STONE, SHELL, OR STEEL? A CLOSER LOOK AT BUTCHERY IMPLEMENTS ON ST. CATHERINES ISLAND, GEORGIA

By

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A THESIS PRESENTED TO THE GRADUATE SCHOOL
OF MONMOUTH UNIVERSITY IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF ARTS

MONMOUTH UNIVERSITY

2014

To my grandma, Rosalie Triozzi, my favorite teacher.

ACKNOWLEDGMENTS

I humbly thank my advisors Dr. Edward Gonzalez-Tenant and Dr. Richard Veit for providing me with guidance during the writing and research process. I graciously thank Dr. David Hurst Thomas for facilitating my participation in excavations on St. Catherines Island, Ga, as an intern and Field Archaeologist with the American Museum of Natural History and for all of your support during my research. I also thank the St. Catherines Island Foundation, especially Royce Hope Hayes and island staff, for supporting the internship program and enabling young researchers to advance their careers and contribute to archaeological knowledge. I thank Elliot Blair for providing me with valuable geospatial data, Dr. Elizabeth Reitz and Mr. Irvy R. Quitmyer for the time they spent preparing the zooarchaeological data and collections analyzed for this project. I thank Matt Napolitano for molding me into a better researcher and archaeologist. Adam Watson and Anibal Rodriguez allowed me access to AMNH facilities during my research. I thank my hosts in Athens, Ga, and Gainesville, Fl, Bess Brown Harris and Ginessa Mahar, respectively. I am in debt to MU faculty and staff, especially Anne Marie Lavin for the extensive equipment loans and Noreen Spinapont for granting me access to the Anthropology Lab. I thank the various pairs of eyes who glanced over my chapters before submission, especially my sister Kirstin Triozzi and my good friends Anna Semon, and Frank O'Shea. I thank Kip at the Hunter's Butcher for gratuitously providing the experimental deer bone. Thank you to Daysi Morales for your "invaluable" data entry contribution. I thank my parents Peter and Nancy Triozzi for their patience. Finally I'd like to thank my grandmother, Rosalie Triozzi, for her support and encouragement.

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January 2014

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Cochair: Richard Veit
Major: Anthropology

Analysis of cutmarks on archaeologically recovered fauna can indicate what type of blade was used for butchery tasks. Taking this approach to evaluating tool choices in a multiethnic community has been done elsewhere but remains a relatively unexplored topic in the American Southeast. Meanwhile, shell butchery is severely understudied. This study evaluates cutmarks observed on zooarchaeological bone collected from the Mission and Pueblo at Santa Catalina de Guale on St. Catherines Island, Ga. Experimental cutmarks made by stone, steel, and shell are compared to zooarchaeological specimens from contact-period contexts. Results show both stone and metal tools were used in significantly different frequencies in secular and non-secular contexts. Indian navigation of Spanish colonial pressures explains the observed heterogeneity in butchery tool choice. Methods employ experimental archaeology, low-powered microscopy, and geographic information system software.

CHAPTER 1: INTRODUCTION

Native inhabitants of the American Southeast were among the first in North America to endure the intense effects of Spanish colonialism. Catchall terms like ‘contact,’ ‘change,’ or ‘colonialism,’ fail to distinguish the peculiarities of microregional and situational circumstances influencing interaction between Europeans and Native Americans (Silliman 2005a). Scrutiny of the archaeological record can magnify the importance of nuances not recorded in ethnohistoric documents. Too often the niceties of everyday life are overlooked resulting in an under appreciation of the subtle ways past peoples coped with drastic cosmological alterations.

This thesis investigates butchery tool use among the inhabitants of Mission Santa Catalina de Guale on Saint Catherines Island, Georgia (Thomas 1987), and the surrounding Pueblo (Brewer 1985; May 1985; 2008; Reitz *et al* 2010). The mission on Saint Catherines Island was one of many Spanish frontier settlements (Deagan 2003; Lightfoot and Martinez 1995; Thomas 2013) in the American Southeast. At Mission Santa Catalina de Guale Native Americans were exposed to Catholicism and pressured to adopt European customs (Jones 1978; Larson 1978, 1980; McEwan 1993, 2001; Milanich 2006; Sturtevant 1962; Swanton 1922; Thomas 1988).

Altered cultural behaviors in the American Southeast during the Spanish colonial era was not unidirectional (Deagan 2003). European customs were practiced and technologies utilized by Native Americans (Deagan 1981, 1983; McEwan 1992; Milanich 2006) while Spanish settlers adopted a distinctly American way of life incorporating local resources (Reitz *et al* 2010) and indigenous material culture into daily life (Deagan 1973, 1983, 2003, 2009; Deagan and Cruxent 2002a, b; McEwan 1992; Thomas

1990b). Modification of traditional subsistence practices (Reitz *et al* 2010), intensification of deer hunting for the skin trade (Pavao-Zuckerman 2007), and an increased reliance on corn (Spielmann *et al* 2009) among some indigenous groups in the American Southeast are believed to have been a direct result of Spanish colonialism.

Mission settlements were areas of spiritual aggregation whereby Catholicism and indigenous belief systems comingled. Frontier mission settlements were also points of fluid exchanges of ideas between Europeans and Indians but cannot be assumed *a priori* to be any less integrated (Lightfoot and Martinez 1995) than La Florida's economic center in St. Augustine (Deagan 1973). For instance, the retention of some indigenous ancestral beliefs by Native American neophytes is observed but is syncretic in nature. Specifically, the inclusion of Catholic paraphernalia, European trade items, and indigenous jewelry as grave goods—an indigenous practice—is contradictory to orthodox Catholicism (McEwan 2001; Thomas 1988, 1993), yet the orientation of most of the deceased, supine and extended with hands crossed over chest is an influence of Spanish spirituality (Larsen 1990: 20).

American Indians living on the frontier of colonial jurisdiction were not passively assimilating into European society (Lightfoot and Martinez 1995). Instead, indigenous alterations to subsistence and participation in emergent economies and politics can be viewed as strategic improvements for individual, familial, or community status within sociopolitical and socioeconomic colonial hierarchies (Beck *et al* 2011; Cipolla 2008; Deagan 2011; Johnson 1997; Thomas 2010b, 2013). As a part of any economy, cuisine is often, and unfortunately, overshadowed in the ethnohistoric record by other noteworthy events. However, zooarchaeological analysis considers cuisine and its inclusionary components such as nutrition, diet, menu, resource procurement, distribution, consumption, and preparation (Reitz *et al* 2010: 17).

Zooarchaeological analysis of cuisine can illuminate a wealth of information about a society (Crabtree 1990). For example, butchery marks on faunal specimens can indicate the preparer's skill and knowledge of animal anatomy (Crabtree 1990). Additionally, anatomical locations of cutmarks and the distribution of butchered bone across a site can help to segregate specialized activity areas within archaeological sites (Lemke 2013). Morphological characteristics of cutmarks can be used to identify the implements used, and together can reveal otherwise unavailable animal processing details (Seetah 2006). Cutmark data can potentially refine our understanding of how people navigated social and economic conditions by illuminating raw tool preferences (Cipolla 2008; Greenfield 1999, 2006).

The focus of this project is to evaluate the behavioral implications of tool choice in the multiethnic environment of the Pueblo and Mission at Santa Catalina de Guale, home to Indians and Spanish friars and soldiers (Worth 1995) for nearly a century (Thomas 1987). This thesis builds on previous findings of subsistence strategies on St. Catherines Island during the Spanish mission period (Reitz *et al* 2010) but will focus on exposing the types of tools used for butchery and the implications of raw material preference under colonial socioeconomic and political pressures (Cipolla *et al* 2007; Cipolla 2008; Cobb 2003; Deagan 2003; Gasco 1992; Johnson 1997; McEwan 1992; Silliman 2004, 2009).

Archaeology in the American Southeast has demonstrated the fluidity between European and indigenous culture in Spanish *La Florida* (Deagan 1973, 1981, 2003, 2007; Larsen 1990, 1994; McEwan 1992, 1993, 2001; Reitz *et al* 2010; Stojanowski 2005; Thomas 1987, 1988, 1990a, b, 1993). Ethnohistoric documents provide an historical framework through which socioeconomic and political conditions governing this observed relationship can be better understood (Francis and Kole 2011; Jones 1978; Washburn 1964 167-175; Worth 1995). The archaeological recovery of Mission Santa Catalina de Guale (9Li274) on St. Catherines Island shows considerable effort by Spanish friars to convert Guale Indians to Catholicism (Thomas 1987, 1990b, 1993). However, this effort was met with significant continuance of indigenous customs (May 2008; McEwan 2001; Reitz and Dukes 2008; Reitz *et al* 2010; Thomas 1988, 2010b, 2013).

Through the examination of mortuary remains beneath Mission Santa Catalina de Guale (Larsen 1990) it is clear that the Spanish were somewhat successful in implementing colonial institutions. However, friars in La Florida permited grave goods, a practice contrary to orthodox Catholicism (McEwan 2001; Thomas 1993, 2010b, 2013). Hence, although Spanish outposts on the frontier of La Florida were focused on religious and cultural conversion (McEwan 1993; Milanich 2006), some indigenous spiritual believes were maintained.

As stipulated by royal Spanish ordinances, Mission settlements towns were to be aligned on a grid system (running 45° west of magnetic north) with the church placed in the center of the town (Garr 1991; Thomas 1987). A central plaza featuring an *iglesia*, *convento, cocina*, and well supplying holy water, "…formed the spiritual heart of Mission

Santa Catalina de Guale" (Figure 1-1; Thomas 2010a: 35). Royal ordinances mandated that the secular Indian village, or pueblo, be separated from the sacred plaza by a palisade (Thomas 1987). This conspicuous reordering of the landscape may also be reflected in archaeological occurrences of distinctly indigenous or European-influenced activities.

If the central plaza is to be considered the focal point of Catholicism and European culture in a once indigenous landscape, it should be expected that behaviors were more secular (i.e., more indigenous) radiating outward. The area situated immediately beyond the palisade walls are considered the Guale *pueblo* is subdivided into Pueblo North, South, East, and West (Thomas 2009a: 72-78). A freshwater creek separates the northern Wamassee Head (9Li13/AMNH 208) from Fallen Tree (9Li8/AMNH 441) in the south (Brewer 1985; Caldwell 1971; May 1985, 2008; Thomas 2008b).

Spanish olive jar and aboriginal pottery with Altamaha decoration motifs dated to the Mission period on the Georgia coast (Deagan and Thomas 2009) have been collected from both Wamassee Head (Caldwell 1971; Thomas 2008b) and Fallen Tree (Brewer 1985; May 1985, 2008; Thomas 1987, 2008b). The combination of aboriginal and European pottery styles in these two areas indicates Wamassee Head and Fallen Tree were likely inhabited by Guale Indians and possibly other relocated groups as part of the Spanish institution of *reducción* (Worth 1995). Reducción augmented Spanish administrative efficiency by merging indigenous communities to barrier islands (Jones 1978; Stojanowski 2005:420; Thomas 2009a). The reorganized sociopolitical relationships between indigenous groups resultant from reducción and the accompanying stress was likely compounded by *repartimiento*. Repartimiento was a Spanish institution that conscripted male Indians to agricultural labor to supply St. Augustine with food. The physical, pathological, and political impacts of reducción and repartimiento (Larsen 1990; Spielmann *et al* 2009; Stojanowski 2005) may have been motivating factors for Indian agency as observed by material culture preferences.

At Mission Santa Catalina de Guale, neophytes likely prepared food for resident friars, which would be taken in silence (Thomas 2010a: 39), but retained traditional cooking methods (Reitz *et al* 2010). Thus in many ways Santa Catalina de Guale reflects a typical frontier settlement where, "there was little social integration of colonized people in these areas into the empire beyond the symbolic acknowledgment of imperial and Catholic dominion," (Deagan 2003: 8).

Comparatively, in St. Augustine where soldiers were urged to intermarry with indigenous women (Deagan 1973), there is pronounced merging of Native American and European customs with respect to resource exploitation (Reitz *et al* 2010) and material culture (Deagan 2003; Deagan and Thomas 2009; McEwan 1992). This merging of disparate cultures may be part organic and part prescribed. Kathleen Deagan indicates, "…the Church tried vigorously to make them [Spanish men and indigenous women] marry," (Deagan 2003: 37).

In St. Augustine intermarriage between Spanish men and aboriginal women encouraged by the Spanish Crown and indigenous women played a significant role in food preparation (Deagan 1973). Where there was, "…mixed Indian-Spanish occupation, food preparation techniques and technology would be predominately aboriginal, with a minimum amount of Spanish influence," (Deagan 1973: 62).

Furthermore, with respect to religion women may have been, "…more receptive to Spanish culture [than men]…" (Deagan 1973: 58). It is therefore pertinent to consider socioeconomic choices of Indians residing in a frontier mission settlement with fewer resident Spaniards and to recognize the demographic impacts of reducción and repartimiento.

If indigenous women were more receptive to Spanish culture but still utilized traditional cooking and subsistence practices in the household in St. Augustine (Deagan 1973), it is pertinent to contemplate food preparation strategies in areas where there were fewer Europeans but intensified religious conversion efforts. Household structures have yet to be definitively identified at Mission Santa Catalina de Guale, but there is clear delineation between secular and non-secular structures (Thomas 1987, 2009a, 2010a). Nonetheless, areas and structures described as religious and secular in the literature (Thomas 1987, 1988, 1993, 2009a, 2010a) allow a useful framework for interpreting butchery technology in the Pueblo and Mission at Santa Catalina de Guale.

As already mentioned, cutmarks on zooarchaeological remains record characteristics of butchery practices and cutmarks can be used to identify what type of tool was used (Cipolla 2008; Dominguez-Rodrigo *et al* 2009; Greenfield 1999, 2002, 2006; Potts and Shipman 1981; Shipman and Rose 1983b; Walker 1978; Walker and Long 1977). Furthermore cutmark analysis leading to the identification of heterogeneous tool sets can indicate additional behavioral implications such as the retention of identity and memory by Native Americans during and after contact with Europeans (Cipolla 2008; Cipolla *et al* 2007; Silliman 2003, 2005b).

In this study provenience data of zooarchaeological specimens corresponding to secular and non-secular areas will allow a fine-tuned assessment of Indian navigation of socioeconomic situations with respect to inferred uses of space (Reitz and Dukes 2008; Reitz *et al* 2010; Thomas 2009a, 2010a). With supporting archaeological and ethnohistorical data, cutmark analysis may demonstrate resiliency or discontinuity of traditional Native American technologies (Cipolla 2008; Cipolla *et al* 2007; Cobb 2003; Johnson 1997) in the face of rigorous religious and cultural conversion tactics. In mission settlements, Franciscan friars were the most poignant conduits of European culture.

Initially, Jesuit friars attempted to convert the indigenous population of St. Catherines Island but were mostly unsuccessful (Gradie 1988; Jones 1978; Thomas 1987, 2012, 2013; Washburn 1964). Later attempts by Franciscan friars were more successful. A mission presence lasted for nearly a century (c. 1587 – 1680 A.D.) but was interrupted by at least one major rebellion in 1597 (Francis and Kole 2011). Orientation of burials in the cemetery at Mission Santa Catalina de Guale reflects Catholic tradition but aboriginal mortuary practices of including grave goods (McEwan 2001; Thomas 1993) indicate that Catholicism was not fully internalized by neophytes (Thomas 2010b). The syncretic nature of burials incorporating themes from both Catholicism and indigenous spirituality (Thomas 2013: 120) offers support for evidence of hybridized technological preferences for ritual activities.

Research on butchery tools during contact in the American Southeast may be eclipsed by important discussions of altered ceramic technologies during contact period La Florida (e.g. Deagan and Thomas 2009). This is problematic given paucity of raw stone materials on American Southeast coasts. Due to the distance between coasts and knappable chert quarries, such as those observed in Georgia (Figure 1-2; Elliot and Sassaman 1995; Goad 1979), stone artifacts occur infrequently in coastal archaeological deposits in the American Southeast. In response to limited availability of stone raw material near American Southeast coasts, a well-developed shell tool industry flourished (Eyles 2004; Luer 1986; Marquardt 1992; Masson 1988) as a regional economic specialization (Trubitt 2003).

Production of utilitarian and non-utilitarian shell tools was likely an integral component of regional trade networks in Mississippian Native America (Claassen and Sigmann 1993). The abundance of shell in marine environments would have allowed coastal dwelling Indians to trade for resources in the interior at relatively low cost (Bullen 1978). However, the maintenance of long distance social relationships enabling the exchange of regional resources was itself quite costly, and perhaps lead to other innovative technologies such as pottery (Sassaman 1993).

Unfortunately, despite the low costs of acquiring shell at some coastal sites and the high cost of accessing raw lithic material, there are limited studies that evaluate shell as an alternative raw material for stone butchery tools (Brett 1974; Choi and Driwantoro 2007; Toth and Woods 1989). Shell would seem to be a more convenient material than stone to create butchery tool for a number of reasons. First, stone tool effectiveness is altered over prolonged use (Shipman and Rose 1983a: 70) depending on specific uses and the morphology of the working edge (Collins 2008). Retouching may prolong the life of a lithic cutting edge until the reduction in size renders the tool dysfunctional for a particular task (Shott and Ballenger 2007), the tool is lost, or it breaks; replacement with additional raw material is inevitable and necessary for sustained stone tool use. For Native Americans inhabiting coastal, stone-free areas the use of lithics can be costly irrespective of the mode of raw stone acquisition be it trade or procurement expeditions. The sheer abundance of shell in coastal areas makes it an obvious raw material choice for butchery tools.

The symbolic importance of shell is not overlooked by this assertion. Indeed coastal and inland peoples alike utilized and fashioned shell into non-utilitarian forms (Eyles 2004). Inhabiting coastal areas impacted, "…trajectories of history, ideology, ritual, ideas of time, political organization, kinship, resistance and resilience, colonization, and travel and transport," (Thompson and Worth 2010: 2). Therefore, shell use itself may have played a unique cultural role that stone could not. For example, the Andamanese, studied by A.R. Radcliffe-Brown, utilize shell as a cutting tool, despite their access to iron, steel, and quartz knives (Williams and Jones 2006: 54). The symbolic importance of traditional technologies may be a driving force behind its use despite access to more exotic or durable materials (Cipolla 2008). The underlying symbolism behind shell use as a butchery tool may never be known because it has yet to be empirically demonstrated among Indian groups in the American Southeast. This issue can be remedied through the analysis of cutmarks, which might display morphological attributes specific to shell butchery implements (Choi and Driwantoro 2007). Assessing shell as a possible raw material for butchery tools and as an alternative to stone and European metal will test another dimension of technological preference at Santa Catalina de Guale.

Technological choices made by Indians living in and around Mission Santa Catalina de Guale may reflect nuanced indigenous strategies for navigating colonial socioeconomic pressures. Guale Indians likely had access to European iron tools through Spanish gift giving practices designed to win over community leaders (Garr 1991), via trade with the French (Blair 2009: 169) and, in at least one case, through ransom (Francis and Kole 2011). The social organization of Mississippian groups was built on privileged control of food surplus (Wesson 1999), exotic materials (Kipp and Schortman 1989), and ritual knowledge (McEwan 2001). The value of understanding technology preference is therefore not restricted to functional attributes (i.e., efficiency, efficacy, durability, etc.) or availability. Material technologies retain other inherent features that are perhaps best understood from an emic perspective, while the replacement of indigenous tools with European tools has both tacit and explicit implications deeper than an index of assimilation (Lightfoot 1995; Lightfoot *et al* 1998).

Gasco (1992) suggests that in Chiapas, Mexico, the replacement of traditional Indian butchery tools with European blades had a negligible effect on social organization. However, in the American Southeast, Europeans were interacting with people who had deep-seated Mississippian economic values. The introduction of European technologies into a sociopolitical system emphasizing privileged access to exotic materials is unlikely to left social organization unscathed. The increased accessibility of European goods and ritual knowledge may have dramatically reorganized indigenous social hierarchies. On the one hand, chiefly authority over supernatural knowledge, food, and exotica may have become threatened by European trade systems. On the other hand, non-elite individuals may have viewed access to

European trade items such as glass beads, metal tools, clothing, and Catholicism as potentially empowering, given Spanish socioeconomic structuring of La Florida (Deagan 2003).

At Mission Santa Catalina de Guale interaction between Native Americans and Europeans is visible through the archaeological recovery of trade goods (Blair *et al* 2009; May 2008; Thomas 1987), diet (Reitz 2008; Reitz and Dukes 2008; Reitz *et al* 2010), mortuary remains (Larsen 1990, 1994; McEwan 2001; Thomas 1993, 1988), and ethnohistoric sources (Francis and Kole 2011; Jones 1978; Washburn 1964: 167-175; Worth 1995). Such evidence illustrates accommodation on behalf of the Spanish as well as the durability of Indian traditions. The data presented here will show Guale technological preference during efforts by the Spanish to convert the native population spiritually and culturally (Deagan 2003; McEwan 2001) and will have implications for Indian agency in colonial La Florida (Thomas 2010b, 2013).

The data will be considered in terms of socioeconomic conditions biasing neophyte tool choice at Santa Catalina de Guale. Cutmark evidence will show that in the multiethnic context of Santa Catalina de Guale, transformation of culture was multidirectional while indigenous peoples actively navigated colonial pressures (Silliman 2009; Thomas 2010b, 2013). Focusing exclusively on evidence from cutmarks on faunal specimens, this paper will address whether European iron, indigenous chert, or expediently crafted shell tools were used to butcher whitetail deer (*Odocoileus virginianus*) and other artiodactyls. The zooarchaeological collection (Reitz 2008; Reitz and Dukes 2008; Reitz *et al* 2010) will be compared to experimental cutmarks to determine which material mission and pueblo residents at Santa Catalina de Guale used for butchery. This comparative approach will draw on criteria established in previous studies that have successfully identified the use of stone, metal, and shell butchery tools based on cutmark morphology (Binford 1981; Blumenschine *et al* 1996; Choi and Driwantoro 2007; Cipolla 2008; Cipolla *et al* 2007; Greenfield 1999, 2002, 2006; Johnson 1997; Olsen 1988; Shipman and Rose 1983a, b; Silliman 2005b; Toth and Woods 1989; Walker 1978, 1990; Walker and Long 1977).

The adoption of European customs and technologies does not suggest that spiritual and cultural conversion efforts disintegrated Guale cosmology. Shifts in technological preferences may be interpreted in terms of individual or community navigation of socioeconomic conditions. For instance, can evidence of the use of European technology for butchery at a mission settlement reflect successful cultural conversion? Would such evidence also indicate spiritual conversion? On the other hand, would the continued use of traditional stone or shell technologies for butchery suggest maintenance of aboriginal identity and memory (Cipolla 2008), or evidence the outright rejection of European customs? Furthermore, what should be the theoretical framework for interpreting the use of both indigenous *and* European butchery technologies? Would such a scenario call for a discussion of resistance (Liebmann and Murphy 2011), accommodation by friars (McEwan 2001), sociopolitical and economic pragmatics (Johnson 1997), or agency (Thomas 2010b, 2013), and are these themes mutually exclusive? Considering spatial patterns across Mission and Pueblo at Santa Catalina de Guale will be instrumental in evaluating some of these issues.

Provenience information of cutmarked specimens will permit the scrutiny of observed differences in butchery tool use. Spatial patterns of butchered bone occurrences will demonstrate whether Indians living beyond the immediate view of the Mission compound continued to use traditional butchery tools. A geographic information system (GIS) will be used to show patterns in the geospatial distribution (Conolly and Lake 2006) of differential tool use if it exists between secular and non-secular areas (Thomas 1987, 2009a, 2010a). This study also addresses the “Guale problem” contemplated by David Hurst Thomas (Thomas 1987: 60), which questions the extent that aboriginal subsistence strategies were reoriented during Spanish missionization efforts lasting from the 16th through the 18th century (see also Thomas 2008 a, b, c, 2012). Specifically, this study will address butchery tool use of the Guale Indians at Mission Santa Catalina on St. Catherines Island under Spanish jurisdiction (c. 1580-1680 A.D.).

The following chapter will introduce La Florida and Santa Catalina de Guale as well as discuss the historical trajectory of the Guale under Spanish colonial rule. Chapter 2 will also review other studies that utilize similar methods to those employed in this thesis. Chapter 3 discusses the materials and methods used to create the experimental sample and those employed in the assessment of the zooarchaeological collection analyzed. Chapter 3 also introduces the study areas on St. Catherines Island. Shell tools are discussed in chapter 4 as a separate topic to devote sufficient attention to the complex issue. The experiments that investigate shell are discussed alongside the interpretation of shell’s possible use for butchery. In chapter 5 results of the experiments are presented with a consideration of each raw material’s cutting efficacy and efficiency. Chapter 5 then reviews the comparative approach taken for understanding the modifications on zooarchaeological materials and discusses analytical methods that utilize statistics and GIS for understanding the geospatial distribution of the zooarchaeological cutmark evidence. Chapter 6 deliberates the historical circumstances presented in chapter 2 in a new light, which considers the results of the experimental and comparative analyses performed. As an interpretive discussion, chapter 6 draws on theoretical themes in anthropology such as agency, identity, and memory to integrate evidence for the use of a heterogeneous tool set at Santa Catalina de Guale with our understanding of Spanish colonial institutions. Chapter 7 summarizes this thesis and reflects on the entirety of this research project to suggest avenues for future study.

Crucial to interpreting tool choice of Santa Catalina de Guale inhabitants is a consideration of macro- and microregional socioeconomic and sociopolitical circumstances in La Florida. Altered socioeconomic and sociopolitical organization, the threat of cultural and spiritual disintegration, rampant European-introduced diseases, European competition over land, and deep-seated indigenous traditions all play a role in framing Guale Indian technological choices. Choice refers to the active selection of any alternative behavior, belief, or technology in response to past, current, and future circumstances (Silliman 2004: 281). As will be demonstrated, indigenous choices in butchery technology on St. Catherines Island were commensurate with socioeconomic and sociopolitical conditions reorganized by Spanish colonial institutions.

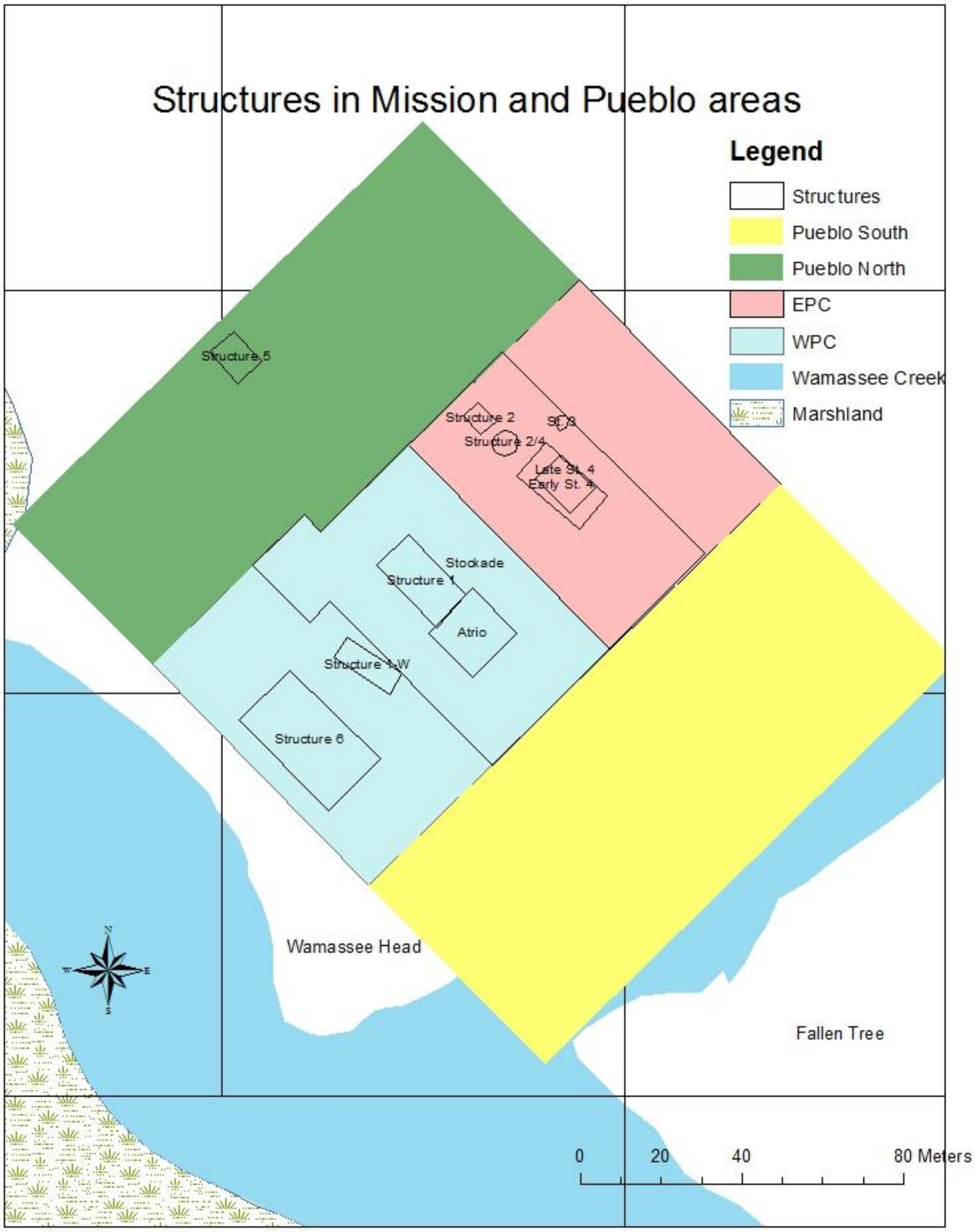

Figure 1-1. Map of Mission Santa Catalina de Guale showing Mission structures, non-secular areas of the Western Plaza Complex (WPC) and the Eastern Plaza Complex (EPC), and the secular Indian Pueblo North and South, after Thomas (2010a: Figure 2.5).

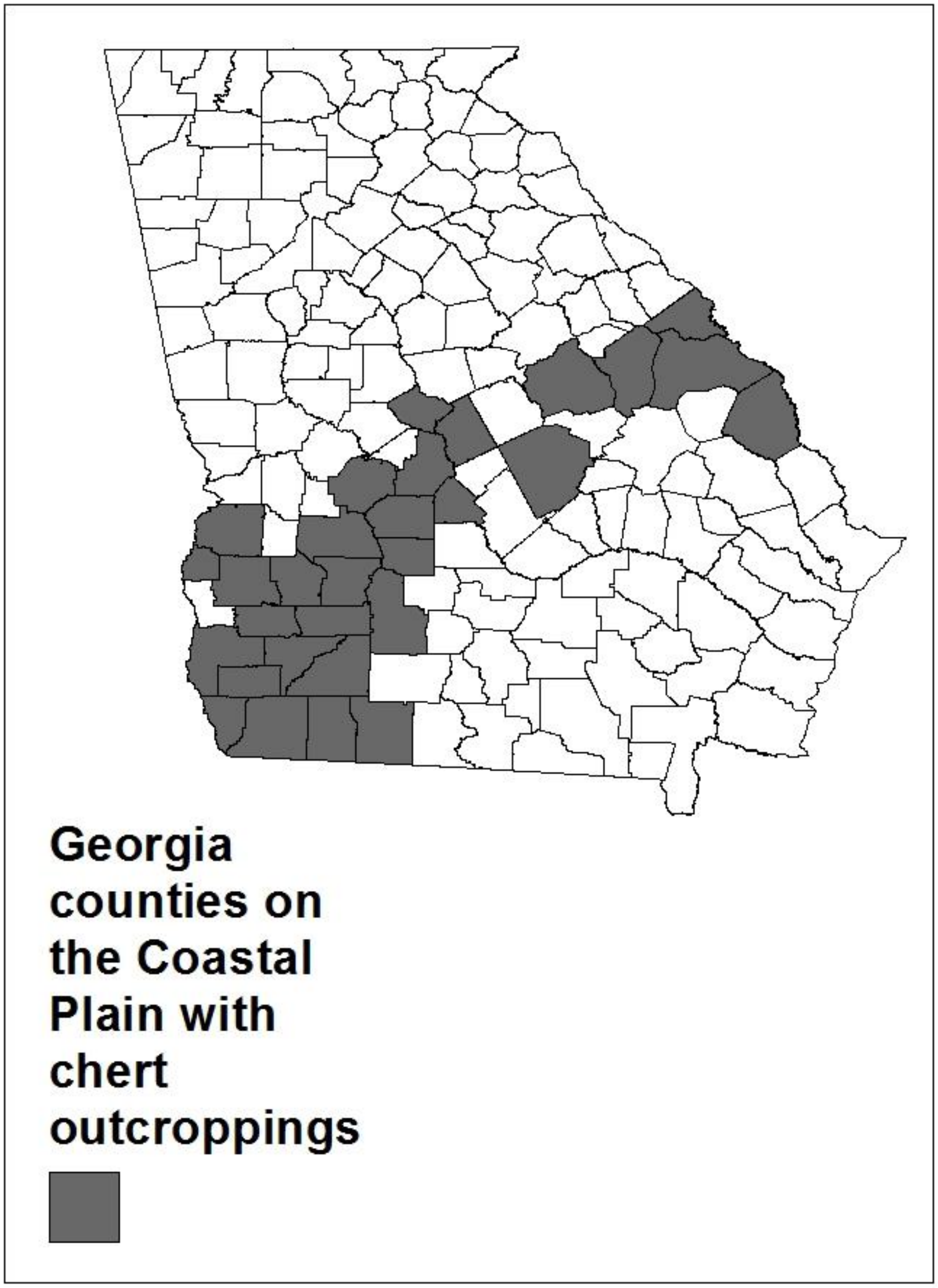

Figure 1-2. Counties on the Georgia Coast Plain with chert outcroppings after Elliot and Sassaman 1995 (Elliot and Sassaman 1995: Figure 3).

CHAPTER 2: CONTACT AND CONFLICT ON ST. CATHERINES ISLAND

The European exploration in the New World began with the Spanish-funded voyage of Christopher Columbus in 1492. With expeditions penetrating much of the Caribbean and Central America, the Spanish eventually took control of the American Southeast with the establishment of the colony of *La Florida*. The Spanish would later obtain much of the western portion of North America extending jurisdiction as far as California. Early interactions between Europeans and the indigenous people of the Caribbean engendered a dichotomized image of Columbus' *los indios* as a people at once both noble and vicious (Thomas 2001). Exaggerated stories of the Arawak and Carib people encountered by Columbus' expedition helped rationalize the Christianization and enslavement of a people, who came to be known as Indians, within the jurisdiction of the Spanish Crown during the early years of Spanish exploration of the Western Hemisphere (Thomas 2001: 9).

Since the Spaniards had begun their colonization of the New World, indigenous people resisted enslavement, land seizure, and Christianity in the face of rampant European-introduced diseases. Eventually, Indians of the American Southeast would be forced to reckon with Catholicism and other institutions of the Spanish regime. Technological choices are very much a component of aboriginal navigation of such colonial pressures. However, the unabated use of stone or the inclusion of metal does not lend any predictability to the social, economic, or political transformative processes at work (Cobb 2003). Thus, it is prudent to provide a background of Spanish La Florida and the mission system to convey the socioeconomic and sociopolitical pressures at work.

The Spanish in the New World

The first European contact with Indians in the New World is credited to the 1492 voyage of Christopher Columbus. Columbus arrived in Hispaniola (Figure 2-1) where the region's principal chief, Guacanagarí, and his people made peace with the Spaniards. Guacanagarí built rapport with Columbus by salvaging supplies and offering shelter to his men (Deagan and Cruxent 2002b: 14-15) after the *Santa Maria* ran aground on a sandbar (Morison 1940). Columbus returned to Spain with a few indigenous Taínos, and left a small group of men in a native village on Hispaniola (Morison 1940).

After showing off Taíno Indians and exotic birds to Spaniards, Columbus amassed support from King Ferdinand and Queen Isabela for a second expedition to explore the unfamiliar lands for riches (Deagan and Cruxent 2002b: 15). When he returned nine months later the encampment, known as La Navidad, was found destroyed and the small group of men slain (Deagan 1987b; Deagan and Cruxent 2002b). According to Chief Guacanagarí, some men died of disease, internal quarrels, and mishaps in the interior, and the rest were massacred by a rival Taíno group (Deagan and Cruxent 2002b: 21). The attack was the first documented episode of Indian resistance to European colonization in the New World (Deagan 2011).

Between 1503 and 1542, the institution of *encomienda* allowed Spaniards to utilize tracts of land and exploit the inhabiting Taínos in exchange for instruction in Christianity and protection (Deagan 2011: 46; Deagan and Cruxent 2002b: 202-203). *Encomenderos* only owned the labor, not the Indians themselves, they could not be inherited like property, and were bound only to the land (Yeager 1995). However, in many cases Indians were forced into labor. *Repartimiento* in Hispaniola allowed Columbus to sanction land to settlers who would work a Spanish landholder's property for four-year terms (Deagan and Cruxent 2002b: 202). Columbus modified repartimiento and created a system that treated the Indians more like slaves than indentured workers, a move that would eventually result in Columbus' prosecution and the outlaw of the institution (Deagan and Cruxent 2002b). These colonial institutions incited indigenous peoples to engage in both violent and subtle resistance in the Caribbean (Deagan 2011).

Although these institutions had a strong presence in Hispaniola, archaeological evidence indicates that there was remarkable continuity of Taíno social and communal practices, evidenced by indigenous material culture lasting, "…well into the sixteenth century" (Deagan 2004: 621). The European presence in the New World was unwelcomed by indigenous populations. Major episodes of disease and depopulation occurred as early as initial land claims in the Caribbean by the Spanish (Dobyns 1983; Lovell 1992). Natives fled to other areas in the Caribbean, also seeking refuge in areas such as Cuba and Florida in response to (and spreading) early epidemics (Purdy 1988) such as syphilis, malaria, modorra, and small pox (Cook 2002: 350) and likely caused immense psychological and cultural shock. Although bioarchaeological data indicates the New World was not without epidemics, intercommunity violence, and warfare prior to the arrival of Europeans (Larsen 1994), large-scale depopulation by disease would have likely rattled indigenous cosmologies.

La Florida

Exploration of La Florida came some twenty years after the establishment of La Isabella in Hispaniola and two years after the 1511 Spanish invasion of Cuba. Sixteenth century La Florida encompassed much of what is now the American Southeast, extending from the Florida peninsula northward to Delaware, and west beyond the Mississippi River (Figure 2-1). Seven major attempts were made to settle La Florida with explorations beginning at various locations along the Gulf and Atlantic coasts (Lyon 1981). European expeditions encountered unfamiliar terrain, peoples, and climate, which hampered successful settlement attempts. Most expeditions were motivated, at least in part, by private acquisition of land (Lyon 1981). Every venture into La Florida accumulated information about the Indians encountered. Early Spanish soldiers and missionaries encountered three major groups, the Timucua, the Guale, and the Apalachee, while attempting to settle La Florida (Figure 2-2). Early amateur ethnographies were vital for future settlements but also represent significant portions of the ethnohistoric record archaeologists draw on today.

The first direct contact with Indians of the American Southeast was documented during Juan Ponce de León's first expedition to North America in 1513 (Sturtevant 1962). Ponce de León was in search of an island called *Bimini* that was believed to be located north of the Bahamas; he renamed the landmass he discovered La Florida after the *Pascua Florida* (Feast of Flowers) (Antonio de Herrera in Davis 1935a). Initial contact with the Indians of Florida began with, "immediate and decisive," resistance (Deagan 2011: 49).

Antonio de Herrera (1559-1625), using access to secret and now lost documents, recorded in great detail Ponce de Leon's 1513 voyage and the April 2 founding of La Florida (Davis 1935a). The account tells of a series of small-scale fights between Ponce de León's expeditionary forces and Florida aboriginals (Herrera in Davis 1935a). The voyage traced the eastern edge of the Florida peninsula, along the Keys, and north to Charlotte Harbor; he then headed to Cuba and returned to the Bahamas upon completing the survey of the perimeter of La Florida (Davis 1935a).

In 1521, Ponce de León decided to return to La Florida and obtain its land (and people) in the name of the Spanish Crown using a contract previously granted by the late King Ferdinand, and reapproved by his successor, King Charles V (Davis 1935b). The contract permitted a more intense exploration of Florida's interior, compelling Ponce de León's party to conquer and convert the natives to Catholicism. If the Indians refused Catholicism, Ponce de Leon was authorized to, "…make war and seize them and carry them away for slaves…" (King Ferdinand, Davis 1935b: 54). This attitude typifies the treatment of Indians by early Spanish explorers. Ponce de León's expedition ended abruptly when he was mortally wounded by an arrow during a skirmish between his soldiers and Florida natives (Davis 1935b: 62). This event marks the end of "…the initial missionary effort in La Florida" (Thomas 1990b: 370).

That same year, Pedro Quexo and Francisco Gordillo entered Chicora territory on an expedition to capture Indians as slaves along the Santee River in South Carolina (Milanich 1990). One Indian, Francisco Chicorano, was taken to Spain where he related stories of his homeland spawning the Chicora Legend, which intensified Spanish and French interest in the area rumored to be rich with natural resources (Hoffman 1984). Motivated by the Chicora Legend, Lucas Vásquez de Ayllón in 1526 led and sponsored the first colonization attempt on the Atlantic coast in Sapelo Sound in Guale Indian territory (Milanich 1990). However, the settlement may have been closer to Santa Elena or Port Royal Sound, South Carolina, where Ayllón made contact with the Guale Indians of the Georgia coast (Jones 1978). Ayllón's colony ultimately failed due to illness, cold, and the Guale's reluctance to supply the hungry colonists with food (Milanich 2006: 62).

On June 27, 1527 Pánfilo de Narváez, a veteran of the 1511 Cuban conquest, began a self-funded expedition believed by some to be "…the greatest failure…" of the conquest of La Florida (Marrinan *et al* 1990: 71). Narváez set out to unite western La Florida with the east coast of New Spain (Mexico), which would have extended Spanish authority further northward and eastward (Milanich 2006). After being held up in Cuba by poor weather for nearly a year, the expedition finally entered La Florida, at what they believed was *Bahía Honda* (near Tampa or Charlotte Harbor, FL), and initiated a northward march through west Florida (Marrinan *et al* 1990). However, the landing area was misjudged due to an error in the ship's charts resulting in a misdirection of a much needed supply ship. When the ship stopped to gather information from Indians on shore, four Europeans were captured and abandoned by the supply ship (Milanich 2006: 64).

Álcar Núñez Cabeza de Vaca was second in command to Narváez, and his written accounts of the journey describe Narváez's failed attempts at amicable relationships with the Indians (Marrinan *et al* 1990). In June of 1528, Apalachee Indians repeatedly attacked the expedition. Only four of the 300 men, including Cabeza de Vaca, survived the Narváez expedition, escaping via the Gulf coast to Mexico (Marrinan *et al* 1990). Narváez's presence may have had cosmological impacts on the Native American groups he encountered through the introduction of new diseases, military tactics, and brutality (Marrinan *et al* 1990). Narváez's hostile interactions with the

Apalachee made Hernando de Soto's 1539 exploration into the interior of the American Southeast all the more onerous (Marrinan *et al* 1990).

However, de Soto was better supplied, more informed than Narváez, and was able to communicate, "…with the Uzita and other Tampa Bay native groups… when his men rescued Juan Ortiz, the Spaniard abandoned [during the Narváez expedition]…" (Milanich 2006: 69). Juan Ortiz had lived among the Tampa Bay Indians for eleven years and assisted with communication between de Soto's men and the natives. However, as they moved north into Apalachee territory the de Soto party constantly encountered hostility (Marrinan *et al* 1990). De Soto eventually abandoned the Apalachee town of Anhaica (presently Tallahassee) and moved north into Georgia on March 3, 1540 (Ewen 1990).

De Soto's party continued through Georgia, the Carolinas, Tennessee, back down south through northwestern Georgia, through central Alabama and into Mississippi, then later into Arkansas (Hally *et al* 1990; Hudson *et al* 1985; Hudson *et al* 1990; Milanich 2006: 68-76). The odyssey ended about a year after de Soto's death by illness on June 20, 1542. The party, now led by Luis de Moscoso de Alvarado, returned to Mexico with only about half the number of men surviving (Milanich 2006). Despite the death of most of de Soto's men, the Chicora Legend endured and interest in Santa Elena was rejuvenated as a potential port through which goods could be transported by land from Mexico and then shipped to Spain (Milanich 2006).

In the 1550's, interest in the Chicora Legend was renewed by Francisco López de Gómara's *História General de las Indias*, which purported vast amounts of wealth in the Santa Elena area (Figure 2-3). The publication was available throughout Europe and referred to the Chicora area as Cape Santa Elena (Hoffman 1984: 426). It has been suggested, based on documentary evidence, that the Spanish Crown's main intent was to bring Catholicism to the natives inhabiting Chicora (Hoffman 1983), but the tales of riches probably enticed most explorers. Spanish interest in Santa Elena also sought to repel their French rivals from intruding further south into Spanish territory (Hoffman 1984).

In 1562, Jean Ribault had built Charlesfort at modern Port Royal Sound, South Carolina and left a party there while he returned to France (Hoffman 1984; Lyon 1981; Wenhold 1959). The men who remained at Charlesfort were afflicted by, "…hunger, a destructive fire, disillusionment, and dissension…" (Cumming 1963: 30). In an attempt to survive, a deserter party set sail for France in a haphazardly made boat, resorting to cannibalism to avoid starvation on the journey (Cumming 1963). One Charlesfort deserter, Guillaume Rouffi, decided to remain on shore and live with natives for a few years before eventually playing a vital role in Pedro Menéndez de Avilés' pursuit of Ribault.

Two years later in June 1564, the French sent Rene de Laudonnière to establish Fort Caroline on the southern side of the St. John's River in present day Florida (Figure 2-3; Davis 1933). Under Laudonnière's command, Fort Caroline was witness to malaria (Davis 1933), deserters, and mutiny (Gorman 1965). As the settlers were preparing to abandon Fort Caroline, an Englishman, Sir John Hawkins, arrived on August 5, 1565 and sold a ship and some supplies to the French (Gorman 1965). Ribault arrived at Fort Caroline shortly after with his own men and supplies (Davis 1933).

Pedro Menéndez de Avilés was contracted by Phillip II to repel the French corsairs who wreaked havoc on Caribbean settlements (Milanich 2006: 82). Menéndez was already planning on travelling from Spain to the New World when he received news in 1563 that his son, Don Juan, had been shipwrecked somewhere on the east coast of La Florida (Bellamy 1927). Menéndez's motivations were personal (i.e., to find Don Juan) and fiduciary—but he was also interested in exploration, fighting pirates, and spreading the word of God to Indians (Gradie 1988: 136). Menéndez's expedition was partially funded by the Spanish Crown (Lyon 1981: 282) and would help Spain tighten its grip on La Florida.

Menéndez arrived in La Florida in 1565. Following a tip from Indians on Anastasia Island, he discovered four of Ribault's ships near the mouth of the St. John's River and entered into a northward pursuit (Davis 1933). The French escaped Menéndez, who then turned back and began to set up camp on Anastasia Island marking the beginning of the settlement at St. Augustine in 1565 (Davis 1933; Deagan 1983). On September 20, 1565, Menéndez attacked Fort Caroline by land, which was made easy because Ribault planned an ultimately unsuccessful attack by sea leaving Fort Caroline vulnerable (Davis 1933). The fort was further weakened because Laudonnière had previously ordered his men to deconstruct the fortress walls for supplies to build a ship to abandon Fort Caroline (Gorman 1965).

After slaying all but the women and boys younger 15 years old (about 140 men), Menéndez renamed the fort San Mateo and returned to St. Augustine (Davis 1933). Ribault's fleet, intending to attack by sea, was blown off course and marooned south of St. Augustine. From here, Ribault along with roughly 350 Frenchmen, began to march north, back to Fort Caroline, but were intercepted by Menéndez; forced to surrender; and then massacred in groups of ten at Matanzas Inlet (Davis 1933; Lyon 1971). Menéndez's brutality has been excused as dutiful loyalty (Bellamy 1927) and justified by the Spanish Ambassador at the time accusing the massacred French of being pirates (Gorman 1965). The event at Matanzas Inlet marks one of the most violent documented episodes during the conquest of La Florida.

When Menéndez landed at St. Augustine, he took possession of Florida in the name of the Crown of Castile, which granted Spain full jurisdiction over its land, minerals, and its native people (Lyon 1990: 286). By 1566 the first Spanish town was established at St. Augustine. Santa Elena also became the capital city of La Florida in 1566. Archaeological investigations on Parris Island, South Carolina have uncovered both Spanish and earlier French occupations (DePratter 2009; South 1988). Santa Elena was abandoned in 1586 (Conner 1926: 110-111). The townspeople at Santa Elena were relocated to consolidate the Spanish presence in La Florida because Spain's Council of the Indies believed their numbers were spread too thin (Francis and Kole 2011: 22).

The settlement of St. Augustine undoubtedly posed a threat to the area's indigenous group, the Timucua; however, it may not have been the military presence of St. Augustine that threatened the autonomy of Timucuan life as much as the first Catholic mission, Nombre de Dios (Gannon 1965b). Archaeological research in St. Augustine (Deagan 1981) has revealed significant integration of European and indigenous culture (Deagan 1973, 1983, 1987a, 2003, 2009; Reitz *et al* 2010). Following Spanish ideology, Menéndez included in his plan (Lyon 1988; Milanich 2006:

86-89) the establishment of Catholic missions to convert the natives and render them loyal subjects of the crown. The mission system was the means through which miscegenation occurred in St. Augustine during the 16th and 17th centuries (Deagan 1973) fostering the integration of disparate customs and visible in archaeological deposits.

Catholic Missions in La Florida

When word of Columbus' discoveries reached Europe, the indigenous people of the New World had begun to take on a prescribed identity created through rumors and myths. Columbus mistakenly believed that the land he found was India and named the people inhabiting the area los indios. Despite eventually recognizing the error, Colombus' misnomer, "…would mask the enormous complexities and variability of Native American people by grouping them together into a vastly oversimplified pan-tribal construct" (Thomas 2001: 4). The early aboriginal people Columbus encountered—the Arawaks, described as peaceful, innocent, and delicate by Bartholomé de las Casas—were viewed as, "…potential vassals and Christians-to-be, fully deserving of royal protection," by Queen Isabela and King Ferdinand (Thomas 2001: 9).

Ironically, Las Casas' blunt recordings of the Spaniard's treatment of Indians in the Caribbean culminated into an the infamously exaggerated *la leyenda negra*, or the Black Legend. Subsequent translations effectively smeared the reputation of the Spanish and eventually bolstered anti-Spanish support for the English seizure of Jamaica during the Spanish-American War (Washburn 1964: 221). Although Las Casas' description referred to the Indians he encountered in the West Indies, Isabela and Ferdinand maintained the ideology that anyone with a soul, even the pagan peoples of La Florida, could become a Christian.

Through Catholicism, the Indians would learn to be more European, and their belief in God would aid in their rendering obedience to the Spanish Crown (McEwan 1993, 2001). The Spanish viewed their culture as superior and believed that Indians could be elevated above their innocent state to the likes of Hispanics through Catholicism (Gradie 1988). A string of missions would eventually line the Atlantic coast and stretch west across north Florida into the panhandle (Figure 2-4). Jesuit and Franciscan missionaries attempted to convert Indians to Catholicism. Violent and subtle forms of native resistance to Catholicism (Francis and Kole 2011), as well as friar accommodation of indigenous customs are evident in ethnohistoric documentation (Jones 1978; Worth 1995) and archaeological evidence (Deagan 2011; Larsen 1990; McEwan 2001; Thomas 1987, 1993, 2010b, 2013).

Jesuit missionaries arrived just after the 1565 establishment of St. Augustine and the founding of Nombre de Dios (Gannon 1965b) marking the beginning of the mission period in La Florida (Sturtevant 1962: 61). The Jesuit mission attempt was short lived, lasting only eight years. Letters written by Jesuit priests describe scattered settlements and low population densities with poor soils, and a general reluctance of Indians in accepting Catholicism (Larson 1978, 1980). Intertribal tension, strained resources, and the disposition of Indians are discussed in Jesuit correspondence (Larson 1978, 1980; Washburn1964). The unfavorable climatic conditions, dispersed settlements, and intergroup tension were likely a result of a drought lasting from about 1562 to 1571 (Blanton and Thomas 2008: 803). One letter by Father Rogel describes the failure of the Jesuits in Guale territory and how after about forty months, only seven Indians were baptized (Sturtevant 1962: 58). Ultimately the Jesuits withdrew in 1572 following the murder of several priests in the Chesapeake Bay area (Gradie 1988).

In 1573, the Franciscans initiated a gradual expansion into Indian land with the establishment of a chain of frontier mission settlements extending from Guale territory along the coastal Timucuan range and west toward Apalachee (Figure 2-4; Sturtevant 1962: 58). The Laws of the Indies mandated settlement layout and planning (Thomas 1987). Mission settlements were established in densely populated so that Catholicism could be spread to greater numbers to maximize converts. It was in these mission settlements where teachings of Catholicism were most intense. Friar records of interactions with Indians provide an incredible wealth of ethnohistoric information about Native American cultures, intertribal relationships, and interactions between natives and Spanish authorities (Francis and Kole 2011; Jones 1978; Worth 1995); many of the ethnohistoric documents focus on friar interactions with Guale Indians on St. Catherines Island.

Named after the chiefdom centered on the island, Mission Santa Catalina de Guale is located on St. Catherines Island and was in use from about 1580 through 1680 (Thomas 1993: 2). Three main Guale chiefdoms dominated the Georgia coast (Figure 2-5), each governed by one of two principal towns. On the Georgia coast, the Guale, *peninsulares* (Spanish-born Europeans), and *criollos* (people of Spanish descent that were born in the New World) (Deagan 1983: 30-34) lived in a village surrounding the Franciscan mission. The mission complex was where the friars lived, prayed, and ate, and was in the heart of a village largely inhabited by Guale Indians. The town layout placed the sacred structures in the middle of a secular village and likely influenced the behaviors of residents of Santa Catalina de Guale.

Indigenous peoples at Santa Catalina de Guale came to inhabit a radically different social landscape than pre-contact. Exploiting a diverse range of microenvironments, the Guale utilized an intimate knowledge of local resources to engage in exchange networks with other groups contributing to a varied regional economy.

The Guale and St. Catherines Island

The Guale were a Muskhogean-speaking people (Booker *et al* 1992; Swanton 1922) first encountered by Ayllón during the initial exploration of the legendary land of Chicora in 1526. The Guale likely had interactions with the French during the occupation of South Carolina's Port Royal area at Charlesfort from 1562-1563 (Jones 1978: 181). In 1566, "…the Guale were exposed to a long and intensive period of Spanish colonization" (Thomas 1987: 55).

St. Catherines Island is one of a chain of Georgia's Golden Isles separated from the mainland by marshes and tidal estuaries. Native Americans inhabited a range of microenvironments on the Georgia Bight (Thompson and Thomas 2013) over the last 5000 years, which are divided into seven cultural periods, beginning between B.C. 2560-2030. The dates are derived from radiocarbon dating of shell collected during an island-wide transect survey (Reitz *et al* 2012; Thomas 2008b). The shell dates were calibrated to correct for regional variation in atmospheric and marine C^{14} levels that would affect shell deposited at different times, which provide more reliable dates than those derived from carbon samples alone (Thomas 2008b: 344-371). Ceramic assemblages within the dates derived from shell represent temporal and cultural intervals of the Georgia coast spanning Archaic, Woodland, Mississippian, and contact eras (Table 2-1; Deagan and Thomas 2009; Guerrero and Thomas 2008; Thomas 2008b: 404-434).

Table 2.1. Cultural periods and chronological age based on calibrated radiocarbon dates (Reitz *et al* 2010). (a) based on historic documents

Period	Chronological age (in 14C years)	Cultural
Altamaha	A.D. 1580-1700a	First Spanish
Irene	cal A.D. 1300-1580a	Mississippian
St. Catherines	cal A.D. 800-1300	Mississippian
Wilmington	cal A.D. 350-800	Woodland
Deptford	cal 350 B.C.-A.D. 350	Woodland
Refuge	cal 1000-350 B.C.	Woodland
St. Simons	cal 2560-2030 B.C.	Archaic

Microenvironments fostered specialization in resource collection, production, and distribution, which may have influenced political relationships between Guale chiefdoms (Figure 2-5) and neighboring tribes (Thomas 2008a: 22-25). Much of what is known about the Guale today is based on ethnohistoric interpretations of letters written by Jesuit and Franciscan priests stationed around the Georgia coast. These first-hand accounts of Guale settlement patterns and subsistence strategies have been interpreted differently and result in conflicting views of Guale life ways (Thomas 1990b: 359-362; 2012: 19-20).

Larson viewed ethnohistoric Jesuit documents as reliable sources to reconstruct Guale settlement patterns (Larson 1978). He argued that infertile and poorly draining coastal soils hindered agricultural development and forced the Guale to live a seasonally mobile, highly dispersed lifestyle, hunt terrestrial game, and to exploit marine and estuarine resources (Larson 1978). This position took the Jesuit account at face value. The Jesuits also held that the Indians had no interest in working the land or domesticating crops (Washburn 1964)

Contrary to Larson (Larson 1978), Grant Jones believed that:

> …Guale horticulture… was sufficiently productive, in combination with other subsistence and productive activities, to account for the presence of permanent towns, a chiefdom level of social organization, temporary federations of chiefdoms under centralized leadership, and long distance trade networks (Jones 1978: 179).

Jones' view suggested that the Jesuit accounts reflected the missionaries discontent with their placement in Guale territory, and the dispersed nature of the settlements may be due to aboriginals fleeing the area (Jones 1978). He cites the forced tribute of maize to Santa Elena and an epidemic, from 1569-1570 allegedly caused by the priests, as reasons for the Guale to avoid contact with the Jesuit missionaries (Jones 1978: 191).

Accumulated evidence from archaeology, behavioral ecology, sclerochronology[1], and zooarchaeology illuminates the truth behind the Jesuit accounts of aboriginal settlements (Reitz *et al* 2012). Data collected from all over St. Catherines Island, ethnohistoric evidence, and human behavioral ecology modeling confirms (Thomas 2012: 28) earlier assertions that by A.D. 1300 the Guale were relatively sedentary relying on cultivated maize with a centralized social organization (Thomas 2008c: 1095-1136). Blanton and Thomas (Blanton and Thomas 2008; Thomas 2012: 28-29) point out the shift in settlement patterns of the Guale, as witnessed by archaeological investigations and the Jesuits (Jones 1978), is likely explained by a crippling 16th century drought. Despite the incongruence of Jones' (Jones 1978) and Larson's (Larson 1978, 1980) interpretations of Guale settlement patterns, the accrual of ethnohistoric

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[1] Sclerochronology considers shell growth patterns contingent on seasonal extremes of water temperature fluctuation. This type of dating can assist in season of capture studies and understanding seasonal settlement patterns where shellfish was collected (Quitmyer *et al* 1997).

and archaeological evidence serve as excellent syntheses of information regarding Guale subsistence practices and sociopolitical organization. This information supports assessments of Guale agency during incessant religious conversion efforts and other European-imposed pressures.

The Guale likely resided in permanent settlements on the banks of large rivers with smaller dispersed enclaves that occupied a diverse range of microenvironments (Thomas 2008a: 22). Guale agriculture intensified during contact because of French, and later Spanish, demands of large maize quantities (Larsen 1990; Larson 1980: 207). Cultivation areas were rotated and would have been situated to the rear of the town center where maize, beans, squash, and melons were grown (Thomas 2008a). Corncobs have been recovered from mission period pueblo sites, such as Fallen Tree (Brewer 1985; May 2008), and were burned in smudge pits in council houses (McEwan 1991). Maize was stored in granaries and distribution of food stores were controlled centrally by the chiefs (Jones 1978).

Guale coastal groups primarily exploited fish in large numbers, evidenced by zooarchaeological remains from Late Prehistoric and Mission-period sites (Reitz *et al* 2010). Ethnohistoric descriptions are the best sources of information for fishing techniques of contact period aboriginals in the southeast because of the little archaeological evidence available pertaining to capture technology (Larson 1978: 15). However, seasonal availability, habits, and habitats of fish can assist in approximating whether the species was collected through mass (nets, baskets, or weirs) or individual (hooks or spears) capture techniques (Reitz *et al* 2010: 234-235).

The Guale hunted a variety of terrestrial mammals. Reitz and colleagues have analyzed and synthesized interpretations of faunal remains collected from the mission and pueblo on St. Catherines Island considered in this study (Reitz *et al* 2010). Inter-site comparisons between Mission Santa Catalina de Guale, the pueblo, Fallen Tree, and the protohistoric site Meeting House Field (Reitz and Dukes 2008; Reitz *et al* 2010) indicate an increase in whitetail deer consumption (*Odocoileus virginianus*) during contact period. This is partly in response to the culturally formed dietary demands of the Spanish but also for the trade of skins (Pavao-Zuckerman 2007; Spielmann *et al* 2009; Thomas 2008a: 139-197). Ethnohistoric accounts suggest that hunting may have increased during winter months to offset decreased harvest (Jones 1978). Meanwhile, deer on St. Catherines are more vulnerable to hunting between late September through January because of their concentration in oak forests and seasonal accumulation of fat stores from mast (Thomas 2008a: 139-197).

Hunting was likely performed with a stalking and ambush approach (Larson 1980: 172). A drawing by Jacques le Moyne de Morgues, a French survivor of the massacre at Matanzas Inlet, depicts Timucua Indians (the southern neighbors of the Guale) disguised in deerskins using bow and arrow to ambush unsuspecting deer (Lorant 1946: 85). Larson also indicates that black bear (*Ursus americanus*) were occasionally hunted (Larson 1980: 173). Settlement locations along rivers and tidal creeks reflect the hunting, foraging, and horticultural strategies employed by the Guale (Jones 1978). The formation of heaping shell middens consisting mostly of oysters (*Crassotrea virginica*), but also clam, whelk, fishes, and terrestrial fauna render areas of subsistence activity archaeologically conspicuous (Larson 1980: 69).

Although probably not as important as oysters, clam species (*Mercenaria mercenaria* and *M. campechiensis*) and gastropods including whelk and conch were also collected for food (Larson 1980). Whelks were harvested opportunistically when encountered near oyster beds where they hunt (Larson 1980). The shells of whelk species made the animal a better raw material for tools than a food source in a habitat devoid of stone resources (Larson 1980: 73). Some examples of whelk species (*Busycon contrarium, B. carica,* and *B. canaliculatum*) fashioned into tools have been recovered on St. Catherines Island (Thomas 2008b: 605-609).

Shell was an important component of many coastal aboriginal groups in the American Southeast. Coastal areas in the American Southeast are limited in knappable stone materials (Elliot and Sassaman 1995; Goad 1979) and there are no stone resources on St. Catherines Island. Any lithics recovered archaeologically at many coastal sites in the American Southeast are acknowledged as having been deposited after making a journey through long-distance trade or resource gathering expeditions (Thompson and Worth 2010). Lithics recovered from Fallen Tree, a Guale village area contemporary with the Mission at Santa Catalina de Guale (May 1985, 2008), indicate inhabitants utilized stone technology for some tasks. Many of the recovered artifacts are quite small in size (May 2008: 742-756) suggesting considerable reuse of stone tools occurred, likely as a response to stone being an expensive and hard-to-acquire resource.

Evidence from the contact-period King site in Georgia, suggests some individuals within the Mississippian polity of Coosa were specialized flintknappers and were high status based on the inclusion of European-made grave goods (Cobb and Ruggiero

2003). Use-wear analysis of expedient and retouched lithic tools from domestic contexts at the King site supports the use of stone for a variety of household tasks (Cobb and Ruggiero 2003). The lithic assemblage from Fallen Tree is not associated with any structural evidence (Thomas 2009a, 2010a). However, ongoing investigations on St. Catherines Island by the American Museum of Natural History may sharpen images of the pueblo.

The presence of lithics on St. Catherines Island may also indicate that the relationships between mainland and island-dwelling people were maintained at least up until contact. Jones points out that the Guale were closely associated with Muskhogean linguistic groups to the west and northwest (Jones 1978: 186). These inland areas correspond to counties in modern Georgia's coastal plain region known to contain chert quarries (Figure 1-2; Goad 1979). Access to imported goods may have been restricted to high-ranking individuals (Wesson 1999).

The abundance of shell on the coast and the high costs of maintaining long distance social relationships necessary for importing stone (Thompson and Worth 2010) are two of the major factors driving the use of shell as a raw material choice for tools. Both coastal and inland peoples utilized and fashioned shell into non-utilitarian forms (Eyles 2004). The non-utilitarian functions of shell include decorative forms, such as jewelry and beads (Eyles 2004) are among forms distributed by prehistoric trade networks (Trubitt 2003).

Typologies of shell tools for the American Southeast have documented a wide range of forms (Eyles 2004; Marquardt 1992). Assignment of the tool's function is often rudimentary (i.e., cutting-edge tool) confounding our understanding of the tool's use.

The abundance of shell encountered during midden excavations makes it difficult to identify a tool, and the poor preservation of hafting elements, such as wood or hides, obscures interpretations of a tool's function. Some of the more common functions suggested for shell tools include bodily adornment, woodworking, and cooking. However, whether Native Americans used shell as a butchery implement is seldom discussed (Brett 1974: 120; Laxson 1964; Luer 1986; Williams and Jones 2006).

It would appear that shell butchery implements are understudied because other tools such as shell hammers and celts are easier to identify since they are larger and conspicuously shaped. Shell hammers and celts are durable and it is more likely for them to survive in the archaeological record intact. Recognizing other types of shell tools can be difficult because some may have been used expediently, with little modification other than controlled breaking (O'Day and Keegan 2001). Furthermore, some shells may be mistaken as modified when chip marks are actually the result of predation by other marine animals, and nothing more (Luer 1986).

Shell tool typologies classify items with obvious modification and use wear. Expedient tools are more difficult to identify making the recognition of shell butchery tools challenging. A novel approach is necessary to determine if shells were used as butchery tools. Evidence of shell tool butchery can be found on butchered fauna (Choi and Driwantoro 2007; Toth and Woods 1989). Although this topic is explored in greater detail in chapter 4, it is vital to note shell's importance for utilitarian tools among Indian groups in the American Southeast and its role as a regional economic specialization.

Lithics and stone tool debitage have been found at coastal sites in Georgia, but they represent the minority of artifacts. Elliot and Sassaman suggest that "…In lieu of rock, coastal occupants fashioned tools from organic media such as bone, antler, and shell" (Elliot and Sassaman 1995: 11). The assumed costs of importing stone from far away and the local abundance of shell materials along Southeastern coastal sites have led many to argue that shell tools served as convenient substitutes for stone tools (Brett 1974; Carr and Reiger 1980; Elliot and Sassaman 1995; Laxson 1964; Lee 1989; Masson 1988: 314; Reiger 1981: 8; Thompson and Worth 2010). The archaeological record of southern coastal Florida shows a particularly well-developed shell tool industry (Marquardt 1992). Shell tools not unlike those described by Marquardt (Marquardt 1992) have been found on Saint Catherines Island (Thomas 2008b: 605-609). Lacking a reliable resource for stone and having access to exotic metal—a chiefly privilege (Wesson 1999)—during the European occupation of the Georgia coast, it is possible that shell was utilized for butchery tasks.

Extensive trade relationships existed between inland and coastal groups that transmitted exotic goods (Larson 1980). Much of the reliance on stone for coastal dwellers would have necessitated a strong trade relationship with inland peoples. However, such relationships could have become unstable during contact when natives fled Europeans and inadvertently spreading disease (Purdy 1988). Intertribal networks were also likely effected by Spanish institutions, such as reducción, where groups were 'herded' together to the coast to be more easily controlled and converted.

