–A.5).</td>
</tr>
<tr>
<td>Conflict occurs throughout the region</td>
<td>Burned sites and site with skeletal trauma will be found throughout the region (Figure A.3).</td>
</tr>
</tbody>
</table>
internal warfare, alliances among settlements, if present, would exist on a small scale and groups allied against a perceived threat from other groups within the region. This situation has occurred in a number of archaeological and ethnographic contexts (Curry 1997; Field 2005; Haas and Cremer 1993; Liston and Tuggle 2006; Nunn 2012). Defensible sites would be found throughout the region but would be located to observe the approach of local enemies (Wilcox and Holmlund 2007). Lookouts or guard posts (to serve as observation posts to provide advance warning of attacks, and to relay messages to allies) would be situated to defend small areas of a region potentially demonstrated by intervisibility between allied tower sites. Peaceful interactions among communities should occur only between communities on a small scale (Haas and Cremer 1993). Warfare-related sites, such as burned structures and skeletal trauma, should occur throughout the region.

The second model (Table 6.2) proposes that during the Gallina phase, settlements experienced minimal conflict with other Gallina settlements. Instead, Gallina settlements experienced assaults from groups outside the Gallina region. A small number of large, settlement cluster should be centrally located without any clear buffer zones (Haas and Cremer 1993). Small settlement cluster, if present, should be located around the periphery of the region (LeBlanc 1999). The location of defensible sites should be situated to restrict access to the Gallina area or to detect encroachments into the Gallina area from hostile groups. Defensible sites could also be concentrated around a central place in the interior, serving as a refuge or sanctuary during attacks along the borders (LeBlanc 1999). Site intervisibility would exist throughout the region, connecting nearly all tower sites into a single network. Similarly, all Gallina communities would likely
Table 6.2 – Model of external warfare and expected results

<table>
<thead>
<tr>
<th>Characteristics of external conflict</th>
<th>Expected pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small settlements may exist in defensible locations but large settlements should be present. Settlements should be relatively close to each other.</td>
<td>Clearly defined large site clusters will be present within the region but no-man’s lands will not exist between clusters. Small site clusters may exist but will be located near the periphery of region (Figure A.6).</td>
</tr>
<tr>
<td>Defensible settlements are situated to restrict access to the region.</td>
<td>Defensible sites will be found along the borders of the regions, at primary access points into the region, or defending a central location (Figure A.7).</td>
</tr>
<tr>
<td>Lookouts or guard posts are situated to defend the entire region. Peaceful interactions occur among Gallina communities.</td>
<td>Observation sites will be found with line-of-sight connections between most site clusters in the region. Similar trade ceramics should be found at all Gallina communities (Figure A.9–A.10).</td>
</tr>
<tr>
<td>Conflict occurs along the margins of a region or at vulnerable sites within the interior.</td>
<td>Burned sites and skeletal trauma will be found concentrated along the boundary of area. Alternatively, conflict-related sites will be concentrated along a path from the boundary of the region toward the interior (Figure A.8).</td>
</tr>
</tbody>
</table>

engage in peaceful exchange, demonstrated by the presence of similar trade ceramics throughout the area (Haas and Cremer 1993). Settlements along the periphery of the region would be the first ones encountered by hostile outside groups. Therefore, sites with burned structures or skeletal evidence of violence should occur with higher frequency near the boundaries of the Gallina area than in the interior. Alternatively, a high frequency of violence-related sites could follow a general path from the boundaries of the region toward the interior, representing an invasion route used by a foreign aggressor.
The third model (Table 6.3) proposes that during the Gallina phase, settlements experienced conflict between other Gallina sites and with groups outside the region. Under these conditions, the resulting settlement patterns will be a combination of the expectations from the two previous models as Gallina settlements at the same time experienced dueling pressures to unify and to segregate. Settlement clusters should be small and found throughout the region. Larger clusters may exist but they would only be

Table 6.3 – Model of mixed warfare and expected pattern

<table>
<thead>
<tr>
<th>Characteristics of mixed conflict</th>
<th>Expected pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>The existence of several small communities with the possibility of a few larger settlements.</td>
<td>Several small settlement clusters will be clearly identified with discernible buffers between each cluster. Larger clusters may exist but would only be moderately larger than the smaller clusters (Figure A.11).</td>
</tr>
<tr>
<td>Defensible settlements are situated to resist attacks from neighbors and outside groups.</td>
<td>Defensible sites will be distributed across the region, situated to defend smaller areas within the region (Figure A.12).</td>
</tr>
<tr>
<td>Lookouts or guard posts are situated to defend small areas of a region. Peaceful interactions occur between other Gallina communities will be limited to the immediate vicinity of communities.</td>
<td>Observation sites, such as towers, will be found with line-of-sight connections between a few site clusters, rather than the majority of sites in the region. Similar trade ceramics will be found at a small number of nearby communities. Connections between a larger number of settlements may occur than with internal conflict with those sites located near the perimeter of the area (Figure A.14–A.15).</td>
</tr>
<tr>
<td>Conflict occurs throughout the region but is still concentrated along the borders of the region.</td>
<td>Burned sites and skeletal trauma will be found throughout the region. Concentrations of warfare-related sites will also be found along the borders of the region (Figure A.13).</td>
</tr>
</tbody>
</table>
moderately larger than the smaller clusters. Buffer zones should be found between most settlement clusters (Haas and Cremer 1993; LeBlanc 1999). Defensible sites will be located across the entire region, but with a concentration of fortifications along one or more borders of the region (Wilcox and Holmlund 2007). Site intervisibility would exist primarily on a small scale with the possible existence of one or two larger networks near the periphery of the region. Like the expectations for internal conflict, similar trade ceramics should only be found at a limited number of nearby sites. Sites with burned structures or skeletal evidence of violence should occur throughout the region. When compared to the internal violence model, a higher frequency of violence-related sites should occur near the boundaries of the Gallina area or following a general path from the boundaries of the region toward the interior.

**Data Collection**

The archaeological data collected for this study is a combination of spatial and attribute site data from Gallina architectural sites. Data was compiled in an ArcGIS personal geodatabase with spatial data stored in geodatabase feature classes, and the tabular data stored in a geodatabase table. Relevant information about each site was stored in fields as shown in Table 6.4.

The bulk of the dataset was obtained from the Archaeological Records Management Section (ARMS) of the New Mexico Historic Preservation Division, with a large portion of those data available electronically through New Mexico Cultural Resources Information System (NMCRIS). NMCRIS is the largest automated cultural resources database in the country and provides online access to tabular and geospatial information of cultural properties within New Mexico. In addition to data gathered from
Table 6.4– Field names and field description of tabular data

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>OBJECTID</td>
<td>Auto-populated unique identifier for record that corresponds to “TABLEID” in the spatial data</td>
</tr>
<tr>
<td>LA_NUM</td>
<td>The Laboratory of Anthropology (LA) site number, if present, of the site</td>
</tr>
<tr>
<td>START_DATE</td>
<td>Earliest date for the Gallina portion of the site</td>
</tr>
<tr>
<td>END_DATE</td>
<td>Latest data for the Gallina portion of the site</td>
</tr>
<tr>
<td>DATING_SOURCE</td>
<td>Source of the chronological determination</td>
</tr>
<tr>
<td>BURNED</td>
<td>Determination of whether the site was burned during or at the end of occupation</td>
</tr>
<tr>
<td>TOWER</td>
<td>Presence of a tower structure at the site</td>
</tr>
<tr>
<td>CERAMICS</td>
<td>Presence of non-Gallina ceramics at site</td>
</tr>
<tr>
<td>CERAMIC_DESC</td>
<td>Notes describing the non-Gallina ceramic types found at site</td>
</tr>
<tr>
<td>SKELETAL_TRAUMA</td>
<td>Presence of trauma on human skeletal remains found at site</td>
</tr>
<tr>
<td>ALT_SITE_ID</td>
<td>Alternative site names and/or numbers</td>
</tr>
<tr>
<td>STRUCTURE_NOTES</td>
<td>Comments on architectural features from review of site records</td>
</tr>
<tr>
<td>PIT HOUSE</td>
<td>Number of pit house structures identified at site</td>
</tr>
<tr>
<td>SURFACE HOUSE</td>
<td>Number of surface house structures identified at site</td>
</tr>
<tr>
<td>TOWER_NUM</td>
<td>Number of tower structures identified at site</td>
</tr>
<tr>
<td>OTHER_STRUCTURE</td>
<td>Number of other structures identified at site</td>
</tr>
<tr>
<td>CAVE</td>
<td>Number of cave features identified at site</td>
</tr>
<tr>
<td>CLIFF_DWELLING</td>
<td>Number of cliff dwelling features identified at site</td>
</tr>
<tr>
<td>STOCKADE</td>
<td>Number of stockade features identified at site</td>
</tr>
<tr>
<td>VIOLENCE_SCORE</td>
<td>Violence-related score for the site</td>
</tr>
<tr>
<td>DEFENSE_SCORE</td>
<td>Defensibility score for the site</td>
</tr>
</tbody>
</table>

ARMS, a significant effort was made to acquire data from two federal agencies. Two of the largest landowners in the Gallina area are the Jicarilla Apache Nation and the Santa Fe National Forest. Statutory protection of archaeological sites on Jicarilla land is overseen by the Bureau of Indian Affairs (BIA), Southwest Region. Copies of all records pertaining to cultural resources are filed at the BIA office in Albuquerque, New Mexico and were reviewed at the BIA office. Portions of the Santa Fe National Forest (SFNF) encompassing the Gallina region include the Coyote, Cuba, and Jemez Ranger Districts.
Copies of all site records for the SFNF are filed at the SFNF Supervisor’s Office in Santa Fe, New Mexico and were reviewed at the Supervisor’s Office.

In order to establish a limit for to the volume of archaeological data that would be investigated, a 10 km buffer of a polygon manually created from the general boundaries of the Gallina region (as defined by previous researchers and discussed in Chapter 5) was used as an initial filter for determining which site records to investigate. Examining site records up to 10 km beyond the previously defined boundaries provided the opportunity to better define the boundaries of the Gallina culture and also guaranteed that potential Gallina sites would not be excluded from the analysis due to boundaries defined by researchers decades ago. Since many records from the BIA and SFNF have not been fully integrated into NMCRIS, records for all sites on the Jicarilla Apache Reservation and from the Coyote, Cuba, and Jemez Ranger Districts were individually examined. Archaeological records at the BIA are organized by fiscal year and include all correspondence, reports, and forms for cultural resources activities. These records date back to 1967 for the Jicarilla Apache Nation, including reports and forms for close to 1,000 sites.

Site records were first reviewed to determine the cultural affiliations of all site components. If one of the site components was designated as Gallina, Largo-Gallina, or Anasazi, the presence of architectural features was then assessed. No further investigation was undertaken for sites lacking these cultural affiliations or lacking architectural features. Records from potential Gallina sites with architectural features were examined in greater detail. Cultural affiliation was first confirmed through a review of the entire site record, with special attention paid to the site narrative. Site records
typically explicitly mention cultural affiliation in the site description. Once a site was confirmed as Gallina, a new record was created in the geodatabase table described above. Information from the site form was transferred to the appropriate fields in the table.

As of February 2012, there were 11,653 archaeological sites registered with ARMS within the expanded Gallina area. Although a great deal of data is available digitally through the New Mexico Cultural Resources Information System (NMCRIS), some site attributes can be discovered only by reading through site records. To whittle down the number of sites from 11,653, sites without architectural features were excluded, leaving 4,216 sites requiring examination of records. Site records for the remaining 4,216 were examined following the same process outlined above. After reviewing site records at ARMS, SFNF, and BIA, a total of 2,129 Gallina architectural sites were identified.

Most of the spatial data was provided by ARMS as site centroids in ESRI shapefile format. Spatial data for sites within the SFNF was provided by the Forest Service as site points as ESRI feature classes from a file geodatabase. When spatial data for a site were available from both the Forest Service and ARMS, preference was given to the Forest Service spatial data, which often contained more recent and accurate site locations. For sites without digital spatial data, site points were manually created from the Universal Transverse Mercator (UTM) coordinates on the site form. In addition to archaeological data, other spatial data were obtained. Digital elevation model files for the region were acquired from the National Elevation Dataset via the National Map (http://nationalmap.gov/) at a resolution of 1/3 arc-seconds (approximately 10 meters).
Data Processing

The three models, previously discussed in this chapter, represent specific spatial manifestations of a limited set of characteristics. These characteristics include clustering, connectivity, defensibility, and violence.

Settlement Clustering

The first step in defining settlement clusters was to use KDE to help visualize the distribution of site locations. KDE estimates the frequency of values across an entire surface based on a sample of locations and values (Conolly and Lake 2006). It provides a way to smooth data across a continuous surface and can aid in identifying trends. Kernel density maps use KDE to graphically present data in a way that often makes the identification of patterns readily apparent. It is a technique that has a wide range of applications and has been used by archaeologists (Grove 2011; McMahon 2004, 2006; Wheatley and Gillings 2002). For the clustering analysis, KDE created a readily-accessible way to identify settlement clusters and provided an opportunity to make observations on potential buffer zones. To simplify the visualization of settlement clusters, contiguous raster cells with site density estimates greater than 1 sites per 4 km$^2$ were then converted to polygons representing settlement clusters in the region.

Conventional cluster analysis assesses the presence of clusters based on straight-line distance between points, but the ability of prehistoric peoples to traverse their landscape was greatly influenced by the distribution of bodies of water and landforms. The only perennial source of water in the region, the Chama River, was likely not an impediment to foot travel except during storms so it was not factored into the analysis. Determining the existence of site clusters without accounting for the extremely rugged
terrain of the Gallina region may have provided an inaccurate impression of how sites are distributed (and potentially connected) across the area. Considering that, in an effort to determine if the KDEs were reliable representations of settlement clusters in the region, a method was developed to incorporate the real-world costs that would be associated with traveling from site to site. After first determining if the distribution of site locations was clustered, random, or regular using nearest neighbor analysis, the approach taken used a combination of least cost analysis (LCA) and Ripley’s k-function.