Ethnohistoric depictions of the Guale indicate close relationships between the coastal living groups and inland peoples (Swanton 1922). This relationship likely centered on trade and was perpetuated by economic specialization of various microenvironments along the Georgia coast. Three major chiefdoms appear to have dominated the area typically attributed to Guale control (Figure 2-5; Jones 1978). The chiefdoms themselves divided power between two principal towns (i.e., Asao-Talaxe), each with a resident leader, or *mico mayor*. The mico mayor retained more power over the other caciques second in command and power inherited matrilineally (Jones 1978: 200-201). Thomas points out, however, that “towns” may not adequately describe the social organization of the Guale, which is probably better represented as, “…a discrete group of people governed by a consensus, fully capable of changing locality, building new shelters, and planting fields in one place after another” (Thomas 2008a: 23).

Nonetheless, in 1526 the political environment of the Guale coast began to experience intense pressure with Ayllón’s arrival in Santa Elena, and later with the French occupation of Charlesfort (Figure 2-4). When the Spanish began to missionize the Indians of La Florida in the 1560s, the goal was to not only convert them to Christianity, but also to have the natives become loyal subjects of the crown (Milanich 2006). The order came down from King Phillip in Spain to Pedro Menéndez de Avilés to bring friars with him to La Florida to teach Catholicism to the Indians (Gannon 1965a). Early attempts at missionization by Jesuits were failures and they pulled out of La Florida after the 1571 massacre of friars in the Chesapeake Bay area (Gradie 1988). The Franciscans came some time later and extended a Catholic presence west of La Florida as well (Thomas 2013).

A New Sociopolitical and Socioeconomic Environment

Eventually political incentives brought indigenous leaders to accept Christianity and even request that their people be baptized. McEwan points out that, “the ethnohistoric evidence suggests that native leaders in Spanish Florida were willing to abandon some traditional priestly power when it no longer reinforced their chiefly authority" (McEwan 2001: 635). In typical Mississippian-era chiefdom tradition, the Guale chiefs—or micos—asserted their authority through the control of supernatural knowledge (McEwan 2001), and the redistribution of food (Jones 1978: 196) and goods (Francis and Kole 2011: 28). The control of surplus food and luxury goods was central to accumulating and retaining power among Mississippian rulers (Wesson 1999).

The political and economic footholds of the Guale and neighboring groups were threatened by drought (Blanton and Thomas 2008) and the arrival of European-introduced epidemics (Cook 2002; Dobyns 1983; Lovell 1992; Purdy 1988). In order to maintain authority during contact, Indian chiefs worked to strengthen relationships with the Spanish. Accepting Christianity on behalf of their people served to lubricate the influx of luxury goods that might be redistributed to commoners (Francis and Kole 2011). Pre-contact peoples traded for skins, exotic shells, and copper but after contact European cloth of various materials, steel and other metals, horses (Francis and Kole 2011: 28-29) and glass beads (Blair *et al* 2009) were introduced. The Spanish recognized this and even incorporated it into their settlement strategy (Garr 1991: 6).

Catholicism may have also threatened the stability of traditional Native American spirituality and cosmology. For example, McEwan suggests Christianity fundamentally undermined the Mississippian spiritual world by permitting more widespread access to ritual knowledge, thereby threatening the priestly power of the ruling class (McEwan 2001: 635). In essence, Indian sociopolitical and socioeconomic organization was threatened on two different fronts: exotic cultural materials and a radically different spiritual ideology. These pressures were not received by indigenous groups passively.

As early as 1576, the town of Guale had centered on St. Catherines Island following a rebellion orchestrated by Guale and Orista leaders lasting approximately four years (Jones 1978). The intensified Indian hostilities combined with a pirate raid of St. Augustine pressured the Spanish to abandon Santa Elena and consolidate Spanish administration (Jones 1978: 203). Franciscans erected Mission Santa Catalina de Guale on St. Catherines Island as early as 1587 (Thomas 1987). Ten years later, in 1597 a major revolt against the Spanish left several friars murdered and had lasting repercussions on Guale towns. Generally speaking, violence was quite rare, so much so that the 1597 uprising came as a surprise to the Spanish.

Accounts of Juanillo's revolt, as it came to be known by historians, provide ethnohistorians with a wealth of information about Spanish-Guale interactions, and for anthropologists, customs, socio-political information, and locations of potential archaeological sites. The Guale rebellion was orchestrated by a unification of Guale chiefdoms in violent protest against the teachings of Christianity (Francis and Kole 2011). It is believed that a dispute regarding the Franciscan condemnation of polygamy sparked the rebellion (Francis and Kole 2011). The rebellion resulted in five friars were murdered; one kidnapped and held for ransom; churches including Mission Santa Catalina de Guale on St. Catherines Island were burned to the ground; and a retaliation campaign ordered by Bartolomé de Argüelles, the governor of St. Augustine, to find and bring to justice the perpetrators (Francis and Kole 2011).

The campaign razed villages and maize fields leaving many Indians dead and in search of those who instigated the revolt. Coincidentally, the retaliation by the La Florida governor may have burned Mission Santa Catalina de Guale. The resulting magnetic anomaly that occurred from the firing of wattle and daub walls helped to pinpoint the location of the mission geophysically (Thomas 1987). Archaeological investigations of Santa Catalina de Guale have expanded our knowledge of this outpost.

Mission and Pueblo at Santa Catalina de Guale

David Hurst Thomas began the search for the mission on St. Catherines Island in 1977 by reviewing ethnohistoric accounts of La Florida missions and utilizing correspondence of friars stationed there (Thomas 1987). Previous excavations in the area now known to be the site of Mission Santa Catalina de Guale (i.e., Caldwell 1971) helped to focus the search. An island-wide transect survey was initiated to rule identify areas with higher concentrations of historic and contact-period occupations (Thomas 2008a, b, c). Geophysical surveys including ground penetrating radar and soil resistivity were conducted in the western and central part of St. Catherines Island where surface collections suggested a probable location of the mission (Brewer 1985; Thomas 2008a). Power auger and test pits covered a 10 hectare area and lead to more focused, large-scale excavations revealing the mission compound (Thomas 1987).

Archaeological deposits in the pueblo area, the surrounding native village (Brewer 1985; Caldwell 1971; May 1985, 2008; Thomas 2008b), have revealed both European and aboriginal artifacts indicating continuity of Native American cultural material. Shell artifacts, lithics, and aboriginal and European ceramics at the pueblo and mission reflect a complex demography on St. Catherines Island during the mission period and indicate preferences in material culture. Evidence of the use of aboriginal and European artifacts at the pueblo and their distribution in relation to the mission will suggest whether a preferred repertoire of ancestral or exotic cultural artifacts exists with any significant spatial patterning.

The archaeology at Mission Santa Catalina de Guale has demonstrated different cultural uses of space (Thomas 1987, 2009a, 2010a). However, excavation areas at Fallen Tree have been limited to small-scale block excavations (May 2008) and there is currently no structural evidence. Ongoing excavations on St. Catherines Island are refining our understanding of Fallen Tree. Recent excavations in the pueblo area were explorative (Thomas 2008b) and the structural evidence beyond the mission compound is mostly supported by geophysical surveys. Nonetheless the archaeology of Mission Santa Catalina de Guale (Thomas 1987) revealed structural features that divided sacred from secular (Thomas 2009a, 2010a).

Ordinances directed the placement of missions in relation to Indian villages (Thomas 1987) mandating that settlers maintain a degree of separation between secular and religious areas. The central plaza adjacent to the mission was to be the heart of the town (Garr 1991) so that all religious and secular activities would centralize people around the non-secular structures. Furthermore, a fresh water creek separates Fallen Tree from Wamassee Head and the mission complex and is another boundary between the religious edifices and the secular, Guale pueblo (Figure 2-6).

Thomas suggests Mission Santa Catalina de Guale may have had a military component with the presence of defensive stockades and may have housed Spanish soldiers (Thomas 1987: 76, 79). Royal ordinances mandated a garrison enclose the mission, and geophysical surveys indicate an enclosing structure, which is inferred to be a bastion (Thomas 2010a). Fallen Tree is separated from the mission complex by a fresh water creek which runs east-west is south of Wamasee Head and the mission complex (Figure 2-6).

Artifacts recovered from excavations at Santa Catalina de Guale can be considered with respect to these features using a geographic information system (GIS) and will be instrumental in understanding the role that natural and structural boundaries may have played in technological preferences. Spatially representing differential tool use between the mission and the pueblo will inform a discussion of the geographical and social divisions evident archaeologically, in historic documents, and on the landscape. Such data is pertinent to evaluating the area's demography and negotiation of colonial sociopolitical and socioeconomic pressures brought on by Europeans and Catholicism.

Agency, Identity, Resistance, and Ethnogenesis

The ongoing incorporation of traditional material culture into daily life in contact-period contexts can be interpreted in a number of ways. For instance, Cipolla and colleagues (Cipolla *et al* 2007: 59) show that post-contact use of chipped stone tools may be interpreted as resistance to Euroamerican culture. However, the interpretation can and should be refined to a discussion about memory and identity (Cipolla 2008). Indeed, the use of stone when metal was available through trade or other means may appear superficially as a form of resistance. On the other hand, such an assemblage occurring in a context of large-scale socioeconomic changes accompanied by violence and denigration calls for a contextual assessment.

Beck and colleagues consider the downfall of the Juan Pardo expedition into the interior Southeast not as Indian resistance to the Spanish, but, instead, recognize the destruction of Fort San Juan in Joara territory as an act motivated by Indian politics with the added effect of halting Spanish expansion (Beck *et al* 2011). In effect, the actions of the Indians were as much a reflection of intertribal relationships as they were a deterrent of the Spanish military. This essential refinement from resistance to agency demonstrates the importance of added scrutiny of previous historical assessments. On the other hand, added scrutiny can also confound more simplistic explanations. For example, the use of stone tool technology instead of metal in other circumstances may be a product of practicality and access than an active and calculated move to deter Europeans from continued expansion (Johnson 1997).

Cipolla and colleagues' study of stone tool use on 19th century Pequot reservation considered the sociopolitical situation of displaced Indians retaining the use of stone technologies, despite working in Euroamerican industries (Cipolla *et al* 2007). Following the massacre of Indians and subsequent relocation onto a 19th the century reservation, life on the Eastern Pequot settlement retained the identity and memory of ancestors through the use of traditional tools (Cipolla 2008). The continued use of stone tools was not borne out of resentment or resistance but was motivated by nostalgia, a retention of familial and ethnic memory, and was a practice of identity (Cipolla 2008).

Use of Native American cooking technologies in St. Augustine was understood to be a product of intermarriage and the inclusion of Indian women into Spanish households (Deagan 1973, 2003). Although identity may have played some part in the maintenance of traditional Indian techniques, it was also largely due to the demography of St. Augustine. The majority of Spaniards who settled the area in the 16th century were male soldiers. In St. Augustine there were few women of Spanish descent, but the Spanish Crown encouraged the miscegenation of Spaniards and Indians (Deagan 1973). In frontier villages there were almost no Spanish women (Worth 1995) and any Spanish men were either stationed soldiers or friars (Thomas 1987). Another factor contributing to the use of aboriginal cooking vessels in the household was the limited access St. Augustine had to European goods (Deagan 2003). Due to hefty taxes (Deagan 2007), piracy (Boyd 1936; Halbirt 2004; Wright Jr. 1960), and unfortunate shipwrecks, imported European wares were more costly items to acquire. This fact made aboriginal-made ceramics a more affordable solution, although some have suggested that Indian wares were produced to as trade or sale items in the market economy of La Florida (Saunders 2004, 2009).

Beginning around 1587 St. Augustine became the capital of Spanish Florida and was a center of Spanish commerce, administration, and military presence. There was a higher concentration of Spaniards at St. Augustine and cannot be easily compared to frontier outposts in La Florida. As evident from zooarchaeological investigations, the inhabitants of St. Augustine utilized domesticated animals to a greater extent than the frontier mission village on St. Catherines (Reitz *et al* 2010). This situation can most likely be explained not by the inhabitants of St. Catherines resisting European culture, but rather the greater availability of domesticate livestock at the more densely populated St. Augustine. Deagan suggests that Spanish men behaved more European in public arenas in St. Augustine because access to labor, land, and resources was contingent on sociopolitical and socioeconomic status (Deagan 1973, 1983, 2003). The Spanish administration in La Florida was urged to recognize the political organization of Indian groups and treat caciques with more respect (Deagan 2003). Therefore, while St. Augustine was not a frontier settlement, Spanish attitudes toward status likely extended into outposts like Santa Catalina de Guale.

As Charles R. Cobb states, “simply put, there is no single answer or predictable nature to either the decline or persistence of stone tools in the Contact era” (Cobb 2003: 2). The compilation of case studies presented in *Stone Tool Traditions in the Contact Era* (Cobb 2003) shows varied interactions between aboriginals and Europeans necessitates an appreciation for contextual perspectives; each one sensitive to contemporary socioeconomic and political circumstances, but also historical trajectories. As Cobb correctly points out, the “…*longue durée* of global economies…” is an essential component of any discussion of indo-European interaction (Cobb 2003: 3).

This study will therefore consider deeply ingrained Mississippian socioeconomic and sociopolitical traditions as a major factor in technological preferences. Behaviors associated with choices in material culture were likely influenced by tradition but were also conscious of Spanish colonial socioeconomic conditions. In effect, the colonial economy of Spanish Florida did not reflect an orthodox adherence to European standards nor was there a strict maintenance of traditional Indian values. Instead, an emergent economy adopted values from both Spanish and Indian socioeconomic traditions and can be demonstrated in spatially patterned evidence for heterogeneous butchery tool use at Santa Catalina de Guale.

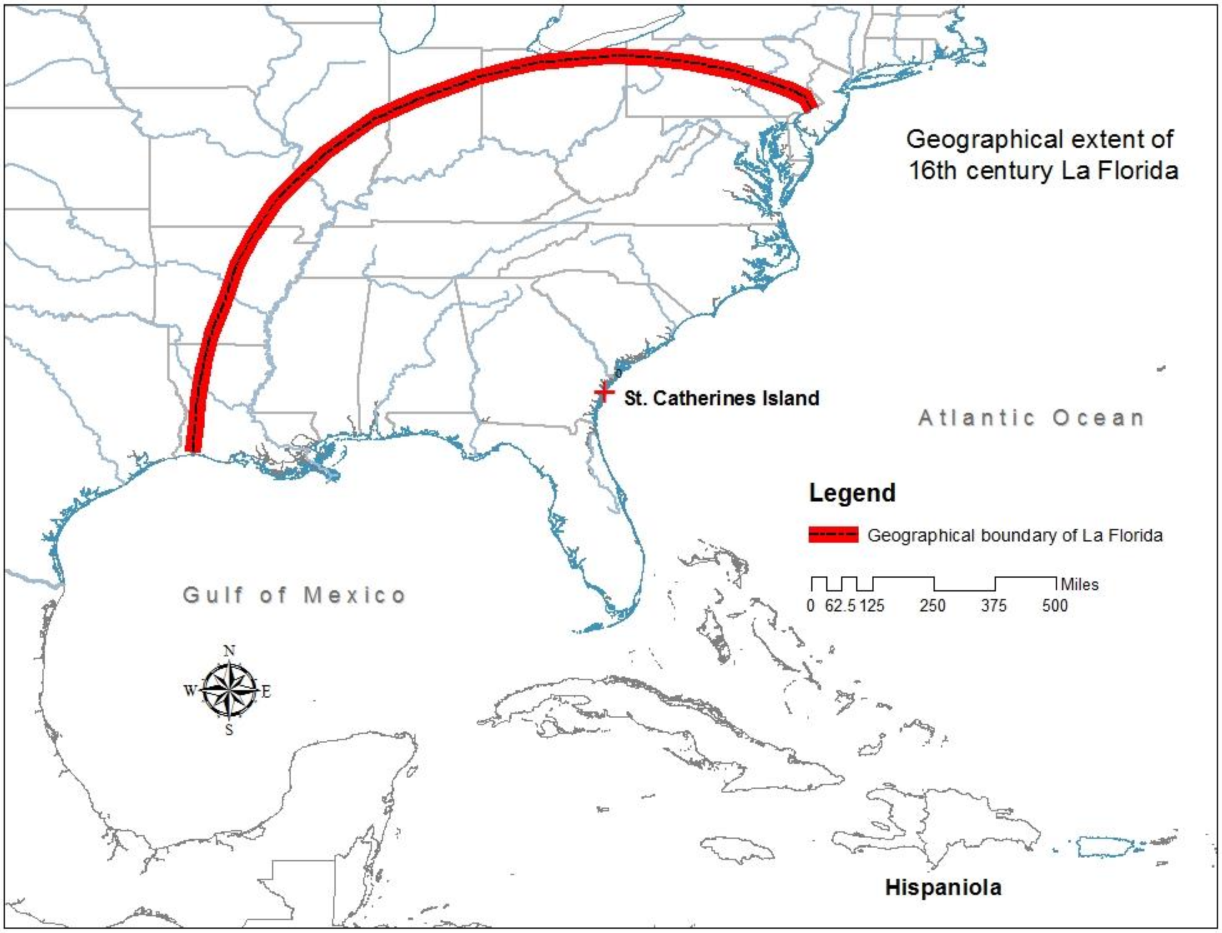

Figure 2-1. Geographical extent of 16th century La Florida, showing Hispaniola and St. Catherines Island.

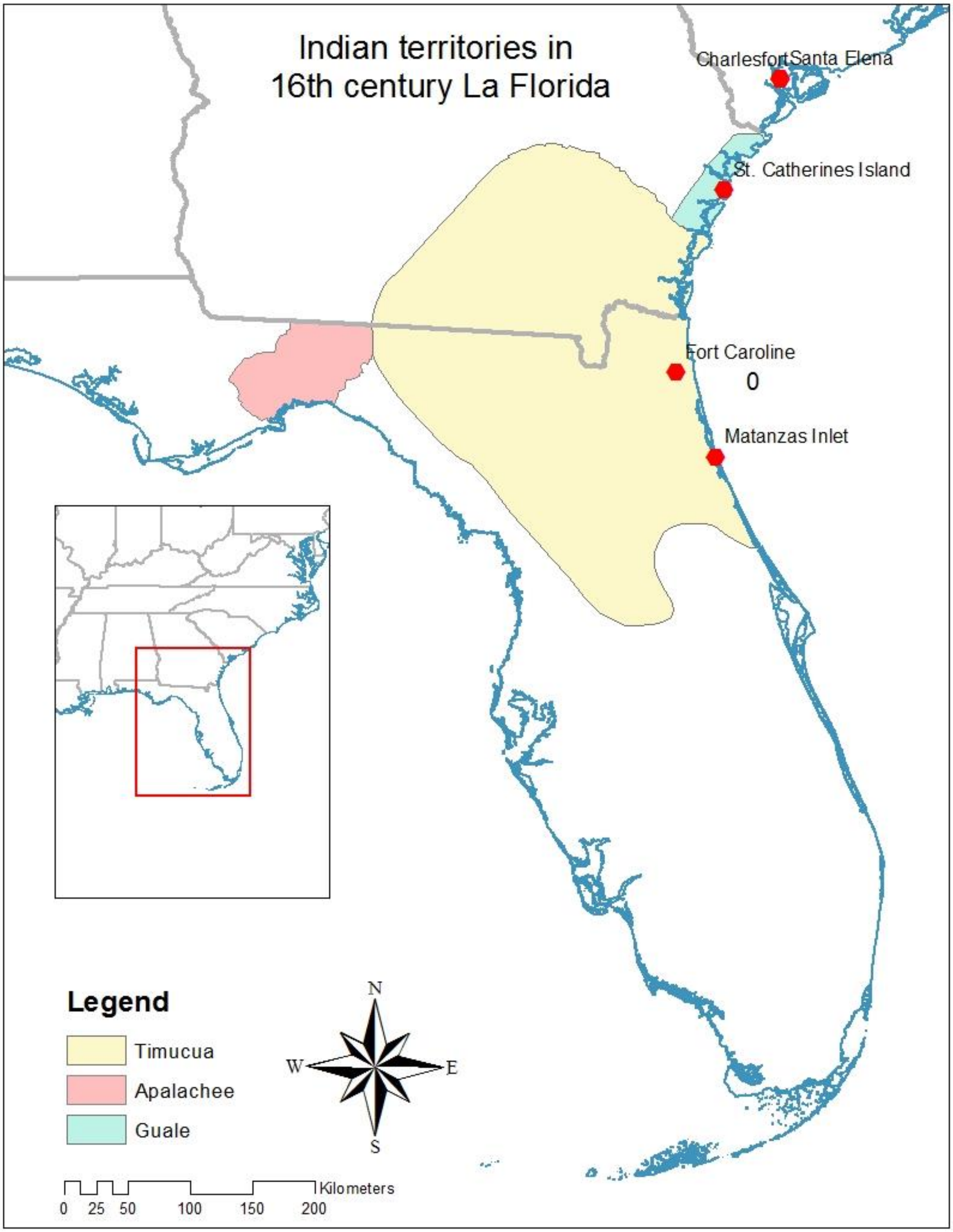

Figure 2-2. Indian territories in 16th century La Florida showing points of interest.

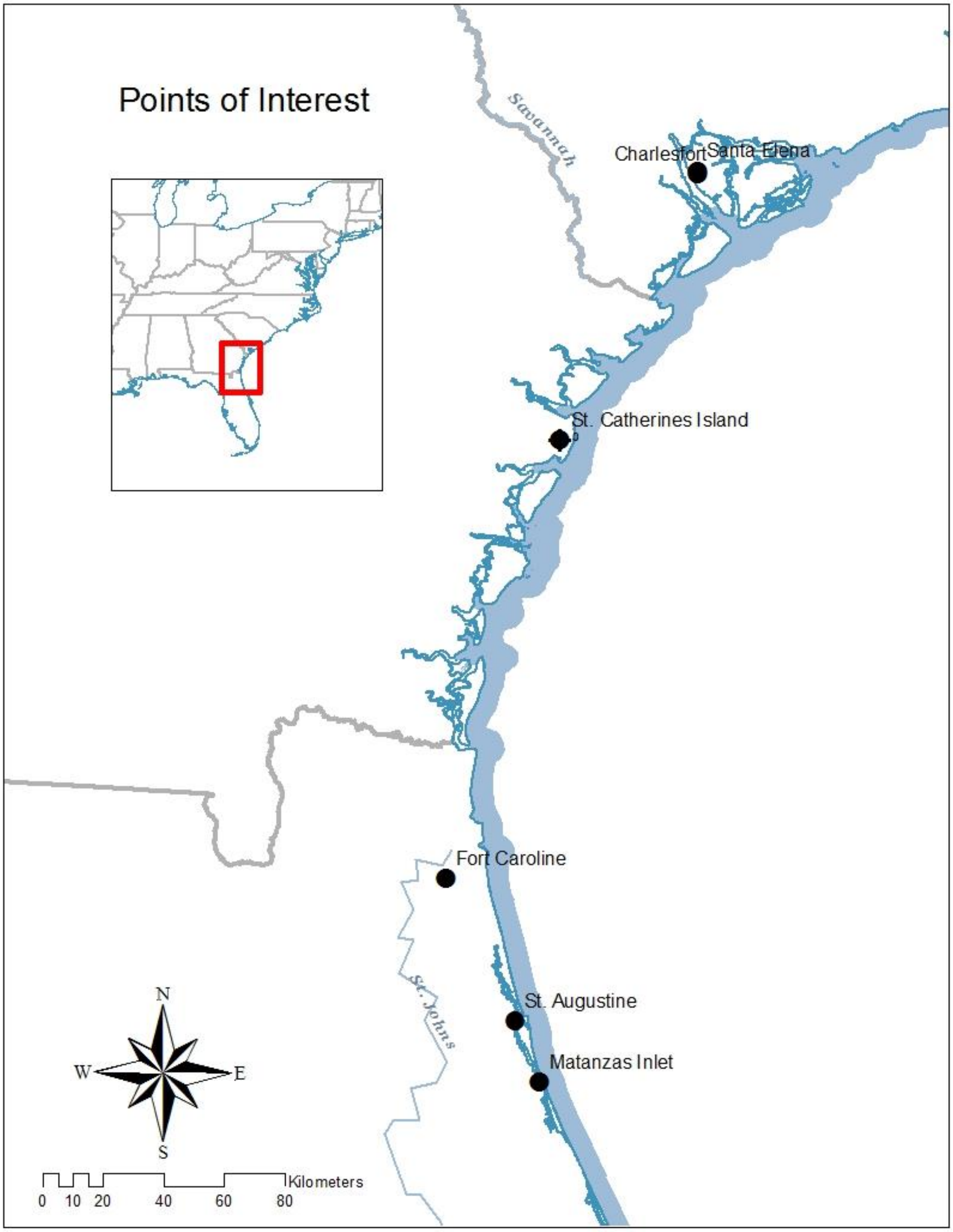

Figure 2-3. Points of interest during the Spanish and French rivalry for control of the Atlantic Coast.

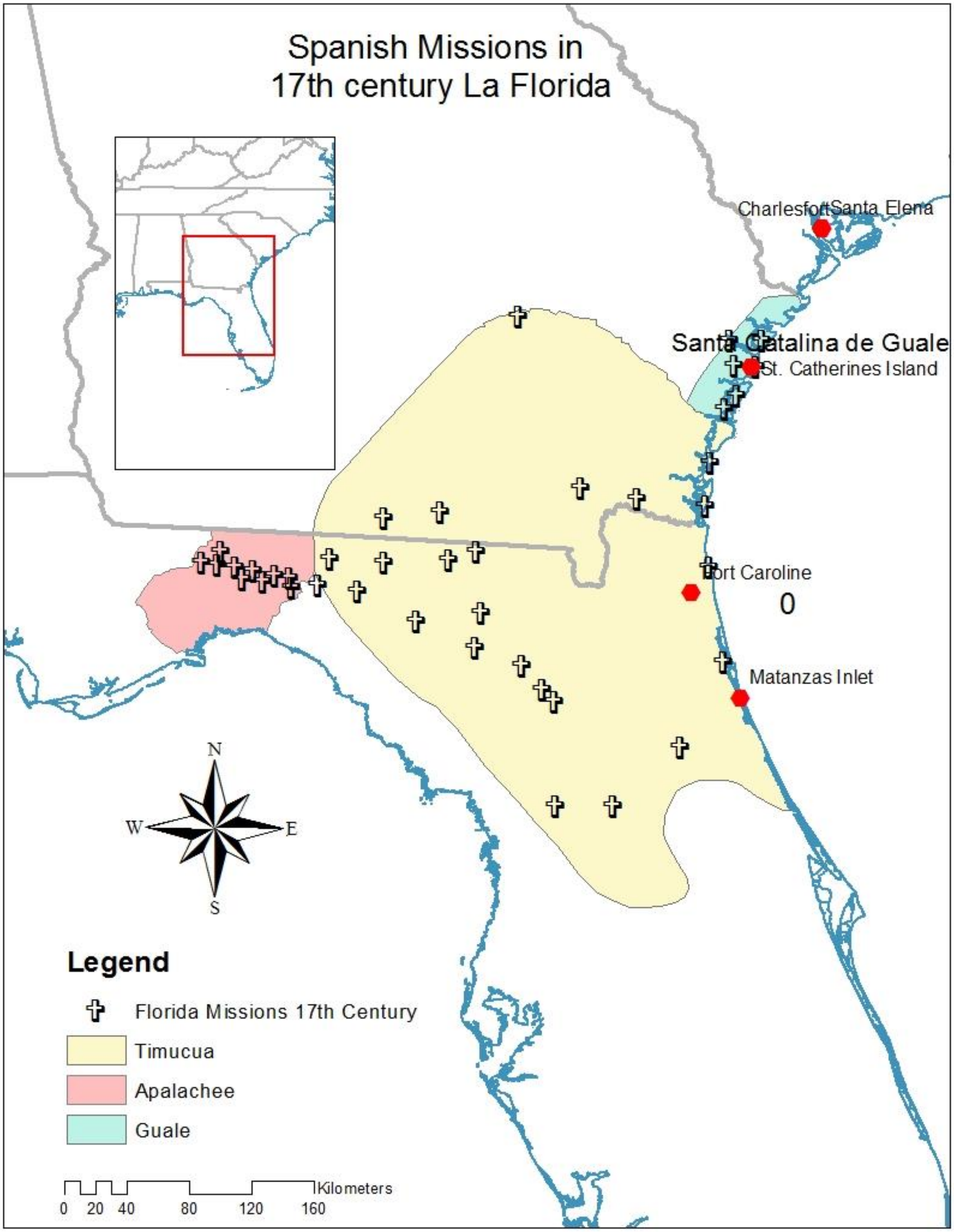

Figure 2-4. Spanish missions in 17th century La Florida.

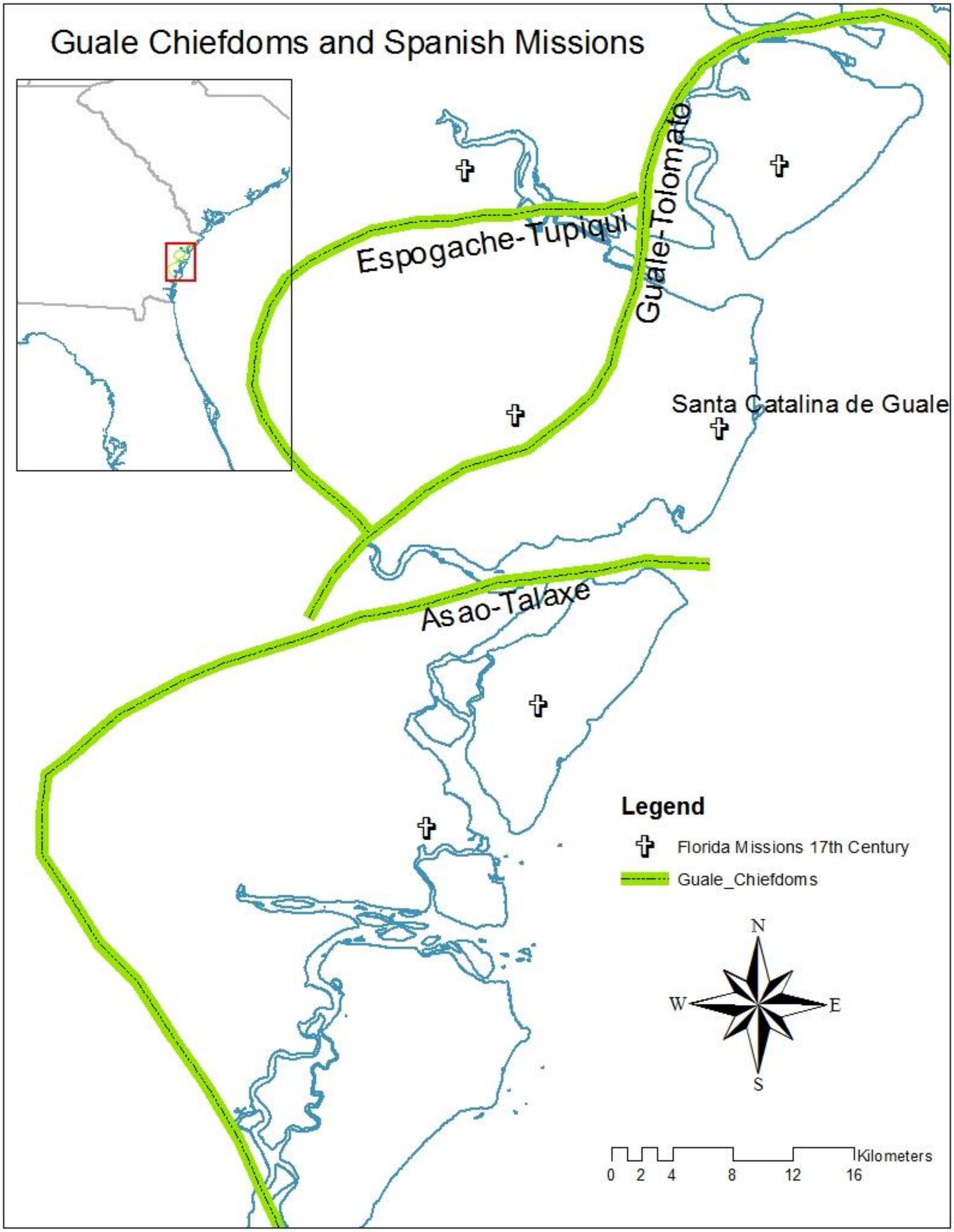

Figure 2-5. Guale chiefdoms and 17th century Spanish missions on the Georgia coast.

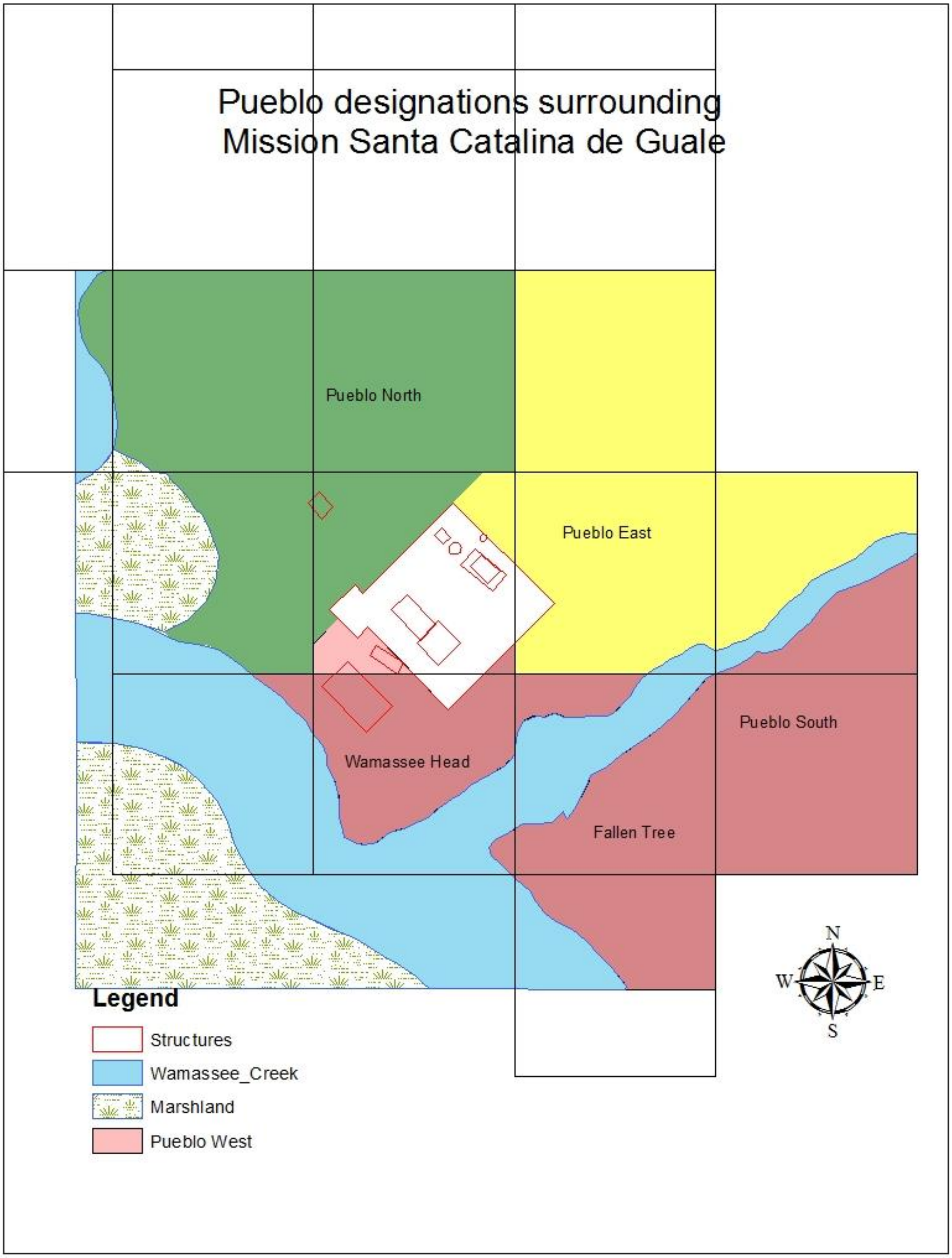

Figure 2-6. Pueblo and Mission at Santa Catalina de Guale showing structures and demographic designations after Thomas (2009a).

CHAPTER 3: METHODS AND MATERIALS

Experimental methods in archaeology, "…force the archaeologist to think about all of the characteristics and qualities of his material, and not just those that are superficially evident" (Coles 1977: 243). The methodology employed in this study adhered to the following guidelines for zooarchaeological investigations:

> (1) The analyst has experience examining control collections of specimens known to have been marked by a single, empirically observed actor and effector…(2) The published diagnostic criteria are applied consistently. (3) The search for marks is conducted using a hand lens or light microscope under strong light, systematically examining all parts of the surface at different angles with respect to the incoming light for conspicuous *and* inconspicuous marks (Blumenschine *et al* 1996: 495).

These suggestions permitted a higher degree of confidence in generating data using qualitative techniques. The specimens discussed in this study were analyzed using microscopy, replication techniques, comparative observation, and geospatial statistics.

This chapter outlines the rationale behind applying techniques that others have used to successfully determine what cutting tool materials were utilized by past peoples. The experiments tested the utility of different butchery tool materials and generated morphological signatures of various cutting implements. Study areas from where the zooarchaeological specimens were recovered are discussed. This chapter also explores the interpretive framework of the geospatial analysis to refine our understanding of daily tool choices in the Mission and Pueblo at Santa Catalina de Guale.

Rationale and Previous Studies

Analysis of modified zooarchaeological remains has assisted researchers in distinguishing between anthropomorphic and taphonomic processes (Binford 1981; Blumenschine *et al* 1996, 2007; D'Errico and Villa 1997; Delaney-Rivera 2009; Njau and Blumenschine 2006; Olsen and Shipman 1988; Shipman and Rose 1983a). When scrutinized, morphological characteristics of butchery marks can indicate the type of tool used to process animal food resources. When viewed under either high- or low-powered microscopy, features of cutmarks on fauna modified by stone (Dominguez-Rodrigo *et al* 2009; Dominguez-Rodrigo *et al* 2005; McPherron *et al* 2010; Potts and Shipman 1981; Semenov 1964; Shipman and Rose 1983a, b), wood (West and Louys 2007), bone (Shipman and Rose 1983a), metal (Binford 1981; Christidou 2008; Greenfield 1999, 2002, 2006; Humphrey and Hutchinson 2001; Shipman and Rose 1983a, b; Vermeij *et al* 2011; Walker 1978, 1990; Walker and Long 1977), and even shell (Choi and Driwantoro 2007; Toth and Woods 1989) can be readily identified. The morphological differences of cutmarks can be scrutinized to enable accurate determinations of the tool material used. By comparing experimentally produced cutmarks with modifications on zooarchaeological specimens it is possible to deduce which types of tool past butchers preferred (Binford 1981; Choi and Driwantoro 2007; Dominguez-Rodrigo *et al* 2009; Greenfield 1999, 2002, 2006; Olsen 1988; Potts and Shipman 1981; Rose 1983; Shipman and Rose 1983a, b; Toth and Woods 1989; Walker and Long 1977) at Santa Catalina de Guale.

Quantitative analyses have utilized measurements of cutmark width, depth, and the angle at which a blade penetrated the bone to determine which types of tools were used for butchery (Bello *et al* 2009; Bello and Soligo 2008; Bello *et al* 2011; Dominguez-Rodrigo *et al* 2009). Qualitative methods also permit accurate diagnoses of the tool material used (Binford 1981; Choi and Driwantoro 2007; Shipman and Rose 1983a, b; Toth and Woods 1989), particularly when the investigator has adequate familiarity with cutmark variables and uses low-powered microscopy (Blumenschine *et al* 1996). A confident visual identification of the tool that produced a cutmark must be supported by advanced, but not necessarily quantitative, methods.

By examining the profiles of cutmarks from zooarchaeological samples and comparing them to profiles of experimental cutmarks (Choi and Driwantoro 2007; Greenfield 1999, 2006; Shipman and Rose 1983a; Walker and Long 1977; West and Louys 2007) the tool type used in the butchery task can be identified. Cutmarks can be highly variable, which complicates recognition of diagnostic features (Shipman and Rose 1983a). Employing established criteria, one can rule out taphonomic processes such as rodent gnawing (Shipman and Rose 1983a), carnivore digestion (Blumenschine *et al* 2007; D'Errico and Villa 1997), and trampling (Dominguez-Rodrigo *et al* 2009; Olsen and Shipman 1988), and positively identify anthropogenic modifications.

A combination of empirically observed and published criteria (Table 3-1) was used to evaluate zooarchaeological specimens from St. Catherines Island. The specimens analyzed in this study feature butchery marks created during the Spanish mission period during which significant changes in both European and indigenous lifestyles occurred (Deagan 1993, 2003; Deagan and Thomas 2009; Liebman and Murphy 2011; McEwan 1992; Reitz *et al* 2010; Thomas 1990a). The influence of European culture on the daily activities of Guale Indians at Mission Santa Catalina on St. Catherines Island may be demonstrated by butchery tool choices evidenced by cutmarked bone.

Study Areas and Zooarchaeological Materials

Previously analyzed zooarchaeological materials collected from Fallen Tree, Wamassee Head, and Mission Santa Catalina de Guale over many field seasons by various institutions (Table 3-2; Dukes 1993; Pavao and Reitz 1998; Reitz 1990; Reitz and Dukes 2008; Reitz and Duncan 1993; Reitz *et al* 2010; Weinand and Reitz 1995) were selected based on the presence of observed butchery modifications. White-tailed deer (*Odocoileus virginianus*) constituted the majority of biomass[2] at the Mission and Pueblo on Santa Catalina de Guale and was the species most frequently modified with cutmarks (Reitz 2008; Reitz and Dukes 2008; Reitz *et al* 2010). The specimens analyzed here are white-tailed deer (*O. virginianus*), unidentified artiodactyla (either *O. virginianus* or *Sus scrofa* [pig]), and unidentified large and small mammal bone.

The faunal specimens studied were recovered during excavations conducted by the University of Georgia, Athens, GA (Caldwell 1971; May 2008) and the American Museum of Natural History, New York, NY (Thomas 1987, 2008a, b, c). Catalogued data cards housed at the Georgia Museum of Natural History (University of Georgia, Athens) reference provenience information, the represented faunal elements, and observed modifications on zooarchaeological remains collected from the Mission and Pueblo areas between 1969 and 2005. The physical specimens are curated at the Florida Museum of Natural History (University of Florida, Gainesville). The specimens selected for analysis were pulled and loaned to Monmouth University, West Long Branch, NJ for the duration of the analysis.

Zooarchaeological samples were recovered from several study areas and sites that are grouped into Mission and Pueblo contexts in the literature (Reitz 2008; Reitz and Dukes 2008; Reitz *et al* 2010). This analysis considers some specimens, initially referred to as materials from mission deposits, are instead interpreted as associated with secular contexts based on a recent synthesis of interpretations of the cultural

[2] Biomass is understood as an index that, "…provides information on the quantity of meat supplied by the animal" (Reitz 2008:618).

geography of Santa Catalina de Guale (Reitz *et al* 2010; Thomas 2009a). An earlier assessment of the village layout considers areas beyond the mission bastion to be part of one of four pueblo areas: North, South, East, and West (Figure 3-1). One interpretation of the layout of Santa Catalina de Guale (Thomas 2010a) places two structures beyond the mission walls as part of the Western Plaza Complex (Figure 1-1, Structure 1-W, Structure 6).

For this study, any excavation area that is beyond the inferred bastion of the mission proper (Figure 3-1; Thomas 1987) is assumed to be associated with secular activities. The distinction relies on interpreted uses of archaeologically identified structures at the mission settlement (Thomas 1987, 2009a, 2010a). As will be shown, despite the 45° west of north (Spanish North) orientation of most of the archaeologically identified edifices (Thomas 1987), secularism is inferred based on an area's juxtaposition to the mission bastion enclosing sacred structures. The geospatial analysis considers cutmark data as it relates to contexts around the mission bastion, distinguishing some materials as secular and others as non-secular.

Mission Santa Catalina de Guale (9Li274)

The zooarchaeological data analyzed from the Mission was recovered during large-scale excavations (Figures 3-2 and 3-3) and auger surveys (Figure 3-4; Pavao and Reitz 1998; Reitz and Duncan 1993; Reitz *et al* 2010; Thomas 1987). Interpretations of faunal remains describe activities of the Spaniards and Guale living on St. Catherines Island in the 16^{th} and 17^{th} centuries and have broadened our understanding of accommodation in cuisine choice and subsistence strategies in La Florida (Reitz *et al* 2010). For example, Elizabeth Reitz and colleagues predict that there are discrete local economies operating within the Mission and Pueblo areas as determined by varied distribution of biomass across two generalized areas (Reitz *et al* 2010). The cutmark data will help to evaluate this prediction by demonstrating technological preference. Cutmarked remains collected from the mission represent 57 excavation areas within the walled fortification and either surround or are directly associated with non-secular structures. Interpretations of the demographic layout of Santa Catalina de Guale (Reitz *et al* 2010; Thomas 2009a) frame this analysis.

The mission is broken down into the Eastern and Western Plaza Complexes largely defined by their structural components (Figure 1-1; Thomas 2010a). The Western Plaza Complex materials were excavated from contexts associated with Structure 1. Structure 1 was the sacred *iglesia* or church (Thomas 1987). This structure was likely destroyed in 1597 during the Guale rebellion (Francis and Kole 2011; Thomas 1987, 2010a: 36). The firing of the wattle-and-daub walls during its destruction created a conspicuous magnetic anomaly and led to the discovery of the mission (Thomas 1987). The church was rebuilt in the early 17th century. Thomas (2010a: 39) indicates that Fray Ruiz supervised the reconstruction of the Mission settlement in 1604.

Structure 1W is also situated in the Western Plaza Complex (Figure 1-1). Structure 1W is to the west of the bastion and its' function is unknown. However, although unreported, the associated faunal elements were analyzed (Reitz *et al* 2010: 239) and will be associated with secular contexts in this analysis because the building is no within the confines of the mission bastion.

Being completely enclosed by a walled fortification the structures in the Eastern Plaza Complex are considered non-secular buildings (Thomas 2010a). Structure 4 is the *convento* or friary, originally erected in the 16th century. The convento was multipurpose, and was connected to an open-air *cocina* or kitchen. Structure 4 was also likely destroyed in 1597 (Francis and Kole 2011; Thomas 1988). A newer, smaller convento was rebuilt in 1604 and is superimposed on the earlier convento (Figure 1-1). An external cocina (Structure 2) where Guale neophytes probably prepared meals for the friars was built some distance away from the new friary to keep sacred separate from secular (Thomas 2010a: 39).

Neophytes who prepared food for friars probably deposited most meal refuse outside of the fortified Mission walls (Thomas 2009a). However, significant amounts of garbage accumulated along the east wall of the convento (Thomas 1988, 2010a: 40). Although Fray Ruiz wanted to keep sacred separate from secular with the construction of a new kitchen, the 17th century cocina is included with non-secular contexts in this study because friars consumed the meals prepared there in silence in their convento according to religious ritual (Thomas 2010a: 39). Thus, its affiliation with sacred customs and the juxtaposition of the early and late cocinas within the confines of mission walls justifies the inclusion of Structure 2 with non-secular contexts.

Structure 2/4 is one of two wells located between the convento and the cocina and is rich in aboriginal and European artifacts including a broken iron hatchet (Thomas 2010a: 40-41). One well, Structure 3, was constructed with wooden barrels and likely dates to the 16th century (Thomas 1993). The other well, Structure 2/4, is much larger and was framed with a two large hollowed cypress logs and cuts into earlier mission deposits suggesting it was one of the last structures built and may have been used up until the 1680 abandonment of Santa Catalina de Guale (Thomas 2010a: 40-41). The circular well structures (Figure 3-1) that were identified are regarded as non-secular because, “water assumed great significance in Franciscan rite, and a source of sacred water was always a matter of concern when positioning a friary,” (Thomas 2010a: 39).

Beneath the mission floor was the sacred *campo santo*, or cemetery where 431 individuals were interred (Larsen 1990; Thomas 1987). The deceased were oriented along the 45° west of north angle aligned with the mission structures (Thomas 1993). The extended, supine, with arms crossed over the chest positioning of the burials is a Catholic tradition while the inclusion of grave goods reflects aboriginal spiritual beliefs (McEwan 2001; Thomas 2010b). There were no zooarchaeological specimens recovered from within the iglesia above the human burials. All of the contexts within the mission bastion are considered to be associated with secular contexts for the analysis. Non-secular materials were collected from various areas beyond the mission walls and are referred to collectively as pueblo materials.

PSCDG Pueblo Santa Catalina de Guale North and South

A limited quantity of modified fauna was recovered from Pueblo North and South. The materials are interpreted as 16th or 17th century materials based on their association with mission-period ceramics (Reitz *et al* 2010; Thomas 1987). The contexts of these materials are outside of the inferred bastion and beyond either of the Mission Plaza Complexes (Figure 3-5; Thomas 1987, 2010a).

Excavations in Pueblo North amassed limited faunal materials that coincide with the geophysically identified Structure 5. Although interpretations of Structure 5’s function are unreported, the faunal materials have been analyzed and butchery modifications identified (Weinand and Reitz 1995). However, Thomas indicates that Structure 5 may be a Native American residence (Thomas 2010a: 41).

Structure 6 is part of the Western Plaza Complex delineated by Thomas (Thomas 2010a). However this structure is considered to be part of Pueblo South, along with Caldwell's excavation units in Wamassee Head (Caldwell 1971; Thomas 2008: 547-579, 2010a: 41). Interpretations of the function of Structure 6 are also unreported but the analysis of zooarchaeological specimens has identified cutmark modifications (Pavao and Reitz 1998). Structure 1W is also situated in the Western Plaza Complex but its juxtaposition beyond the inferred mission bastion relegates it as a pueblo edifice and is the sole structure in the area defined as Pueblo West (Figure 3-1; Thomas 2009a 2010a). There is no interpretation of the use of Structure 1W in the literature but it was extensively excavated (Figure 3-3) and the faunal materials have been analyzed (Pavao and Reitz 1998; Reitz *et al* 2010). Structure 1W, Structure 5, and Structure 6 are the only three buildings in all pueblo areas that have been identified either archaeologically or geophysically. Though they have been yet to be more thoroughly interpreted (Reitz *et al* 2010) the zooarchaeological materials collected from within these structures are considered evidence of secular activities.

AMNH-441 Fallen Tree (9Li8)

The majority of the faunal specimens that represent the secular pueblo were recovered from various excavations at Fallen Tree (Figure 3-6), subsequently analyzed, and modifications identified (Dukes 1993; May 1985, 2008; Reitz 1990, 2008; Reitz and Dukes 2008; Reitz *et al* 2010; Thomas 1987, 2008b: 579-580). The site was initially investigated by Lewis H. Larson in 1959 (Brewer 1985) and yielded a varied assemblage of majolica as well as, "…hand-wrought nails, iron pins, glass fragments, a lead ball, a blue glass bead, and a brass finger ring" (Thomas 2008b: 579-580). However, recovered faunal materials from Larson's work at Fallen Tree are not included in this study. In 1969 Joe Caldwell began working at Fallen Tree and Wamassee Head (Thomas 1987, 2008b: 574-579)[3] and explored middens in both areas recovering a large quantity of faunal specimens (Reitz 1990, 2008; Reitz *et al* 2010).

In 1977 Fallen Tree was revisited during the island-wide transect survey of St. Catherines (Thomas 2008b: 525-601). In 1980 the site was covered in the systematic search for Mission Santa Catalina de Guale with 32 randomly placed test pits concentrated in Quad I (Figure 3-6; Thomas 1987). To conserve time and labor, an auger survey blanketed the 10-hectare area believed to contain Mission Santa Catalina de Guale and included Fallen Tree (Figure 3-4; Thomas 1987). A low density of pre-contact ceramics at Fallen Tree indicates a diffuse pre-Hispanic occupation (May 2008: 741; Thomas 2008b).

Following the rediscovery of Mission Santa Catalina de Guale, Alan May surveyed the area (May 1985) and opened four block excavation areas and recovered, "a large sample of prehistoric ceramic fragments, smoking pipe fragments, bone tools, stone tools, and historic glass and metal fragments…seeds, corncob, and peach pit fragments" (May 2008: 731). Faunal specimens from Thomas' and May's excavations at Fallen Tree have been analyzed and interpreted as a distinct area but still a representation of pueblo materials (Dukes 1993; Reitz and Dukes 2008; Reitz 2008; Reitz *et al* 2010).

[3]The locations of Caldwell's units are complicated. Proveniences of some of the pulled faunal specimens are incomplete and ambiguous. Reports confound Caldwell's Wamassee Head, Mission Santa Catalina de Guale, and Fallen Tree collections using site numbers that do not correspond to the site names (remains coded AMNH-441 appear to refer to Wamassee Head instead of Fallen Tree). These materials may not be accurately represented in the GIS as they had to be approximated using a field sketch map without a scale (Caldwell n.d.) and descriptions of units in relation to one another (Thomas 2008b:574-579). However, none of Caldwell's excavation units are in sacred contexts and they are appropriately included in the statistical analysis described in Chapter 5.

Excavations at Fallen Tree have revealed a significant contact-period presence, however, no structural features have been identified. Burned cob pits and high occurrences of aboriginal pipe fragments, and European luxury goods such as beads (Blair 2009), may be indicative of activities commonly associated with high-status council house structures (McEwan 1991: 42). Current excavations by the American Museum of Natural History are generating additional data. Nonetheless, the array of artifacts is consistent with a mission-period settlement of Guale Indians impacted by the presence of a nearby Spanish mission.

AMNH-208 Wamassee Head (9Li13)

Wamassee Head sits on the north side of the freshwater creek across from Fallen Tree but is largely contained within Quad II and is just south of Mission Santa Catalina de Guale (Figure 3-1). As with Fallen Tree there is evidence of limited pre-contact occupation of Wamassee Head (Brewer 1985; Caldwell 1971; May 2008; Thomas 2008b: 574-580). The area was tentatively identified as the likely location of Mission Santa Catalina de Guale by Lewis H. Larson in 1959 based on surface collections of Spanish majolica and olive jar sherds (Brewer 1985; Thomas 2008b: 575). The area was subsequently tested several times. The first excavations at Wamassee Head were run by Caldwell (Caldwell 1971) and those areas were relocated during the island-wide transect survey (Thomas 2008b: 525-601). Wamassee Head was revisited during the search for the mission with a power auger survey (Figure 3-4; Thomas 1987). Despite its close proximity to the mission and the incorporation of Wamassee Head's artifact collection into mission contexts (Reitz 1990, 2008), this research is framed by more recent interpretations of Mission Santa Catalina de Guale's cultural geography

(Thomas 2010a). Wamassee Head, as separate site well beyond the mission bastion, is discussed as part of the secular Native American pueblo (Thomas 2010a: 41).

Summary of Study Areas

Collectively several pueblo areas discussed in the literature represent the secular contexts of Santa Catalina de Guale. Zooarchaeological specimens collected and analyzed from Pueblo North and Pueblo South (Reitz *et al* 2010), Wamassee Head (Reitz 2008), and Fallen Tree (Dukes 1993; Reitz 2008; Reitz and Dukes 2008; Reitz *et al* 2010) are associated with contexts situated on the outside of the mission bastion (Thomas 1987). The bastion enclosed several structures utilized for sacred activities, particularly the iglesia, the convento, and the wells. Although the cocina was likely utilized by neophytes preparing food using traditional cooking methods (Reitz *et al* 2010), many meals were prepared there for the friars and consumed in silence (Thomas 2009a, 2010a).

The dichotomization of secular and non-secular contexts for this analysis does not necessarily preclude the possibility that the iglesia’s sacred influence was contained to within the bastion walls. Similarly, the mobility of food parcels between the mission and surrounding pueblo cannot be accounted for. However, the distinction between sacred and secular allows an additional dimension of scrutiny of the zooarchaeological evidence for different butchery tools. Evidence for the use of one tool type or another will be shown to be meaningful as they occur with respect to sacred or secular areas.

Experimental Materials and Methods

Several different raw materials were used to disarticulate deer hind- and forequarters. The butchery trials were concerned with evaluating the disarticulation of limb bones, the creation of deliberate, conspicuous cutmarks, and the recording of general qualitative observations. There were no controls for pressure, length of cut, number of cuts, and directionality of the slicing action as used elsewhere (Shipman and Rose 1983a). Steel, chert, various species mollusk and gastropods were tested. This chapter outlines experiments pertinent to the final interpretation that considers only metal and stone tool butchery at Santa Catalina de Guale. Experiments with shell tools and interpretations of the results of shell butchery trials are discussed at length in Chapter 4.

Materials

Deer (*O. virginianus*) was a staple food item among Santa Catalina de Guale residents (Reitz 2008; Reitz and Dukes 2008) and may reflect traditional Iberian cuisine preferences (Reitz *et al* 2010). Therefore, because deer consumption was so common at Santa Catalina de Guale fresh deer limb bones were selected as the primary experimental material to recreate cutmarks with high fidelity for comparison with the zooarchaeological record. Similar bone density is assumed between the deer consumed on St. Catherines Island and experimental samples, although the zooarchaeological sample does contain some pig (*Sus scrofa*) and other unidentified mammals. Fresh, defleshed, articulated limb bones (Figure 3-7) were acquired gratuitously from a local butcher (The Hunter's Butcher, Howell, NJ). Each element was inspected for cutmarks inflicted by the butcher. Limbs were unmodified but some scapulae possessed incidental cutmarks and were discarded.

To account for and generate variability in the experimental sample (Greenfield 1999, 2006; Mathieu and Meyer 2002), tools of the same material with differently shaped cutting edges were used to recreate butchery marks (Table 3-3). Knives imported from Europe during the 16th century were typically made of iron. Other sites in the American Southeast known to be areas where there was contact between aboriginals and Spaniards have demonstrated the use of iron knives (Thomas 1987), and Spanish iron artifacts were recovered at the mission (Thomas 2009a), Fallen Tree (Brewer 1985), and Wamassee Head (Caldwell 1971).

For this study, access to iron cutlery was limited. Instead steel knives were used for the experimental butchery trials (Figure 3-8). Greenfield used steel knives to test the use of high-tin bronze (Greenfield 1999). The literature does not indicate any significant differences between cutmarks made by iron and steel blades and remains a topic of inquiry for future study. Since most of the metal found at Fallen Tree was iron (May 2008: 769-771) it is likely that if there were metal knives being used at Mission Santa Catalina de Guale or the Pueblo, they were made of iron.

Keokuk chert was purchased as non-retouched flakes to best approximate the Coastal Plains chert found at Fallen Tree (May 2008: 742-756). Walker determined that unmodified stone tools were more efficient forms for butchery (Walker 1978). Retouched stone tools will leave more complicated cutmarks than non-retouched flakes making them harder to identify (Greenfield 2006: 155), but distinct from unmodified forms. The experimental replications (Figure 3-9) do not test for retouched tools. Therefore, this analysis draws on established criteria that distinguish between cutmarks made by unmodified and retouched stone tools (Table 3-1; Dominguez-Rodrigo *et al* 2009; Greenfield 2006).

Shell used to experimentally replicate cutmarks was collected on South Beach via the Jungle Road entrance and on North Beach near Sand Pit Road on St. Catherines Island (Figure 3-10). Fresh, cooked, and weathered shells were fashioned into expedient tools. Mollusks and gastropods were crudely broken into fragments by wrapping the shell in a towel and crushing it with a barefoot heel. Durable whelk was fractured while wearing a steel-toe boot. From the broken shell fragments a piece of manageable size with a sharp edge was selected. Although extensive typologies address the variation of shell tool types (Eyles 2004; Marquardt 1992), literature that empirically addresses shell tool butchery is scarce (Brett 1974; Choi and Driwantoro 2007; Toth and Woods 1989). This study seeks to contribute to a fleeting discussion of shell tool butchery by qualitatively evaluating the efficiency of various types of expedient shell tools and is discussed in greater detail in Chapter 4.

At very high magnification (i.e., scanning electron microscope) stone with different grain sizes, such as chert versus obsidian (Greenfield 2006) will have identifiable differences in morphology. At low magnification, the morphology of the cutmark will describe the shape and length of the cutting edge (Shipman and Rose 1983a: 86), and the kinematics of the butcher's hand (Semenov 1964). A low powered dissecting microscope thus provides a satisfactory level of magnification for this analysis since stone and metal tools tend to have different cutting edge morphologies (Blumenschine *et al* 1996).

Molds have proven to be vital for evaluating cutmark morphology (Greenfield 1999, 2002, 2006; Rose 1983; Shipman and Rose 1983a). Thus, two Hydrophilic Vinyl Polysiloxane molding agents with different viscosities were used to obtain cross-sections of cutmarks. The first brand, Reprosil Light Body, was used on a few of the experimental bones. Applying this molding agent was an educational process, and since Reprosil Light Body was unavailable for purchase an alternative was sought.

Aquasil Ultra Heavy Body regular set dental impression material was purchased online (www.heydentalsupply.com). To obtain high-fidelity impressions it was necessary to render a good ratio of base and catalyst ingredients. If the ratio were off the mold material would not set and would leave residue on the bone. Each bone that was molded was subsequently cleaned with acetone applied with cotton.

A well-mixed compound, gravity, and time affected the quality of the molds. After solidifying, impressions were bisected perpendicular to the length of the cutmark to achieve an advantageous view of the cross-section of the modification. Molds were taken of both experimental and zooarchaeological materials. The cross-sectioned molds of experimental and zooarchaeological modifications were then viewed under a low-powered dissecting microscope and compared to molds of experimental cutmark samples.

Methods

Deer limbs were disarticulated using a number of materials (Table 3-3). Each tool was used on an epiphysis of a bone to create 4-6 cutmarks. All cutmarks were made holding the blade perpendicular to the bone surface. Photographs were taken of the location of each set of cutmarks inflicted and the tool edges (Figures 3-11 to 3-15).

After being experimentally modified bones were boiled in tap water several times for anywhere from 2 to 4 hours with a small amount of organic laundry detergent (7th generation) to remove flesh and sinew. Between boiling sessions meat was picked off by hand and with plastic and wooden utensils to avoid marking the bone. After having let the bones dry for a period of time they were sectioned with a circular saw (Figure 3-16). The bones were boiled again to remove any marrow. Preliminary analyses of the experimentally cutmarked bone were conducted using an optical light microscope (Motic

SMZ-168 Series) equipped with a digital camera (Axiocam ERc5s) housed at the American Museum of Natural History.

Zooarchaeological materials were first viewed under a low-powered optical microscope with an internal, downward shining light source with 10.5x to 45x magnification at Monmouth University. Archaeological bone was photographed under a dissecting microscope fitted with a Nikon E990 digital camera at varying focal lengths and magnification. Specimens were rotated about and viewed from different angles because "…when viewed from directly overhead (90º angle), cut-marks lose their shape and depth" (Greenfield 1999: 799). Observations of cutmark apex shapes of zooarchaeological bone were made taking note of features that helped diagnose the probable tool type (Appendix A). When the tool type was unknown or ambiguous the specimen was set aside for molding along with bones showing exemplary diagnostic features (Table 3-1).

Molds of select experimental cutmarks representative of each tool type were cross-sectioned to expose the profile. Some of the molds of the experimental specimens were taken with either Reprosil or Aquasil. Aquasil was used on all zooarchaeological specimens selected for molding. Some specimens could not be molded due to fragility, heavy wear, marks that were too shallow, too small, or had cuts in areas where placement of the mold was made difficult by the contours of the bone. A razor blade was used to cross-section the molds at the point where the cut appeared to be the deepest.

Cross-sectioned molds were viewed with a low-powered stereoscopic dissecting microscope and photographed with a Nikon E990 digital camera at Monmouth

University. There were no ocular scales used, and magnification was difficult to calculate through the combination of lens attachments, the camera adapter, and the telescopic zoom function of the camera. Impressions of the experimental bones were photographed and used for comparison with zooarchaeological bones. Comparisons between the experimental and zooarchaeological cut mark impressions was critical when overhead features on zooarchaeological bone were ambiguous. Molds of zooarchaeological butchery marks were used to confirm earlier diagnoses made during overhead analysis.

Observations on the apex shape, relative depth, width, and breadth were recorded along with additional notes informed by published criteria (Table 3-1; Appendix A). The analysis does not rectify the confounding effects of fragmented modified bone as discussed by Abe and colleagues (Abe *et al* 2002). Accordingly, tallies of observed tool types in this study reflect individual fragments (i.e., fragment-count) and not frequencies of discrete cutmarks (i.e., cutmark-count; Abe *et al* 2002: 646). Furthermore, since most of the specimens analyzed in this study were fragmented bone, the observed frequency of individual cutmarks and cutmarked bone fragments is theoretically less than the actual frequency of modified bone due to depositional processes (Abe *et al* 2002)[4].

Fragmentation from anthropogenic and natural taphonomic processes obscures the agent of modifications and destroys less dense bone areas, "…reduces the amount of bone surface area studied by the analyst," and in effect, may render some cutmarks invisible (Abe *et al* 2002: 649). However, while the data collected for this study is not

[4] The data necessary to remedy the fragmentation issue (Abe *et al* 2002) including animal size category, element modified, and cutmarks observed per bone fragment was collected and can be revisited to refine the current analysis (Appendix A).

widely comparable to similar data from other sites, the quantification of observed butchery tool use in secular and non-secular areas is nonetheless pertinent.

The analysis is multifaceted and utilizes tallies of instances of stone or metal tool use and interprets this evidence using specimen provenience information. Following the diagnosis of the modification agents, the provenience information associated with each specimen was related to a geographic information system (GIS). Elliot Blair and the American Museum of Natural History provided a geodatabase of all previous excavation units, structure footprints, and current shoreline dimensions. The cutmarks that were diagnosed as having been created by metal, stone, undetermined, or other were then integrated into the GIS according to their respective proveniences.

Geographic Information System

Spatial analysis of the cutmark data from the Mission and Pueblo at Santa Catalina de Guale was essential for shedding new light on the site's discrete economies (Reitz *et al* 2010). Representing the distribution of the use of differential butchery tools and practices digitally is instrumental for interpreting influences on tool preferences. The geospatial patterning of differential butchery practices can be compared along side historical information to contemplate a relationship between observed distributions and socioeconomic and sociopolitical pressures. Therefore, a GIS was created with ArcMap (Environment System Research Institute) to manage and understand the spatial distribution of the zooarchaeological data.

Employing a geodatabase featuring geospatial information (Tennant 2007) compiled during excavations by the American Museum of Natural History, provenience information of every bone specimen analyzed was integrated into a digital representation of Santa Catalina de Guale. A total of 92 excavation areas represent the

280 specimens analyzed. The cutmark data added to the geodatabase was analyzed according to a spatially and demographically dichotomized interpretation of structural evidence at Santa Catalina de Guale (Thomas 2009a, 2010a).

The zooarchaeological data is distributed over 92 excavation units, many of which contain multiple analyzed specimens. A total of 280 analyzed bone fragments exhibited evidence for stone, metal, undetermined tool, or other non-anthropogenic taphonomic processes. Tallies were logged as attributes of 92 point shape files corresponding to excavation units in the study areas. Using the mission bastion (Thomas 1987) as the boundary between secular and non-secular contexts (Thomas 2010a: 41), tool usage across the landscape was assessed. A selection process redefined the data recovered by Caldwell from Wamassee Head as pueblo and not mission materials (e.g., Reitz 1990, 2008).

Caldwell excavated areas of Wamassee Head (Thomas 1987, 2008b: 574-579) but the faunal materials are reported as Fallen Tree and Mission Santa Catalina de Guale (Reitz 1990, 2008). Wamassee Head's artifact composition is mostly Altamaha series pottery and Brewer's review of the artifact collection does not indicate religious paraphernalia was recovered (Brewer 1985). Recent discussions of the layout of Mission Santa Catalina de Guale and the pueblo confine the Mission Plaza Complexes (Thomas 2010a). The designation of Caldwell's Wamassee Head excavations that associated the collection with the mission (Reitz 1990, 2008: 617) predates the refined delineation of the mission and pueblo areas (Thomas 2010a).