LCA incorporates the differential costs to travel across a landscape. Travel costs can be calculated by the creation of a cost surface using an unlimited number of variables but are commonly calculated based primarily on slope. Due to uncertainties about the prehistoric landscape, the homogeneity of the current land cover data for the region, and its relatively limited impact in the region on travel costs, a final cost surface was created using only slope.

A slope map layer was derived from the 1/3 arc-seconds DEM provided by the National Map. The DEM was represented as a raster file in ERDAS IMAGINE (.img) format. Slope was calculated using the built-in “Slope” tool within ArcGIS, which created a slope raster with slope represented in degrees. The relationship between the cost to traverse an area and slope angle is not a linear one. Costs increase significantly as slope increases (Bell and Lock 2000; Howey 2007). To effectively represent this relationship, a non-linear function must be used. One common approach in calculating walking cost across uneven terrain is Tobler’s Hiking Function (Tobler 1993). Based on empirical data from Imhof (1950), Tobler’s function predicts walking speed based on slope and is expressed by the following equation:
\[ W = 6 \times \exp \{-3.5 \times \text{abs} \ (S + 0.05)\} \]

where \( W \) is the walking velocity (km/hr) and \( S \) is the slope (tangent of slope angle).

On level ground, walking speed, as calculated by the formula, would be roughly 5 km/hr. Speeds become increasingly slower as the angle of the slope increases, approaching 0 km/hr around a slope angle of 55 degrees (see Figure 6.1).

In this analysis, the goal is to assess the cost distance between points across an uneven surface. Rather than calculate walking speed, Tobler’s function was adapted to calculate a cost factor that could be used to calculate cost distances from a point to any

![Figure 6.1 – Tobler’s Hiking Function displaying walking speed at different slope angle](image-url)
other point on the landscape. The revised formula is as follows:

\[
F = \exp\left\{ -3.5 \times 0.05 \right\} / \exp\left\{ -3.5 \times \text{abs}(S + 0.05) \right\}
\]

where \( F \) is the cost factor and \( S \) is the slope (tangent of slope angle).

The cost factor for flat ground (slope of 0) would be 1 and would increase logarithmically as slope increases (see Figure 6.2).

Any advantages gained by travelling down a slope are negated by the disadvantages on the return trip travelling up that same slope. Considering this, when calculating cost distances between points, directionality was not a factor in the calculation. Derived from the DEM layer, a cost raster was created for the Gallina region at a resolution of approximately 10 meters. The cost raster was creating using the Raster Calculator tool, a built-in tool in ArcGIS, and applying the modified Tobler’s (1993) function. Using the built-in ArcGIS Cost Distance tool, a cost distance raster was created

![Figure 6.2 – Relationship between cost factor and slope using the modified Tobler’s function](Image)
for each site from the cost raster. In the interests of speeding up the processing time, the
cost distance calculations were limited to 50 km, meaning cost distances greater than 50
km were not calculated for each site’s cost distance raster. Within the cost distance raster
for each site, each cell in the raster represented the cost distance (in meters) to travel to
that location from that site. The large number of sites (2,129) and the length of time
required to complete the process for each site (approximately 20 minutes) made this task
ideally suited for script automation. A custom Python script was written that iterated
through each site point in the geodatabase and created a cost distance raster for that site.
Even with the aid of scripting, this step in the process took several weeks of continuous
processing to complete.

Once the cost distance raster for each site was created, cost distances between
sites were determined. Since each cell in the cost distance raster reflects the cost distance
involved in traveling to that cell from the given site, the cost distance to a site from the
given site is the value of the cost distance raster cell that the site point is located within
(see Figure 6.3). For example, the cost distance between site A and site B can be found
by locating site B in the cost distance raster generated for site A and extracting the raster
value for that cell. That process was duplicated for each site for each cost distance raster
with the results stored in a separate table for each site. The separate tables for each site
were consolidated into a single table. A custom Python script was created to aid in this
process.

Ripley’s k-function is commonly used to quantitatively assess spatial clustering at
multiple scales. The function compares the expected number of neighbors for each
feature (x) against the actual number of neighbors within a set distance (r) from x. The
expected results can be generated by a Monte Carlo simulation, typically obtaining a 95% confidence interval within 1,000 to 5,000 iterations (Manly 1991). The function is repeated for multiple values of $r$ with the expected results summarized as an expected $K$ (number of neighbors within $r$ from $x$) value. If the actual results are greater than the expected results for any given value of $r$, then the collection is considered clustered at that distance. If the actual results are less than the expect results, then the collection is considered dispersed. Results within the confidence envelope are statistically considered random (Figure 6.4).
Figure 6.4 – Ripley’s k-function from ESRI (2014)

This type of cluster analysis is typically applied using Euclidean or straight-line distances and most readily available tools, such as the built-in ArcGIS “Multi-Distance Spatial Cluster Analysis” tool, do not accommodate cost distances. Instead, GeoDaNet, an open-source software application for spatial analysis on undirected networks (Hwang and Winslow 2012), was used to estimate clustering using cost distance rather than Euclidean distance. Unfortunately, survey coverage for much of the Gallina area is uneven, resulting in large areas without sites. Due to the patchy nature of survey coverage, it is unclear whether or not these empty spaces represent an actual absence of sites or reflects differences in the level of survey effort. Including these regions in the cluster analysis could lead to misleading results. Instead, the area of spatial analysis was restricted to a region where roughly 95% of all Gallina structural sites occur (Figure 6.5). A table representing a list of cost distances between sites was created and used as the distances input parameter. Additionally, the cost area for the region of analysis was used rather than the area calculated by Euclidean measurements. The total cost area was computed by calculating the cost area of each cell in the cost raster by multiplying the real-world area of the cell by the value of each cell. All raster values above 100 were set
Figure 6.5 – Area of spatial cluster analysis for Gallina architectural sites
to 100 for the purposes of calculating the cost area. Calculating cost using Tobler’s
(1993) formula resulted in extremely large cost area values for locations with relatively
steep slopes. Capping the cost area at 100 served to minimize the computational effect of
the exponential function on the total sum. The sum of the cost area for all cells
(5,319,540,817 m²) was used as the total area input parameter for k-function analysis.
Compared to the actual area of the area of spatial analysis, the total cost area was roughly
twice the actual area (2,549,579,064 m²). The k-function was calculated at intervals of
100 meters up to 50,000 meters. A 95% confidence envelope was created with 1,000
simulations.

The final results of the k-function analysis functioned as a statistical test for the
presence of settlement clusters and buffer zones within the area of analysis. By
quantitatively identifying the different distances at which clustering occurred,
conclusions derived from the KDEs could be verified and potential problems with the
KDEs could be identified. Comparing the results of spatial analysis using cost distance
to results using Euclidean distance would be a bit like comparing apples to oranges.
Instead, the Ripley’s k-function provided an opportunity to confirm that clustering
existed and at what cost distances a clustered or dispersed distribution were found. If
clustering was found to exist at only small distances, then any larger settlement clusters
identified with KDE would be called into question. Along the same lines, if clustering
was found at higher distances, then the absence of large KDE-defined clusters would cast
doubt on the validity of KDE results.

The final product of the Ripley’s k-function is a table that lists the expected
values and the range of values for the 95% confidence interval and defined distance
intervals (100 meters). Expected values less than the range of the confidence interval represented a spatial distribution that would be considered statistically dispersed while expected values greater than the range of the confidence interval represented a clustered distribution. Observed values that fell within the confidence interval represented a distribution that was considered random. The greatest distance at which clustering is found in the Ripley’s k-function results was compared to the dimensions of the clusters defined using the KDEs. In theory, the distance from the center to the edge of any KDE-identified cluster would correspond to a distance interval where clustering was confirmed with the Ripley’s k-function. Similarly, the Ripley’s k-function results provided an additional way to test the validity of KDE-defined buffer zones. In theory, the distance at which the distribution of sites is considered dispersed should correspond to the distances between KDE-defined settlement clusters.

This entire process was repeated for a variety of site types (single pit house, multiple pit house, single surface structure, multiple surface structure, pit house and surface structure, multiple structures, and tower sites) to investigate any potential patterns within specific site types. The single pit house category included sites containing a single pit house only and no other structural types. The multiple pit houses type referred to sites containing more than one pit house and no other structural types. Single surface structure sites contained a single surface structure (not including towers) and no other structural types. Multiple surface structures were defined as sites containing more than one surface structure (not including towers) and no other structural types. Pit house and surface structure sites had at least one pit house and at least one surface structure. The multiple structures category corresponded to sites containing more than one structure regardless of
type. Finally, tower sites were sites containing at least one tower. These categories were not mutually exclusive and some sites would have been included in multiple categories.

Since clustering was evaluated at many difference distances, the results of Ripley’s k-function analysis were also used to assess the potential levels of regional organization. For example, if clustering was only found to exist at distances of 1 km or less, then it might indicate a low-level of community integration within the region. Conversely, if clustering was found to exist at distances of 20 km or less, then some degree of regional system could be inferred.

Once the KDE-defined settlement clusters and buffer zones were verified with Ripley’s k-function, their size and location were considered with respect to the models of tribal conflict. Settlement clusters within a context of internal conflict should be relatively small and distributed across the region. Clear buffer zones, represented by areas with no or very few settlements, should be seen between the clusters. For external conflict, a large settlement cluster should be clearly defined with an absence of buffer zones within the cluster. Smaller settlement clusters, if present, would be found on the margins of the Gallina region. The expected distribution of settlement clusters and buffer zones within a context of mixed conflict mirrors the expected pattern for internal conflict. There should be several small settlement clusters across the region with buffer zones between them. A larger cluster could exist, but it would not be significantly bigger than the other clusters.

**Connectivity**

Connectivity between Gallina communities was evaluated by examining the spatial distribution of non-Gallina ceramics and line-of-sight connections between tower
sites. There have been a limited number of clearly-defined non-Gallina ceramic types found at Gallina architectural sites. These ceramic types can be grouped into a few broader ceramic categories: White Mountain red wares, Mesa Verde white wares, Cibola white wares, and Rio Grande white wares. During the course of data collection, these categories were subdivided into groups for ceramic types that were contemporary with the Gallina phase and ceramic types that pre-dated the Gallina phase (Table 6.5). The revised chronology for the Gallina phase (A.D. 1150 to 1300) was used to assess whether a ceramic type was contemporary with the Gallina culture. Earlier wares, while likely produced before the Gallina phase, could still have been exchanged for centuries after their production. Small numbers were found of other trade wares at Gallina architectural sites and were recorded in the “Other” category and were found too infrequently to be useful in the analysis. Ceramics described generically, such as white ware, red ware, or gray ware, were recorded in the “Indeterminate” category. Pottery types whose production has been demonstrated after A.D. 1300 were excluded from the analysis.

Relationships between sites with ceramic assemblages containing foreign ceramics from the same ceramic categories were represented as lines in a feature class created in the project geodatabase. The lines were drawn in a way to provide the easiest way to visualize the connections between sites and were not intended to imply any specific direction of exchange. Due to the small number of sites where foreign ceramics were found, the previously defined settlement clusters were used rather than the individual sites to assess connectivity between communities based on the presence of trade wares.
Table 6.5 – Non-Gallina ceramic types found at Gallina architectural sites, assigned categories, and their associated chronological ranges.

<table>
<thead>
<tr>
<th>Ceramic Type</th>
<th>Category</th>
<th>Associated Date Range</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chaco Black-on-white</td>
<td>Cibola white ware (earlier)</td>
<td>A.D. 1075- A.D. 1150</td>
<td>Toll and McKenna (1997)</td>
</tr>
<tr>
<td>Escavada Black-on-white</td>
<td>Cibola white ware (earlier)</td>
<td>A.D. 925- A.D. 1125</td>
<td>Breternitz (1966)</td>
</tr>
<tr>
<td>Gallup Black-on-white</td>
<td>Cibola white ware (earlier)</td>
<td>A.D. 1000- A.D. 1125</td>
<td>Breternitz (1966)</td>
</tr>
<tr>
<td>McElmo Black-on-white</td>
<td>Mesa Verde white ware</td>
<td>A.D. 1190- A.D. 1275</td>
<td>Breternitz (1966)</td>
</tr>
<tr>
<td>Reserve Black-on-white</td>
<td>Cibola white ware</td>
<td>A.D. 1050- A.D. 1200</td>
<td>Hays-Gilpin and van Hartesveldt (1998)</td>
</tr>
<tr>
<td>Santa Fe Black-on-white</td>
<td>Rio Grande white ware</td>
<td>A.D. 1200- A.D. 1350</td>
<td>Breternitz (1966)</td>
</tr>
<tr>
<td>Socorro Black-on-white</td>
<td>Cibola white ware</td>
<td>A.D. 1050- A.D. 1300</td>
<td>Breternitz (1966)</td>
</tr>
</tbody>
</table>

These results were then compared to three models of conflict. During internal conflict, the expectation would be that similar trade wares would be found within a small number of local communities. For external conflict, the opposite is true. Similar trade ware should be found in communities spanning the region. Expectations for mixed
conflict should be similar to the expectations for internal conflict with similar trade wares found within a restricted geographic extent.

Line-of-sight was used to assess connectivity between communities with towers. The potential for some Gallina towers to have served as relay points for a communication network has been documented by previous studies (Byrd 2010; Ellis 1991; Page 1986; Sleeter 1987, 1990). The current study expands on previous investigations and benefits from the identification of additional tower sites through the exhaustive review of Gallina site records. The initial step for line-of-sight analysis was calculating the viewshed. Since the viewshed for each site (not just tower sites) would be used in analyzing defensibility, the viewshed for each site was calculated using the same process.

Viewshed analysis is a staple of GIS-based landscape analysis (Conolly and Lake 2006; Wheatley and Gillings 2002). It requires two sets of data, a DEM and a layer of observation locations. A viewshed is calculated by constructing a raster layer and determining the visibility of each target cell from the observer location(s). The target cell is defined as visible if it is visible from the observer location(s). Conceptually, this is done by drawing a line in three-dimensional space between the target and observer locations. The elevation of any point along the line is a simple linear function based on the distance of the line and the difference in elevation between the target and observer locations. If the elevation of any cell along that line is greater than the elevation of the line at that point, then the target cell is not considered visible (Conolly and Lake 2006).

The source DEM layer obtained from the National Map server was slightly modified to represent the height at which the average Gallina observer would be
regarding the surrounding area at each site. The average height for Gallina men and women was 158 cm and 151 cm respectively (Bell 1940; Chase 1976, 1978; Constan 2011; Hibben 1939). These averages were rounded up to 2 m and a raster layer was created with a value of 2 for each cell that contained a Gallina occupation site. This layer was then added to the source DEM adding 2 m to the elevation at each cell that contained a site. Considering that most surface houses were at least 2 meters high and some towers have been reported to have been at least 10 meters tall (access to both structures was via the roof), adding only 2 meters to the source DEM was a conservative approach for many site locations. Adding an observer offset is also functionally necessary to achieve meaningful results. On a completely flat surface, without providing an observer offset value, the viewshed would be zero since the viewshed is calculated by determining if there are any obstructions between cells with different elevations. If elevation is constant, there would never be a difference in elevations between cells. Without adding an observer offset value, the viewshed for most site locations would have been zero.

Using the modified DEM and a point layer of site locations, the built-in ArcGIS “Viewshed” tool was used to calculate the viewshed separately for each site. Each site’s viewshed was saved as a separate raster and used in subsequent analysis. A custom Python script was written to facilitate the calculations for each site.

Once the viewshed was calculated for each site, line-of-sight was assessed between tower sites. This was done by first examining the viewshed raster for each tower site (Tower A) and determining which of the other tower site locations fell within a visible cell for Tower A. If any of the other tower locations fell within the viewshed of Tower A, a line feature was created in a line-of-sight layer between Tower A and any
visible tower locations. The site names were then written to the appropriate fields for the line’s record in the attribute table. This process was repeated for every tower location. A custom Python script was written to iterate through this process for each tower site, resulting in a final line-of-sight layer.

The final line-of-sight layer was saved in the project geodatabase and used to create maps that were compared to the models’ expectations. Internal conflict should result in line-of-sight links between a limited number of tower sites. Line-of-sight should be seen for the vast majority of tower sites within a context of external conflict. If violence could be blamed on perpetrators with both within and outside the region, line-of-sight connections should exist between only a relatively small number of sites.

**Defensibility**

The defensibility of a site is defined in this study as the difficulty for attackers to approach the site (accessibility), the ability of defenders to quickly spot attacks (visibility), and the existence of fortifications. The first two of these factors can be quantified using the cost distance and viewshed results. These reclassified accessibility and visibility values were added together, along with a set value for sites with fortifications, to create a final defensibility score for each site.

In the Gallina area, the terrain provides ample opportunities for locating sites along ridge lines or on mesa tops. The previously calculated cost distance rasters provided a way to quantify the accessibility of each site. Using the cost distance rasters for each site, the sum of the cost distance values for each raster cell within 500 meters of the site’s location was calculated. The first step in this process was to create a 500-meter buffer polygon from a site’s point location using the ArcGIS “Buffer” tool. Next, I
calculated the sum of all cost distance raster cells that intersected with the 500-meter buffer. This was done using the built-in ArcGIS tool “Zonal Statistics as Table.” This process was repeated for each site. For each site, each sum was divided by the maximum sum for all sites and multiplied by 10 to normalize the value on a scale of 0 to 10. A custom Python script was created to automate this process. The final accessibility score was saved to a geodatabase table.

Defensibility was also assessed by evaluating how difficult it would be for an enemy to approach a site without being seen. Using the previously calculated viewsheds for each site, the area of the viewsheds was calculated for each site. Determining the area of rasters is calculated by multiplying the area of a raster cell by the number of raster cells. For the viewshed rasters, the area of the viewshed was found by multiplying the number of visible cells by the area of a cell (roughly 100 square meters). These areas were also normalized on a scale of 0 to 10 by dividing each area by the maximum area for all sites and multiplying by 10. A custom Python script was written to assist in the process.

While both the cost distances and viewsheds were, at their source, derived from the slope of a site’s surrounding area, they do not necessarily result in similar outputs. A site on top of a steep mountain slope will most likely possess a large viewshed with high cost distance values surrounding it. On the other hand, some sites are relatively inaccessible yet possess a limited visibility of the surrounding area. During the initial rounds of data exploration, the viewshed area was assumed to be an accurate measure of both accessibility and visibility. It soon became apparent that the relative inaccessibility
of some sites was not being adequately reflected in the viewshed area and the decision was made to incorporate the cost distance into the defensibility analysis.

Fortifications or the presence of defensive structures in the Gallina region were assessed by identifying sites with potentially defensive feature types. Within the Gallina region, there are a very small number of potentially defensive feature types. These types are caves, cliff dwellings, stockades, and towers. Each of these types is not necessarily defensive and the possibility remains that defense was not a consideration at that time of occupation. That being said, determining the exact function for each instance of these feature types is an exercise outside the scope of this study. Regardless of the intended purpose of each potentially defensive structural type, each of them would have conferred some degree of defensive advantage. Sites containing one or more of these features were given a value of 10 while sites without any of these features were given a value of 0.

The final defensibility score for each site was a weighted average of three individual scores. The following formula was used to calculate the final score:

\[ D = (0.25 \times C) + (0.25 \times V) + (0.5 \times F) \]

where \( D \) is the defensibility score, \( C \) is the accessibility score, \( V \) is the visibility score, and \( F \) is the fortification score.

Once the final defensibility score was assigned for each site, a kernel density map was created. In this study, each site’s location and its corresponding defensibility score were used to create a kernel density map using the ArcGIS “Kernel Density” tool. The calculations for the default cell size and search radius were used.

The kernel density map for defensibility was examined to assess how the degree of defensibility was distributed across the region before finally comparing the map to the
expectations within the three models. Expectations for the distribution of fortifications during internal conflict expressed as a kernel density estimate would show areas of high estimated density for fortified sites occurring throughout the region rather than along the boundaries of the region. Conversely, a kernel density estimate of fortifications due to external conflict would show fortifications concentrated along the boundaries of the area. If conflict was due to both internal and external aggression, kernel density estimates should appear as if the two previous density estimations were overlaid on top of each other. Areas of with high frequencies of fortifications should occur along the periphery of the region and also found throughout it.

**Violence**

The final criterion of analysis was the spatial distribution of violence at archaeological sites in the Gallina region. Generally, archaeological evidence for violence from individual sites can consist of osteological evidence, weaponry, iconography, site burning, and defensibility (see Chapter 3). Exclusively warfare-related artifacts, such as shields, armor, or swords, have not been identified at Gallina sites and neither has there been any evidence of war iconography. Defensibility was assessed separately, leaving osteological evidence and site burning as the available criteria for assessing violence at Gallina sites. Of the two, only skeletal trauma is universally accepted as conclusive evidence of violence. Site burning can occur for many reasons, many of which are not violence-related. Considering this, the final violence score, on a scale of 0 to 10, was heavily weighted toward osteological evidence.

During the data collection phase, the presence or absence of site burning or skeletal trauma was noted for each site. Sites were given a value of 10 for the
“BURNED” field if the site had been burned and a value of 0 if there was no evidence of site burning. If a site contained skeletal evidence of violence, it was given a value of 10 for the “SKELETAL_TRAUMA” field. Otherwise, a value of 0 was assigned for that field. The violence score for each site was then calculated using the following formula:

\[ V = (0.2 \times B) + (0.8 \times S) \]

where \( V \) is the violence score, \( B \) is the “BURNED” value, and \( S \) is the “SKELETAL_TRAUMA” value.

The final violence scores were used in the creation of a kernel density map. The kernel density map was then compared to the expected results of the models. Within a context of internal conflict, areas of violence intensity would be expected to be distributed throughout most of the region. For external conflict, a kernel density map will demonstrate a pattern of violence concentrated along the boundaries of the area or along a path from the periphery of the region towards the interior. If attacks came both from within and from outside the Gallina region, then the expected kernel density would appear as an amalgam of the expectations for internal and external violence. Sites with high violence scores would be seen throughout the region but clear concentrations should be seen along the periphery of the region or along a path towards the interior.

**Final Synthesis**

Once all of the individual analyses (clustering, connectivity, defensibility, and violence) was completed, the results were viewed together and evaluations were made on how consistent they were with each other. The three models of tribal conflict represent hypothetical situations and the expectations for each are the best-case scenarios for their archaeological correlates. As is often the case in the real world, actual results may rarely
match expectations. The final step in the analysis was to reconcile the actual with the hypothetical and provide a coherent interpretation of the observed patterns as they relate to contexts of internal, external, or mixed conflict.
Chapter 7—Results

The apparent distribution of Gallina sites is greatly affected by the variable intensity of archaeological investigations throughout the region. The absence of known sites in areas where archaeological investigations have not been conducted clearly cannot be construed as a true absence of sites. Sites may exist but have not yet been formally recorded. In this study, the degree to which the region has been investigated archaeologically was assessed primarily by consolidating survey and site boundaries from NMCRIS and SFNF. Site boundaries were included because many sites, especially those with low LA numbers, were recorded in NMCRIS without an accompanying project area. This included all sites with an available site boundary in NMCRIS, not just Gallina sites. As a result, the resulting dataset is more accurately described as visited space rather than survey coverage. Survey areas for most projects on Jicarilla Apache land have not been recorded digitally in NMCRIS, resulting in a somewhat inaccurate view of the overall level of effort for the Gallina region (Figure 7.1). A dataset consisting of a limited selection of surveys conducted by BIA archaeologists ameliorated this situation to some extent.

Even in areas that have been surveyed, many sites (especially pit house sites) may be buried under alluvial and aeolian deposits and may not be visible on the surface. This situation could be quite common in many of the low-lying areas of the Jicarilla Apache Reservation (personal communication, Bruce Harrill, 2014). Within the Gallina occupation area, survey coverage (determined primarily from NMCRIS and SFNF survey and site boundaries, with a limited selection of surveys from BIA) was 20.4% (339,392 of 1,663,902 acres).
Figure 7.1 – Visited space in the Gallina area
After reviewing available site records, a total of 2,129 Gallina sites with at least one pit house, surface house, or tower were identified. These 2,129 sites were distributed across the traditional Gallina area, with a clear concentration of sites within the area commonly considered the heartland of the Gallina culture (Figure 7.2). Pit houses, surface houses, and towers were found within the same site and also in isolation from the other architectural types (see Table 7.1 and Figures 7.3 through Figure 7.9). The following categories are not mutually exclusive and one site could be counted in multiple categories. For example, a site with three pit houses, two surface houses, and a tower would be counted in the “Pit House and Surface Structure”, “Multiple Structures”, and “Tower Sites” categories.

Table 7.1 – Distribution of structural types among Gallina sites

<table>
<thead>
<tr>
<th>Site Type</th>
<th>Description</th>
<th>Number of Sites</th>
<th>Sites within spatial analysis area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Pit House</td>
<td>Sites containing a single pit house only and no other structural types</td>
<td>495</td>
<td>480</td>
</tr>
<tr>
<td>Multiple Pit Houses</td>
<td>Sites containing more than one pit house and no other structural types</td>
<td>153</td>
<td>148</td>
</tr>
<tr>
<td>Single Surface Structure</td>
<td>Sites containing a single surface structure (not including towers) and no other structural types</td>
<td>687</td>
<td>647</td>
</tr>
<tr>
<td>Multiple Surface Structures</td>
<td>Sites containing more than one surface structure (not including towers) and no other structural types</td>
<td>190</td>
<td>169</td>
</tr>
<tr>
<td>Pit House and Surface Structure</td>
<td>Sites containing at least one pit house and at least one surface structure</td>
<td>512</td>
<td>491</td>
</tr>
<tr>
<td>Multiple Structures</td>
<td>Sites containing more than one structure regardless of type</td>
<td>914</td>
<td>867</td>
</tr>
<tr>
<td>Tower Sites</td>
<td>Sites containing at least one tower</td>
<td>136</td>
<td>129</td>
</tr>
<tr>
<td>Architectural sites total</td>
<td>Sites containing at least one structure</td>
<td>2129</td>
<td>2027</td>
</tr>
</tbody>
</table>
Figure 7.2 – Gallina architectural sites
Figure 7.3 – Gallina sites with a single pit house
Figure 7.4 – Gallina sites with multiple pit houses and no other structural types
Figure 7.5 – Gallina sites with a single surface structure only
Figure 7.6 – Gallina sites with multiple surface structure and no other structural types
Figure 7.7 – Gallina sites with at least one pit house and at least one surface structure
Figure 7.8 – Gallina sites with multiple structures of any type (including towers)
Figure 7.9 – Gallina sites with at least one tower
Settlement Clusters

The initial impression of the distribution of Gallina sites is that they are densely situated throughout much of the region, especially within the heartland of the area. A kernel density map supports that assumption while also providing an opportunity to visualize the size and distribution of settlement clusters for the region (Figure 7.10). The most clearly seen settlement cluster covers most of the middle of the region, containing by far the highest site densities for the region. There were nine other discrete concentrations of sites (greater than 1 sites per 4 km\(^2\)) occurring closer to the boundaries of the Gallina area. Two of these clusters are less than 3 km from the primary cluster. There are very few surveys recorded for the areas between these two clusters and the primary cluster, so it is possible that more fieldwork would link these clusters to the primary one. Of the other seven clusters, two of the smaller clusters are approximately 1.5 km from another cluster and can be safely combined with their neighbors. The end result is six distinct groups of sites (Figure 7.11).