The use of GIS in this study juxtaposed Caldwell's excavation areas (Caldwell n.d.; Thomas 1987, 2008b: 574-579) and current views of the layout of the Mission

(Figure 3-1; Thomas 2009a). Based on the arrangement of the Wamassee Head excavation units and Thomas' layout of the Mission Plaza Complexes and pueblo areas (Figure 3-1; Thomas 2010a), the Caldwell materials from AMNH-208 (Caldwell 1971) will be considered as an area distinct from the mission and associated with the secular pueblo.

The observational data of zooarchaeological specimens were considered with respect to structural features at Santa Catalina de Guale. Distributions of various cutmarked bones were analyzed using the geostatistical analyst tool (an extension of ESRI's ArcGIS software) making basic descriptive statistics available. Variance in the tallies between observed tool uses in secular and non-secular areas were then analyzed using an F-test. The F-test calculates the statistical significance of difference between variances. Though the F-test is not typically applied to nominal data but the assessment of different observed variances between stone and metal tool use in secular and non-secular areas seemed useful.

Additional descriptive illustrations of the data were created to visualize basic trends in the data. Distribution maps show basic descriptive statistics such as mean center (Conolly and Lake 2006), which assists in understanding spatial trends in the data visually. Though there is not much analytical depth to those diagrams, they assist in illustrating some of the observed variation in stone and metal tool usage across the site. Thus, maps illustrating descriptive statistics encourage a more informed assessment of the symbolic presence of the Catholic iglesia in the heart of the Native American pueblo.

The GIS allowed the separation of secular and non-secular contexts so that the data could be analyzed as separate lines of evidence describing presumably different behaviors. Furthermore, the GIS enabled selective analysis of metal and stone tool frequencies. Essentially, the GIS assisted in the delineation of four separate categories of data: 1) stone use in secular areas, 2) stone use in sacred areas, 3) metal use in secular areas, and 4) metal use in sacred areas. A chi-square test of association was used then to evaluate the null hypothesis that there is no association between observed frequencies of either stone or metal raw materials in secular or non-secular contexts. The results of these statistical tests are explained in Chapter 5 and the pertinent diagrams are presented.

Spatial distribution of cutmark data supporting the use of metal and stone was highly variable. To compensate for rigid changes in tool frequencies across space, interpolation models were explored. The splines interpolation method (Conolly and Lake 2006) helped to smooth out differences to create a surface model. This model provided an easy-to-interpret visual display of occurrences of stone and metal tool use evidence. The model was then augmented with the use of isolines (Conolly and Lake 2006) and helped to contextualize differential occurrences of technologies across space. Additional details on the utility of isolines for distribution maps are discussed in Chapter 5.

Summary

Several study areas represented by numerous excavations at Mission and Pueblo at Santa Catalina de Guale are classified as either secular or non-secular contexts. The distinction is based on spatial occurrences of zooarchaeological specimens as well as interpretations of archaeological features defining structures in the mission village. Secular areas are largely representative by investigations in the pueblo while non-secular, sacred, contexts are confined to excavation units situated within the mission bastion.

A comparative approach is employed to test whether Guale Indians at Santa Catalina de Guale were using stone, shell, or metal tools for butchery tasks. Employing experimental techniques to be used for comparative purposes demands some foresight of potentially confounding variables. Comparing zooarchaeological modifications to experimental data requires accurate replications. The creation of expedient shell tools can be problematic if there are not prescribed controls. Without much backing from empirically studied expedient shell tool production (Brett 1974), the process was guided by trial and error (see Chapter 4). On the other hand there is a large body of research supporting predicted cutmark morphologies for stone and metal tools, against which, experimental data can be weighed. For stone and metal, empirically tested and replicable criteria were critical for confirming the morphological fidelity of experimentally produced modifications.

Comparisons between experimental data and zooarchaeological specimens were performed for 220 specimens representing 92 contexts. Inferred uses of structures (Knapp and Ashmore 1999; Snead and Preucel 1999), perceptions of space (Rodning 2010), and perspectives of the modern landscape (Hamilton *et al* 2006) will guide the interpretation of evidence from secular and sacred spaces at Santa Catalina de Guale (Thomas 1987, 2009a, 2010a) and are crucial to this study. Visual representations of the data generated here reflect comparisons between butchery modifications occurring in areas divergent in their inferred social and symbolic meanings (Rodning 2010).

Results discussed in Chapter 5 are more thoroughly integrated into these themes in Chapter 6.

This chapter has outlined the methods for experimental and zooarchaeological analysis employed in this thesis. Results of the experiments and analyses discussed here are described in discussed in Chapter 5. This chapter briefly discussed the procedure for creating butchery marks using stone, steel, and shell. The peculiarities of the shell butchery experiments are discussed in Chapter 4 because the results could not be reliably included in the final analysis. The following chapter will provide an in-depth consideration of shell tools and their possible role as butchery tools using qualitative data generated by experimental archaeology. Chapter 5 will refocus on Santa Catalina de Guale materials and will allude to interpretations central to the focus of this thesis.

Table 3-1. Criteria used to interpret cutmarked bone from St. Catherines Island.

Metal	*Stone*		*Shell*	*reference*
	Unretouched	**Retouched**		
internal surface with longitudinal microstriations; lacks crushing, V-shaped	-	-	-	Blumenschine et al (1996)
distinct apex at bottom; straight walls; V-shaped, can be asymmetrical if blade held at an acute angle	wide, shallow, interconnected grooves irregular grooves; do not terminate at a single, distinct apex; concave sides	-	-	Walker and Long (1977)
deep, steeply sided, culminating in an apex that has a sharp point or a horizontal platform; uniform or slightly off-angle V-shape in profile depending on angle and type of edge; deep and narrow or deep and wide; edge of the groove slopes steeply downwards; as blade becomes duller the marks will have a |_|-shaped profile; cut mark width tends to be wider than stone tools; parallel ridges uniform in height, orientation and angle; cleaner more even slicing cut	two distinctly different sides, one smooth and one rough; distinctive groove one steep smooth side and the other gradual with multiple striae; shallower, less even cut mark; more variability in shape; cut appears full of debris (dirty), apex weaving back and forth; wide irregular groove; ancillary parallel striations lateral to apex, uneven in length and thickness; always uneven in cross section, one relatively steep side and one gradual side with more striae		-	Greenfield (2002)

Metal	Stone		Shell	reference
	Unretouched	Retouched		
	sharply defined; high apexes, steep sides, narrow cross-sections and well-defined parallel ancillary ridging	no steeply rising side to the apex, sides are stepped or ridged, contain a series of parallel striations, cuts are not as deep as unmodified tools, frequently create two or more parallel broad flat terraces or steps on each side of the apex sometimes with deep troughs between steps; if tool was unifacially retouched one side will be angled steeply and the other side will display a large number of parallel striations		Greenfield (2006)
either a narrow V-shaped groove with a distinct apex at the bottom or a broader |_|-shaped groove with a flat bottom; uniform patterns; either no striations or striations that are more uniform in depth and spacing compared to stone; cleaner and more even slicing cut	cut contains debris; grooves with ancillary parallel striations lateral to apex of uneven length and thickness; almost always uneven in cross-section with one steep side and an opposite gradual side; one side is rough and the other is smooth	-	-	Greenfield (1999)

Metal	*Stone*		*Shell*	*reference*
	Unretouched	**Retouched**		
-	narrow grooves with multiple striations within that groove	-	retouched oyster shell will produce mophologically similar marks to those produced by a stone tool	Toth and Woods (1989)
-	-	-	(clam) two parallel grooves (double-tracks) with a bone ridge in the middle; grooves are shallow and round-bottomed with jagged margins	Choi and Driwontoro (2007)
-	closed V-shaped or closed \ /-shaped, continuous, straight microstraitions on walls; symmetrical, less frequent shoulder effect; as deep or deeper than width	open \ /-shaped grooves; irregular edges create broad marks with parallel striae running along the shoulder; extensive flaking of shoulder; multiple intersecting grooves	-	Dominguez-Rodrigo et al (2009)
hairline in size, generally long	-	series of short parallel strokes occurring in groups, more open cross sections	-	Binford (1981)

Table 3-2. Summary of study areas and relevant reports and publications.

Area	other info	UGA Accn# pre 10-1987	UGA Accn# post 10-1987	Report	Publication
Pueblo		99	105	Reitz 11/27/99 Table 62	Reitz 2008:653, Reitz et al 2010:112
Structure 2	Cocina; part of Eastern Plaza Complex	99	107	Reitz & Duncan 11/28/93 Table 18	Reitz et al 2010:122
Structure 2/4	Garden & well, part of Eastern Plaza Complex, between Str. 2 and 4	99	107	Reitz & Duncan 11/28/93 Table 18	Reitz et al 2010:145
Structure 4	Friary; part of Eastern Plaza complex	99	108	Reitz & Duncan 11/28/93 Table 18	Reitz et al 2010:151
Pueblo South	Pueblo II	n/a	177	Weinand & Reitz 6/6/95 Table 8	Reitz et al 2010:145
Pueblo North	Pueblo IV	n/a	177	Weinand & Reitz 6/6/95 Table 14	Reitz et al 2010:151
Misc Contexts	uncombined data	n/a	194	Pavao & Reitz 2/12/98 Table 6	Reitz et al 2010:261
Auger Survey		n/a	194	Pavao & Reitz 2/12/98 Table 11	Reitz et al 2010:255
Mission Survey		99	105	Reitz 11/27/99 Table 67	Reitz 2008:655
Thomas & Caldwell Fallen Tree		99	105	Reitz 11/27/99 Table 62	Reitz 2008:653
Thomas & May Fallen Tree			142	Dukes 1993; Tab 17 + Tab 23	Reitz & Dukes 2008:796
Str. 1 W	west side of Eastern Plaza Complex	n/a	129		
Structure 1NWC	NW corner of Str. 1	n/a	131		

Table 3-3. Summary of experimental tools and the respective bone cut.

code	material	comments	bone cut
K1	steel	chef knife	B1a
K2	steel	paring knife	B1b
K4	steel	clam knife	B2a
K3	steel	unserrated steak knife	B2b
F1	chert	flake	B3a
F4	chert	flake	B3b
F7	chert	flake	B4a
F10	chert	flake	B4b
C1a	clam	weathered	B5a
C2a	clam	cooked	B5b
C4a	clam	cooked	B6a
C3a	clam	cooked	B6b
S5a	cockle		B7a
S6a	cockle		B7b
S6b	cockle		B8a
S6c	cockle		B8b
S2	cockle	Whole, unbroken	B8c
O2	oyster	fresh	B9a
O4	oyster	weathered	B9b
O1	oyster	fresh	B10a
O6	oyster	weathered	B10b
M1	mussel	cooked	B11a
M2	mussel	cooked	B11b
W3	whelk		B12a
W13	whelk	blade	B12b
W10	whelk		B13a
W9	whelk		B13b

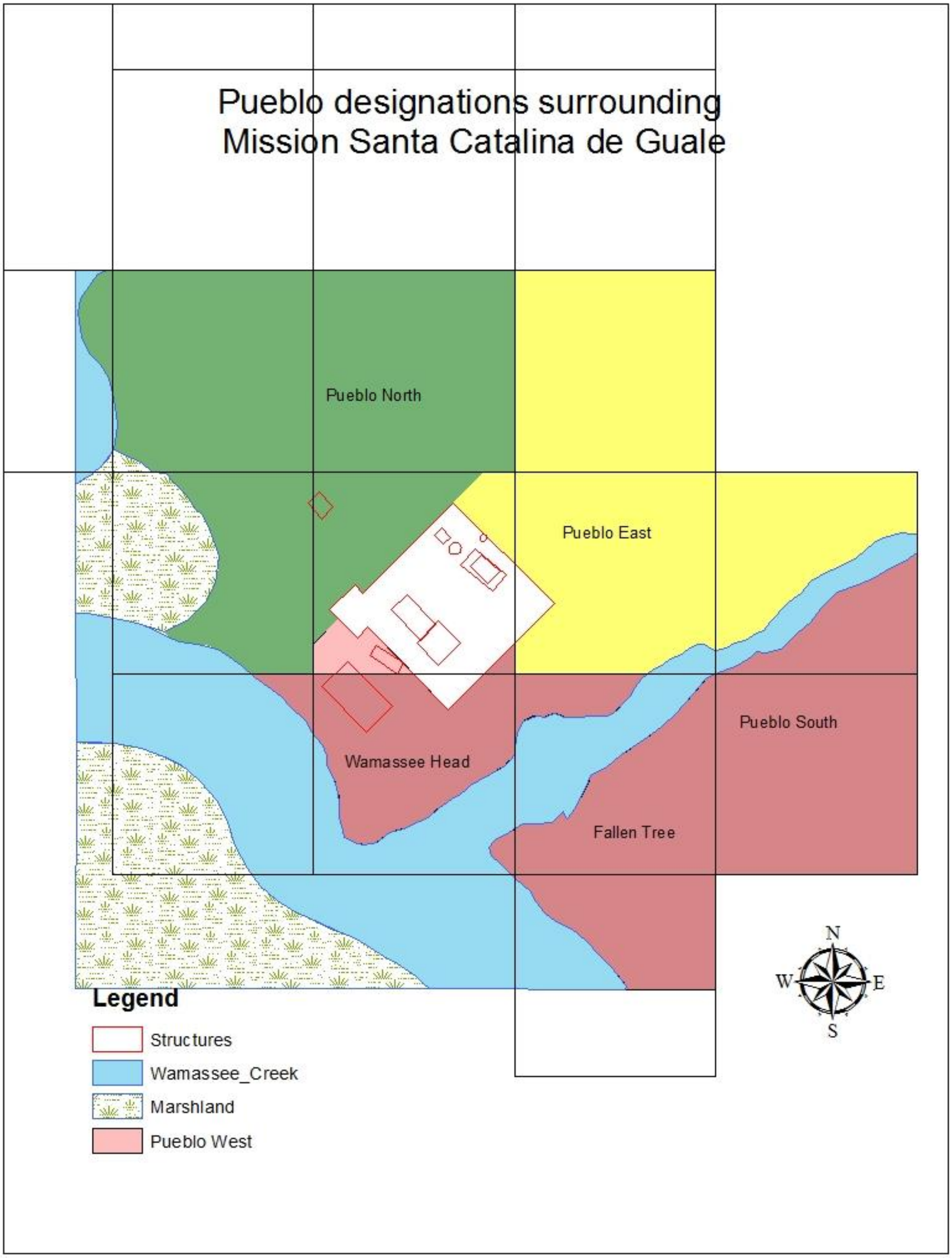

Figure 3-1. Interpretation of the Native American Pueblo surrounding Mission Santa Catalina de Guale after Thomas (2009a: Figure 2.18).

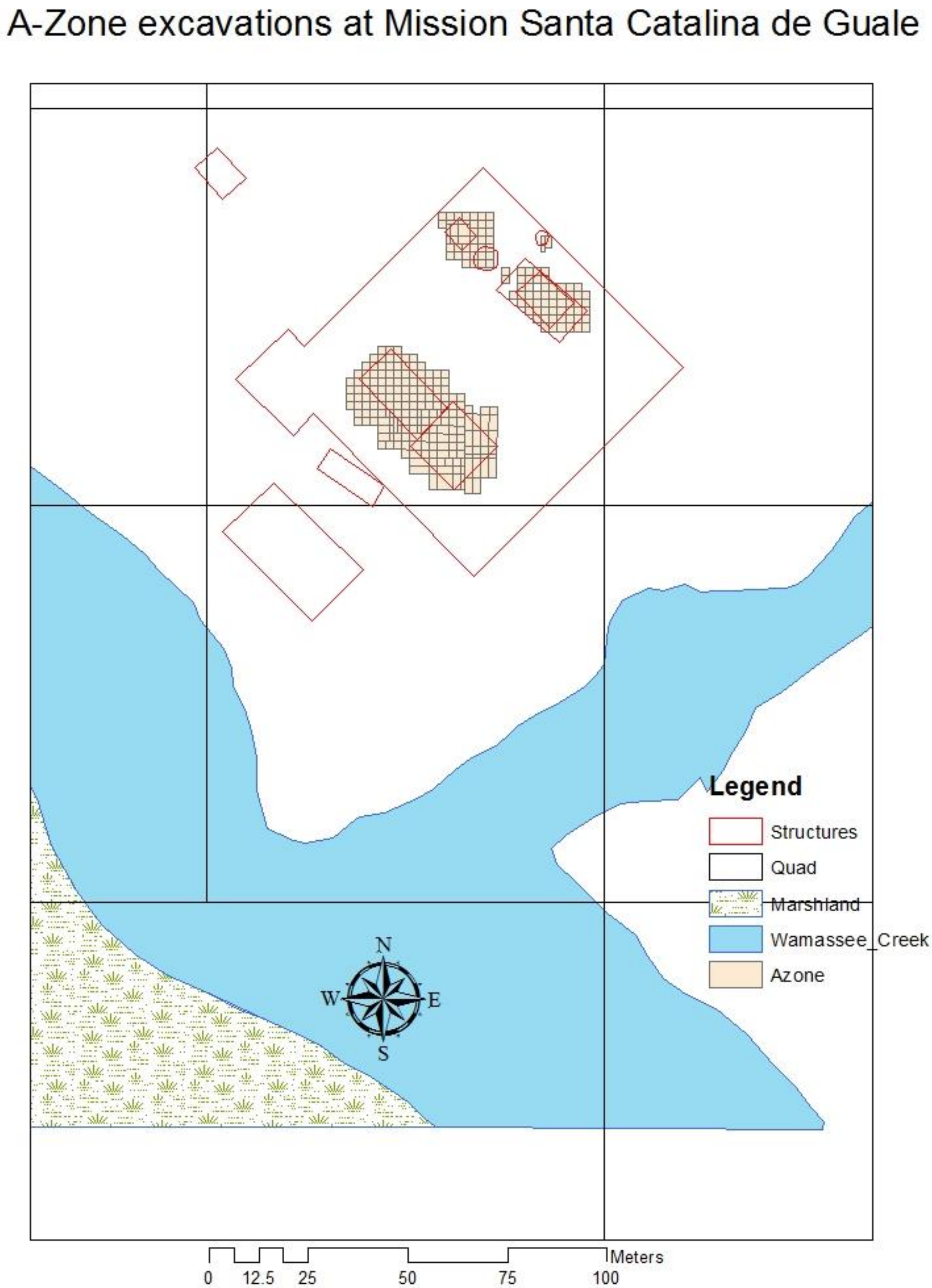

Figure 3-2. A-Zone excavations at Mission Santa Catalina de Guale (Thomas 1987).

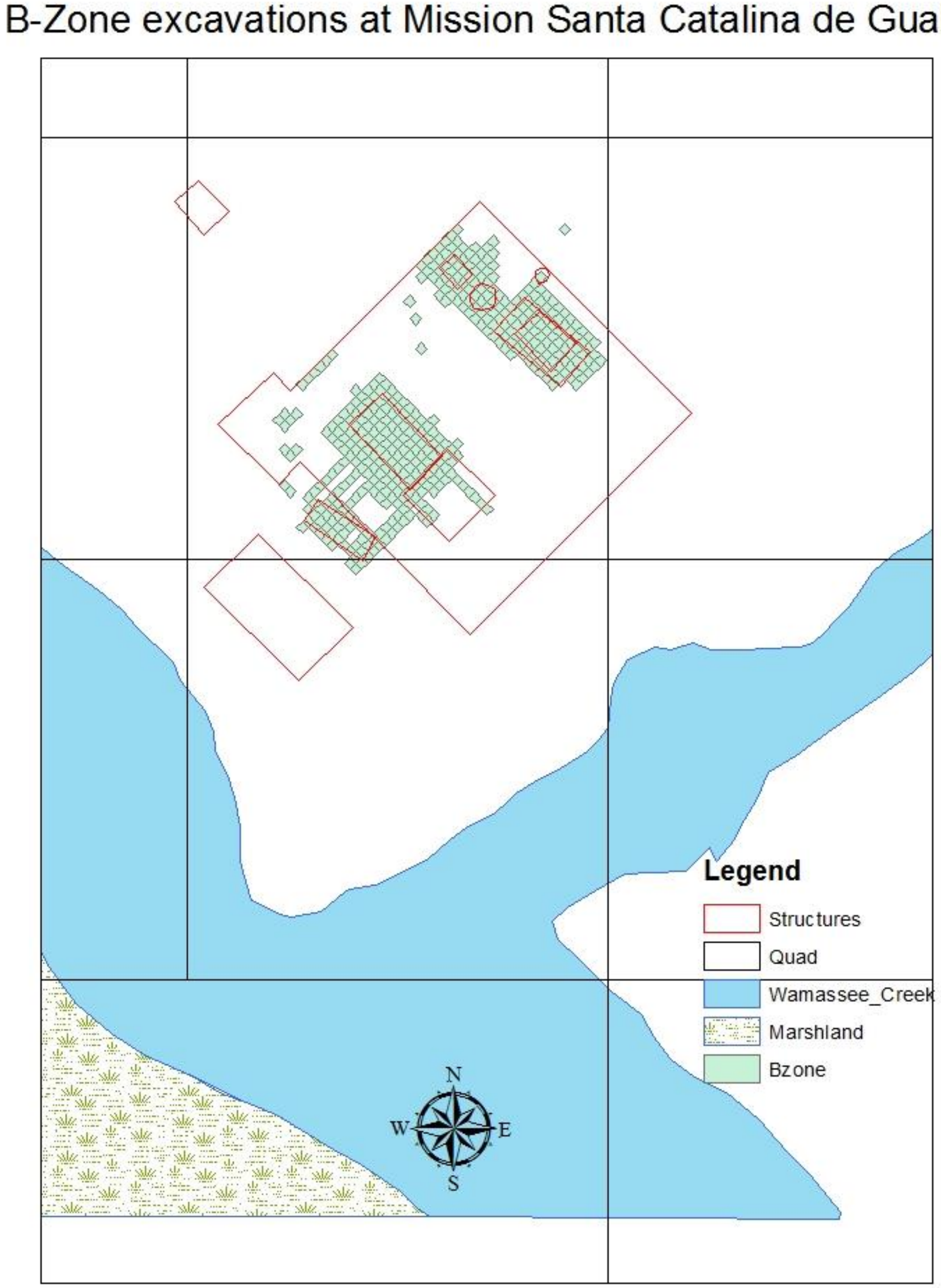

Figure 3-3. B-Zone excavations at Mission Santa Catalina de Guale (Thomas 1987).

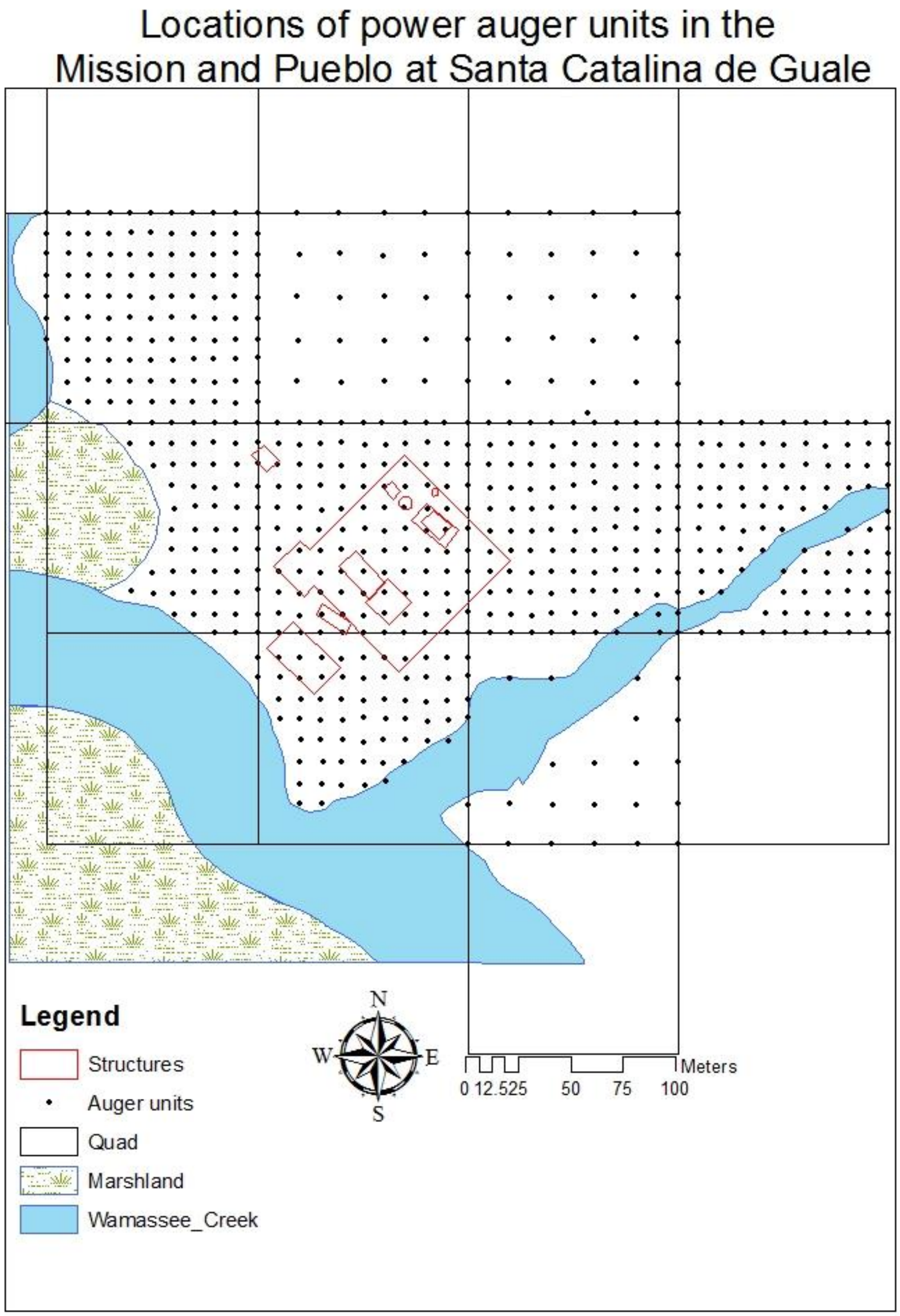

Figure 3-4. Map of auger survey units (Thomas 1987).

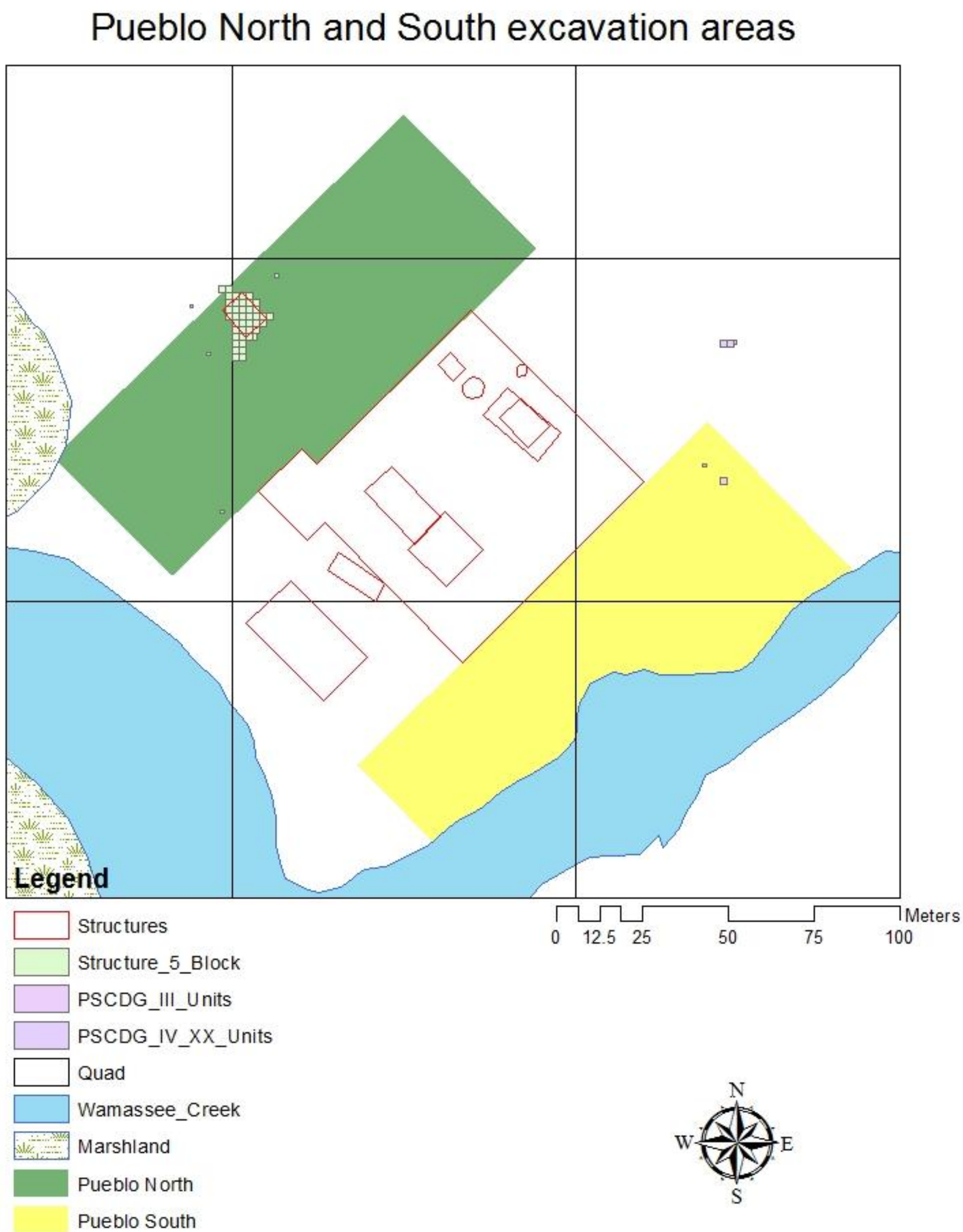

Figure 3-5. Excavation areas in Pueblo North and South.

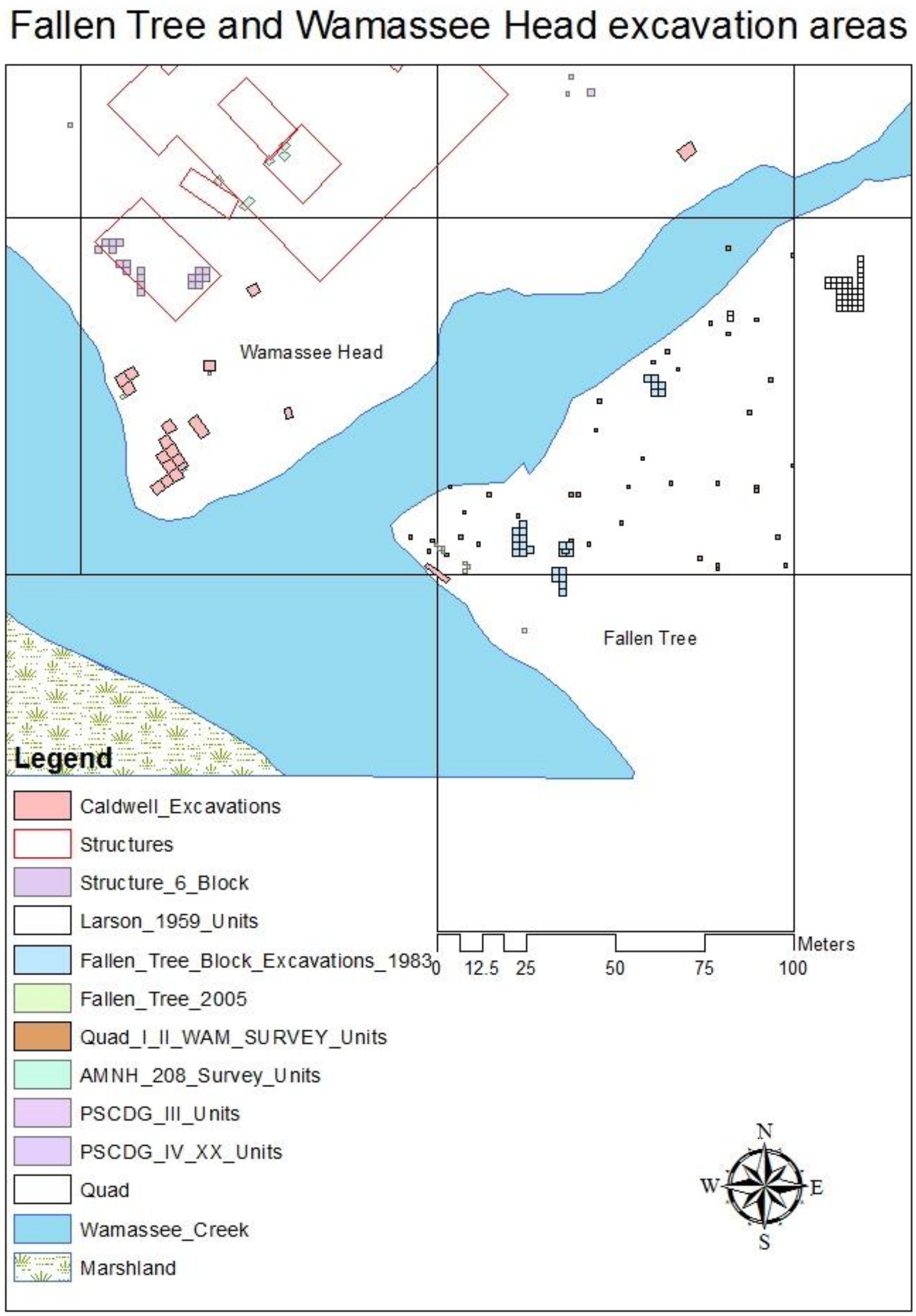

Figure 3-6. Excavation areas at Fallen Tree and Wamassee Head.

Figure 3-7. Fresh articulated deer limb bones before butchery trials.

Figure 3-8. Steel knives used in experimental trials.

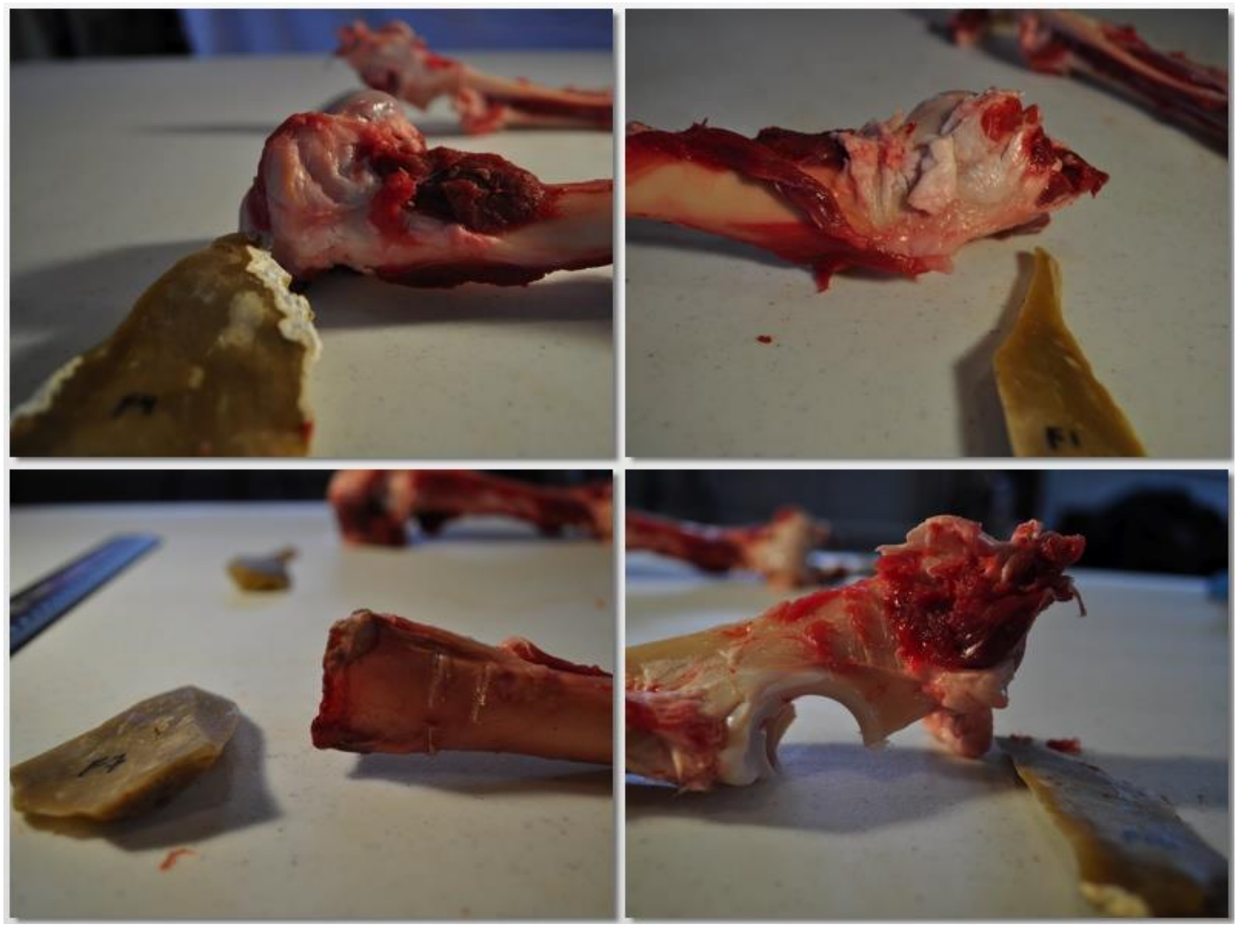

Figure 3-9. Flaked chert tools used in experimental trials.

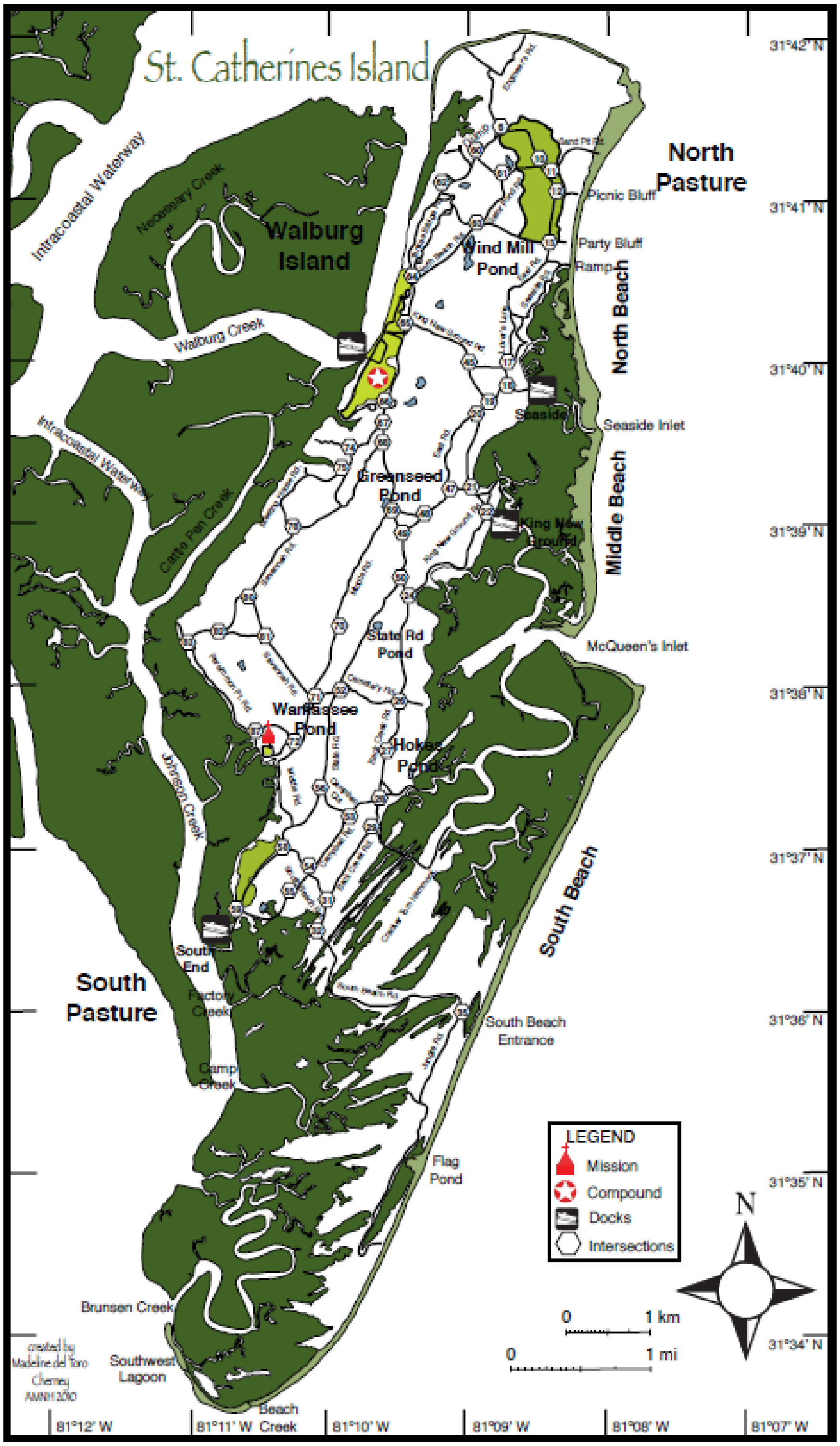

Figure 3-10. Roads and points of interest on St. Catherines Island (North American Archaeology Lab, American Museum of Natural History, on file).

Figure 3-11. Chert flake and experimental deer bone.

Figure 3-12. Clam shell tools and butchered deer bone.

Figure 3-13. Cockleshell tools and butchered deer bone.

Figure 3-14. Oyster shell tool and butchered deer bone.

Figure 3-15. Mussel shell tool and butchered deer bone.

Figure 3-16. Bone sectioned with circular saw.

CHAPTER 4: SHELL TOOLS

In the American Southeast, rock outcroppings yielding suitable raw material for crafting lithic technologies are generally located some distance from coastal environments. As a result, lithic artifacts are seldom observed in large quantities at coastal archaeological sites in the American Southeast. Stone material that is desirable for creating tools should be, "…homogenous, brittle, elastic, and isotropic, and it must fracture conchoidally," (Khreisheh *et al* 2013: 37). Raw cryptocrystalline stone, particularly chert, is a preferred material because it fractures in relatively predictable ways, and sharp edges can be produced and maintained with retouching techniques (Orton 2008).

Generally, the geographic distribution of Coastal Plain chert begins, "…around Tampa Bay, Florida, proceeding up the western half of the Florida peninsula including the panhandle, northward into extreme southern Alabama, then northeastward on a diagonal following the upper Coastal Plain of Georgia," (Goodyear and Charles 1984: 4). The distribution of chert raw material in the interiors of states in the American Southeast such as Georgia (Figure 1-2; Elliot and Sassaman 1995; Goad 1979) and South Carolina (Goodyear and Charles 1984), partially explains the limited archaeological occurrences of lithic artifacts (Thompson and Worth 2010).

Lithic raw material availability is frequently a factor in settlement pattern analyses (e.g., Daniel 2001). Despite the restricted availability of local chert resources near the coasts in the American Southeast, the Georgia Bight has been witness to a 5000-year human occupation of barrier reef island environments such as St. Catherines Island (Thomas 2008a, b, c; Thompson and Thomas 2013).

As an alternative to stone, shell became a critical source material for utilitarian and non-utilitarian technologies for Indian communities inhabiting coastal areas in the American Southeast (Eyles 2004). The archaeological record in the American Southeast (Eyles 2004; Marquardt 1992) demonstrates highly developed Native American shell tool industries in coastal areas situated far from knappable stone resources. Shell, as an abundant and viable technological resource, was an integral part of heterogeneous regional economies of coastal-dwelling Native American groups in the American Southeast.

The low densities of stone artifacts present at coastal archaeological sites reflect exchange relationships between coastal and interior Native American groups (Goad 1979). Maintenance of long-distance social and economic relationships necessary for the acquisition of stone resources were probably very costly (Thompson and Worth 2010). Indeed, the movement of shell material across vast distances represents trade relationships and highlights the growth of social complexity among Native American groups (Claassen and Sigmann 1993).

Prehistoric use of shell tools has been documented in various areas in the American Southeast (Beriault 1986; Hudson 1976; Larson 1980; Marquardt 1992). Historic and protohistoric uses of shell tools were recorded during pseudo amateur ethnographic accounts by European explorers (e.g., LeMoyne in Lorant 1946) and by early 20th century anthropologists (Boas 1921; Radcliffe Brown in Williams and Jones 2006). The continued use of shell during the contact period in the American Southeast may reflect sustained unavailability of stone. The accessibility of stone during the contact period may have shifted as a consequence of Spanish occupation of the New

World and colonial institutions. On the other hand, the abandonment of shell tool technologies during the contact period could indicate an increased availability of stone or imported European metal tools.

Depopulation by European-introduced epidemics (Dobyns 1983), the forced aggregation of Indian groups into coastal mission settlements by the Spanish, and the availability of European-made goods, likely altered exchange networks among American Indian groups. For this study, shell is considered as a plausible raw material alternative to stone and metal. However, in pursuit of demonstrating shell tool butchery by contact-period Indians on St. Catherines Island, unforeseen complications and unfortunate obstacles were encountered.

Increased variability in the experimental sample was introduced by differences in expedient shell tool materials and working edges. Limited previous attempts to recreate expedient shell tools (i.e., Brett 1974) and document shell butchery marks (Choi and Driwantoro 2007; Toth and Woods 1989) presented a significant disadvantage. Furthermore, inexperience in crafting expedient shell tools and a general disparity in the literature concerning shell tool cutmark morphology prevented the incorporation of experimental shell cutmark data as a validating source of comparison. Experimental cutmark data collected during the shell tool butchery trials cannot be confidently compared to the collections from Santa Catalina de Guale. However, the data presented here contributes to the small quantity of literature describing shell cutmark morphology and offers useful conclusions of the viability of different shell materials for butchery.

Since there is a lack of corroborating criteria from other studies and because of the wide range of variables introduced during experimentation, there is little comparative potential for the experimental shell tool data with the zooarchaeological collection from Santa Catalina de Guale. Experiments with shell are thus discussed here as an isolated topic but utilizes qualitative observations and historical circumstances to explore the role of shell tools for butchery during the contact period. Inherent to this discussion is a consideration of socio-economic circumstances of the Spanish contact period. Also prudent for this discussion is a general review of shell tools in the American Southeast, previous experimental work with shell, the experimental procedures and results of this study, and a consideration of shortcomings with recommendations for future research.

Implications of Shell Tool use by Mission-period Guale

For Guale, and pre-Guale populations living on the Georgia coast, the acquisition of stone would have relied on strong and amicable relationships with neighboring inland groups controlling chert-producing areas (Goad 1979: 1). Sturtevant indicates an exchange relationship between the Guale and Creek Indians of central Georgia (Sturtevant 1962). Coastal Plain chert artifacts that occur on St. Catherines Island may reflect this relationship.

If access to chert was restricted, it may have become further limited by shifts in trade networks occurring as a result of Spanish institutions and the effects of disease and depopulation (Dobyns 1983). Additionally, easier access to European goods via trade could have led to the reorganization of social hierarchies, which may have complicated indigenous trade relationships (Kipp and Schortman 1989). On the other hand, sustained chert availability may indicate that exchange networks among coastal and inland groups were unaltered by colonial factors. For instance, in En Bas Saline, Kathleen Deagan notes that there was an increase in chert tool use after contact, possibly reflecting shifts in household tasks and food preparation (Deagan 2004).

Fluctuations in stone tool use between prehistoric and Spanish mission-period sites deserve special attention but are beyond the scope of this study. However, there was shell and stone tool use observed at Fallen Tree (May 2008) indicating traditional tools were being used by contact-period Guale Indians. The cost of maintaining long distance trade relationships was high (Thompson and Worth 2010). Elliot and Sassaman suggest, "…In lieu of rock, coastal occupants fashioned tools from organic media such as bone, antler, and shell" (Elliot and Sassaman 1995:11). How can one explain the use of costly stone when shell is widely available? It is unclear whether the the use of stone was a status symbol at Santa Catalina de Guale. Lacking interpretations of structural data in secular areas of Santa Catalina de Guale, it is difficult to gauge household socioeconomic status differences.

The interpretation of geospatial evidence of differential tool use and ethnohistoric data presented in this study may suggest that individuals using metal were high-status. The choice to use metal when stone was available represents an active process of navigating a unique social hierarchy created by a residual Mississippian chiefdom organization, marginally altered by Spanish colonial institutions. If shell was indeed used for butchery practices, what are the social implications of its' use in the diverse technological repertoire that may be visible at Santa Catalina de Guale? Would social implications be reflected in spatial distribution of shell butchery evidence across Mission and Pueblo at Santa Catalina de Guale? Inherent to these questions is an understanding of the role of shell tools in the prehistory of the American Southeast.

Shell Tools in the American Southeast

The shell tool industry in the American Southeast was well developed; trade networks spanned incredible distances dispersing utilitarian and non-utilitarian shell items across the landscape. Sourcing techniques trace the movement of shell items from the coast during the Mississippian period (Claassen and Sigmann 1993). Shells in the archaeological record were crafted into symbolic items as well as practical tools and were also prepared and traded to inland groups for later consumption (Waselkov 1987). Accordingly, Eyles points out that “as distance from the sources of marine shell increase, shell becomes increasingly used for decorative and/or clearly status items” (Eyles 2004: 10).

Non-utilitarian tools include jewelry such as shell pins, beads, and gorgets (Wheeler 2001). Utilitarian shell tools are identified as those with functions relating to daily work tasks and do not have implications of being elite (Eyles 2004). Utilitarian shell tools have been recovered from sites in southwestern coastal Florida such as the Caloosahatchee area (Marquardt 1992), Charlotte County, Florida (Luer *et al* 1986), Key Marco (Cushing 1896; Reiger 1981), Chokoloskee Island (Reiger 1981), east central Florida (Webster 1970), the Lehigh site on the Floridian east coast (Carr and Reiger 1980), the Apalachicola area in northwest Florida (Eyles 2004), and the northern West Indies (O’Day and Keegan 2001).

Utilitarian shell tools from these areas include a variety of the following: fishing net weights, hammers, pounders, grinders, perforators, sinkers, planes, adzes, celts, anvils, choppers, knives, scrapers, gauges, spindles, dippers, cups, saucers, spoons (Eyles 2004; Marquardt 1992), anchors (Reiger 1981), money, projectile points, and pottery temper (Brett 1974). Whelk was also, “…utilized as cooking vessels by the archaic shellfish food gatherers…" in Astor, Florida (Webster 1970: 1). Marquardt notes that *Busycon contrarium*, or lightening whelk, appears to have been the preferred vessel for consuming the ceremonial Black Drink (Marquardt 1992) common among Indian groups in the American Southeast (Hudson 1976: 226-229). Vessels served as cups or saucers for drinking before ceramic pottery (Bullen 1978) and were crafted by removing the columella and smoothing the edges (Webster 1970).

Extensive trade of whelk products is evident in Floridian pre-ceramic freshwater middens along the St. John's River where *Busycon* artifacts have been found and sourced to locations up to 20 miles away (Bullen 1978). Luer and colleagues suggest whelks found at Big Mound Key in Charlotte County, Florida were imported from a distance of at least 7-8 km (Luer *et al* 1986). Whelk products were also traded from parts of Florida into the Ohio River Valley (Bullen 1978) and used by Mississippian societies as gorgets (Marquardt 1992). Large *Strombus* celts, commonly referred to as conch, were also imported to the St. Johns River area from at least 200 miles away (Bullen 1978). Other shell products have traveled as far inland as western Tennessee and were probably traded for steatite (Bullen 1978).

Large *Busycon* hammers occur in the archaeological record with greater frequency on the west coast of Florida than the east coast (Luer *et al* 1986). Celts made from *Strombus gigas* shells native to the lower southeast coast are extremely versatile (Luer *et al* 1986). Their abundance likely replaced the need for conserving imported *Busycon* tools in that region (Luer *et al* 1986: 119). The high frequency of *Strombus gigas* celts in southeast Florida even when *Busycon* was present underscores the degree of variation in resource preference for utilitarian tools (Carr and Reiger 1980: 69).

Accordingly, it seems that shells and shell tools were highly coveted by coastal and inland societies alike for both utilitarian and non-utilitarian purposes (Eyles 2004). Camila Licate (Thomas 2008b: 605-608) shows the Guale on St. Catherines Island utilized shell tools similar to those used by their southern neighbors but no shells have been identified as knives or scrapers. Additionally, non-utilitarian shell items were recovered from mortuary contexts at Mission Santa Catalina de Guale, which demonstrates the persistence of aboriginal spirituality and appreciation of indigenous luxury items after contact (Thomas 1988).

In the American Southeast, shell tools may have played a vital role in subsistence activities but were also a major part of interregional economies (Claassen and Sigmann 1993; Trubitt 2003). Coastal areas providing shell raw material and other marine resources enabled groups occupying these areas to become specialized in shell tool production. With a virtually endless supply of shell material, groups occupying shell-bearing localities had unrestrained access to resources. Thus coastal groups in the American Southeast controlled the production of utilitarian and non-utilitarian shell tools and experienced enhanced distributional power.

Recognizing Shell Tools

Unfortunately shell tools can be difficult to identify in the archaeological record. Midden archaeology (Waselkov 1987) often complicates the recovery of shell tools and inexperience in distinguishing a tool from meal refuse can result in the discard of artifacts in the field. The issue is even more complicated with expedient tools. A trained eye may be able to discern a broken shell from an expedient tool, but when excavating a shell midden, thousands of shells may potentially qualify as expedient tools.

Identifying shell tools necessitates an understanding of the basic anatomy of whelks and bivalves alike. For instance, Luer identifies a number of sites sharing remarkable trend; nearly every intact *Mercenaria* shell found in the region of Big Mound Key in West Florida was a left valve (Luer 1986). However the significance of exclusively left valve occurrences is ambiguous. Luer points out, however, that clamshell and whelks possess "chips" that can be mistaken as intentional human modifications (Luer 1986). Furthermore, *Cliodinae*, a family of demosponges, bore into mollusks creating the appearance of drill modifications. Therefore, some marks may be mistaken as use-wear because they are frequent and common but they may in fact only be a byproduct of the aquatic food chain (Luer 1986).

On the other hand, some marks are diagnostic of the shell's intended use as a tool. Luer and colleagues describe a cache of 19 whelks found at Big Mound Key on Florida's Gulf Coast modified into tool "blanks" to be fashioned into "cutting-edge" tools (Luer *et al* 1986). They also identify four distinct enhancements intended to increase the sturdiness of the proto-tool including, "…(1) a perforation in the spire's last body whorl (2) a shortened siphonal canal (3) a modified lip (4) a modified columella tip" (Figure 4-1; Luer *et al* 1986: 106). Some of these modifications, such as the ones on the siphonal canal and the columella, are intended to increase the tool's sturdiness (Luer *et al* 1986). The lip modification reduces the likelihood of that area fracturing during use. The perforation in the whorl area allows easier extraction of the meat contained inside the shell but also is instrumental for hafting (Carr 1986: 167).

Hafting modifications stand out distinctly from other forms of wear. Frank Hamilton Cushing describes the hafting modifications of conch shell tools from Marco Island in the Ten Thousand Islands area of southwestern Florida:

> …the conch-shell heads of these tools were most ingeniously hafted. The whorl was usually battered away on the side toward the mouth, so as to expose the columnella [*sic*]. The lip was roundly notched or pierced, and the back whorl also perforated oppositely. Thus the stick of handle could be driven into these perforations, past the columnella [*sic*] in such manner that it was sprung or clamped firmly into place… secured with raw-hide thongs (Cushing 1896: 368).

In addition to hafting modifications, the columella was typically beveled at one of two angles, which categorizes "cutting-edge" tools into two distinct types with presumably different functions (Luer *et al* 1986). Caches of whelks on the Floridian coast with incomplete perforations indicates the shells were probably performs to hafted tools (Moore 1921).

Luer and colleagues go on to argue that whelk tools may have been subject to a continuous modification process beginning with tool blank formation, followed by cutting-edge tool creation, and ultimately used as a hammer (Luer *et al* 1986). On the west coast of Florida, large sturdy whelks were prized because they were relatively uncommon (Luer *et al* 1986: 119). Robust whelks were the preferred material for these tools. Remodification of whelk tools maximized the time and energy required to gather shell materials for communities far from coasts.

Shell tools have also been recovered in burial contexts. Two caches of *Stombus* shell celts were found to be associated with burials at the Lehigh site near the Miami River during surface collections in 1979 (Carr and Reiger 1980). The celts were placed in the burial either to accompany the individual into the afterlife as a tribute to work performed during life and may indicate gender-specific division of labor in the prehistoric

Glades Culture Area (Carr and Reiger 1980: 73). One celt cache also contained calcitic sandstone, which, "…obviously served as an abrader for sharpening the tool edges" (Carr and Reiger 1980: 69). This furthers Luer and colleagues idea that aboriginal groups in lithic-deprived environments frequently engaged in retouching and remodifying shell tools, especially when preferred forms of raw materials were scarce (Luer *et al* 1986). Carr and Reiger specify the uses of shell celts as woodworking items (Carr and Reiger 1980: 73) and is in agreement with others' suggestions that whelk cutting-tools were primarily for processing plant materials (Cushing 1896; Luer 1986; Reiger 1981).

However, the conclusion that most shell tools were used as woodworking materials deserves attention. Marquardt highlights the regional differences in the locations of hafting notches in whelk tools (Marquardt 1992). Different hafting angles suggest different functions (Lee 1989). Notably, quahog clamshells have hafting notches, which indicate their probable use as hoes (Cushing 1896: 368). Not all shell tools were hafted and their function is elusive. There is considerable discussion owed to tools that fail to display hafting notches such as some quahog tools.

Clamshell artifacts are more abundant on the west coast of Florida than the east coast (Reiger 1981). Although most specimens appearing to be intentionally cut also seem to be unmodified; however, the edges of some *Mercenaria campechiensis* fragments appear, "…sometimes to have been worked into a kind of serrated blade" (Reiger 1981: 4). Identifying *Mercenaria* shells as tools in the record can be difficult. Reiger suggests that the fragments are overlooked as scrap when in fact:

> …depending on whether they had a smooth, sharp, or serrated edge, one can visualize them being employed as spoons, to smooth clay, as knives, and for scraping the fat off of skins and the charred wood out of dugout-canoe performs (Reiger 1981: 5).

Quahog tools are understudied (Reiger 1981) and consideration of their use as butchery tools is extremely limited (Brett 1974; Choi and Driwantoro 2007; Toth and Woods).

Generally speaking, expedient shell tools are misunderstood. For instance, while Reiger discounts *M. campechiensis* fragments as possible wedges to open other clams based on unpublished experiments (Reiger 1981), Boas recorded a woman as she took, "…a piece of a broken shell of a horse-clam and cuts open the small clams and cockles to take off the shells" (Boas 1921: 179). Given the wedge-like edges of shells and that they can be sharpened, it is possible that fragments of shell, be it clam, oyster, or whelk, were indeed used as expedient and disposable cutting implements. Brett attempted to experimentally reproduce specific shapes to test their existence as proto-tools or otherwise expedient implements, but provides little data suggesting their functionality (Brett 1974). Until experiments can assign definitive functions to some tool forms, archaeologists need to interpret shell tools with caution.

Marquardt criticizes previous attempts to broadly categorize shell artifacts, claiming that the description of the item pigeonholes it into a predetermined function (Marquardt 1992: 192). Meanwhile, Luer and colleagues warn against applying restrictive terms such as, "…'adze,' 'axe,' 'gouge,' or 'spokeshave'…" and are in favor of the more general term, "cutting-edged tool," (Luer *et al* 1986: 110). A shell's function can be recognized through careful measurement of hafting angles and rigorous experimentation. For example, Lee describes how hafting angles, "…provide a clue as to the tool's use, since an angle smaller than 90 degrees would make the tool more useful in chipping, as opposed to chopping" (Lee 1989: 157). Thus, assigning a specific function to a tool can be restrictive but using general terms can equivocate the item's purpose.

It is likely that shell tools are simply misunderstood in absence of ethnography and an inability to definitively identify characteristic wear patterns. Experimental studies may be the only appropriate method for determining shell tool function. Cushing may have been one of the first investigators to apply experimental techniques for understanding shell tool function. He describes the reliable functioning of sharpened whelk tools hafted onto a stick for cutting and hacking, as well as the use of the inner spiral as chisel-like implements (Cushing 1896: 368-369).

Although Cushing's experiments show the functionality of hafted whelk tools, the literature seems biased; a majority of the research identifies the use of whelk and clam cutting-edge tools for woodworking (Brett 1974; Carr and Reiger 1980: 73; Cushing 1896; Luer 1986; Luer *et al* 1986; Masson 1988; O'Day and Keegan 2001; Reiger 1981). However, despite observations that, "…unmodified [*Strombus*] lips would function effectively when used to cut soft materials," (O'Day and Keegan 2001: 282) few studies go on to suggest shell use for scraping animal skins (Brett 1974: 120; Cushing 1896: 368; Reiger 1981), or butchery (Laxson 1964; Luer 1986; Williams and Jones 2006). Furthermore, there are limited studies attempting to empirically demonstrate shell tool butchery (Brett 1974: 120; Choi and Driwantoro 2007; Toth and Woods 1989). This study contributes to this literature by experimentally creating expedient shell tools and testing their performance in butchery tasks.

Experimental Techniques to Evaluate Shell Butchery Tools

Many factors complicate shell tool analysis. For example, shell tools are sometimes only visible in the archaeological record when they exist as nearly complete specimens as opposed to whole specimens. Also, fragmentary shell tools found in the field can be easily mistaken as refuse when they may in fact be debitage from tool manufacture. Deposition and sloppy excavation techniques can also damage fragile shell artifacts (Waselkov 1987: 148). The fragmentation of mollusk shell that is necessary for sclerochronology makes it impossible to analyze some samples for wear and diagnostic use (i.e., Quitmyer and Jones 1997). A lack of understanding of expedient shell tool forms resulting from such circumstances makes it difficult to accurately reproduce shell tools for experimental purposes.

However, shell tools can sometimes be identified when compared to stone analogs (Masson 1988; O'Day and Keegan 2001). As Waselkov observed, "when dealing with shell middens, even a small excavation can potentially recover millions of mollusks" (Waselkov 1987: 150). Therefore, looking for expedient shell tools in a midden can be like finding a needle in a haystack. Little is known about shell's performance as a butchery tool because of the lack of empirical data showing its efficiency compared to other raw materials.

Brett experimentally recreated common shapes of shell to evaluate the possibility of expedient shell tool use in the American Northeast (Brett 1974). Also, Beriault developed an algorithm to help distinguish shell artifacts that were used expediently from systematically crafted shell items (Beriault 1986). Nonetheless, the fact that some forms of shell tools underwent frequent remodification (Luer *et al* 1986) qualifies minute shell fragments as possible debitage.

Some have attempted to recreate cutmarks observed in the zooarchaeological record with expedient shell tools (Choi and Driwantoro 2007; Toth and Woods 1989) but these studies focus on East African materials. While one could, in theory, utilize characteristics of shell tool butchery marks observed in other studies (Choi and Driwantoro 2007), shell has been shown to create cutmarks similar to those made by stone tools (Toth and Woods 1989). In response to the paucity of established criteria for shell tool cutmark morphology, shells collected from St. Catherines Island were used to recreate butchery modifications on fresh whitetail deer bone (*Odocoileus virginianus*). Relative cutting efficiency was also qualitatively observed.

Methods and Materials

Whelk (*Busycon carica*), clam (*Mercenaria sp.*), oyster (*Crassotrea virginica*), mussel (*Mytilidae sp.*), and incongruous ark (*Anadara sp.*) shells were used to disarticulate fresh, defleshed deer (*O. virginianus*) limb bones. All shells were collected from North Beach or harvested from marshland on St. Catherines Island. Fresh and weathered oyster shells were used whole and broken (Figure 4-2). Fresh oyster shell was collected from St. Catherines Island and consumed raw. The shell was saved and remained unaltered until experimentation nearly four months later. Weathered oyster shell was recovered from North Beach, washed up on shore and bleached by sunlight. Fresh shell, even four months after harvesting was significantly softer than the hardened, weathered shell.

Cooked and weathered quahog (*Mercenaria sp.*) and cooked mussel (*Mytilidae sp.*) shells were also tested. Cooked quahog and mussel shell were collected from marshland, baked, and consumed. The shells were saved for experimentation. Weathered quahog was collected from North Beach. Cockleshells were collected as weathered samples washed up on North Beach and bleached by the sun. The weathered specimens were tumbled by waves and bleached from sunlight.

Whelks discussed in the archaeological literature are typically lightning or left-handed whelks (*Busycon contrarium*). The carnivorous animal is edible and, being quite large with shell sizes reaching up to 40cm in length, provides a substantial amount of meat. As described by Luer and colleagues, the “robust” specimens closely related to, but distinct from, *B. contrarium* and *B. perversum* were carefully chosen for their sturdiness (Luer *et al* 1986). Other tools observed archaeologically were made from species within the genera *Strombus, Pleuroploca*, and *Mercenaria*, representing the true conch, the horse conch, and edible saltwater clam, respectively. The whelk used in this study is the knobbed whelk (*Busycon carica*). These experimental tools were weathered by ocean currents and altered by sunlight (Figure 4-3).

The shells were fractured to create expedient tools. This was completed without any previous training and published literature (Brett 1974) provided limited insight into the production techniques of expedient shell tools. Expedient tools were created by applying steady downward pressure barefoot on the shell until it broke, rendering several shell fragments from each whole shell (Figures 4-4 and 4-5). Shell fragments were selected based on their size and how sharp an edge appeared to be. The shells broke in fairly predictable ways but there was significant variation in the shape and size of shells.

Barefoot stomping did not break whelk. One attempt was made to hammer the shell with a defleshed deer bone but was a failure. The bone fractured leaving the whelk completely unaffected (Figure 4-6). Stomping on them with a steel-toe boot broke whelks. Even using the reinforced boot, the whelk was minimally affected but a large enough fragment did separate from the rest of the shell allowing two working edges. This was repeated for another whelk specimen (Figure 4-7).

Disarticulation and defleshing of bone followed a similar procedure as described in Chapter 3. Qualitative observations on each shell's performance were recorded. After the bones were completely defleshed the cutmarks were analyzed with a low-powered dissecting microscope. Whenever possible, molds were made of the shell-modified bone. Whether a cutmark could be molded depended on the depth of the cut. Molds were bisected perpendicular to the length of the cutmark and viewed under low magnification. Lacking a significant amount of published criteria outlining how shell cutmarks should look, butchery marks created by experimental shell tools were excluded from comparison with the zooarchaeological materials. However, as an isolated experiment, the observations of cutmark morphology and the relative efficiency of shell tools as cutting implements are valid and useful for future research.

Results

Generally speaking, the expedient shell tools used for butchery experiments were marginally effective for dismemberment. Based on qualitative observations of the overall efficacy, the expedient shell tools used here were capable of disarticulating one limb from another. However, their relative efficacy is as poor as relative efficiency. Compared to trials with stone and steel, the expedient shell tools used here were generally less efficient. In a few cases the expedient shell was incapable of completing the disarticulation task. In most cases, the task was completed when the to tool was used more vigorously. These results should not discourage future research. Indeed, low efficacy and efficiency may be taken to reflect the unlikelihood of expedient shell tool use. However, one must keep in mind the techniques used to fashion the tools were unguided, and probably unrealistic.

Clam cutting ability and butchery marks

Clam as an expedient cutting tool was disappointing. Although the expedient clamshell tools effectively disarticulated bone, their size and shape made them difficult to use efficiently (Figure 4-8). Edges produced by the expedient process were very wide and did not provide a narrow enough bevel desirable for butchery tasks (Figure 4-9). Furthermore, edges of the broken clamshell dulled quickly and required significant force to cut through muscle tissue. Ligaments required intensive sawing action with dull clam edges making the butchery task laborious. The clam shells tended to break in such a way that only one small corner of the shell was sharp enough to be useful.