As was mentioned in Chapter 6, the area of spatial cluster analysis integrating cost distance was reduced to an area that included about 95% of all Gallina architectural sites. First, the distribution of sites was established as not random by conducting a nearest neighbor analysis. The distribution was deemed clustered with a greater than 99% likelihood of the distribution not being random. The expected average distance to the nearest neighbor was 670 m, yet the observed average distance to the nearest neighbor was 366 m. Spatial cluster analysis was conducted by using Ripley’s k-function to determine at what scales sites possessed a clustered, dispersed, or random
Figure 7.10 – Kernel density map displaying the density of Gallina architectural sites
Figure 7.11 – Gallina settlement clusters
distribution. The maximum distance at which sites were deemed clustered can be compared to the previously defined clusters to assess their validity. The distances at which sites were found to be statistically dispersed indicated at which distances gaps between sites (and potential buffer zones) might have developed. Spatial cluster analysis was conducted for each of the site type categories listed in Table 7.1.

The results of the Ripley’s K analysis are summarized here. For complete results, please see Appendix B. The area of analysis was also restricted so only sites from the large central cluster and the two most northernmost ones would have been included in the multiple scale cluster analysis. For all structural sites, the K-function analysis determined that sites were clustered at each distance interval from 100 to 20,000 meters with sites distributions considered dispersed at the 30,200 m distance and beyond. The analysis for the specific site types yielded similar results with some slight variations. In general, these results (one or more large clusters should be present without the presence of buffer zones within them) are consistent with what was found using KDE.

**Connectivity**

Connectivity between communities was measured in two ways. First, the presence of trade wares at sites was noted in the study. Sites containing trade wares from the same ceramic categories represented possible evidence for non-violent interactions. Connectivity was also assessed by determining line of sight between sites with towers.

**Potential Trade Interactions**

While the simplest explanation for the co-occurrence of trade goods at neighboring sites is that those sites were directly interacting with the communities producing the wares, this is not necessarily the case. Alternatively, trade wares could
have been exchanged among Gallina communities. Itinerant traders could also have
distributed goods to a large number of communities across a wide area without any of
those communities having direct contact with each other. Yet in that case, the traveling
merchants are the connection between communities, serving as conduits for information
and exchange. It is possible that communities indirectly linked through trade could
behave antagonistically toward each other, but other lines of evidence should indicate
hostile relations. In the absence of those other lines of evidence, the likeliest explanation
is that the evidence for trade indicates peaceful interaction between communities. To
avoid making too great a leap in logic, it would be more appropriate to state that, at a bare
minimum, the existence of common trade goods indicates the possibility of exchange
between sites.

Assessing interaction by examining the distribution of trade goods presents
somewhat of a problem in the Gallina area. Non-local ceramics, the most easily
identified foreign artifacts, are uncommon at Gallina sites. Even when present at a site,
these ceramics often represent an extremely low percentage of a site’s total ceramic
assemblage. They have been found at a relatively small number (86 out of 2,129) of
architectural sites, with diagnostic ceramic types found at an even smaller number (59) of
those sites (Table C.1). Since four of those sites contained ceramic types not seen at any
other site, investigations into potential trade connections were restricted to only 2.6% (55
out of 2129) of Gallina architectural sites. The remaining 55 sites formed six potential
interaction networks (Table 7.2) with some sites included in more than one potential
network. Considering the small sample size, potential trade connections can be used to
discuss interactions between Gallina settlement clusters rather than individual sites.
### Table 7.2 – Number of sites within each ceramic category

<table>
<thead>
<tr>
<th>Ceramic Category</th>
<th>Number of sites in ceramic category</th>
</tr>
</thead>
<tbody>
<tr>
<td>White Mountain Red Ware Contemporary</td>
<td>28</td>
</tr>
<tr>
<td>White Mountain Red Ware Earlier</td>
<td>0</td>
</tr>
<tr>
<td>Mesa Verde White Ware Contemporary</td>
<td>20</td>
</tr>
<tr>
<td>Mesa Verde White Ware Earlier</td>
<td>5</td>
</tr>
<tr>
<td>Cibola White Ware Contemporary</td>
<td>26</td>
</tr>
<tr>
<td>Cibola White Ware Earlier</td>
<td>17</td>
</tr>
<tr>
<td>Rio Grande White Ware Contemporary</td>
<td>29</td>
</tr>
<tr>
<td>Rio Grande White Ware Earlier</td>
<td>0</td>
</tr>
</tbody>
</table>

The six potential ceramic trade networks identified at Gallina architectural sites connect four of the settlement clusters with another cluster directly in the path of one ceramic network (Figure 7.12). No directionality of exchange is implied with these network. They only indicate that these settlements clusters were linked by the presence of common wares. Four of the ceramic networks connect the same three settlement clusters (the primary cluster and the two southernmost clusters). Two ceramic networks connect the northernmost cluster to the primary cluster in the center of the region. One ceramic network, Rio Grande white ware contemporary, extends from the northernmost cluster to the southernmost ones with connections to sites in the primary cluster as well. While it is difficult to draw too many conclusions from such a small sample size, these results do support the suggestion that the peaceful exchange occurred between and within Gallina settlement clusters.

**Tower line-of-sight**

A communication network necessarily implies some level of connection between communities. While one could make an argument that a communication network can be used to send hostile messages to enemies or to monitor potential adversaries,
Figure 7.12 – Potential ceramic networks in the Gallina area
establishing a communication network would be an extremely inefficient way to accomplish those goals. A communication network also requires cooperation between communities to a degree that is improbable among hostile groups. It is more likely that the existence of a communication network implies friendly relationships among the communities that participate in the network. Communication networks do not require specialized structures, but many researchers have speculated that Gallina towers might have been part of a communication network (e.g., Byrd 2010; Ellis 1976; Sleeter 1987, 1990). While the precise function of Gallina towers is not conclusively established (see Mackey and Green 1979; Schulman 1950), field tests have confirmed that communication could have been possible between towers (Ellis 1991; Page 1986). Defining line-of-sight links between tower sites establishes that a message could be conveyed from tower to tower.

Gallina towers were clearly specialized structures but accepting, without reservations, that their primary purpose was communication would be a mistake. Tower construction would have required more labor and materials than other structures, and signals could have been effectively conveyed from roofs of surface houses. Even if towers were used as signaling stations, they likely served other functions as well. That being said, based on their estimated heights and being often located on high ridges or promontories, visibility seems to have been an important factor in the decision to build these structures. (For the sake of simplicity, visibility, in the following discussion, refers to both being seen from a distance and the view of the surrounding landscape.) Despite the uncertainty about the functions of the towers, examining tower intervisibility remains a useful measure of connectivity between communities. Whatever their actual functions
were, the towers likely served those same functions at each site they were built, strongly implying the existence of shared traditions or practices at those sites. Assessing visibility between these special structures, which were likely built with visibility in mind, provides a way to objectively define connections between communities sharing those traditions. Out of 2,129 sites with structures, 136 sites contained at least one tower. One’s initial impression of the location of many towers might be that they were located to maximize the view of the surrounding landscape. While this impression is supported by the data (the average viewshed of tower sites is 24,470.5 acres), all sites appear to have been located to maximize visibility (the average viewshed of all sites is 24,730.5 acres). Due to the uncertainty with the estimated original height of a tower (up to 10 meters), tower height was not factored into visibility analysis and likely resulted in a far too conservative number for the viewshed of each tower. Twenty-four of the 136 tower sites were not visible from another tower site, including the northernmost towers in the region. The remaining 112 tower sites formed three discrete networks (Figure 7.13). The primary network consisted of line of sight connections among 101 tower sites. The other two networks were significantly smaller, consisting of 6 and 5 tower sites.

Towers not visible from any other tower require some discussion. If the intended function of towers was to relay messages, one would expect that all would be visible to another tower. While this result could serve as an indication that towers were not (in all instances) intended as means of communication, these results could also be due to issues with the data (incorrect identification of structures as towers, location error, etc.) that could not be resolved without visiting the sites. The possibility remains that there are undiscovered tower sites in the vicinity that would link these towers. Signals could also
Figure 7.13 – Visibility links between Gallina tower sites from all distances
have been relayed from the roofs of other structures or from ridge tops to connect the towers.

The greatest distance between two intervisible tower sites was about 40.8 km, which most likely is too far for any signal other than smoke to be seen reliably. Tests between Gallina tower sites using reflective selenite demonstrated an effective maximum signaling range of 7.6 km (4.8 miles), yet the researchers believed that range could be extended if a reflective stone was properly prepared. Smoke signals can be seen from distances of up to 72 km [45 miles] (Ellis 1991). The distance between tower sites was factored into the analysis by assessing the existence of potential networks at 5 km, 7.6 km, 10 km, 15 km, 20 km, 25 km, 30 km, 35 km, and all distances (Table 7.3).

Table 7.3 – Intervisibility between tower sites, grouped by distance

<table>
<thead>
<tr>
<th>Maximum distance between sites</th>
<th>Number of networks</th>
<th>Maximum number of sites in a network</th>
<th>Minimum number of sites in a network</th>
<th>Average number of sites in a network</th>
<th>Total number of tower sites visible from at least one other tower site</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 km</td>
<td>10</td>
<td>30</td>
<td>2</td>
<td>8.60</td>
<td>86</td>
</tr>
<tr>
<td>7.6 km</td>
<td>7</td>
<td>41</td>
<td>2</td>
<td>14.14</td>
<td>99</td>
</tr>
<tr>
<td>10 km</td>
<td>7</td>
<td>55</td>
<td>2</td>
<td>14.43</td>
<td>101</td>
</tr>
<tr>
<td>15 km</td>
<td>5</td>
<td>93</td>
<td>2</td>
<td>21.00</td>
<td>105</td>
</tr>
<tr>
<td>20 km</td>
<td>4</td>
<td>98</td>
<td>2</td>
<td>27.00</td>
<td>108</td>
</tr>
<tr>
<td>25 km</td>
<td>4</td>
<td>100</td>
<td>2</td>
<td>27.75</td>
<td>111</td>
</tr>
<tr>
<td>30 km</td>
<td>4</td>
<td>101</td>
<td>2</td>
<td>28.00</td>
<td>112</td>
</tr>
<tr>
<td>35 km</td>
<td>4</td>
<td>101</td>
<td>2</td>
<td>28.00</td>
<td>112</td>
</tr>
<tr>
<td>40 km and beyond</td>
<td>3</td>
<td>101</td>
<td>5</td>
<td>37.33</td>
<td>112</td>
</tr>
</tbody>
</table>

Irrespective of the distance between tower sites, 74.2% (101 of 136) of tower sites were part of a single intervisibility network, found almost entirely within the primary site cluster. Yet some of those towers would have been much too far from each other to transmit any message using any method other than smoke signaling. (Building a fire on
the roof of a tower would be inadvisable.) Limiting line-of-sight connections to towers within 7,600 m, the effective signaling maximum distance defined by field tests (Ellis 1991), still results in a significant proportion of tower sites connected by line-of-sight (Figure 7.14). At that distance, 99 tower sites were visible from other tower sites, with 88 of those sites forming five separate but nearby networks within the primary settlement cluster.

While tower intervisibility was not evident among Gallina settlement clusters, those links are clearly defined among tower sites within the primary settlement cluster. Connecting back to the question of internal or external conflict, these results, when viewed in isolation, indicate that conflict was unlikely within sites in the primary settlement cluster. The lack of visibility connections between tower sites in different settlement clusters could indicate some degree of social distance between these communities, but this could just be a consequence of the physical distance between these sites, a geography that limits the potential for intervisibility, or of towers that have not yet been documented. The possibility also exists that the different settlement clusters are not contemporaneous. If that were the case, the lack of intervisibility between settlement clusters would be insignificant.

**Defensibility**

The defensibility of each site was quantitatively assessed in terms of accessibility, visibility, and fortifications. Accessibility was determined by assigning a relative value to each site on a scale from 0 to 10, based on its cost area value, relative to maximum cost area for all sites (see Chapter 6). The visibility for each was quantified by assigning
Figure 7.14 – Visibility links between Gallina tower sites within 7,600 m of each other
a 0 to 10 value based on the viewshed area relative to the maximum viewshed area for all sites. Each site was also assigned a fortification score based on the presence of potentially defensive feature types, such as caves, cliff dwellings, stockades, and towers. These three scores were combined, with added weight given to the fortification score, to determine the final defensibility score. The final defensibility score was used in the creation of the defensibility kernel density map.

The defensibility results from the Gallina region (excluding kernel density estimations less than 1) for the most part mirror the site density results (Figure 7.15). Defensibility appears to be high for all of the same areas that are represented by the previously defined settlement clusters. Within the primary settlement cluster, there are clear high intensity areas for defensibility that seem to occur more often at the edge of the cluster, perhaps indicating a greater need to protect themselves from outsiders than the interior sites. The levels of high defensibility in the other, smaller clusters appear to represent defensible sites situated to protect the immediate area. These results could be misleading, however. Most Gallina architectural sites (88.5%) possess relatively low (score of less than 2) defensibility. Considering that point density is a main determiner in kernel density estimation, the effect of the defensibility score is negligible with the complete dataset.

Another way to examine defensibility would be to assess defensibility score estimations using only sites with a defensibility score of 2 or greater (244 sites). These modified results portray a somewhat different impression of defensibility across the region (Figure 7.16). Rather than presenting a picture of a highly defended region, there are only a handful of isolated pockets of high defensibility sites with the highest intensity
Figure 7.15 – Kernel density estimation of defensibility score (excluding estimation scores less than 1) for all Gallina architectural sites
around the edges of the primary settlement cluster, occurring predominantly in the areas with the greatest topographic relief for the region. One interpretation of these modified results is that they indicate a concern with only protecting specific access corridors into the interior of the primary settlement cluster. On the other hand, their location could demonstrate a concern with defending small areas rather than the entire region or the primary settlement cluster. Alternatively, since the high intensity areas occur predominantly in the areas with the greatest topographic relief for the region, the high defensibility score could just be an unintended consequence of site location rather than the primary factor in deciding where to live.

**Violence**

Each architectural site was given a violence score from 0 to 10, based on the evidence indicating that the site had been burned and the presence of osteological evidence of violence (see Chapter 6). Violence scores were heavily weighted for the presence of skeletal trauma. The greatest intensity of violence occurs across the middle of the region, but appreciable levels of violence are found throughout the Gallina region (Figure 7.17). Notable hot spots for violence were found in the northernmost and southernmost extents of the region as well. The initial results of the estimated violence score for the Gallina region identified violence concentrations, most clearly defined within the primary settlement cluster. Small pockets of violence were also identified in both the northernmost and southernmost ends of the region. Each of these concentrations occurred near the outside of a settlement cluster or in some cases extends into the interior of the settlement cluster. These results are consistent with expected pattern if attacks were from a foreign attacker.
Figure 7.16 – Kernel density estimation of defensibility score (excluding estimation scores less than 1) using Gallina architectural sites with defensibility scores of 2 and greater
Figure 7.17 – Kernel density estimation of violence score (excluding estimations less than 0.5)
Table 7.4 – Elevational and defensibility data for Gallina architectural sites with evidence of violence

<table>
<thead>
<tr>
<th>Site category</th>
<th>Number of sites</th>
<th>Minimum elevation</th>
<th>Maximum elevation</th>
<th>Mean elevation</th>
<th>Mean Defensibility Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sites with evidence of skeletal trauma</td>
<td>16</td>
<td>2,089 m (6,853 ft.)</td>
<td>2,319 m (7,609 ft.)</td>
<td>2,198 m (7,211 ft.)</td>
<td>1.99</td>
</tr>
<tr>
<td>Burned sites</td>
<td>400</td>
<td>2,045 m (6,709 ft.)</td>
<td>2,630 m (8,627 ft.)</td>
<td>2,270 m (7,449 ft.)</td>
<td>1.37</td>
</tr>
<tr>
<td>Sites with evidence of violence</td>
<td>410</td>
<td>2,045 m (6,709 ft.)</td>
<td>2,630 m (8,627 ft.)</td>
<td>2,269 m (7,443 ft.)</td>
<td>1.37</td>
</tr>
<tr>
<td>All sites</td>
<td>2129</td>
<td>1,960 m (6,429 ft.)</td>
<td>3,074 m (10,085 ft.)</td>
<td>2,285 m (7,496 ft.)</td>
<td>1.24</td>
</tr>
</tbody>
</table>

The initial results of the estimated violence score for the Gallina region identified violence concentrations, most clearly defined within the primary settlement cluster. Small pockets of violence were also identified in both the northernmost and southernmost ends of the region. Each of these concentrations occurred near the outside of a settlement cluster or in some cases extends into the interior of the settlement cluster. These results are consistent with expected pattern if attacks were from a foreign attacker.

Examining the elevation and defensibility score data for sites with evidence of violence yields some interesting results (Table 7.4). Although the sample size is small, the sites found with evidence of skeletal trauma occurred on average at elevations nearly 300 feet lower than the average elevation for a Gallina architectural site. Contrary to what might be expected, the mean defensibility score was nominally higher at sites with evidence of violence compared to all sites. More defensible sites, although the difference in scores was slight, seem to have been more likely to be attacked. The difference was more pronounced when comparing the sites with osteological evidence of violence to all sites.

It is possible that these sites served as refuges for surrounding settlements and local population fled to them when an attacking group approached their settlements.
Attacking groups might have bypassed empty settlements and concentrated their attacks where people were congregating. Alternatively, the observed results could represent a change in settlement patterns through time. If the sites with evidence of violence were roughly contemporaneous with each other and sites without evidence for violence occurred earlier, any differences in the defensibility score are the result of changes in site selection. Unfortunately, this is another area where the course-grained nature of the chronology for the region makes it difficult to arrive at definitive answers. In either scenario, an outside attacking force is the more likely option. A third option is that while many of these sites were in locations that provided commanding views of the surrounding landscape, they were actually more vulnerable due to their high visibility. As Bremer and Burns (2013) point out, despite being located on ridgelines or mesa tops, many sites are easily approached and would not provide a defensive advantage.

Another approach is to look at the rates of violence for sites outside the previously defined settlement clusters. Located, for the most part, near the margins of the Gallina area, the assumption is that these sites would be easy prey for raiders and rates of violence should be higher for these sites than for sites within settlement clusters. This appears to be the case. For the 104 sites outside of the settlement clusters, the rate of violence was 27.9%, compared to 18.8% for sites within clusters. The 16 sites with osteological evidence of trauma bear a closer look (Figure 7.18). The potential migration routes Borck (2012) suggested for groups moving from the Four Corners region to the Northern Rio Grande appear to be relatively close to those 16 sites, strongly suggesting that those groups attacked the Gallina.
Figure 7.18 – Gallina architectural sites with osteological evidence of violence
Chapter 8—Conclusions

Within the subject of tribal warfare, the Gallina area is an ideal area for archaeological research, especially for examining spatial patterns related to conflict. The Gallina culture was a short-lived and unique manifestation within the Ancestral Puebloan tradition. The Gallina people inhabited an isolated region of northern New Mexico and apparently had little contact with neighboring groups. The extent of Gallina settlement was fairly discrete and did not appear to be limited by neighbors encroaching on their territory. Despite their apparent isolation (or in spite of it), incidents of violence were widespread in the region prior to its complete abandonment. The region remained largely uninhabited until different groups moved into the area in historical times. Much of the context of the conflict and abandonment is poorly understood despite a steady accumulation of data for the region. Several thousand sites, including the 2,129 architectural sites used in this study, have been identified as Gallina over decades of archaeological fieldwork, yet there have been few attempts to synthesize this data, and in the past 20 years there have been no documented attempts to examine the spatial pattern of sites. Due to the unanswered questions about the Gallina culture and the large volume of available data, the Gallina region is fertile ground for researchers.

Rather than focus on individual sites or a collection of sites, this study considers the entire Gallina region as the unit of study. Incorporating spatial and tabular data, this study used GIS to investigate the nature of violence during the Gallina phase. Were the Gallina people attacked and eventually eliminated by hostile foreigners? Did the Gallina people turn on each other? Or were the Gallina people confronted by enemies from
within and from without? To answer these questions, three scenarios were constructed representing expected spatial patterns within these contexts.

The next phase of the process was data collection, which entailed reviewing thousands of site records with the goal of building a comprehensive dataset of Gallina architectural sites. During this process, the presence or absence of particular site characteristics, including site burning, skeletal trauma, non-local ceramics, and specific types of architectural features, were noted. The resulting collection of site data formed the basis for multiple forms of spatial analysis, which sought to find spatial patterns to provide insights on the four main factors of the three scenarios: clustering, connectivity, defensibility, and incidences of violence. The results were then compared to the expectations of three potential scenarios for conflict in the Gallina region.

**Settlement Clusters**

As discussed in Chapter 3, settlement aggregation can occur for different reasons but is an often mentioned consequence of tribal warfare (Haas 1990; Haas and Creamer 1993; LeBlanc 1999; Wilcox and Haas 1993). Seeking safety in numbers, people will settle within increasingly concentrated populations as a response to a perceived threat. Homesteads located close to other sites can provide support to neighboring settlements when attacked, and vice versa. Settlement aggregation can also be spurred by an influx of refugees who seek protection from the aggressors who destroyed their villages. The creation of dense settlement clusters is not exclusively a defensive strategy. Leaders would likely find it far easier to raise a sizeable attack force from a densely settled community rather than from a population dispersed across a large area. Consequently, the size of a settlement cluster can also provide a measure of the scale and scope of
conflict for a region. Aggregation is a process that occurs over time and the lack of fine chronological resolution for Gallina sites precludes the option of investigating any temporal trends. Instead, the presence or absence of settlement clusters can still provide meaningful information about how Gallina settlements interacted with each other and at what scales the Gallina may have defined their concept of community.

The current study identified six settlement clusters in the Gallina region. A large primary cluster covered most of the area; five other, significantly smaller clusters were located nearer the edge of the region. It is possible that the primary cluster and the secondary clusters indicate a temporal trend. Sites within the secondary clusters could predate sites from the primary cluster and (assuming the establishment of settlement clusters was a response to conflict in the region) could signify a retreat to the interior of the region as a defensive response to threats from outsiders. Alternatively, sites within the secondary clusters could postdate sites within the primary cluster and thus represent an attempt by Gallina people to create some distance from other Gallina communities. A third option is that all site clusters were contemporaneous. If that were the case, seeing smaller groups of sites outside a larger aggregation of sites is consistent with expectations for a region concerned with an outside threat.

The lack of absolute dates for most Gallina sites makes it difficult to definitively accept or reject any one of the three models, but most of the available tree-ring dates indicate that sites within the interior of the Gallina region (primary cluster) were some of the last communities to be occupied (Bremer and Burns 2013; Constan 2011; Towner et al. 2015). The first and third models are the more likely ones and both indicate concerns for attacks from outside the region. The presence of the large primary settlement cluster
also sheds some light on how the Gallina people defined their community. The primary cluster stretching across the bulk of the Gallina region likely indicates that the Gallina people considered themselves all part of the same social group and far less likely to perpetrate a massacre on a neighbor like was seen at Rattlesnake Ridge (Hatch et al. 1994).

**Interaction**

Social connections between communities and the lack of connections between other communities can be viewed as a demonstration of social boundaries. Tribal warfare greatly impacts the formation of social boundaries between groups (Haas and Creamer 1993). Consequently, the establishment and structure of social boundaries can be informative about the nature of tribal conflict within a region. Near and distant communities may peacefully interact with each other in many ways (exchange, marriage, ritual, and sharing information) but few of them are discernible in the archaeological record. Trade between communities is one such way interaction is seen archaeologically and can be identified by the existence of similar trade goods among site artifact assemblages. Identifying intervisibility links is another way connections between communities can be defined.

Viewing the ceramic and intervisibility networks together, the primary site cluster exhibits strong visibility links between its sites, and there is some exchange occurring between sites in different site clusters. These results paint a picture of communities across the region maintaining some level of social connection and interaction. If Gallina communities were engaged in internecine conflict, one would expect to see a more
noticeable social separation between communities. Instead, the opposite situation appears to exist, consistent with an external source of conflict.

The extremely low frequency of non-local ceramics should not be glossed over, however. Definitely typed, non-local ceramics were found at less than 3% of all architectural sites and represented a miniscule fraction of the total ceramic assemblage at most of these sites. Strongly arguing for the existence of networks based on such limited evidence would be ill advised. Yet that same low frequency of non-local ceramics could reinforce the notion that violence was due to foreign aggressors.

Some caution also should be exercised when interpreting the intervisibility of tower sites. The topography for much of the region virtually guarantees that sites located on ridgelines would be visible from nearby ridgelines. Most architectural sites were likely connected visually with other sites in the region, which was demonstrated by Ireland (1984) for the sites on the northern portion of the Jicarilla Apache Reservation. In terms of labor and material, towers would have been very expensive to construct. If towers were built exclusively for the purposes of communication, they are an excellent example of over-engineering. They must have served another important function for the Gallina communities, but further research is required to fully unlock that mystery. Still, it is difficult to see how visibility would not have been an essential factor in their creation. Visibility was likely a key aspect of how prehistoric people made sense of the space they lived in (Llobera 2007). The importance of visibility of natural and cultural objects in the American Southwest has been discussed in a number of studies (Bernardini et al. 2013; Hayes and Windes 1974; Snead 2008; Van Dyke 2008; Van Dyke and King 2010). Visibility links structures and communities, if for no other reason that seeing an
object everyday fixes it in people’s minds as part of their world. While it may be a leap to conclude that the Gallina towers were part of a regional communication network, there is a strong case for them linking communities either actively or passively. As was mentioned when discussing the primary settlement cluster, communities that maintained strong social links are far less likely to have perpetrated on each other the types of violence seen in the Gallina region.

**Defensibility**

Defensibility is an inherent characteristic for most of the Gallina architectural sites. The topography of most of the region is extremely rugged and difficult to traverse. Most habitation structures were not built near water sources or near the best agricultural land, which is in the valleys. Instead, most structural sites are located along ridge lines and on mesa tops. While these sites could have been located along ridges to avoid cold air drainages or biting insects (Bremer and Burns 2013), their site location often provided some defensive advantages, whether or not intentional. These advantages came from an increased ability to spot potential attackers or decreased accessibility (sites which are harder to approach are easier to defend). Another factor that aids in defending a region is the density of settlements. Several settlements situated closely to each other would be far less appealing targets that an isolated habitation. Similarly, several highly defensible sites in close proximity would provide a greater level of defense than several lesser defensible sites. The distribution of defensible sites across a region can provide an indication from what direction people would anticipate attacks or where attacks occurred in the past.
The topography of the Gallina region provides ample opportunity to maximize site defensibility. If they so desired, the Gallina people could have situated their communities to provide even greater levels of defense against invaders, but the results of this study indicate that they did not take full advantage of that opportunity. If people were concerned with protecting their communities against foreign aggressors, highly defensible sites should be located to prevent or monitor incursions into their territory.