Overhead views of the cutmarks were highly variable. However every cut was marked by some degree of sinuosity and featured multiple microstriations running parallel to the kerf[5] within the groove. Cuts were also typically shallow, contained debris, and had a rougher appearance (Figure 4-10). Some of the cutmarks also retained the convexity of the shell cutting edge. These semi-rounded cutmarks may be a product of the small size of the shells used. Furthermore, at this level of magnification there were no apparent differences between butchery mark morphology of weathered and cooked shells.

The most common attribute of profiles of clamshell cutmarks is the shallowness of the grooves. Profiles of the clam cutmarks are rounded, wide, and can be inconsistently symmetrical (Figure 4-11). The molds are generally inconsistent in shape

[5] Kerf is the groove made by a cutting tool (Humphrey and Hutchinson 2001: 230).

because of the variability of cutting edges. For example, some cutmarks exist as singular grooves and others have multiple intersecting and parallel striae. Grooves with parallel ancillary striae show an undulated profile (left images in Figure 4-11). The wide and shallow molds demonstrate the cutting tool had a wide, blunt edge, which did not deeply penetrate the bone. Generally, acquiring high-fidelity molds of cutmarks created by expedient clamshell tools was made difficult by the shallowness of grooves. Furthermore, some of the cutmarks were so shallow that molds did not detect any groove on the bone surface[6].

Overall, clamshell was successful in disarticulation but the task was completed with limited efficiency. Fragments selected for butchery were awkward to hold and had relatively wide cutting edges. Shell that fractured along annuli were preferred but did not increase the overall efficiency of the butchery task. Overhead views of cutmarks showed some consistency with respect to debris-filled grooves, ancillary striae, width, and depth. Cuts sometimes reflected the convexity of the shell and also demonstrated the relatively wide cutting edge of the clamshell tool based on the shallowness of the groove. Molds showed high variability within the clamshell sample. Furthermore, both the profiles and overhead views of the grooves did not satisfy previously reported criteria (Choi and Driwantoro 2007) and therefore do not serve as useful comparative samples for assessing zooarchaeological modifications.

Cockle cutting ability and butchery marks

Cockleshell cutting ability was variable. One shell was implemented in its unmodified form because the edge of it appeared to be quite sharp on its own (Figure 4-

[6] It is noted that the inability of the molding agent to detect some butchery modifications may be an artifact of the quality of the molding agent. Alternatively, the use of a vacuum would serve to increase the fidelity of the mold's representation of the bone surface, but such instrumentation was unavailable during the experimentation.

12). In practice, the unmodified edge of S2 was not an efficient cutting tool. It was unable to disarticulate the distal radi-ulna from the adjoining metacarpal bone; the task was abandoned and six marks were made on the distal end of the bone (Figure 4-13). On the other hand, the broken cockle fragments retained sharp, serrated edges running parallel to grooves in the shell (Figure 4-14). These edges made for excellent cutting tools that efficiently severed ligaments with a sawing motion. However, these shells, being rather thin, were flimsy and would break with too much downward pressure.

In nearly all cases, cutmarks were created with deliberate downward force with the intention to produce conspicuous grooves (Figure 4-15). Other marks better described as incidental were shallower, sinuous, intersecting, and debris-filled (bottom left Figure 4-15). These marks were non-linear were similar to what would be expected from a rough-edged, retouched stone tool with an offset edge, or possibly trampling (Dominguez-Rodrigo *et al* 2009).

Molds of cockle-marked bone were not generally consistent within the sample. This is certainly a product of different amounts of force applied during the cutting tasks. The most conspicuous impact of differential force visible in the cross-sectioned molds is the relative depth recorded by the impressions (Figure 4-16). Cutmarks that penetrated deeper into the bone tend to be asymmetrical. Shallower cutmarks produced molds that reflect more symmetry, greater relative width, and are more rounded.

Most of the molds demonstrate the morphology of cutmarks resulting from deliberate attempts to mark the bone. The lack of pressure controls undoubtedly influenced the variability observed in both overhead and profile views of the cutmarks. The variability introduced by unregulated pressure restricts the potential for the cutmark data to be utilized as a valuable comparison with zooarchaeological materials. Some features of these experimental cutmarks are similar to what one would expect from unmodified stone tools (Greenfield 1999). This would be problematic for assessments of zooarchaeological bone if the profiles of these grooves were consistent within the cockleshell sample. Therefore, irrespective of the lack of expertise in creating the experimental tools, the inability of the sample to corroborate itself by being internally consistent invalidates the potential to compare the cockleshell results with the zooarchaeological collection.

These experiments thus retain the most value in evaluating cutting abilities of expedient cockleshell tools. The fashioning of this expedient tool form was simplistic and the resulting cutting edge was incidentally serrated. The serration of the expedient cockleshell tools provided a substantial advantage over unmodified cockleshell and outperformed the other species of shell used in the experiments. Lacking consistency in morphological attributes, these experimental cutmarks cannot be used to empirically demonstrate cockleshell butchery at Santa Catalina de Guale. Expedient cockleshell would be a viable, widely available raw material for cutting tools in theory, but cannot be confirmed by these results.

Oyster cutting ability and butchery marks

Oyster shell butchery performance was dismal. Fresh oyster shell dulled quickly during the cutting task and flaked away when applied directly to the bone. The weathered oyster shell was used unaltered. There were two seemingly satisfactory working edges on the weathered right valve, which was fairly flat and blade-like. This item was more durable and held up better to the pressure necessary to cut through ligaments and tendons. When applied to directly to the bone it flaked but not as dramatically as fresh shell. A second weathered shell was used unmodified. No attempts to expediently fashion a working edge were made because the edge opposite of the hinge felt sharp enough to slice through meat. With enough force, the unmodified, weathered oyster shell did disarticulate the limbs.

Over-head views of the bone cut by weathered oyster show that cuts were relatively deep, penetrating further into the bone than other expedient shell tools. Grooves are sinuous featuring parallel ancillary striations, debris in the groove, and pronounced shouldering (Figure 4-17). The cutmarks indicate a tool with an offset edge was used. These cutmarks may appear to be similar in plan view to cutmarks created by an unretouched stone tool. Cutmarks made by fresh oyster shell were extremely faint. These cutmarks did not photograph well (not pictured) and molds demonstrate the inability of fresh oyster shell to penetrate bone.

Molds of the cutmarks made from weathered oyster shell demonstrate cuts that penetrated the bone deeper than fresh oyster shell. Collectively, molds indicate the variability of the cutmarks. The molds of cutmarks created by weathered oyster shell are extremely heterogeneous. Furthermore, lacking in symmetry and definable form, profiles of cutmarks made by weathered expedient oyster shell tools do not consistently share any attributes (Figure 4-18). In cross-section, the cutmarks are shallow and generally lack symmetry. Additionally, the molds are examples of how the impression material was barely able to record modifications on the bone surface. While this may be a product of molding quality, it is noted that the fresh oyster shell created very faint cutmarks.

The abundance of oyster shell on coastal sites makes it tempting to speculate its' use for butchery tasks. However, qualitative assessments of the efficacy of experimental tools refuse to support such a theory. Poor durability of fresh oyster shell and the way it flaked off into the flesh suggests that it would not have been viewed as a desirable raw material. On the other hand, weathered oyster shell performed much better and could conceivably have been used to fashion tools. Results of the experimental trials suggest the expedient tool forms tested here are very poor examples of hypothetical weathered oyster shell tools.

Mussel cutting ability and butchery marks

Mussel shells were also used in their unmodified forms (Figure 4-19). The shells were very thin and could not hold up to the pressure necessary to slice through the tendons and ligaments holding together the limb bones. One of the mussel shells fractured after using it in a sawing motion. The exposed edge was used to complete the task but functioned no better than the unmodified edge. As was the case in the cockleshell trials, the mussel shell was used to deliberately mark the bone.

The cutmarks left by these shells were highly inconsistent, probably a result of deliberately modifying the bone. Some cutmarks were straight, others were sinuous. Some of the cuts were deep while others were very shallow. The only consistent attributes were the debris and shouldering of the grooves (Figure 4-20). Molds of cutmarks made by mussel shells recorded very shallow marks without much consistency other than shared depth attributes (Figure 4-21). These molds demonstrate asymmetry and very few definable attributes that would make for useful comparisons with zooarchaeological specimens.

The plan, profile, and qualitative observations of cutting ability suggest that mussel shell was not likely utilized as a cutting tool in its unmodified form. Flimsy structure and small size are two of the main factors striking down a theory of mussel shell use as a butchery tool. Plan images of cuts made by mussel shell approximate overhead views of cutmarks made by stone tools. However profile characteristics are not suitable for creating a well-defined criteria for mussel shell tools.

Whelk cutting ability and butchery marks

Whelk shells were expediently fashioned by battering away the lip of the shell in an attempt to crudely recreate cutting-edge tools (Goggin 1949; Marquardt 1992). Initially an attempt was made to render beveled edges from the lips of several whelks using a defleshed deer bone. The bone shattered on impact (Figure 4-6). Eventually a steel-toe boot was used to modify the whelks and four expedient tools were created (Figure 4-7).

Three of the four expedient tools were extremely awkward to use. These three whelks were mostly intact. The awkward working edges on the end of the columella and the lip area limited their ability to be manipulated into cutting tools. One whelk blade tool was better suited for the butchery task because it enabled better dexterity and smoother slicing motions. It was clear that these whelk tools did not accurately represent some of the scrapers described elsewhere (Eyles 2004; Marquardt 1992). However, the goal of this experiment was to impress upon the bone a cutmark from an expedient beveled edge of whelk. While it is acknowledged that the whelk tools were inexpertly fashioned, it is assumed that the raw material used approximates the minimally modified edges of whelk tools observed archaeologically.

Cutmarks made by whelk are typically sinuous and thin. Marks are also shallow, contain debris, and appear rough. Microstriations are present along the inside walls of the cutmarks (Figure 4-22). Ancillary cutmarks may be a product of the awkward angle at which whelk tools were held during the butchery task whereby the cutting edge and another part of the whelk tool impacted the bone simultaneously. Lacking definition in profile cross-section, it is difficult to define characteristics from profile views of whelk cutmarks (Figure 4-23). Generally, the profiles show shallow, rounded, fairly symmetrical grooves. Profiles of whelk tools typically reflect what is visible in overhead views. Particularly, depth can be assessed from overhead views and is consistent with the cross-sectioned mold view. The blade extracted from the whelk lip served as a useful cutting tool compared to the bulky, nearly complete forms. The whelk tool trials indicate that if expedient whelk tools were utilized for butchery tasks, they were likely fashioned with at least some preconception of a desired form.

Results of experiments and analysis discussed in Chapter 5 suggest that both plan *and* profile views are necessary for comparative methodology. Lacking general consistency between results of experimental data on shell cutmarks and the impoverished literature describing expected morphology, the cutmark data from expedient shell tools are excluded from comparison with zooarchaeological specimens. Profiles were necessary for tool assessments of the zooarchaeological collection for stone and metal. Plan view assessments were most reliable when paired with profiles. The experimental data may not be useful for comparative purposes but qualitative data is still useful for guiding future research and tentatively interpreting expedient shell tool use by coastal dwelling Indians in the American Southeast.

Discussion

The uninformed fashioning of expedient shell prevents the use of experimentally reproduced cutmarks for interpreting zooarchaeological modifications. Although raw material may be viewed as a control during replication techniques, there is no way of assuring fidelity in cutmark edge without drawing on explicit examples of how expedient tools ought to look and how they were made. Interpreting the cutmarks created during these experiments requires an acknowledgement that the cutting edges may not accurately represent expedient shell tools used by coastal dwelling aboriginal peoples in the American Southeast.

However, these experiments are useful for demonstrating relative cutting efficiency of shell types through qualitative observations. Although assessing the efficiency of the shell tool materials still falls victim to a lack of understanding of expedient shell tool forms, reflecting on material types and the likelihood of their implementation in butchery tasks is valuable.

It seems appropriate to dismiss mussel shell as a likely butchery tool material. The shells used here lacked the structural integrity one would assume necessary for continuous butchery. If fracturing of mussel shell rendered the expedient tool useless, one could envision its rapid replacement with another mussel shell. However, the sheer numbers of oyster shell compared to mussel in middens (Waselkov 1987) in the American Southeast make this assumption unlikely[7]. Other studies discount the low quantity of mussel shell in prehistoric middens in the American Southeast as evidence of their use for tools (Peacock 2000). While there have not been any mussel shell tools

[7] I have personally observed significantly fewer mussel and incongruous ark shell during excavations in shell midden contexts on St. Catherines Island. It seems to me that the abundance of oyster shell makes it a better material for rapid discard and replacement compared to mussel and cockle.

identified from St. Catherines Island, the experiments here restrict the possibility of expedient mussel shell tool use for deer butchery.

The experiments also made it clear that the clamshell tools were not effective butchery implements. This interpretation is without a doubt due to the inability of the researcher to fashion an effective expedient clamshell tool. However with previous experimentation using expedient clamshell being quite limited (Choi and Driwantoro 2007; Toth and Woods 1989), the creation of an accurate representation of expedient clamshell tools used by Native Americans in the American Southeast was hit or miss.

There has been considerably more research on expedient whelk and conch tools (O'Day and Keegan 2001) and whelk tools are readily identifiable in the archaeological record owing to extensive shell tool typologies (Eyles 2004; Marquardt 1992). However there are limited guidelines on the creation of whelk tools (Lee 1989; Reiger 1981) for experimental purposes, which, makes the replication of tools difficult.

Demonstrating shell tool butchery in the archaeological record is problematic for two reasons, both generated by an impoverished body of research. On the one hand, a lack of protocol for identifying expedient shell tools restricts our understanding of them. Shell fragments in the archaeological record can be an ambiguously expedient tool or a product of deposition or taphonomy. Lacking the research attention they deserve, expedient shell tools are hard to identify and therefore difficult to recreate.

The second reason is a direct result of the first. Without a firm understanding of what an expedient shell butchery tool ought to look like based on archaeological examples, there is virtually no way of replicating tools for experimentation. The potential for experimentation using shell tools is therefore inaccessible. Taken a step further, given the current body of literature, it is nearly impossible to identify archaeological cutmarks that were created with shell tools because no experimental modifications have been accurately replicated with any degree of certainty. The quantity of literature dealing with shell butchery marks pales in comparison to the body of research that discusses metal- and stone-modified bone.

These skeptical assertions highlight a gap in the literature that could be easily filled with a series of focused, well-controlled (Khreisheh *et al* 2013) experiments. The goals of these experiments would be to (a) replicate likely forms of expedient shell tools based on examples of regional shell tool types, (b) define shell tool manufacturing procedures, (c) create a typology of expedient shell tool types, and (d) establish characteristics of cutmark morphology resulting from the use of the expedient tools for butchery tasks. Following these experiments, it should be possible reproduce the results and to compare the characteristics of the experimental cutmarks to additional experiments for validation. Only then can one demonstrate shell tool butchery in the archaeological record.

The degradation of shell in the archaeological record has discouraged others from pursuing the empirical demonstration of shell tool butchery. Masson states that unlike woodworking, butchery and hide working, "…do not leave behind much evidence of use on the artifacts" (Masson 1988: 322). Compared to use-wear analyses of stone and metal, leeching of shell in midden deposits and weathering may erase any trace of animal butchery on the shell artifacts themselves.

The solution to this problem lies in the use of indirect evidence such as that visible on butchered bone (i.e., cutmarks). Furthermore, pursuing evidence for expedient shell tools used for butchery tasks is promising. For instance, Choi and Driwantoro note that when shell is broken and expediently used for butchery, cutmarks on bone are macro- and microscopically distinct from the typical V grooves left by lithic tools (Choi and Driwantoro 2007: 51-52). Their study shows that evidence for the use of *expedient* shell tools may yet be available in faunal collections. Previous work encountered difficulty in distinguishing lithic cut marks from retouched shell cutmarks (Toth and Woods 1989).

This and previous research stresses the need for empirical work to either credit or discount the use of shell tools for butchery. As Marquardt puts it, "ultimately, one cannot be reasonably certain that the correct function has been inferred in the absence of indisputable functional context or, at the very least, extensive experimentation" (Marquardt 1992: 191). The hypothesis that emerges from the issue of whether shell tools were used for butchery is testable and pertinent. Methodology for understanding shell tool butchery has already been established but has yet to be applied to archaeological sites in North America. This study attempted to recreate experiments used elsewhere but has been confounded by an absence of corroborating data. Future research is needed to build on these qualitative assessments in order to understand shell technologies of pre-contact Native Americans living in Florida and coastal Georgia.

This chapter has focused exclusively on demonstrating the methods and results of shell tool butchery tasks. The shell tool data was discussed separately because of difficulties in comparing the inconsistent, uncorroborated data with the zooarchaeological record. Experiments with metal and stone were significantly more successful. Results of those butchery experiments are discussed in Chapter 5. As will be shown, a portion of the interpreted tool set has been classified as ‘undetermined’ and could, in theory, be attributed to shell tools. However, the variability and inconsistency in the experimental shell sample prohibits confident comparisons with zooarchaeological specimens. Successfully corroborating the experimental data of stone and metal tools was central to the discussion of European and indigenous technologies. Yielding verifiable data, the metal and stone butchery sample is compared to the zooarchaeological sample and used to interpret evidence of a heterogeneous butchery tool set at Santa Catalina de Guale.

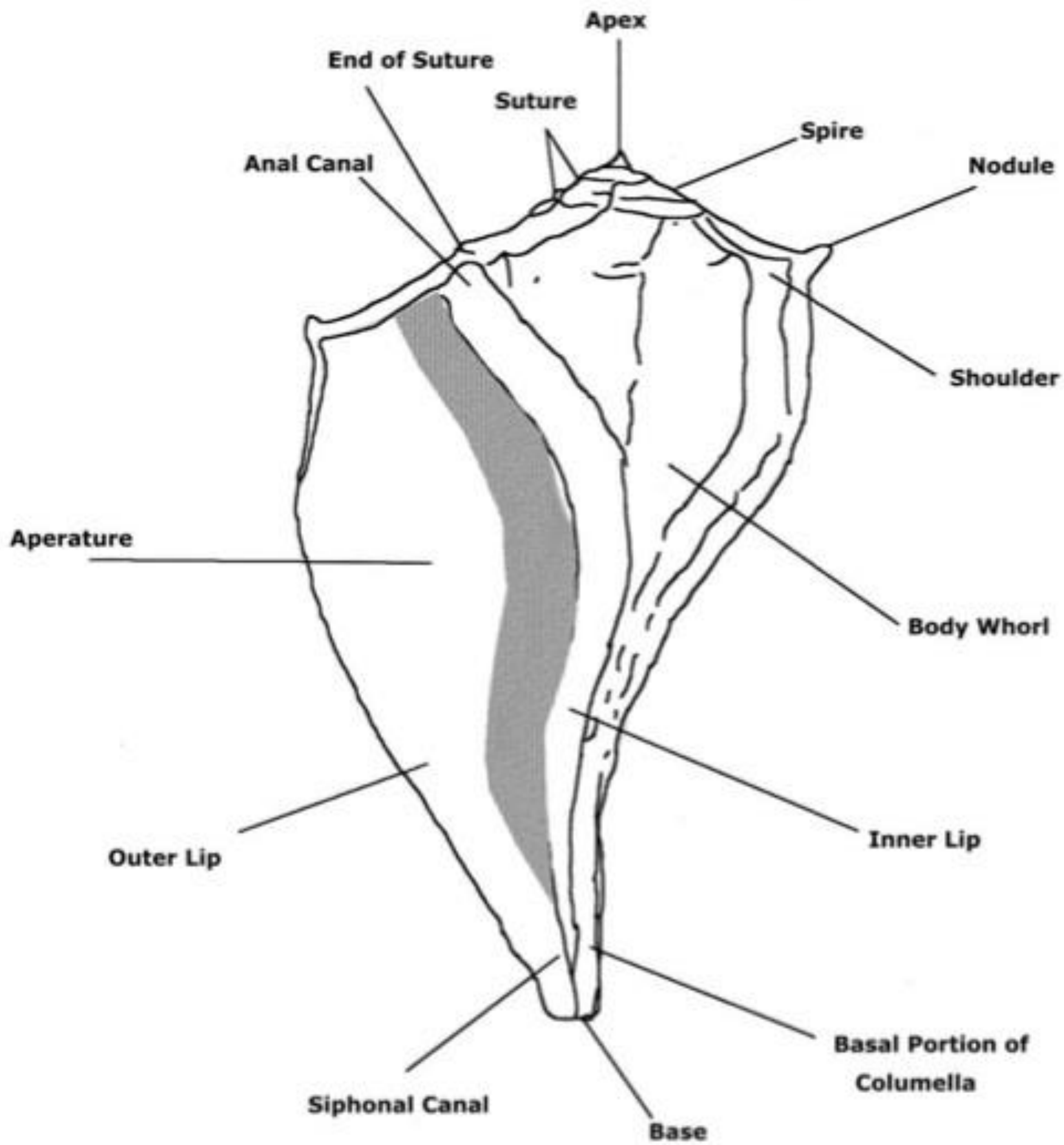

Figure 4-1. Diagram of whelk anatomy from Luer (1986)

Figure 4-2. Fresh (left two) and weathered (right two) oyster shell used for experimental butchery tasks.

Figure 4-3. Modified whelks collected for experimental butchery tasks.

Figure 4-4. Expedient cockleshells.

Figure 4-5. Expedient clamshells.

Figure 4-6. Rudimentary bone hammer fractured on impact with unmodified whelk.

Figure 4-7. Expedient whelk shell tools.

Figure 4-8. Expedient clamshell tools used in butchery trials.

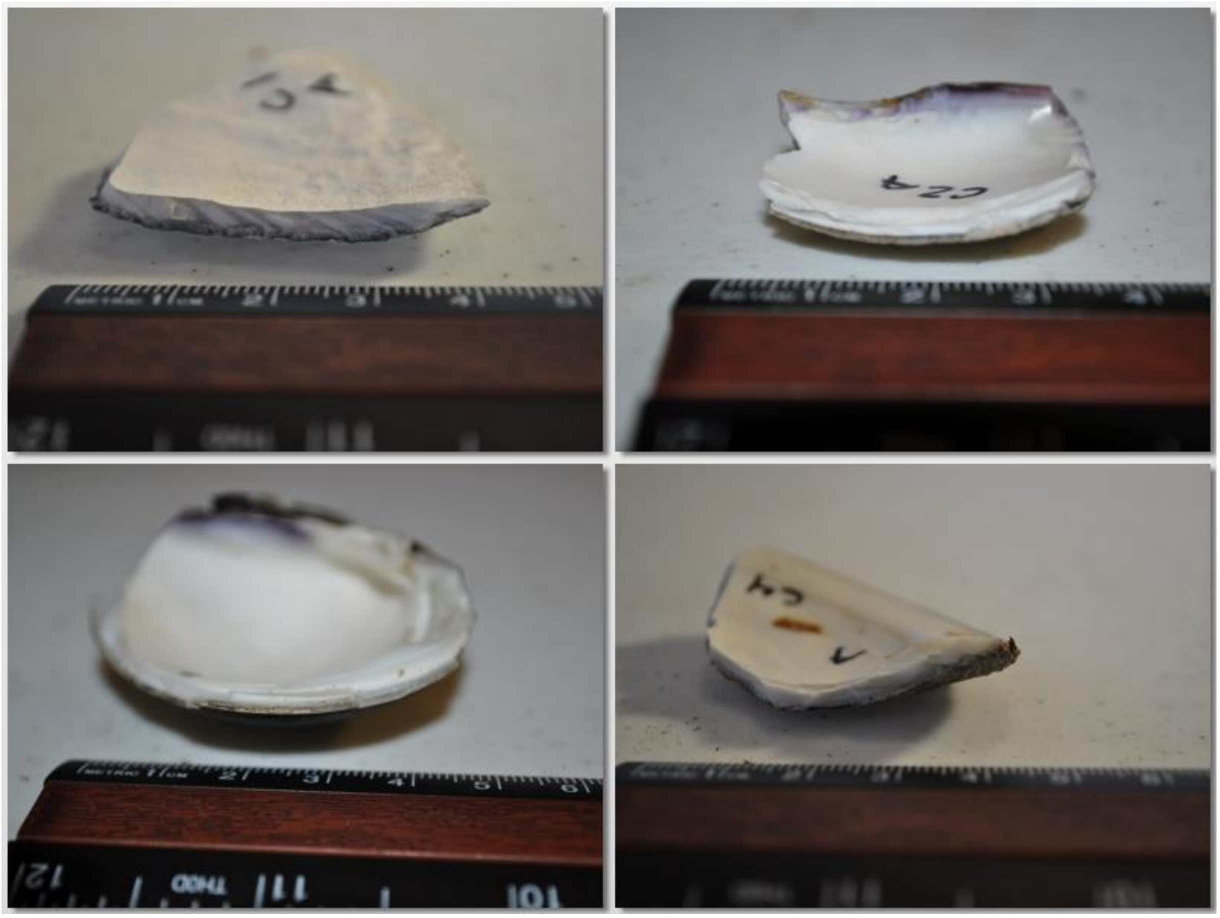

Figure 4-9. Edges of expedient clamshell tools used in butchery trials.

Figure 4-10. Overhead views of experimental butchery marks made by weathered(top) and cooked (bottom) clamshells. Views at 29x magnification.

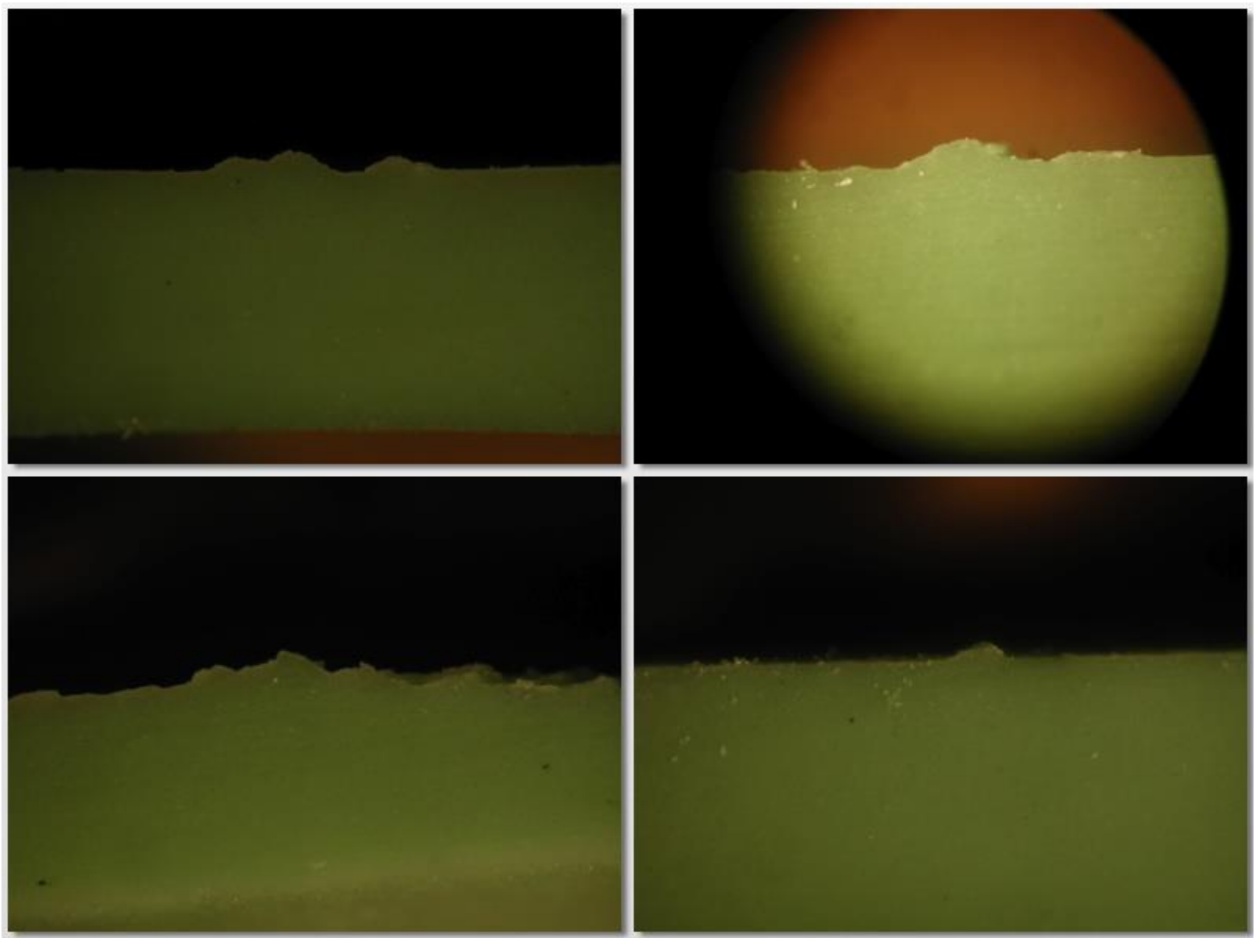

Figure 4-11. Cross-sectioned molds of cutmarks showing profiles of grooves for weathered (bottom left) and cooked clamshell.

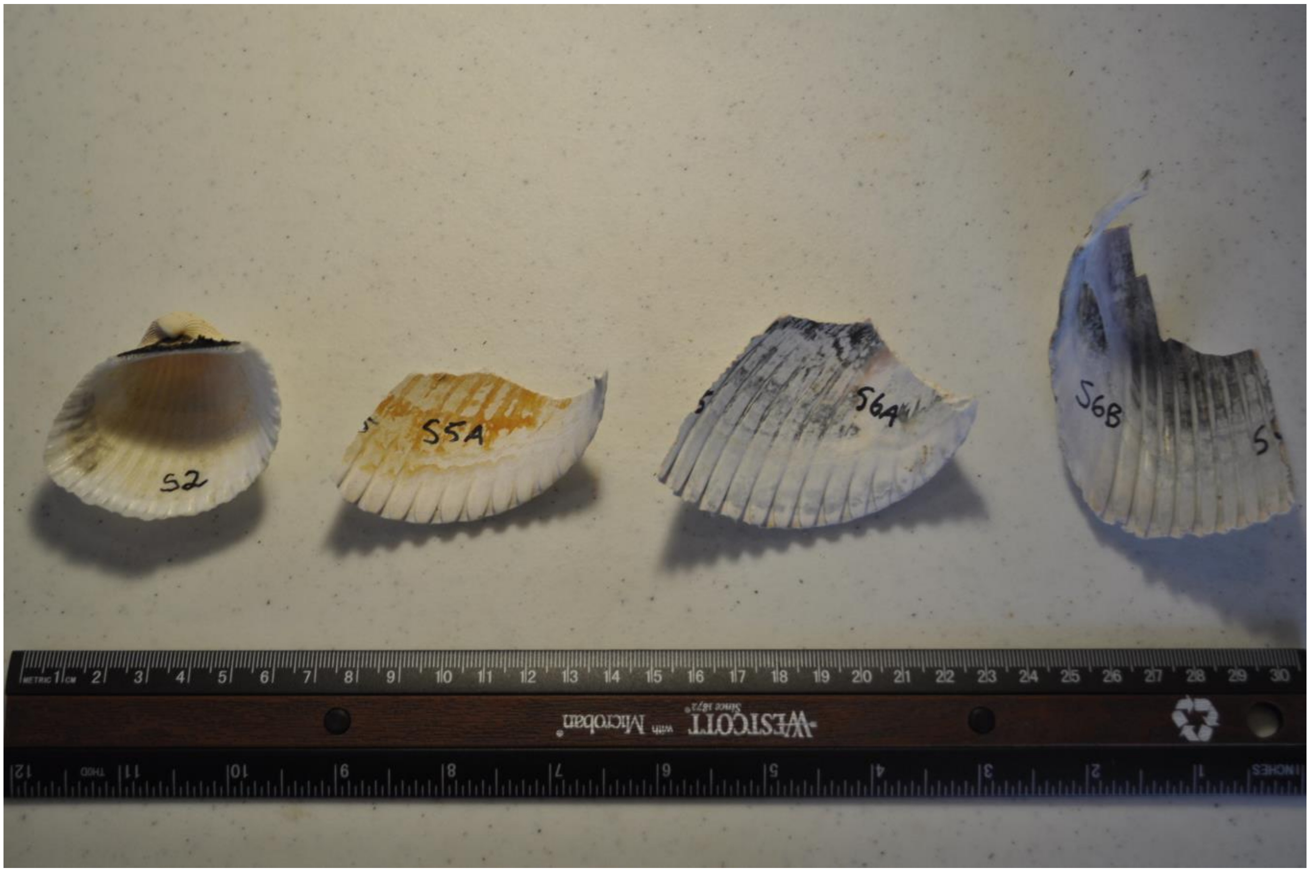

Figure 4-12. Unmodified (left) and modified cockleshells used for experimental butchery tasks.

Figure 4-13. Unmodified scallop and deliberate cutmarks on distal end of radi-ulna.

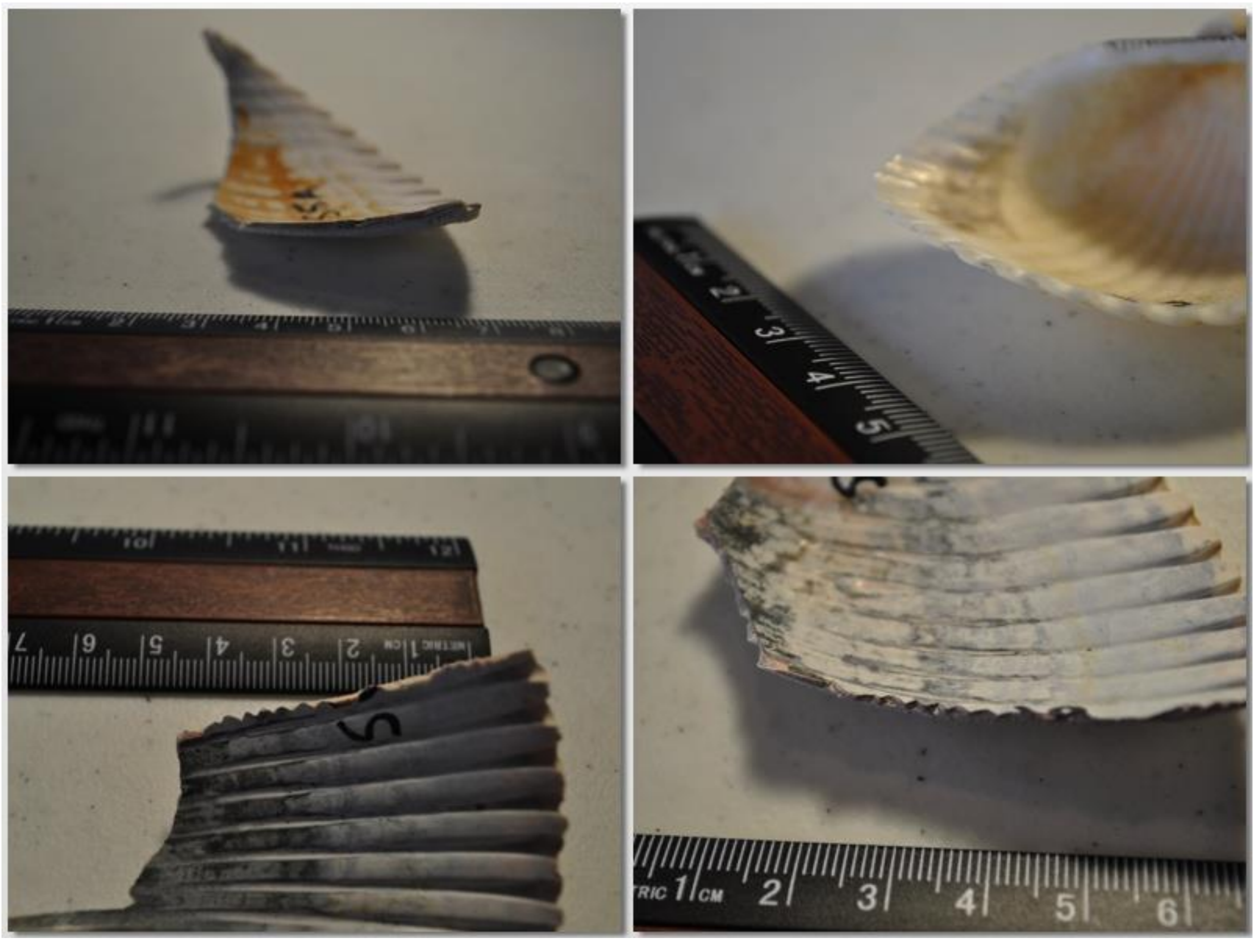

Figure 4-14. Edges of expedient and unmodified (top right) cockleshells used during butchery tasks.

Figure 4-15. Overhead view of deliberate and ‘incidental’ (bottom left) cutmarks made by expedient and unmodified (bottom right) cockleshells.

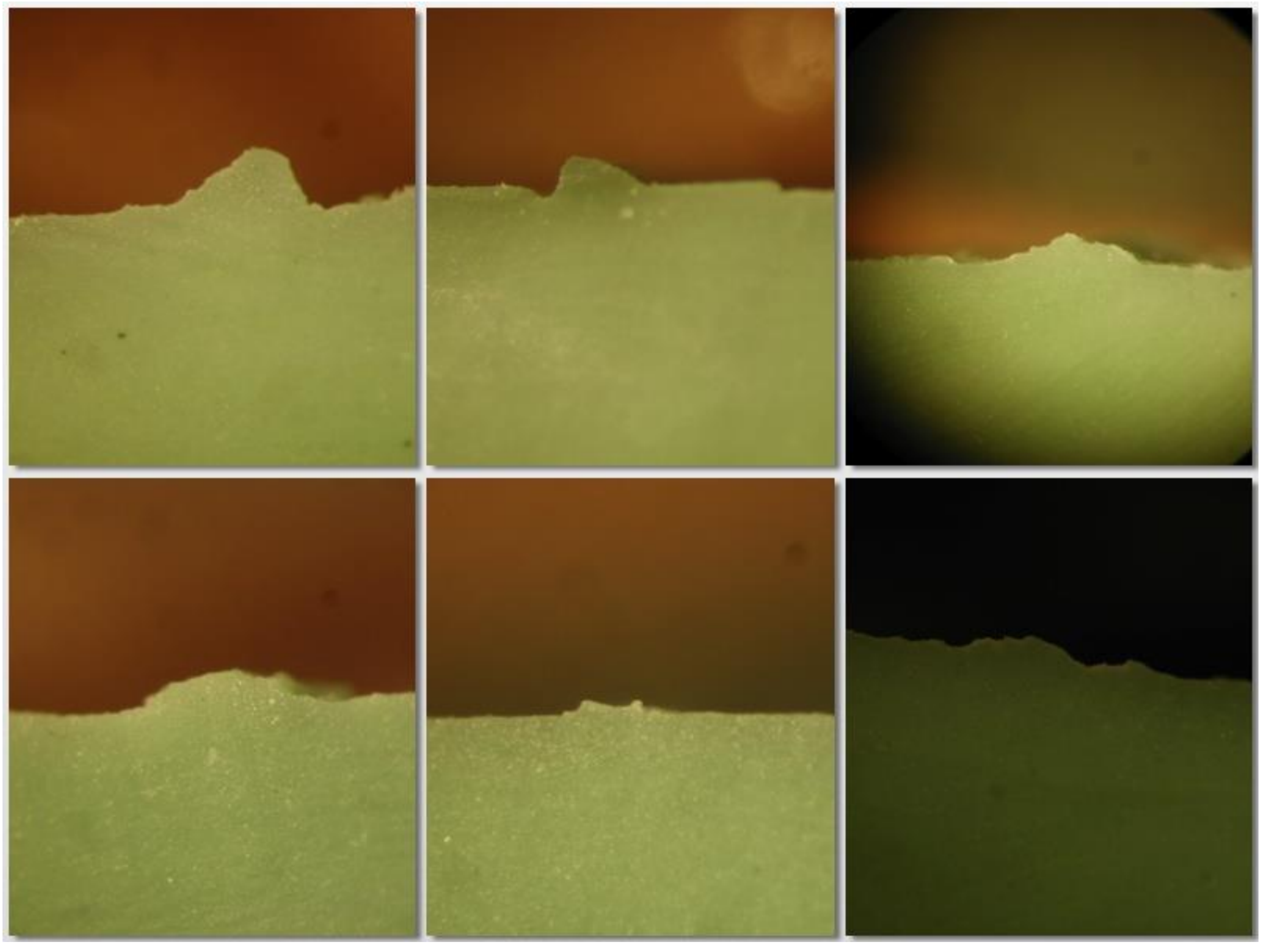

Figure 4-16. Profiles of experimental cutmarks created by cockleshell tools.

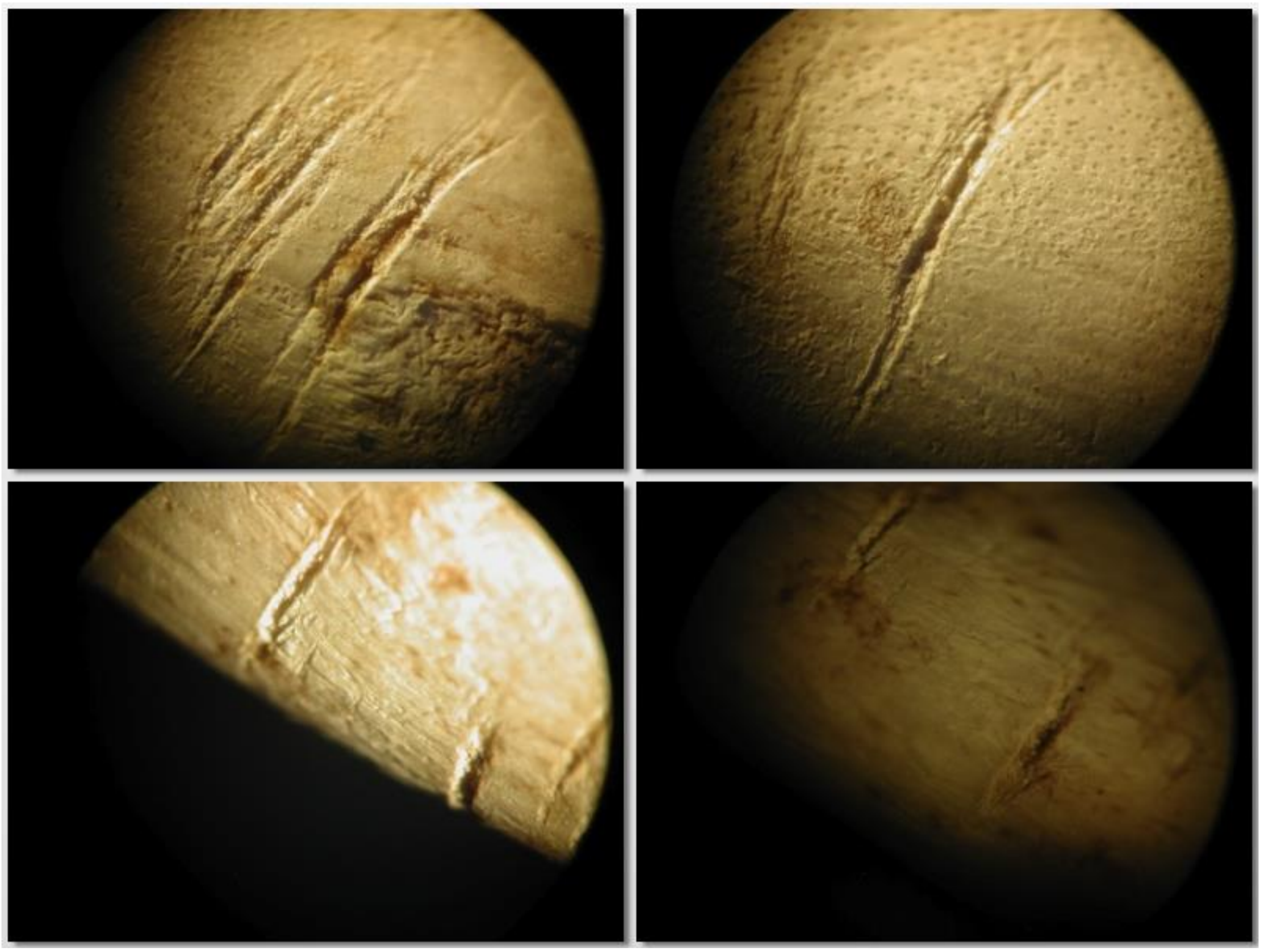

Figure 4-17. Overhead views of bone cut experimentally by expedient oyster shell tools.

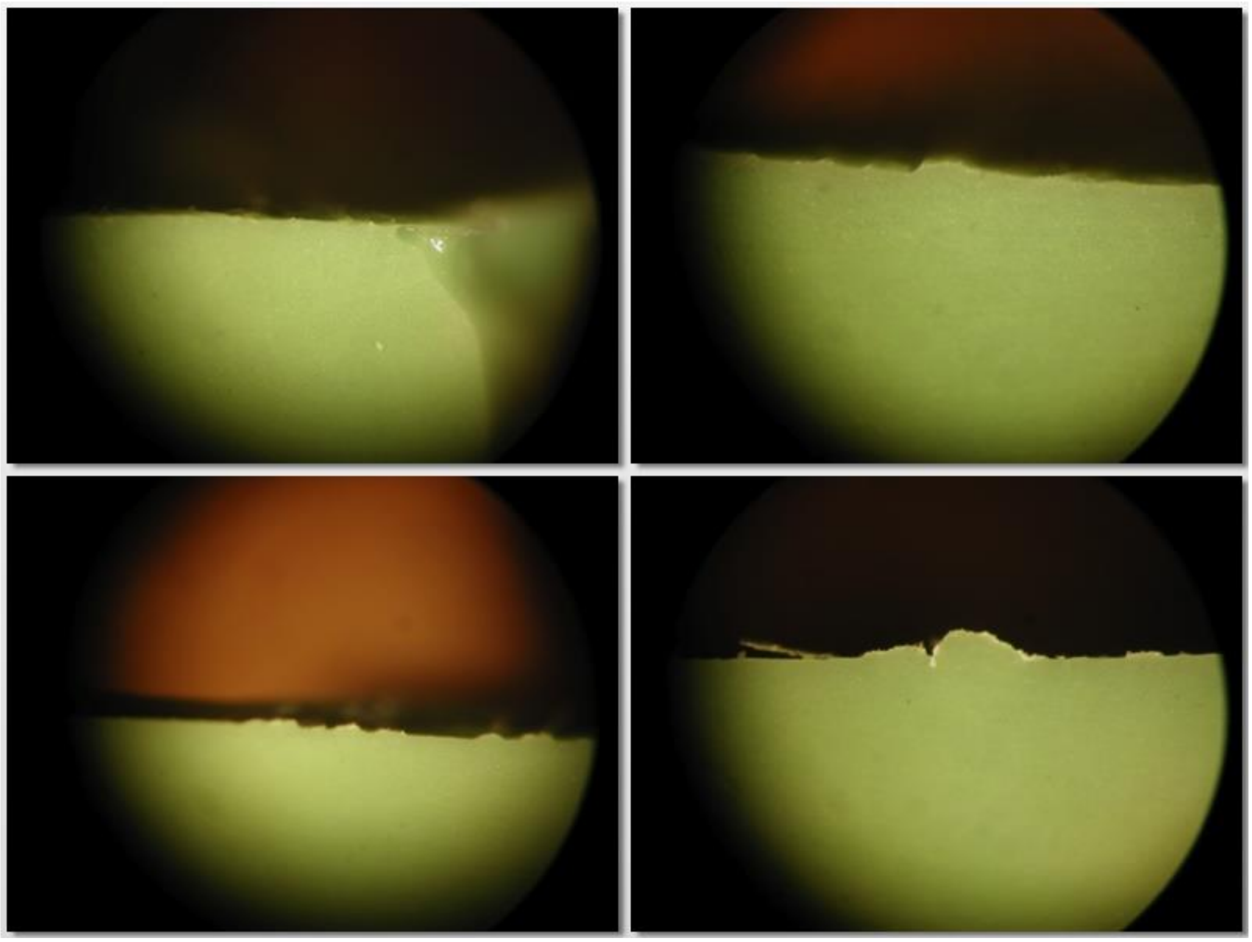

Figure 4-18. Cross-sectioned molds of experimental cutmarks made by fresh (top) and weathered (bottom) expedient oyster shell tools.

Figure 4-19. Unmodified mussel shell used in experimental butchery tasks.

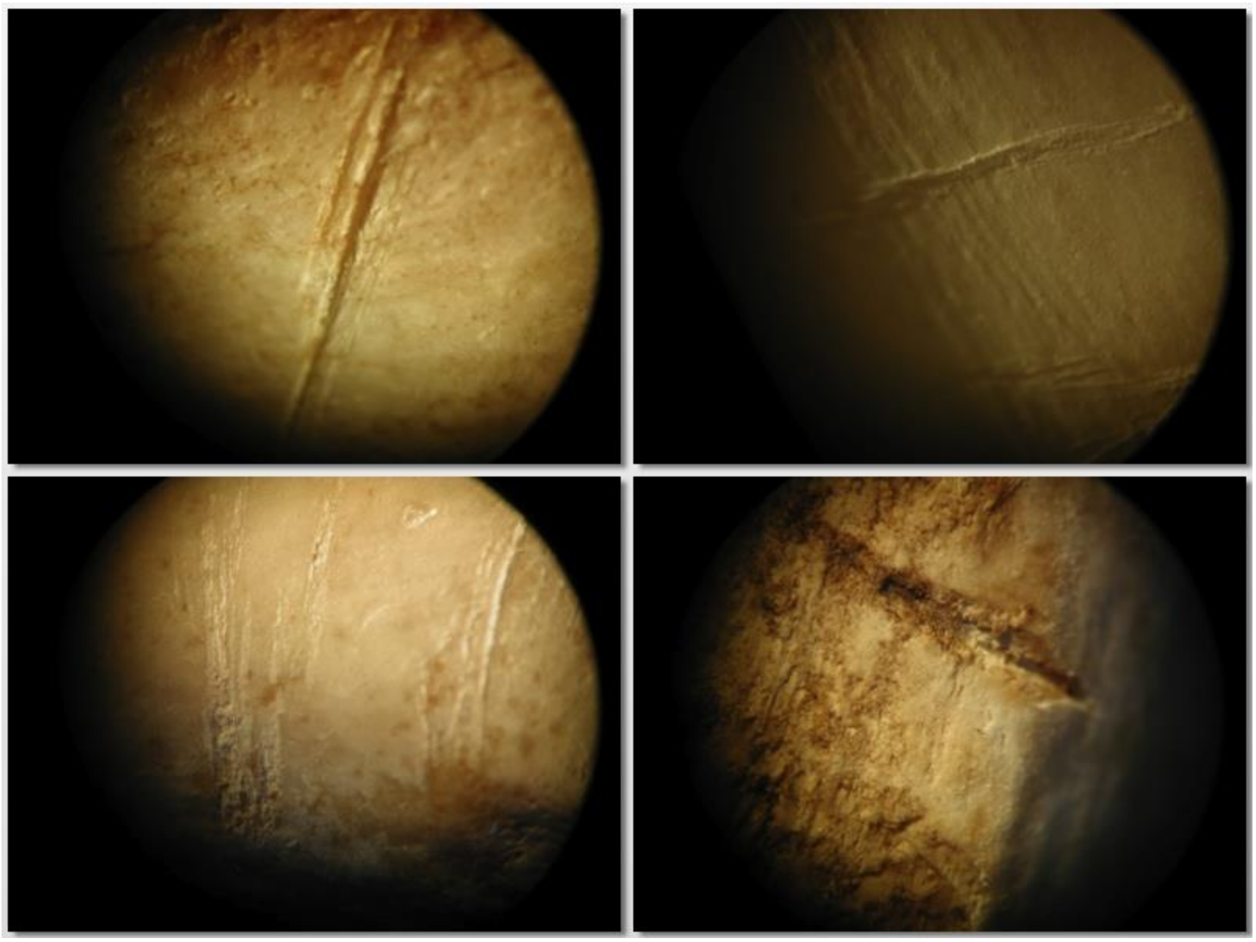

Figure 4-20. Overhead views of experimentally produced cutmarks using mussel shell.

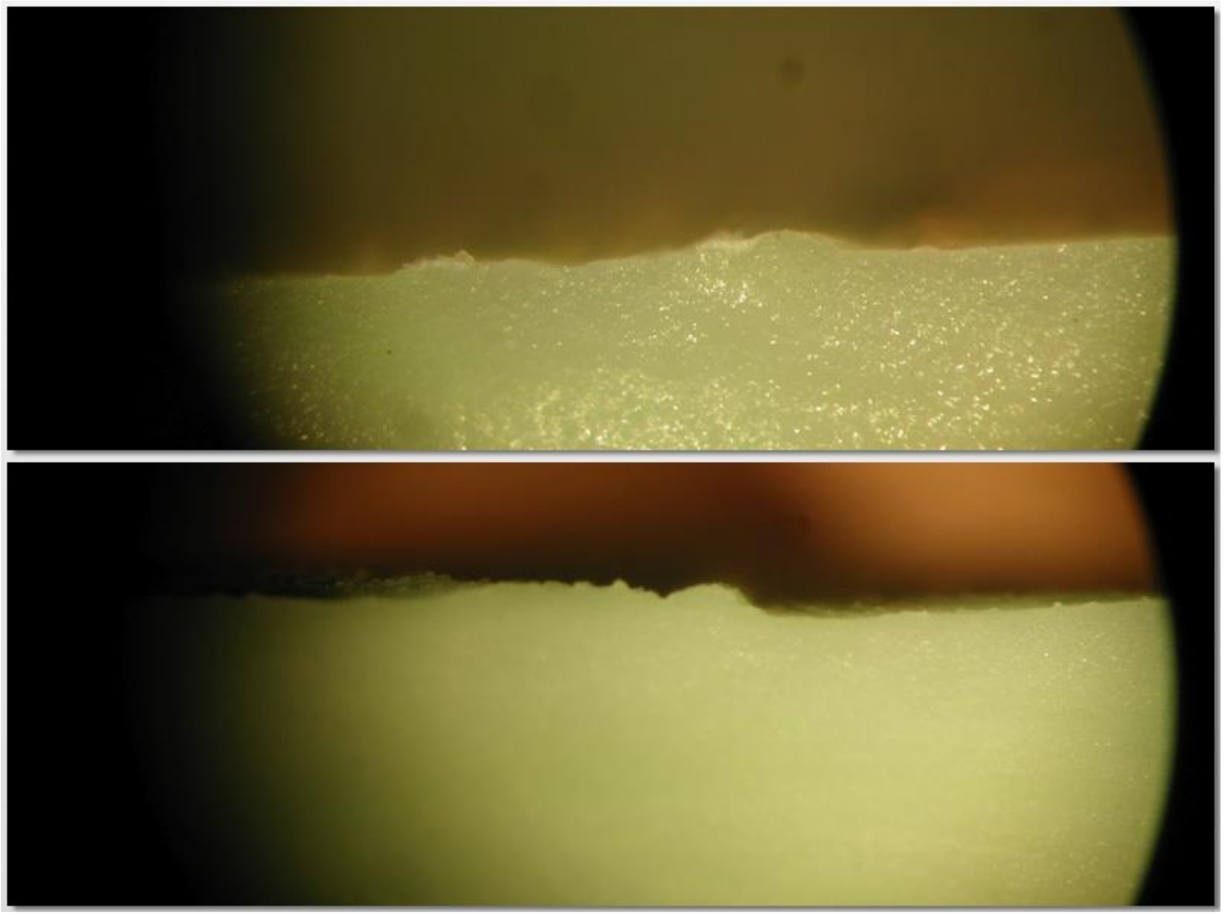

Figure 4-21. Cross-sectioned molds of experimentally produced cutmarks using mussel shell.

Figure 4-22. Overhead views of experimental cutmarks made by expedient whelk tools.

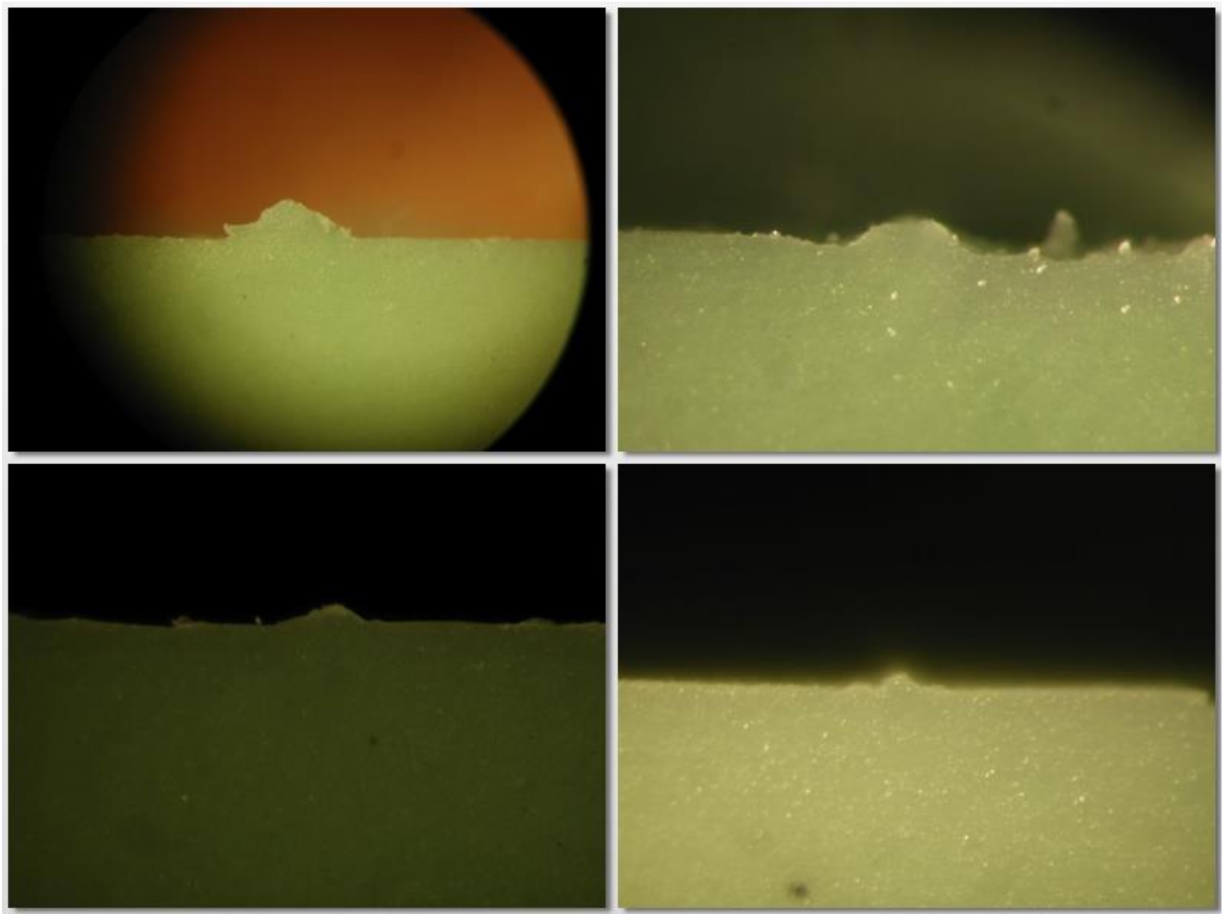

Figure 4-23. Cross-sectioned molds of experimental cutmarks made by expedient whelk tools.

CHAPTER 5: RESULTS AND ANALYSIS

Experimentally cutmarked deer (*O. virginianus*) bone was compared to zooarchaeological specimens recovered from the Mission and Pueblo at Santa Catalina de Guale (Reitz 2008; Reitz and Dukes 2008; Reitz *et al* 2010; Thomas 1987). After the experimental sample was created using several butchery tool materials, dental impression material was used to gain a perspective of the cutmark profiles for both the archaeological and experimental bone. Metal, stone, and different types of shell were tested in butchery trials to account for a range of tools that might have been used by people living at Santa Catalina de Guale. The interpretation of molds of zooarchaeological cutmarks required comparison with experimental examples and published criteria. The tool used to modify archaeological bone was determined by examining the cutmarks and the profile views obtained from cross-sectioned impressions using low-powered microscopy. This comparative analysis confirmed the use of metal and stone tools in the pueblo and mission areas.

The number of bone fragments cut by metal and stone tools and bones modified by other taphonomic or unidentifiable processes were considered with respect to their association with secular and non-secular contexts. Proveniences of the zooarchaeological specimens were entered into a geodatabase (Tennant 2007), which oriented cutmark data with excavations at the mission (Thomas 1987) and the pueblo (Caldwell 1971; May 1985, 2008) as well as other investigations in the Wamassee Head and Fallen Tree areas (Caldwell 1971; Thomas 2008a, b, c). Statistical tools in ArcGIS (Environment Systems Research Institute) enabled spatial analysis. These data are presented here and are synthesized and interpreted in the following chapter.

Overview of Experimental Butchery

Experimental zooarchaeology should consider many variables in order to select, "…the most compelling or parsimonious hypotheses" (Lubinski and Shaffer 2010). Using multiple lines of supportive evidence such as testing different tool materials and drawing on ethnohistory, experimental zooarchaeology can be fertile ground for revisiting faunal collections to elaborate on previous interpretations of a site's use. To consider a range of tool types that may have been used by Satna Catalina de Guale residents, stone, shell, and steel were used to create butchery marks for comparative purposes.

Butchery tasks were completed using four types of non-serrated steel blades, four Keokuk chert flakes, and a number of expedient shell tools. Each tool was used to deliberately mark a part of a limb bone. Qualitative observations on the efficacy of a tool's cutting ability are discussed for the stone and steel blades used. Shell was not a very useful cutting tool material and was excluded from the geospatial analysis but is discussed in depth in the preceding chapter. Some tool materials were excluded since the impressions taken from their respective experimental cutmarks were lacking in their diagnostic potential. Because the expedient shells used in these trials were generally inefficient butchery tools and because the impressions made of the cutmarks were not very distinct or useful, and lacked diagnostic features discussed elsewhere (Choi and Driwantoro 2007), shell was not compared to the zooarchaeological collection.

Experimental butchery tasks demonstrate that metal was the most effective butchery tool material. Although one of the metal blades was a dull clam knife, the cutting efficacy remained constant because the stainless steel did not dull with each slice. Chert, on the other hand began to dull while the limb bones were being disarticulated. With chert, slicing through thick tendons and ligaments caused the blade to dull slightly but the task could still be completed. On the other hand, while using some shell materials, the ligaments and tendons were unaffected even during forceful sawing motions. Experimentally produced cutmarks using metal and stone tools were morphologically consistent with experimental cutmarks in other studies in plan and profile views (Table 3-1).

Plan views provided initial assessments of zooarchaeological modifications and were corroborated by profile views of experimental cutmarks and examples in other studies. Profile views were critical for diagnosing the tool material that created butchery marks on zooarchaeological bone (Cipolla 2008; Greenfield 1999, 2002, 2006; Shipman and Rose 1983a). This perspective was obtained using molds taken with Aquasil Ultra Heavy Body regular set dental impression material. Quality impressions were made with adequate mixing of the base and catalyst of the molding agent. A well-mixed compound, gravity, and time determined the quality of the molds. After solidifying, impressions were bisected perpendicular to the length of the cutmark.

The sectioned molds of zooarchaeological modifications were then viewed under a low-powered dissecting microscope and compared to molds of experimental cutmarks. Profiles of cutmarks made by metal and stone were consistent within the experimental sample, and also held up to published criteria (Cipolla 2008; Greenfield 1999, 2002, 2006; Potts and Shipman 1981; Shipman and Rose 1983a; Walker and Long 1977). Experimental cutmarks made from stone and metal tools were suitable for comparative analysis based on consistencies within the replicated sample and with previous studies on cutmarks made from metal and stone (Binford 1981; Blumenschine *et al* 1996; Cipolla 2008; Dominguez-Rodrigo *et al* 2009; Greenfield 1999, 2002, 2006; Shipman and Rose 1983a; Walker and Long 1977).

Experimental Butchery with Metal Tools

Select bones cut with steel tools were molded and photographed. Overhead plan views of the experimental cutmarks match attributes of butchery modifications created by metal blades elsewhere (Greenfield 1999, 2002; Shipman and Rose 1983a; Walker and Long 1977). In plan view the cuts appear deep and straight with minimal flaking of the walls and unpronounced shoulders (Figure 5-1).

Impressions of experimental cuts made with steel tended to be deeper than their width featuring symmetrical walls and either a round, flat, or triangular apex (Figure 5-2). Cuts made with the unserrated steak knife were wide and left an apex that was rounded with symmetrical walls suggestive of a relatively dull blade (Figure 5-1, top left). Similar profiles with rounded apexes have been observed in experiments using dull blades (Greenfield 1999, 2002).

The paring knife is stored in a sharpener and is resharpened before every use. Cuts made with this blade were conspicuously thinner and were deeper than wide. The cuts created by the paring knife were short in plan view. These cuts had a clearly defined apex and minimal flaking of shoulder ridges that occur while slicing (Shipman and Rose 1983a). The impressions show cuts that are thin, deep, and symmetrical. Profile views of this cut are almost rectangular in shape (Figure 5-2, top right).

The cuts created by the steel clam knife were deep, wide, and rounded in plan view with flaked shoulders. In the profile view using the cross-sectioned impression, there are two apexes adjacent to one another, which were probably created by the dragging slicing motion and the irregular kinematics of the experimenter (Semenov

1964). This imperfection resulting in two apparent grooves in the cutmark represented by the bottom left impression in Figure 5-2 could be misinterpreted as a cut made by a stone or shell tool with an offset edge (image G, Figure 5-3; Choi and Driwantoro 2007; Shipman and Rose 1983a). The kinematics of the butcher are partially responsible for the morphology of the cut, as the cutting process is an imperfect mechanical process (Shipman and Rose 1983a); the main source of variation in cutmark morphology may actually be as much a product of the butcher's irregular movements as the tool edges themselves (Semenov 1964).

The chef knife is a well-maintained blade and, like the paring knife, is stored in a sharpener. In plan view the cuts are thin and long which may be a factor of the blade length and the added dexterity of a longer, thinner blade. A longer blade is advantageous for separating ball and socket and hinge joints because it can reach deeper and greater leverage can be achieved. Steel is strong enough that the blade will not snap from added torque sometimes necessary to disarticulate limb bones.

Profile views show that the steel chef knife leaves cutmarks similar in morphology to other steel blades with symmetrical walls and an apex that is flat, central, and distinct (Figure 5-2, bottom right). The apex is flat and may have been created as a result of the longer slices that would have pulled displaced bone debris along the kerf floor[8] and flattening the once pointed, triangular apex. Alternatively, the flattened kerf floor could have been a product of a deceptively dull beveled edge. Distinct, deep triangular apexes are formed by metal blades is when it is chopped or hacked and no dragging of bone debris occurs (Figure 5-4). Entry wounds of hacked bone are typically

[8] Kerf floor is the base of the groove, the length of the apex (Humphrey and Hutchinson 2001: 230)

sharp and narrow but can also display fracturing of peripheral bone material caused by pressure radiating outward from the point of impact (Humphrey and Hutchinson 2001). None of the experimental bone mimicked hacking marks but hacked bone was easy to identify in the zooarchaeological collection. Clean, deep, symmetrical cuts with striations running perpendicular to the kerf were taken as evidence of hacking inflicted by a metal tool (Humphrey and Hutchinson 2001).

Profiles of cutmarks experimentally created by steel blades all appear to have apexes that are rounded (U-shaped) or flat (|_|-shaped) rather than sharp (Greenfield 1999). Also, the cutmarks were typically symmetrical in cross-section and deep. Attributes of cutmarks made by steel blades are similar to those described in published literature (Figure 5-5, 5-6, 5-7; Cipolla 2008; Greenfield 1999, 2006). The experimental samples created here were integral in diagnosing zooarchaeological specimens with similarly shaped cutmarks. Profile drawings of cutmarks made by metal blades in other studies (Cipolla 2008; Greenfield 1999) assisted in confirming the fidelity of experimental cutmarks. The impressions made of zooarchaeological materials helped to corroborate assessments overhead views.

Experimental cuts made by steel were typically deeper than they were wide. The cuts were also straight and clean looking with little to no debris in the groove and minimal flaking of shoulders. Many cuts in the zooarchaeological sample matched experimental steel-cut bone. Profile views of zooarchaeological samples with rounded apexes, symmetrical walls, were deeper than wide, as well as molds that were rectangular in shape were diagnosed as having been cut by a metal blade. The experimental sample revealed that a high degree of variability is introduced by blade size and sharpness. Additionally the butcher, whose motions area rarely robotic, leaves cutmarks with variable morphologies when multiple marks are created with the same blade.

The variability in the experimental sample highlights to the potential difficulty of interpreting zooarchaeological butchery modifications. Literature assists in identifying natural modifications such as rodent gnawing (Shipman and Rose 1983a), carnivore tooth marks (Blumenschine *et al* 1996; Shipman and Rose 1983a), and trampling (Andrews and Cook 1985; Dominguez-Rodrigo *et al* 2009; Olsen and Shipman 1988) from human agency, but none prepare experimenters for the variability of human kinematics (Semenov 1964). However, some studies introduce additional variables such as different human actors and varying cutting angles to account for kinematic differences (Bello and Soligo 2008; Humphrey and Hutchinson 2001). For this reason, the experimental sample sought to provide a limited range of comparative examples while published examples of cutmark morphology (Table 3-1) effectively expands that range and allows more confident assessments of butchered remains.

Experimental Butchery with Stone Tools

Keokuk chert was purchased from an online vendor (www.neolithics.com). The chert was quarried and flaked to order. Although the majority of the lithics recovered from Pueblo Santa Catalina de Guale was Coastal Plains chert (May 2008), it is expected that the two types of chert would produce similar cutmarks. Greenfield showed that even at high magnification, differentiating between stone raw materials can be difficult (Greenfield 2006). However, there are considerable differences between retouched and non-retouched stone tools (Dominguez-Rodrigo *et al* 2009) and unequivocal contrasts between lithics and metal based on typical cutting edge morphologies (Blumenschine *et al* 1996; Greenfield 1999, 2002; Shipman and Rose 1983a; Walker 1978; Walker and Long 1977). There is no evidence that two different types of chert will produce disparate cutmarks visible with the low-powered microscopy techniques used in this study. Substituting Keokuk for Coastal Plains chert is therefore justifiable for the comparative analysis employed here.

Four flaked chert blades were selected based on dissimilarity of their cutting edges. Width, length, angle, and sinuosity of the beveled edge were factors that differentiated the four flakes used (Figure 5-8). All stone tools were expedient, non-retouched flakes. Flaked chert tools sliced through deer muscle, tendons, and ligaments with relative ease.

However after cutting through the tougher ligaments it was clear that performance dropped because the blade was becoming dull, as is known to occur with stone tools (Shipman and Rose 1983a). To circumvent diminished performance resulting from the dulling of stone blades, added pressure and sawing motions were used to disarticulate limb bones. All experimental stone tool marks had asymmetrical walls with mostly distinct apexes (Figure 5-9). Stone tools in other studies produced cutmark profiles with either sharp or rounded apexes but always had asymmetrical walls (Greenfield 1999).

Cutmarks on experimental bones made with stone are sinuous and often filled with debris (Figure 5-10; Greenfield 2002). The edges of the grooves tend to be flaked and feature a pronounced shoulder (Dominguez-Rodrigo *et al* 2009). Profiles of the experimental cutmarks were typically asymmetrical and featured either one steep side and one gradual side, or two walls that are very jagged and irregularly sloped. Apexes of cutmarks made by stone tools can be described as either culminating into a distinct point or rounded with walls that flare out into a wide V (Figure 5-9).

Although most of the cutmarks made by stone tools are similar in morphology, they are a product of the slicing motion and the blade edge. Depth is especially dependent on the force applied by the butcher, and the kinematics of the butcher's minor motor skills are frequently a variable in cutmark morphology (Semenov 1964). Despite the variation produced from non-regulated butchery motions, sinuosity and debris in the groove were two standard features of experimental cutmarks made by stone. After considering the variability of recreated cutmarks and comparisons with examples in other studies (Cipolla 2008; Dominguez-Rodrigo *et al* 2009; Greenfield 1999, 2006; Shipman and Rose 1983a; Walker and Long 1977), it was clear that the experimental sample could not possibly incorporate every morphological characteristic observed in the zooarchaeological sample.

Nonetheless, preliminary observations of bone modified experimentally by stone tools in this study held up to criteria outlined by others (Binford 1981; Choi and Driwantoro 2007; Cipolla 2008; Dominguez-Rodrigo *et al* 2009; Greenfield 1999, 2002, 2006; Potts and Shipman 1981; Shipman and Rose 1983a; Walker and Long 1977). Diagnoses of tool materials assessed from the kerf were frequently confirmed during subsequent profile analyses. As expected, the profile views served to corroborate initial plan view assessments.

The experiments using stone were successful in terms of their comparative potential. The samples created during these experiments can be reused and the molds are an invaluable resource for future studies. Furthermore, the experiments indicate that stone cutting ability is comparable to steel but far exceeds the utility of shell tools for butchery tasks.

Experimental Butchery with Shell Tools

The shell used in experimental butchery trials a made a dismal performance. Shell dulled with every slice and in some cases the soft material would fracture or flake during the trial. Although time was not empirically recorded during any of the butchery tasks, the shell tools required noticeably more time and effort to complete the disarticulation task. Cutmarks created experimentally using the expedient shell tools were extremely variable and could not be used to establish useful diagnostic criteria as has been done elsewhere (Choi and Driwantoro 2007; Toth and Woods 1989).

Replicated impressions of the cutmarks showed inconsistent morphologies and were not suitable for comparison with the zooarchaeological sample. In order to complete the butchery task some shell had to be used with sawing motion, compromising the integrity of the cutmarks. The poor performance of shell in general made it clear that the expedient tool set created by the experimenter did not adequately represent tools that would have been used by Guale Indians. There is little doubt that inexperience restricted modeling of accurate expedient shell tools. Though some literature exists on the issue (O'Day and Keegan 2001), no prior attempts to render expedient shell tools had been made by the investigator resulting in poorly performing and naively created tools.

While it is possible that some of the unidentified cutmarks observed in the zooarchaeological samples could have been created by shell, the experimental results did not assist in confirming the use of shell butchery tools on St. Catherines Island. Shell butchery marks lacked traits created by experiments elsewhere (Choi and

Driwantoro 2007; Toth and Woods 1989). Inconsistency between the experimental results and published criteria is likely due to different methods for creating the shell tools. Choi and Driwantoro made expedient shell tools using thick and thin clamshell (Choi and Driwantoro 2007). Fracture patterns are fairly predictable but it is impossible to deliberately create a specific edge (Choi and Driwantoro 2007: 52). Even so, shells fractured are said to fracture along annuli, or growth rings (Choi and Driwantoro 2007: 52). Such a fracture will tend to leave a distinct edge defined by two outer layers of cortex flanking a void where the annuli was removed creating two barbs (Figure 5-3, image G). Choi and Driwantoro consider fossil and experimental cutmark morphology alongside the absence of stone artifacts as evidence for the use of shell as butchery tools (Choi and Driwantoro 2007). However there is no consideration of the efficacy of the cutting ability of the shell tools used in that study (Choi and Driwantoro 2007).

The experiments presented here are useful for addressing qualitative observations of shell tool butchery efficiency. Replicated cutmarks using naively fashioned shell tools cannot serve as effective comparisons with the zooarchaeological record. The shell tools left indistinct and shallow cutmarks that could not be molded or related to published criteria. The cutmark morphology of clamshell tools did not conform to the double-track grooves observed elsewhere (Figure 5-3; Choi and Driwantoro 2007). The sawing motion enabled some tools to cut through the ligaments and caused wide, heavily flaked marks that could be mistaken as cuts made by stone (Toth and Woods 1989). Some of the profiles were unattainable with molds because the cuts did not penetrate deep enough into the bone. Additionally, different edges created by one shell could produce a range of cutmark morphologies, adding variables and confounding any possible comparison with zooarchaeological samples. Therefore, the results of clam, cockle, oyster, mussel, and whelk shell butchery trials are considered exclusively in the preceding chapter and no zooarchaeological bone was diagnosed as having been cut by shell.

Results of Microscopic Comparisons of Zooarchaeological and Experimentally Cutmarked Bone

Walker and Long were among the first to demonstrate microscopic differences in cutmark morphology made by stone and steel tools using cross-sections of cutmarks (Walker and Long 1977). Behavioral circumstances such as the angle the blade is held relative to the bone, the pressure and irregularity of slicing motions, and the butcher's skill influence cutmark morphology (Semenov 1964; Shipman and Rose 1983a; Walker and Long 1977). The unregulated butchery trials introduced significant but useful variability. In some cases zooarchaeological modifications were ambiguous. Modifications observed on zooarchaeological collections were also likely subject to the unregulated butchery of human agents preparing food at Santa Catalina de Guale. Microscopy allows the evaluation of nuanced features of cutmark modifications crucial for diagnosing tool use but relies on comparative criteria. Using criteria outlined in previous studies (Table 3-1; Binford 1981; Blumenschine *et al* 1996; Choi and Driwantoro 2007; Cipolla 2008; Dominguez-Rodrigo 2009; Greenfield 1999, 2002, 2006; Shipman and Rose 1983a; Toth and Woods 1989; Walker and Long 1977) microscopic examination of zooarchaeological and experimental cutmarks indicated both steel and metal use by Santa Catalina de Guale residents in the mission and pueblo areas.

Analytical Techniques

A total of 280 bone fragments collected from various contexts at Santa Catalina de Guale were analyzed and compared with experimental cutmarks. Although the bones are fragmented, may have multiple cutmarks, and may have coinciding proveniences, the specimens were tallied individually. Quantification of bone fragments modified by butchery tasks may misrepresent actual frequencies of tool use (see Abe *et al* 2002). The frequency of stone and metal tool use in this study is a product of how many bone fragments have butchery modifications, not the count of the cutmarks themselves. In this study the number of individual specimens (NISP) is representative of discrete butchery tasks, as opposed to the minimum number of individuals (MNI), which would have reduced the inferred occurrences of tool use (Abe *et al* 2002). Nonetheless, the results of the analysis of modified bone fragments are statistically significant with regards to the spatial distribution of butchery tool evidence across Santa Catalina de Guale.

All zooarchaeological samples were analyzed using a low-powered dissecting microscope with magnification from 10.5x to 45x. Overhead views fostered descriptive observations (Appendix A) of the cut’s sinuosity (Greenfield 1999), depth, width, the presence of shoulders (Shipman and Rose 1983a), flaking, or debris in the groove (Greenfield 1999), the presence of double grooves (Choi and Driwantoro 2007) and barbs (Shipman and Rose 1983a). An advantageous perspective of the apex could be achieved viewing from above and manually rotating the specimen. This technique used shadows from the light source to better evaluate the shape of cutmarks before obtaining cross-section views of the apexes using impression material (Cipolla 2008; Greenfield 1999; Rose 1983).

Not every cutmark required additional analysis with molds. Many of the cutmarks on zooarchaeological bone showed diagnostic features visible with overhead views that were characteristic of cutmarks made by metal or stone blades according to experimental and published criteria (Table 3-1). For instance, asymmetrical walls and sinuosity of microstriations within the groove and alongside the kerf itself suggest a stone blade with an offset edge (Greenfield 1999). Terraced walls and parallel ancillary striae running along side the main groove are typical features of cuts made by a stone blade (Greenfield 2002). Wide, flaky, shouldered cutmarks also suggest that either a retouched or non-retouched blade was used (Dominguez-Rodrigo *et al* 2009).

Alternatively, narrow, deep, and straight cuts with minimal flaking are signature features of metal blades (Blumenschine *et al* 1996; Greenfield 1999). Cuts made by metal blades tend to be singular and isolated, are usually long but hairline in size compared to cuts made by stone, which are typically reflected by multiple, short, parallel incisions running perpendicular to the length of the bone shaft (Binford 1981). There were also specimens that were hacked or chopped and could be easily attributed to metal blades (axe or cleaver) based on their width, depth, and sharp apex (Humphrey and Hutchinson 2001). When the agent of modification was clear a diagnosis was recorded and depending on the state of preservation of the specimen, it was set aside for molding.

The morphology of the kerf floor could be observed when the specimen was rotated by hand under the dissecting microscope utilizing a dual fiber optic light source to cast shadows and better assess the depth of the cut. However, some specimens retained ambiguous modifications, sharing features of both stone and metal blades, as well as indications of weathering, gnawing, or trampling. These samples were also selected for further analysis using impressions.

Profile views of the cutmarks were attained using Vinyl Polysiloxane (Aquasil Ultra Heavy Body Regular Set), a material used by dentists to take dental impressions. The use of impressions and replicas allows zooarchaeological specimens to be preserved when analytic techniques may potentially damage them (Rose 1983). This technique allowed greater scrutiny of ambiguous cutmarks. Molds were made for 39.2% of the collection (n=118 of 301 specimens). Cross-sectioned impressions were held in place using Silly Putty (Crayola) under a dissecting microscope fitted with a Nikon E990 digital camera. Photographs of cutmarks and cross-sectioned molds were taken using varying focal lengths and magnifications.

A total of 118 cross-sectioned molds were analyzed. Profile views corroborated initial tool material diagnoses for 69.5% of the 118 specimens (N=82). The other 30.5% of the molded sample was previously ambiguous. For 11.9% of 118 (N=14) specimens overhead views did not display convincing criteria for either stone or metal tool use, and were diagnosed after the cross-section view became available. Some of those specimens were initially classified as either undetermined (UD) or other until molds were analyzed. Thus 18.6% of 118 (N=22) bones had been initially diagnosed as stone, metal, other, or UD but further review of apex shapes using impressions resulted in a new diagnosis.

The sample of 280 specimens represents 93.0% of 301 bones borrowed from the Florida Museum of Natural History. Bones excluded from the analysis either lacked conspicuous cutmarks or sufficient provenience information necessary to integrate them into the GIS. For example, there were positive assessments of the tool type used for butchery for at least two bone fragments recovered from test pits excavated by Caldwell (Caldwell 1971, n.d.; Reitz 2008), but the location of those test pits were not among those rediscovered during the island-wide transect survey (Thomas 2008b). The only clues of their spatial whereabouts are in field sketch maps with no scale (Caldwell n.d.) and the units may have been lost to erosion processes, which have been observed to compromise archaeological data on St. Catherines Island and elsewhere along the Georgia Bight (DePratter and Thompson 2013).

Identifying cutmarks from other taphonomic processes (Andrews and Cook 1985; Dominguez-Rodrigo 2009; Njau and Blumenschine 2006; Shipman and Rose 1983a) only requires a hand lens and a trained eye (Blumenschine *et al* 1996) but distinguishing what type of material was used to modify the bone necessitates a higher level of magnification and scrutiny. Modifications on specimens collected from the Florida Museum of Natural History were evaluated and butchery marks identified (Dukes 1993; Reitz 2008; Reitz and Dukes 2008; Reitz *et al* 2010). Reanalysis of the specimens using low-powered microscopy showed that 20 specimens were incorrectly labeled as butchered bone during earlier analyses. For this 7.1% (N=20) of the sample, the diagnoses was ‘other,’ indicating the presence of scraping, trampling, or gnaw marks, the specimen was damaged during excavation (e.g., trowel marks), or in one case, impacted with shell debris (Figure 5-11). The use of a dissecting microscope and a fiber-optic lighting system helped to confirm the presence of butchery modifications and exclude bones that were modified by other taphonomic processes (e.g., Andrews and Cook 1985; Blumenschine *et al* 1996; Dominguez-Rodrigo *et al* 2009; Olsen and Shipman 1988; Shipman and Rose 1983a; Walker and Long 1977) from the analysis.

Cutmarked zooarchaeological specimens that were extensively weathered were problematic for determining the agent of modification. Silicon molds helped to remedy this issue (Olsen 1988) for some of the specimens. Modifications could not be definitively attributed to natural or cultural agents for 14.3% (N=40) of the bone collection analyzed, and were classified as undetermined (UD). However, seemingly conspicuous cutmarks that did not yield diagnostic molds useful for comparison to experimental samples were also included in the UD category (Figure 5-12). Other specimens could not be molded because they were too badly worn. Some bones were poorly preserved and too delicate to collect impressions of worn and shallow cutmarks without damaging the specimen. For those bones, molding could not be justified and were excluded from the analysis. In sum, 220 bones (78.6%) were positively identified as having been modified by either stone (N=93) or metal (N=127) (Figure 5-13). Side-by-side comparison of experimental and zooarchaeological specimens and based on published criteria (Table 3-1).

Criteria for Determining Butchery Tool Material for Zooarchaeological Specimens

Criteria outlined in other studies (Table 3-1) were crucial for diagnosing the modification agent when the specimen was viewed from above. Sketches of apex shapes (Figure 5-5, 5-6, 5-7; Cipolla 2008; Greenfield 1999, 2006) helped evaluate cross-sectioned molds. Some of the variables overlapped and in many cases cutmarks displayed features characteristic of both stone and metal in overhead views. In such instances it was necessary to mold the cutmark so that the shape of the apex could be evaluated in cross-section. Bones were initially viewed using a 10x-20x hand lens for presence of butchery marks at the Florida Museum of Natural History while the collections were being pulled. No analysis was performed on the specimens at that location; the objective was to exclude misidentified specimens and to be sure that the artifacts pulled matched elemental and species descriptions reported elsewhere (Dukes 1993; Reitz 2008; Reitz and Dukes 2008; Reitz *et al* 2010).

Although the hand lens afforded good magnification it was clear that the best views of cutmarked bone was between 35x-45x using the dissecting microscope. The use of a fiber optic light source during later stages of analysis allowed better perspectives because two differently angled lights could illuminate features by casting shadows. The quality of contrast of a dissecting microscope is hardly comparable to the contrast available with a scanning electron microscope (SEM). The SEM provides greater depth of field, magnification, image resolution, and contrast than standard optical microscopes (Greenfield 2006: 152; Shipman and Rose 1983a: 64). Due to time constraints a SEM was not utilized for this study. Although the SEM has superior imagery capabilities and would have been useful for this study it turned out to not be necessary. Some of the critical features of cutmarks that are necessary for determining the butchery tool material used can be identified without the level of magnification offered by a SEM. Much of the criteria outlined elsewhere can be readily observed with a low-powered dissecting microscope. While determinations of the tool type used for 69.5% of molded specimens was consistent, impressions are a vital aspect of the analysis. Even with the use of a SEM it would still behoove a researcher to utilize impression material to observe the apex shape in profile. Irrespective of the microscopy instrumentation, there are criteria that need to be identified for correct diagnoses of butchery tool type.

The apex along with the overhead view of the cut was considered and a determination of tool type was made based on whether the cutmark exhibited more criteria supporting metal or stone. After overhead and profile observations were made, every bone was compared to experimental bones that appeared to be similar. Molds of experimental cutmarks were readily available for side-by-side comparison and assisted in diagnosing the agent of butchery. The categorical tallies were restrictive to four classes: stone, metal, other, and undetermined (UD). The shape and form of zooarchaeological cutmark profiles diagnosed as stone and metal were consistent with those created in the experiments and other studies (Figures 5-5, 5-6, 5-7; Cipolla 2008: 206; Greenfield 1999: 803, 2006: 152).

Criteria for metal tools

Metal blades tend to leave straight cutmarks that can be both narrow and V-shaped with a distinct apex (Walker and Long 1977) or broad with a flat bottom (Greenfield 1999). Flat-bottomed cutmarks with horizontal platforms are usually produced by duller knives (Greenfield 2002) but can also be an effect of serrated edges (Greenfield 1999). Striations appear within the groove running parallel to its length and are uniform in depth and spacing when compared to stone (Greenfield 1999). Metal blades used for slicing leave cuts with little to no bone crushing (Blumenschine *et al* 1996) often seen with hack and chop marks (Humphrey and Hutchinson 2001; Khreisheh *et al* 2013). While Binford observed cutmarks made by metal tools to be hairline in size (Binford 1981) they are noted elsewhere for their tendency to be wider than cuts made by stone blades (Greenfield 2002). Bone ridges running parallel along the side of the cut (i.e., shoulders) are present and uniform in height, angle, and orientation along the axis of the bone (Greenfield 2002). In general the cuts appear to be cleaner and show little flaking or deposition of bone debris in the groove (Greenfield 2002).

In profile, the apex of cutmarks made by metal blades appear as either a V-shape, a |_|-shape, or a symmetrical U-shape (Blumenschine *et al* 1996; Greenfield 1999, 2002; Walker and Long 1977). Molds of zooarchaeological cutmarks showed a great degree of variation however the determining criterion for diagnosing a cutmark as created by a metal blade was the symmetry of the apex. Cutmarks that had asymmetrical but distinct apexes resembling a V-shape were evaluated with a consideration of other features, such as the presence of debris and relative width and depth. Bone was also classified as metal when it featured hack marks defined by wide, long, symmetrical cuts with distinct apexes, or if the bone had evidence of being chopped clean through (Humphrey and Hutchinson 2001).

Cutmarks created by metal tools experimentally typically adhered to published criteria and provided valid comparative material for both overhead and (Figure 5-14) profile assessments (Figure 5-15). Characteristics such as symmetrical walls, deeper than wide cuts, and apex shape seen in experimental molds (Figure 5-2) matched observed features reported elsewhere (Table 3-1; Figures 5-5, 5-6, 5-7). The congruence of the experimental and previously reported criteria supported confident assessments of metal blade use on zooarchaeological bone.

Criteria for stone

Flaked stone tools leave cutmarks that are wide, shallow and irregular with concave sides (Walker and Long 1977). These cuts usually do not terminate at a distinct apex because flaked stone tools tend to have offset edges (Shipman and Rose 1983a; Walker and Long 1977). Stone tools also leave cutmarks that have two distinctly different sides; one steep and smooth, the opposite gradual, sometimes terraced and jagged, containing multiple striations (Greenfield 2002). The cuts will be uneven, asymmetrical, and are typically sinuous, which is a product of the wavy edge of the stone tool (Walker and Long 1977). Stone tools leave cutmarks that are more variable in shape (Greenfield 2002). The edge of the stone tool widens the cut and the irregularity of the edge will cause the sides of the cut to flake off and deposit debris in the kerf floor giving a "dirty" appearance with a weaving apex (Greenfield 2002). Along the sides of the cutmark there may be parallel ancillary striations that are both within the groove and on the bone surface caused by the offset edge of a flaked stone tool (Greenfield 1999, 2002).

Flaked tools will tend to be deeper than they are wide when compared to retouched tools (Dominguez-Rodrigo *et al* 2009). Retouched stone tools produce open V-shaped, broad grooves with irregular edges that contain striae running along the shoulder (Dominguez-Rodrigo *et al* 2009). Bifacial tools also tend to create more flaking of the shoulder and feature multiple intersecting grooves, which are a product of an offset edge (Dominguez-Rodrigo *et al* 2009). Generally speaking stone tools are made in a series of short parallel strokes that occur in groups and have wider cross-sections (Binford 1981).

The apexes of stone tool cutmarks are typically asymmetrical and can either have a sharp, distinct kerf or one that is slightly rounded (Figure 5-5, 5-6, 5-7, 5-9; Cipolla 2008; Greenfield 1999, 2006). Asymmetry in the profile and the presence of one steep and one gradual, jagged, or terraced wall was often the diagnostic criteria for stone tool cutmarks when other features were ambiguous.

The experimental sample generally agreed with published criteria for cutmarks made by stone tools. An exception is the criteria discussed for retouched stone tools. Since no experimental data was created to account for the use of bifacial stone blade, assessments of zooarchaeological specimens demonstrating features of cutmarks made by retouched blades relied exclusively on criteria discussed elsewhere (Dominguez-Rodrigo *et al* 2009; Greenfield 2006). Nonetheless, many cutmarks on zooarchaeological specimens were similar to the experimental examples when viewed overhead (Figure 5-16) and in cross-section (Figure 5-17), indicating the use of flaked stone tools at Santa Catalina de Guale.

Stone and Metal Tool use in the Pueblo and Mission

Experimental and zooarchaeological cutmarks shared sufficient attributes with published criteria (Cipolla 2008; Cipolla *et al* 2007; Dominguez-Rodrigo *et al* 2009; Greenfield 1999, 2002, 2006; Walker and Long 1977) to allow confident determinations of the cutting tool used at Santa Catalina de Guale. Side-by-side comparisons of experimental bone modified by stone and metal with zooarchaeological specimens demonstrate consistency between expected (Table 3-1) and observed (Appendix A) morphological features. Many of the bones analyzed came from the same excavation units. Spatial consideration of the artifacts was performed without a consideration of stratigraphic depth.

Using provenience information each specimen was related back to the excavation unit where it was recovered. Tallies for the number of modified specimens were made (Table 5-1). A GIS organized the spatial data. Structural remains identified during excavations at Mission Santa Catalina de Guale (Thomas 1987) helped to delineate secular areas from non-secular areas (Figure 5-18). Using more recent interpretations (Thomas 2009a), areas referred to as Pueblo North, South, East, and West, including Wamassee Head and Fallen Tree (May 2008) constituted secular zones. The area within the inferred bastion (Thomas 1987, 2009a) is designated as a non-secular area.

The delineation of secular and non-secular areas is non-arbitrary. The non-secular zone contained the church, the central plaza, the friar's convento, and the cocina (Thomas 2010a). Although the structure itself may be a defensive fortification, the area enclosed by the bastion wall (Thomas 1987) may have symbolically restricted aboriginal culture from compromising religious orthodoxy. Meanwhile, in the secular pueblo there are remains of European-style structures made conspicuous by their orientation along a 45-degree angle west of north (Figure 5-18; Thomas 1987, 2010a). Although the pueblo is largely defined here as the area outside of the bastion, the friars' influence while attempting to convert Indians to Catholicism likely extended well into the secular zone. Nonetheless, the church was ordained to be the center of village life and to remain distinct from the Indian village (Thomas 1987).

A comparison of the artifacts recovered from secular and non-secular contexts was necessary to evaluate whether daily life at Santa Catalina de Guale integrated European and aboriginal technologies or effectively relegated Indian culture to areas beyond the enclosed non-secular zone. Because the exact nature of structure 5, structure 6, and structure 1W's use is elusive (Thomas 2009a, 2010a: 41), and because they are completely contained within pueblo areas, these buildings are considered to be secular (Figure 5-18).

A total of 104 zooarchaeological specimens represent 35 excavation areas in secular contexts (Table 5-2). Of this subsample, 48 bones were diagnosed as butchered by stone tools and 32 bones by metal blades. Undetermined processes modified 17 bones. Other taphonomic processes were observed on 7 bones. Pueblo artifacts are concentrated in Wamassee Head (Caldwell 1971, n.d.). Within the pueblo there is evidence of metal tool use by Guale Indians, but is less frequent than stone tool use.

The remaining 57 excavation areas within the walled enclosure surrounding the church, plaza, cocina, and convento represent the non-secular contexts. 176 specimens were distributed among the 57 excavation areas and are concentrated near structure 2, the cocina (Figure 5-20). In the non-secular area there were 45 bones cut by stone and 95 cut by metal tools (Table 5-3). The remainder of the bones was either modified by other taphonomic processes (N=13) or butchered by an undetermined tool (N=23). These data show that within the mission area both European and aboriginal technologies were utilized (Figure 5-21).

The implications of bone butchered by both stone and metal at Santa Catalina de Guale are understood by the contextual relationship between inferred physical boundaries and secular and non-secular uses of space. From the outset it was hypothesized that the tools used to butcher bone in secular and non-secular contexts would represent aboriginal and European technologies, respectively. To evaluate whether the presence of butchered bone modified by stone and metal in secular and non-secular contexts was meaningful or by chance, a chi-square test of significance was performed on the butchery tallies. The chi-square test indicates a statistically significant association between bones cut by metal and stone and their occurrence in secular and non-secular areas (X^2=16.99, df=1, α=0.05). Accordingly the null hypothesis, that there is no relationship between the amount of bone butchered using stone or metal in secular contexts or non-secular contexts, must be rejected. Thus, there is a relationship between the frequencies of bone modified by stone or metal in secular or non-secular contexts. Heightened uses of metal in sacred areas is not due to chance, and elevated stone tool butchery in the pueblo is likely related to the secular nature of the Indian village.

Within the secular and non-secular areas the counts of metal and stone tool use are significant as well. The variance of the pueblo data was calculated in ArcGIS taking into account the spatial distribution and counts of each unit in secular contexts. The difference in variance between the 35 excavation areas in the pueblo containing 48 occurrences of stone tools (S^2=6.462) and 32 instances of metal tool use (S^2=0.992) is statistically significant (F_{calc}=6.514, F_{dist}<1.80, α=0.05, $df_{a,b}$=34, one tail):

$$
\begin{aligned}
F_{pueblo} &= \frac{S^2_{stone}}{S^2_{metal}} \\
&= \frac{6.462}{0.992} \\
&= 6.514 \\
df &= n_{stone} - 1 \\
&= 35 - 1 \\
&= 34 \\
df &= n_{metal} - 1 \\
&= 35 - 1 \\
&= 34 \\
F_{dist} &< 1.80 \\
F_{pueblo} &> F_{dist}
\end{aligned}
$$

The difference between stone and metal tool use is not due to chance. This result is meaningful because it shows that the higher frequency of stone tool use in the pueblo supports the hypothesis that secular life witnessed a continuity of traditional lithic technologies despite the apparent availability of metal tools.

Furthermore, drawing on statistics calculated in ArcGIS on the tallies of tool use in the mission area, an F-test shows the difference in variance of stone (S^2=3.430) and metal (S^2=12.503) tool use in 57 non-secular areas is significantly different (F_{calc}=3.645 F_{dist}<1.58, α=0.05, $df_{a,b}$=56, one tail):

$$
\begin{aligned}
F_{mission} &= \frac{S^2_{metal}}{S^2_{stone}} \\
&= \frac{12.503}{3.430} \\
&= 3.645
\end{aligned}
$$

$$
\begin{aligned}
df &= n_{metal} - 1 \\
&= 57 - 1 \\
&= 56
\end{aligned}
$$

$$
\begin{aligned}
df &= n_{stone} - 1 \\
&= 57 - 1 \\
&= 56
\end{aligned}
$$

$$F_{dist} < 1.58$$

$$F_{mission} > F_{dist}$$

Thus, the possibility that more metal than stone tool use was observed in the mission area cannot be explained by chance. Within the mission walls there was more frequent use of European than aboriginal butchery tools. However, the use of lithic technology indicates that, as in the pueblo, tool sets were heterogeneous.

As predicted, the use of metal was greater where European life and Catholicism was centered. Furthermore, the relationship between stone and metal frequencies and sacred and secular contexts indicates that there were culturally mediated economic practices in the pueblo and mission areas. The significant association between stone and metal use and secular and non-secular contexts shows that although Catholicism did not completely envelop aboriginal life ways at Santa Catalina (McEwan 2001), the presence of European culture influenced hybridized of technology use.

Geographic Information Systems (GIS) Analysis

The 280 zooarchaeological specimens analyzed were collected from 92 excavation units between 1969 and 2005. Every bone analyzed had provenience, sometimes with considerable overlap (Table 5-1). Using Environment Systems

Research Institute's (ESRI) ArcMap a GIS was created to manage all of the provenience and observation data. A geodatabase created and maintained by Elliot Blair (University of California, Berkeley) featured the locations of previous excavation units, modern marshland, freshwater creek boundaries, and the locations of structural features. Observational data (Appendix A) was integrated with geospatial data linked to each zooarchaeological specimen (Table 5-1) in the database. This allowed the data to be segregated into secular (Table 5-2) and non-secular (Table 5-3) contexts and enabled the distribution of stone (Figure 5-22) and metal (Figure 5-23) tool evidence to be visualized across all study areas.

Figure 5-20 shows the secular and non-secular bone and its distribution at Santa Catalina de Guale. Descriptive statistics were generated for secular and non-secular evidence. The mean center is a calculation of weights of each data point and demonstrates the spatial tendency of the data (Conolly and Lake 2006). The stone and metal frequencies in secular (Figure 5-24) and non-secular (Figure 5-25) contexts assist in visualizing trends in the data and corroborate the chi-square and F-test statistical findings discussed earlier. Higher-level interpolation techniques were performed to bolster the implications of the statistical results.

Once the data was successfully imported and a distribution map of the locations of cutmarked bone in relation to secular and non-secular areas was established, the data was interpolated to better understand the distribution of butchered bone and predict occurrences in unexcavated areas. Interpolation is a powerful method for understanding discontinuous data. Applying the first law of geography (Tobler 1970), that things closer together are more similar, "…interpolation is a mathematical technique of ‘filling in the gaps’ between observations,” (Conolly and Lake 2006: 90). This technique is useful for any type of quantitative data (Conlloy and Lake 2006) even if it is collected nominally.

In order to successfully implement an interpolation model, the data must be spatially autocorrelated (Conolly and Lake 2006: 158). Spatial autocorrelation is a measure of how similar a data point is to a neighboring data point and some interpolation models are better suited to data that has high positive spatial autocorrelation (Conolly and Lake 2006). For both the stone (Figure 5-26) and metal (Figure 5-27) data sets there were outliers. These outliers are concentrated inside the mission bastion behind the cocina (Thomas 1987) and at Wamassee Head (Caldwell 1971). Higher concentrations of stone or metal modified bone may skew interpolation models. Nonetheless, the outlier data reflects the behaviors of the individuals who frequented these refuse areas.

To better visualize the variation, a Voronoi map was generated to show the standard deviation of both stone (Figure 5-26) and metal (Figure 5-27). Voronoi maps illustrate variation in a dataset represented by Thiessen polygons. Thiessen polygons encompass an area around a data point that is closer to that data point than any other points. The Voronoi map enables one to visualize the local variation of specified attributes of features in a GIS (Conolly and Lake 2006). The Voronoi maps illustrate areas where outliers skew the data and might inflate interpreted uses of secular and non-secular space based on butchery tool choice. Interpolation is useful for addressing such suspicions that may arise from discrete data points with high variation. Furthermore, interpolation models can help rectify bias introduced by the non-arbitrary placement of excavation areas based on geophysical surveys (Thomas 1987). The splines interpolation method was useful for this data set and retained an accurate index of local variation (Conolly and Lake 2006).

The interpolation tools in ArcMap assist enable one to create a surface model that predicts continuous values based on discrete data. Interpolation is often used in building digital elevation models, typically finished with digitized contour lines (Conolly and Lake 2006: 90). Using the weighted, discrete points in this data set, interpolated surface models were generated. Isolines[9] were applied to assist in visualizing spatial evidence of different tool types. The splines interpolation method effectively smoothes the surface model by replacing sharp breaks in the data (caused by extremely high or low values) with weighted averages (Conolly and Lake 2006: 97). Compared to other interpolation methods such as kriging, the surface model produced by the splines method yields an aesthetically pleasing model that is more easily interpreted (Conolly and Lake 2006). Additionally, for this discrete data set, the splines method rendered an interpolated surface that fostered curvilinear isolines better suited to predicting values in areas lacking cutmark data.

Using the splines method, interpolated surface models were rendered from cutmark data including and excluding outliers. Surface models that include outlier data for stone (Figure 5-28) and metal (Figure 5-29) were generated. Isolines were drawn at designated intervals over these surface models, including outliers, enabling better visual association of predicted butchery evidence with structural features on the archaeological landscape (Figures 5-30 and 5-31).

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[9] Isolines are similar in principle to contour lines. Each line on an isoline map represents a single value. Semantically, contour lines refer to elevation data.

The selection of outliers was guided by illustrated variation in Voronoi diagrams (Figures 5-26 and 5-27). From the metal tool evidence, data from unit “W121” was excluded as an outlier, which comprised 18.9% of the sample (Table 5-1). Outliers from the stone tool evidence were data from unit “W121” and “Caldwell_Area_A_Square_B” amounting to 28.0% of occurrences (Table 5-1). Cutmark frequencies following the removal of outliers continue to indicate a significant association between stone and metal evidence in secular and non-secular areas (χ^2=10.45, df=1, α=0.05). Surface models for cutmark evidence excluding outlier data were generated using the splines interpolation method for stone (Figure 5-32) and metal (Figure 5-33). In designated intervals, isolines trace continuous changes in interpolated values, excluding outliers, of frequency for stone (Figure 5-34) and metal (Figure 5-35) tool evidence.

Compared to interpolated surface models omitting outliers (Figures 5-32 and 5-33), models including outlier data (Figures 5-28 and 5-29) feature inflated maximum and minimum values of predicted tool occurrences. The surface model maps show negligible shifts in interpolated values of metal tool evidence when outlier data is excluded (Figures 5-29 and 5-33). Across the study areas, predicted values for metal tool use remain fairly consistent between data sets with and without outliers.

On the other hand, the surface models of interpolated stone tool evidence show marked alteration in areas where stone tool use was predicted to be low. The model that omits outliers (Figure 5-32) predicts low stone tool occurrence within the mission walls while the outlier data (Figure 5-28) shifts the extremely low predicted frequency to the north of, and beyond, the inferred bastion. Similarly, the isoline diagrams highlight the radical drop in predicted stone tool evidence near Wamassee Head following the removal of outliers (Figures 5-30 and 5-34).

Since there are conspicuous yet confounding differences in interpolated models due to the omission of outliers, it is prudent to rationalize the use of one data set over another for an interpretation of culturally charged landscape use. For both stone and metal interpolated surfaces, the inclusion or omission of outlier data complicate interpretations of observed occurrences. In the case of stone, the removal of 28.0% of the stone tool evidence gave rise to predictions that stone tool use occurred with greater frequency in the mission walls than in the surrounding Indian village. While the sample may be spatially biased and therefore occur at elevated levels near the mission cocina, where meals were prepared, the omission of outliers suggests stone tool use beyond the mission walls was quite sparse. This scenario makes sense considering the possibility that cuts of meat may have been butchered elsewhere such as the kill site or in domestic settings in the pueblo, then curated to the cocina for further processing. In absence of archaeological evidence for domestic structures in the pueblo, it is tempting to incorporate this scenario into the interpretation.

However, the surface model excluding 18.9% of metal tool evidence creates the illusion that metal tools were virtually absent from the technological repertoire of butchers working in the mission. Again, while it is possible that field stripping of carcasses may account for a significant proportion of butchery marks, it is reasonable to suspect that many of the butchery marks occurred during meal preparation in the cocina. Thus, while the omission of outliers maintains a significant association between stone and metal tool evidence occurring in secular or non-secular contexts, it offers limited contribution to the predictive modeling of behaviors at Santa Catalina de Guale.

With respect to the interpolated models that incorporated the original data set, isoline maps indicate that there was a concentration of stone use at Wamassee Head and in the center of the mission bastion (Figure 5-30). Alternatively, elevated metal use appears to be restricted to the center of the mission and drops off to the north and south, radiating outward toward the pueblo (Figure 5-31). These interpolation models contextualize the distribution of cutmark data and encourage a discussion of unique and surprising implications.

Summary and Preliminary Interpretation

Zooarchaeological bone recovered from Mission and Pueblo Santa Catalina de Guale featuring butchery marks (Reitz 2008; Reitz and Dukes 2008; Reitz *et al* 2010) was analyzed and compared to experimental data and published criteria of cutmark morphology. 220 bones were identified as having been modified by either stone (42.3%) or metal (57.7%) blades. Superficially, frequencies of different tool use indicate that neither metal nor stone dominated the butchery technology repertoire at Santa Catalina de Guale. However, proveniences and frequencies of cutmarked bone modified by different tools were analyzed spatially in a GIS. Evidence for differential tool use was considered with respect to specimen proveniences in areas inferred to host secular and non-secular activities.

Differences in the frequencies of observed tool use are significantly associated with secular and non-secular areas. Within secular and non-secular areas, evidence of stone and metal tool use occurs at different rates. This variation in spatial distribution of tool use frequency in sacred and secular areas is statistically significant. Spatial distributions of cutmark data were interpolated to generate a predictive surface model in GIS, and augmented with isolines. These figures offer visual support for socioeconomic implications of heterogeneity in butchery tool use.

The results of the microscopic and GIS analyses strongly suggest that there were differential tool preferences in secular and non-secular areas. Where European life was centered, metal tool use dominated butchery practices. In the surrounding area inhabited by Guale natives, traditional technologies were utilized hand in hand with metal tools. These results corroborate conclusions formulated by Reitz and colleagues based on zooarchaeological analyses, that aboriginal subsistence practices were altered during European occupation of St. Catherines Island (Reitz *et al* 2010). The results presented here demonstrate that some of the alterations were manifested by butchery tool choices.

As active members of their new, possibly creolized (Reitz *et al* 2010: 135), community, Guale Indian choices in butchery technology were likely charged by rearranged socioeconomic conditions. Spanish colonial pressures including depopulation by disease, consolidation of administrative authority through indigenous community relocation, repartimiento labor drafts, and spiritual and cultural conversion tactics pressured the emergence of unique and opportunistic identities. Aggrandizement of an individual or family may have either tacitly or explicitly motivated Native American adoption of European technologies and spirituality. From an etic perspective, a modern understanding of historical circumstances of the Spanish colonial regime in the American Southeast suggests radical and regional discord in socioeconomic and political systems of indigenous groups. The results presented here indicate Santa

Catalina de Guale resident butchery tool choice reflects an emic understanding of the social landscape.

Table 5-1. Summary of the object ID number corresponding to the shapefile in GIS, the proveniences analyzed, the classification tool types for each provenience, and samples studied.

OBJECTID	UNIT	STONE	METAL	OTHER	UD	SAMPLES	NOTES
1	Caldwell_Area_A_Square_A	3	4	1	5	01051286, 1140; 01052722, 1144; 01052713, 1141; 01052729, 1145	
2	Caldwell_Area_A_Square_B	14	2	1	4	01052734, 1146; 01052744, 1149; 01052763, 1152; 01052764, 1152; 01052773, 1153; 01052785, 1154; 01052787, 1154; 01052775, 1153	
3	Caldwell_Area_A_Square_C	3	2	1	1	01072034, 471	
4	Caldwell_Area_A_Square_D	3	1	0	0	01050258, 208/123; 01050290, 208/127; 01050389, 208/151	
5	Caldwell_Area_A_Square_E	0	1	0	0	01052816, 1164	
6	Caldwell_Area_A_Square_H	2	4	1	1	01052834, 1167; 01050268, 208/124; 01050242, 208 (WAM)/120; 01050265, 208/124; 01050266, 208/124; 01050269, 208/124; 01052825, 1166	
7	175N 53W	0	2	1	0	1940123, 046; 00990788, 227	
8	174N 54W	2	0	0	0	00990795, 229; 00990857, 246	
9	9N 23E	1	1	0	0	01420546, B2170; 01420546, B2171a	
10	52N 62E	1	0	0	0	01420627, B1445	
11	IM1	1	0	0	0	1420309	
12	IE4	6	1	1	1	01420128, B1215i; 01420128, B1209a; 01420128, B1217i; 01420128, B1215g; 01420128, B1215e; 01420140; 01420165; 01420165 B2371a; 01420176, B2080	
13	186N 706E	0	1	0	0	1771771	
14	180N 700E	0	1	0	0	1771002	

15	178N 108E	0	0	1	0	1770975	
16	034N 064W	0	1	0	0	0990462, 105	
17	80N 734E	1	0	0	0	1770113, LOT 2B	
19	AA125	0	0	0	1	00990226, 051	
20	Z124	1	0	0	0	00991220, 345	
21	Y123	1	0	0	0	00990265, 054; 00991578, 454	
22	Y122	1	0	0	0	00991184, 337	
23	W124	0	1	0	0	1947787, 1268	
24	W123	1	2	0	3	00990047, 023; 00991334, 377; 0991336, 378	
25	W122	0	2	1	0	00990334, 067; 00991267, 360; 00991275, 363	
26	W121	12	24	4	7	01070016, 001; 01070034, 004; 01070081, 010; 01070082, 010; 01070304, 034; 01070434, 088;	W120/121
27	W120	2	12	0	0	01070117, 016; 01070119, 016; 01070177, 158; 01070213, 024; 01070233, 026; 01070632, 095; 01071070, 158; 01071160, 200; 01071181, 205	W120/121
28	X120	0	1	0	0	00991434, 407; 00991496, 429	
29	X121	0	5	1	0	01070192, 023; 01070198, 023; 00991409, 401	SW QUAD
31	X123	0	1	0	0	00991402, 399	
32	X125-W126	0	1	0	0	00990097, 004	
33	U125	1	2	0	0	1947771, 1263; 1947905, 1300; 1947915, 1299	
34	U123	0	2	0	0	01071786, 690; 00991351, 381	FS(2/4) 80
35	U122	0	0	0	1	009913160, 384	

36	V121	6	7	1	1	01070266, 028; 01070267, 028; 01070317, 037; 01070318, 037; 01070488, 068; 01070739, 099; 00990303, 059	
37	V122	0	1	0	0	01070369, 045	NW QUAD
38	U121	1	3	0	0	01070145, 019; 00991159, 338; 00991160, 338	N 1/2
39	V120	4	3	1	3	01070098, 011; 01070168, 021; 01070184, 022; 00990015, 026; 00990934, 276; 00990954, 283; 00991045, 301; 0990667, 179	00990667, 179; 0990934, 276; 0990954, 283-from ST_2_TPII
40	T122	0	1	0	0	01071545, 314	FS(2/4) 513
41	S122	0	3	1	1	01071427, 281; 01071476, 294	
42	S123	0	1	0	1	00990963, 288; 0991283, 365	
44	P122	1	2	0	0	01081104, 777	FS(4) 75
45	P128	0	1	0	0	01080524, 306	
46	M126	0	0	0	1	01080106, 057	
47	L126	1	0	0	0	01080925, 482	FS(4) 198
48	J127	0	1	0	0	01080148, 076	S 1/2
49	G126	0	0	1	0	01080384, 219	FS(4) 130 S. Block
50	G121	0	1	0	0	01080068, 043	
51	G93	1	0	0	0	1290038, 436	FS(w) 226
52	G92	1	0	0	0	1942777, 1236	N1/2 FS(w) 226
53	G88-89	0	1	0	0	1290015, 428	
54	G89	0	1	0	0	1290020, 431	W 1/2
55	L92	2	1	0	0	1947905, 1300	
57	H101	1	0	0	0	1940747, 233	
58	I102	1	1	0	0	01280100, 034; 01280193, 080	
59	H98	0	0	1	0	01280012, 006	W 1/2
60	I99	1	2	0	0	01280804, 444; 01280471, 230	
61	K98	0	1	0	0	01280434, 211	FS(w) 251
62	S98	0	1	0	0	01280260, 115	AREA 1 CONTROL

63	S99	0	1	0	0	01281108, 623	
64	T105	0	1	0	0	01280259, 114	FS(w) 342
65	ST4_102	2	0	1	0	01080653, 368	
66	ST2_7	1	0	0	1	00990763, 224	
67	ST2_13	1	0	0	0	00990707, 186	
68	ST2_5	0	1	0	0	00990835, 241	
69	ST2_3	0	1	0	0	00990375, 077	
70	ST2_34	0	1	0	0	00990607, 149	
71	ST2_24	0	1	0	0	00990656, 169	
72	ST2_17	0	1	0	0	00990808, 234	
73	ST2_19	0	1	0	0	00990553, 133	
74	Q123	0	1	0	0	01072034, 980	
75	H99	0	0	0	1	01280019, 008	E 1/2
76	I98	0	1	0	0	01280107, 036	S 1/2
78	11N 23E	0	0	0	0	01420579, B2203	no cut marks
80	AA123	2	0	0	1	00990194, 046	
81	H89	0	0	0	1	1290237, 1306	FS(w) 263
83	208D, TPI	1	0	0	0	01050471, 208D/193	
84	2S 36E	0	1	0	0	described in Reitz and Dukes (2008:791)	NOT ANALYZED BY NT
85	N128 W182	3	0	0	0	1940076, 029; 1940078, 029	
86	N128 W180	0	1	0	0	1940110, 035	
87	N130 W178	0	1	0	0	1940113, 036	
91	N116 W166	0	1	1	0	1942467, 1101	
92	N112 W157	0	1	0	0	1942544, 1132	
93	M89	0	0	0	1	1290509, 1407	FS(2) 201
94	M90	0	1	0	0	1290103, 471	
95	82N 734E	1	0	0	2	01050260, 208/121; 01050246, 208/121 01050260, 208/121	
96	TPII, STRUCTURE 2	0	0	0	1	0990667, 179	
97	208, TPI	2	0	0	0	01050297, 208/128	
98	BHT1	1	0	0	0	1940368, 068	
99	BHT4	0	1	0	0	1941950, 908	
100	441, TP3	0	1	0	1	01050953, 448; 01050954, 448	
101	441, TP4	3	1	0	0	01050966, 453; 01050967, 453; 01050959, 451	
102	441, TP5	0	2	0	0	01050977, 458; 01050976, 458	
	TOTAL	93	127	20	40		
	TOTAL BONES IN ANALYSIS				280		

Table 5-2. Tallies of zooarchaeological modifications in secular contexts.

OBJECTID	AREA	UNIT	STONE	METAL	OTHER	UD	SAMPLES	NOTES
1	391	M89	0	0	0	1	1290509, 1407	FS(2) 201
2	392	M90	0	1	0	0	1290103, 471	
3	165	82N 734E	1	0	0	2	01050260, 208/121; 01050246, 208/121 01050260, 208/121	
4	120	208 TP 1	2	0	0	0	01050297, 208/128	30-40cm "Altamaha"
5	9	BHT1	1	0	0	0	1940368, 068	
6	13	BHT4	0	1	0	0	1941950, 908	
7	8	AMNH_441_TP_III	0	1	0	1	01050953, 448; 01050954, 448	
8	9	AMNH_441_TP_IV	3	1	0	0	01050966, 453; 01050967, 453; 01050959, 451	
9	10	AMNH_441_TP_V	0	2	0	0	01050977, 458; 01050976, 458	
10	91	Caldwell_Area_A_ Square_A	3	4	1	5	01051286, 1140; 01052722, 1144; 01052713, 1141; 01052729, 1145	
11	92	Caldwell_Area_A_ Square_B	14	2	1	4	01052734, 1146; 01052744, 1149; 01052763, 1152; 01052764, 1152; 01052773, 1153; 01052785, 1154; 01052787, 1154; 01052775, 1153	
12	93	Caldwell_Area_A_ Square_C	3	2	1	1	01072034, 471	
13	100	Caldwell_Area_A_ Square_D	3	1	0	0	01050258, 208/123; 01050290, 208/127; 01050389, 208/151	
14	99	Caldwell_Area_A_ Square_E	0	1	0	0	01052816, 1164	
15	110	Caldwell_Area_A_ Square_H	2	4	1	1	01052834, 1167; 01050268, 208/124; 01050242, 208 (WAM)/120; 01050265, 208/124; 01050266, 208/124; 01050269, 208/124; 01052825, 1166	

OBJECTID	AREA	UNIT	STONE	METAL	OTHER	UD	SAMPLES	NOTES
16	157	175N 53W	0	2	1	0	1940123, 046; 00990788, 227	
17	155	174N 54W	2	0	0	0	00990795, 229; 00990857, 246	
18	57	9N 23E	1	1	0	0	01420546, B2170; 01420546, B2171a	
19	62	52N 62E	1	0	0	0	01420627, B1445	
20	30	IM1	1	0	0	0	1420309	
21	42	IE4	6	1	1	1	01420128, B1215i; 01420128, B1209a; 01420128, B1217i; 01420128, B1215g; 01420128, B1215e; 01420140; 01420165; 01420165 B2371a; 01420176, B2080	
22	119	186N 706E	0	1	0	0	1771771	
23	109	180N 700E	0	1	0	0	1771002	
24	104	178N 108E	0	0	1	0	1770975	
25	121	034N 064W	0	1	0	0	0990462, 105	
26	162	80N 734E	1	0	0	0	1770113, LOT 2B	
27	415	G92	1	0	0	0	1942777, 1236	N1/2 FS(w) 226
28	417	G88-89	0	1	0	0	1290015, 428	
29	416	G89	0	1	0	0	1290020, 431	W 1/2
30	359	L92	2	1	0	0	1947905, 1300	NW QUAD
31	48	11N 23E	0	0	0	0	01420579, B2203	no cut marks
32	382	H89	0	0	0	1	1290237, 1306	FS(w) 263
33	119	208D, TPI	1	0	0	0	01050471, 208D/193	
34	78	2S 36E	0	1	0	0	described in Reitz and Dukes (2008:791)	NOT ANALYZED BY NT
35	MISC	N128 W180	0	1	0	0	1940110, 035	
		TOTAL	48	32	7	17	104	

Table 5-3. Tallies of zooarchaeological modifications in non-secular contexts.

OBJECTID	AREA	UNIT	STONE	METAL	OTHER	UD	SAMPLES	NOTES
1	MISC	N130 W178	0	1	0	0	1940113, 036	
2	MISC	N116 W166	0	1	1	0	1942467, 1101	
3	MISC	N112 W157	0	1	0	0	1942544, 1132	
4	98	TPII, STRUCTURE 2	0	0	0	1	0990667, 179	
5	305	AA125	0	0	0	1	00990226, 051	
6	163	Z124	1	0	0	0	00991220, 345	
7	157	Y123	1	0	0	0	00990265, 054; 00991578, 454	
8	156	Y122	1	0	0	0	00991184, 337	
9	142	W124	0	1	0	0	1947787, 1268	
10	139	W123	1	2	0	3	00990047, 023; 00991334, 377; 0991336, 378	
11	133	W122	0	2	1	0	00990334, 067; 00991267, 360; 00991275, 363	
12	138	W121	12	24	4	7	01070016, 001; 01070034, 004; 01070081, 010; 01070082, 010; 01070304, 034; 01070434, 088;	W120/121
13	130	W120	2	12	0	0	01070117, 016; 01070119, 016; 01070177, 158; 01070213, 024; 01070233, 026; 01070632, 095; 01071070, 158; 01071160, 200; 01071181, 205	W120/121
14	148	X120	0	1	0	0	00991434, 407; 00991496, 429	
15	149	X121	0	5	1	0	01070192, 023; 01070198, 023; 00991409, 401	SW QUAD
16	151	X123	0	1	0	0	00991402, 399	

OBJECTID	AREA	UNIT	STONE	METAL	OTHER	UD	SAMPLES	NOTES
17	315	X125-W126	0	1	0	0	00990097, 004	
18	147	U125	1	2	0	0	1947771, 1263; 1947905, 1300; 1947915, 1299	
19	141	U123	0	2	0	0	01071786, 690; 00991351, 381	FS(2/4) 80
20	135	U122	0	0	0	1	009913160, 384	
21	136	V121	6	7	1	1	01070266, 028; 01070267, 028; 01070317, 037; 01070318, 037; 01070488, 068; 01070739, 099; 00990303, 059	
22	134	V122	0	1	0	0	01070369, 045	NW QUAD
23	137	U121	1	3	0	0	01070145, 019; 00991159, 338; 00991160, 338	N 1/2
24	131	V120	4	3	1	3	01070098, 011; 01070168, 021; 01070184, 022; 00990015, 026; 00990934, 276; 00990954, 283; 00991045, 301; 0990667, 179	00990667, 179; 0990934, 276; 0990954, 283- from ST_2_TPII
25	172	T122	0	1	0	0	01071545, 314	FS(2/4) 513
26	177	S122	0	3	1	1	01071427, 281; 01071476, 294	
27	178	S123	0	1	0	1	00990963, 288; 0991283, 365	
28	193	P122	1	2	0	0	01081104, 777	FS(4) 75
29	300	P128	0	1	0	0	01080524, 306	
30	268	M126	0	0	0	1	01080106, 057	
31	260	L126	1	0	0	0	01080925, 482	FS(4) 198
32	271	J127	0	1	0	0	01080148, 076	S 1/2
33	280	G126	0	0	1	0	01080384, 219	FS(4) 130 S. Block
34	232	G121	0	1	0	0	01080068, 043	
35	414	G93	1	0	0	0	1290038, 436	FS(w) 226
36	4	H101	1	0	0	0	1940747, 233	
37	14	I102	1	1	0	0	01280100, 034;	

OBJECTID	AREA	UNIT	STONE	METAL	OTHER	UD	SAMPLES	NOTES
							01280193, 080	
38	1	H98	0	0	1	0	01280012, 006	W 1/2
39	17	I99	1	2	0	0	01280804, 444; 01280471, 230	
40	36	K98	0	1	0	0	01280434, 211	FS(w) 251
41	69	S98	0	1	0	0	01280260, 115	AREA 1 CONTROL
42	70	S99	0	1	0	0	01281108, 623	
43	118	T105	0	1	0	0	01280259, 114	FS(w) 342
44	13	ST4_102	2	0	1	0	01080653, 368	
45	72	ST2_7	1	0	0	1	00990763, 224	
46	78	ST2_13	1	0	0	0	00990707, 186	
47	70	ST2_5	0	1	0	0	00990835, 241	
48	96	ST2_3	0	1	0	0	00990375, 077	
49	94	ST2_34	0	1	0	0	00990607, 149	
50	80	ST2_24	0	1	0	0	00990656, 169	
51	79	ST2_17	0	1	0	0	00990808, 234	
52	82	ST2_19	0	1	0	0	00990553, 133	
53	186	Q123	0	1	0	0	01072034, 980	
54	2	H99	0	0	0	1	01280019, 008	E 1/2
55	18	I98	0	1	0	0	01280107, 036	S 1/2
56	167	AA123	2	0	0	1	00990194, 046	
57	MISC	N128 W182	3	0	0	0	1940076, 029; 1940078, 029	
		TOTAL	45	95	13	23	176	

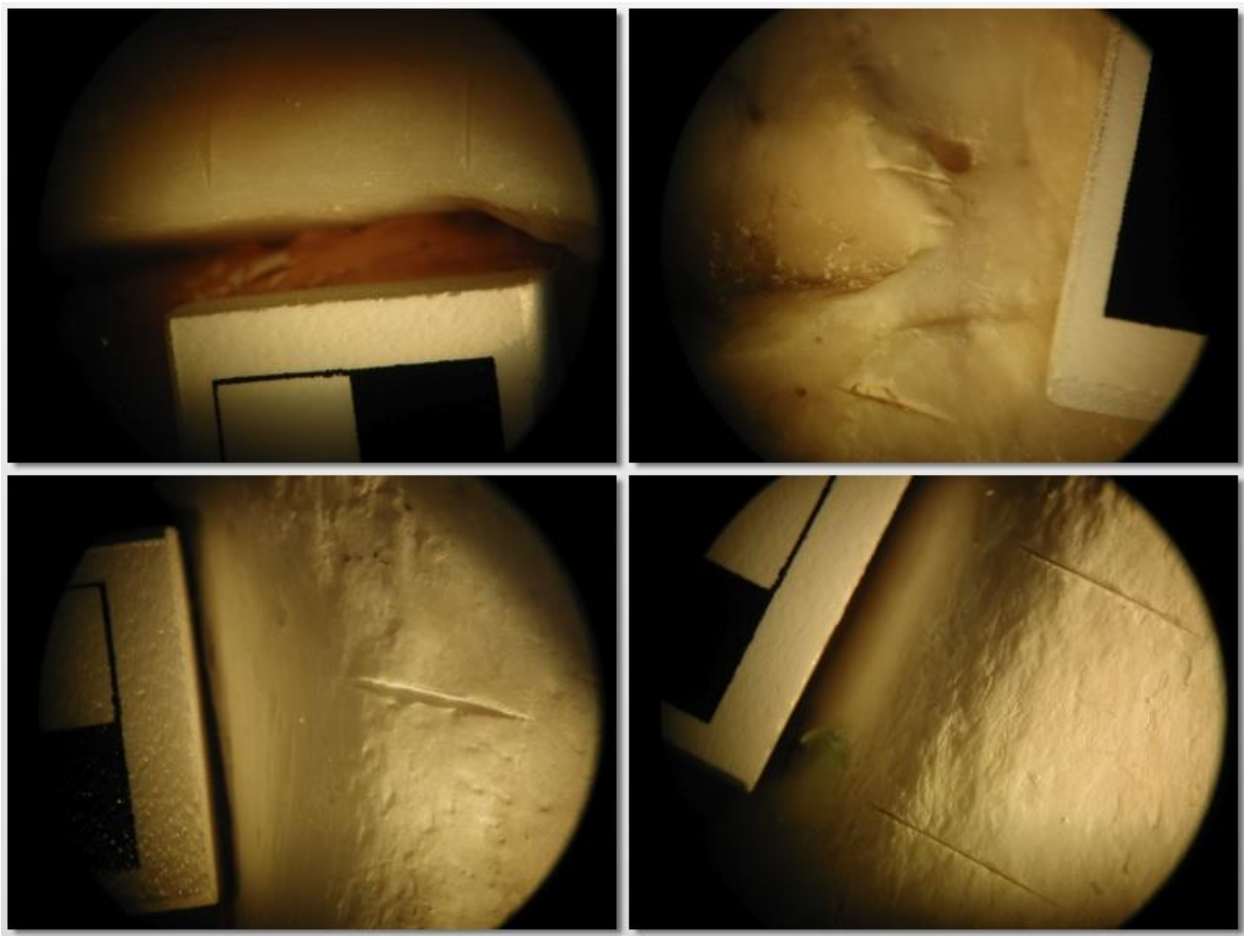

Figure 5-1. Experimental bone cut by unserrated steak knife (top left) paring knife (top right) clam knife (bottom left) chef knife (bottom right).

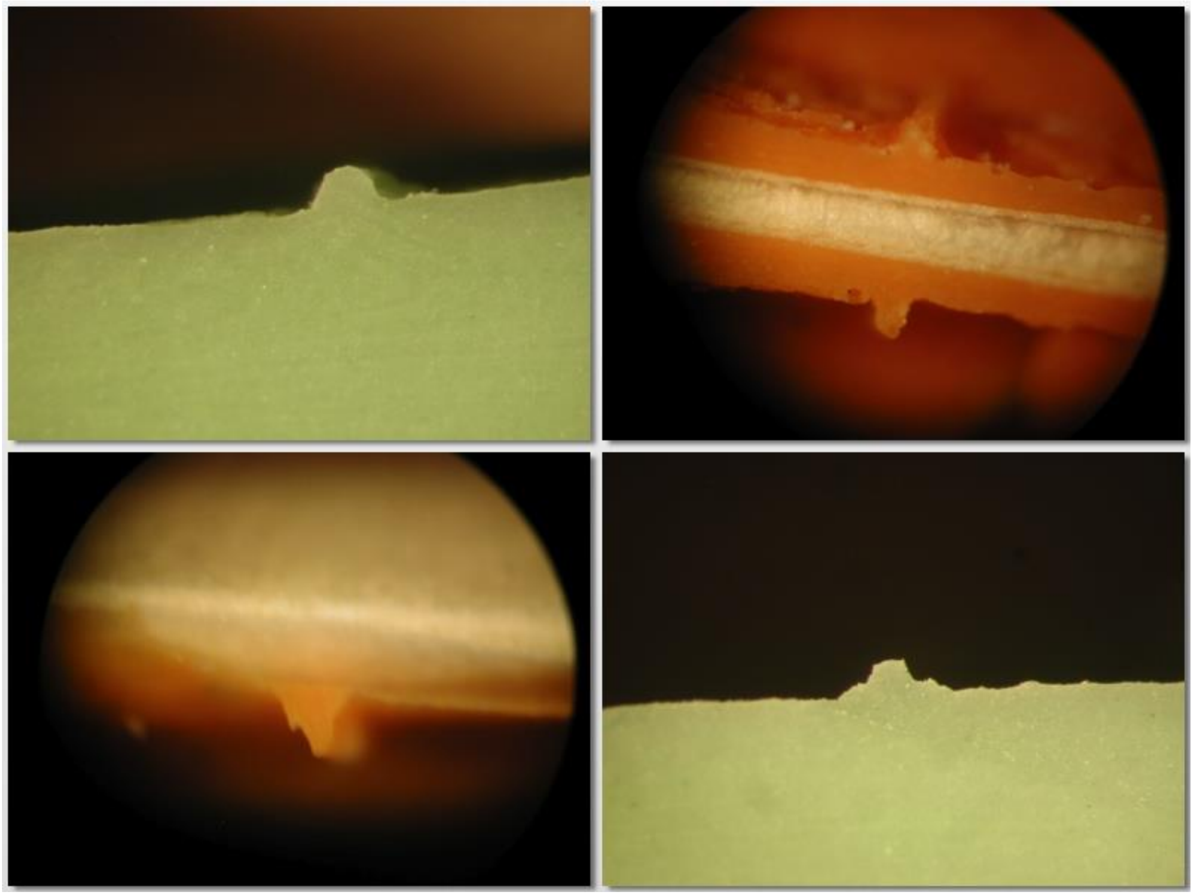

Figure 5-2. Impressions of experimental cutmarks made with steel blades: unserrated steak knife (top left) paring knife (top right) steel clam knife (bottom left) chef knife (bottom right).

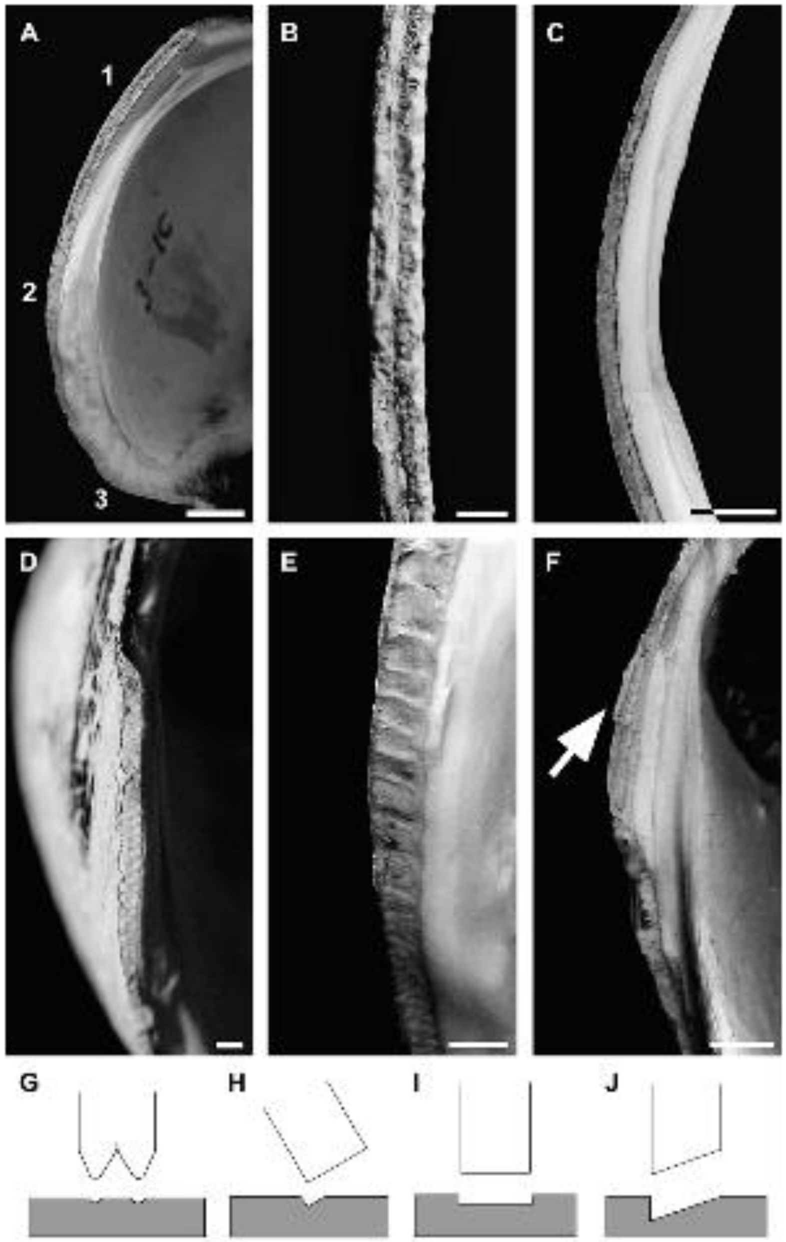

Figure 5-3. Cutting edges of expedient clamshell tools. Image G shows how an offset edge can produce double track grooves that flank the ridge between annuli (Choi and Driwantoro 2007: Figure 6, partial).