If anything, defensibility appears to have been maximized to protect only small regions. As discussed in Chapter 7, the overall defensibility results mirror the results for site density. By excluding sites with a relatively low defensibility score (less than 2), a more accurate picture of the impact of defensibility can be seen (Figure 7.17). Higher levels of defensibility are found in much smaller and more isolated areas. If the observed patterns are a result of regional conflict, this sort of result would be more consistent with the expectations for internal warfare rather than external conflict. It is entirely possible that violence was not a factor in where the Gallina people located their communities or in how those communities were structured. The overall defensibility results indicate that the Gallina were only minimally concerned with defending their territory. With only a moderate amount of additional work, the Gallina could have constructed formal fortifications, such as encircling walls and trenches, at many settlement locations that would have made them virtually impervious to attacks. The lack of these kinds of fortifications is telling and suggests that the Gallina people chose the location of their settlements for reasons having very little to do with warfare. With respect to the three models of tribal conflict, the defensibility results must be considered inconclusive.
Violence

Violence is a common, if not ubiquitous, characteristic of tribal conflict. Groups conducting raids leave devastation in their wake, in the form of bodies of victims or destruction of a settlement. For many archaeologists, the only conclusive archaeological evidence of violence is human skeletal remains exhibiting clear signs of lethal trauma. This type of data is most commonly collected during excavations. Unfortunately, most archaeological data from the Gallina region is the result of cultural resource survey. Osteological evidence of violence, if present, could lie buried at many sites. Despite the relative scarcity of excavations in the region, the remains of 159 individuals have been found with a majority (57%) showing signs of violence (Constan 2011). Osteological studies have found rates of violence of up to 38% (Chase 1976; Stanerson 2012; Weaver 1976). Another potential indicator of violence is site burning. As discussed in previous chapters, site burning does not necessarily imply that a settlement has been raided but it is often a consequence of a violent attack. Nearly 19% of all Gallina architectural sites showed signs of burning. This evidence, along with the towers and the few cliff dwellings, is the record of violence most often cited by archaeologists (e.g. LeBlanc 1999; Wilcox and Haas 1994).

Taken as a whole, the evidence for violence in the Gallina region points towards external conflict. The highest frequencies of violence were seen along the margins of the primary site cluster and decrease in frequency farther into the interior, consistent with an outside group focusing its attacks on the perimeter of Gallina territory with occasional sorties into the interior. These are also the areas were the most sites have been found and the most fieldwork has been carried out, including the lion’s share of excavations.
The violence score of a site was heavily weighted toward the presence of human remains with signs of violence. Only 16 sites contained osteological evidence of violence with almost all (86%) of the osteological evidence of violence found at five sites. These 16 sites become focal points for the violence score density estimation and tend to occur near the margins of site clusters or along a direct line from the edge of the cluster into the interior of a cluster.

Potential migration routes through the Gallina region for groups traveling from the Four Corners region to the Rio Grande region are strongly correlated with the locations of nearly all sites with skeletal trauma (Borck 2012, 2015). Rattlesnake Ridge with its 35 individuals meeting a violent end has been pointed out as an exception to this trend and cited as evidence of internecine conflict (Borck 2012, 2015; Ellis 1976), but Rattlesnake Ridge is 5 km from one of the proposed migration routes. Five kilometers may have seemed like a small distance to groups that had already travelled hundreds of miles from Four Corners region. Destroying the largest settlement within hostile territory would have been considered essential to eliminate a potential threat while traveling with women and children through hostile territory. As discussed in Chapter 4, communities in the Four Corner regions had already seen their fair share of violence during the latter half of the 13th Century and groups leaving that region were likely very concerned with their own defense and primed for a conflict.

**Final Thoughts**

For the four factors under consideration (site clustering, connectivity, defensibility, and violence), three of these indicate an external source of conflict. The one large settlement cluster encompassed most of the central portion of the Gallina
region. In addition to the large primary cluster, five smaller clusters near the periphery of the area were identified. This pattern of clustering is consistent with external warfare. Likewise, the distribution of non-local ceramics and intervisibility between tower sites along the presence of a large settlement cluster indicate that social bonds between communities existed across most of the region. Incidents of violence were located primarily near the boundaries of the region. When it was present within the interior, a path linking other sites with evidence of violence could be discerned from the interior to the margins of the Gallina territory. The migration routes identified by Lewis Borck (2012) and the locations of the sites with osteological evidence of violence provide compelling evidence for an external source of violence.

While arguments could be made that the pattern of defensibility in the Gallina region demonstrated that Gallina communities were defending themselves and protecting small areas against their Gallina neighbors, it is just as likely an unintended consequence of the region’s topography rather than a result of strategic planning. The overall defensibility results with respects to indicating a source of conflict is inconclusive. The Gallina region is exceedingly rugged in parts and maximizing visibility appears to have been an important concern. Visibility should not be equated with defensibility. A settlement situated on top of a sheer cliff face provides a limited amount of strategic advantage if it can be easily approached from its other sides. This is often the case with Gallina sites. Fortifications, such as walls or stockades, would have provided some measure of protection, but there have been few recorded examples of these. In contrast to the common narrative which presents Gallina sites as defensive, the more likely interpretation of the defensibility results is that they demonstrate that defensibility was
not a strong concern for the Gallina people. Instead, the Gallina people chose to settle this remote and rugged region for reasons currently unknown to researchers. By choosing to isolate themselves during a time of significant social turmoil throughout the greater Southwest, the Gallina people could have been making a strong statement about their own uniqueness compared to other groups in the Southwest. Recent studies how begun to look at the importance of identity for the Gallina people and should shed some light on this topic (Kocer 2015; Simpson 2015).

The contradictory lines of evidence raise an important question. If the threat of violence from an outside group encouraged the Gallina people to congregate, why were communities not situated to provide greater defensive advantage? One possibility is that the primary settlement cluster was not a response to a threat of violence. The shift toward higher elevations was a trend that was seen across many regions of the Southwest in the 12th and 13th centuries (Roney 1996). During a time of extremely volatile climatic conditions, it was an adaptation that was successful for some groups. Alternatively, aggregation could have been a strategy adopted by the Gallina people prior to their migration to the region and that pattern was simply continued when they moved into the area. A large settlement cluster also is extremely unlikely to have occurred on the scale that it did if the Gallina people were not unified to some degree. The connectivity results provide further indication of that unity.

The distribution of incidents of violence is less ambiguous, but it also leads to an interesting question. If the spatial distribution of violence appears to be a result of foreign aggressors, why did the Gallina people not erect better defenses? The likeliest explanation is that they had no warning. For the most part, the Gallina people were cut
off from the rest of the prehistoric Southwestern world and potential sources of information that might have warned them about impending danger. It is a distinct possibility that the attacks on Gallina settlements all happened within a short period. People simply did not have the option of organizing more adequate defenses. If faced with a large group that they had no hope of defeating, the options would have been extremely limited. They could resist and perish, flee to other Gallina settlements, or leave the region entirely. If true, the Jemez oral legend recounted in Chapter 5 could serve as a good explanation for what happened to the Gallina people.

Unfortunately, problems with chronology plague Gallina research. In the absence of absolute dates for the overwhelming majority of Gallina sites, those sites have been treated as contemporaneous, a situation that is far from ideal. Perhaps if the data could be analyzed through a finer temporal lens, clearer (and maybe different) more nuanced patterns will emerge. For now, the record strongly suggests that the violence in the Gallina region was due to an unknown number of external groups, possibly from the Four Corners region, who entered the region en route to the Rio Grande region. These groups attacked Gallina settlements along their way and ultimately drove the Gallina people from the region.
References Cited

Adams, E. Charles

Adams, E. Charles, Vincent M. LaMotta, and Kurt Dongoske

Adler, Michael A.

Akins, Nancy

Alexakis, Dimitrios, Apostolos Sarris, Theodore Astaras, and Konstantinos Albanakis

Alexander, Richard D.

Allen, Mark W. and Elizabeth N. Arkush

Andrews, Michael J. and Richard Ambler
1982  *An Archaeological Assessment of Homolovi III and Chevelon Ruin, Northern Arizona*. Department of Anthropology, Northern Arizona University.

197
Anschuetz, Kurt F.

Anschuetz, Kurt F., and Thomas Merlan

Anschuetz, Kurt F., Richard H. Wilshusen and Cherie L. Scheick

Anyon, Roger and Steven LeBlanc

Arkush, Elizabeth N.

Ashmore, Wendy and Gordon R. Willey

Aswani, Shankar and Michael W. Graves

Atkins, Victoria M. (editor)
Axtell, R. L., J. M. Epstein, J. S. Dean, G. J. Gumerman, A. C. Swedlund, J. Harburger, S. Chakravarty, R. Hammond, J. Parker, and M. Parker

Bahti, Thomas N.

Bailey, G., T. Cadbury, N. Galanidou, and E. Kotjabopoulou

Bailey, Vernon

Baker, Larry L., and Stephen R. Durand, editors
2003 *Prehistory of the Middle Rio Puerco Valley, Sandoval County, New Mexico.* Archaeological Society of New Mexico Special Publication No. 3.

Baker, Larry L. and Kristin Langenfeld

Baker, Shane A.

Baltz, Elmer H.

Bandelier, Adolph Francis
Barthélemy, Marc

Bartlett, Katherine
1932 *Why the Navajos Came to Arizona*. Museum of Northern Arizona, Museum Notes No. 5, Flagstaff.

Basso, K. H. (editor)

Bayer, Laura

Beal, John D.

Bell, Robert E.
1940 *Measurement and Observation of Gallina Burials*. Unpublished Honors Paper, Department of Anthropology, University of New Mexico, Albuquerque.

Bell, T. and G. R. Lock

Benedict, Ruth

Bennet, Ivan

Bennett Ross, J.
Bernardini, W.  

Bernardini, Wesley, Alicia Barnash, Mark Kumler, and Martin Wong  

Berry, B. J. L. and W. L. Garrison  

Bevan, Andrew and James Conolly  


Bice, Richard A.  

Bigelow, R.  

Billig, M.  

Billig, M. and H. Tajfel  

Billman, Brian R., Patricia M. Lambert, and Banks L. Leonard  

Binford, L. R. and S. R. Binford  
Bingler, Edward C.  

Biosi, Thomas  

Blackburn, Fred M. and Ray A. Williamson  

Blanton, R. E.  

Blitz, J. H.  

Blumenthal, E. H., Jr.  

Boehm, C.  

Bogannan, L.  

Boissevain, Jeremy  

Bongers, Jacob, Elizabeth Arkush, and Michael Harrower  
Boone, James L.  


Boone, James L. and F. Scott Worman  

Borck, Lewis  


Borck, Lewis and J. Michael Bremer  

Borzunov, V. A.  

Bowe, Frederick J.  

Boyd, Robert and Peter J. Richerson  

Bradbury, Andrew P., Jessica L. Allgood, Jason M. Anderson, Michael D. Richmond, and Deborah L. Rotman  

Bradley, B. A.  
Bremer, J. Michael and Denver Burns  

Breternitz, David A.  


Breternitz, Cory D., David E. Doyel, and Michael P. Marshall (editors)  

Bretzke, Knut, Philipp Dreschsler, and Nicholas J. Conard  

Brew, John O.  


Brown, J. A. and L. G. Freeman  

Bunzel, Ruth L.  
Burton, Jeffrey F.


Bussey, Stanley D.
1963 *The Llaves Site: Salvage Excavations at LA 5859.* Laboratory of Anthropology Note No. 23. Museum of New Mexico, Santa Fe.

Bustard, Wendy

Byrd, Adam


Campillo, Xavier Rubio, Jose María Cela, and Francesc Xavier Hernàndez Cardona

Carlson, Roy L.
1963 *Basketmaker III Sites near Durango, Colorado.* University of Colorado Studies, Series in Anthropology 8, Denver.


Carneiro, Robert

Cater, J. D. and William L. Shields
1992 *A Cultural Resources Inventory of the Phillips San Juan 29-6 Unit Gathering System Located in the Greater Gobernador Area, Rio Arriba County, New Mexico.* Daggett and Chenault Report No. 91-DCI-044, Farmington.

Cattanarch, George S., Jr.
Chagnon, Napoleon

Change, Kwang-Chih

Chase, James E.

Childe, V. Gordon

Christaller, Walter.

Christiansen, J. H. and M. Altaweel

Chuipka, Jason, Richard Wilshusen, and Jerry Fetterman
Clark, Jeffery J., Deborah L. Huntley, J. Brett Hill, and Patrick D. Lyons  
2012  The Kayenta Diaspora and Salado Meta-Identity in the Southern U.S. Southwest.  
In *Hybrid Material Culture: The Archaeology of Syncretism and Ethnogenesis*,  

Coltrain, Joan Brenner, Joel C. Janetski, and Michael D. Lewis  
2012  A Re-assessment of Basketmaker II Cave 7: Massacre Site or Cemetery Context.  

Conolly, James and Mark Lake  

Constan, Connie I.  

*Archaeology Southwest* 29(1):13–14.

Contreras, Daniel A.  
2009  Reconstructing Landscape at Chavín de Huántar, Peru: A GIS-Based Approach.  

Cope, Edward D.  
*United States Geographical Survey West of the 100th Meridian* Vol. III, VII  
Archaeology. Engineers Department of the United States Army, Washington DC.