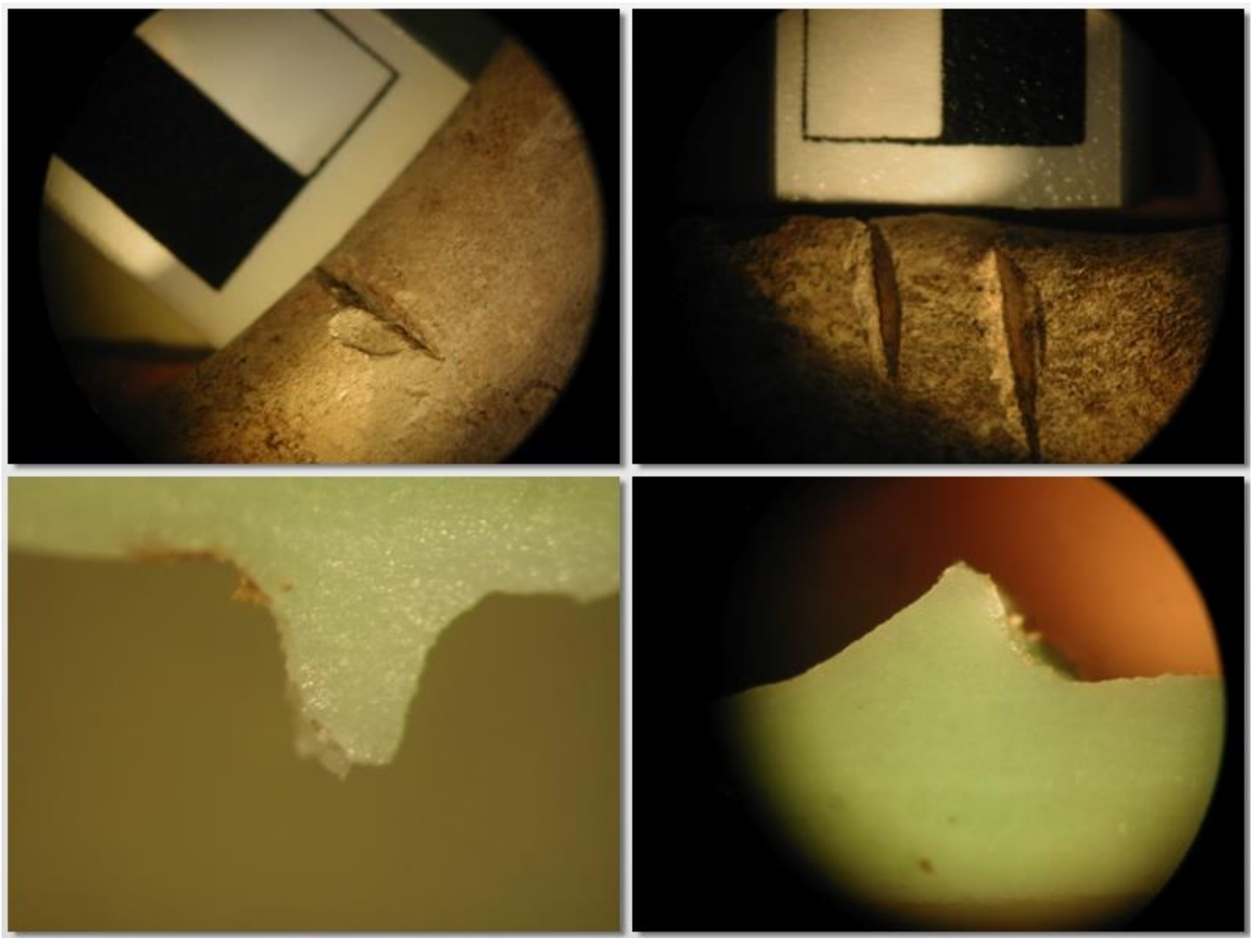

Figure 5-4. Plan views of zooarchaeological hacked bone (top) and profile views their corresponding profiles (bottom). Note distinct apexes and symmetry of walls.

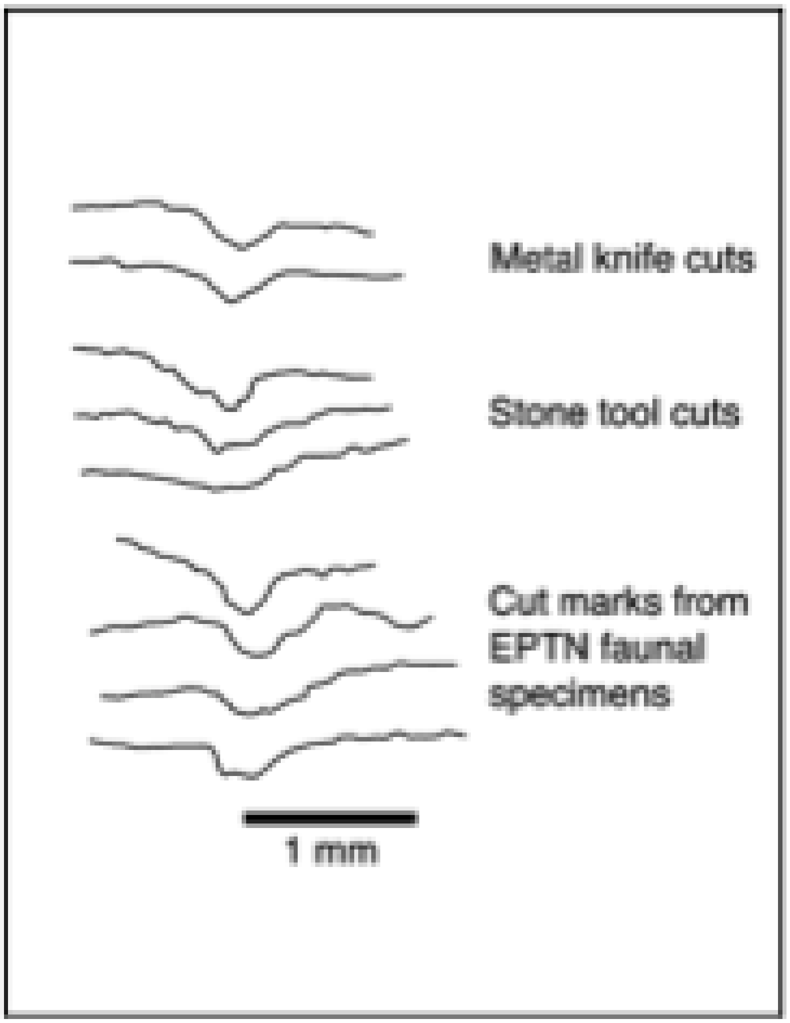

Figure 5-5. Profiles of cutmarks made by experimental methods (top) and observed in the Easter Pequot reservation (Cipolla 2008: Figure 2).

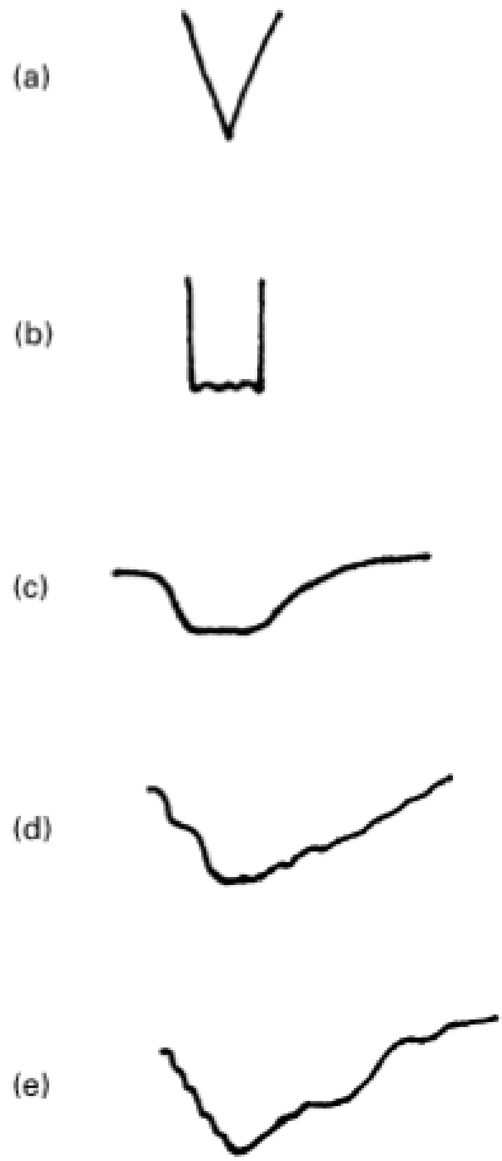

Figure 5-6. Profiles of cutmarks made by (a) sharp metal tools, (b), (c), dulled metal blades (d), (e), and stone blades (Greenfield 1999: 803).

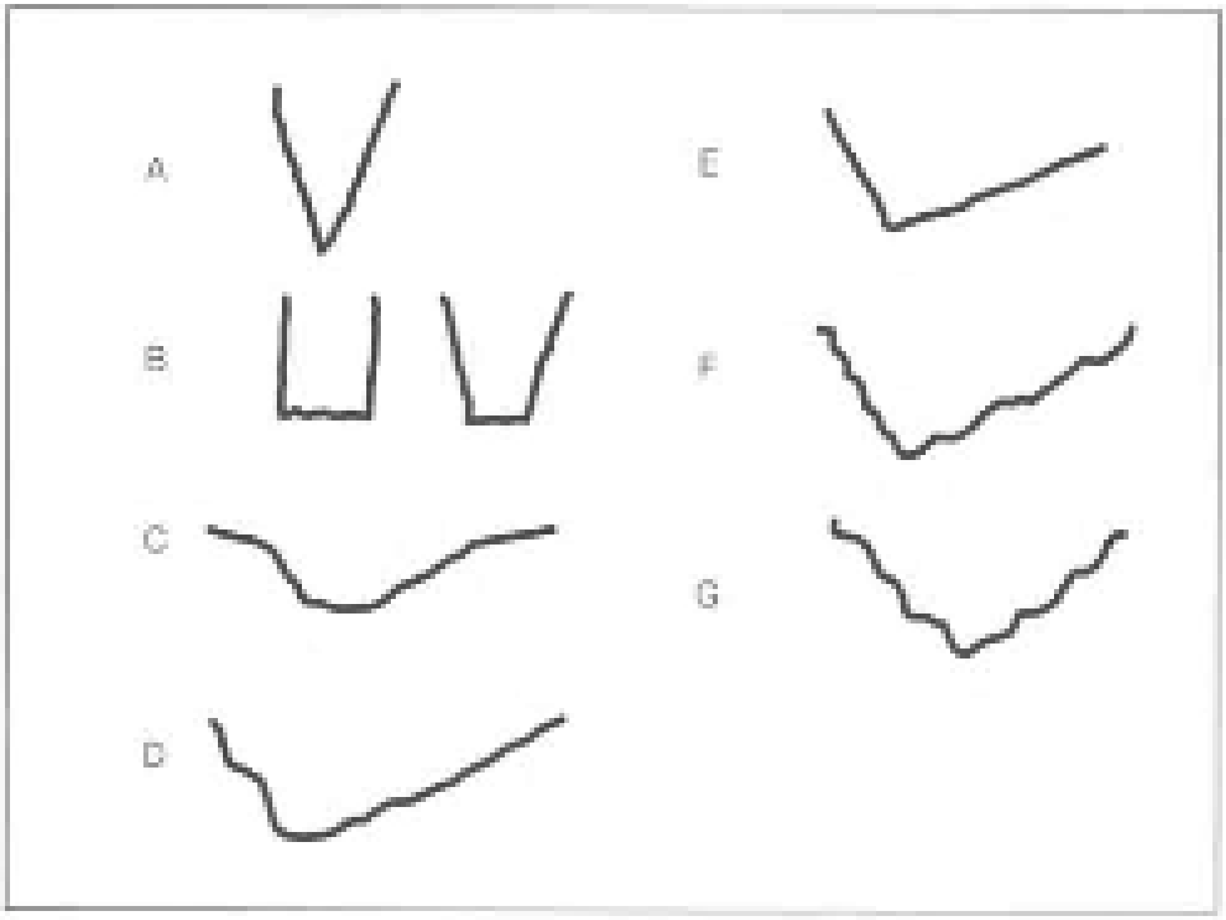

Figure 5-7. Profiles of cutmarks made by (A) sharp flat-edged metal blade, (B) dulled flat-edged metal blade, (C) serrated-edge metal blade, (D) chipped stone side scraper, (E) chipped stone blade, unmodified, (F) chipped stone blade with unifacial retouch, and (G) chipped stone blade bifacially retouched (Greenfield 2006: 152).

Figure 5-8. Chert flakes used for experimental butchery trials.

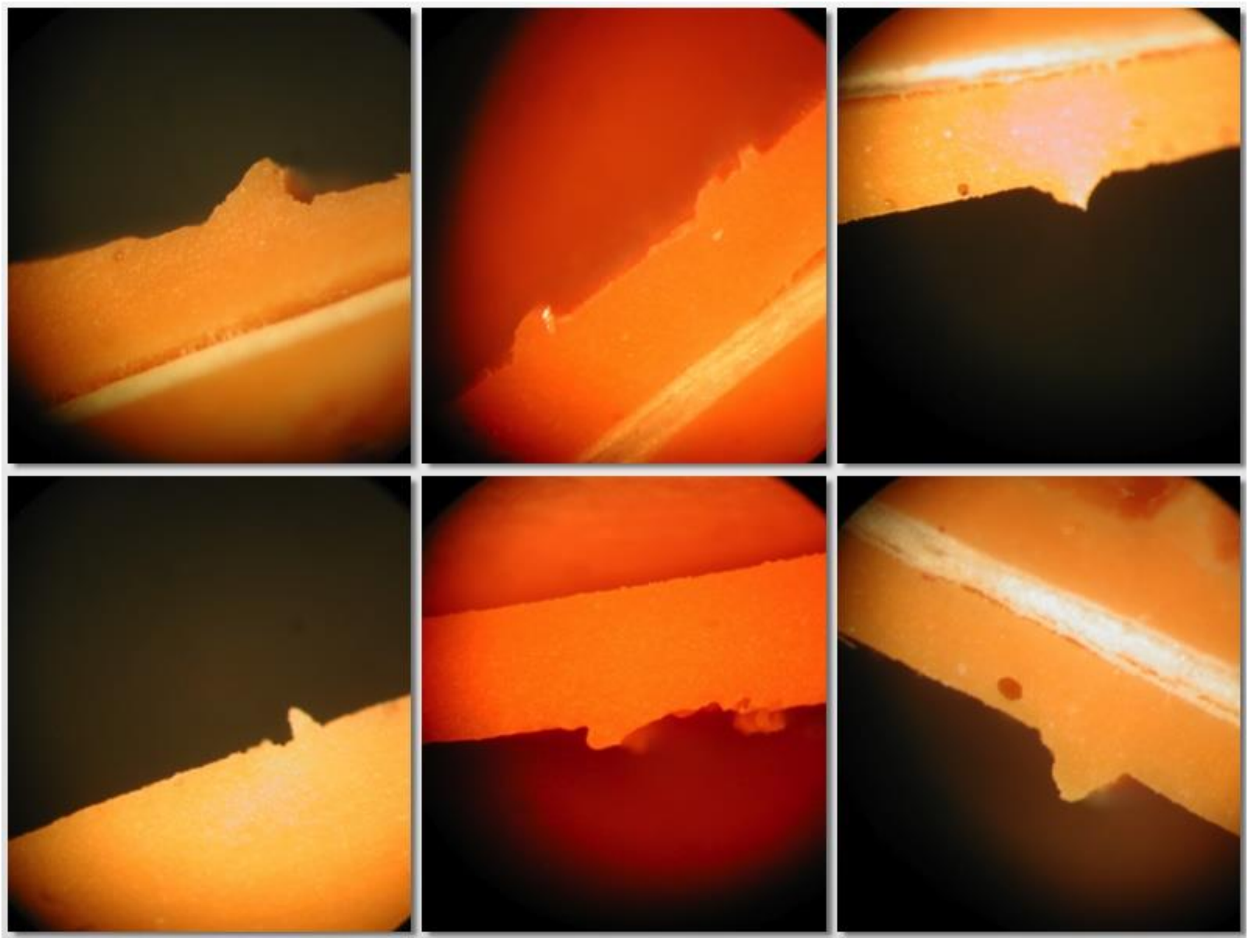

Figure 5-9. Impressions of experimentally produced cutmarks made with flaked chert tools. The negatives show asymmetry and fairly distinct apexes, some with rounding.

Figure 5-10. Experimental bone cut by flaked chert tools. Grooves are sinuous and contain debris.

Figure 5-11. Bone with shell impacted, labeled as modified by “other” taphonomic process.

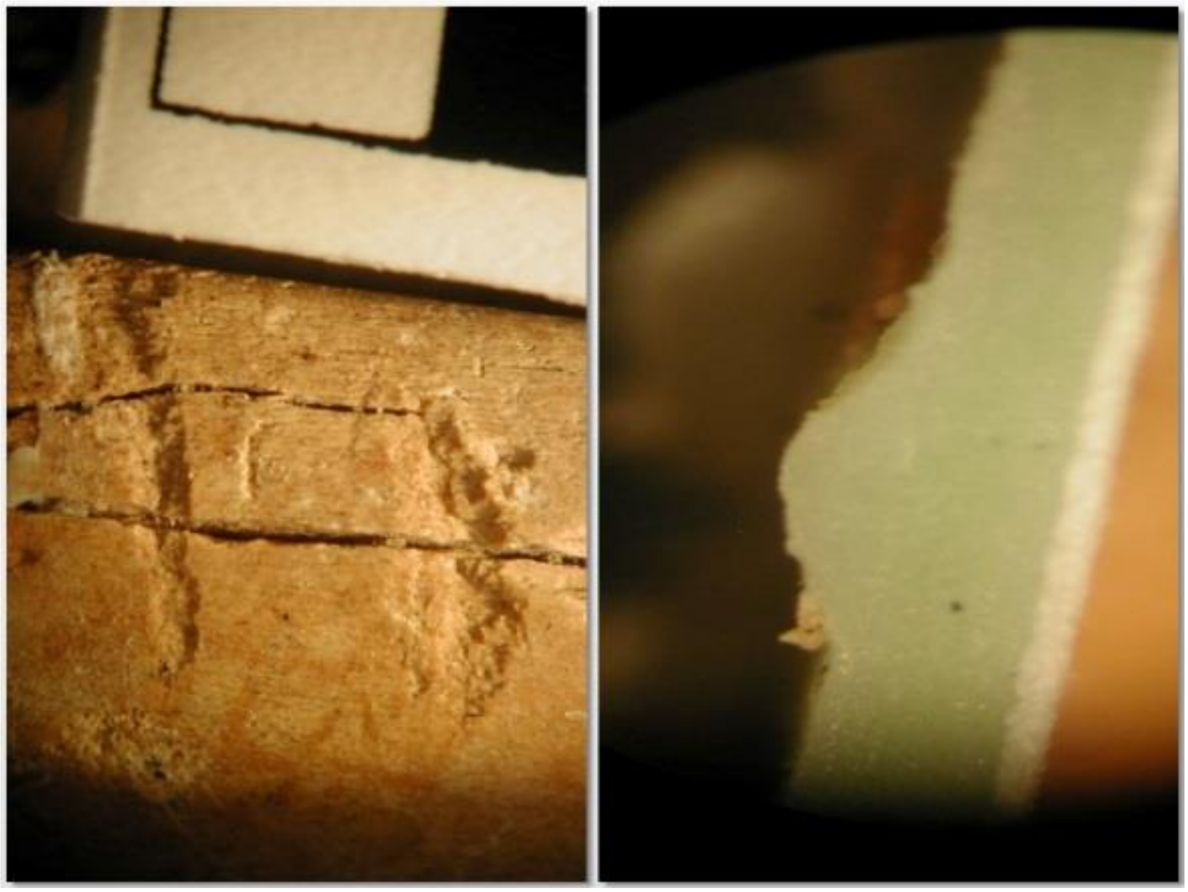

Figure 5-12. Shallow cutmarks with flaking suggests a retouched stone tool, but profile view does not corroborate the assessment. This specimen was categorized as undetermined.

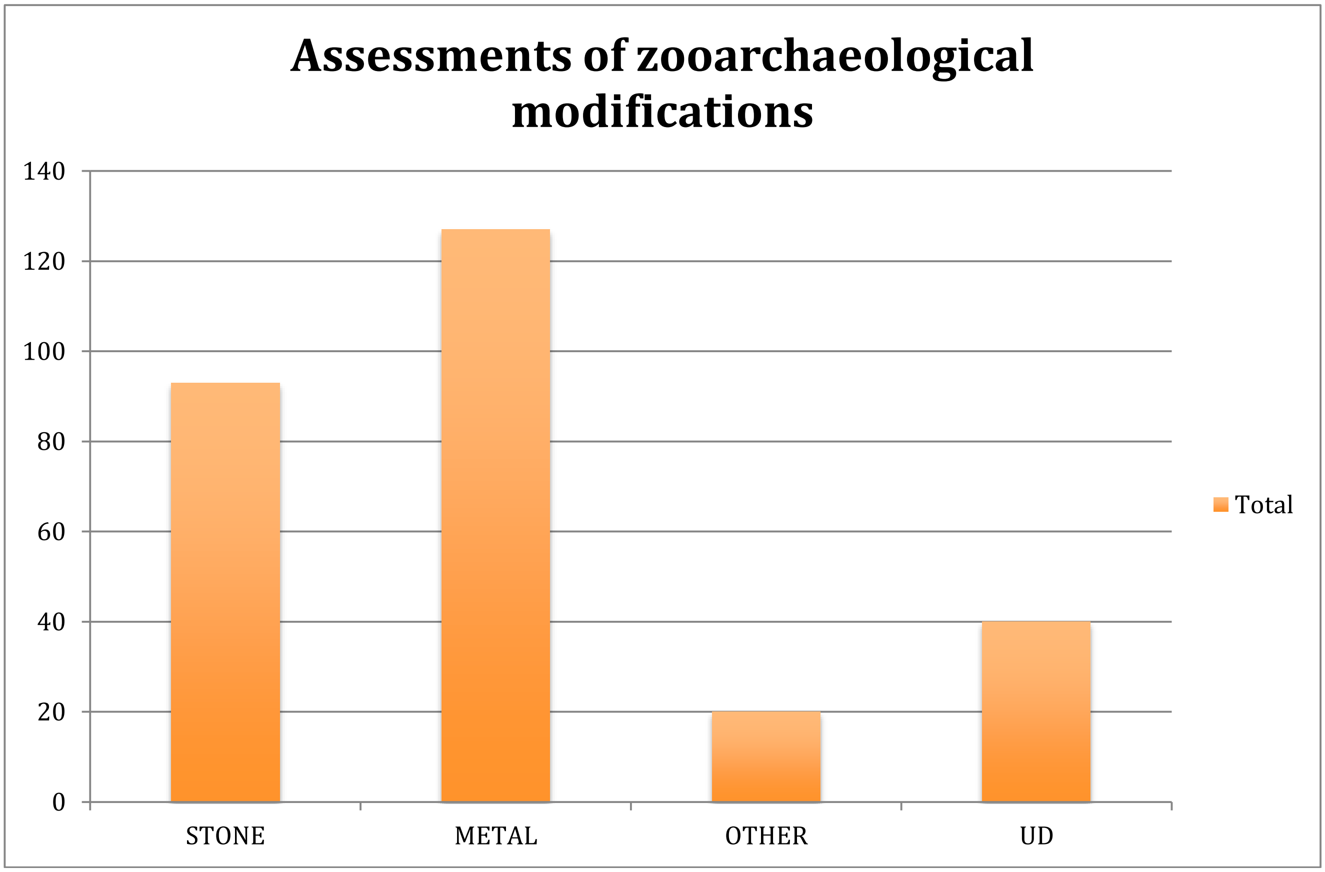

Figure 5-13. Graph shows frequencies of observed modifications on zooarchaeological bone made by stone (N=93), metal (N=127), other (N=20), and undetermined (UD) (N=40).

Figure 5-14. Experimental cutmarks made with metal (top) and zooarchaeological bone modified by metal tools (bottom).

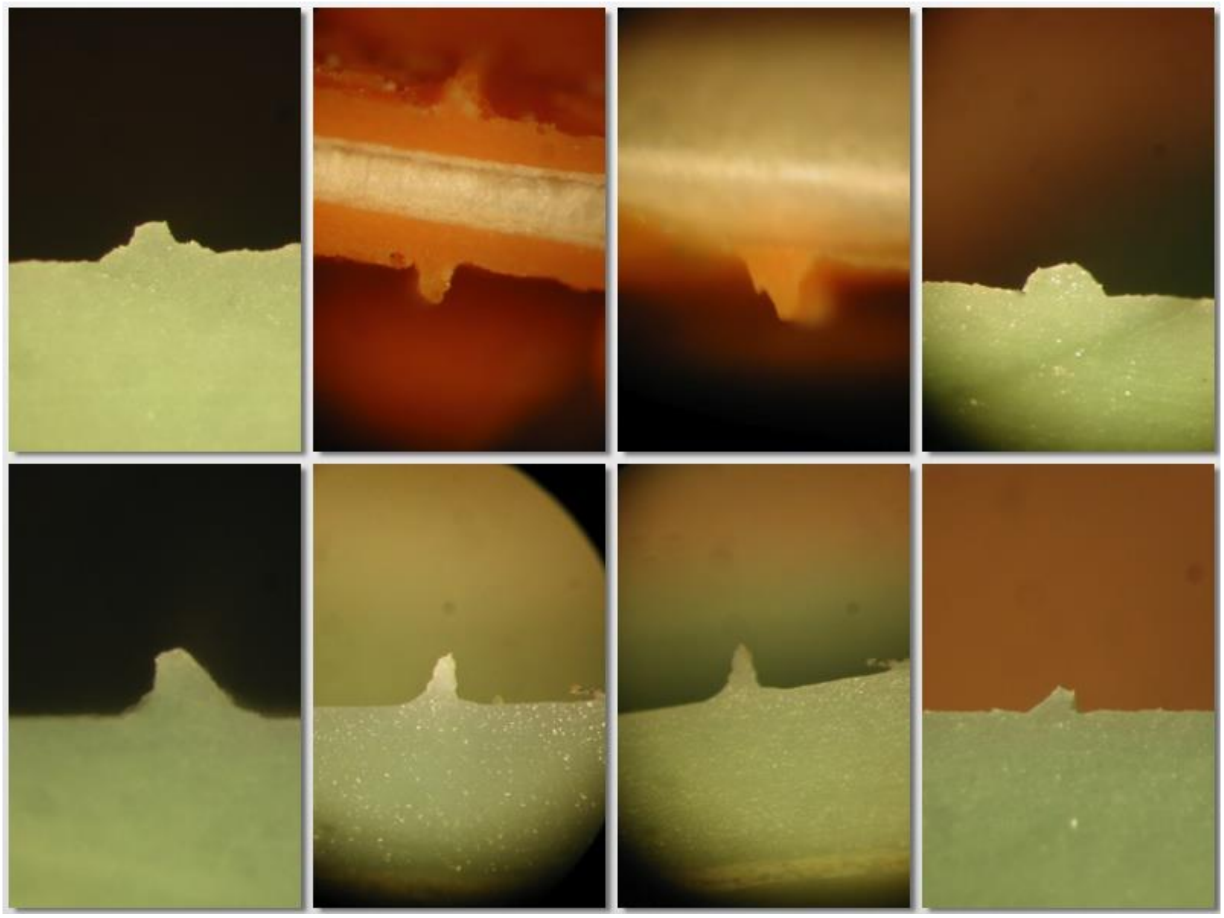

Figure 5-15. Cross-section view of molds of experimental cuts made by steel (top) and zooarchaeological modified bone (bottom).

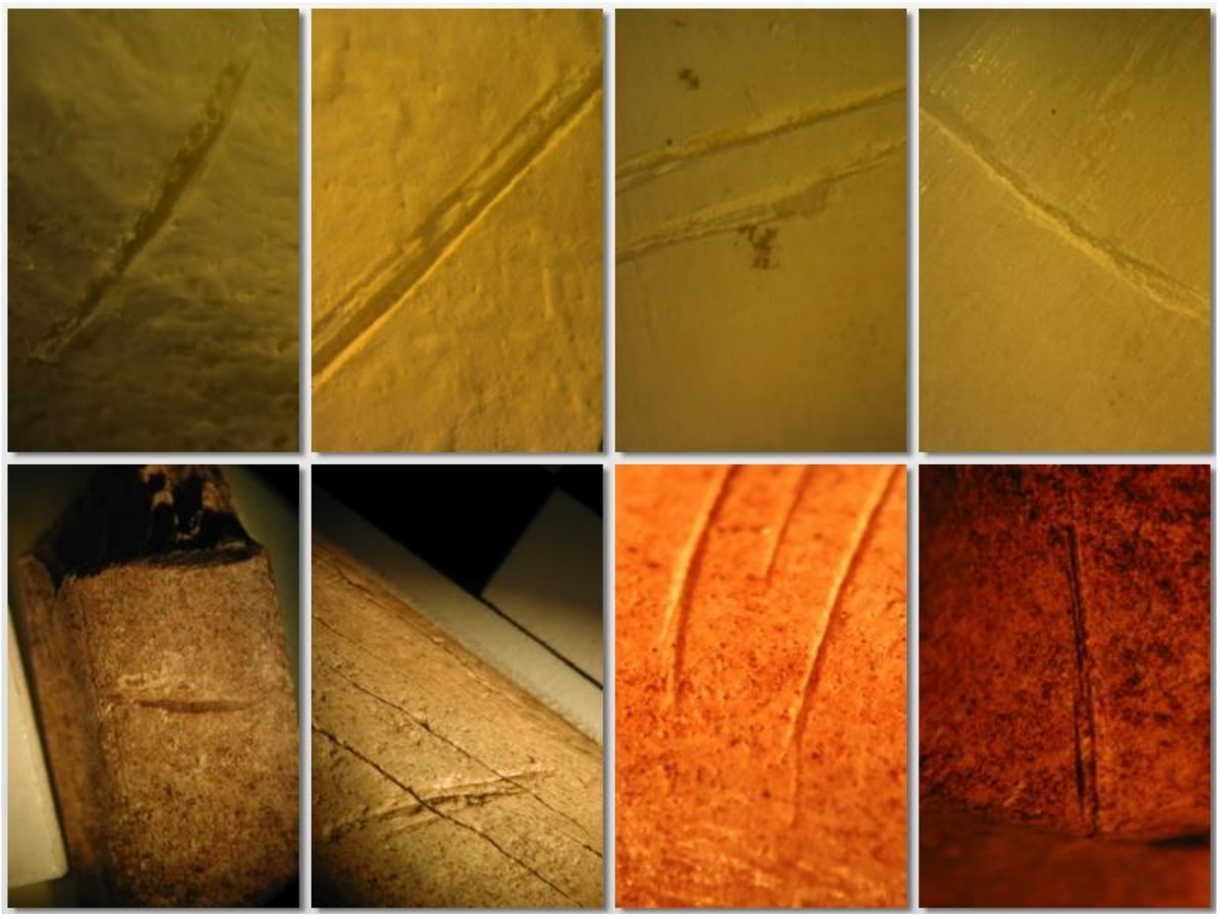

Figure 5-16. Experimental cutmarks made with stone (top) and zooarchaeological bone modified by stone tools (bottom).

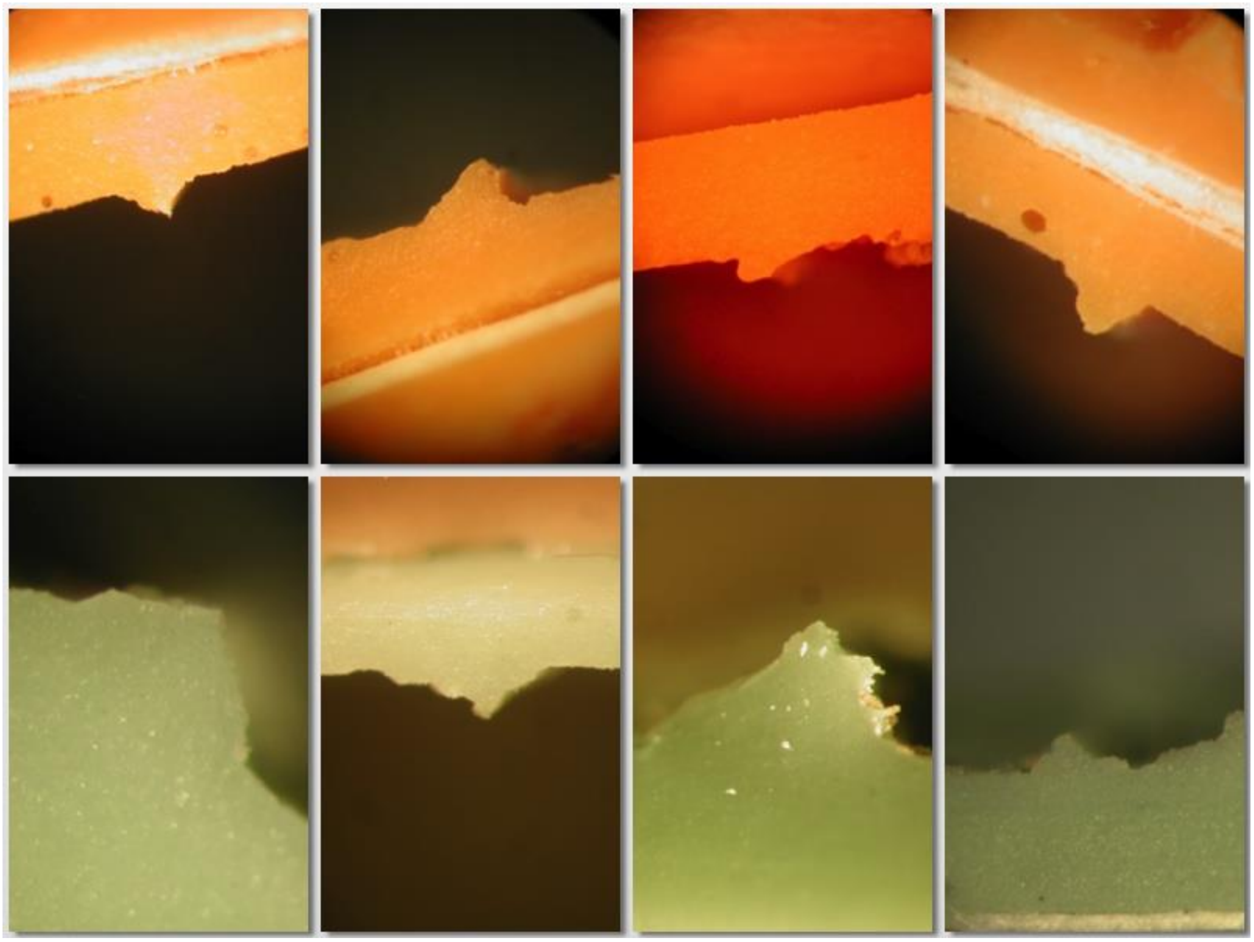

Figure 5-17. Cross-section view of molds of experimental cuts made by stone (top) and zooarchaeological modified bone (bottom).

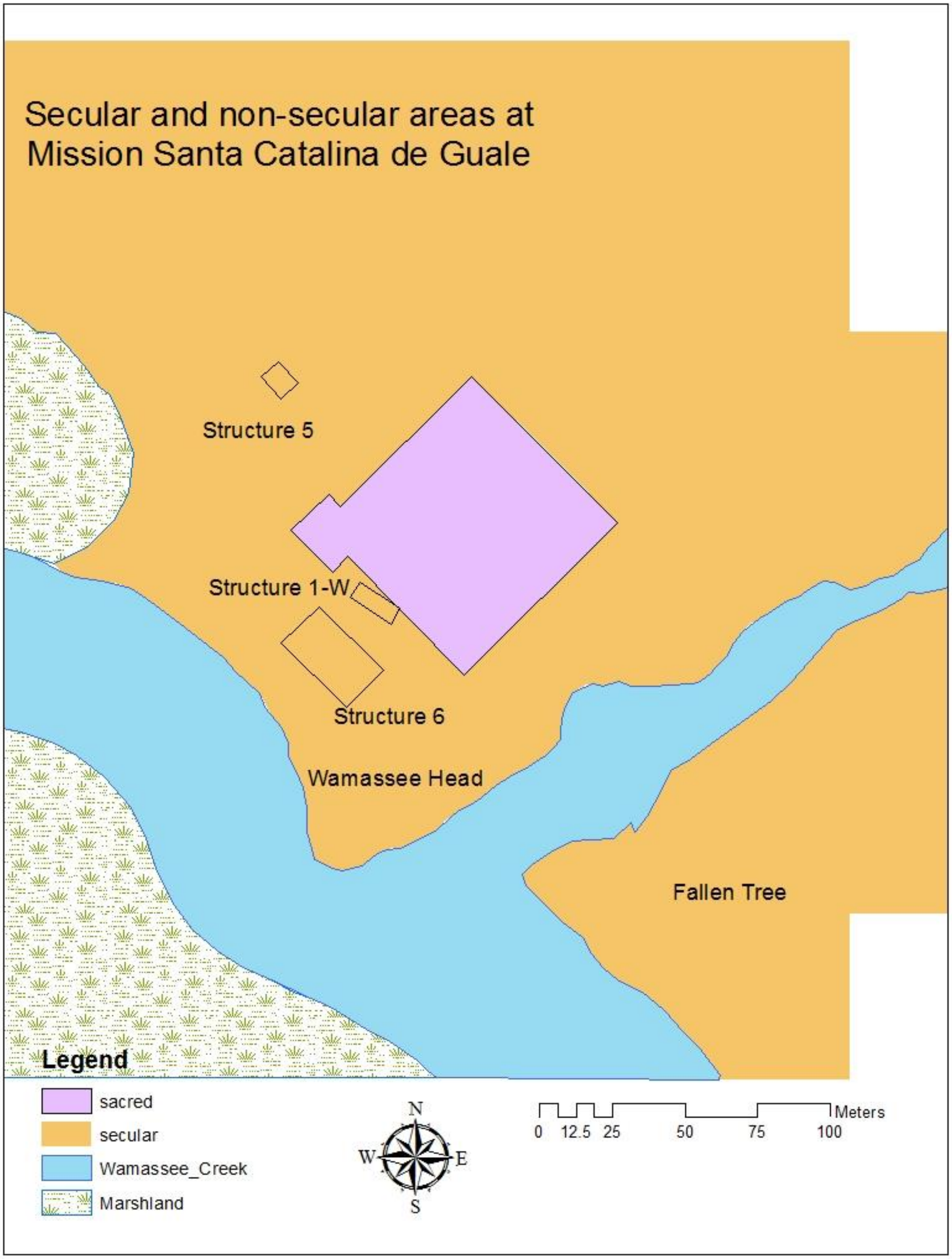

Figure 5-18. Inferred secular and sacred areas of Santa Catalina de Guale.

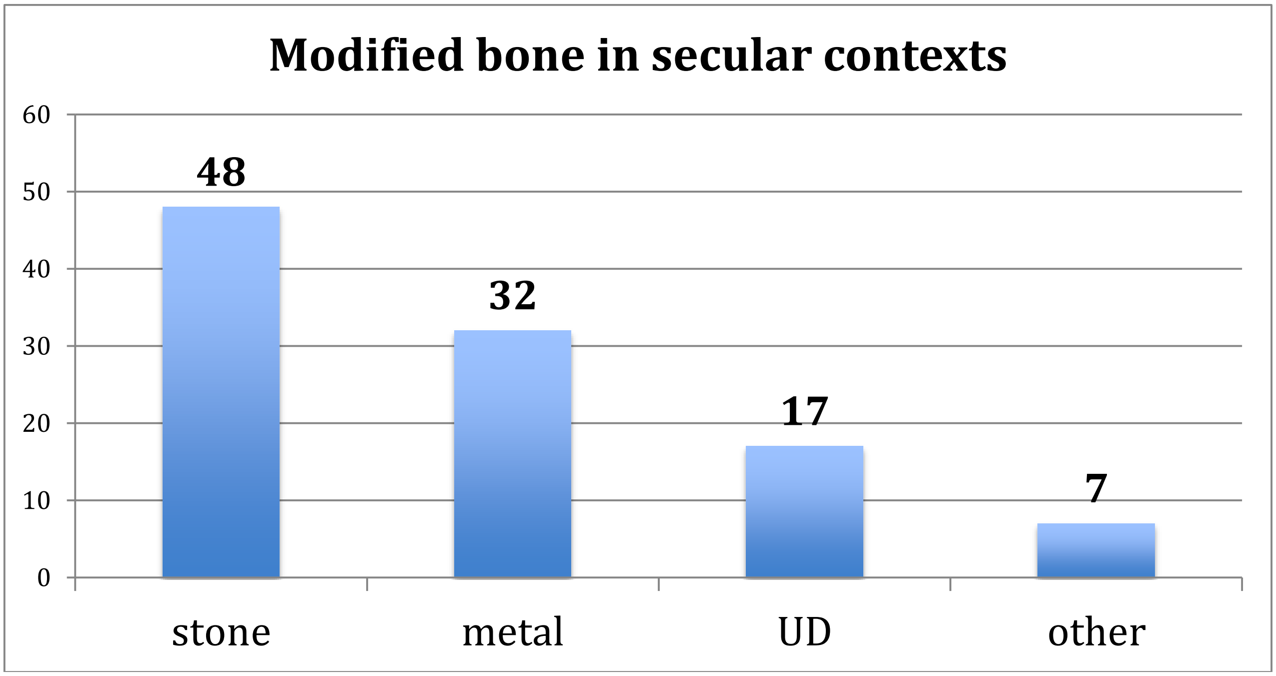

Figure 5-19. Frequencies of observed modifications on zooarchaeological specimens collected from secular contexts. Also see Table 5-2.

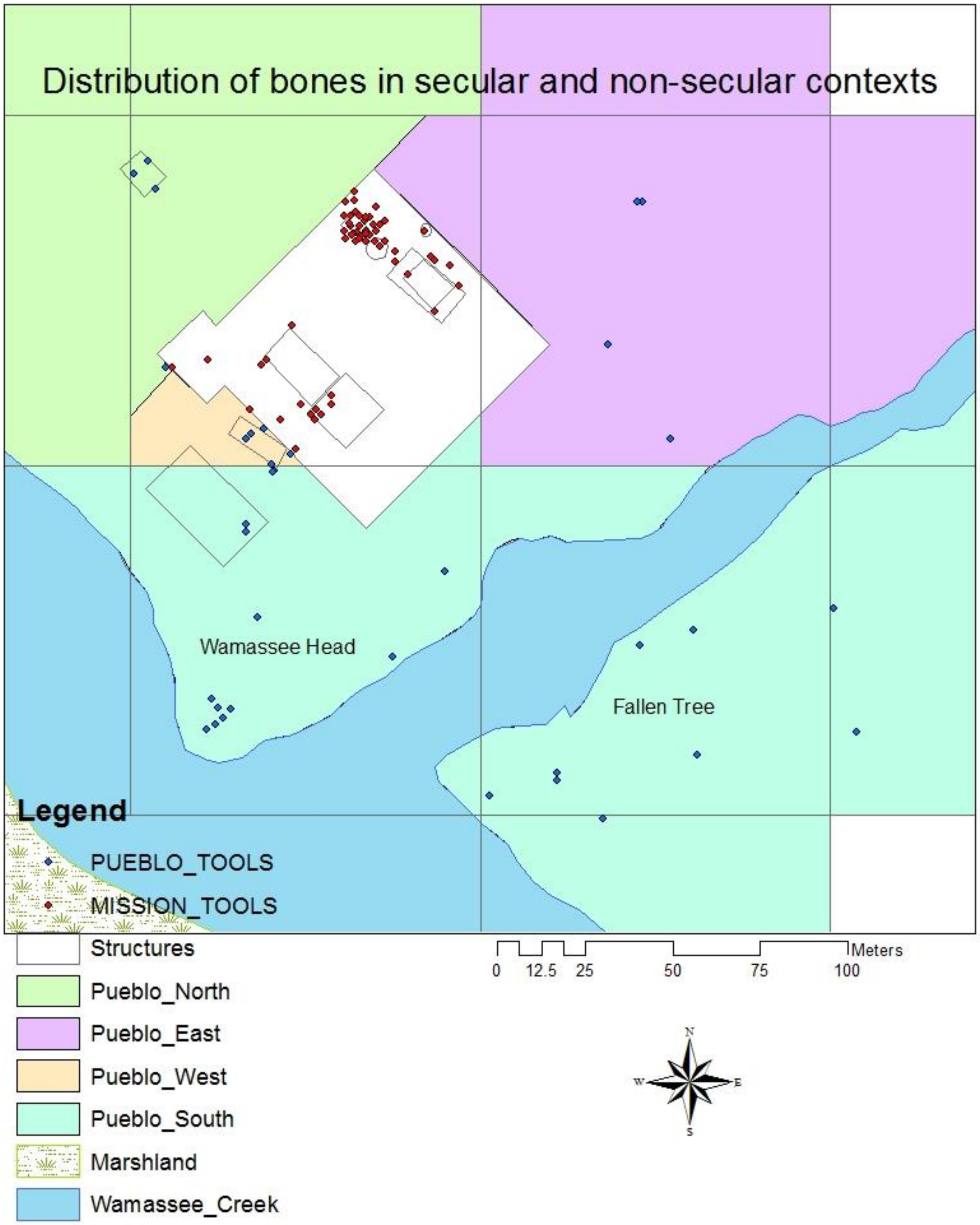

Figure 5-20. Distribution of modified bone recovered from Mission and Pueblo contexts.

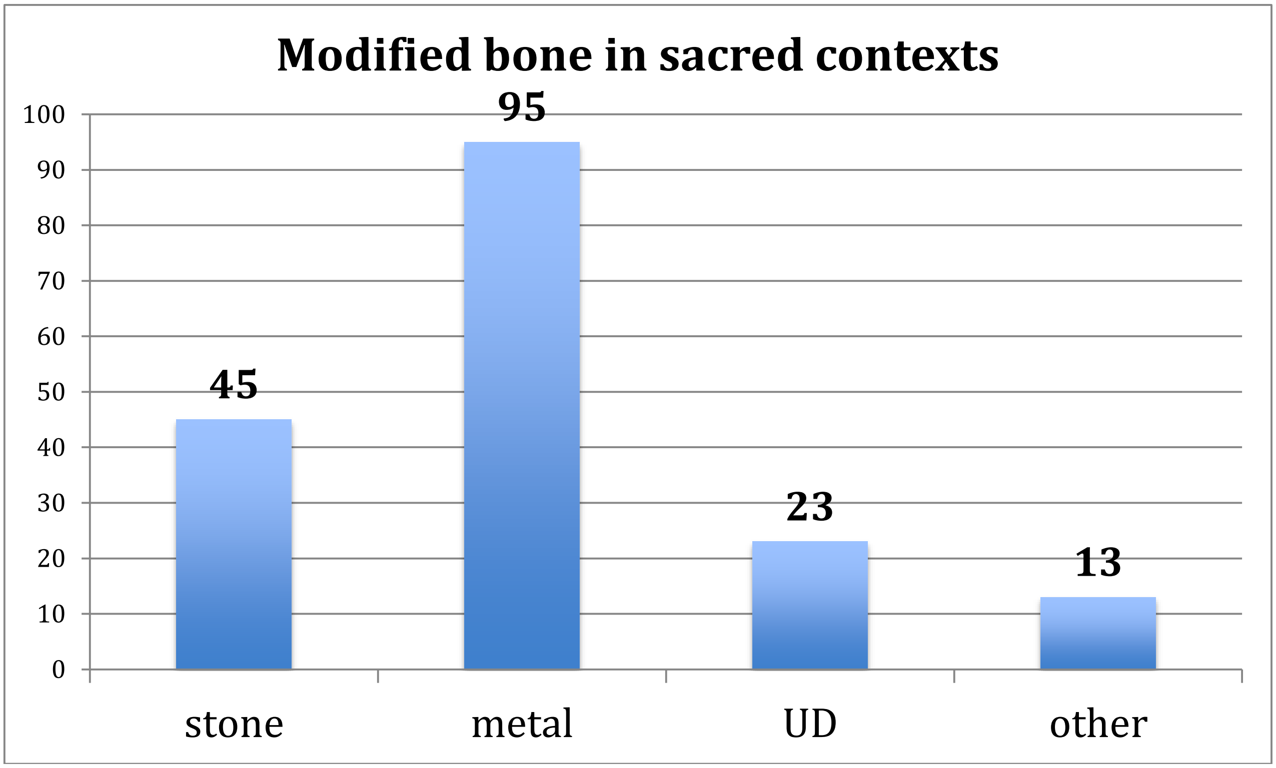

Figure 5-21. Frequencies of observed modifications on zooarchaeological specimens collected from non-secular contexts. Also see Table 5-3.

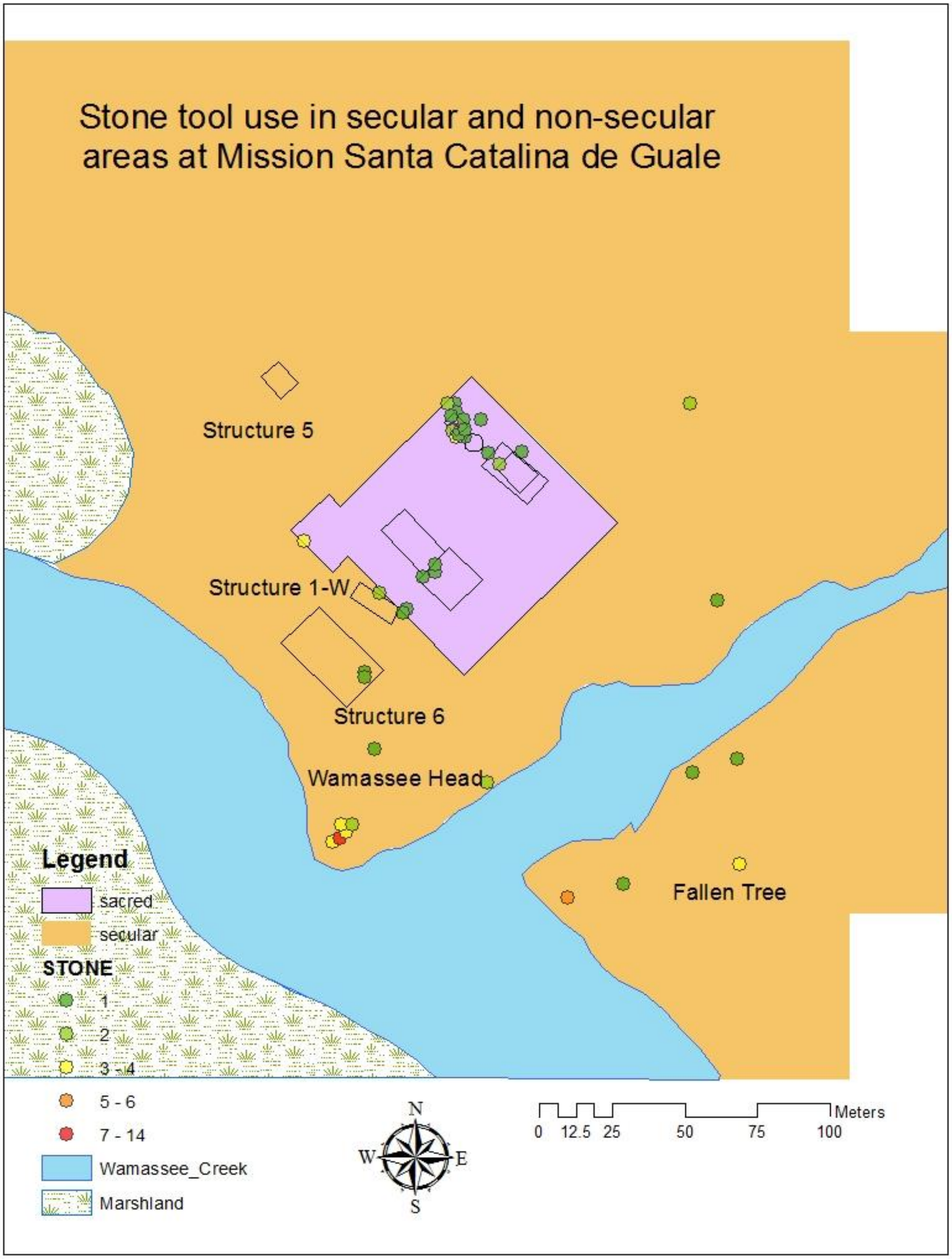

Figure 5-22. Locations of evidence for stone tool butchery.

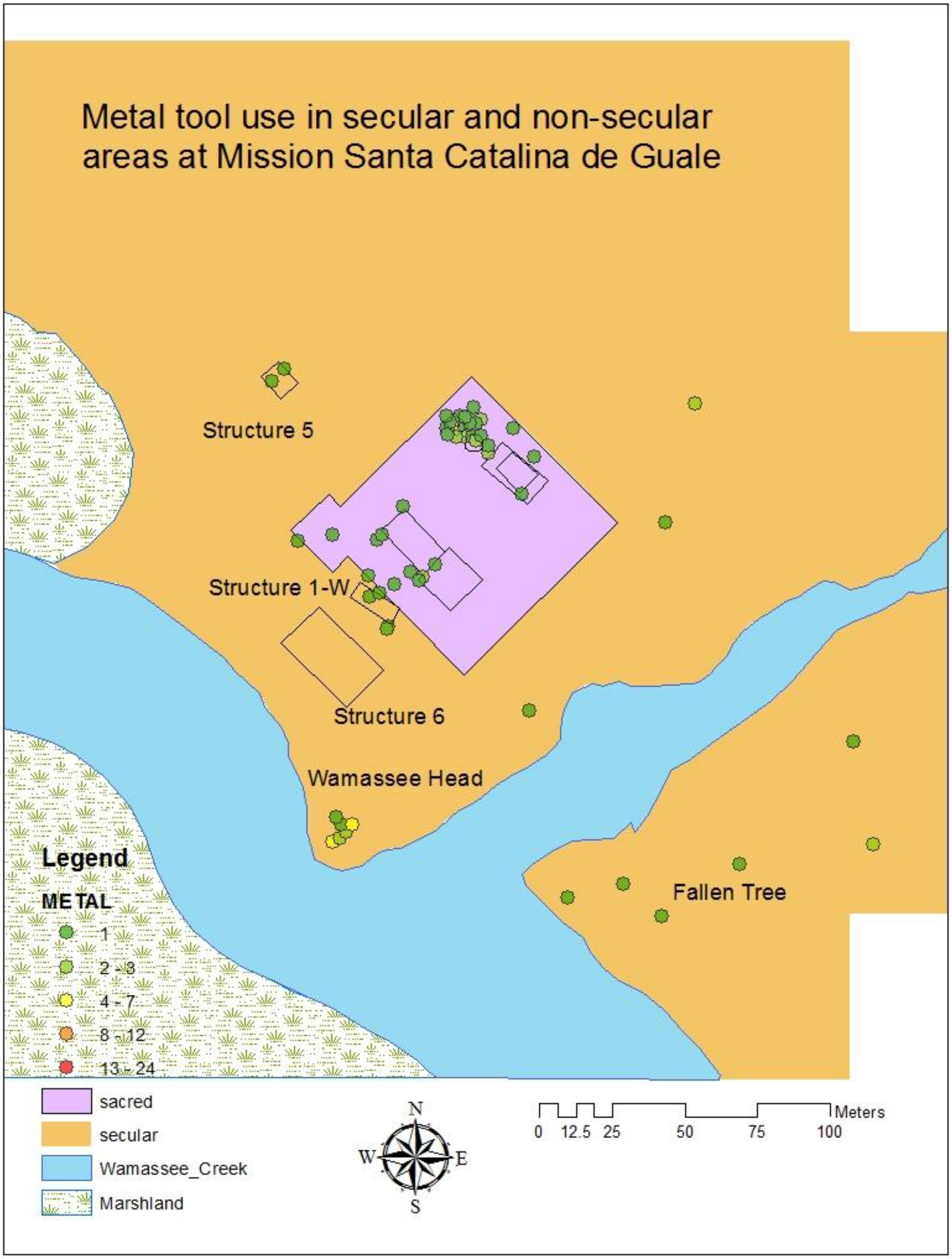

Figure 5-23. Locations of evidence for metal tool butchery.

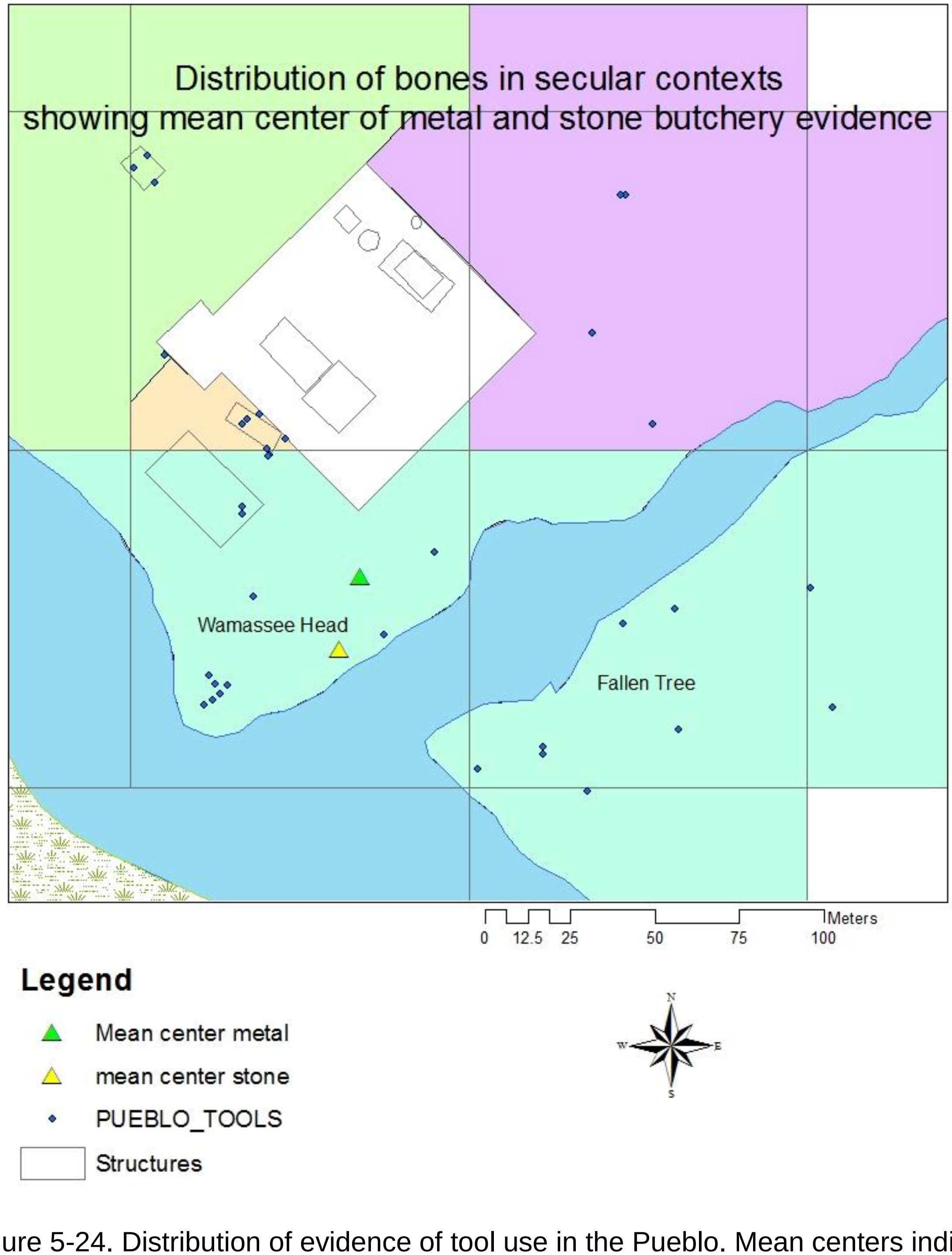

Figure 5-24. Distribution of evidence of tool use in the Pueblo. Mean centers indicated by triangles show that on average evidence of metal tool use is closer to the mission than the average occurrences of stone tool use.

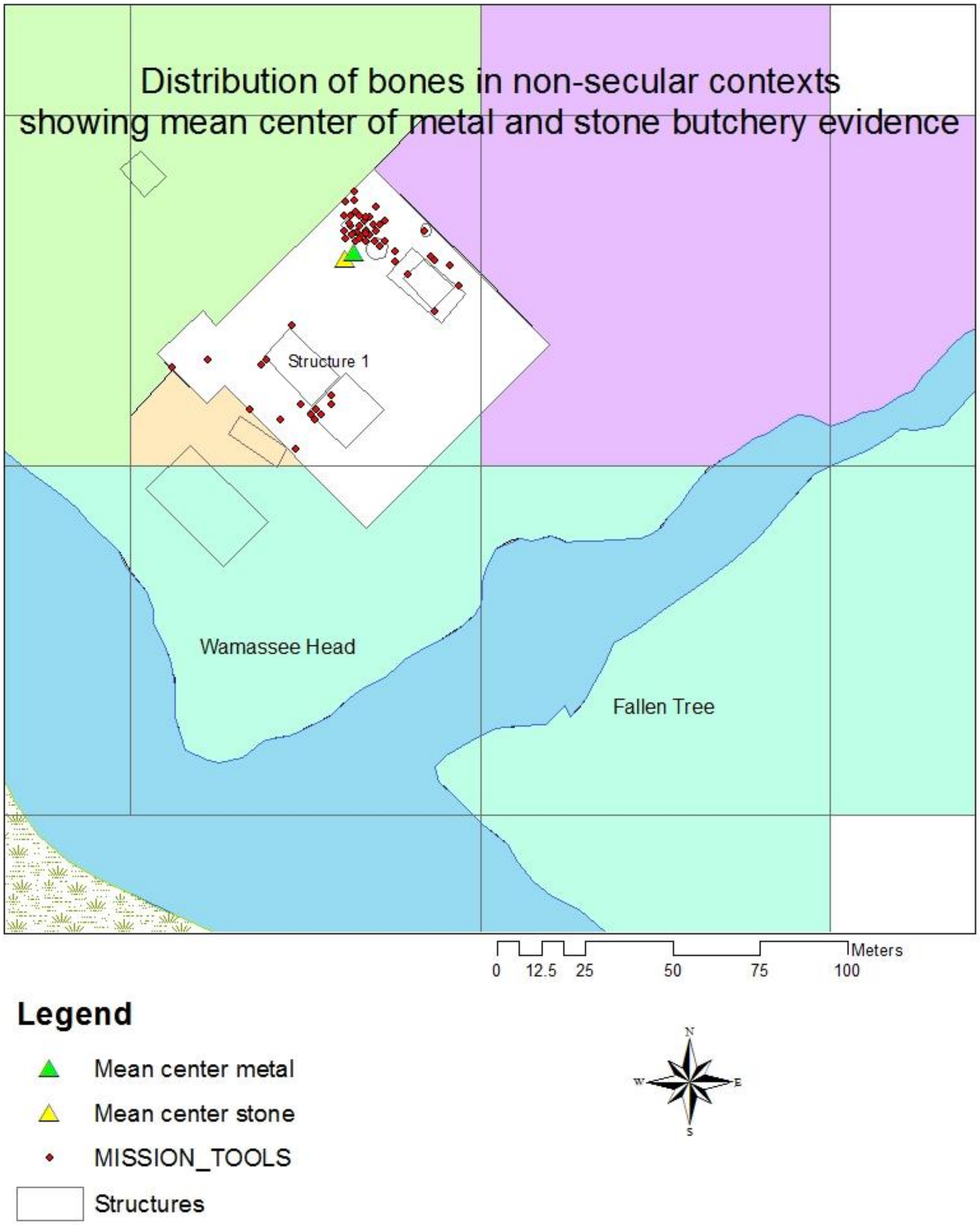

Figure 5-25. Distribution of evidence of tool use in the Mission. Triangles indicate mean centers showing little difference in the average spatial distribution of stone and metal tool evidence within the walls of the bastion.

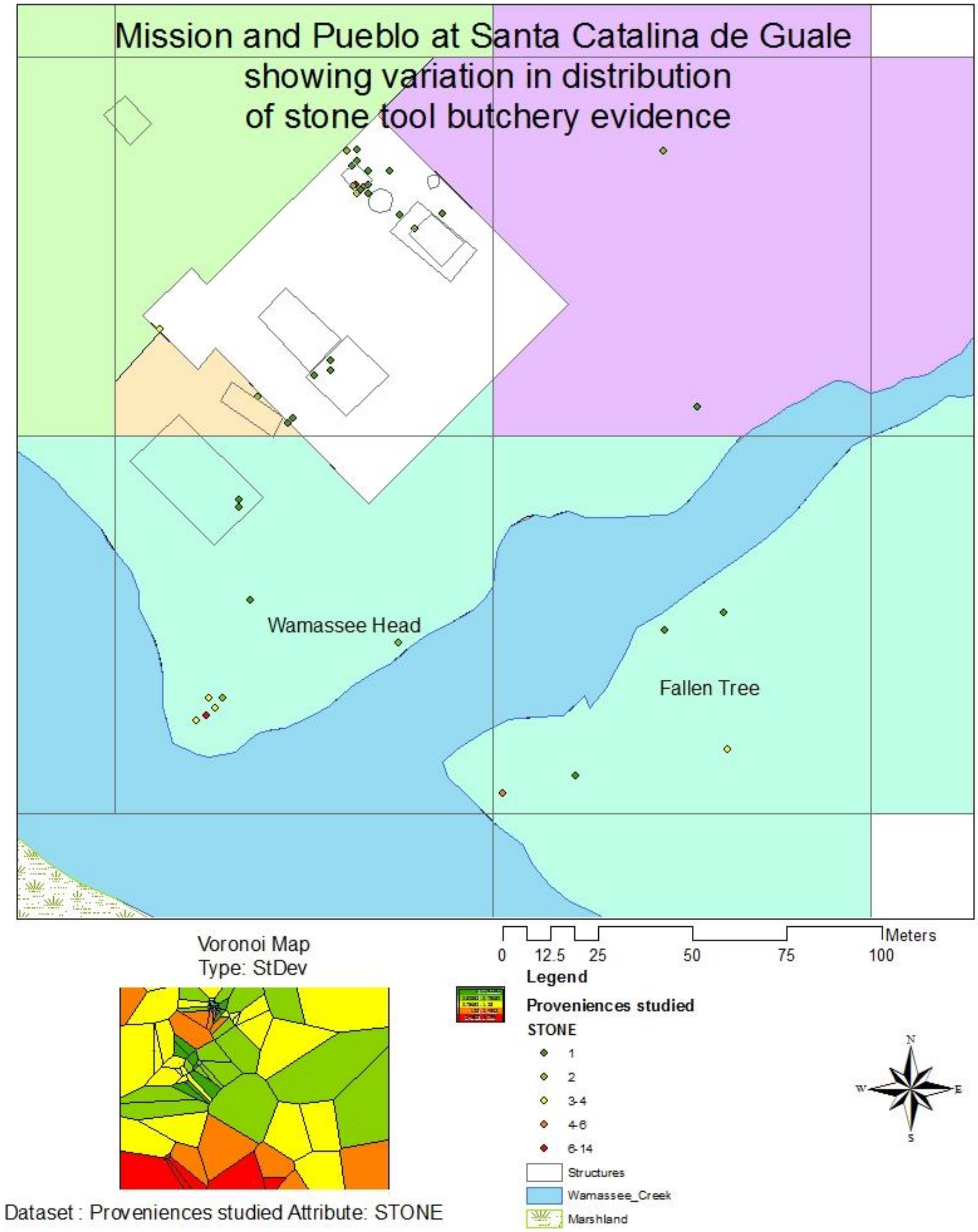

Figure 5-26. Distribution of stone tool use. Higher density of evidence occurs at Wamassee Head and Fallen Tree. Voronoi diagram illustrates inflated variation between the secular and non-secular areas due to an outlier value at Wamassee Head.