Cordell, Linda S.  

1989a  Northern and Central Rio Grande.  

1989b  Warfare: Some Issues from the Prehistoric Southwest.  

Corning, P. A.

Cowgill, G.

Creel, Darrell and Roger Anyon

Crema, Enrico R., Andrew Bevan, and Mark W. Lake

Cremaschi, M. and S. di Lernia

Crotty, Helen K.

Crown, Patricia L.

Crown, Patricia L. and W. James Judge (editors)

Crown, Patricia L., Janet D. Orcutt, and Timothy A. Kohler

Crumley, C. L. and W. H. Marquardt
Curry, George  

Darling, J. Andrew  

Dean, Jeffrey S.  

Dean, Jeffrey S., William H. Doelle, and Janet D. Orcutt  

Dean, Jeffrey S., G. J. Gumerman, J. M. Epstein, R. L. Axtell, A. C. Swedlund, M. T. Parker, and S. McCarron  

Dew, Margaret A.  

Dick, Herbert W.  


Dick, Herbert W. and Hugh Davidson

Doolittle, W. E.

Douglas, Michele Toomay and Ann L. W. Stodder

Douglas, William B.

Doyel, David E. (editor)

Doyel, David E. and Jeffrey S. Dean
2006 Environmental Change and Human Adaptation in the Ancient American Southwest. University of Utah Press, Salt Lake City.

Drennan, R. D. and C. E. Peterson

Duff, A. I. and R. H. Wilshusen
Dunnell, Robert C. and William S. Dancey

Durham, W.

Dutton, Bertha P.
1963  *Sun Father’s Way: The Kiva Murals of Kuaua, a Pueblo Ruin, Coronado State Monument, New Mexico.* University of New Mexico Press, Albuquerque.

Earle, Timothy K.

Eckert, Suzanne L. and Linda S. Cordell

Eddy, Frank W.
1966  *Prehistory in the Navajo Reservoir District Northern New Mexico.* Papers in Anthropology No. 15. Museum of New Mexico, Tucson.

Eggan, Fred

Elliott, Michael
1982  *Large Pueblo Sites near Jemez Springs, New Mexico.* Cultural Resources Report, No. 3, Santa Fe National Forest, Santa Fe.

Ellis, Andrea
Ellis, Florence Hawley

Elmore, Francis H.

Elyea, Janette M.

Ember, Carol R. and Melvin Ember

ESRI

Euler, Robert C., George J. Gumerman, Thor N. V. Karlstrom, Jeffery S. Dean, and Richard H. Hevly

Ezzo, Joseph A.

Fassett, James E.
Federal Register

Fenneman, Nevin M.

Ferguson, R. Brian

Fewkes, J. Walter

Field, Julie S.

Fiero, Kathleen
1978  Archaeological Investigation at LA 11850: A Gallina Phase Village on the Continental Divide, Rio Arriba County, New Mexico. Laboratory of Anthropology Note No. 111f. Museum of New Mexico, Santa Fe.
Fish, S. K., P. R. Fish, and M. E. Villalpando

Fish, S. K. and S. A. Kowalewski (editors)

Flannery, Kent V.


Fletcher, Thomas F.
1994  *Archaeological Data Recovery Excavations at the Sanders Great House and Six Other Sites Along US Highway 191, South of Sanders, Apache County, Arizona.*  Zuni Archaeological Program Report No. 471, Research Series No. 9, Pueblo of Zuni.

Flinn, Lynn, Christy G. Turner II, and Alan Brew

Ford, R. I.

Fotheringham, A.S., C. Brunsdon, and M. Charlton

Fox, Cyril

Frisbie, Theodore R.

Fuller, Steven L.

Fuller, Steven L., and James N. Morris

Gat, Azar

Gesch, Dean B., Michael J. Oimoen, and Gayla A. Evans

Gilpin, D.
2003 Chaco-Era Site Clustering and the Concept of Communities. Kiva 69:171–205.

Goetze, David and Patrick James

Goings, Chad A.

Goldfrank, Esther Schiff

Graves, Dorothy

Green, Roger C.
Green, Roger C., Maryanne A. Danfelser, and Gwinn Vivian

Gregor, Thomas

Griffin, Arthur F. and Charles Stanish

Griffith, D.

Grimes, W. F.

Grove, M.

Gumerman, G. J., A. C. Swedlund, J. S. Dean, and J. M. Epstein

Haas, Jonathan

Haas, Jonathan, and Winifred Creamer

Hackett, Charles Wilson (editor and translator)
Haining, Robert  

Hall, Edward Twitchell, Jr.  

Hallasi, Judith A.  

Hamilton, Scott  

Hammack, Laurens C.  
1965  *The Lagunitas Highway Salvage Project*. Laboratory of Anthropology Note No. 33. Museum of New Mexico, Santa Fe.

Hammond, George P., and Agapito Rey, eds.  

1953  *Don Juan de Oñate: Colonizer of New Mexico, 1595–1628*. University of New Mexico Press, Albuquerque.

Harry, K. G.  

Hatch, Sinclair, Jr., John Hayden, Cheryl Muceus, Mary Purdy, Pat Trusell and Fred Trussell  
Haury, Emil and Lyndon L. Hargrave
1931 Recently Dated Pueblo Ruins in Arizona. Smithsonian Miscellaneous Collections Vol 82, No. 11. Smithsonian Institution, Washington, D.C.

Hawley, John W.

Hayes, Alden C. and Thomas C. Windes

Hays-Gilpin, Kelley and Eric van Hartesveldt (eds.)

Heider, Karl

Helbling, J.

Henrich, Joseph

Hibben, Frank C.
1937 Excavations of the Riana Ruin and Chama Valley Survey. Anthropological Series No. 2(1). University of New Mexico, Albuquerque.


1939 The Gallina Culture of North Central New Mexico, Unpublished Ph.D. dissertation, Department of Anthropology, Harvard University, Cambridge.


Hill, W. W.
Hobbes, Thomas

Hodder, Ian R. (editor)

Hodder, Ian R. and Clive Orton

Hogg, A. H.

Holden, Jane

Holbrook, Sally J.

Holbrook, Sally J. and James C. Mackey

Howard, Julie and Joel C. Janetski

Howey, Meghan C. L.

Hudspeth, William B.
Hudspeth, William, Anastasia Steffen, and Alysia Abbott  

Hunt, Charles B.  

Hunt, Eleazer D.  

Huntley, Deborah L., Jeffery Clark, Robert Jones, and Katherine Dungan  

Huntley, Deborah L. and Keith W. Kintigh  

Huo, Xiao-Ni, Hong Li, Dan-Fend Sun, Lian-Di Zhou, and Bao-Guo Li  

Hurst, Winston B.  

Hurst, W. B., and Christy G. H. Turner, II  

Hwang, Myung-Hwa, and Andrew Winslow  
Imhof, E.

Ireland, Arthur K.

Johannesson, Erik G. and Michelle L. Machicek

Johnson, C. David

Johnson, Gregory A.

Jones, Eric E. and Sharon N. DeWitte

Jordan, K. A.

Judd, Neil M.

Kane, Allen E.
Kane, Allen E., and C. K. Robinson

Kang, Bong W.

Kantner, John

Kantner, John and N. M. Mahoney (editors)
2000  **Great House Communities Across the Chacoan Landscape.** University of Arizona Press, Tucson.

Karsten, R.

Keeley, Lawrence

Kelly, R.

Kenzle, Susan C.

Kessel, John L.

Kiddell, Alfred V. and Samuel J. Guernsey

Kim, Karl and Eric Y. Yamashita
Kintigh, Keith W.

Kirch, P.

Kliendienst, Maxine

Kluckhohn, Clyde.

Knapp, A. B. and W. Ashmore

Kocer, Jacqueline Marie

Koch, K-F.

Kohler, Timothy A.
Kohler, Timothy A., J. Kresl, C. R. Van West, E. Carr, and R. H. Wilshusen

Kohler, Timothy A., Janet D. Orcutt, Kenneth L. Peterson and Eric Blinman

Kohler, Timothy A. and Kathryn Kramer Turner

Kowaleski, Stephen A.

Krumbein, W. C. and F. A. Graybill

Kuckelman, Kristen A.

Kuckelman, Kristen A., Ricky R. Lightfoot, and Debra L. Martin


Kvamme, L. K.

Lally, James R.
Lambert, Patricia M.

Lambert, Patricia M., Brian R. Billman, and Banks L. Leonard

Lancaster, James A., Joan M. Pinkley, Philip F. Van Cleave, and Don Watson

Lane, Elizabeth A., Daniel Newsome, and Lynn A. Neal

Lange, Charles H.
1940  *A Cranial Series from the Gallina Region*. Honors Paper, Department of Anthropology, University of New Mexico, Albuquerque.

Lange, Frederick, Nancy Mahaney, Joe Ben Wheat, Mark L. Chenault, and John Cater

Lape, Peter V. and Chao Chin-Yung
2008  Fortification as a Human Response to Late Holocene Climate Change in East Timor. *Archaeology in Oceania*. 43:11–21.

Largueche, Fatima-Zohra Benmostefa

LeBlanc, Steven A.
Lee, Y. K.

Lekson, Stephen

Leusen, Pieter Martijn van

Lightfoot, Ricky R. and Mary C. Etzkorn

Lipe, William D., James N. Morris, and Timothy A. Kohler

Lister, Florence C. and Robert H. Lister

Lister, Robert H.

Liston, Jolie and H. David Tuggle

Llobera, M.

Lockett, H. Claiborne and Lyndon L. Hargrave
Lomatuway'ma, Michael, Lorena Lomatuway'ma, and Sidney Namingha Jr.

Longacre, W. A.

Luebben, Ralph A. and Paul R. Nickens

Mackey, James C. and Roger C. Green

Mackey, James C. and Sally J. Holbrook

Madry, Scott L. H. and Lynn Rakos

Madsen, D. B.

1973 *Soil Associations and Land Classifications for Irrigation, Rio Arriba County, New Mexico*. New Mexico State University Agricultural Experiment Station Research Report No. 254.

Maker, H.J., Harold E. Dregne, V.G. Link, and James U. Anderson
1974 *Soils of New Mexico*. New Mexico State University Agricultural Experiment Station Research Report No. 285.

Malotki, Ekkehart
Malville, Nancy J.

Manly, B. F. J.

Mantha, Alexis

Marlar, Richard

Marshall, Michael P., John Stein, Richard W. Loose, and Judith E. Novotny
1979  *Anasazi Communities of the San Juan Basin*. Public Service Company of New Mexico and New Mexico Historic Preservation Division, Albuquerque and Santa Fe.

Martin, Debra L., Nancy J. Akins, Bradley J. Crenshaw, and Pamela K. Stone

Martin, Debra L., Nancy J. Akins, Alan H. Goodman, William Toll III, and Allen Swedlund
2001  *Harmony and Discord: Bioarchaeology of the La Plata Valley, New Mexico*. Museum of New Mexico Press, Santa Fe.

Martin, Paul S.

Martin, Paul S., John B. Rinaldo, and Ernst Antevs
Marzano, Annalisa

Maschner, H. D. G. (editor)

Massouh, Paula A.
2009 The Largo-Gallina Household: A View from the L/102 Site. Ph.D. dissertation. Anthropology Department, American University, Washington DC. ProQuest/UMI, Ann Arbor

Matson, R. G.

McClelland, John A.,

McCoy, Mark D., Peter R. Mills, Steven Lundblad, Tim Rieth, Jennifer G. Kahn, and Rowan Gard

McDonald, James A.

McKenna, Peter J.

 McMahon, Todd C.
McNamee, William D.  

McNamee, William D. and Nancy S. Hammack  

McNamee, William D., Raymond G. Harriman, and Richard W. Yarnell  

Meggitt, M.  

Melotti, Umberto  

Mera, Harry P.  
1935 *Ceramic Clues to the Prehistory of North Central New Mexico*. Laboratory of Anthropology Technical Series, Bulletin No. 8, Santa Fe.  

Mercer, R.  

Merrill, Michael and Dwight Read  

Milner, G. R.  

Mindeleff, Cosmos  

Mitchell, A.  

Mohr, Albert and J. Simopoulis  

Morain, Stan  

Morgan, Lewis H.  

Morris, Ann Axtell  

Morris, Earl H.  

Morris, Elizabeth Ann  

Morris, James N., Linda Honeycutt, and Jerry Fetterman  
Mount, James E., Stanley J. Olsen, John W. Olsen, George Teague, and B. Dean Treadwell

Muceus, Cheryl and Bob Lawrence


Murphy, Robert

Myers, Nate

Neitzel, Jill

Nelson, Greg C. and Felicia C. Madimenos

Netting, R.

Nolan, Patrick D.

Nunn, Patrick D.
O’Sullivan, D. and D. J. Unwin

Ogilvie, Marsha D. and Charles E. Hilton

Orcutt, Janet D.

Orcutt, Janet D., Eric Blinman, and Timothy Kohler

Osgood, R. and S. Monks with J. Toms

Otterbein, Keith F.

Page, Gordon

Palkovich, Ann M.

Parker, Douglas R.

Parsons, Elsie Clews

Parsons, Jeffrey R.

Pattison, Natalie B.

Paynter, R. W.

Peckham, Stewart
1959  *The Palisade Ruin, LA 3505: Archaeological Salvage Excavations Near the Abiquiu Dam, Rio Arriba County, New Mexico*. Report prepared in cooperation with the National Park Service, Region 3, United State Department of Interior, Santa Fe. School of American Research, Santa Fe and the Museum of New Mexico, Albuquerque.

Pepper, George H.

Peterson, John A., David V. Hill, Alfredo Enriquez, and Tim Graves

Pettit, P.