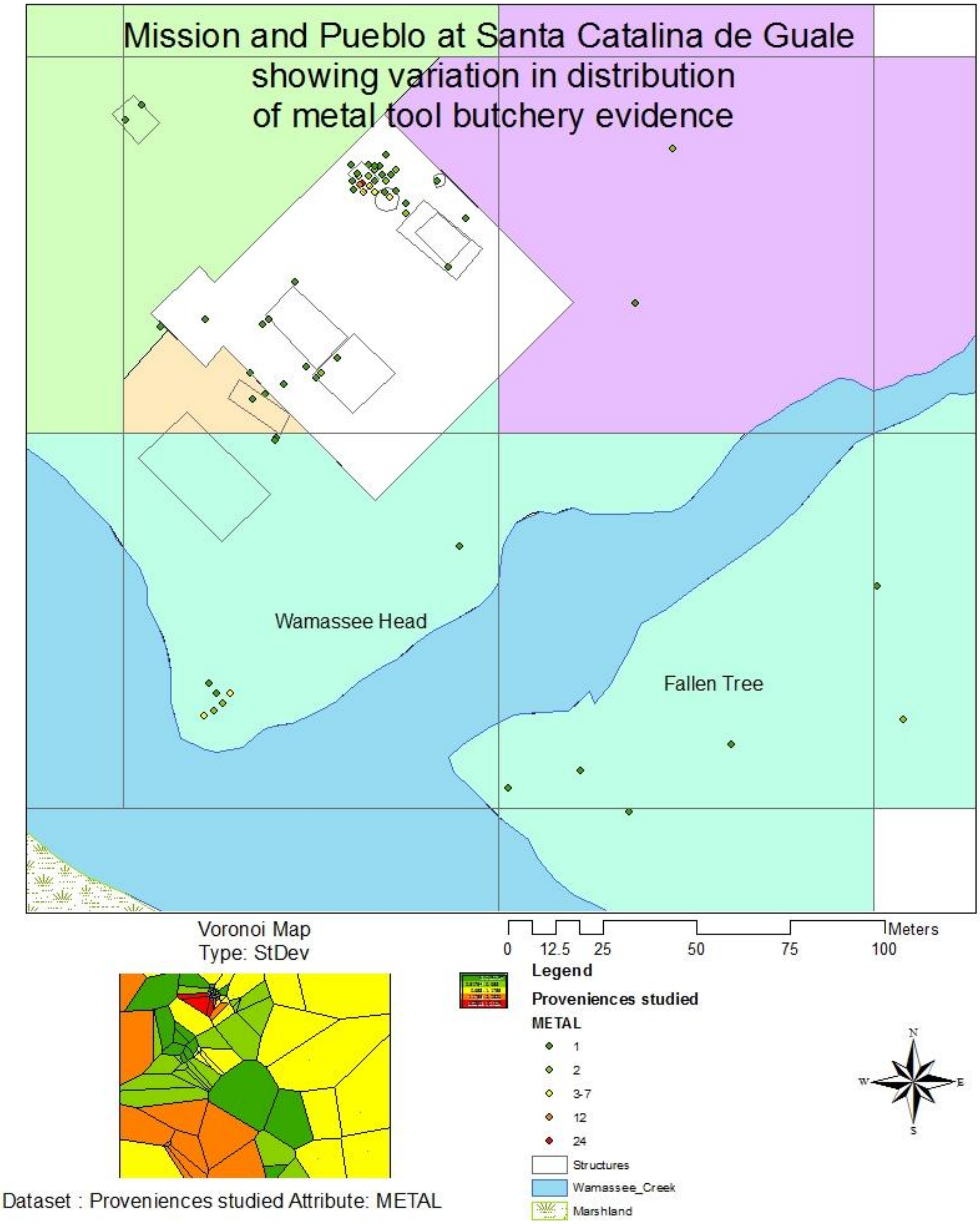

Figure 5-27. Distribution of metal tool use in the Mission and Pueblo areas. The Voronoi diagram highlights the spike in metal tool use in the non-secular area due to an outlier value near Structure 2.

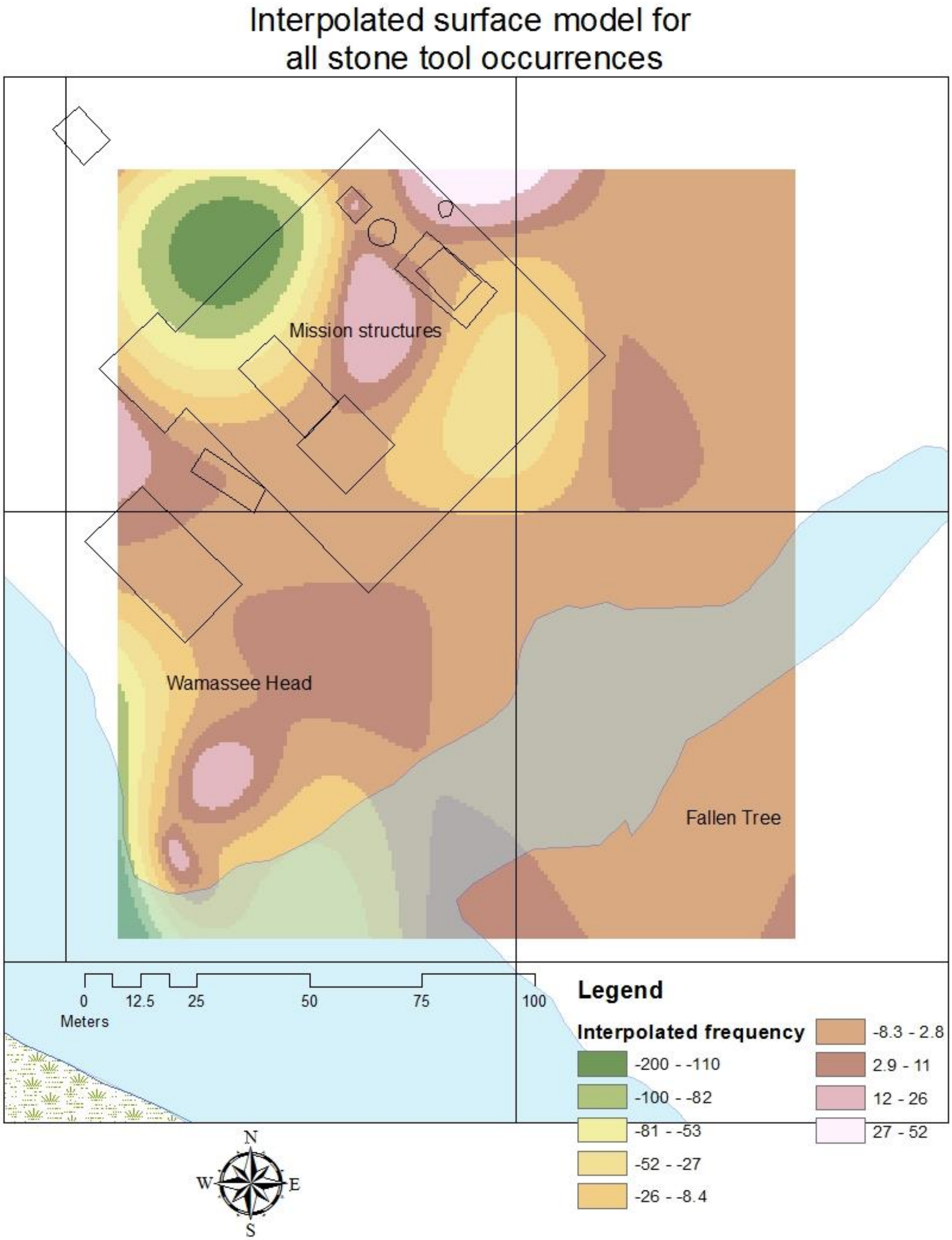

Figure 5-28. Interpolated surface model of stone tool occurrences in secular and non-secular contexts including outlier data at Wamassee Head using the splines method.

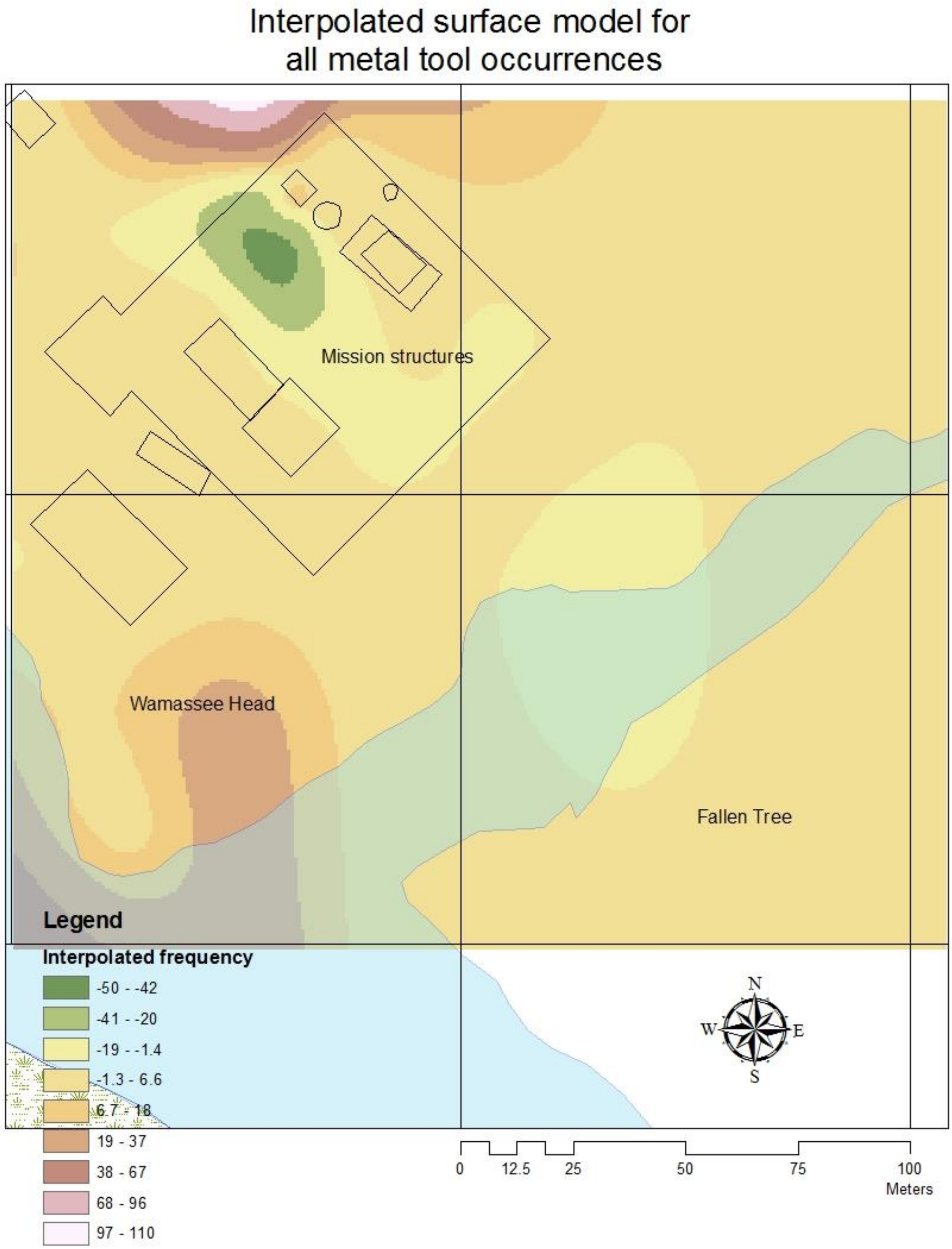

Figure 5-29. Splines method interpolated surface model of metal tool occurrences in secular and non-secular contexts including outlier data at Wamassee Head and Structure 2.

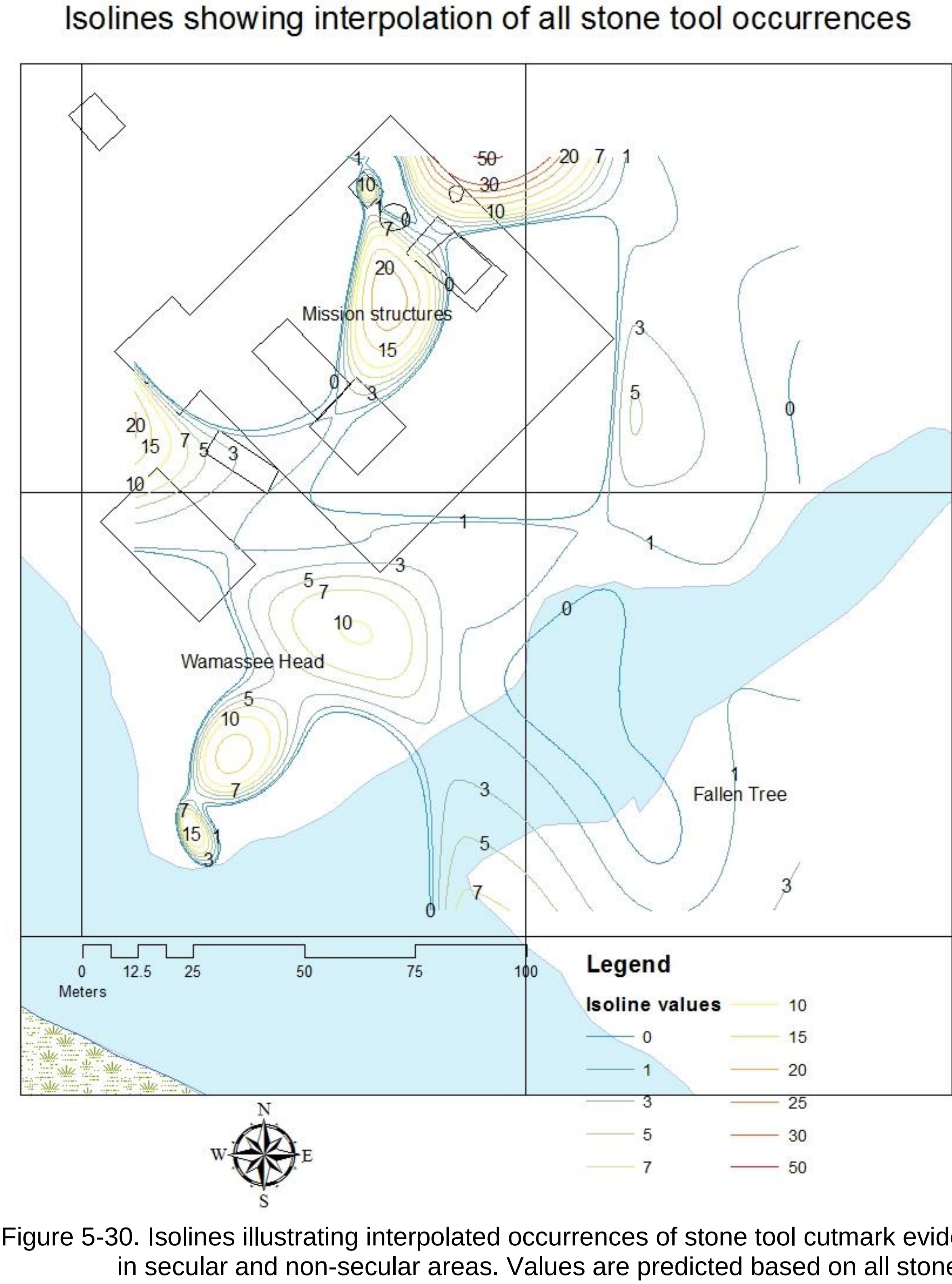

Figure 5-30. Isolines illustrating interpolated occurrences of stone tool cutmark evidence in secular and non-secular areas. Values are predicted based on all stone tool occurrence data including outliers at Wamassee Head and near Structure 2.

Isolines showing interpolation of all metal tool occurrences

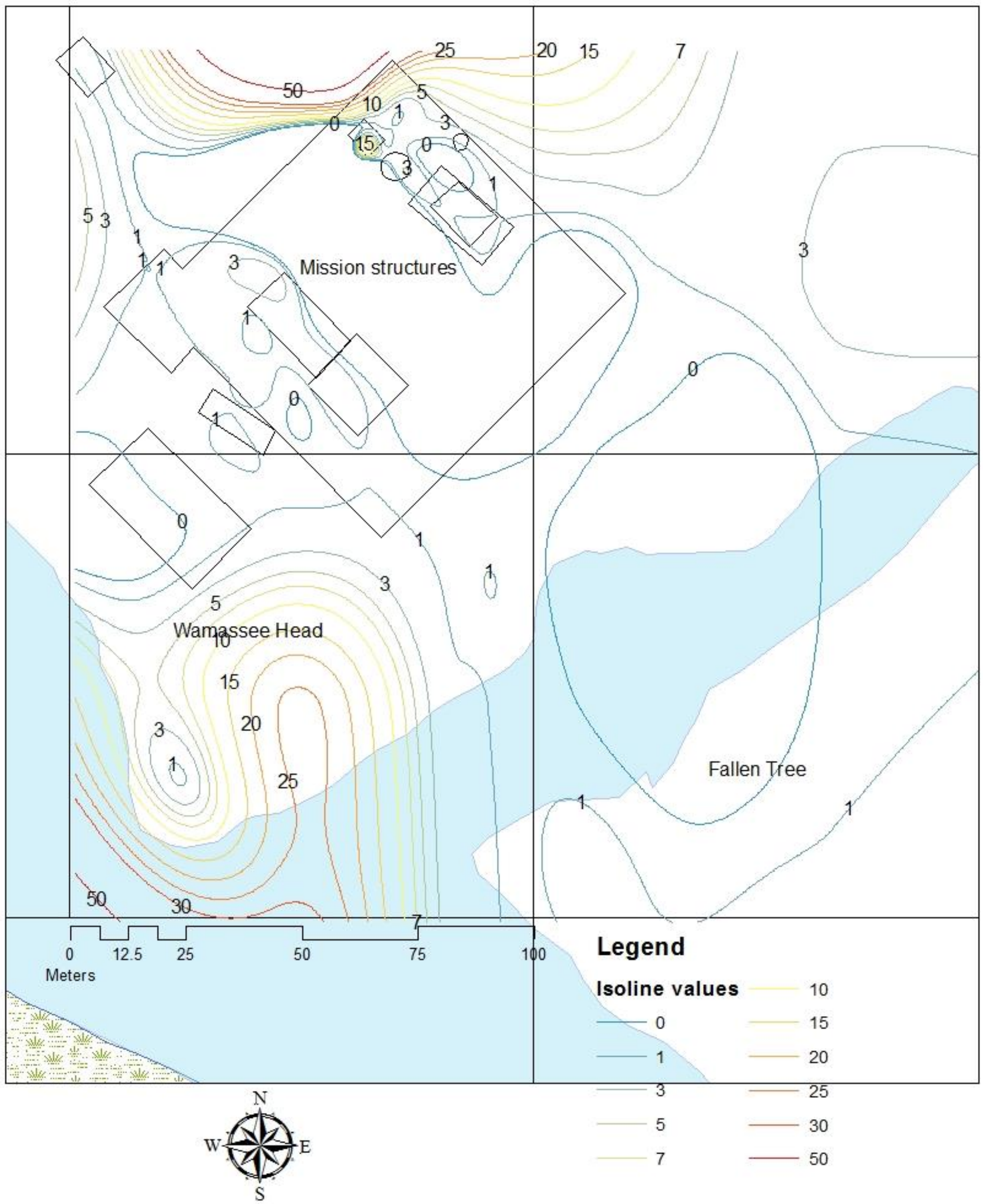

Figure 5-31. Isolines illustrating interpolated occurrences of metal tool cutmark evidence in secular and non-secular areas. Values are predicted based on all metal tool occurrences, including an outlier at Structure 2.

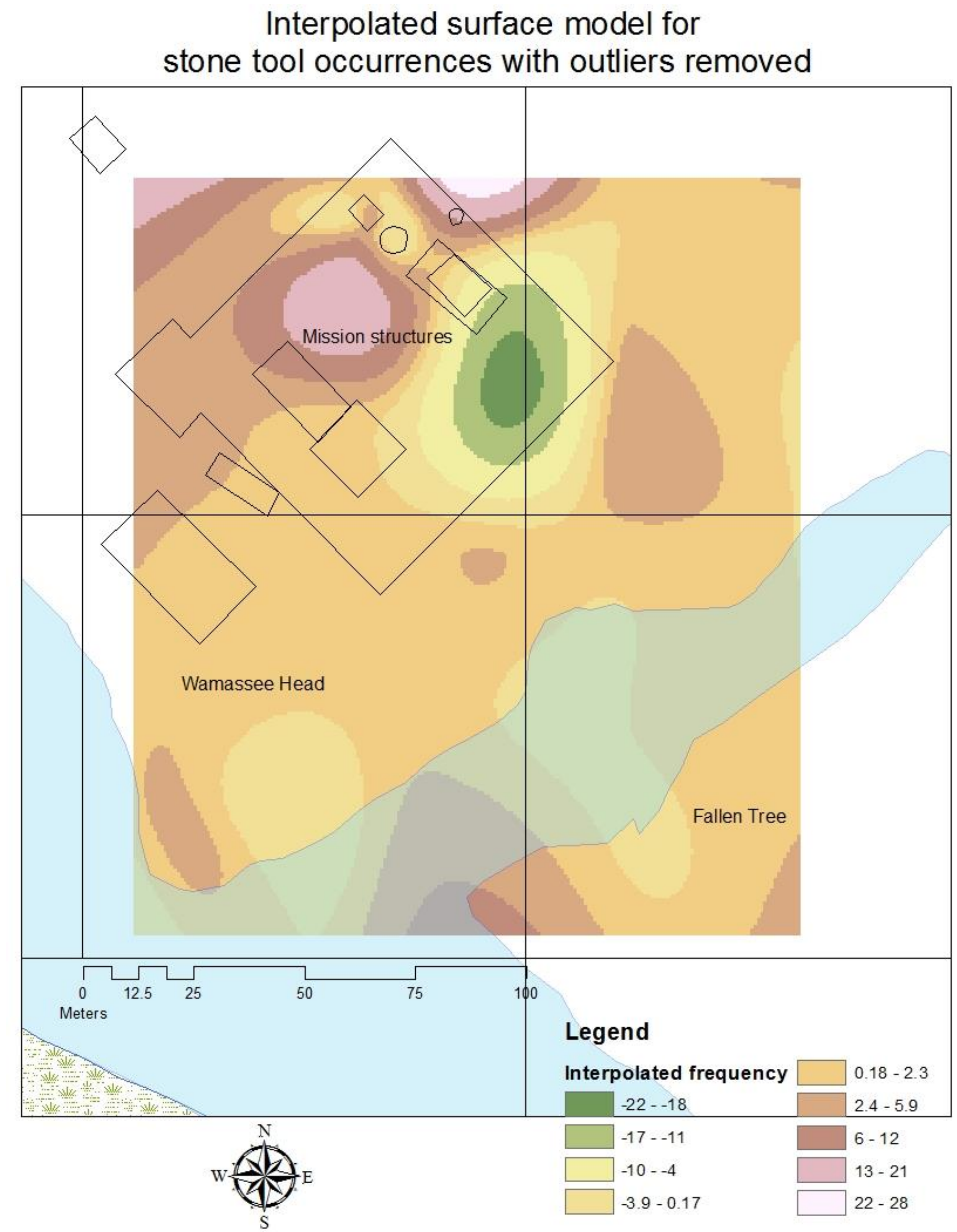

Figure 5-32. Surface model showing interpolated values of stone butchery tool evidence excluding outlier data from Wamassee Head and near Structure 2.

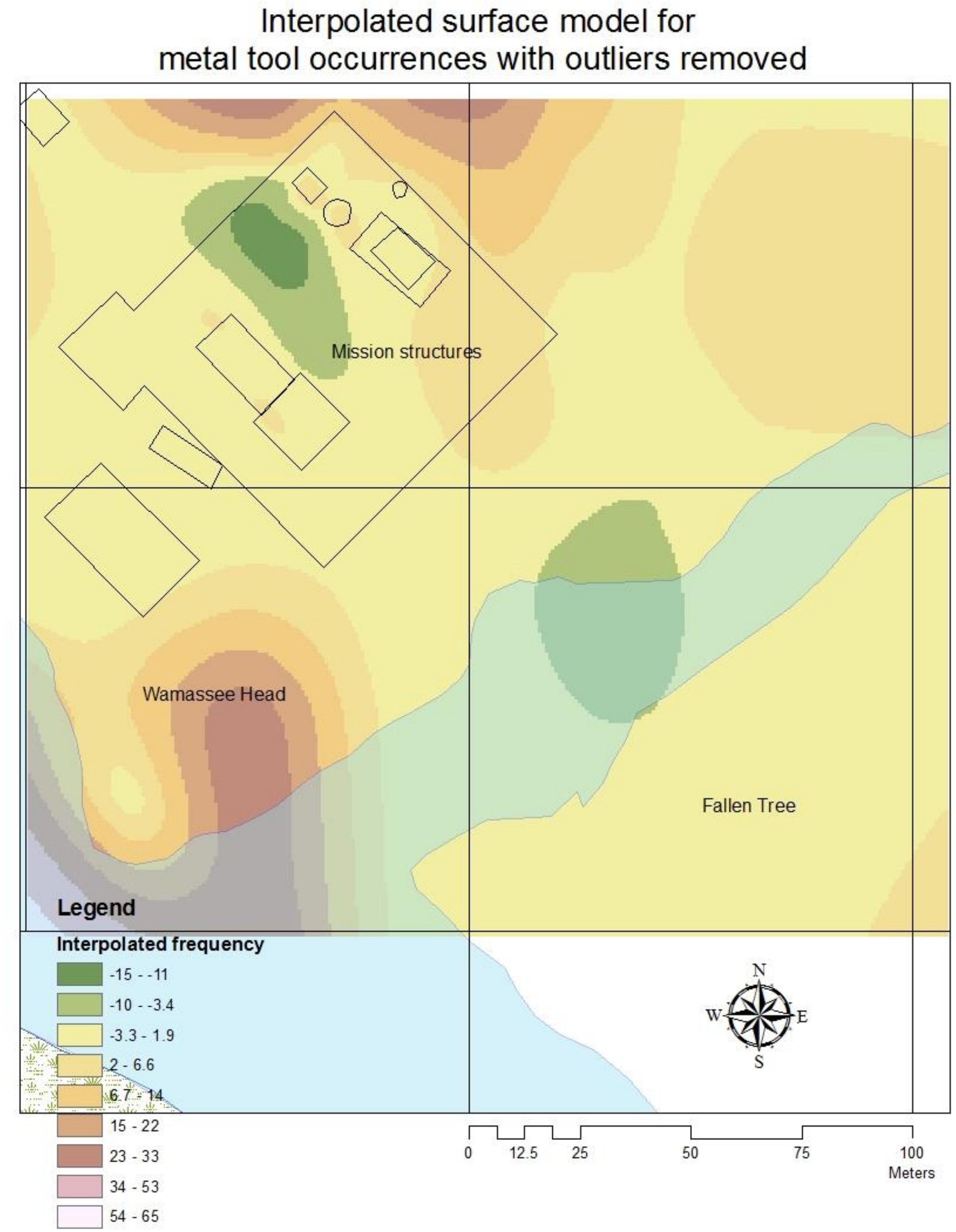

Figure 5-33. Surface model showing interpolated values of metal butchery tool evidence excluding outlier data from near Structure 2.

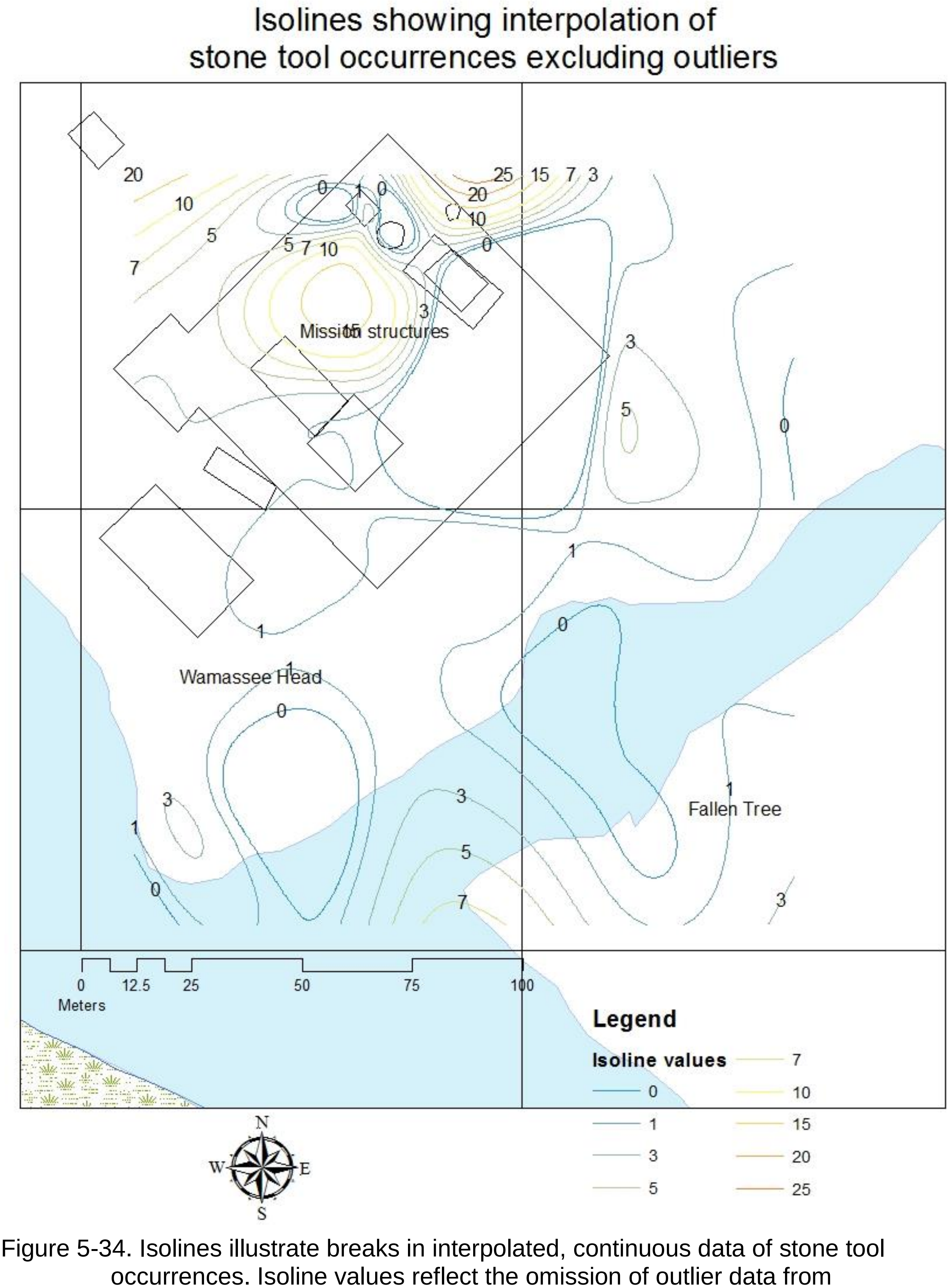

Figure 5-34. Isolines illustrate breaks in interpolated, continuous data of stone tool occurrences. Isoline values reflect the omission of outlier data from Wamassee Head and Structure 2.

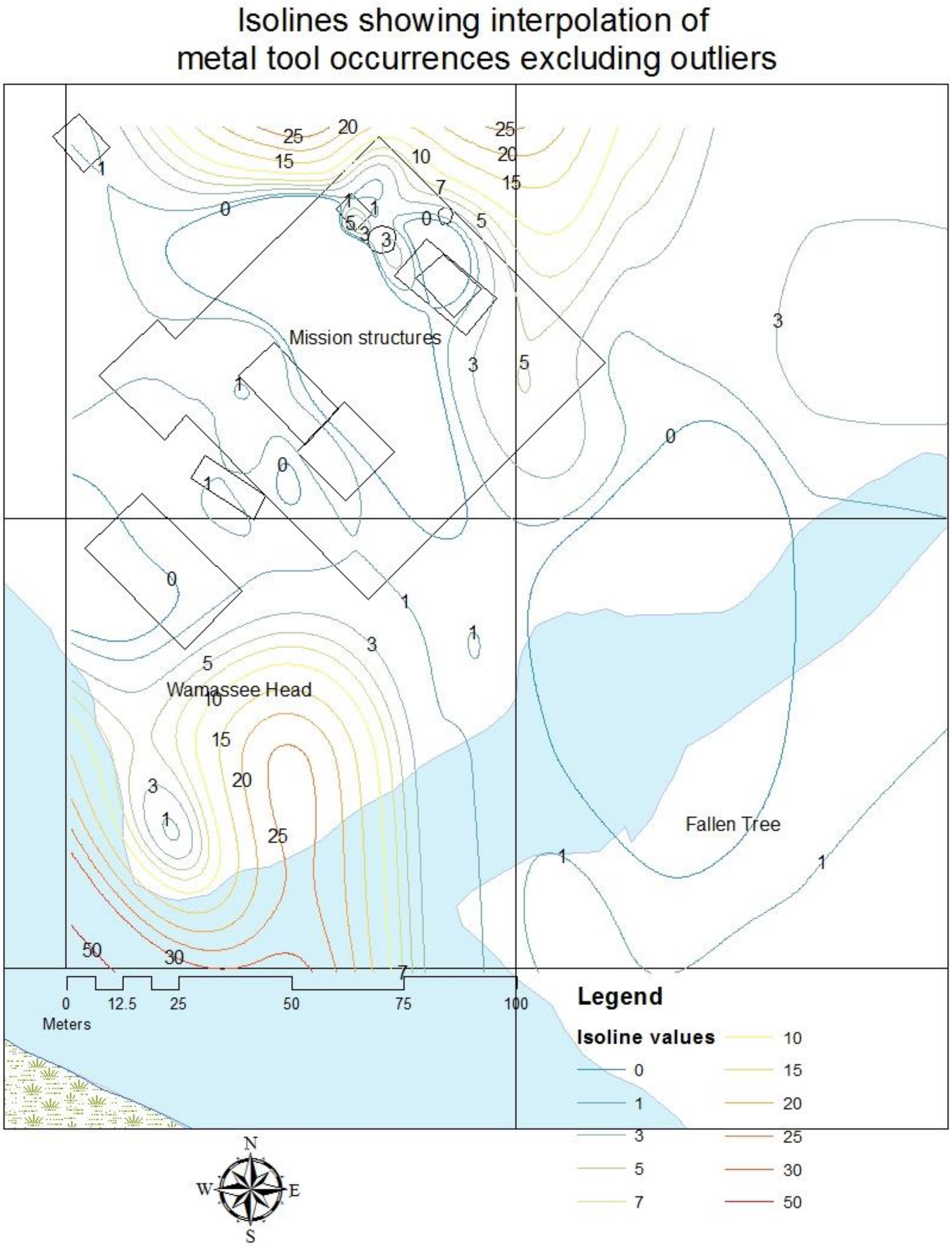

Figure 5-35. Isolines illustrate breaks in interpolated, continuous data of metal tool occurrences. Isoline values reflect the omission of outlier data from Structure 2.

CHAPTER 6: INTERPRETATION

Comparative analysis of zooarchaeological artifacts and experimental samples has the potential to refine previous interpretations of a site's use and can possibly illuminate emic perspectives of past people. A combination of empiricism and collections research has been employed here to better understand Guale navigation of socioeconomic pressures caused by Spanish colonial influences. In particular, missionization had profound impacts on indigenous spirituality (McEwan 2001), and certainly on sociopolitical and socioeconomic tradition. Methodology employed here seeks to evaluate altered technological preferences and interpret the role of different inferred uses of space in butchery tool choices.

Collectively, this project sought to address (a) the viability of shell compared to stone and metal butchery tools, (b) evidence for a heterogeneous toolset used by mission-period Guale butchers, and (c) tool preferences of Guale Indians working and residing in secular and sacred contexts at Santa Catalina de Guale. Experimental techniques tested the efficacy of a variety of tool materials by recording qualitative observations that served to support or refute the use of those material types by past peoples. Cutmarks created experimentally were compared to zooarchaeological butchery modifications to demonstrate raw material preference. The geospatial distribution of zooarchaeological evidence was also analyzed. Utilizing an inferred cultural geography of the Mission and Pueblo at Santa Catalina de Guale (Thomas 2010a), the niceties of butchery technology can demonstrate nuances of Spanish colonial pressures on the mission-village landscape.

Experimental Butchery and the Viability of Shell Tool use by Guale Indians

The experiments presented here suggest that the durability and strength of tool material is as important as the longevity and sharpness of the cutting edge. Metal and stone tools were far superior to expedient shell tools created for the experimental butchery tasks. Overall, butchery capability of shell was poor. However, the experimental results must be interpreted with caution. The trials were designed to incorporate most types of local shell that would have been readily available to people living on St. Catherines Island, but the expedient shell tools tested are poor representations of actual butchery tools.

At first glance, expedient shell tools seem to be easy to replicate. It has been shown that quahog clamshells beak in fairly consistent shapes (Brett 1974) and, although the edge morphology cannot be predicted, clamshells tend to break along annuli (Choi and Driwantoro 2007). Identifying an expedient shell tool in a midden deposit can be problematic. However, Reiger suggested that fractured clamshell accumulations recovered from sites in the Everglades in South Florida may be cutting implements used for animal working (Reiger 1981). Furthermore, shell knives are exemplified in typologies of shell tools in the American Southeast (e.g., Eyles 2004; Marquardt 1992). The paucity of lithics along much of the American Southeast coast (Thompson and Worth 2010), and the presence of major shell industries with tool forms recognized throughout the region (Eyles 2004; Marquardt 1992), suggests that shell butchery implements were indeed utilized for a variety of purposes by coastal Native Americans groups.

This assumption is supported by ethnographic accounts of shell tool butchery by peoples inhabiting marine environments. Franz Boas observed the use of shell cutlery by Kwakiutl natives (Boas 1921). Additionally, Radcliffe-Brown witnessed butchery practices completed with shell despite the availability of more durable stone and metal materials (Williams and Jones 2006: 54). Early ethnographic data of Indians in the American Southeast mentions natives using shell to expertly process the hides of hunted deer (Lorant 1946: 85). Previous research on shell tools collected archaeologically (Carr and Reiger 1980; Eyles 2004; Luer *et al* 1986; Marquardt 1992; Masson 1988; Moore 1921; O'Day and Keegan 2001; Webster 1970) has prompted some investigators to suggest the use of shell for animal working activities (Brett 1974:120; Laxson 1964; Luer 1986). The naturally keen edges of some shells have also inspired field experimentation to test the plausibility of expedient shell butchery tools (Marquardt 1992; Williams and Jones 2006).

Empirical studies testing the use of shell as a butchery tool are few and far between (Brett 1974; Choi and Driwantoro 2007; Toth and Woods 1989) and virtually unexplored with regards to the American Southeast. The results of experiments performed here can neither support nor refute butchery with shell tools on St. Catherines Island. Cutmarks made with naively created expedient shell tools were highly variable and generally conflicted with other experimental data (Choi and Driwantoro 2007). To better address the issue of shell butchery tools one must prepare more accurate replicas of implements observed archaeologically. This can be done with intensive study of shell tool collections (Eyles 2004; Marquardt 1992). Recreating commonly observed shell tools will involve trial and error techniques, access to a large quantity of shell resources, and time. Replicating archaeologically identified shell tools would be very much like teaching oneself how to flintknap; no easy task.

Expedient shell tools have been recognized archaeologically (Brett 1974; O'Day and Keegan 2001; Reiger 1981) and would, in theory, be produced relatively easier than replicating tools selected from a typology. However, since there are very few examples of expedient shell tools in the archaeological record, this process would be extremely difficult, time consuming, and the results would be highly variable. Because expedient shell tools have less predictability in form, evidence for their use may exist exclusively in cutmarked bone. Lacking typologies of expedient tools recovered archaeologically from sites in the American Southeast, identifying likely tool forms by way of cutmark data is a daunting task beyond the scope of the current project. Cutmarks created with expedient shell tools in this analysis confounded assessments of modifications on zooarchaeological specimens not meeting the criteria for stone or metal butchery marks.

The literature does not adequately outline criteria that can be used to identify bone cut with shell. Definitive criteria need to be established before shell can be empirically proven as a butchery tool material. Diagnostic features of shell-butchered bone are sometimes similar to morphological characteristics that resemble retouched stone tools (Toth and Woods 1989). Furthermore, the double-track grooves observed by Choi and Driwantoro (Choi and Driwantoro 2007) were observed in cutmarks created by flaked stone with an offset edge elsewhere (Shipman and Rose 1983a). Variability in the experimental data in this study complicates any potential contributions to criteria for identifying shell cutmarks. However, the investigation here provides a comprehensive assessment of observed cutmarks by different shell materials, and this data will be useful for future research projects.

Conservatively, it may be said that shell tools *could* have been used to modify zooarchaeological specimens assigned to the undetermined (UD) modification category. However, the undetermined classification incorporated cutmarks that did not meet stone or metal criteria and were not comparable to experimental data. Low fidelity between undetermined zooarchaeological modifications and established criteria leave open the possibility that some bones were modified by shell. But it is also equally likely that weathering obscured butchery marks made by stone, metal, or other non-anthropogenic processes. For instance, one specimen was recovered with a shell particle lodged in it (Figure 5-10), which could indicate that a butcher attempted to chop the bone using a shell implement, or the anomaly is due to the depositional environment of a shell midden.

While the comparative potential of the experiments using shell butchery tools presented here is limited, reflecting on the techniques employed is nonetheless valuable. It is recommended that future studies seeking to provide conclusive evidence for shell tool butchery focus on fewer material alternatives to avoid difficulties in confidently assigning highly variable cutmarks to one of three classifications of tool types (e.g., stone, metal, and shell). Limiting variables could be accomplished by focusing on zooarchaeological specimens recovered from pre-contact sites to exclude other possible butchery tool materials (e.g., iron). Adequate identification of butchery marks from other taphonomic agents such as trampling (Dominguez-Rodrigo *et al* 2009), gnawing (Shipman and Rose 1983b), carnivory (Blumenschine *et al* 1996), rooting, and digestion processes (D'Errico and Villa 1997) should precede the evaluation of butchery marks to avoid confounding observations. Another means of control is a consideration of archaeological sites where past peoples likely relied on shell, and the archaeological recovery of stone tools is minimal.

Experimentation should also be more controlled than the techniques utilized here. While useful, the variability within the experimental sample highlights a major concern. Care should be taken in creating a repertoire of experimental data so that shell materials (e.g., scallop, clam, whelk etc.) can be evaluated for their cutting ability prior to replicating cutmarks to eliminate unlikely materials. Such an analysis would employ more advanced microscopic technology allowing for quantitative analysis (Bello *et al* 2009; Bello *et al* 2011; Bello and Soligo 2008). Furthermore, multiple protagonists should modify the bone as to eliminate bias in the replication of cutmarks (e.g., Humphrey and Hutchinson 2001: 230).

Shortcomings of the present study's evaluation of shell butchery tools make the above recommendations for future research prudent. This research sought to evaluate whether Guale Indians could have used shell to process animal food resources at the mission and pueblo at Santa Catalina de Guale. There is insufficient evidence to support the use of shell butchery by Guale Indians at the mission and pueblo. It is possible that aboriginal St. Catherines Island dwellers *could* have used shell butchery implements. However, the available evidence from both experimental data and previous research is unsatisfactory for a tentative suggestion that cutmarks classified as undetermined reflect shell butchery tool use.

Stone and Metal Butchery Tool use by Guale Indians on St. Catherines Island

There are many archaeological examples of heterogeneous toolsets incorporating items of European and aboriginal manufacture (Cobb 2003). However, extrapolating unrelated circumstances of other regional Euro-Indian interactions to the microcosm of Santa Catalina de Guale would be undependable. As Cobb points out, there are circumstances particular to a site's formation that need to be considered before interpreting evidence for heterogeneous toolsets in communities impacted by the effects of colonialism (Cobb 2003). This is relevant for the mission and pueblo at Santa Catalina de Guale. Reitz and colleagues correctly point out:

> Every colonial community pursued a novel strategy that emerged from the influence of local indigenous knowledge and subsistence practices, economic needs, specific environmental opportunities and constraints, and the expectations of local colonized and colonizers alike (Reitz *et al* 2010: 175).

The interpretation of a heterogeneous toolset observed at Santa Catalina de Guale is unique to that mission settlement's individual and regional history.

Frontier contexts ought not to be evaluated within a dichotomous framework discussing Native American groups as passive recipients of European conquest, culture, and technology (Liebmann and Murphy 2011; Silliman 2005a); nor should discourse entertain the idea of a people dominated by forceful acculturative processes (Odell 2003). Instead, an interpretation of evidence of a diverse toolset utilized by the multiethnic community at Santa Catalina de Guale (Jones 1978; Worth 1995), considers, "…the varied backgrounds, interests, and motivations of individuals on all sides of the frontier" (Lightfoot 1995: 483). The evidence presented here is thus cognizant of specific events that may have impacted socio-cultural stability of both Spaniards and Indians on the Georgia coast in the 16th and 17th centuries.

Comparisons of published (Binford 1981; Blumenschine *et al* 1996; Choi and Driwantoro 2007; Cipolla 2008; Dominguez-Rodrigo *et al* 2009; Greenfield 1999, 2002, 2006; Potts and Shipman 1981; Shipman and Rose 1983a; Walker and Long 1977) and experimental criteria, describing cutmark morphology, indicate the replicated sample reported here is an accurate representation of butchery marks made by stone and metal tools. Further comparative analysis indicated that Guale Indians living under Spanish colonial rule utilized traditional stone and European metal tools for butchery tasks at the mission and pueblo at Santa Catalina de Guale. The use of metal tools alongside traditional lithic technology signifies heterogeneous food preparation techniques. While the use of stone precludes the outright abandonment of indigenous food preparation rituals, evidence for metal use suggests a departure from traditional butchery behaviors among the Guale Indians. What remains to be addressed are the reasons for and implications of this departure.

The durability of metal cutlery compared to stone is observed in experimental trials (e.g., Greenfield 1999; Shipman and Rose 1983a). On a practical level, metal would be preferred because, unlike stone, sharpening does not significantly reduce the size of metal blades. On the other hand, retouching techniques employed to maintain the cutting edge of stone blades risk destroying the tool with a misplaced strike. However, attributing the inclusion of metal in the Guale indigenous butchery tool repertoire to cutting efficacy is unsatisfactory; stone and metal tools were comparable in cutting efficiency and efficacy in experiments. The durability and desirability (Francis and Kole 2011) of metal blades cannot adequately explain its use by Guale Indians in the frontier mission village without understanding metal's symbolic value.

Metal goods that were imported from Europe were vulnerable to piracy (Boyd 1936; Halbirt 2004; Wright Jr. 1960), high taxation, irregularly scheduled shipments, hurricanes, and shipwrecks (Deagan 2003: 6). These circumstances may have made it difficult for inhabitants of La Florida's frontier villages to obtain metal tools in sizable quantities. Differential availability of metal has explained the exclusive use of stone scrapers by Chickasaw Indians living in some areas while other locales exhibited heterogeneous toolsets (Johnson 1997). Political relationships between French traders were stronger in areas close to trading posts, which lubricated the exchange of metal items (Johnson 1997). Frontier settlements were also in short supply of Eurasian livestock compared to La Florida's capitol, St. Augustine (Reitz *et al* 2010).

On the other hand, the acquisition of stone would have also been difficult to acquire because its availability along the coasts of the American Southeast is limited (Elliot and Sassaman 1995; Thompson and Worth 2010). Barring the presumptive difficulties of acquiring stone resources, the Guale continued to utilize lithic materials, even though, as the zooarchaeological record indirectly indicates, metal blades were available for daily butchery tasks.

A similar phenomenon is observed among descendents of the Pequots where 19th century archaeological deposits on the reservation exhibited the exploitation of Euro-American animals (Cipolla *et al* 2007). Furthermore, the 19th century Pequot continued to use indigenous lithic technologies for the butchery of Euro-American livestock (Cipolla 2008). Cipolla interprets the continuity of traditional butchery techniques in post-colonial contexts, despite the availability of metal tools, as an active process of memory preservation and identity formation (Cipolla 2008).

One should be hesitant to draw analogous conclusions from sites exhibiting similar heterogeneity in material culture when Indian interactions with Europeans took off in disparate trajectories (Silliman 2005a). However, Native American groups were not likely, "…completely severed from their past social, political, economic, and religious practices," (Silliman 2004: 276) despite spiritual and cosmological rattling that likely followed depopulation through epidemics (Dobyns 1983; McEwan 2001; Purdy 1988). Therefore, it can be argued that the Guale Indians utilized stone tools despite their inferior durability and high cost because these traditions represented remnant sentiments of stability experienced before contact with Europeans.

At Santa Catalina de Guale, indigenous knowledge and maintenance of pre-contact traditions were expressed through the incorporation of grave goods in Catholic-style burials (McEwan 2001) and aboriginal ceramic production techniques (Deagan and Thomas 2009). However, as discussed earlier, extrapolating the maintenance of identity and memory, from Cipolla and colleagues' (Cipolla *et al* 2007) study, to Santa Catalina de Guale is still problematic. While both populations witnessed massive depopulation as a result of colonial processes, the processes and the people engaged in them were fundamentally divergent in ideology and practice.

Contrary to English colonial policy, which sought to push Indians southward to serve as a buffer between Anglo-American colonies and La Florida, Spain was concerned with controlling Indians and indoctrinating them into European civilization (Milanich 2006). It was up to Spaniards at frontier missions, "…to change the Indians from heathen barbarians into good Christians" (Thomas 2009b: 22). Religious conversion was prominent in the Spanish colonial agenda (Gannon 1965a), and through missionization Indians would theoretically become loyal Spanish subjects (Milanich 2006). However, the ideals envisioned by Spanish administrative powers seldom materialized in frontier settlements. In fact, there seems to have been more alterations to Spanish than aboriginal customs but nonetheless reflect creolized communities (Deagan 1973, 1983, 2003; Reitz *et al* 2010).

At Mission Santa Catalina de Guale, Spanish foodways were altered while indigenous cuisine was marginally refined. Europeans were inexperienced with local resources and friars relied on Indian knowledge, resources, and subsistence strategies (Reitz *et al* 2010). In most of La Florida Indians were supplying goods and services to missions through repartimiento labor (Milanich 2006; Reitz *et al* 2010). Reliance on Indians, unfamiliarity with American resource procurement strategies, and the limited availability of domesticated livestock forced Europeans in La Florida frontier settlements to modify traditional Iberian diets by utilizing indigenous resource exploitation strategies (Reitz *et al* 2010). For friars living in frontier mission settlements, adapting to local resource availability was a matter of survival.

In catering to the demands of friars at Santa Catalina de Guale, neophytes modified indigenous subsistence practices (Reitz *et al* 2010). The altered dietary practices of the Guale are reflected in the altered exploitation of animal species and which portions of the animal were utilized (Reitz *et al* 2010: 176). This shift in diet occurred relatively rapidly, evidenced by zooarchaeological analyses of pre-contact, Irene period contexts dated from 1300 to 1580 A.D. (Dukes 1993; Reitz 2008; Reitz and Dukes 2008; Reitz *et al* 2010). Furthermore, the change coincides with the 1587 establishment of Mission Santa Catalina de Guale (Jones 1978; Thomas 1987) and the arrival of Spaniards and their dietary demands (Larsen 1990, 1994; Spielmann *et al* 2009). As a component of animal resource exploitation, butchery tasks at Santa Catalina de Guale were also altered.

Evidence for the use of differential tool materials across the study areas indicates metal was used alongside stone in both secular and non-secular areas. Cobb and Ruggiero (Cobb and Ruggiero 2003:28) warn against interpreting the combined use of European and indigenous tools to substantiate claims for universal, integrative processes. For instance, interpreting heterogeneous tool use as examples of Native American assimilation into colonial regimes discounts the historical significance of nuanced choices. Instead, social roles play a key part in the incorporation of novel technologies into daily use (Cobb and Ruggiero 2003). This assertion based on the King site in Georgia is backed by mortuary evidence, and suggests that absorption of and access to European technologies may be dependent on individual social or economic specializations, such as flintknappers (Cobb and Ruggiero 2003). Butchery tool evidence indicates that choices in material were heterogeneous and socially charged, reflecting behaviors appropriate to the cultural landscape.

It is difficult to surmise based on grave goods which individuals interred in the Mission cemetery (Larsen 1990; McEwan 2001; Thomas 1987) would have had access to metal tools (e.g., Cobb and Ruggiero 2003). A consideration of census data (Worth 1995) and inferred uses of the landscape at Mission Santa Catalina de Guale (Thomas 1987, 2009a, b, 2010b) shows that the village community was socially stratified. Resident male and female caciques, and indigenous women in Santa Catalina de Guale were exempt from repartimiento consignments (Worth 1995). Although Larsen tentatively suggests that there may be an association between the general location of burials and social status (Larsen 1990: 22), there is no indication, based on grave goods, of specialized domestic, political, or economic roles of individuals. Further analysis of grave goods at Santa Catalina de Guale may indicate which individuals had access to European metal blades and whether lithic production was a valued skill during the mission period on St. Catherines Island.

Indigenous women in St. Augustine, even when married to Spanish men, practiced traditional food preparation techniques in the household (Deagan 2003) and may continued to use stone tools. Meanwhile, Spaniards living at St. Augustine practiced Iberian customs in places with high social visibility because access to land and resources depended on status and Spanish descent (Deagan 2003). Life in the frontier, however, was quite different for Spaniards who made significant, "…adjustments to an American mode of life" (Deagan 2003: 8). Friars and other Europeans living in frontier villages relied on Indian neophytes for survival and were at their mercy when it came to dietary sustenance (Reitz *et al* 2010). However, guided by piety, friars were continuously trying to acquire converts while they practiced strict adherence to Catholic customs.

Equipped with knowledge of numerous indigenous languages and dialects; experience in teaching the arts, reading, and writing; and authoritative influence on religious and social policies in La Florida (Thomas 2009b: 22-23), friars were a force to be reckoned with. Ordained and funded by the Spanish Crown, friars ventured into unfamiliar territory and often encountered hostility while trying to indoctrinate neophytes with strict instruction (Gannon 1965a; Gradie 1988) and even attempted to modify behavior with corporeal punishment (Francis and Kole 2011: 54). It was up to friars to monitor Indian behaviors for lewdness and indecency in order to mold them into members of Spanish civilization (Sturtevant 1962: 65). Friars in frontier villages, though accommodating when it came to burials and, up to a point, polygamy (Francis and Kole 2011), were the driving force of Spanish acculturative efforts (Thomas 2009b: 23). A population dominated by Guale Indians (Jones 1978; Larsen 1990; Worth 1995), the use of metal by Santa Catalina residents is a direct reflection of exposure to European customs. Operating as agents of spiritual and cultural conversion, the fruits of the friars' labor are reflected differently in sacred and secular contexts (Figures 5-19 and 5-21).

Stone and Metal use in Secular and Non-secular Contexts

The argument that the presence of friars at Santa Catalina de Guale influenced on butchery tool choice is corroborated by statistically significant variation in the frequency of evidence for stone and metal use in secular and non-secular areas. A statistically significant association between the evidence for the use of metal and stone in either secular or non-secular contexts suggests that tool variation between different areas was influenced by emic understandings of the cultural landscape and perhaps pressured by the presence of Spaniards. As a component of an area's social visibility, architectural features on the landscape convey and reinforce symbolic behaviors (Rodning 2010) of neophytes such as the use of preferred material culture.

Conservatively, the results of statistical analyses supporting associations between tool evidence and inferred cultural uses of space at Santa Catalina de Guale (Thomas 1987, 2009a, 2010b) may be an artifact of differential sampling. Large-scale excavations in the Mission area (Figures 3-2 and 3-3) compared to the Pueblo (Figures 3-5 and 3-6) may partially contribute to the variance observed in the analysis. However, this potential source of error is addressed by interpolated surface models with and without outliers, as discussed in the previous chapter.

Interpolated surface models including outliers reflect inflated frequencies of evidence for tool use near Structure 2 and at Wamassee Head. Accordingly, implications for differential butchery tool use in secular and non-secular areas are best understood by considering the cultural demography of Santa Catalina de Guale (Thomas 2010b) and the historic formation of the mission village site (Jones 1978; Sturtevant 1962; Thomas 1987; Worth 1995).

Dynamic aboriginal-European exchanges occurred over nearly 100 years of occupation beginning with the c.1587 establishment of Santa Catalina de Guale (Jones 1978; Thomas 1987), its destruction in 1597 (Francis and Kole 2011), its 17th century reinstatement (Thomas 1987, 2009a) and its eventual abandonment in 1680 (Jones; 1978; Worth 1995). Archaeologically recovered deposits represent the entire span of occupation, and the faunal evidence analyzed does not distinguish between these events. As a snapshot, however, distribution maps showing variation across the landscape portray significant imbalance in the spatial occurrence of stone and metal butchery evidence in secular and non-secular areas. This imbalance is a product of mediating socially visible actions according to the symbolic perception of architectural and natural features on the landscape (Knapp and Ashmore 1999; Rodning 2010: 186; Snead and Preucel 1999). Where available, structural evidence is useful for predicting the concentration of one type of tool over another.

Within the non-secular confines of the Mission bastion, metal use is most significant near Structure 2, the cocina. The heightened frequency of evidence for metal tool use in this area may indicate that friars made metal tools available for Indians working within the Mission walls. Friars may have urged the use of metal over stone, promoting metal butchery tool use as a facet of “civilized” food preparation, despite a diet that was dominated by indigenous cuisine (Reitz *et al* 2010).

The heavy concentration of fauna modified by metal butchery tools in the vicinity of the Mission cocina suggests that a majority of meals, to be consumed by friars and possibly neophytes, were prepared in the non-secular arena (Thomas 2010a). Use of metal tools in the mission does not however indicate that Indians working in the mission cocina embraced European tools and customs. If friars encouraged the use of metal, it should be expected that evidence for its use would be more intense closer to where friars were instructing natives on religious and European customs. However the inclusion of indigenous items of shell and bone in mortuary contexts under the iglesia (Blair *et al* 2009; Thomas 1988, 1990, 1993) suggests that the friars did achieve a wholesale abandonment of indigenous customs and material culture.

Areas within the Mission walls would have been easily visible by friars because of the location of living and prayer quarters (Thomas 2010a). It is conceivable that neophytes preparing food in the cocina, under the watchful eye of resident friars, were criticized, discouraged, and possibly even chastised for using stone butchery implements. Since emphasis on religious and cultural conversion was probably most intense in the non-secular areas, evidence for lithic technology occurs with less frequent than metal. Friars may have viewed traditional lithic technologies as uncivilized and incorporated the use of European tools into their conversion agenda and enforced with more rigor in non-secular contexts.

Neophyte use of stone tools in the cocina was may have been occasional and is significantly less frequent than metal. Similarly this line of evidence does not immediately suggest a conscious retention of indigenous identity in blatant opposition to friars. A conservative interpretation posits that fauna recovered with modifications made by stone tools in non-secular contexts, is evidence of contributions made by Indians possibly originating in secular areas. Bone butchered by stone recovered in non-secular areas may have been fieldstripped and relocated to mission contexts.

Nonetheless, differences in butchery tool use in the pueblo might be a reflection of neophyte internalization of European customs. As opposed to non-secular contexts, the pueblo evidence the retention of indigenous technologies may have implications for memory and identity maintenance. Inferred uses of non-secular areas (Thomas 2009a, 2010a) help to distinguish between the behavioral implications of pueblo and mission evidence.

Structural remains in secular areas (i.e., Structures 1W, 5, and 6) have yet to be interpreted (Reitz *et al* 2010: 239). For this study, these structures are considered secular (Figure 5-18). Evidence for stone tool use occurs minimally in Structure 6 and Structure 1W but there was no evidence that stone tools were used for butchery in Structure 5 (Figure 5-22). On the other hand, Structure 6 shows no evidence for metal tool use (Figure 5-23). Fauna butchered with metal tools appear in Structure 5 and Structure 1W (Figure 5-23).

The occurrence of exclusively metal butchery tool use in Structure 5 is remarkable because it indicates that there was both access to, and preference for, metal tools by individuals using this pueblo structure. Without the support of published interpretation of the function of Structure 5, an explanation for the exclusivity of metal tool use is conjectural. However one can tentatively infer that access to metal blades is not a product of its juxtaposition to the Mission. Instead, this evidence allows Structure 5 to be interpreted as a building possibly used by neophytes with preferential access to metal.

A similar situation is seen in Structure 1-W where there is a higher frequency of stone tool use. Structure 1-W's location close to the iglesia, and intersecting the Mission bastion, may suggest that the social visibility of this space was at one point, not obscured by the bastion walls. The observed domination of European butchery technology over indigenous techniques at Structure 1-W is likely a product of high social visibility where the demonstration of Spanish customs was more pronounced.

High-status Spaniards depended on maintaining a highly visible Spanish lifestyle to secure access to land, labor, and resources (Deagan 2003). If Guale Indians viewed the outward demonstration of European behaviors as potentially advantageous in terms of economic or social mobility within the Spanish colonial system, it would not come as a surprise to see evidence for European butchery tool use by natives in socially visible arenas. Evidence for the use of metal tool use in Structure 1-W may reflect neophyte recognition of practicing European customs in highly visible areas as beneficial. At some distance from the mission, and obscured by the bastion, metal tool use in Structure 5 may be evidence for the internalization of the social benefits conferred by using European technology. The perceived symbology of architectural components on the landscape may assist in explaining the use of different butchery tools.

Despite the absence of evidence for structures at Fallen Tree (May 2008), this secular area was likely less visibile by resident friars. Experiencing the modern landscape allows the consideration of the freshwater creek separating Fallen Tree from the rest of the mission village (Figure 3-1) as a physical boundary (Hamilton *et al* 2006). From the perspective of the modern landscape it is clear this natural boundary would have restricted the social visibility of activities occurring at Fallen Tree. Stone and metal tool use occurred in comparable frequencies at Fallen Tree (Figure 5-22). Beyond the immediate view of the mission, residents of Fallen Tree engaged freely in butchery practices without much concern for elevating one's perceived status by participating in European customs. However, the use of metal alongside stone is remarkable.

A limited reliance on Eurasian livestock and Spanish animal husbandry practices is observed at Fallen Tree (Reitz and Dukes 2008; Reitz *et al* 2010: 135). Whether or not the Guale living at Fallen Tree practiced Spanish customs to the same degree as Indians living in other areas of the Pueblo is unresolved (Reitz *et al* 2010: 135). The use of both metal and stone by Guale residents at Fallen Tree does not occur in discrete clusters, and is more normally distributed spatially than Wamassee Head and other areas of the Pueblo (Figure 5-22).

When considering other material culture at Fallen Tree including Spanish ceramics and iron (Caldwell 1971), indigenous wares and stone tools (May 2008), and evidence for the implementation of European and indigenous cutlery, it can be suggested that Spanish customs were accepted but did not dominate. Fallen Tree may have been a community wherein traditional and foreign technologies were integrated into daily rituals and subsistence behaviors. Evidence supporting tentative suggestions that Fallen Tree was creolized (Reitz *et al* 2010: 135) is manifested by the incorporation of foreign material culture and limited use of Eurasian animals. Future research at Fallen Tree will help to relate archaeologically recovered evidence of a creole community to structural components and will illuminate whether the incorporation of European customs into daily life was associated with different levels of social stratification.

Summary

Much of the interpretation considers the use of metal by the Guale as a product of incessant and intense conversion tactics in an attempt to control indigenous peoples spiritually and culturally. It is inappropriate, however, to employ the occurrence of metal use as an index of spiritual or cultural apostasy. As McEwan shows, boundaries between European and indigenous customs were fluid (McEwan 2001). What resulted was a disruption in local, indigenous technologies and belief systems on account of intense Spanish influences, such as epidemics (Dobyns 1983), European competition over territory, and inter-chiefdom politics. Newly introduced European goods were frequently distributed and highly coveted (Blair *et al* 2009; Kipp and Schortmann 1989).

Indigenous tools were not entirely replaced but were rather utilized selectively depending on the structural, demographic, and natural circumstances of the landscape. A collusion of these conditions affected social visibility, which, in turn, guided butchery tool choice. While cutmark evidence from the mission and pueblo is quite heterogeneous, the significant association between raw material and sacred or secular contexts verifies the theory that Spanish and indigenous behaviors were perceived differently in areas with presumably varied social visibility. If in some parts of the pueblo, the Guale participated in Spanish customs as a strategy for elevating social status in a creolized community, then butchery tool choices were an explicit part of this process. Furthermore, the continued use of stone at a higher rate in the pueblo, where friars could not readily observe and instruct, corroborates the idea that the implementation of traditional lithic technologies was more acceptable in the eyes of the Guale compared to Spanish friars.

This argument should not be mistaken to support a dichotomous relationship between oppressed peoples and oppressive colonial powers (Lightfoot and Martinez 1995; Silliman 2004). On the contrary, Guale Indians, in recognizing that there may be social and economic advantages to adopting Spanish customs became active agents that controlled their social status. By choosing to utilize metal tools, and thereby behave more European in socially visible arenas, Native American neophytes were proactively augmenting individual and possibly familial eminence (Silliman 2004). Conditionally, stone tool use was not entirely abandoned because of the limited availability of European metal and familiarity indigenous technologies and customs. Future excavations that will identify domestic structural features in the pueblo may exude a more refined discourse on memory and identity maintenance occurring in distinctly indigenous spaces.

CHAPTER 7: CONCLUSION

This research sought to evaluate the use of butchery tools at Mission Santa Catalina de Guale and the surrounding pueblo through experimental methodology and comparative analysis. Experimentally produced cutmarks were compared to zooarchaeological specimens with butchery modifications to evaluate whether stone, metal, and/or expedient shell tools were used for animal processing tasks in the study area. Overall the butchery tool repertoire at Santa Catalina de Guale appears binary; either metal or stone modified most bones. There also exists a possibility for a third, shell tool class, but there was insufficient comparative evidence to fully confirm the use of any species of expedient shell tool. Further research must be done to empirically demonstrate the use of shell for butchery at Santa Catalina de Guale.

Employing a range of peer-reviewed criteria is essential for diagnosing the tool material used by past butchers. In this study, evaluation of cutmarks relied on previous research demonstrating metal and stone-tool butchery. Insufficient exploration of shell tools limited the application of experimental and comparative techniques to the evaluation of cutmarks created by stone and metal tools. Utilizing molding agents to expose the cross-section of cutmark profiles was a necessary analytical technique for corroborating overhead microscopic observations.

Using fragment counts as opposed to cutmark counts (Abe *et al* 2002) the use of metal and stone showed a statistically significant association with secular or non-secular contexts. This can be interpreted as differential symbolic uses of space. Butchery tool choice appears to be influenced by the social landscape defined by architectural features. Inferred uses of structures in secular and non-secular areas (i.e., Thomas 1987, 2009a, b, 2010a) guided the interpretation of evidence of varied tool use.

A GIS was created to analyze the spatial distribution of evidence for metal and stone tool use. Powerful analytical tools in ArcGIS enabled the exploration of the relationship between Europeans and Indians living at Santa Catalina de Guale. Interpolated surfaces provided predictive models of where stone and metal tool use would be more frequent. These models suggest an elevated use of metal in non-secular areas and the ubiquitous presence of stone tool use throughout the study area. Interpretation of these models is complimented by consultation of ethnohistoric syntheses and archaeological investigations.

The Spanish mission on St. Catherines Island was a conspicuous physical and symbolic presence to Native American groups residing in the area. Individuals and communities that were organized by prehistoric Mississippian sociopolitical hierarchies navigated missionization efforts and Spanish institutions (Thomas 2010b). Negotiating political and social landscapes of the contact period was an active identity forming process; Native Americans were not passive recipients of European culture (Silliman 2004). Native American spirituality was in limbo, compromised by the devastating spread of disease with Catholicism on its heels.

On St. Catherines Island, Catholicism and Indian spirituality intermingled in non-secular mission contexts where friars accommodated Native American belief systems during mortuary practices (McEwan 2001; Thomas 2009b, 2010b). Indigenous mortuary customs were practiced despite efforts to indoctrinate neophytes into European culture and Catholicism. Friars also experienced indigenous menus although there was some Eurasian livestock observed in the zooarchaeological record (Reitz *et al* 2010). The present analysis indicates European butchery tools were used in mission contexts with greater frequency than stone. The distinction between sacred and secular areas at Santa Catalina de Guale is therefore not only expressed by inferred structural fortifications (Thomas 1987), but also evidence of a fusion of European and indigenous customs motivated by heightened social visibility (Deagan 2003).

In the surrounding pueblo there are higher instances of stone tool use than metal. Although there is limited structural evidence in the pueblo, the buildings there were likely used for secular purposes, as mandated by royal ordinances (Garr 1991; Thomas 1987). The presence of distinctly indigenous products such as smoking pipe fragments, shell and bone tools, and Native American ceramics at Fallen Tree (Brewer 1985; May 2008) suggests a significant Guale occupation. Also present at Fallen Tree and Wamassee Head were artifacts of European manufacture including ceramics and Spanish iron (Brewer 1985; May 2008; Thomas 2008b). The combination of evidence supporting a more Americanized diet in the pueblo, biased toward indigenous cuisines, and Native American and European material culture suggests a creolized community existed at Santa Catalina de Guale. It is plausible that the use of European goods in this community was an active choice that reflected or elevated individual or familial social status.

There are however, potential shortcomings in evaluating the extent of culture change when using materials from contact-period contexts without consulting evidence for prehistoric butchery tool use (Lightfoot 1995). Therefore, this study addresses a temporal snapshot (c.1587 through 1680) of the varied preferences of technologies in a pluralistic cultural context. Although informative, the frequency of stone and metal tool occurrences at Santa Catalina de Guale may fail to elucidate a definitive measure of cultural integration; ratios of historic to prehistoric material culture cannot identify the directionality of dynamic social processes at work in a colonial context (Lightfoot 1995: 206). Therefore, this study does not consider the frequency of cutmarks as significantly informative except for where the data show differences in spatial occurrences of butchery tool evidence. The spatial relationships between the data hold more weight than the counts of butchery tool occurrences because it shows that there was some bias in the use of metal depending on where the butchery task may have occurred.

For instance, although there is a higher frequency of evidence for metal tool use than stone, it cannot be assumed that European culture was dominating the livelihood of Guale Indians. Indeed, the frequency of cutmarked, fragmented bone obscures the integrity of such an interpretation (Abe *et al* 2002). In the context of the understood demographic layout of Mission and Pueblo at Santa Catalina de Guale (Thomas 2010a), there were divisions between the secular and non-secular areas of the settlement made conspicuous by inferred defensive enclosures (Thomas 1987). It cannot be adequately determined whether the bastion surrounding the church, convent, and kitchen was meant to keep hostile Indians out, or if these walls served to keep neophytes—and ideas—in. Essentially, within the mission walls, there may have been more strict rules to follow as a neophyte. These “rules” may have translated into social mores that could be violated outside of the bastion, in the pueblo.

A neophyte living at Fallen Tree would have had to cross the fresh water creek in order to attend mass. Beyond the iglesia would have laid a ball court and the continuation of the secular village to the north (Thomas 2010a: 41). The sound of bells ricocheting off the slowly flowing water in the creek would have been a stark reminder of the foreign Spanish presence in the area once sparsely populated by Irene-period Native Americans (Thomas 1987, 2008b).

From the perspective of a friar or Spaniard living at the mission proper one may have smelled council house fires and recognized bits of a foreign language echoing from the pueblo. A friar would have had his meals prepared by young neophytes, teaching them early on the language and ways of the Spanish so that they may one day return to their home village as adults and govern and assist the Spanish with conversion (Francis and Kole 2011: 95). The fresh water creek separating the mission area from the village at Fallen Tree would have been used for drinking as there were, "…two major wells, presumably for holy water…" (Thomas 2010a: 39). The natural divider between the mission area and the southern-lying pueblo at Fallen Tree is an extra step that a friar would have had take in order to reach a densely populated Indian village.

Visualizing Mission Santa Catalina de Guale from both Indian and European standpoints enables one to appreciate the inferred cultural landscape evoked by archaeology using the perspective of the modern landscape (Ingold 1993). Essentially there are aspects of life at Mission Santa Catalina de Guale that we as archaeologists may never fully understand. Butchery tools are a nuanced component of every day life but help to add depth to an understanding of an integrated, pluralistic community. Indeed, the cultural activity occurring on a landscape compels an archaeological interpretation of a space to transcend to a place (Rodning 2010). Santa Catalina de Guale is a site of both peaceful and turbulent interaction between Spaniards and Native Americans.

There was at least one episode where a dramatic rejection of Catholicism by Guale Indians took place and culminated in a major rebellion (Francis and Kole 2011). However, the continued use of stone tools by Indians in the pueblo cannot be taken to indicate an outright rejection of European culture in general. Indeed, metal tools were luxurious items to the Indians of the American Southeast; they were coveted among beads, blankets, and firearms and acquired through the deerskin trade (Hudson 1976: 316). The desire to acquire luxury goods and evidence for the use of metal tools by Guale Indians does not immediately suggest apostasy of Indian economic values. On the contrary, the control of luxury items was integral in Mississippian sociopolitical hierarchies. However, the continued use of traditional stone materials despite the availability of metal could have been a way for Guale Indians, likely alienated by an imposing Spanish colonial regime, to maintain their identity (i.e., Cipolla 2008).

Based on the absence of stone quarries local to the Georgia coast (Elliot and Sassaman 1995) it is clear that all of the stone present on St. Catherines Island arrived via trade or during resource procurement expeditions. Disruption in social and political stability of some Indian groups occurred in the Georgia coast region with the arrival of the Spanish (Jones 1978: 204). European quarrels over New World territory (Hoffman 1984), depopulation from epidemics (Dobyns 1983), the displacement of communities due to the Spanish institution of reducción (Deagan and Cruxent 2002b), and repartimiento (Milanich 2006) also prompted action by Native Americans. These and other non-documented events related to the expansion of Spanish rule in the New World could have altered the stability of Mississippian trade networks and the availability of stone on the Georgia coast.

A shift in the availability of stone materials may have also increased the economic value of lithic technology while depopulation emphasized the importance of expert stone tool knappers (Cobb and Ruggiero 2003). It is also likely that the socio-economic importance of such rare materials as stone dropped with the introduction and availability of exotic European metal tools. Kipp and Schortman conclude that trade is a destabilizing practice that can complicate political relationships between chiefdoms reliant on one another for exchanges of luxury items (Kipp and Schortman 1989: 378). Pressures introduced by the Spaniards probably strained the relationship between the Guale and their inland neighbors whom supplied stone.

Sociopolitical hierarchies of Mississippian chiefdoms in the American Southeast were structured around chiefly redistribution of goods (Wesson 1999). After the Spanish began introducing European culture and Old World diseases, the cosmology of Indians surviving through initial contact may have become very different from those born during Spanish colonization. Disparate experiences between the generations may have played a role in the spacing and prevalence of metal and stone use at Santa Catalina de Guale. On the other hand, as a marker of identity, stone tools would have held an irreplaceable value in cultural memory (Cipolla 2008) as entire communities vanished from epidemics, rattling Indian spirituality and cosmology (Dobyns 1983; McEwan 2001).

However, archaeological evidence suggests that Indian belief systems did not dissolve. There was some accommodation of Indian spiritual beliefs on behalf of the friars at Santa Catalina de Guale as evident from burials in the church cemetery (Larsen 1990; McEwan 2001; Thomas 1988, 1993, 2009b). Nonetheless, Guale Indians living there appear to have held the friars in high regard. Francis and Kole indicate, that during the Guale rebellion of 1597, because of the respect the Indians had for Fray Miguel, the Guale rebel who killed the friar later hanged himself in despair (Francis and Kole 2011: 50). Despite the coordinated rebellion many Guale Indians were loyal Christians and prayed with one of the friars before he was murdered (Francis and Kole 2011). Furthermore, following the destruction of the church, the remaining neophytes requested another church be built so they could participate in mass (Thomas 1987)

A ransom to barter the return of captive Fray Francisco de Ávila to the Spanish was issued by Guale Indians in aftermath of the rebellion and demands metal knives and other European items for payment (Francis and Kole 2011: 101). Interestingly, the quantities of materials issued in the ransom demand are limited to six knives, six hatchets, and twelve iron axes were demanded (Francis and Kole 2011: 101). If the redistribution of exotic goods could be used for power, why not accumulate a larger supply? One possible answer is the difficulty the St. Augustine experienced in importing European goods due to restrictions on commerce with other nations, which resulted in illicit exchange relationships (Deagan 2007). This situation would have limited the availability of European goods forcing those demanding ransom to face the reality of the limit of such demands. On the other hand, keeping European goods in low supply may have allowed the demand for exotic goods to remain high and conferred an advantage to those controlling the items.

The use of metal by Guale Indians at Mission Santa Catalina de Guale reflects an acceptance of European cultural practices, perhaps as urged by friars (Milanich 2006), while traditional stone tools were not completely phased out. However the likelihood that traditional standards of sociopolitical status were maintained in the indigenous community should not be overlooked. Communities at Santa Catalina de Guale existed with flexible boundaries where both tradition and novelty was incorporated into everyday life. It seems appropriate to understand the mission and pueblo area in terms of a ripple in water. The center church area is the hub of European culture and its cultural pervasiveness decreases in intensity radiating outward. Indigenous culture is less affected by European influences as one moves further away from the direct line of sight of the Mission.

Decreased social visibility outside of the mission area testifies to the likelihood that Guale Indians were deciding to use metal partly to appear more privileged to Spaniards and other Indians. Access to European technology would have put one at an advantage in an indigenous sociopolitical hierarchy organized around the exchange of luxury goods. In using metal tools within view of Spaniards, Indians would appear more “civilized” and could more easily acquire European goods. The heterogeneous accumulation of butchery tool evidence in the pueblo area can attest to varied usage of both metal and stone tools with a preference for metal in non-secular areas. To what degree can one associate the efficacy of missionization of Native Americans based on their use of European tools in secular contexts? The significantly higher frequency of metal use closer to the Mission indicates that the non-secular area was a hub for European economic and spiritual practices surrounded by an indigenous territory diffusely permeated with European goods and ideas.

The heterogeneous tool set employed by Santa Catalina de Guale neophytes demonstrates a synergism where, “new cultural traits were adopted, modified, and created to fit within the underlying ideological structure of both non-European and European peoples," (Lightfoot 1995: 206). Villagers at Santa Catalina de Guale exhibited distinctive butchery tool choices that reflect hierarchical and cosmological disruption experienced by protohistoric Native Americans during the Spanish colonial occupation of La Florida.

Differences in tool use between pueblo contexts supports the suggestion that there were distinct communities experiencing the colonial economy differently. Elemental distribution of faunal remains in the pueblo indicated the possibility of different community groups residing in the pueblo utilizing varying subsistence strategies (Reitz *et al* 2010). The higher density of evidence for metal tool butchery at Wamassee Head compared to Fallen Tree suggests there could have existed different social spheres within the pueblo (Reitz *et al* 2010: 155). Adoption of European cultural practices by Native Americans was integral to Spanish colonial ideology (Milanich 2006). Interactions between friars and the neophytes at Santa Catalina de Guale were give-and-take; accommodation existed in the enforcement of burial practices in the Catholic tradition indicating flexibility in spiritual rituals (McEwan 2001). With regards to material culture, both European and non-European tools were used by neophytes who prepared food for the friars in the Mission proper.

This research demonstrates the power of cutmark data for providing evidence of nuanced daily routines. These routines incorporate decisions, which reflect active processes of identity maintenance and formation. In choosing to use one raw material over another, Native American neophytes living in Santa Catalina de Guale were actively manipulating their status amongst community members as well as within regional political spheres. Access to European goods may not be immediately visible in the archaeological record. Cutmark data can supply the necessary, indirect lines of evidence that shed light on overlooked constituents of daily rituals. Revisiting modified fauna at other contact sites along the Georgia coast and elsewhere in La Florida will contribute to the findings presented here. By investigating Spanish colonial sites with similar lines of evidence, a clearer picture of European-Indian relationships across the La Florida region can be illustrated.

APPENDIX A

OBSERVATIONS OF CUTMARKED ZOOARCHAEOLOGICAL BONES

Table A-1. Summary of samples analyzed, species, tool assessments, and relevant notes.

UGA number	Accn No.	Code	species	element	apex shape	tool	notes	mold	mag

UGA number	Accn No.	Code	species	element	apex shape	tool	notes	mold	mag
00990015	99	026	O. virginianus	R innominate acetabulum area	V-shaped, distinct apex	metal	cuts are clean and long with flat walls and distinct apexes lacking debris. Shoulders are not heavily flaked and are ridged. Bone is starting to break apart	no	40x
00990047	99	023	O. virginianus	R astragalus	V-shaped, distinct apex, symmetrical	metal	cuts are deep with symmetrical walls, smooth and shouldered. Grooves are clean and lacking in striations	no	45x
00990047	99	023	O. virginianus	R metatarsus longitudinal groove	V-shaped, distinct apex, symmetrical	metal	cuts are deep with symmetrical walls, smooth and shouldered. Grooves are clean and lacking in striations	no	45x
00990047	99	023	O. virginianus	R metatarsus distal epiphysis	not pulled	N/A			
00990097	99	004	Artiodactyla	scapula fragment	cut through	metal	cut is clean through	no	0x
00990194	99	046	O. virginianus	L proximal tibia shaft	V-shaped, distinct apex	stone	multiple parallel cuts that are short, deep, distinct apexes and varied wall profiles. Some have symmetrical clean walls and others are asymmetrical with one straight wall and the other flaked	yes	40x
00990194	99	046	O. virginianus	proximal humerus fragment	V-shaped, distinct apex, asymmetrical	stone	cut has parallel ancillary groove suggestive of a barb or offset edge with a distinct apex and fairly clean walls	yes	40x
00990194	99	046	O. virginianus	misc shaft fragment	cut not deep enough to diagnose	UD			
00990226	99	051	O. virginianus	distal femur fragment	V-shaped, distinct apex, asymmetrical	metal	cut is angled with one wall gradual and the other undercut and flaked. Cut is clean in appearance	yes	40x
00990265	99	054	O. virginianus	R radius fragment	no cut marks	N/A			

UGA number	Accn No.	Code	species	element	apex shape	tool	notes	mold	mag
00990281	99	056	Artiodactyla	rib	V-shaped, distinct apex, symmetrical	metal	cuts are deep, straight, clean and have distinct apexes with nearly no shouldering or flaking	no	35x
00990282	99	056	O. virginianus	L proximal tibia	no cut marks	N/A			
00990282	99	056	O. virginianus	R distal humerus	no cut marks	N/A			
00990303	99	059	O. virginianus	R calcaneous fragments	V-shaped, distinct apex	metal	cut is short and on an angle leaving asymmetrical walls but a distinct, clean apex with minimal flaking of edge	no	25x
00990334	99	067	O. virginianus	proximal radius fragment	V-shaped, distinct apex	metal	cuts are straight and clean with distinct apexes, flat walls and no flaking of shoulders	no	25x
00990375	99	077	O. virginianus	L calcaneous fragment	V-shaped, distinct apex	metal	cuts are straight and clean with distinct apexes, flat walls and no flaking of shoulders. One shoulder is destroyed. Cuts are very narrow	no	35x
00990462	99	105	O. virginianus	proximal phalanx	V-shaped	metal	cuts are clean, symmetrical apex with straight walls	yes	40x
00990553	99	133	Artiodactyla	radius	V-shaped	metal	cut is shallower but straight and clean. Walls have minimal flaking from cut, any flaking is probably from wear on cancellous bone. No forking or barbing evident, the other cut is too shallow to be diagnostic	no	45x
00990607	99	149	O. virginianus	R proximal metacarpal	_/-shaped	stone	cuts have parallel grooves along sides, offset edge evident suggesting stone flake. Cuts are not deep and have a rougher look to them, are sinuous but long.	yes	35x

UGA number	Accn No.	Code	species	element	apex shape	tool	notes	mold	mag
00990656	99	169	Artiodactyla	rib	V-shaped, distinct apex, symmetrical	metal	cut is deep with symmetrical walls and a moderately smooth bottom yet retaining distinct apex. Bone is deteriorated compromising the integrity of the walls but they are generally symmetrical lacking significant flaking	no	40x
00990667	99	179	O. virginianus	R distal humerus shaft fragment	cut too worn	N/A			
00990707	99	186	O. virginianus	R ulna fragment	V-shaped	stone	cut has parallel ancillary grooves suggesting edge that is offset or barbed. Striations in groove.	yes	35x
00990763	99	224	O. virginianus	distal metapodial	_/-shaped	stone	cuts are short and deep with asymmetrical walls and terraced grooves within. Microstriations intersect and the one narrowest groove is sinuous and has a shorter parallel ancillary groove. Larger grooves are as wide as they are deep	no	30x
00990763	99	224	O. virginianus	R pubis fragment	V-shaped	UD	cut is at an angle with parallel ancillary lines running above it, looks to be product of scraping. Groove is too shallow to interpret	yes	30x
00990788	99	227	Artiodactyla	metapodial fragments	V-shaped, wide	metal	cut is deep with one flat wall, straight cut, the other wall is flaked off	no	20x
00990795	99	229	O. virginianus	L distal humerus	_/-shaped	stone	cut is wide and very shallow with heavy flaking of shoulders cut appears too shallow to mold. Faint parallel ancillary striations. Consider shell	yes	45x
00990808	99	234	O. virginianus	R distal humerus fragment	closed V-shape	stone	cuts are thin and short but appear to have striations indicating offset edges, are asymmetrical and non-uniform in shape	no	20x

UGA number	Accn No.	Code	species	element	apex shape	tool	notes	mold	mag
00990835	99	241	O. virginianus	L proximal femur shaft	debris, needs to be cleaned	metal	clean cut, apex is ambiguous, cut is straight with little shoulder effect, very thin	no	40x
00990857	99	246	Artiodactyla	antler core fragment	_/-shaped	stone	cut is shallow, rough, and heavily flaked on both walls. Indistinct apex	yes	45x
00990934	99	276	Artiodactyla	distal phalanx fragment	_/-shaped	stone	cut is wide on one end with a bone ridge in center indicating offset edge and possibly a barb. Looks similar to biface images in references, striations in apex	yes	45x
00990954	99	283	O. virginianus	metatarsal fragment	no cut marks	UD			
00990963	99	288	O. virginianus	L distal humerus fragment	cut damaged	UD			
00991045	99	301	O. virginianus	R proximal tibia	_/-shaped	UD	cut is rough looking with no definition in walls or apex, need to mold	yes	20x
00991159	99	338	Artiodactyla	tibia shaft fragment	_/-shaped	stone	cut is rough with wavy apex, one steep wall, one terraced wall with significant flaking on both shoulders	yes	35x
00991160	99	338	O. virginianus	R distal humerus	V-shaped	metal	cuts are clean looking with minimal flaking of shoulder, symmetrical apexes, some flaking of one of the cuts shoulders	no	40x
00991160	99	338	O. virginianus	distal metapodial	V-shaped, distinct apex	metal	cuts are clean looking with minimal flaking of shoulder, symmetrical apexes, striations in walls	no	40x
00991184	99	337	Artiodactyla	R ulna fragment	closed V-shape	stone	cuts are deeper than width, variable in shape and depth with parallel striae in wall, shoulders are not symmetrical, sides are not symmetrical	yes	40x
00991220	99	345	O. virginianus	R proximal radius	U-shaped	metal	apex is rounded, cut is long, and one side is flaked with the other gradual. Fairly wide, blade likely dull	yes	35x

UGA number	Accn No.	Code	species	element	apex shape	tool	notes	mold	mag
00991267	99	360	O. virginianus	R proximal metatarsal	cuts look recent, trowel?	UD			
00991275	99	363	O. virginianus	L scapula fragment	V-shaped, distinct apex	metal	apex is distinct, walls are straight, cuts look clean and symmetrical, cut is thin, one cut spans uneven surface	no	20x
00991283	99	365	Artiodactyla	rib or mandible fragment	V-shaped, distinct apex, asymmetrical	metal	cut has one steep wall and a gradual wall that is clean looking. Minimal debris in cut but apex is slightly sinuous. Cut was probably made with a metal blade at an angle. One cut is possibly a hack attempt, the other appears more successful because it is at the fracture	no	40x
00991316	99	384	Artiodactyla	L calcaneous fragment	debris, needs to be cleaned	UD	apex filled with sand, cut is straight and short, deep.	no	30x
00991334	99	377	O. virginianus	metapodial shaft fragment	cut not convincing	UD			
00991334	99	377	O. virginianus	R distal tibia shaft fragment	cut not convincing	UD			
00991336	99	378	O. virginianus	L proximal femur	V-shaped, stepped apex	stone	bone has several cuts on it that have been cut by blades with offset edges, cuts are short with ancillary parallel lines	yes	35x
00991351	99	381	Artiodactyla	femur head	V-shaped	metal		yes	20x
00991402	99	399	O. virginianus	hyoid	|_|-shaped	metal	apex is flat bottomed with striae running along bottom, walls are clean and edges are not flaked, no debris in cuts. Cuts are distinct and clean	no	35x
00991409	99	401	O. virginianus	R calcaneous fragment	V-shaped	metal	apex is distinct, cuts are clean with flat walls. Apex is symmetrical	no	45x
00991434	99	407	O. virginianus	mandible fragment	no cut marks	UD			

UGA number	Accn No.	Code	species	element	apex shape	tool	notes	mold	mag
00991496	99	429	Artiodactyla	L astragalus fragment	V-shaped, distinct apex	metal	apex is distinct, walls are straight, and cut looks clean and symmetrical. A bit of sinuosity but bone could be warped from burning, zero flaking of shoulders	no	45x
00991578	99	454	Artiodactyla	L humerus fragment	_/-shaped	stone	apex is distinct and straight but the edges are wide with gradual stepped edges	yes	40x
01050225	105	208/115	O. virginianus	R astragalus	V-shaped, distinct apex, symmetrical	metal	apexes are distinct, walls are symmetrical and clean, and cuts are short and deep. Cuts are also very narrow	yes	40x
01050242	105	208 (wam) /120	O. virginianus	L proximal radius	gnawed	gnawed	two parallel grooves, rounded bottom		15x
01050246	105	208/121	Artiodactyla	misc fragment	cut damaged	UD			
01050258	105	208/123	O. virginianus	L proximal humerus	V-shaped, wide, open	UD	apexes are distinct, walls are clean and symmetrical with minimal shoulder flaking showing clean cuts. Multiple parallel ancillary striae appear on the deepest cut but are likely due to sawing motion. Some cuts show indications of offset edges. Molds of marks will confirm tool when profile is available.	yes	35x
01050260	105	208/121	O. virginianus	R proximal metacarpal	_/-shaped	stone	cut is rough looking with grooves coming out of side appearing to be barbs suggesting offset edge	yes	35x
01050260	105	208/121	O. virginianus	R calcaneous fragment	cut too worn	UD			
01050265	105	208/124	UID mammal	misc shaft fragment	V-shaped, wide	stone	double track groove, edges are rough and flaked. Compare with shell cutmarks, but most likely biface used	yes	25x

UGA number	Accn No.	Code	species	element	apex shape	tool	notes	mold	mag
01050266	105	208/124	UID Large mammal	misc shaft fragment	U-shaped	metal	no striations, grooves are short but clean with no debris in cut, several parallel grooves, that do not appear to be made on same stroke	no	30x
01050268	105	208/124	Artiodactyla	vertebra fragment	_/-shaped	stone	cut is deep with an indistinct, flat apex, shoulders are flaked, and walls have many microstriations on one side with the other relatively flat. Cut is sinuous	yes	45x
01050268	105	208/124	Artiodactyla	metapodial condyle	V-shaped	UD	cut is deep, walls are flat, cut is sinuous, apex is indistinct because the cut coincides with a longitudinal-running crack in the bone	no mold	45x
01050269	105	208/124	O. virginianus	L cuneiform	U-shaped	metal	rounded apex, steep walls and deep, probably a dull iron knife		25x
01050269	105	208/124	O. virginianus	L proximal metacarpal	cut not convincing	other			N/A
01050290	105	208/127	O. virginianus	L mandible fragments	closed V-shape	stone	cut is closed v shape associated with multiple parallel cuts, possibly from scraping or cutting away flesh. Cut is not very deep or uniform in shape or depth. Apex is hard to see because of closed shape. One half of cut is straight and thin and clean with the other half rough and wide. cut is sinuous.	no	45x
01050290	105	208/127	O. virginianus	R distal humerus	_/-shaped	stone	cut is clean on one side and rough on the other with internal striae on the apex. Apex is indistinct, one wall is steep and clean and the other is gradual with flaking. Cut is sinuous.	yes	45x

UGA number	Accn No.	Code	species	element	apex shape	tool	notes	mold	mag
01050297	105	208/128	O. virginianus	R astragalus	V-shaped, stepped apex	stone	cuts have multiple striations that are terraced suggesting offset edges of the blade, ancillary parallel grooves on some of the cuts. Cuts are short and deep	yes	45x
01050297	105	208/128	O. virginianus	R mandible fragment	V-shaped, wide	stone	cuts are deep and asymmetrical with one steep wall and another gradual sloping wall, sides are concave. Cuts are short but show sinuosity. Too short to show microstriations	yes	45x
01050302	105	208/129	O. virginianus	R proximal humerus	V-shaped, wide	stone	cut is clean on one side and rough on the other with internal striae on the apex. Apex is indistinct, one wall is steep and the other is gradual with flaking. Striae suggests an offset edge	yes	40x
01050303	105	208/129	O. virginianus	R distal humerus	V-shaped, wide	stone	cut is rough with a distinct apex and striations running inside main grooves. Cuts are short with heavily flaked edges	no	35x
01050303	105	208/129	O. virginianus	L scapula glenoid process	no cut marks	N/A			
01050310	105	208 (wam) /133	UID Large mammal	misc shaft fragment	ww-shaped	possibly shell	multiple striations running along same line, very sinuous, shallow. Need to compare with shell. Could be trampling mark, also evidence of scraping	yes	15x
01050310	105	208 (wam) /133	UID Large mammal	misc shaft fragment	_/-shaped	UD	striations along bottom of groove, wider than deep, short cuts, probably a retouched stone tool when compared to reference, bone is deteriorated in most of cut area	no	15x
01050312	105	208 (wam) /133	Artiodactyla	R femur head	V-shaped, wide	stone	apex is indistinct with flaking on edge. Shallow and short	yes	45x

UGA number	Accn No.	Code	species	element	apex shape	tool	notes	mold	mag
01050338	105	208 (wam) /133	O. virginianus	R mandible fragment	U-shaped	metal	apex is rounded, cut is clean and polished looking. May not be a cutmark. Need mold or second opinion.	yes	20x
01050338	105	208 (wam) /133	O. virginianus	L patellae	_/-shaped	metal	apex is rounded, edges are rough looking and wide, probably made by a dull knife	yes	20x
01050338	105	208 (wam) /133	O. virginianus	phalanx	no cut marks	N/A			
01050389	105	208/151	O. virginianus	proximal rib fragment	_/-shaped	stone	cut has significant flaking of edge with one side straighter than the other and a gradual side. Cut is shallow and horizontal, apex is indistinct	no	25x
01050471	105	208D/193	UID Large mammal	misc shaft fragment	needs mold	UD	cuts are thin and shallow, and long. Appear to be sinuous with a rounded apex. Need mold/cross section	yes	45x
01050953	105	448	UID Large mammal	scapula or pelvis fragment	U-shaped	UD	cut is too worn/does not appear to be a cut	no	30x
01050954	105	448	UID mammal	misc fragment	V-shaped, distinct apex	metal	cut is clean and symmetrical with straight walls and shouldering unflaked. Cut is straight and deep	no	20x
01050959	105	451	UID mammal	misc shaft fragment	V-shaped, distinct apex	stone	cut is deep, looks like a chop marks with one side flat and clean at an angle; the other side is flaked off leaving one side of the apex visible. Profile is V-shaped with one flat wall.	no	20x
01050966	105	453	Artiodactyla	misc shaft fragment	_/-shaped	stone	uneven apex with smooth bottom, one side steep, the other gradual, extensive flaking on one side	no	35x
01050966	105	453	Artiodactyla	rib fragment	_/-shaped	stone	uneven apex with smooth bottom, one side steep, the other gradual	no	35x

UGA number	Accn No.	Code	species	element	apex shape	tool	notes	mold	mag
01050967	105	453	UID Large mammal	misc fragment	V-shaped, distinct apex	metal	apex distinct, walls are straight, cuts are straight and deep, with clean shoulders, no flaking of edge but cuts were made in cancellous area.	no	40x
01050976	105	458	Artiodactyla	rib fragment	U-shaped, wide	UD	rounded apex, straight single groove	yes	20x
01050977	105	458	UID Large mammal	misc fragment	V-shaped, distinct apex	metal	multiple cuts all with one flat straight wall, and the opposite wall flaked off. Bone was hacked many times probably with the blade of a metal knife judging from flat walls and straight cuts	no	20x
01051286	105	1140	O. virginianus	R proximal femur shaft	U-shaped, wide	UD	cut is shallow with a rounded bottom and indistinct apex. Mold to compare with shell marks	yes	45x
01052713	105	1141	UID mammal	shaft fragments	broad U-shape	UD	wide cut, sinuous, no striations, short in length, one side is flaked, lacks definition, could be trampled because mark is isolated and singular; other fragment has no cuts	no	20x
01052722	105	1144	O. virginianus	mandible fragment	|_|-shaped	metal	cut is deep and wide with a flat or rounded bottom. Cut is clean with no flaking on edge, cuts are long and walls are straight and vertical	yes	20x
01052722	105	1144	O. virginianus	L metatarsal fragment	_/-shaped	stone	cuts are wide and shallow, rough looking with flaking present on shoulders. Apex indistinct and rounded with terracing along sides	no	40x
01052722	105	1144	O. virginianus	R distal femur shaft fragment	_/-shaped	stone	cut is wide, and rough, apex is indistinct, minimal shoulder, flaking present, cut is short and not terribly deep. Probably a biface	no	20x
01052722	105	1144	O. virginianus	L distal metatarsal	no cut marks	N/A			

UGA number	Accn No.	Code	species	element	apex shape	tool	notes	mold	mag
01052722	105	1144	O. virginianus	R proximal radius	cuts look recent, trowel?	other			
01052722	105	1144	O. virginianus	L calcaneous fragment	cut too worn	UD			
01052722	105	1144	O. virginianus	L distal tibia	cut too worn	UD			
01052722	105	1144	O. virginianus	R radius	cut too worn	UD			
01052729	105	1145	O. virginianus	L proximal ulna	_/-shaped	metal	cuts are flat-bottomed and have straight clean symmetrical walls showing minimal striae in walls	no	40x
01052729	105	1145	O. virginianus	distal metapodial	U-shaped	metal	cuts have smooth rounded bottoms with symmetrical sides and some shoulder flaking, there are many parallel cuts within the same groove area suggesting sawing. The rounded bottoms of the grooves suggest a dull knife was used	yes	40x
01052729	105	1145	O. virginianus	rib fragment	_/-shaped	metal	cut has smooth rounded bottom with pronounced shouldering and an indistinct apex. Probably made with a dull knife	yes	40x
01052729	105	1145	O. virginianus	L scapula fragment	no cut marks	N/A			
01052729	105	1145	O. virginianus	R ischium fragment	no cut marks	N/A			
01052729	105	1145	O. virginianus	axis fragment	not pulled	N/A			
01052734	105	1146	O. virginianus	metapodial shaft fragment	_/-shaped	stone	cuts are wide and broad with rough shoulders and indistinct apexes. One cut appears to have bone ridge in middle. Shoulders are flaked and there is debris in the groove. Looks like chop marks with a biface	yes	20x
01052744	105	1149	O. virginianus	femur shaft fragment	_/-shaped	stone	cuts are sinuous, short and rough looking. Probably retouched biface used	yes	20x
01052744	105	1149	O. virginianus	rib fragment	no cut marks	N/A			

UGA number	Accn No.	Code	species	element	apex shape	tool	notes	mold	mag
01052763	105	1152	O. virginianus	rib fragment	V-shaped, distinct apex, asymmetrical	stone	cuts are asymmetrical with one flat wall and another flaked. Striations run parallel to groove within mark and some cuts show evidence of barbs. One cut is long enough to call highly sinuous	yes	45x
01052764	105	1152	UID mammal	misc fragment	_/-shaped	stone	cuts are wide with rough edges and an indistinct, stepped apex with terracing and extensive flaking of edges	no	20x
01052773	105	1153	O. virginianus	R distal humerus	U-shaped, wide	metal	cut is symmetrical with a rounded smooth bottom and striae running along bottom of groove. Cut is deep and clean	yes	40x
01052773	105	1153	O. virginianus	L metatarsal fragment	V-shaped	stone	cut is sinuous and fairly clean. Other cut has parallel striae running in groove and evidence of an offset edge and barbing	yes	35x
01052773	105	1153	O. virginianus	R astragalus	_/-shaped	stone	cuts are deep with rounded apexes and striations running on walls parallel to groove. Edges are not heavily flaked but are wide. Walls are concave and there are other cuts that are shallow and rough looking	yes	45x
01052773	105	1153	O. virginianus	L proximal metacarpal	_/-shaped	stone	cuts are rough looking with distinct apexes and indistinct apexes, gradual walls lots of flaking and debris in cuts	yes	35x
01052773	105	1153	O. virginianus	L astragalus	no cut marks	N/A			
01052773	105	1153	O. virginianus	cervical vertebra fragment	U-shaped, V-shaped	stone	no pronounced shoulder on one vertebre, the other has more cuts with narrower marks		N/A

UGA number	Accn No.	Code	species	element	apex shape	tool	notes	mold	mag
01052775	105	1153	UID mammal	misc fragment	_/-shaped	possibly shell	cuts are short, shallow, and straight with multiple microstriations inside and outside of the groove. Compare with shell cuts	yes	30x
01052785	105	1154	O. virginianus	L occipital condyle	|_|-shaped	metal	cuts are parallel and deep, clean with flat walls and a rounded, smooth apex. Minimal flaking of edges	yes	45x
01052785	105	1154	O. virginianus	vertebra fragment	shell could be arrow tip, very small	possibly shell	shell impacted in bone	no	45x
01052785	105	1154	O. virginianus	L distal tibia half	_/-shaped	UD	two parallel cuts with rounded indistinct apexes. Very small and short but isolated, could be gnawing, need 2nd opinion.	no	45x
01052787	105	1154	UID mammal	misc shaft fragment	U-shaped	metal	wide single groove, dull iron or biface		N/A
01052808	105	1161	O. virginianus	L metacarpal fragment	_/-shaped	possibly shell	cuts are extremely rough and shallow. The only indication that they may actually be cut marks is that they are in a group of three and parallel compare with shell cut marks	yes	30x
01052816	105	1164	O. virginianus	distal metacarpal shaft	|_|-shaped	metal	two cuts are deep, straight, clean and symmetrical. One cut appears rougher and may be a trampling mark.	yes	45x
01052825	105	1166	UID mammal	misc fragment	V-shaped, distinct apex	metal	apex is distinct, walls are straight, cuts look clean and symmetrical	no	40x
01052834	105	1167	O. virginianus	L proximal femur shaft	V-shaped, stepped apex	stone	multiple parallel cuts, one cut has evidence of barb, several cuts are curved suggesting concave blade used, apexes are distinct, walls uneven	yes	25x
01070016	107	001	Artiodactyla	shaft fragment	U-shaped, narrow	metal	apex appears rounded, cut is straight with straight walls. Knife may have been dull	yes	45x

UGA number	Accn No.	Code	species	element	apex shape	tool	notes	mold	mag
01070016	107	001	Artiodactyla	vertebra fragment	V-shaped, distinct apex	stone	cuts are thin and short but appear to have striations indicating offset edges	yes	45x
01070034	107	004	Artiodactyla	shaft fragment	_/-shaped	UD	cut is wide and rough looking with heavily flaked shoulders and a lot of debris in groove. Apex is indistinct, cut lacks definition	yes	30x
01070081	107	010	O. virginianus	distal tibia	V-shaped, distinct apex	metal	cuts are deep, walls are flat, and apexes are distinct. One cut has an ancillary parallel groove but this is probably a separate cut. Cuts are straight and clean looking.	no	45x
01070081	107	010	O. virginianus	L proximal femur shaft	V-shaped, distinct apex	metal	cuts are deep, narrow, and straight. One wall is flat, the other is not there, cuts made at a downward angle, one cut has intersecting grooves with no visible striations, probably two cuts on same mark, other cuts are straight, sharp metal blade	no	45x
01070081	107	010	O. virginianus	L mandible	cut on crack	UD			
01070081	107	010	O. virginianus	misc fragment	trampled	other			
01070081	107	010	O. virginianus	rib fragment	trampled	other			
01070082	107	010	Artiodactyla	rib fragment	_/-shaped	stone	cut is wide, short, and asymmetrical. One wall is flat the other is gradual and flaked. Apex is indistinct and striae run on the flat wall parallel to groove	yes	40x
01070098	107	011	O. virginianus	L distal humerus	V-shaped, stepped apex	stone	cuts are rough, wide and fairly shallow, cuts appear with striations and evidence of offset edge with barbs	yes	20x
01070117	107	016	O. virginianus	R humerus shaft fragment	V-shaped, distinct apex	metal	clean cut, distinct apex, straight walls	no mold	40x
01070119	107	016	Artiodactyla	rib fragment	no cut marks	N/A			

UGA number	Accn No.	Code	species	element	apex shape	tool	notes	mold	mag
01070145	107	019	Artiodactyla	glenoid process of scapula or acetabulum	U-shaped	metal	cut is deep with a rounded apex, long and clean looking. Probably made with a dull metal blade	yes	20x
01070168	107	021	O. virginianus	R ilium fragment	closed V-shape	metal	two definite cuts are deep and parallel with 0.5cm space between, straight and long, distinct apex, clean look. Bone probably trampled, many other marks with no pattern	no	20x
01070168	107	021	O. virginianus	rib fragment	broad U-shape	UD	very shallow, main groove has two ancillary striations to one side, no shoulder, not convincing of a cut but has another groove next to it. Could be trampled	no	30x
01070168	107	021	O. virginianus	R proximal ulna	broad U-shape	UD	wide short cut, asymmetrical walls with extensive flaking on one side, probably retouched stone tool, cut not entirely convincing, isolated	yes	20x
01070177	107	158	O. virginianus	R acetabulum, ischium, and pubis	V-shaped, distinct apex	metal	cuts are deep with straight walls and distinct apexes. Clean cuts with no debris in groove, single grooves with minimal to no flaking of shoulders.	no	25x
01070177	107	158	O. virginianus	R proximal tibia shaft	V-shaped, distinct apex	metal	cut is deep, on an angle, straight, flat walled and distinct apex. Two cuts along same groove, not barbed.	no	25x
01070177	107	158	O. virginianus	R scapula glenoid fossa	_/-shaped	metal	cuts are deep and wide, two parallel cuts with rounded bottoms and indistinct apexes. Hack marks likely made with dull metal blade	no	25x
01070177	107	158	O. virginianus	L proximal tibia shaft	cut is oblique	metal	cut has removed a large portion of bone or it broke off during excavation or deposition. Depth and width suggests cut was made by a metal blade	no	25x

UGA number	Accn No.	Code	species	element	apex shape	tool	notes	mold	mag
01070184	107	022	O. virginianus	vertebra fragment	V-shaped, distinct apex	metal	cut is deep with flat clean walls and a distinct apex with no debris in groove. Shoulders are minimally flaked	no	40x
01070184	107	022	O. virginianus	vertebra fragment	_/-shaped	stone	cut is rough with an indistinct apex and flaked shoulders. One gradual and one vertical wall observed	yes	40x
01070184	107	022	O. virginianus	vertebra fragment	no cut marks	UD			
01070192	107	023	O. virginianus	cervical vertebra fragment	hacked clean	metal			N/A
01070192	107	023	O. virginianus	rib fragment	gnawed	other			15x
01070192	107	023	O. virginianus	thoracic vertebra fragment	U-shaped	metal	situated next to rodent tooth marks, probably dull iron		15x
01070198	107	023	Artiodactyla	vertebra fragment	closed V-shape	metal	cuts are narrow, straight, long, and clean with minimal flaking of shoulders and deep symmetrical grooves.	no	35x
01070213	107	024	O. virginianus	L ilium fragment	V-shaped, distinct apex	metal	deep hack mark probably made by a metal blade, walls are straight and flat, the other wall is terraced	no	20x
01070233	107	026	O. virginianus	R ischium	V-shaped, distinct apex, symmetrical	metal	cuts are clean looking with distinct apexes and debris-free grooves. Shoulders are not flaked and walls are flat and symmetrical	no	45x
01070233	107	026	O. virginianus	R ilium fragment	V-shaped, distinct apex, asymmetrical	metal	cuts have distinct apexes but vary in wall symmetry. Some appear to have been made on an angle with an undercut wall and a gradual wall yet retains distinct apexes.	no	45x
01070266	107	028	O. virginianus	L distal femur	V-shaped, wide	metal	cut is a deep hack mark probably made by metal; flat walls, distinct apex	no	40x
01070266	107	028	O. virginianus	R proximal femur shaft	V-shaped, wide	metal	cut is a deep hack mark probably made by metal; flat walls, distinct apex	no	40x

UGA number	Accn No.	Code	species	element	apex shape	tool	notes	mold	mag
01070266	107	028	O. virginianus	L innominate fragment	_/-shaped	stone	cut is wide with a rounded apex. One wall is vertical and the other is gradual. Cut has extensive flaking of shoulders. Either dull blade or stone biface used.	yes	40x
01070266	107	028	O. virginianus	L proximal ulna	no cut marks	N/A			
01070267	107	028	Artiodactyla	diaphysis	V-shaped, distinct apex	metal	cut is deep and straight, striations indicate multiple cuts along same groove. Blade repositioned after each cut, straight clean cut with minimal flaking of edge, distinct apex and flat walls	no	45x
01070267	107	028	Artiodactyla	rib fragment	_/-shaped	metal	cuts are long and straight, extensive flaking of shoulder and an indistinct apex. Could have been made with dull metal knife	no	45x
01070267	107	028	Artiodactyla	rib fragment	_/-shaped	stone	cut is rough looking with no definition in walls or apex, terracing on one side with the other side rough and gradual. Possibly sawed with stone. Definitely not metal	no	45x
01070267	107	028	Artiodactyla	shaft fragment	no cut marks	N/A			
01070267	107	028	Artiodactyla	rib fragment	trampled	other			
01070304	107	034	O. virginianus	hyoid	w-shaped, V-shaped	stone	double track groove in two cuts, one cut is V-shaped with flaking on one side, not much debris in groove. Tough call, look again	no	40x
01070317	107	037	O. virginianus	R distal radius	V-shaped, distinct apex	metal	cuts are short, and deep with walls that are fairly straight and moderately flaked shoulders. Not much debris in cut. May have to mold to show apex	yes	40x

UGA number	Accn No.	Code	species	element	apex shape	tool	notes	mold	mag
01070317	107	037	O. virginianus	L proximal femur	_/-shaped	stone	cuts are fairly deep and straight but are rough looking with debris in grooves. Flaked shoulders and rough walls	no	40x
01070317	107	037	O. virginianus	L proximal femur	_/-shaped	stone	cuts are wide and rough looking with a distinct apex but heavily flaked shoulders	no	40x
01070317	107	037	O. virginianus	R distal femur condyle	V-shaped	stone	cut is long with rough walls and an apex that is distinct but very sinuous, corresponding with roughness of the walls. This tool was probably a biface	yes	40x
01070318	107	037	Artiodactyla	rib fragment	cut too worn	UD			
01070369	107	045	O. virginianus	R proximal radius diaphysis	V-shaped, distinct apex	metal	cut is clean and symmetrical with straight walls and shouldering unflaked. Cut is straight and fairly deep. Walls are flat, not much debris in groove	yes	40x
01070434	107	088	O. virginianus	R scapula fragment	V-shaped, distinct apex	metal	hack marks with flat walls and distinct apex probably made by metal axe	no	20x
01070434	107	088	O. virginianus	R distal humerus shaft fragment	closed V-shape	stone	cut has one steep wall with a clean edge and a steep wall with extensive flaking on shoulder, the other cut is has a steep wall with the other side gradual and terraced	yes	45x
01070488	107	068	O. virginianus	hyoid fragment	V-shaped, distinct apex	metal	cut is clean, shoulders are not flaked and have symmetrical ridging. Apex is distinct with no debris in groove. Walls are flat. Cut is short and on edge of bone straight	no	45x
01070589	107	089	O. virginianus	R mandible fragment	V-shaped, distinct apex	metal	cuts are clean looking with flat walls and distinct apexes, and no debris in groove	no	40x

UGA number	Accn No.	Code	species	element	apex shape	tool	notes	mold	mag
01070591	107	089	Artiodactyla	rib fragment	V-shaped, distinct apex	metal	cuts are deep with straight walls and distinct apexes. Clean cuts with no debris in groove, single grooves with minimal to no flaking of shoulders.	yes	30x
01070613	107	090	Artiodactyla	rib fragment	V-shaped, distinct apex	metal	one cut is deep, straight and clean looking with a distinct apex and semi-straight walls. The other cut is shallow, straight and filled with sand, apex is hard to see. Judging from lack of flaking and straightness of cuts they were probably made with metal blades. mold to confirm	yes	35x
01070613	107	090	Artiodactyla	sternum fragments	V-shaped, distinct apex, symmetrical	metal	cuts are deep and wide, with distinct apex, cuts are likely hack marks made by a metal axe. Other sternum bone is not cut	yes	20x
01070632	107	095	Artiodactyla	scapula fragment	V-shaped, distinct apex	metal	cuts are long and straight, narrow with no debris in groove. Grooves are singular, no striations visible, clean cuts spanning gap in bone divot	no mold	15x
01070641	107	091	O. virginianus	lumbar	V-shaped, distinct apex, symmetrical	metal	cuts are straight, clean, and have symmetrical walls with minimal flaking of shoulders and no debris in groove	yes	40x
01070641	107	091	O. virginianus	L ilium fragment	V-shaped, distinct apex	metal	cut has distinct apex, one flat wall the other undercut suggested bone was cut by a metal knife at an angle. The cut itself is clean and lacks debris in the groove.	no	40x

UGA number	Accn No.	Code	species	element	apex shape	tool	notes	mold	mag
01070641	107	091	O. virginianus	L mandible fragments	V-shaped	metal	cuts are deep and clean with distinct apexes and minimal flaking of shoulders. One fragment has hack marks that have distinct apex and one flat wall with the other undercut and flaked. The shape of the apexes suggests the blade was even and straight and sharp.	yes	40x
01070642	107	091	Artiodactyla	rib fragment	_/-shaped	stone	cuts are moderately deep with indistinct apexes and significant flaking on edges. Cuts are straight, one long and one short. Both cuts have one straighter wall with another gradual wall, debris in cuts, walls are not flat. Probably made by biface, but need mold to confirm	yes	30x
01070667	107	093	Artiodactyla	rib fragment	V-shaped, distinct apex	metal	chop mark is rough looking but has distinct apex and one straight steep wall. Slicing mark is curved and could have been made with a stone flake but the apex is filled with sediment. Needs another look	yes	20x
01070667	107	093	Artiodactyla	rib fragment	V-shaped, distinct apex	metal	clean chop mark, apex is distinct and straight, one wall is straight the other is flaked from chop. Slicing mark on bone is thin and clean with striations on flat wall	yes	45x
01070668	107	093	O. virginianus	R distal tibia shaft	V-shaped, stepped apex	stone	cuts are shallow, sinuous, and have multiple parallel striations. One possible instance of barbing in beginning of cut. One flat wall, the other wall gradual	yes	45x

UGA number	Accn No.	Code	species	element	apex shape	tool	notes	mold	mag
01070702	107	096	Artiodactyla	rib fragment	_/-shaped, stepped	stone	cuts are short, rough looking with highly flaked shoulders and an indistinct apex. Walls are terraced and spaced far apart and are highly asymmetrical	yes	40x
01070703	107	096	O. virginianus	R mandible fragment	V-shaped, distinct apex, asymmetrical	UD	cut is deep, straight, clean, but walls are asymmetrical, pronounced shouldering and a parallel groove suggesting a barb. Cut is also terraced.	yes	45x
01070711	107	097	O. virginianus	R femur shaft	V-shaped, angled	UD	marks suggest scraping perpendicular to length of shaft. Multiple parallel striae culminating in an asymmetrical apex indicating downward motion. Deep wide hack or saw mark extends across condyle indicating blade was long. Because cuts are asymmetrical with one steep side and the other gradual containing many parallel ancillary striae it may be stone. Or one cut was made with metal and the other with stone...	yes	20x
01070739	107	099	Artiodactyla	rib fragment	V-shaped, distinct apex, symmetrical	metal	cuts are deep, symmetrical, clean looking, and have distinct apexes. Bone also features two hack attempts that have U-shaped apexes.	no	45x
01070753	107	100	O. virginianus	L scapula spinal area	V-shaped, distinct apex, symmetrical	metal	cut is thin, straight, clean and has a distinct apex with symmetrical walls and minimal flaking of shoulders	no	40x
01070753	107	100	O. virginianus	R scapula glenoid fossa	_/-shaped	metal	cut appears to have been a hack mark, long, straight, deep, with a distinct but flat apex, symmetrical walls	no	40x

UGA number	Accn No.	Code	species	element	apex shape	tool	notes	mold	mag
01070754	107	100	Artiodactyla	rib fragment	V-shaped, distinct apex, symmetrical	metal	cuts are deep, clean, and have acute apexes with pronounced shoulders and minimal flaking	yes	35x
01070754	107	100	Artiodactyla	rib fragment	V-shaped, wide	stone	cut shows highly flaked walls with debris in cut. Apex is fairly distinct but width and roughness of cut suggests biface.	yes to confirm cut	35x
01070754	107	100	Artiodactyla	rib fragment	V-shaped	UD	cuts are on edge of bone	no	35x
01071067	107	157	O. virginianus	L scapula	N/A	UD	not analyzed		N/A
01071067	107	157	O. virginianus	skull fragment with L occipital condyle	N/A	UD	not analyzed		N/A
01071070	107	158	Artiodactyla	rib fragment	V-shaped	metal	cuts are clean, symmetrical and distinct apex with straight walls. Cuts are slightly concave but could be result of bone curvature	no	45x
01071160	107	200	O. virginianus	antler fragment	_/-shaped	metal	cuts are wide but clean, apex is indistinct and rounded, striations occur on base of cut with no shoulder. Apex is also symmetrical and cut is straight and long. Could be dull blade	yes	20x
01071160	107	200	O. virginianus	parietal and antler fragment	_/-shaped	metal	cuts are wide and rough, probably because the bone is worn, the blade used was probably a dull metal knife	yes	20x
01071160	107	200	O. virginianus	R antler fragment	_/-shaped	stone	cut is wide with one steep wall and another gradual wall, rounded apex, one shoulder is raised and prominent the other is worn or flaked off extensively	yes	20x
01071168	107	204	Artiodactyla	distal tibia fragment	V-shaped	metal	cuts are straight and clean looking with minimal shouldering and distinct v-shaped apexes	no	45x

UGA number	Accn No.	Code	species	element	apex shape	tool	notes	mold	mag
01071168	107	204	O. virginianus	vertebra fragment	closed V-shape	stone	cut is closed V-shape sinuous and contains debris in groove. Probably made by unretouched stone tool	no	30x
01071168	107	204	O. virginianus	rib fragment	V-shaped, distinct apex	stone	cut is deep and wide with debris in groove and is sinuous. Multiple grooves with rounded smooth apex possibly result of trampling.	no	30x
01071168	107	204	Artiodactyla	scapula fragment	cuts look recent, trowel?	other			
01071181	107	205	O. virginianus	R proximal femur	V-shaped and narrow U-shaped, open	metal	cuts are short, open, wide and fairly deep. Symmetrical walls and distinct apex suggest metal, cuts are clean	no	35x
01071181	107	205	O. virginianus	R humerus shaft fragment	V-shaped, distinct apex	metal	cuts are short and straight, deep and fairly wide with symmetrical walls and distinct apexes, generally clean looking with limited shouldering. One cut appears with asymmetrical walls but it could have been cut at an angle. Apex on at least one cut appears to have a flat or rounded bottom.	yes	35x
01071181	107	205	O. virginianus	L radius	V-shaped, distinct apex, symmetrical	metal	cuts are long, clean looking and appear to have distinct apexes. Grooves are thin with nearly no shouldering and are straight	yes	35x
01071181	107	205	O. virginianus	R radius	cuts look recent, trowel?	other			
01071184	107	205	Artiodactyla	rib fragment	cut not convincing	UD			
01071427	107	281	O. virginianus	metatarsal shaft fragment	cut too worn	UD			
01071427	107	281	O. virginianus	R calcaneous fragment	cuts look recent, trowel?	UD			

UGA number	Accn No.	Code	species	element	apex shape	tool	notes	mold	mag
01071476	107	294	O. virginianus	R intermediate lunate	V-shaped, distinct apex	metal	apex distinct, walls are straight, cuts are straight and deep, with clean shoulders, no flaking of edge and singular grooves.	no	25x
01071476	107	294	O. virginianus	L cuneiform	_/-shaped	metal	apex distinct but rounded, walls gradual but straight, dull blade	no	40x
01071476	107	294	O. virginianus	hyoid fragments	V-shaped, distinct apex	metal	distinct apex, deep cuts, straight walls, symmetrical apex, raised shoulders on both sides but clean, cuts are short, small bones	no	40x
01071545	107	314	O. virginianus	hyoid fragments	_/-shaped	metal	apex is rounded at bottom, walls are flat and have minimal flaking or ridging. Parallel microstriations in groove suggest that it was sawed or one back and forth motion, cut made by dull metal knife	no	40x
01071786	107	690	O. virginianus	R proximal ulna diaphysis	V-shaped, distinct apex, symmetrical	metal	apex is distinct, cut is clean with flat walls, minimally flaked shoulders. Apex is symmetrical and pointed	no	25x
01072034	107	980	O. virginianus	R mandible with p234	V-shaped	metal	straight, low shoulder, one mark with offset line, probably cut with a metal blade		35x
01080068	108	043	O. virginianus	R proximal femur head	V-shaped, distinct apex, symmetrical	metal	cuts are short but clean, apex is distinct V-shape with straight walls, no striations	no	25x
01080106	108	057	O. virginianus	R proximal ulna	cut not deep enough to diagnose	UD			
01080148	108	076	O. virginianus	L distal humerus	narrow U-shape	metal	longer cut, uniform in shape, clean and minimal flaking of edge, apex is smooth, no striations	no	12x
01080384	108	219	O. virginianus	R proximal ulna	cuts look recent, trowel?	other			

UGA number	Accn No.	Code	species	element	apex shape	tool	notes	mold	mag
01080524	108	306	O. virginianus	R ilium fragment	V-shaped, distinct apex	metal	looks like two hack marks, one straight wall, one very flaked, distinct apex	no	35x
01080653	108	368	O. virginianus	L proximal tibia shaft fragment	V-shaped, distinct apex, asymmetrical	stone	distinct apex, one pronounced shoulder, one steep side one gradual side	no	45x
01080653	108	368	O. virginianus	L proximal tibia shaft fragment	V-shaped, distinct apex, asymmetrical	stone	distinct, sinuous apex with flaking on both sides. One cut has ancillary parallel striations lateral to apex	yes	45x
01080653	108	368	O. virginianus	R tibia midshaft	scraping marks	UD			
01080925	108	482	O. virginianus	R calcaneous	V-shaped	stone	needs mold, cut at angle, apex appears distinct but cut is sinuous. Closed V-shape	yes	45x
01081104	108	777	O. virginianus	L scapula glenoid fossa area	V-shaped, wide	metal	wide angle hack mark	yes	20x
01081104	108	777	O. virginianus	L distal humerus shaft	V-shaped	stone	multiple separate parallel marks on femur head, steep walls, straight grooves	yes	20x
01081104	108	777	O. virginianus	L proximal femur shaft	V-shaped	metal	multiple parallel and skewed grooves, deep steep walls	yes	20x
01280012	128	006	O. virginianus	L proximal humerus shaft	trampled	other			
01280019	128	008	O. virginianus	sesamoid	cut too worn	UD			15x
01280100	128	034	Artiodactyla	proximal metapodial	_/-shaped	metal	cuts are rough looking, hacked probably with an axe, or biface chopper (?) apex is distinct but area around cut is destroyed	no	20x
01280107	128	036	O. virginianus	R mandible	V-shaped	metal	steep walls, round bottom, sharp apex at one point, axe or dull iron		15x
01280193	128	080	O. virginianus	L proximal humerus	_/-shaped	stone	cut is deep, wide, and rough but apex is distinct. Probably a chop mark, internal striae discontinuous	no	40x

UGA number	Accn No.	Code	species	element	apex shape	tool	notes	mold	mag
01280259	128	114	O. virginianus	R distal humerus shaft fragment	V-shaped, distinct apex, symmetrical	metal	cuts are deep with straight walls and distinct apexes. Clean cuts with no debris in groove, single grooves with minimal to no flaking of shoulders. There is also evidence of percussive modification, either on the bone or using the bone to bash something. possibly a stone chopper used on the bone.	no	45x
01280260	128	115	O. virginianus	R proximal femur	V-shaped, distinct apex, symmetrical	metal	cut is clean and symmetrical with straight walls and shouldering unflaked. Cut is straight and deep	no	20x
01280434	128	211	O. virginianus	R ilium fragment	_/-shaped	metal	2 cuts on same plane, long dull iron blade	yes	10.5x
01280471	128	230	O. virginianus	R distal humerus	V-shaped	stone	dual parallel ancillary grooves suggestive of offset edge or barbs	yes	35x
01280804	128	444	O. virginianus	R distal ulna	narrow V-shape	metal	2 parallel deep cuts	no	35x
01280804	128	444	O. virginianus	distal metatarsal	V-shaped and narrow U-shaped	metal	many parallel cuts, short, deep, some clean, others have peripheral flaking. Blade was thin and sharp. Two different blades appear to have been used; one thicker and duller than the other	yes	45x
01281108	128	623	O. virginianus	L stylohyoid	V-shaped, distinct apex, symmetrical	metal	cut is deep with a flat wall and a distinct apex. The other wall is rougher but the cut was made on an angle. The flatness of the other wall is telling of a metal blade	no	40x
01420128	142	B1217i	O. virginianus	styloid	_/-shaped	stone	cuts have one flat wall and one gradual wall. Some cuts have ancillary parallel lines	no	40x

UGA number	Accn No.	Code	species	element	apex shape	tool	notes	mold	mag
01420128	142	B1215 i	O. virginianus	misc fragment	_/-shaped	stone	cuts are wide, short, and rough. One cut is longer and sinuous with a rounded bottom and multiple striations in bottom of groove.	no	40x
01420128	142	B1215 g	O. virginianus	L astragalus fragment	V-shaped, stepped apex	stone	cut is deep but short, apex is V shaped with one flat wall and one terraced wall. Apex is distinct and sharp, shoulders not flaked because cut is so short.	no	40x
01420128	142	B1209 a	O. virginianus	atlas fragment	_/-shaped	stone	cuts are wide and broad with indistinct apexes. Significant debris in cuts, short and many microstriations that are parallel to main grooves	no	40x
01420128	142	B1215 e	O. virginianus	scapula fragment	trampled	other			
01420140	142		O. virginianus	L eye orbit	U-shaped	stone	three cutmarks, one with a raised shoulder, middle mark is shallow, could be sawed		25x
01420165	142	B2371 a	O. virginianus	metapodial fragment	|_|-shaped	metal	cut is deep and long, looks like it could have been sawed. One wall is steep and fairly flat with the other side gradual in some areas. Bottom of cut is flat. Looks like outer layer of bone sawed and then bone snapped.	yes	35x
01420165	142		O. virginianus	lumbar vertebra	V-shaped	stone	cut has one steep wall with a clean edge and a steep wall with extensive flaking on shoulder, other bone has a cut that looks recent	no	35x
01420176	142	B2080	O. virginianus	L distal humerus	V-shaped, distinct apex	stone	many parallel cuts, shallow, sinuous with evidence of barbs on flakes. Cuts are very thin and there are many, apexes are wavy and not distinct	no	40x

UGA number	Accn No.	Code	species	element	apex shape	tool	notes	mold	mag
01420309	142		O. virginianus	R distal humerus	_/-shaped	stone	cuts are short, rough, and shallow. Walls are significantly flaked, cuts are many, probably made with a biface	no	45x
01420546	142	B2171 a	O. virginianus	L tibia shaft fragment	closed V-shape, asymmetrical	stone	multiple short parallel cuts	no mold	30x
01420546	142	B2170	O. virginianus	L ilium fragment	debris, needs to be cleaned	stone	fork-shaped groove, suggests offset edge	no mold	30x
01420579	142	B2203	O. virginianus	metapodial fragment	no cut marks	N/A			
01420627	142	B1445	O. virginianus	phalanx	_/-shaped	stone	cut is shallow, apex is indistinct with significant flaking on edges. Depth is variable, cut is sinuous	yes to confirm cut	45x
1290015	129	428	O. virginianus	L distal humerus	V-shaped and narrow U-shaped	metal	many short cuts, some on same plane, distinct apexes, straight walls, clean cuts, no debris in cut	yes	12x
1290020	129	431	O. virginianus	rib fragment	V-shaped, distinct apex, symmetrical	metal	many parallel grooves, short and long, deeper than wide, clean cuts with moderate shoulder effect	no	45x
1290038	129	436	O. virginianus	R proximal radius	_/-shaped	UD	hack marks, not very diagnostic	no	20x
1290103	129	471	O. virginianus	R metacarpal shaft	V-shaped	metal	cut extends across gap, no shouldering, hack mark probably by axe or iron blade		15x
1290237	129	1306	O. virginianus	R proximal metatarsal	no cut marks	UD	chop mark not conspicuous		
1290509	129	1407	O. virginianus	R proximal ulna	cut too worn	UD			
1770113	177	lot 2B	UID mammal	misc fragment	closed V-shape	stone	apex is not uniformly deep, shoulders are rough looking and there is debris in groove	no mold	35x
1770975	177		O. virginianus	L femur shaft fragment	trampled	other	striae resemble trampling more than cutmarks		

UGA number	Accn No.	Code	species	element	apex shape	tool	notes	mold	mag
1771002	177		UID mammal	misc fragment	V-shaped, distinct apex, symmetrical	metal	cuts are thin, walls are straight and clean and symmetrical. Cuts are long and parallel, two slicing cuts both thin and clean	no	20x
1771771	177		UID mammal	misc fragment	debris, needs to be cleaned	metal	cuts are thin and long, clean looking	no mold	20x
1940076	194	029	UID mammal	misc fragment	_/- shaped	stone	cut has one steep wall with a clean edge and a steep wall with extensive flaking on shoulder, other bone has a cut that looks recent	yes	45x
1940078	194	029	O. virginianus	L scapula fragment	U-shaped	stone	cuts are rough looking with asymmetrical walls and flaking on at least one wall. One cut has steep straight wall with opposite wall gradual and flaked. Apex is indistinct and smooth looking	yes	40x
1940110	194	035	O. virginianus	R calcaneous fragment	U-shaped	metal	cut is clean, with a distinct but rounded apex, straight walls	no mold	12x
1940113	194	036	UID mammal	misc fragment	V-shaped, distinct apex	metal	cuts are clean, symmetrical apex with straight walls	no	20x
1940123	194	046	O. virginianus	distal metacarpal shaft fragment	trampled	TRAMPLED			
1940386	194	068	O. virginianus	R distal tibia shaft fragment	V-shaped, distinct apex, symmetrical	metal	cut is clean, flat walls and distinct apex. No shouldering, cut is straight with sand lodged in groove. Compare to B2b	no	40x
1940747	194	233	O. virginianus	R cubo navicular fragment	V-shaped, wide	stone	apex is distinct with one wall steep the other gradual, sides are asymmetrical in two cuts, and one cut is long and sinuous. Cuts have flaked shoulders and contain debris	yes	40x

UGA number	Accn No.	Code	species	element	apex shape	tool	notes	mold	mag
1941950	194	908	O. virginianus	R radial carpal fragment	V-shaped, distinct apex, symmetrical	metal	apex is distinct, cut is clean with flat walls, minimally flaked shoulders. Apex is symmetrical and pointed	no	30x
1942467	194	1101	O. virginianus	L ulnar carpal	V-shaped and narrow U-shaped, open	stone	cut is U-shaped on one end and V-shaped toward other end, debris in cut, sinuous	no	30x
1942467	194	1101	O. virginianus	misc radius shaft fragment	gnawed	other			
1942544	194	1132	O. virginianus	R ulna shaft fragment	V-shaped, distinct apex	metal	cuts are deep, V-shaped with straight walls and a distinct apex	no	12x
1942777	194	1236	O. virginianus	R proximal tibia fragment	_/-shaped	stone	cuts are wide and shallow, rough looking with flaking present on shoulders. Apex indistinct and rounded with terracing along sides, cuts very worn, look again and compare with shell	no	20x
1947771	194	1263	O. virginianus	axis fragment	V-shaped, distinct apex, symmetrical	metal	cuts are deep, clean and have flat walls with minimal flaking of shoulder, no debris in groove and a distinct sharp apex	yes	45x
1947787	194	1268	O. virginianus	3rd phalanx fragment	V-shaped, distinct apex	metal	evenly spaced striations on walls, distinct apex, cuts long and deep, appears as result of attempt to sever bone	yes	15x
1947905	194	1300	O. virginianus	vertebra fragment	_/-shaped	metal	Apex is rounded, cut is long and straight, clean	no mold	20x
1947905	194	1300	O. virginianus	L distal radius fragment	V-shaped, distinct apex	metal	long, crosses over bone divot, straight and clean cut	no mold	20x
1947905	194	1300	O. virginianus	L scapula glenoid fossa area	_/-shaped	metal	wide cut, distinct apex, long cut with straight walls, rounded bottom, duller blade	yes	20x

UGA number	Accn No.	Code	species	element	apex shape	tool	notes	mold	mag
1947905	194	1300	O. virginianus	L proximal femur fragment	V-shaped, distinct apex	stone	cuts are narrow but asymmetrical, one straight wall, one gradual wall, longest cut is sinuous, other cuts are short but straight, one cut has a fork shape suggesting offset edge	yes	20x
1947915	194	1299	Artiodactyla	vertebra fragment	closed V-shape	stone	very thin cuts, asymmetrical, debris in cut, striations within are irregular but continuous, probably unretouched flake	no	45x

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BIOGRAPHICAL SKETCH

Nick Triozzi received his Bachelor's of Science degree in Evolutionary Anthropology from Rutgers University in May of 2011. The skills he acquired while completing an honors research thesis at Rutgers gave him the initiative to pursue an advanced degree. That fall he enrolled in Monmouth University's Master of Arts in Anthropology program and was among the first admitted into the new graduate degree tract there. In September of 2011 he began an internship with the American Museum of Natural History, New York, NY working in the Nels Nelson Lab in the North American Archaeology department.

He began working on St. Catherines Island as a field technician through the internship program and eventually as staff field archaeologist, accruing seven months of fieldwork experience by the time he completed this project. During these excavation seasons Nick developed his interest in Southeastern Archaeology and formulated an idea for a M.A. thesis while completing MU coursework. Between St. Catherines excavations, Nick worked in San Francisco, CA, Nevis, West Indies, and in the Delaware Water Gap Recreation Area, NJ. Nick defended this thesis on November 14, 2013 with distinction and received his degree in January 2014. He was soon after hired as Assistant Field Director by the American Museum of Natural History and continues to work on excavations at Fallen Tree and other sites on St. Catherines Island, GA.