Phillips, David A., Jr.
Phillips, P., J. A. Ford, and J. B. Griffin

Pilling, Arnold R.

Pippen, Lonnie C.

Plog, Fred

Potter, James M. and Jason P. Chuipka

Prince, Paul

Przywolnik, K.

Purdy, Mary and James Shibley

Ramenofsky, Ann F. and James K. Feathers
Rappaport, R.

Rautman, Alison E.

Redmond, E.

Renfrew, Colin

Richerson, Peter J. and Robert Boyd

Richter, J.

Ripley, B. D.

Riviere, Peter

Robarchek, C. and C. Robarchek

Roberts, David

Roberts, Frank H. H. Jr.
1929 *Shabik’eschee Village, A Late Basketmaker Site in the Canyon, New Mexico*. Bureau of American Ethnology Bulletin No. 92. Smithsonian Institution, Washington, D.C.


Rohn, Arthur H.

1977 *Cultural Change and Continuity on Chapin Mesa.* Regents Press of Kansas, Lawrence.


Roney, John R.

Ross, Jane Bennett

Rousseau, Jean Jacques
1950 [1762] *The social contact, and Discourses.* Dutton, New York.

Rua, Helena

Ruggles, A.J., and R. L. Church
Ruggles, C. L. N. and D. J. Medyckyj-Scott  

Sample, L. Laetitia and Albert Mohr  
1975  Archaeological Excavations at Site No. L/102 Rio Arriba, County New Mexico-1973. Laboratory of Anthropology Note No. 83, Museum of New Mexico, Santa Fe.

Sanders, W. T.  
1965  The Cultural Ecology of the Teotihuacán Valley. Ms. thesis, Department of Anthropology, Pennsylvania State University, University Park, University Microfilms, Ann Arbor.

Savage, S. H. and S. E. Falconer  

Schollmeyer, Karen Gust  

Schulman, Albert  

Seaman, Timothy J.  

Service, Elman  

Schaafsma, Polly  
Schachner, Gregson

Shackley, M. Steven

Shipman, Jeff H.

Siart, Christoph, Bernhard Eitel, and Diamantis Panagiotopoulos

Simek, Jan F.

Simmons, Marc

Simpson, David Erik


Sleeter, Richard

Smith, C. A.

Smith, Michael E.

Snead, James

Snead, James E., Winifred Creamer, and Tineke Van Zandt

Snow, Bryan Edward

Solometo, Julie


Spencer, C. S. and E. M. Redmond

Spielmann, Katherine A.

Stanerson, Vlisha L.
Stein, John and Andrew P. Fowler  

Stephen, Alexander M.  

Stevenson, M. C.  

Steward, Julian H.  

Stewart, K. M.  

Stuart, David E., and Rory P. Gauthier  

Swanson, Steve  

Tobler, W. R.  

Thomas, Alfred B.  

Thomas, D. H.  
Titiev, Mischa

Toll, H. Wolcott and Peter J. McKenna

Towner, Ronald H., Galen L. McCloskey, Benjamin A. Bellorado, and Rebecca R. Renteria

Turner, Christy G. H.

Turner, Christy G. H. and Nancy T. Morris

Turner, Christy G. H. and Jacqueline A. Turner
1999  *Man Corn: Cannibalism and Violence in the American Southwest and Mexico*. University of Utah Press, Salt Lake City.

Turner, Christy G. H., Jacqueline A. Turner, and Roger C. Green

Turney-High, H. H.

Turpin, S.A.

Turton, D.

Ullah, Isaac I. T.
Upham, Steadham

Upham, Steadham and Paul F. Reed

Van Dyke, Ruth

Van Dyke, Ruth and Anthony G. King

Van Keuren, Scott and Christopher I. Roos

Varien, Mark D.
1990 *Excavations at Three Prehistoric Sites along Pia Mesa Road, Zuni Indian Reservation, McKinley County, New Mexico*. Zuni Archaeological Program Report, No. 233, Research Series No. 4. Zuni Pueblo.
1999 *Sedentism and Mobility in a Social Landscape*. University of Arizona Press, Tuscon.


Vayda, A. P.

Verhagen, Philip and Thomas G. Whitley
Vierra, Bradley J.

Vierra, Bradley J., and Richard I. Ford


Vita-Finzi, C. and Higgs, E. S.

Voth, H. R.

Walker, William H.


Walker, William H., V.M. LaMotta, V.M., and E.C. Adams, E.C

Watson, Patty Jo, Steven A. LeBlanc, and Charles Redman
Weaver, David S.

Webster, David

Wendorf, Fred
1953 Salvage Archaeology in the Chama Valley, New Mexico. Monograph No. 17. School of American Research, Santa Fe.

Wernke, Steven A.

Wetherington, Ronald K.

Whalen, M. E. and P. E. Minnis

Wheatley, David and Mark Gillings

White, Leslie
1932b The Pueblo of the San Felipe. American Anthropological Association Memoir 38, Menasha, Wis.

White, Tim D.
Wilcox, David


Wilcox, David and Jonathan Haas

Wilcox, David and James Holmland
2007 The Archaeology of Perry Mesa and its World. Ralph M. Bilby Research Center, Northern Arizona University, Flagstaff.

Wileman, Julie

Wilkinson, Nancy M.

Wilkinson, T. J., J. H. Christiansen, J. Ur, M. Widell, and M. Altaweel

Wilks, Maureen E.

Willey, Gordon R.

Willey, P.
Williamson, Ray

Wills, W. H.

Wills, W. H. and Thomas C. Windes

Wilshusen, Richard H.
1988 Excavations at Marshview Hamlet (Site 5MT2235), a Pueblo III Habitation Site. In *Dolores Archaeological Program: Aceramic and Late Occupation at Dolores*, compiled by G. T. Gross and A. E. Kane, pp. 17–84. Bureau of Reclamation, Engineering and Research Center, Denver.

Wilshusen, Richard H. and Scott. G. Ortman

Wilson, C. D., and E. Blinman

Windes, T. C., R. M. Anderson, B. K. Johnson, and C. A. Ford
Winter, Joseph C.  
1981  Anasazi Agriculture at Hovenweep II: The Development and Use of Towers.  
Mexico Press, Albuquerque.

Winter-Livneh, Rona, Tal Svoray, and Isaac Gilead  
2010  Settlement Patterns, Social Complexity and Agricultural Strategies During the 
Chalcolithic Period in the Northern Negev, Israel. _Journal of Archaeological 

Winters, H. D.  

Wiseman, Regge N.  
2007  On the Relationship Between the Largo-Gallina and the Jemez. In _Texas and 
Points West: Papers in Honor of John A. Hedrick and Carol P. Hedrick_, edited by 
Regge N. Wiseman, Thomas C. O’Laughlin, Cordelia T. Snow, and Cathy Travis, 
pp. 201–222. Papers of the Archaeological Society of New Mexico No. 33.

Wolf, E. R.  
1987  Cycles of Violence: The Anthropology of War and Peace. In _Waymarks: The 
Notre Dame Inaugural Lectures in Anthropology_, edited by K. Moore, pp. 127– 
150. University of Notre Dame, Notre Dame, Ind.

Woolridge, S. W. and D. L. Linton  
1933  The Loam-terrains of Southeast England and Their Relation to it Early History. 
_Antiquity_ 7:297–310.

Wrangham, Richard and Dale Peterson  

Wyatt, Bill B.  
1995-10-078. On file at the Santa Fe National Forest Supervisor’s Office, Santa 
Fe.

Cultural Affiliation of Southwestern Indian Tribes_. Technical Guide pp. 147–151, 
USDA Forest Service Southwestern Region, Albuquerque.

Yeates, M.  
1974  _An Introduction to Quantitative Analysis in Human Geography_. McGraw-Hill, 
New York.

Zefferman, Matthew R. and Sarah Mathew  
2015  An Evolutionary Theory of Large-Scale Human Warfare: Group-Structured 
Cultural Selection. _Evolutionary Anthropology_ 24:50–61.
Zárate Salmerón, Fray Geronimo De
1966  *Relaciones; an account of things seen and learned by Father Jeronimo de Zárate Salmerón from the year 1538 to year 1626*, translated by Alicia Ronstadt Milich. Horn & Wallace, Albuquerque.

Zegwaard, G. A.

Zier, Christian J.

Zipf, G. K.
1941  *National Unity and Disunity*. Principia Press, Bloomington.

Zubrow, E. B. W.
Appendix A—Expected Patterns of Tribal Conflict

Figure A.1—Expected settlement cluster distribution within a context of internal conflict
Figure A.2—Expected defensibility results within a context of internal conflict
Figure A.3—Expected violence results within a context of internal conflict
Figure A.4—Tower sites and expected line-of-sight connections between them within a context of internal conflict.
Figure A.5—Sites with non-Gallina ceramics and expected trade connections between them within a context of internal conflict
Figure A.6—Expected settlement cluster distribution within a context of external conflict
Figure A.7— Expected defensibility results within a context of external conflict
Figure A.8— Expected violence results within a context of external conflict
Figure A.9—Tower sites and expected line-of-sight connections between them within a context of external conflict
Figure A.10—Sites with non-Gallina ceramics and expected trade connections between them within a context of external conflict
Figure A.11—Expected settlement cluster distribution within a context of mixed conflict
Figure A.12—Expected defensibility results within a context of mixed conflict
Figure A.13—Expected violence results within a context of mixed conflict
Figure A.14—Tower sites and expected line-of-sight connections between them within a context of mixed conflict
Figure A.15—Sites with non-Gallina ceramics and expected trade connections between them within a context of mixed conflict
Appendix B—K-Function Results

All Structural Sites

K-function analysis for all structural sites determined that sites were clustered at each distance interval up to 20,000 meters (see Figure B.1). Observed results deviate from random expectations most strongly at distances less than 10,000 meters. Between the distances of 20,100 meters and 30,200 meters, the number of sites observed was consistent with expected results. At distances over 30,200 meters, sites were dispersed. In other words, the average radius of a site cluster was 20,000 m. At the 30,200 m distance and beyond, sites were farther away from each other than expected.

Figure B.1 – K-function results for all Gallina structural sites
Single Pit House Sites

For sites with only a single pit house, k-function analysis determined that sites were clustered at each interval up to 19,900 meters (see Figure B.2). As with the all sites category, the strongest degree of clustering occurred at distances less than 10,000 meters. The number of observed sites was consistent with a random distribution at distances between 20,000 and 26,200 meters. For distances greater than 26,200 meters, single pit house sites were dispersed.

Figure B.2 – K-function results for Gallina sites containing only a single pit house
Multiple Pit House Sites

Looking at sites with multiple pit houses but no other structural types, the results demonstrate that sites were clustered up to 15,500 meters (Figure B.3). As with the previous two categories, the degree of clustering is strongest at distances less than 10,000 meters. The distribution of sites at distances from 15,600 and 23,400 meters can be considered statistically random. At distances greater than 23,400 meters, sites were dispersed with a noticeable increase in the degree of dispersiveness at about 30,000 meters.

![K-Function of Multiple Pithouse Sites](image.png)

**Figure B.3** – K-function results for Gallina sites with multiple pit house and no other structural types
**Single Surface Structure Sites**

Sites with only a single surface structure and no other structural types were clustered at distances up to 17,500 meters, with the strongest degree of clustering evident at about 10,000 meters (Figure B.4). Observed results fell within the 95% confidence intervals at distances between 17,600 and up to 50,000 meters. Single surface structure sites were not considered dispersed at any distance interval.

![K-Function for Single Surface Structure Sites](image)

Figure B.4 – K-function results for Gallina sites with a single surface structure only
Multiple Surface Structure Sites

At distances up to 16,300 meters, sites with multiple surface structures and no other structural types were defined as clustered (Figure B.5). Clustering was also established at distances between 24,900 and 36,800 meters. Clustering was strongest at around 10,000 meters. At distance intervals between 16,400 and 24,800 meters and, the observed results could be considered random. From 36,900 up to 50,000 meters, the observed results also fell within the 95% confidence interval for expected results.

Figure B.5 – K-function results for Gallina sites with multiple surface structure and no other structural types
Pit House and Surface Structure Sites

The k-function results for sites with at least one pit house and at least one surface structure demonstrated that sites were clustered at distances up to 42,300 meters (Figure B.6). The strongest degree of clustering was seen at distances of about 22,000 meters. From 42,400 up to 50,000 meters, observed results were consistent with expectations for a random distribution. Sites were not considered dispersed at any distance.

Figure B.6 – K-function results for Gallina sites with at least one pit house and at least one surface structure
Multiple Structure Sites

For sites with multiple structures regardless of structural type, clustering was present at distances up to 27,800 meters (Figure B.7). The strongest degree of clustering was seen about 13,000 meters. Between 27,900 and 46,800 meters, the observed distribution of sites was consistent with a random distribution of sites. From 46,900 up to 50,000 meters, multiple structure sites were dispersed. Of the site categories, the multiple structures category is likely the most useful for evaluating the distribution of larger settlements. The distribution of these sites is similar to that for all sites, with one large primary cluster and a handful of other smaller clusters closer to the boundaries of the region (Figure 7.12). The average size of a cluster for that category was 27,800 m with dispersiveness found beyond distances of 46,900 m.

Figure B.7 – K-function results for Gallina sites with multiple structures of any type.
Tower Sites

Clustering for sites with at least one tower was found for distance intervals up to 26,500 meters (Figure B.8). Clustering was most clearly defined at distances of about 14,000 meters. The distribution of tower sites was consistent with a random distribution between 26,600 and 48,300 meters. Towers sites were dispersed at distances between 48,300 and 50,000 meters.

Figure B.8– K-function results for Gallina sites with at least one tower
### Table C.1—Gallina architectural sites with non-local ceramics

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